UNIVERSITY OF MICHIGAN MEDICAL CENTER

Division of Acute Care Surgery

TRAUMA/BURN CENTER

PROTOCOL MANUAL

2017-2018

Contributions by:
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Acute Care Surgery Chief Residents
University of Michigan

Edited by:
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Acute Care Surgery & Trauma/Burn Staff

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Physician Assistants:		
Jill Jakubus, PA-C, EMT, MS *ACS* Pager #14770	**Michelle Kelm, PA-C** *ACS* Pager #12832	**Christine Oldenburg-McGee, PA-C, MS** *ACS* Pager #16505
Andrea Wei, PA-C, MS *ACS* Pager #18856	**Shahrzad Patterson, PA-C** *ACS* Pager #14715	**Anna Krzak, PA-C** *ACS TBICU* Pager #19444
Amy Kaufman, PA-C *ACS* Pager #16553	**Rachel Schrock, NP** *ACS* Pager #19442	**Sandra Gay, PA-C** *ACS* Pager #19473
Shabnam Shidfar, PA-C *ACS* Pager #16069	**Jonathon Priebe, PA-C** *ACS* Pager #19472	**Lara Bond, PA-C** *ACS* Pager #19597
Amy Prentiss – NP *ACS* Pager #19326	**Erika Mora, PA-C** *ACS* Pager #19529	**Whitney Hayes PA-C** *General Surgery Float* Pager # 20342
Leah Schew PA-C ACS Pager #20906	**Chelsea Blow PA-C** ACS Pager #20918	

Trauma/Burn Program Administration:		
Chris Wagner, BSN *Trauma Program Manager External* 936-9658 / Pager #6561	**Karla Klas, BSN** *Injury Prevention & Community Outreach Director* 232-3815 / Pager #0950	**Kristy Brown** *Injury Prevention & Community Outreach Events Coordinator* 232-3814
Cindy Wegryn, BSN *Trauma Program Manager Internal* 936-3690 / Pager #35324		

Acute Care Surgery Clinic Staff:		
Margaret (Peggy)Gordon, RN ACS2 936-9669 / Pager # 30053	**Carrie Cook, RN** ACS2 936-9669 / Pager # 2631	**Cindy Smythe, RN** ACS1 936-1740 / Pager #1338
Connie Dexter, LPN ACS1 615-6879 / Pager #2589	**Kathy Herman, RN** ACS1 936-1740 / Pager #39128	
Trauma/Burn Center Staff:		
Lori Pelham, MSN RN Nurse Manager 645-7289 / Pager # 7284	**David Stoll, RN** Nurse Supervisor 936-9647 / Pager #5298	**Sarah Taylor MSN RN ACNS-BC** Clinical Nurse Specialist 763-9340/ Pager #3526
Trauma/Burn Support Services:		
Becky Noel, MSW *Social Work* 647-2257 / Pager #9721	**ER Social Worker** Pager # 3365	**Maria Reale, MSW** *Social Work* 647-2257 / Pager #1106
Trauma/Burn Ancillary Services:		
Physical Therapy Pager # 37141	**Occupational Therapy** Pager # 37056	**Trauma/Burn Resource Lab** 936-9673 **Photography:** Pager #30502
Trauma/Burn Pharmacy Specialists **Nicholas Farina, PharmD**		BICU Patients, Pager #35412
Kimberly Bauser, RT *Respiratory Therapist* Pager #9661	**Tiffany Dogan, MPH CIC** *Infection Prevention* Pager #9039	
Respiratory Therapy Rotating Pager #3301		**Pat Lynch, RD** *Dietician (SA1)* Pager #3100

Phone Prefixes:
3=763 4=764 5=615 6=936 7=647 8=998

M-Line Physician to Physician contact Phone #s:
http://www.med.umich.edu/i/pcc/pendingscheds/TabsRadiology.htm

Transfer Center Internal Line: 232-6224

LABORATORY:			
Central Distribution	936-6777	**Hematology**	936-6866
Chemistry	936-6702	**Immunology**	936-6749
Drug Analysis & Toxicology	936-6758	**Surgical Pathology**	936-6799
Flow Cytometry	763-9420	**Virology**	763-2568
Microbiology	936-6877	**Coagulation**	936-6798
Blood Bank	936-6888	**Blood Gas**	936-5249
OPERATING ROOM:			
Main Desk	936-8470	**OR #13**	936-8922
Main Scheduling	936-8500	**OR #17**	936-8549
Main OR Family Waiting	936-4388	**OR #21**	936-9119
OR #1	936-8484	**OR #27**	936-9648
OR #2	936-8474	**OR #28**	764-2444
OR #4	615-8504	**OR #29**	764-2123
OR #6	936-8544	**Perfusion**	936-8920
OR #7	936-8554	**Pump Room**	936-8920
OR #8	936-8654	**Mott OR**	763-2430
OR #10	936-8534		
DIAGNOSTIC TESTING:			
Angiography	936-4566	**MRI Neuro**	936-2544/ 6-8860/6-8861
Cardiac Cath Lab	936-5625	**PICC Charge**	Pager 2957
Cardiac Cath Sched.	936-7375	**Radiology – Bone Read Room**	615-2195
CT Interventional	(Ellen #5451) or 936-4574	**Radiology (CXR, US)**	936-4500
CT Body & Abd Read Room	936-4545/6-4546	**Radiology – CXR Hard Copy**	936-4529
CT -Chest Read Room	936-8359	**Radiology (XR) Lead**	936-4507
CT -Neuro Read Room	936-6303	**Radiology - Interventional**	936-4500
CT Tech- Lead	936-3127	**Radiology- GI Reading room**	936-4501
Echo Lab	936-5630	**GI Rad. Tube (C3)**	936-4284 /936-7930
EEG (Tube E5)	936-9035	**Radiology Resident**	Pager: 1800
EKG	STAT #141or Urgent #2142	**PFT Lab**	Tube (B5) or 936-5250
Holter	936-5628	**US Tube (C3)**	936-4566(3)
MPU	936-2887/ RN Desk 936-9265	**US tech**	(after hours, weekends) #9652
MRI Tube (E6)	936-8876	**Vascular lab**	936-5937 Fax: 73238
MRI Body/ABD	936-8862/6-8863	**Vascular Lab Tech**	(after hours, weekends) #3500
MRI Musculoskeletal	615-2195		

FLOORS and MISCELLANEOUS:			
ACS Clinic	936-9665	**CVC ICU**	936-6514
Clinic Fax	936-9669	**CVC Main OR**	232-4553
ACS Conference Rm	763-4089	**C&W Obstetrics**	763-6295
TBICU RN Charge	Pager # 8720	**Mott Main OR**	763-2430
TBICU	936-9631	**Mott PICU**	763-2402
TBACU	936-9639	**4A**	936-6486
TBICU Nursing Lounge	936-9643	**4B**	936-2703
TBICU Fax	615-7101	**4C**	936-6501
TBICU Tub Room	936-9644	**4D (NICU)**	936-6520
Skin Bank	936-9673	**4DN (TICU)/4CI**	936-6514
Chief Call Room	936-9640	**5A**	936-6538
Intern Call Room	936-2005	**5B**	936-6552
Acute Pain Service	9031	**5C**	936-6568
Anesthesia Adult Intubation	Pager: 1514	**5D (SICU)**	936-6581
Anesthesia Peds Intubation	Pager: 1534	**6A**	936-6258
Anticoagulation Clinic	998-6944	**6D (CCMU)**	936-4753
ECMO Tech	Pager: 9766	**7D (CICU)**	936-4744
ED - Charge Nurse	615-8836	**8D**	936-4661
Pharmacy - ED	647-5431	**Psych**	936-4950
Pharmacy - 5th floor	936-8251	**SWAT Charge**	Pager 8000
Pharmacy - Outpatient	936-8260(Taubman) 936-8911(Cancer Ctr)	**Transfer Center**	764-3289
Gift of Life	973-1577		
Pediatric Emergency Resources:			
PICU Fellow	Pager: 6893	**PICU Unit Phone**	736-2401
PICU Charge Nurse	Pager: 9473	**Peds Anesthesia/Airway**	Pager: 1534

Trauma Radios/Chargers & Unit Cell Phones

- Two trauma radios are transferred between ECRs; chargers are available in the call rooms as well as in the TBICU.
- If your radio malfunctions, contact the External Trauma Program Manager (Chris Wagner) for replacements. Do not take the TBICU nursing radio from clerk's desk.

Service Cell Phone List:

Trauma Attending	734-998-5350	ACS Fellow	734-998-5362
TBICU Attending	734-998-5351	TBICU Fellow	734-998-5361
Trauma Chief	734-998-5354	ECR On-Duty	734-998-5355
SICU Fellow	734-216-6974		

Emergency Consult Resident (ECR): pager 91111

Obtaining Stat Imaging and Related Sedation/Anesthesia

Obtaining Stat MRI or CT Myelography

Stat MRI:

- **Call the Lead MRI Tech** at 6-8876. Be prepared to discuss special needs such as sedation/anesthesia (see more below), metal implants or foreign bodies, or large body habitus.
- **If Lead MRI Tech cannot facilitate** the study within the recommended time frame:
    - **During day hours** (8:00 am to 6:00 pm), ask to speak to the Neuroradiology attending **for MRI**.
    - **After hours** (Weekdays 6:00 pm – 8:00 am, and all day on weekends and holidays), call the Radiology Superchief (ext 3-1800 or pager 1800). If this person cannot facilitate the study within the recommended time frame, ask to speak to the **Diagnostic** Neuroradiology Attending on call *.

Stat CT myelography:

- **During day hours** (7:00 am to 5:00 pm), call the Lead Neuroradiology Procedure Nurse at 5-3774.
- **After hours** (Weekdays 5:00 pm – 7:00 am, and all day on weekends and holidays), call the Radiology Superchief (ext 3-1800 or pager 1800). If this person cannot facilitate the study within the recommended time frame, ask to speak to the **Procedure** Neuroradiology Attending on call *.

Arranging Sedation or General Anesthesia for MRI

Nurse-monitored sedation (e.g., for patients with claustrophobia, pain, or inability to remain still):

- **Discuss need for sedation with the Lead MRI Tech** (6-8876). The Lead Tech may be able to facilitate the procedure with sedation provided by the radiology nurses.
- **If the Lead Tech is unable to facilitate** the procedure with sedation in a timely manner (e.g., lack of radiology nurse capacity, or off-hours), the two options for provision of sedation are:
    - Contact SWAT (pager 8000). The SWAT nurse can provide moderate sedation for MRI's 24/7, but this will require that a physician who is credentialed in conscious sedation be present in the MRI area during the scan. During regular hours, a radiologist is present who can perform this role. During off-hours a physician from the primary service will be required to be present to perform this role.
    - Contact the Anesthesia UH OR Clinical Director (pager 8003). The anesthesiologists can provide moderate sedation in some situations (e.g., the primary hospital physician is not credentialed for moderate sedation), but their availability is limited.

General anesthesia (e.g., patient required general anesthesia for MRI in the past or failed imaging using lighter sedation):

- **Discuss the need for general anesthesia** with the Lead MRI Tech (6-8876), as above. The Lead Tech may be able to facilitate the procedure directly with Anesthesiology.
- **If the Lead Tech is unable to facilitate** the procedure directly with Anesthesiology in a timely manner, the Lead Tech may direct you to page Anesthesia UH OR Clinical Director (pager 8003) to discuss the case.

* The phone numbers for radiology on-call from 5PM to 8AM, as well as holidays and weekends are available at http://www.med.umich.edu/rad/oncall/

Dictation Instructions

Central Transcription **CareWeb/MiChart**
Dictation Instructions Revised 12/17/2012
For Assistance please call (734) 936-5325

STEP 1: ACCESS SYSTEM (Cell phone is discouraged).

Dial extension **188 followed by the # key.** (Inside Hospital)
Dial **(734) 615-5000.** (Outside Hospital)

STEP 2: DICTATE AFTER VOICE PROMPTS
Please provide the following:
Dictation Provider ID followed by the # key
Worktype followed by the # key
CSN or Medical Record Number(MRN) followed by the # key.
Begin dictation immediately after " **BEEP**"
Please provide the following:

- Say **Your Name and ID#**
- Say **Attending or Signer's name and ID#.** (To avoid delays, residents must provide an attending at the time of dictation.)
- Provide **Patient Name** (spell if possible).
- Provide Patient CSN (Contact Serial Number)or Medical Record Number(MRN) as appropriate. **(This helps us verify against what was manually entered).**
- Provide **Department/Service and location** where you saw the patient
- Provide **Date of Service**
- Provide the **Document type** (Operative Note)

Copy to: (CC's & Referrings)

- Provide first and last name of the physician
- Provide address **OR** if you know there is a new address, please tell us.
  Note: cc's for MiChart only available for work types 54 and 55. DO NOT USE for letters to patients or caregivers that do not appear in MiChart.

STEP 3: MULTIPLE DICTATIONS WITH ONE CALL:

- **Same work type/Same patient Press 6#(New)**
- Different Work Type/Different Patient ID Press 8
- Same Work Type/Different Patient ID Press 0
- New Work Type/Same Patient ID Press 1
- To Disconnect & receive a confirmation # Press 5

Templates:

- If you are using a dictation template give the template name

FUNCTION KEYS:
2-Record/Pause
3-Review
4-Fast Forward
7-Rewind
9-Play
44-Go to the end
77-Go to the beginning
*9- Suspend Dictation

Dictations Instructions & Work types (New work types will be updated here)

http://www.med.umich.edu/i/him/Dictation/instructions.html

STAT = EMERGENT PATIENT CARE ONLY
Reports needed **STAT:** Call (734)936-5325. This should **NOT BE** used for late dictations or for billing purposes. All outpatient reports are returned within 10 hours. Inpatient reports are prioritized and generally available within 2- 4 hours.

Health Information Management Website (resources for documentation requirements and electronic dictation cards):
http://www.med.umich.edu/i/him/index.html

UMHS DICTATION WORKTYPES

Work Type	Description/MRN or CSN	Display
6	Operative Report /MRN	CareWeb
7	Inpatient Progress Note/MRN	CareWeb
81	NB Discharge Summary	CareWeb
8	Discharge Summary/MRN	CareWeb
9	Admit H&P/MRN	CareWeb
10	New Inpatient Consult/MRN	CareWeb
92	Inpatient H&P/Consult Report/MRN	CareWeb
101	Followup Inpatient Consult/MRN	CareWeb
11	Inpatient Letter/MRN	CareWeb
15	Inpatient Psychiatric Eval/MRN	CareWeb
51	Inpatient Fetal Management Note/MRN	CareWeb
52	Inpatient Procedure Note/MRN	CareWeb
56	Med Observation Unit Note/MRN	CareWeb
21	ED Consult/MRN	CareWeb
61	Inpatient Preop H&P/MRN	CareWeb
89	ED Direct Service Eval	CareWeb
62	Cardiac Cath/MRN	CareWeb
48	Inpatient difficult airway	CareWeb
69	Inpatient Bone Marrow Aspirate Report/MRN	CareWeb
96	Remote Second Opinion Note/MRN	CareWeb
97	Skilled Nursing Facility Progress Note/Discharge Summary/MRN	CareWeb
99	Skilled Nursing Facility H&P/MRN	CareWeb
3	Partial Dictation/CSN	MiChart
85	Partial Dictation ED & Psych ED/CSN	MiChart
30	ED Note/CSN	MiChart
31	ED Ultrasound Report/CSN	MiChart
32	Psychiatric ED Note/CSN	MiChart
34	Outpatient Psychiatric Eval/CSN	MiChart
82	Outpatient Note/CSN	MiChart
46	HME/CSN	MiChart
79	Outpatient Consult Report/CSN or MRN	MiChart
68	Outpatient Consult Request/CSN	MiChart
72	Outpatient PreAdmit H&P/CSN	MiChart
80	Outpatient Preop H&P/CSN	MiChart
76	Clinic Performed Procedure/CSN	MiChart
24	Phone Note/CSNor MRN	MiChart
65	Outpatient Bone Marrow Aspirate Report/CSN	MiChart
53	Outpatient Fetal Management Note/CSN	MiChart
93	Outpatient H&P/Consult Report/CSN	MiChart
77	Outpatient Chemotherapy Consent Note/CSN	MiChart
54	Outpatient Letter/Progress Note/CSN	MiChart
55	Outpatient Letter/CSN	MiChart
94	Non-UMHS Clinic Note/CSN or MRN	MiChart
73	Outside Records Summary /CSN or MRN	MiChart
18	Research Note/CSN or MRN	MiChart

Red areas above indicate new CareWeb work types

Acute Care Surgery Weekly Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
New Consults	ACS1	ACS2	ACS1	ACS2	ACS1	ACS2	ACS1
0530	Resident Sign-out	Resident Sign-out	Resident Sign-out	Resident Sign-out	Resident Sign-out	Resident Sign-out	Resident Sign-out
0600							
0700				General Surgery D&C			
0730	ACS1 Sign-out	ACS2 Rounds TBE conference rm wound rounds			TEAM Training-Q mo		
0745	ACS2 wound rounds*		ACS2 wound rounds*		ACS2 wound rounds*		
0800	TBICU Rounds (0815)	TBICU Rounds	TBICU Rounds	TBICU Rounds (0815)	TBICU Rounds (0815)	TBICU Rounds (0815)	TBICU Rounds (0815)
0900							
1000		ACS1 Trauma, and GS Clinic (0900-1100)	ACS2 Burn Clinic (0900-1100)				
1100							
1200			ACS Critical Care Conference	Trauma Conference or ACS Conference			
1300	ACS2 Burn, Trauma, and GS Clinic (1300-1400)	ACS Conference			ACS2 - PA Burn Clinic (1300-1500)		
1400							
1500							
1600	TBICU Fellow Rounds	TBICU Fellow Rounds	TBICU Fellow Rounds	TBICU Fellow Rounds	TBICU Fellow Rounds	TBICU Fellow Rounds	TBICU Fellow Rounds
1700				AAST Webcast (Q mo)			
1730	Resident Sign-out	Resident Sign-out	Resident Sign-out	Resident Sign-out	Resident Sign-out	Resident Sign-out	Resident Sign-out
1800							

ACS2 wound rounds – start at 0745 BACU - *Monday is ACS Multi-Disciplinary Rounds*

**Monday afternoon ACS Conferences are subject to change in dates and times depending on the needs of the service*

Acute Care Surgery Resident Schedule

ON-CALL

TIME	ACTIVITY	PERSONNEL	TIME (mins)
0530	Floor sign-out	Night Intern/PA/NP & chief --> ON chiefs**	10
	Consult sign-out***	Night ECR & chief--> ON chiefs, ECRs	5
0545	BICU Primary Service Rounds/Bedside Sign-out	Night 2/3 --> ON chiefs, BICU Team	30
0615	Floor Rounds	ON chiefs, PA/NPs	60
0730	OR, etc.		
1745	Floor sign-out	PA/NP --> Night intern/PA/NP, night chief	15
	Consult sign-out	ECR/Day chief --> ECR, 2/3, night chief	30
1800	BICU sign-out	BICU Team --> Night 2/3, chief	30

POST-CALL*

TIME	ACTIVITY	PERSONNEL	TIME (mins)
0530	Floor sign-out	Night Intern/PA/NP & chief --> ON chiefs**	15
	Consult sign-out***	Night ECR & chief--> ON chiefs, ECRs	15
0600	BICU sign-out	BICU Team --> Night 2/3, chief	30
1745	Floor sign-out	Night Intern/PA & chief --> POST chiefs**	15
1800	Consult/Admit sign-out	Night ECR & chief--> POST chiefs	15
1815	BICU Primary Service Rounds/Bedside Sign-out	Night 2/3 --> POST chiefs, BICU team	30
1845	Floor Rounds	POST chiefs, PA/NPs	60
2000	OR, etc.		

*On Monday AM when ACS1 is both ON Call and POST Call, ACS1 follows the POST CALL position to allow extra time for sign-out of new admits.
**PA/NP presence is very welcome but not mandatory (as information can be communicated via the day chief on rounds
***Should be short as there are no new admits to the ON call team (except burns to ACS2)

Resident Schedule Grid

			SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DAYS		BICU	A, C	F, A, C	F, A, B	F, B, D	F, B, D	F, B, D	F, B, D	B, D	F, B, D	F, B, C	F, C, A	F, C, A	F, C, A	F, C, A	C, A
	ACS1	Chief		5	5	5	5	5	5	5	5	5	5	5	5		
	ACS1	Consult	3	3	3	3	3	3			3	3	3	3	3	3	3
		Floor	B	P, P	P, P	P, P	P, P	P, P	C	C	P, P	P, P	P, P	P, P	P, P	D	D
	ACS2	Chief	4C	4A	4A	4A	4A	4A	4A	4A	4B	4B	4B	4B	4B	4B	4B
	ACS2	Consult			4B	4B	4B					4C	4C	4C			
	ACS2	Floor	2	P, P	P, P	P, P	P, P	P, P	2	2	P, P	P, P	P, P	P, P	P, P	2	2
		ECR	A	A	A	2, B	2, B	2, B	B	B, C	C	C	2, A	2, A	2, A	A	A, B
NIGHTS		Chief	4B	4C	4C	4C	4B	4C	4C	4C	4A	4A	4A	4C	4A	4A	4A
		BICU	2	2/3	2/3	2/3	2/3	2/3	2/3	2	2/3	2/3	2/3	2/3	2/3	2/3	2
		Floor	D	D	C	C	A	A	A	A	A	D	D	B	B	B	B
		ECR	B	B	B	C	C	A, C	A, C	A	A	A	B	B	B, C	B, C	C

			MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DAYS		BICU	F, C, A	F, C, D	F, D, B	F, D, B	F, D, B	F, D, B	D, B	F, D, B	F, D, A	F, A, C	F, A, C	F, A, C	F, A, C	A, C
	ACS1	Chief	5	5	5	5	5	5	5	5	5	5	5	5		
	ACS1	Consult	3	3	3	3	3			3	3	3	3	3	3	3
		Floor	P, P	P, P	P, P	P, P	P, P	A	A	P, P	P, P	P, P	P, P	P, P	B	B
	ACS2	Chief	4C	4C	4C	4C	4C	4C	4C	4A	4A	4A	4A	4A	4A	4A
	ACS2	Consult		4A	4A	4A					4B	4B	4B			
	ACS2	Floor	P, P	P, P	P, P	P, P	P, P	2	2	P, P	P, P	P, P	P, P	P, P	2	2
		ECR	B	B	2, C	2, C	2, C	C	C, A	A	A	2, B	2, B	2, B	B	B, C
NIGHTS		Chief	4B	4B	4B	4A	4B	4B	4B	4C	4C	4C	4B	4C	4C	4C
		BICU	2/3	2/3	2/3	2/3	2/3	2/3	2	2/3	2/3	2/3	2/3	2/3	2/3	2
		Floor	B	A	A	C	C	C	C	C	B	B	D	D	D	D
		ECR	C	C	A	A	B, A	B, A	B	B	B	C	C	C, A	C, A	A

KEY:			
	Fellow	F	
	HO5	5	
	HO4s	HO4A-C	
	HO3	3	
	HO2 OR HO3	2/3	
	ECRs	A,B,C in the ECR rows	
	Interns	A,B,C,D in the BICU or Floor r	
	PAs	P	

Acute Care Surgery Roles & Responsibilities

INTERNS

TBICU

- Gather vitals; examine each TBICU patient daily prior to rounds.
- Formulate a daily, systems-based plan for each TBICU patient, under the guidance of the fellow.
- Present each TBICU patient during daily TBICU rounds.
- Enact plans, maintain list, and write daily progress notes for TBICU patients.
- Communicate with primary ACS1 or ACS2 services regarding patient events, plans, etc.
- Perform ICU procedures under the guidance of the fellow, TBICU Attending, or experienced residents.
- Ensure AM labs, CXRs, pre-op, Mallampati/conscious sedation sheets are complete for AM.
- Sign-out TBICU patients to the night TBICU HO2/3
- Wedge intern may help in with OR, clinic, or floor when not busy in the TBICU
- Use Yellow Sheets

FLOOR

- Round on ACS1 floor patients with the ACS1 Chief
- Enact plans, maintain list, and write daily progress notes for ACS1 floor patients.
- Sign-out ACS1 floor patients to the night intern/PA/NPs

NIGHT

- Receive sign-out on ACS1 and ACS2 (ACS1 only once night PA/NPs available) patients.
- Promptly respond to nurse pages for all ACS floor patients
- Help in the TBICU when TBICU HO 2/3 is in the OR or ED
- Notify Night Chief and/or ACS Attending on call of any and all status changes/events
- Update the list with significant results/events
- Print the AM team lists – 3 sets: TBICU, ACS1 + TBICU patients, ACS2 + TBICU patients
- Provide a succinct sign-out to the incoming Day Chief

ECRs

- All ECRs travel with the on-call team for the day
- Respond to all traumas, staff with the on-call chief or ACS Attending
- Respond to all general surgery consults, staff with the on-call chief or senior
- Respond to all burn consults, staff with the ACS2 chief. May staff ACS patients directly with the ACS attending when the chief is delayed or unavailable.
- Respond to STX and SVA consults on nights/weekends, staff with the appropriate fellow
- Immediate sign-out of each new admission to the covering fellow, junior resident or PA/NP.
- Dictate consult notes in a timely manner
- Update the list with new consults/admissions
- AM sign-out of overnight admissions/consults to the post-call day team
- Attend M/T/W clinic
- Always have 1 surgery and 1 ED ECR on Wednesday and Thursday day for ED and surgery teaching conferences, respectively

ACS Roles & Responsibilities (cont'd)

SURGERY HO 2

- Same weekday responsibilities as the ECR
- Same weekend day responsibilities as the intern, covering ACS2 (until weekend PA/NP coverage available)
- Same night responsibilities as the Surgery HO 2/3
- *At all times*, the Surgery HO 2 is welcome in the trauma bay and OR, provided other patient care responsibilities have been addressed

SURGERY HO 2/3 (night only)

- Receive evening sign-out on TBICU patients
- Respond to TBICU pages; close communication with TBICU charge – *do not need to be present in the* TBICU
- Round with Charge nurse once per shift
- Use Yellow Sheets
- Perform necessary TBICU procedures, etc, under guidance of the trauma chief as needed
- Respond to all traumas
- See consults with ECRs as TBICU acuity allows
- OR with the trauma chief or attendings
- Provide concise sign-out of TBICU patients to the day teams during primary service rounds

TRAUMA CHIEFS: HO 5/4/4/3

DAY CHIEF

- ACS1: HO 5/3. ACS2: HO 4/4
- TBICU /Floor: Each chief team is responsible for the ongoing care/management of their existing floor patients as well as co-management of existing TBICU patients with the TBICU Fellow/team.
    - Rounds on floor patients, directs management, staffs
    - Rounds on TBICU patients, provides recommendations to the TBICU team
    - Provides sign-out to SCC Fellow for all new admits to the TBICU.
- Existing consults: Each team follows the consult patients that they initially staffed
    - ACS2 staffs all burn consults
    - Round on consult patients, provides recommendations, document, staff
- Clinic:
    - ACS1 – Tuesday (ACS)
    - ACS2 – Monday(Burn + ACS), Wed (Burn)
- Consults/Traumas: Respond to all consults/traumas with the ECRs/HO2
    - ACS1 – M, W, F, Su
    - ACS2 – Tu, Th, Sa
- OR

NIGHT CHIEF

- Respond to all traumas and consults (*except* SVA and STX consults)
- Oversee BICU management by the HO 2/3, Oversee floor management by the intern/PA/NP, Oversee AM sign-out

ACS Roles & Responsibilities (cont'd)

WEEKEND CHIEFS

- Same responsibilities as weekdays
- On any day if there is no TBICU fellow, each ACS chief assumes primary responsibility for their own BICU patients with support from the TBICU interns/PA/NP
- The on-call chief is supported in consult/trauma coverage by the off-call chief.
- When the Surgery HO 3 is on call for ACS1 without the Surgery HO 5, Level I Trauma Center compliance is maintained by the presence and involvement of the off-call ACS2 HO 4.

TBICU FELLOW

- Supervises critical care in the TBICU, in collaboration with the ACS1 & 2 chiefs in management of TBICU patients.
- Guides TBICU intern in formulation of daily plans
- Supervises intern in TBICU procedures
- Receives AM sign-out from night chief and
- Oversees intern PM sign-out of TBICU patients
- Provides sign-out to service chief when a patient is transferred out of the TBICU

Floor PA/NPs

- Responsibility for all aspects of floor patient care: rounding with the chief and/or faculty, enacting chief/fellow plans, writing daily progress notes, entering orders, responding to floor pages, updating the list, participating in PM sign-out, wound care/VACs, calling consults, interacting with SW/nutrition/PT/OT, d/c planning, discharges, help in clinic

TBICU PA/NP/Liaison

- Responsible for assisting in all aspects of patient care in the TBICU: rounding with the TBICU fellow and/or faculty, enacting daily plans, writing daily progress notes, entering orders, responding to TBICU nurse pages, updating the list, performing yellow sheet tasks, participating in AM sign-out, wound care/burn care/VAC changes, interacting with SW/nutrition/PT/OT/discharge planning, writing discharges, performing procedures. As the Trauma Liaison, excellent frequent communication with consulting services is essential.

VACATIONS

- No vacation for interns, night HO 2/3, or 5
- Day 2 can be covered by a float 2
- No ED ECR vacation weeks
- Day 3 or 4 can be covered by a float 3
- Day 3, 4, or 5 can be gone for short absences and can be cross-covered by the wedge senior on the contralateral ACS service on call days

Documentation

General

Proper documentation within the medical record is important for many reasons. Patient notes are the main form of written communication with other providers and services within the healthcare system; they serve to clarify any confusion regarding verbal communication. Without proper documentation no billing for services rendered in care of the patient can be performed. Lastly, the only real definitive record of what was done for the patient is what has been documented in the medical record.

When writing or dictating notes, it is important to utilize the common rules of English grammar. This includes use of complete sentences, avoidance of slang, and use of proper punctuation. Medical acronyms are okay, but should be limited to those commonly used and accepted. Use of text messaging abbreviations or shorthand is **not** acceptable. Your documents should be succinct, factual, correct, and something that you are proud to sign your name to. They are a reflection of your work. You should not be embarrassed to show them to your chairman or program director.

What follows are guidelines and recommendations for how to perform the documentation required on the Acute Care Surgery Service. With few exceptions, the documentation should be performed in MiChart using the electronic medical record. In selected instances it may be necessary to write a note on the yellow inpatient portion of the chart. These notes should include your printed name, doctor number, date/time and be signed with your signature. Various levels of residents, PA/NPs and attendings are responsible for assuring that the documentation is performed. If you are confused please ask so that a clarification can be made.

Admission and Discharge/Death Notes

All patients admitted to the ACS services require an admission note written in the EMR within 24 hours of admission. The Note should be sent to the on call attending at the time of admission. Accepted Transfers will be housed on the service accepting consults the day & time of patient arrival (SA1 M/W/F/Sun, SA2 T/Th/Sat, Burn patients are always housed on the SBUR service. Discharge/Death summaries must be sent to the attending of the week, NOT the admitting attending. *Note: Death summaries must be dictated as a Discharge Note.*

Daily Progress Note (TBICU)

Responsibility for the daily progress notes in the TBICU belongs to the intern/PA/NP in the ICU and the TBICU fellow. A daily progress note is required for each patient in the ICU, regardless of status (ICU, stepdown, floor). Exceptions are that no progress note is required on the date of discharge or the date of admission H&P. The notes must be completed and forwarded to the TBICU attending for review and signature on a daily basis. It is the responsibility of the chief on call, intern on call, and TBICU fellow to work together as a team so that the notes are completely in a timely fashion (before the next day).

The important feature of these notes is that they reflect the medical problems of the patient, changes in patient condition, daily physical exam, new findings (lab, studies), and feedback from consultants. The conclusion of the note should accurately depict the care plan for the patient for that day. Exhaustive lists of labs/study results that can be found in MiChart are not necessary.

Documentation (cont'd)

Instead, pertinent positives should be emphasized. An example is citing an Hct of 19.4 ***and*** the fact that you will transfuse the patient with 1 unit of PRBC's.

Daily Progress Note (SICU)

A brief note is required from the SA1 or SA2 service each day in addition to the note generated by the SICU service. The rounding chief is responsible for dictating this note or delegating it to the PA/NP/intern each day. The focus should be on surgical issues, wound documentation/care, and communication with the SICU service.

Daily Progress Note (Floor)

The PA/NP/intern will dictate/create the floor notes each day, even on the days when the patient is scheduled to go to the OR. The rounding chief is responsible for providing the attending with a copy of the patient list complete with vital signs, brief Physical Exam, and plan for the day.

Special Notes (Family meeting, clinical event) (Alert Note)

Whenever important meetings about the patients' condition are held, and especially if decisions are made regarding code status or ICU care, a brief dictated or written note documenting the meeting should be performed. If the patient has an acute event to which the house staff and or attending responds a brief note detailing the event, actions, and plan should be recorded. Recording the date and time in these notes is important. These notes are the responsibility of the chief resident/TBICU fellow, unless the attending tells you that they will dictate the note.

New Consult

Every consult will be dictated and sent to the on-call ACS attending or burn surgeon. The dictation should follow the format of CC, HPI, PMH, PSH, FH, SH, ROS (minimum 10 systems), PE, Labs, Radiology, Consults, Catalog of Injuries, Assessment and Plan. The ECR seeing the patient is responsible for this documentation.

Consult Follow-up

Follow-up consult notes should be brief and follow the SOAP format. The SA1 or SA2 Chief/HO3 resident is responsible for these notes and they should be forwarded to the ACS and/or burn attending on for the day.

Pre-operative Note

All patients receiving a planned operation will have a pre-op note. This will be the responsibility of the intern or PA/NP.

Brief Operative Progress Note

All patients receiving an operation should have a brief operative progress note in MiChart. This is the responsibility of the resident who performed the case.

Formal Operative Note

The attending who performed the operation will usually dictate the formal operative note. In selected cases the attending may ask the resident who performed the case to dictate the operative note.

Burn Patient Documentation

Level 1 and 2 Trauma Activations with Burn Injury

An **ED CONSULT NOTE** will be sent to the responding "ACS attending" (if this attending is not also an SBUR attending i.e. Dr. Stewart Wang or Dr. Mark Hemmila) which details the primary and secondary survey and critical care provided by the Trauma team in the ED as would be done for any trauma patient.

An **ADMISSION NOTE** will also be sent to the "SBUR Attending". Detailing the burn resuscitation and wound care plan. However, if the responding attending is a "SBUR Attending", i.e. Dr. Stewart Wang or Dr. Mark Hemmila, only ONE note –an Admission Note- needs to be generated documenting both the trauma resuscitation and wound care plan.

ED Burn Consults

A **CONSULT or ADMISSION NOTE** should be created and sent to the "SBUR Attending" only.

ICU and Stepdown status Burn patients in the TBICU

An **ICU PROGRESS NOTE** should be created and sent to the "TBICU Attending" (if this attending is not also an SBUR attending i.e. Dr. Stewart Wang or Dr. Mark Hemmila) detailing the critical care provided by systems.

A **second WOUND CARE NOTE** should also be sent to the "SBUR Attending." However, if the TBICU attending is a Burn Attending (i.e. Dr. Stewart Wang or Dr. Mark Hemmila) only ONE note –An ICU Progress Note- needs to be generated.

Floor Status Burn Patients

A **DAILY PROGRESS NOTE** should be created and sent to the "SBUR Attending" only.

CONSENTS

PHONE CONSENT

- CALL 6-5087
- OPERATOR WILL NEED THE FOLLOWING INFORMATION:
  - WHAT PROCEDURE(S) ARE BEING PERFORMED
  - WHO IS THE ATTENDING?
  - WILL ANESTHESIA BE INVOLVED?
  - ARE BLOOD PRODUCTS NEEDED?
- OPERATOR WILL INITIATE A CONFERENCE CALL BETWEEN PERSON REQUESTING CONSENT AND FAMILY MEMBER
  - THIS CALL WILL BE RECORDED
  - MUST DISCUSS RISKS AND BENEFITS OF PROCEDURE
  - THE FAMILY MEMBERS RESPONSE WILL BE NOTED
- EVERY NIGHT ALL CONSENTS ARE SCANNED INTO MICHART
  - IF RESIDENT NEEDS CONSENT SOONER IT CAN BE FAXED L:\ADMINSURG\RESTRICTED\RESIDENTS\CONSENTS

Note: *Remember to obtain serial consents for large wounds and burns for serial debridement and for potential open abdomens for serial washouts.*

Daily TBICU Progress Note

Post-operative Note
Every patient who receives an operation should have a post-operative note. The main purpose is to assure that a member of the team checks on the condition of the patient 4-6 hours after the operation has been completed. Attention to hydration status, airway, pain relief, neurologic and mental status is the objective. This is the responsibility of the intern or PA/NP. An example is provided in the Appendix.

Clinic Note
The resident or PA/NP seeing the patient is responsible for dictating a clinic note on the patient. These are usually brief and in the format of HPI/Subjective, Physical Exam, Studies, Assessment and Plan.

Procedure Notes
All of the procedures common to the service have a template in MiChart. The appropriate note should be completed for any procedure performed by the resident/PA/NP who performed the procedure. If it is a procedure without a template, please dictate a note in the same format.

Procedure notes available under Create Documents/Approved Templates	
Arterial line placement	DPL
Chest tube placement	Intubation
Central line placement	Suture closure of laceration
Bronchoscopy	Swan-Ganz catheter placement
Dialysis catheter placement	Wound vacuum placement or change

Tertiary Survey Alert Note
The ECRs are responsible for performing and documenting the tertiary survey. During this exam the patient is assessed head to toe for evidence of missed injuries. All diagnostic imaging final reads are reviewed to assure that identified injuries have been properly addressed. Incidental findings (i.e. masses, lymphadenopathy, etc…) should be documented, reported to the chief/attending, explained to the patient, and should be documented in the discharge summary with a plan of action (typically follow up with primary care provider). If new unexplained pain findings are identified on physical exam, proper imaging study(s) should be ordered and the chief/attending notified. Labs are also reviewed for evidence of missed injuries.

Guidelines for Acute General Surgery Consults

Patients should be assured of excellent clinical care. The service requesting consultation should be assured of prompt and thorough recommendations. The initial consultation note should reflect a plan from the appropriate service and surgeon that will manage the patient.

***KNOWN patients*:** Patients within 30 days of discharge from index operation; patients with issues clearly related to the index operation (even if >30 days from discharge); patients within 30 days of admission to a surgical service; patients with an upcoming OR date

***PENDING patients*:** Patients with a pending clinic appointment

***NEW patients*:** Directed consults (elective/semi-acute consults directed to a specific surgeon or the GSB/GSM/GSW services) or Undirected consults

For consult requests routed to SA1/2 resident (ECR or SA1/2 Chief):

If the consult is ACUTE (ACUTE is defined as requiring an operation in 12 hours (e.g., peritonitis, perforation, acute obstruction, ischemia, ongoing bleeding, shock states) and **not KNOWN** patient: **SA1/2 resident staffs with SA1/2 attending.**

ACUTE Consult and KNOWN patients: the primary surgeon (or the attending covering that service) is notified by the SA1/2 resident. The primary surgeon/service attending will call the ACS Attending if they desire assistance from them.

If the consult is NOT ACUTE:
SA1/2 resident sees new consult patients.
-If it is a ***known patient***, the primary surgeon is notified by the SA1/2 resident.
-If it is a ***pending patient***, notify primary surgeon but triage should be based on presentation, diagnosis and urgency of presentation. *Troubleshooting should be taken care of via an attending-to-attending discussion.*
-If it is a ***directed consult***, SA1/2 resident staffs directly with GSB/GSM/GSW attending. If there are expected delays with the SA1/2 resident seeing the consult, the GSB/GSM/GSW consult resident may be asked to see the patient.
-If it is an ***undirected consult***, staff with SA1/2 attending. If the case is deemed to require **specialty care**, staff with GSB/GSM/GSW as appropriate. *Troubleshooting should be taken care of via an attending-to-attending discussion.*

Specialty surgical cases: Pancreatic mass/cancer (not acute pancreatitis, necrotizing pancreatitis); sarcoma, melanoma; breast disease; bariatric surgery; burns (including TENS, SJS); All breast abscess consults directed to the Breast Fellow.

Colorectal cases (per the following guidelines):
• Known colorectal cancers (i.e., need for diversion for partial obstruction, presented at tumor board)
• Request for transfer for colorectal cancer patients with extensive comorbidities (not emergent surgery)
• Complex perirectal disease (i.e., s/p abscess drainage with multiple fistulae/seton placement; needs definitive and long-term care)

Guidelines for Acute General Surgery Consults (cont)

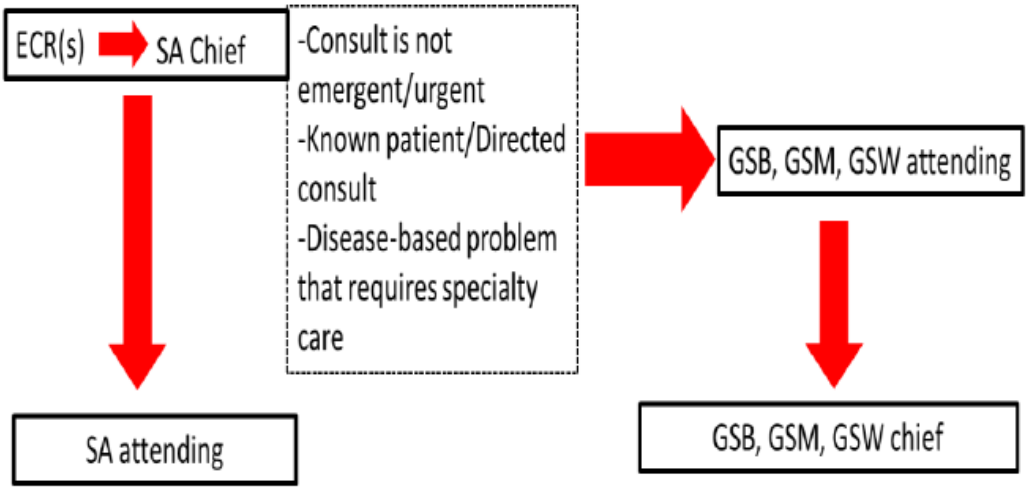
• Inflammatory Bowel Disease

-Chronic issues, failure of medical management, failure to improve
-New **ulcerative colitis or Crohn's disease** patient, no acute issues (bleeding obstruction), reviewing options of surgery vs. medical management (particularly if considering biologics), desire to discuss restorative proctocolectomy/J-pouch
-Enterocutaneous fistula with IBD, not requiring emergent surgery
-All pouch issues
☐Overarching principles for Colorectal Surgery: Call intraoperative consultation by CRS as needed.

Staffing with CRS is not appropriate for:
• **Not** for acute colonic obstruction, bleeding, perforation, ischemia, acute diverticulitis
• **Not** for toxic megacolon, bleeding, perforation, acute intestinal obstruction
• **Not** for patients requiring surgery within 12 hours (i.e. peritonitis, ischemia, obstruction, perforation)

To transfer patients to Specialty Surgical services:
1. ACS Attending to call Specialty service Attending, attending agreement to transfer patient to Specialty service
2. ACS Resident to Specialty Resident (Chief level optimal) discussion to formally transition patient to Specialty service; Specialty Resident to write orders to transfer patient to Specialty service.

If a known or pending patient is being sent to the ED by a Specialty surgical service :
☐The primary surgical attending should call the on-call Specialty service attending and their service residents.
☐If the patient is deemed to require an **ACUTE** consult (defined as requiring an operation in 12 hours, e.g., peritonitis, perforation, acute obstruction, ischemia, ongoing bleeding, shock states), then the primary surgical attending should call the on-call ACS Attending to provide information and proposed plan of care. Decision regarding which team should operate will be addressed at the attending level



Pre-Op NPO Guidelines in the Adult Patient

The following table summarizes the guidelines for preoperative fasting. Several caveats are listed in the "notes" section. See Burn section for NPO guidelines on burn patients.

Table 1. Summary of preoperative fasting recommendations to reduce the risk of pulmonary aspiration in adult patients.

Ingested Material	*Minimum Fasting Period*[2]
Clear liquids [3]	**2 h**
Non-clear Liquids & Solids [5]	**6 h**

Notes:

1. These recommendations apply to healthy patients who are undergoing elective procedures. They are not intended for women in labor. Following the guidelines does not guarantee complete gastric emptying has occurred.
2. The fasting periods noted above apply to all adult ages.
3. Examples of clear liquids include water, fruit juices without pulp, carbonated beverages, clear tea, and black coffee. 1-2 glucose tablets is considered NPO Continue to advise not to chew gum or suck on hard candy for 6hrs prior to procedure. If, on day of surgery, patient is chewing gum or sucking on hard candy, they should be required to spit it out - there is no need to delay the procedure if they comply. Miralax, which is polyethylene glycol or PEG 3350, completely dissolves and leaves no particulate matter. Consider Miralax as a clear fluid.
4. Since non-human milk is similar to solids in gastric emptying time, the amount ingested must be considered when determining an appropriate fasting period.
5. The policy pertaining to "solids" is applicable to any quantity of solid food. Best is a light meal typically consisting of toast and clear liquids. Meals that include fried or fatty foods or meat may prolong gastric emptying time. Both the amount and type of foods ingested must be considered when determining an appropriate fasting period.
6. Medications can be taken the morning of the procedure with up to 60 cc's of water. See Burn Section for Adult & Pediatric Burn patients.

Websites for Reference

Internal

ACS Call Schedules:
http://surgery.i.medicine.umich.edu/acute-care-surgery

CME
http://ocpd.med.umich.edu/cme

Department of Surgery:
http://surgery.med.umich.edu/portal/
http://surgery.i.medicine.umich.edu/

SICU Critical Care Manual
http://surgery.i.medicine.umich.edu/acute-care-surgery/resource-links/sicu-critical-care-manual

Trauma Burn Home:
http://surgery.i.medicine.umich.edu/acute-care-surgery/trauma-burn

Trauma Burn Protocol Manual:
http://surgery.i.medicine.umich.edu/sites/default/files/downloads/Trauma-Protocol-Book%20for%20Website-FINAL_0.pdf

Trauma Burn Program Policies:
http://www.med.umich.edu/i/trauma_burn/default.htm

External

www.traumaburn.org
www.east.org
www.aast.org
www.westerntraumaassociation.org
www.sccm.org

Adult Trauma Activation Criteria (Abbreviated)

Class I Trauma Activation Criteria

Intubated patients, use of rescue airway, respiratory compromise
Need for emergent airway control
Systolic BP < 100mm Hg at any time
GCS ≤ 8 not attributable to suspected drug/alcohol intoxication
Paralysis or rapid deterioration in GCS score
GSW to head, neck, chest, abdomen or groin
Threatened limb:

- **Near or total amputation above wrist or ankle**
- **Tourniquet application**
- **Pulseless extremity**
- **Significant crush injury**
- **Asymmetric ABI**

Physician discretion

Class II Trauma Activation Criteria

Systolic BP ≥ 100mm Hg
GCS 9-13 not attributable to suspected drug/alcohol intoxication
Pelvic fractures – must admit to a surgical service
Depressed or open skull fracture
Open long bone fracture (humerus/femur/tibia/fibula)
Stab/Impalement to head, neck, chest, abdomen or groin
Fall > 12 ft (one flight of stairs
High speed motorcycle crash
High risk auto crash (significant intrusion, death in vehicle, ejection)
Auto vs. Pedestrian/Bicyclist > 25 mph
Injuries to 2 or more body systems/regions

- **Neurologic (head and spine)**
- **Pulmonary, Cardiac, Vascular**
- **Abdominal, Genitourinary, Musculoskeletal**

Class I GERIATRIC Trauma Activation Criteria
Age ≥ 65 years

Class I: **Have a low threshold for upgrade to Class I**
Consider comorbidities
Consider anticoagulant use with bleeding risk

(Highlighted sections: Revised 4/2017)

Upgrading and Downgrading Traumas

Any staff directly involved in the patient care can upgrade/downgrade a trauma using either the trauma radio or contacting Survival Flight dispatch- 66035

Upgrade to Level I for:

- Hypotension
- Airway issues
- Hemorrhage
- Deterioration in neuro exam
- Change in extremity neurovascular exam

ED Protocol Labs

Study	Class 1	Class 2	Class 3
ABG w/lactate	**Yes**	**Yes**	**#**
T&C	**Yes**	**#**	**#**
T&S	**-**	**Yes**	**#**
Pregnancy Test	**Yes +**	**Yes +**	**#**
EtOH	**Yes**	**Yes**	**#**
Urine Tox Screen	**Yes**	**Yes**	**#**
CBC	**Yes**	**Yes**	**#**
Coags (PT/PTT, INR)	**Yes**	**Yes**	**#**
Basic (Electrolytes, BUN, Creatinine)	**Yes**	**Yes**	**#**

Legend:

if clinically indicated, + Females, age 10-45

FOR PATIENTS ON PLAVIX AT RISK FOR BLEEDING:

-Consider Platelet Function Test (P2Y12 – Plavix Platelet Test)
-Blue Top Tube; Full 2.7 mL volume; Mon-Fri 8AM – 3PM (1 hr.)
-Test results reported as percent inhibition
-Higher % inhibition indicates greater antiplatelet effect.
-Presurgical desired <20% inhibition

The Trauma/Burn Patient Revised Classification & Response System

	CLASS I	CLASS II	CLASS III (Trauma Consult)

Severity of Injury	• Gunshot wounds to the head, neck, chest, abdomen, or groin
	• Threatened limb to include:
	  ○ Near or total amputation proximal to the wrist/ankle
	  ○ Tourniquet application
	  ○ Pulseless extremity
	  ○ Significant crush injury
	  ○ Asymmetric ABI
	• High voltage electrical injury / lightning strike transported from scene
	• Physician discretion
	
	Geriatric Criteria > 65 years old
	• Consider Class 1 trauma activation for geriatric patients on anticoagulants and/or significant co-morbidities
		Stable vital signs in patients with:
		• Pelvic fractures
		• Multi-system injuries
		• Open long bone fractures
		• Burns >20% (full- or partial-thickness)
		• High voltage electrical injury
		• Full-thickness circumferential burns
		• Depressed or open skull fracture
		• Stab/Impalement wound to head, neck chest, abdomen or groin
		• Fall > 12 ft (one flight of stairs)
		• High speed motorcycle crash
		• High risk auto crash
		  ○ Significant intrusion
		  ○ Death in same vehicle
		  ○ Ejection
		• Auto vs. Pedestrian/Bicyclist > 25 mph
			Stable vital signs in patients with:
			• Significant injuries identified:
			  ○ e.g. long bone fx pneumothorax, axial skeleton fx, etc.
			• Patient requires admission
			• Isolated injury
			• Burns >5% partial-thickness burns >2% full-thickness
			• Any burn to face, hand, feet, genitalia, perineum or joints

Neurological Status	• GCS ≤ 8 with mechanism attributed to trauma • Documented decline in neuro status • Paralysis following traumatic injury • Focal neurologic deficit • Subdural or epidural of >1cm thickness in patient transferred from another facility	• GCS 9-13 (not related to medication administration) • No change in GCS from initial evaluation • No focal finding	• GCS of 14-15 • No change in GCS from initial evaluation • No focal finding
Respiratory Status	• Respiratory compromise or airway obstruction • Intubated trauma patients • Rescue airway in place	• Stable respiratory status • No respiratory distress or need for emergent invasive airway	• No need for any type of invasive airway
Cardiovascular Status	• Confirmed blood pressure of <100 mm Hg at any time • Transfer patients from other hospital receiving blood to maintain vital signs	• Adult: SBP ≥100 mm Hg • No ongoing fluid infusion to maintain SBP	• No ongoing fluid infusion to maintain SBP

Revised 04/2017

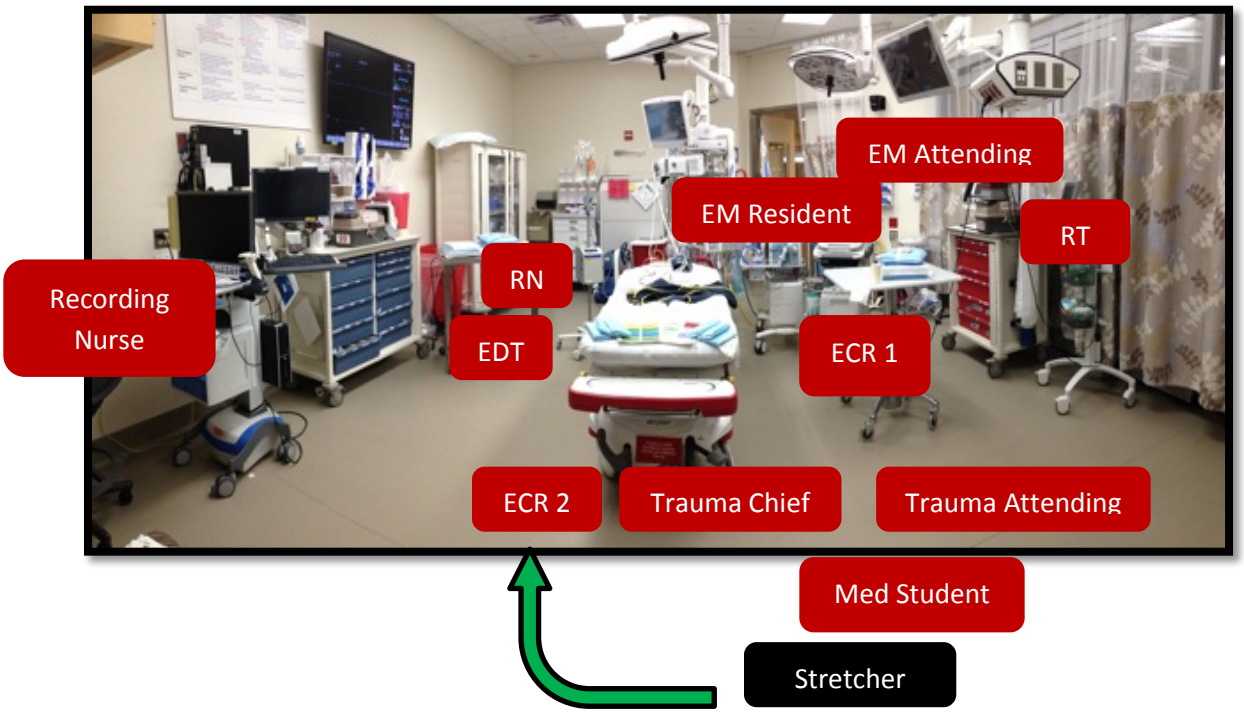
Revised Classification & Response System (cont'd)

	CLASS I	CLASS II	CLASS III (Trauma Consult)
Method of Activation	• Survival Flight Communication Center Initiates Trauma Radio & Paging System	• Survival Flight Communication Center Initiates Trauma Radio & Paging System	• Hospital Paging Activated
Personnel Notified	• ED Attending • ACS Chief Resident • ED Charge Nurse • OR Charge Nurse • Respiratory Therapy • TBICU Charge Nurse • ACS Attending • ACS ECR • Anesthesiology • Radiology • Blood Bank • Social Work	• ED Attending • ACS Chief Resident • ED Charge Nurse • OR Charge Nurse • Respiratory Therapy • TBICU Charge Nurse • ACS Attending • ACS ECR • Anesthesiology • Radiology • Blood Bank • Social Work	• ED Attending • ED Charge Nurse • ACS ECR & ACS Chief Resident consulted per ED Attending
Personnel Responding To ED	• ED Attending • ACS ECR • ACS Chief Resident • Social Work • ACS Attending w/in 15 minutes • ED Nurse • TBICU Charge nurse	• ED Attending • ACS ECR • ACS Chief Resident • ED Nurse • ACS Attending (at the discretion of the ACS attending) • Social Work	• ED Attending • ED Nurse • ACS ECR & Chief Resident consulted per ED Attending
Consult Services	• Requested per ACS, as needed.	• Requested per ACS, as needed.	• Requested per ED and ACS, as needed.

*Isolated Head Injury with cardiovascular instability or suspicion for multi-system injury is designated Class I or Class II as outlined above.
*Isolated Blunt Head Injury 2° fall from standing height or less & low suspicion of multi-system injury despite neurologic/resp status will have Neurosurgery consult only.
*Pregnant Patients with injuries will be classed as designated above based on severity of injury to the mother.
*All Pregnant Patients ≥ 20 weeks gestation will have immediate OB consultation in ED (exception: isolated distal extremity injuries). Fetal monitoring will be initiated upon arrival to the ED via modem to Labor and Delivery. Refer to ED Manual.
* Near Drowning and Hanging Injuries are to be classed as trauma patients using the physiologic parameters outline above for classification.

ED Trauma Team Resuscitation Roles and Responsibilities

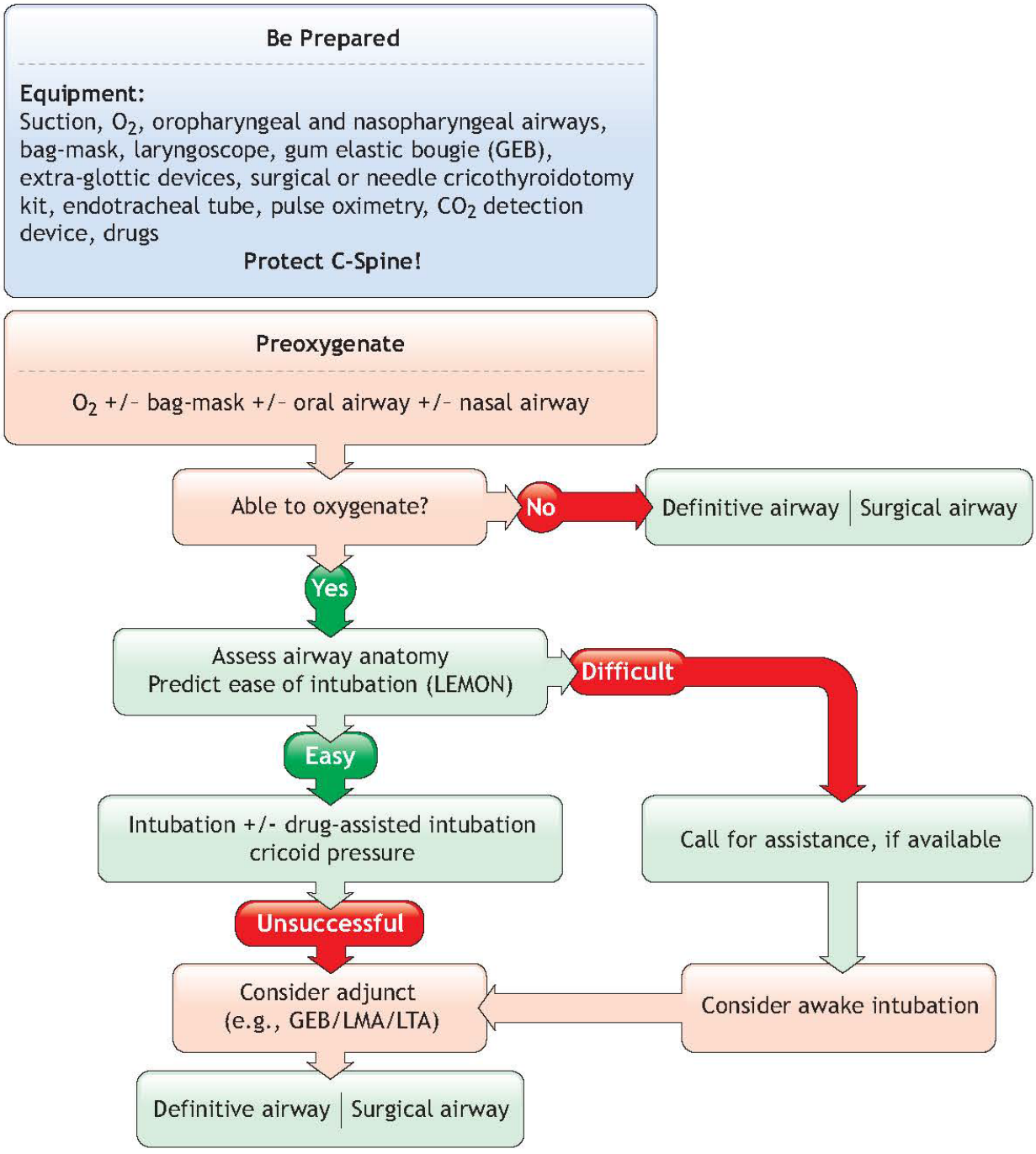
All team members need to wear blue poly, non-sterile gloves, mask and hat for personal protection. ECRs should wear lead.



VOMIT

V – Vitals
O – Oxygen
M – Monitor
I – IV/IV Fluids/Labs
T – Transition to CT and Treatment

Airway Decision Scheme



■ FIGURE 2-3 **Airway Decision Scheme** Used for deciding the appropriate route of airway management. *Note: The ATLS Airway Decision Scheme provides a general approach to airway management in trauma. Many centers have developed detailed airway management algorithms. It is important to review and learn the standard used by teams in your trauma system.*

References:

- American College of Surgeons Committee on Trauma. *ATLS Student Course Manual*, 9th Ed.; American College of Surgeons: Chicago, 2012.

ACS Trauma Team Overview

Trauma Team Objective

Primary role is to get things done as quickly as possible, not to duplicate the physical exam or medical decision making being carried out by ECR's and trauma chief.

Trauma Bay Communication

- Only one person should be talking at a time.
- Statements should be brief, organized and factual.
- Remain silent when someone else is speaking.

Trauma treatment team (ECR(s), ED resident, patient nurse, ED technicians, medical student) is responsible for:

1. Airway, breathing (ED resident, ECR)
2. Exposing the patient. (ECRs, ED technicians, medical student)
3. Placing monitors. (patient nurse and ED technicians)
4. Drawing blood. (ED technician) ABG. (ECR)
5. Placing IV's (ED technician) or central lines (ECR(s) as necessary.
6. Rectal exam. (ECR)
7. Foley catheter. (ED RN After FAST exam)
8. NG/OG tube. (ED RN/ED resident)
9. Other procedures as directed by team leader.
    a. Calling consultants and blood bank. (Trauma Chief, ECR2)
    b. Arranging diagnostic studies and requisitions. (Trauma Chief, ECR1)

ACS Trauma Team Roles/Responsibilities

Team Leader

- Directing resuscitative efforts of the team.
- Coordinating the primary and secondary surveys.
- Performs surgical airway if necessary and directs all other major surgical intervention (chest tube, central line, etc.).
- Assimilation of communicated patient information from other team members and assignment of treatment tasks.
- FAST exam with “ECR .”
- Intervening clinically at any level, as necessary

- Team Leader will be identified prior to initiation of each trauma resuscitation.
- Trauma chief and Senior (3rd yr.) ED ECR are both qualified to act as team leader.
- When the Senior ED ECR is on call they must alternate on an every other patient basis with the trauma chief as team leader.
- When the trauma chief is not the team leader he should assume the role of ECR and provide assistance to the Senior ED ECR in his/her role as Trauma Team Leader.
- Doing what is clinically right for the patient should prevail; educational experience should also be stressed during the trauma resuscitation.

Team Leader/Attending Staff

- Overseeing resuscitative efforts of the team.
- Primary viewing of radiographs and communicating findings to Team.
- Direct and review FAST exam.
- Assisting procedures.
- Formulation of further diagnostic evaluation and treatment plan.
- Communicating with OR.

Airway Resident/ED Attending

- Controlling airway, supplying oxygen (100% non-rebreather face mask is standard).
- Suction availability and function.
- *Calls out airway findings to Team*
- Cervical spine control.
- Insertion of NG or OG tube if necessary (after exam of face).
- Procedures (intubation, central line, etc.) as directed by Team Leader.
- Holds head and does count/coordination for logroll.
- May rotate to ECR2 role if only one ECR available and airway/c-spine tasks completed.

ACS Trauma Team Roles/Responsibilities

(cont'd)

ED Attending Staff

- Communicating pre-hospital information to Trauma Chief and Attending.
- Assisting ED Resident in control of airway.
- Primary attending for the patient until trauma staff arrives.
- Working in conjunction with Trauma Chief to provide team leadership of resuscitation
- Intervening clinically at any level, as necessary.
- Directing patient flow in ED.

ECR 1

- Airway and breathing assessment.
- Circulation assessment (carotid pulse).
- Verification that upper body is exposed.
- Primary survey from waist up.
- GCS.
- Procedures on upper body and left side (Chest tube, Cordis, etc.).
- FAST exam with trauma chief.
- Secondary survey.
- *Calls out all pertinent findings to Team.*
- Complete documentation of history and physical exam as consult or admission H&P.

ECR 2 (if available)

- Circulation (femoral pulse).
- Verification that lower body is exposed.
- Primary survey from waist down.
- ABG/Blood draw.
- Procedures on lower body and right side (Chest tube, Cordis, etc.).
- Splints.

Patient Nurse

- Preparation of room.
- Obtaining first set of vital signs and announcing them verbally to the team.
- Administering drugs, fluids, blood products.
- Switch pre-hospital IVF to warm LR.
- Reporting status of IVF and blood products given.
- Coordinating nurses/technicians.
- Accompanies patient to studies.
- Reports to the receiving patient unit.

ACS Trauma Team Roles/Responsibilities

(cont'd)

Trauma Recording Nurse

- Preparation of room.
- Recording of patient data.
- Recording team member presence and arrival time to trauma bay.
- Assistance in bedside care of patient as needed.

ED Technician 1

Preparation of room.

- Preparation of rapid infuser (All Class 1's; Class 2's when requested).
- Exposure of patient.
- EKG leads, BP cuff, pulse oximetry, temperature (Coordinate with ED Tech 2 if present).
- IV in Left arm.
- Assist in rolling patient.
- Assure that patient is covered with blankets after primary and secondary exam is done.
- STAT ABG and Blood to lab.
- Bair hugger if required.
- Pleur-evac setup if required.
- Retrieval of O negative blood from ED if required.

ED Technician 2

- Preparation of room.
- Exposure of patient.
- EKG leads, BP cuff, pulse oximetry, temperature (Coordinate with ED Tech 1)
- IV in Right arm.
- Assist in rolling patient.
- Pleur-evac setup.
- Offloading tasks from ED Technician 1.

Medical Student

- Help move patient from stretcher to gurney.
- Help remove patient clothing (focus on lower body).
- Assist in Foley placement.
- Assist in log rolling patient.
- CPR if necessary
- Take OSH studies to 1800 radiologist.

Trauma Preparation

- Efficient planning ***prior to arrival*** of patient makes for a smooth resuscitation.
- Members of the Trauma Team should assemble and introduce themselves before the patient arrives and their roles (ECR's, patient nurse, recording nurse, etc.) made clear to all present.
- Identify Team Leader (Trauma Chief or senior ED ECR). Team Leader runs trauma and hands out all other assignments. Communication flow is to and from the Team Leader. ***All team members should wear barrier protection.***
- Two team members with lead on (2 ECRs).
- Prepare USN and Prepare for any likely procedures.

Briefing

- When time permits all team members should assemble in their positions.
- Each member should verbally identify themselves starting with the Trauma Chief ("I'm Bob, Trauma Chief").
- A check of equipment should be performed (IVF, Rapid infuser, USN, etc.). Any special needs should be identified and communicated between team members (e.g. patient received needle thoracostomy in field, will need a chest tube.).
- Prepare to carry out ABC's of Primary Survey.

Room Preparation

- Gurney in place.
- Hang **2 L Warm Lactated Ringer's** (pressure bags).
- Make sure US is in room on patient left at the head of gurney.
- Clear room of unnecessary equipment and personnel.
- Prepare Rapid infuser if requested.
- Prepare for procedures if requested.

Patient Arrival

- The formal report at the time of arrival signifies transition of care from pre-hospital provider to the trauma team.
- The Team Leader should identify himself or herself.
- The patient should not be moved from the transport stretcher to the resuscitation stretcher (exclusive of those patients with an airway or cardiac crisis) until a concise (30-45 sec) pre-hospital report is completed by a single pre-hospital provider.
- All other team members quiet, don't interrupt.
- Prepare to transfer patient during report.
- Following the report and patient transfer, a designated team member (Team Leader/Trauma or ED Attending) should discuss the details of the incident, pre-hospital care provided, and patient PMH with the pre-hospital providers.

Secondary Survey

- Perform FAST exam.
- Complete physical exam by ECR1.
- Insert Foley catheter after FAST and rectal exam.
- NG/OG tube in unconscious or intubated patient.
- Roll patient and remove backboard.
- Keep patient **WARM**.
- "ECR 1" gives report to recording nurse.
- "ECR 2" and Team Leader call consultations, schedule diagnostic tests and communicate with OR.

IV Fluid

- Lactated Ringer's or Normal Saline – All IV fluid liter bags must be numbered (stickers).
- Warm fluid with rapid warmer if > 2L resuscitation.
- Consider switching to blood early (before the 2nd liter of crystalloid) if patient still unstable (SBP < 95 mmHg). Effort should be made to limit crystalloid administration to less than 2 liters.
- Consider restricting initial IV fluid administration in penetrating trauma that needs to go directly to OR.
- *"Rapid Infuser" must be primed with NS only!*

Assessment Hints

- Frog leg patient and do rectal exam so that Foley can go in early. Don't wait until log rolling patient and placement on foam pad to do rectal exam.
- Vaginal exam when appropriate to look for tampon or open pelvic fracture

Operating Room

- Class 1 Trauma
  - OR on standby until released.
  - Prepared for thoracotomy, laparotomy, vascular procedures.
- Class 2 Trauma
  - No OR on standby. Need to contact OR charge nurse.
  - Specify procedures anticipated and equipment needed.
- Order blood if you are going to OR. Start with one Trauma Pack (6u PRBC, 4u FFP, 1-5pk Plt).
- In most instances you should be going straight to the specific operating room. No stopping in the anesthesia holding area.

Studies

- CT c-spine if getting head CT.
- CT chest based on CXR findings.
- CT abdomen and pelvis. Fine cuts of pelvis if suspect pelvic fracture.
- CT angiogram of neck if suspect blunt injury to neck blood vessels.

ED Propofol Usage

Patients who meet the following criteria may be candidates for Propofol sedation:

A. Intubated adult patients requiring frequent neurological checks
B. Intubated adult patients who are unable to be managed by other means

EXCLUSIONS

A. Propofol is not approved for use for patients 17 and younger
B. Propofol should be used cautiously in patients with potential for hypotension
C. ED Registered Nurses may administer Propofol only after successful completion of an ED approved educational module and test

ACTIONS

A. Patients meeting the above criteria are considered candidates for Propofol sedation.
B. To initiate Propofol sedation, a physician order for the rate of continuous infusion will be written on the ED Encounter Document.
C. The ED Registered Nurse (RN) will review the order and obtain medication from the ED Omnicell/ED pharmacist.
D. The ED RN will administer Propofol via intravenous pump to infuse at prescribed initial dose and titrated to maintain sedation. For rapid sedation of an intubated patient during initiation of Propofol infusion, bolus doses of 10 -20 mg given over 10-20 seconds may be given every 2 minutes to achieve initial sedation. Bolus doses of Propofol should not be used in patients with hypotension.
E. The ED RN will monitor vital signs continuously and document every 5 minutes for initial 15 minutes. The ED RN will then document vital signs every 15 minutes for 1 hour and thereafter as indicated by patient condition.
F. Level of sedation will be evaluated using the Ramsey Sedation Scale (see Scores/Scales section) and documented along with vital signs every 5 minutes for initial 15 minutes and as Propofol is titrated to maintain sedation.

ED Med Pack CED Pharmacy

- Vecuronium 10 mg vial (x2)
- Morphine sulfate 10 mg syringe (x2)
- Midazolam 1 mg/mL vial (x2)
- Fentanyl 50 mcg/mL vial (x2)
- Naloxone 0.4 mg/mL ampule (x2)
- Sterile Water 1 vial (to reconstitute the Vecuronium)

Massive Transfusion Protocol (MTP) – ADULT

➢ 50 KG

University of Michigan 7/5/16 Rev 7

Appropriate Initial Interventions:

- Intravenous access – 2 large bore IVs and Central Venous Cath
- Labs: T&S, CBC, Plts, INR, PT, PTT, Fibrinogen, Electrolytes, BUN/Creatinine, ionized calcium, ROTEM
- Continual monitoring: VS, U/O, Acid-base status
- Aggressive re-warming
- Prevent / Reverse acidosis
- Correct hypocalcemia: CaGluconate or CaCl
- Target goal ionized calcium 1.2 – 1.3
- If use CaCl 1 gm, give slowly IV
- Repeat lab testing to evaluate coagulopathy
- Stop crystalloid - avoid dilutional coagulopathy

Other considerations:

- **Anticipate hypocalcemia and infuse 1g calcium gluconate per 1-2 units PRBC's transfused**
- Cell salvage: Anes Tech via front desk 93-64270 (Main & CVCOR)
- Heparin reversal: Protamine 1mg IV/100 U heparin
- Warfarin reversal: Vitamin K 10 mg IV; Consider Prothromin Comp 4 Factor PCC Kcentra INR 2-4 25units/kg, INR>4-6, 35 units/kg, INR>6, 50 units/kg; repeat doing not recommended

Chronic Renal Failure + VW Factor; DDAVP 0.3 µg/kg IV x 1 dose

- Consider antifibrinolytics:
  - Tranexamic acid 1 gm bolus plus infusion 1 gm over 8 hrs
  - Amicar 5 gm IV bolus then 1 gm/hr IV infusion

Additional help

- Anesthesia: Page 8003;Trauma Chief (via web or operator)
- Rapid Response Team pager 90911 or call stat page 141

General Guidelines for Lab-based Blood Component Replacement in Adults:

Product	Consider for	Dose
RBCs	N/A	MD discretion
FFP	INR > 1.5	4 units FFP
Platelets	< 100,000	One 5-pack Plts
Cryoprecipitate	Fibrinogen < 100	Two 5-packs Cryo

Identify and Manage Bleeding

(Surgery, Angiographic Embolization, Endoscopy)

Adult: 4U RBCs in<4 hours and ongoing bleeding

Clinical Team Activates MTP & Designates Clinical Contact

Clinical Contact phones Blood Bank (BB) at 936-6888 and:

- Provides name of clinical contact person to Blood Bank (BB)
- Provides MR#, sex, name, location of patient
- Records name of BB contact, calls if location/contact information changes
- Sends person with **patient name and MRN** to pick up the cooler
- Ensures that MTP protocol electronic order is entered in CareLink

BB Prepares MTP Pack

MTP Pack: 5U RBCs; 5U FFP; One 5-pack Platelets or one apheresis platelet

This will result is an approximate 1:1:1 ratio

Hemostasis & resolution of coagulopathy?

YES

Stop MTP

- Notify BB & return any unused blood ASAP
- Resume standard orders
- D/C MTP Electronic order

NO

Repeat Labs

- CBC, Platelets
- INR/PT, PTT
- Fibrinogen
- ABG (Ionized Calcium, Potassium, Lactate, Hematocrit

WITH Orange Card

Clinical Contact calls BB at 6-6888 for another MTP pack

** MD can adjust pack based on labs PRN

If persistent coagulopathy consider:

rFVIIa: 90 µ/kg dose

4 Factor PCC: Kcentra INR 2-4 25units/kg, INR>4-6, 35 units/kg, INR>6, 50 units/kg; repeat doing not recommended

Tranexamic Acid

Tranexamic acid (TXA) is an antifibrinolytic that inhibits both plasminogen activation and plasmin activity, thus preventing clot break-down rather than promoting new clot formation. TXA has been used around the world to safely control bleeding since the 1960s. A large randomized trial recently conducted in >20,000 trauma patients (CRASH-2) adds to the large body of data documenting the usefulness of TXA in promoting hemostasis. A recent review by Napolitano et al delineated clearly the appropriate criteria (above) for administration of TXA in trauma.

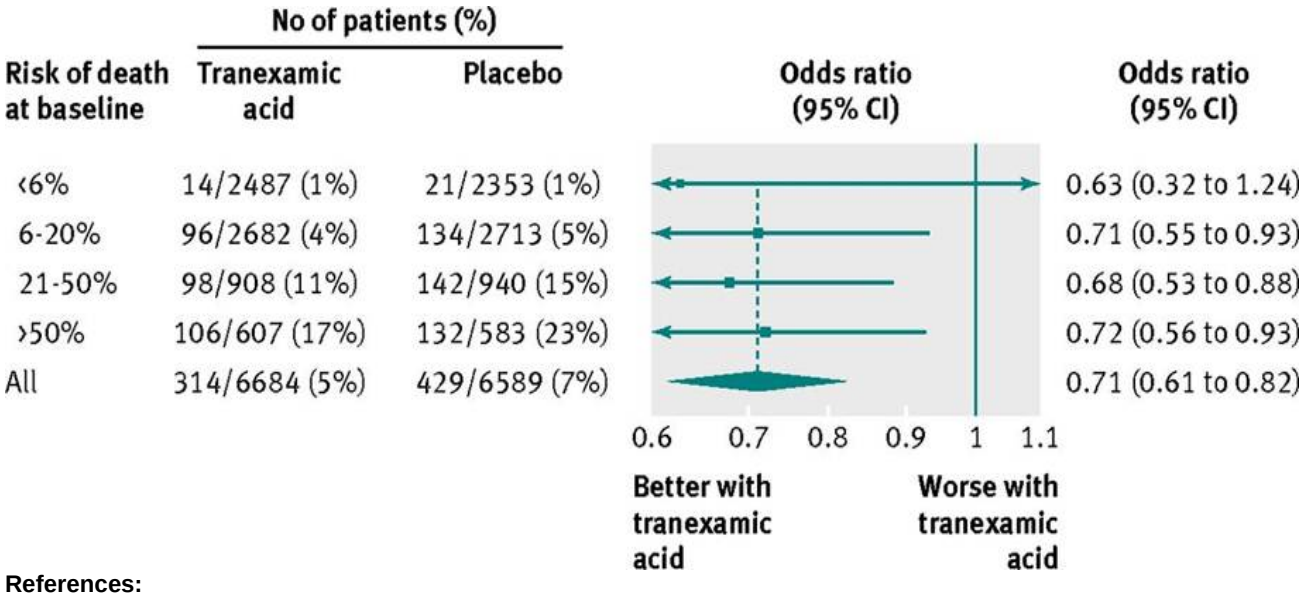
Tranexamic acid will be administered if treatment is initiated within 3 hours of injury and if one or more of the following criteria are met:

- The adult patient is in severe hemorrhagic shock (SBP ≤70)
- The patient has known predictors of fibrinolysis (hypothermia, acidosis, hemodilution, prolonged hypotension)
- The patient has known fibrinolysis by TEG (LY30 >3%)
- The patient is managed with the massive transfusion protocol.

Tranexamic acid is available in the ED and OR pharmacies and in 6th floor pharmacy.
Dosing is:

- **1 gram infused intravenously over 10 minutes**
- **followed by 1 gram infused intravenously over 8 hours**

Death from bleeding in patients with traumatic bleeding according to treatment with tranexamic acid:

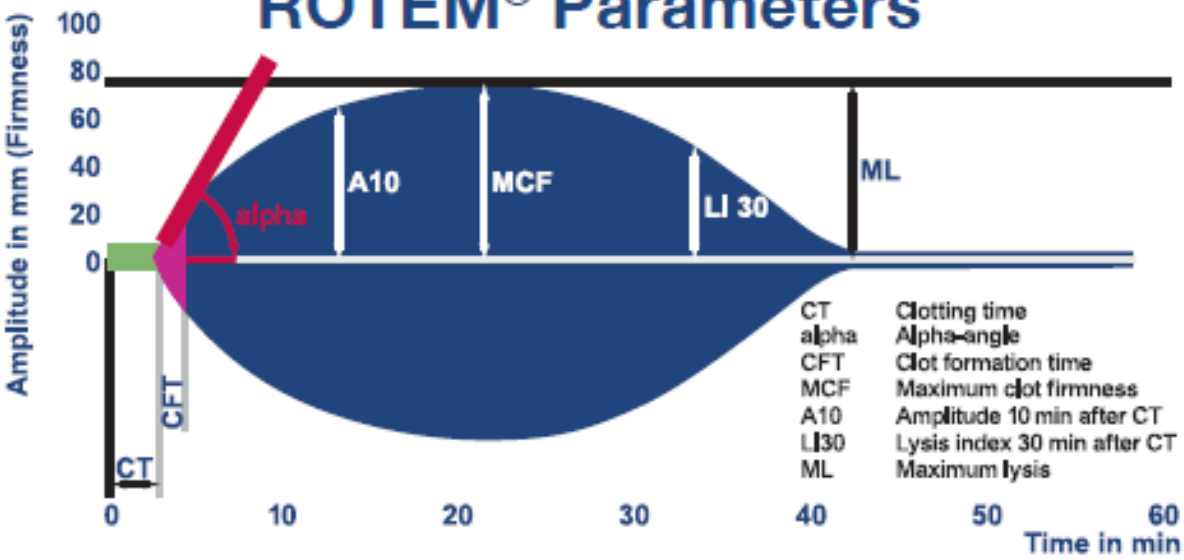


References:

- *Napolitano L, Cohen MJ, Cotton BA, Schreiber MA, Moore EE. Tranexamic acid in trauma: How should we use it? J Trauma Acute Care Surg. 2013; 74:6 1575-1585*
- *The CRASH-2 Collaborators. Effects of tranexamic acid on death, vascular occlusive events, and blood transfusion in trauma patients with significant hemorrhage (CRASH-2): a randomised, placebo-controlled trial. Lancet 2010; 376: 23–32*
- *Kashuk JL, Moore EE, Sawyer M, Wohlauer M, Pezold M, Barnett C, Biffl WL, Burlew CC, Johnson JL, Sauaia A. Primary fibrinolysis is integral in the pathogenesis of the acute coagulopathy of trauma. Ann Surg. 2010;252:434-442; discussion 443-444.*
- *Brohi K, Cohen MJ, Davenport RA. Acute coagulopathy of trauma: mechanism, identification and effect. Curr Opin Crit Care. 2007;13: 680-685.*
- *Ganter MT, Pittet JF. New insights into acute coagulopathy in trauma patients. Best Pract Res Clin Anaesthesiol. 2010;24:15-25.*

ROTEM® POCKET GUIDE

ROTEM® Parameters

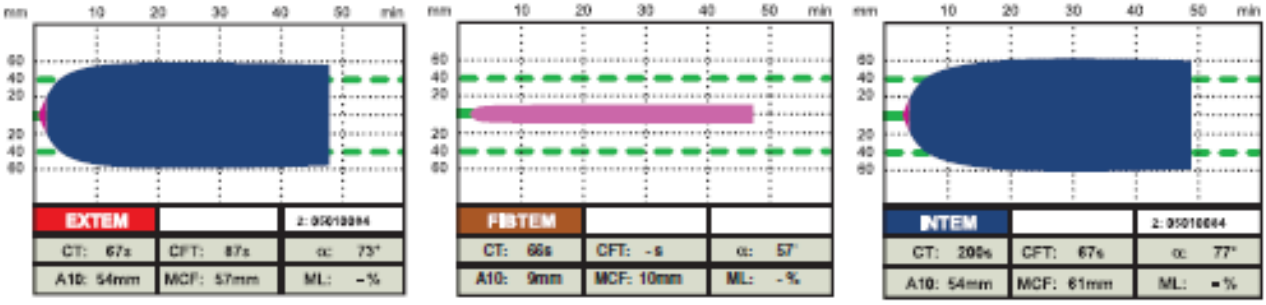


Parameter Reference Range[1]

	CT	CFT	α angle	A10[2]	A20	MCF
INTEM	122-208	45-110	70-81	40-60	51-72	51-72
EXTEM	43-82	48-127	65-80	40-60	50-70	52-70
FIBTEM						7-24
HEPTEM	Compare to INTEM					
APTEM	Compare to EXTEM					

"Normal" TEMograms Shapes

(example of normal clot onset, propagation rate and amplitude shape)



ROTEM Customer Support:

Phone: 919-941-7777, option 2 Email: support@roteminc.com

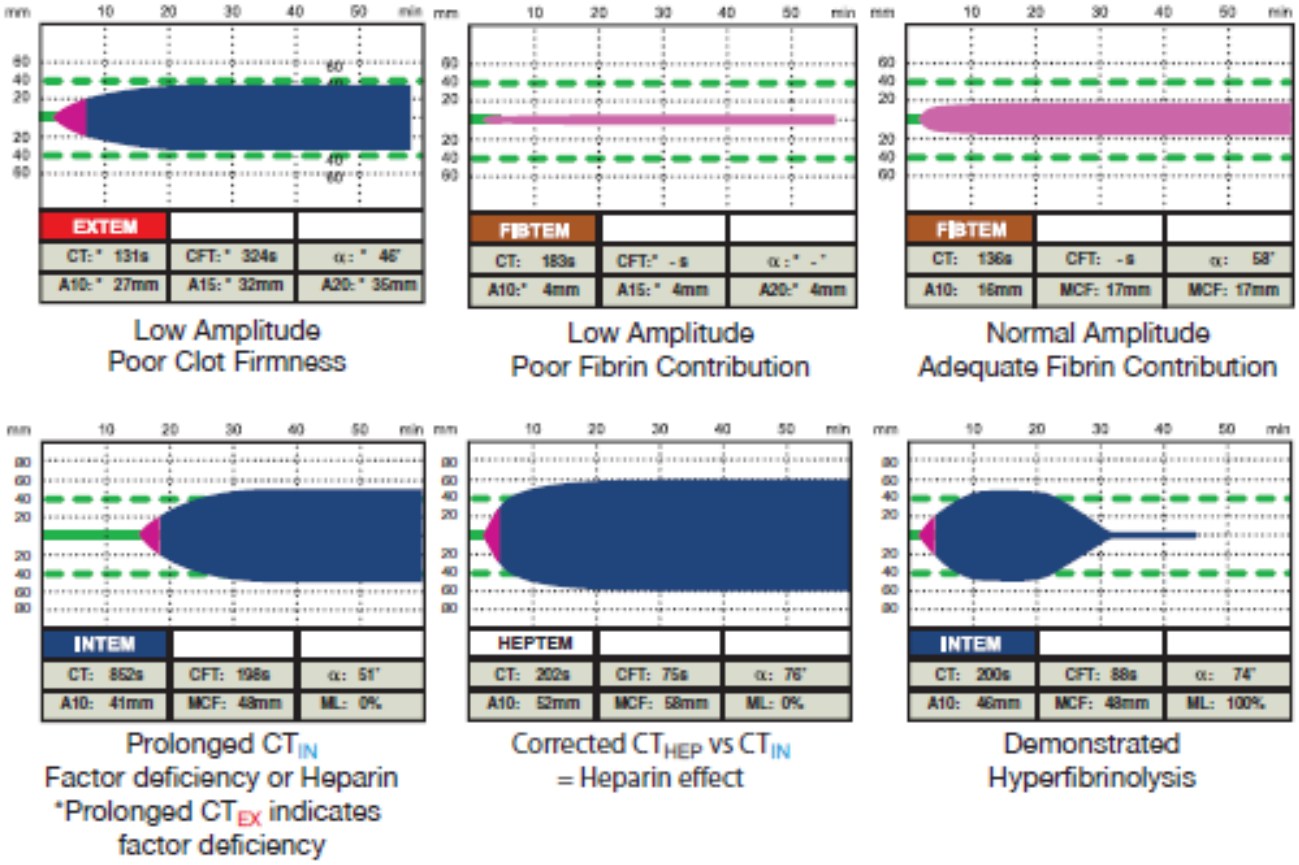
Disclaimer: This Pocket Guide is intended for use by qualified and trained ROTEM® users to assist in the safe use and interpretation of the results of the ROTEM® *delta* Thromboelastometry System. Results from the ROTEM® *delta* should not be the sole basis for a patient diagnosis; ROTEM® *delta* results should be considered along with a clinical assessment of the patient's condition and other coagulation laboratory tests.

BR2013.01v02

ROTEM® Results in Clinically Significant Bleeding

CT_{IN}	*Prolonged*	Suggests Heparin influence or intrinsic factor deficiency
CT_{EX}	*Prolonged*	Suggests extrinsic factor deficiency
$A10_{IN, EX}$	*Reduced*	Suggests poor clot firmness as a result of decreased: Platelets, fibrinogen and/or FXIII
$MCF_{IN, EX}$	*Reduced*	Suggests poor clot firmness as a result of decreased: Platelets, fibrinogen and/or FXIII
MCF_{FIB}	*Reduced*	Suggests poor fibrin contribution to clot firmness
$ML_{IN, EX, FIB}$	*> 15%*	Suggests hyperfibrinolysis

ROTEM® TEMograms in Clinically Significant Bleeding



Low Amplitude
Poor Clot Firmness

Low Amplitude
Poor Fibrin Contribution

Normal Amplitude
Adequate Fibrin Contribution

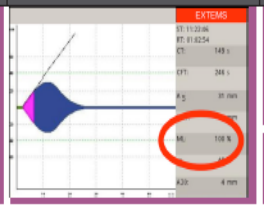
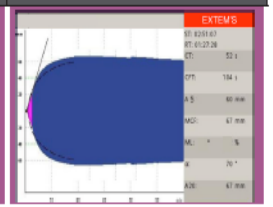
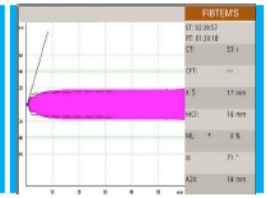
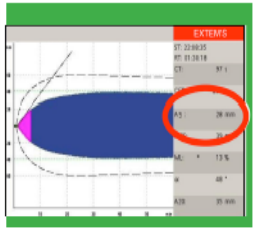
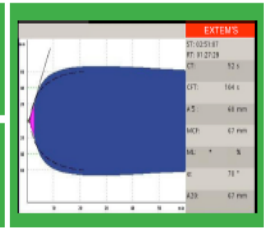
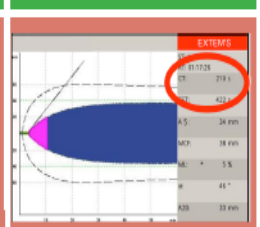
Prolonged CT_{IN}
Factor deficiency or Heparin
*Prolonged CT_{EX} indicates factor deficiency

Corrected CT_{HEP} vs CT_{IN}
= Heparin effect

Demonstrated
Hyperfibrinolysis

References – (1) ROTEM® *delta* reference ranges (adult values listed in the above table) have been determined in 3 US clinical centers on reference group samples with no signs of impaired coagulation. These values are for orientation only. They are not binding and may vary from lab to lab. Please note that reference ranges for coagulation parameters depend on the reference population, the blood sampling technique and other pre-analytical factors. It is recommended to confirm the ranges with a hospital specific reference group.

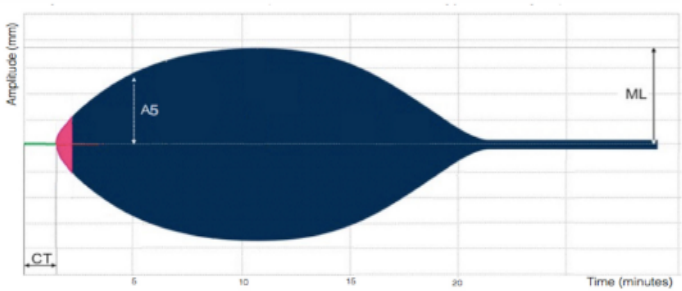
Key Points: This algorithm is for use in patients with CRITICAL BLEEDING only. Only treat abnormal values if active bleeding or at high risk of bleeding. Repeat ROTEM analysis 10 mins after intervention to assess response.

	ABNORMAL ROTEM	CRITERIA	DIAGNOSIS	INTERVENTION	CORRECTED ROTEM
FIBRINOLYSIS		Early Diagnosis **EXTEM A5≤35mm** or **FIBTEM CT >600s**	**High likelihood of excess fibrinolysis**	**Tranexamic acid 1g** Consider repeat dose if has lost over 1 blood volume since initial dose (If no contra-indications)	
		Late Diagnosis **EXTEM or FIBTEM ML ≥5%**	**Excess fibrinolysis**		
FIBRINOGEN		**FIBTEM A5≤10mm**	**Low fibrinogen**	**Cryoprecipitate** (see dosing guide)	
PLATELETS		**EXTEM A5 ≤35mm** and FIBTEM A5 >10mm	**Low platelets**	**Platelets: 1 adult dose** (correlate with platelet count)	
		EXTEM A5 ≤25mm and FIBTEM A5 ≤10mm	**Low platelets** and **Low fibrinogen**	**Platelets and fibrinogen** (correlate with platelet count)	
FACTORS		**EXTEM CT 80-140s** and FIBTEM A5 ≤10mm	**Low fibrinogen**	Correct **fibrinogen** and reassess	
		EXTEM CT >80s but FIBTEM A5 >10mm	**Low coagulation factors**	**FFP 1-4U or** (+ Fibrinogen if indicated)	
		EXTEM CT >140s and FIBTEM A5 ≤10mm	**Low fibrinogen and Low coagulation factors**		

Fibrinogen Dosing Guide

FIBTEM A5 Target: ≥12mm		
FIBTEM A5 Cryoprecipitate*	**Increase required**	**Cryoprecipitate***
9-10mm	2-3 mm	10 Units
7-8mm	4-5 mm	15 Units
4-6mm	6-8 mm	20 Units
<4mm	≥9mm	20-25 Units

*Cryoprecipitate dosing is for standard adult units
(Cryo 5 units = Fibtem A5 increase of approx 2mm)



Guidelines for Blood Product Transfusion in Trauma

The Trauma Burn Service and Blood Bank have developed and implemented the following process for blood transfusion during acute trauma resuscitation for treatment of hemorrhagic shock:

1. **ED PACK** of uncrossmatched blood should be used first (4UPRBC/ 4UFFP immediately available in ED refrigerator).

2. A STAT request for a **TRAUMA-PACK** should be sent to the blood bank when trauma labs are sent at time of ED arrival. [**TRAUMA-PACK** contains type-specific (available within 15 min) or crossmatched (available within 40 min) 5U PRBC, 5U FFP, One (1) 5-pack Platelets]

3. The blood sample for the **TRAUMA-PACK** must be hand delivered by the ED Tech directly to the blood bank

4. In an emergency situation the blood bank will deliver an additional **TRAUMA-PACK** to the ED in a cooler. The blood should stay with the patient if they travel to CT or angiography imaging, or to OR

5. If an uncrossmatched **TRAUMA PACK** is required, the blood bank will be notified of this need by the ED/Trauma team calling 6-6888 while directing an ED Tech to retrieve the **TRAUMA-PACK** from the blood bank

6. When retrieving emergency uncrossmatched **TRAUMA-PACK** the ED tech should provide the blood bank with the patient's ED registration sticker

7. If patient is going to the OR, the remaining blood available should be sent to the OR with the patient to avoid duplicate orders to the blood bank

8. Any blood that is not used should be sent back to the blood bank as promptly as possible in an effort to not waste blood products

9. If additional blood is necessary, an additional request must be made to the blood bank, either for additional **TRAUMA-PACK**, or specific blood component therapy as necessary (PRBC, FFP, and Platelets)

10. If pre-thawed FFP or cryoprecipitate is necessary (i.e. for a trauma patient with known coagulopathy being transferred to us), please call blood bank directly with this request as early as possible to facilitate prompt receipt of thawed FFP

Hypothermia/Rewarming Guideline

Hypothermia will be identified in the primary survey and appropriate rewarming techniques will be instituted in the ED resuscitation bay.

Definitions
Mild Hypothermia: 32-35 º Celsius (90-95 º Fahrenheit)
Moderate Hypothermia: 28-32 º Celsius (82-90 º Fahrenheit)
Severe Hypothermia: < 28 º Celsius (82 º Fahrenheit)

• ***Clinical treatment of mild hypothermia***
Passive external rewarming
- Removal of wet clothing/wet dressings if present
- Apply warmed blankets to patient
- **Increase resuscitation room temperature to 24 degrees Celsius (72 degrees Fahrenheit)**
- Hourly measurement of temperature until normothermia is achieved

• ***Clinical treatment of moderate hypothermia and refractory mild hypothermia***
Active external/internal warming
- Forced air rewarming blanket (Bair Hugger)
- Warmed IV fluids via Ranger infusion pump or Level I infuser
- Warmed humidified oxygen by ventilator if patient intubated
- Hourly measurement of temperature until normothermia is achieved

• ***Clinical treatment of severe hypothermia***
- Use the InnerCool® device for rewarming; InnerCool femoral catheter will be placed by the ED staff. The temperature sensor will be continuously monitored by the primary nurse (see photos of temperature sensor application for rewarming) to prevent interruptions in rewarming
- The patient will be warmed to 32 degrees Celsius and then transitioned to active external/internal rewarming as outlined above until normothermia is achieved

• ***Clinical treatment of severe hypothermia complicated by cardiac arrest***
- If known cardiac arrest time is greater than 1 hour consideration to terminate resuscitation (regardless of temperature) may be appropriate.
- If known cardiac arrest time is less than or equal to 1 hour the patient will be rewarmed using the InnerCool device as outlined above with a rewarming temperature goal of 32 degrees Celsius.
- CPR will continue throughout the rewarming process.
- ECMO should also be considered for rewarming if no evidence of asphyxia (avalanche, drowning)
- Attempts at defibrillation and use of intravenous medications at temperatures lower than 32 degrees will be at the discretion of the ED and ACS attending physicians.
- At 32º Celsius ACLS interventions will be utilized in an attempt to produce a perfusing cardiac rhythm.
- If ACLS measures are unsuccessful at producing a perfusing cardiac rhythm once patient is rewarmed to 32 degrees Celsius, termination of resuscitation may be considered.

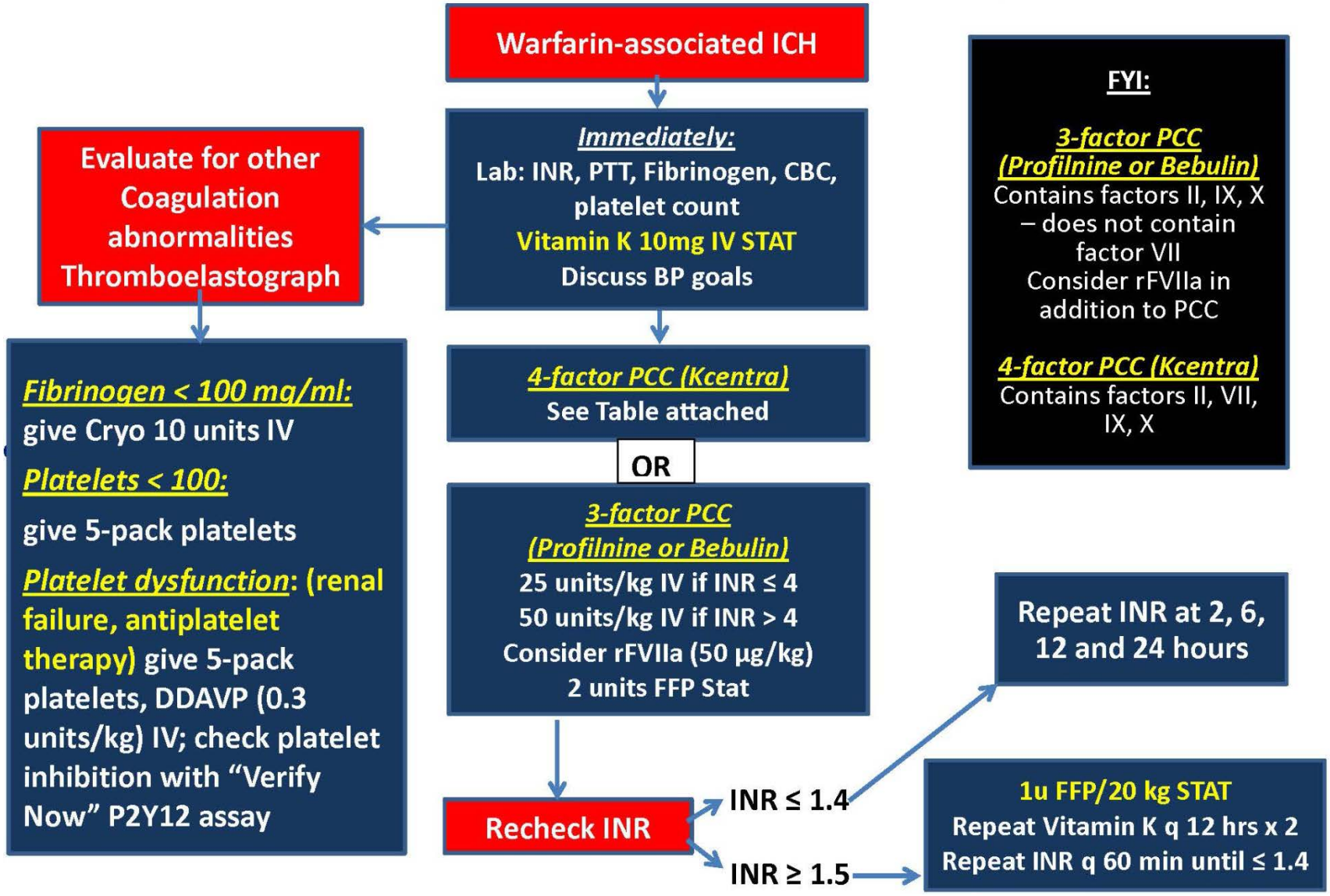
Hypothermia/Rewarming Guideline (cont'd)

- If ACLS measures **ARE** successful in producing a spontaneous circulating rhythm the patient will be maintained at a temperature of 32 degrees (via the InnerCool device) and the guidelines for therapeutic hypothermia for survivors of cardiac arrest will be instituted.
- The patient will be admitted to the trauma service and cared for in an intensive care unit capable of monitoring the InnerCool device.

References

- Laniewicz M, Lyn-Kew K, Silbergleit R. Rapid endovascular warming for profound hypothermia.Ann Emerg Med. 2008;51(2):160.
- 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care: Hypothermia. Circulation 2005; 112(24 Suppl):IV (136).
- Giesbrecht GG. Cold stress, near drowning and accidental hypothermia: a review. Aviat Space Environ Med. 2000;71(7):733.
- Jurkovich GJEnvironmental cold-induced injury.Surg Clin North Am. 2007;87(1):247.
- Hughes A, et al., Full neurological recovery from profound (18 °C) acute accidental hypothermia: successful resuscitation using active invasive rewarming techniques, *Emerg Med J* **24** (2007), pp. 511–512
- Rutterman E et al. ECMO improves survival in hypothermic cardiocirculatory arrest. J Thor Card Surg 2007;134:594-600.
- Scaife ER et al. Established ECMO protocol promotes survival in extreme hypothermia. J Ped Surg 2007;42:2012-2016.

Warfarin Reversal for Intracranial Hemorrhage (ICH)



Warfarin Reversal for ICH (cont'd)

PCC Dosing for ICH

3-Factor PCC:

Dosing Bebulin in Serious Bleeding for Coumadin Reversal

INR	Dosing
2-3.9	Dose 25 IU/kg
4-5.9	Dose 35 IU/kg
>6	Dose 50 IU/kg
Elderly	Total dose 500 IU and follow

Hanley JP. Warfarin Reversal. *Journal of Clinical Pathology* 2004; 57:1132-1139.

4-Factor PCC: Kcentra

----------DOSAGE AND ADMINISTRATION----------

For intravenous use only.

- Kcentra dosing should be individualized based on the patient's baseline International Normalized Ratio (INR) value, and body weight. (2.1)
- Administer Vitamin K concurrently to patients receiving Kcentra to maintain factor levels once the effects of Kcentra have diminished.
- **Repeat dosing with Kcentra is not supported by clinical data and is not recommended. (2.1)**
- Administer reconstituted Kcentra at a rate of 0.12 mL/kg/min (~3 units/kg/min) up to a maximum rate of 8.4 mL/min (~210 units/min.). (2.3)

Pre-treatment INR	2 – < 4	4 – 6	> 6
Dose* of Kcentra (units† of Factor IX) / kg body weight	25	35	50
Maximum dose‡ (units of Factor IX)	Not to exceed 2500	Not to exceed 3500	Not to exceed 5000

* Base dosing on actual potency, which is stated on the carton and will vary from 20-31 Factor IX units/mL. Nominal potency is 500 units per vial, approximately 25 units per mL after reconstitution.

† Units refer to International Units.

‡ Dose is based on body weight up to but not exceeding 100 kg. Do not exceed stated maximum dose for patients weighing more than 100 kg.

Warfarin Reversal for ICH (cont'd)

Table 5. Prothrombin complex concentrate (PCC) products available for reversal of warfarin-associated coagulopathy

Product (manufacturer)	Factor levels			
	II	VII	IX	X
Available in the US				
PCCs, 3-factor (II,IX,X)				
Profilnine SD (Grifols)*,**	≤ 150	≤ 35	≤ 100	≤ 100
Bebulin VH (Baxter)*	24-38	< 5	24-38	24-38
Available outside the US				
PCCs, 4-factor (II, VII, IX, X)				
Beriplex (CSL Behring) †	20-48	10-25	20-31	22-60
Octaplex (Octapharma) ‡	14-38	9-24	25	18-30
Cofact (Sanguin), IU/mL§	14-35	7-20	25	14-35
Prothromplex T (Baxter) ‖	30	25	30	30
PPPSB-HT¶	20	20	20	20
PCCs, 3-factor (II,IX,X)				
Prothromplex HT (Baxter)#	30	—	30	130

*Product insert specifies: "Indicated for replacement of factor IX in patient with hemophilia B. Not indicated for treatment of factor VII deficiency."

**The values given for factor contents are the number of units present per 100 factor IX units in each vial. For all other values, IU/mL.

†United Kingdom, European Union.

‡United Kingdom, Canada, European Union.

§European Union.

‖Austria.

¶Japan

#Australia.

Kcentra: 4-factor PCC

Table 7: Composition per Vial of Kcentra 500 Units*

Ingredient	Kcentra 500 units
Total protein	120 – 280 mg
Factor II	380 – 800 units
Factor VII	200 – 500 units
Factor IX	400 – 620 units
Factor X	500 – 1020 units
Protein C	420 – 820 units
Protein S	240 – 680 units
Heparin	8 – 40 units
Antithrombin III	4 – 30 units
Human albumin	40 – 80 mg
Sodium chloride	60 – 120 mg
Sodium citrate	40 – 80 mg
HCl	Small amounts
NaOH	Small amounts

* Exact potency of coagulant and antithrombotic proteins are listed on the carton

Snake Bite Envenomation Policy

Efforts should be made to identify the type of snake if possible utilizing local resources, Department reference materials and/or the Poison Control Center. The Snake Bite Severity Score will be used to assess local reaction and grade of bite. Note that this scale is primarily designed for crotalidae envenomations and may be less helpful for exotic snake bites or snake bites with primarily neurotoxic envenomation.

Plastic Surgery (SPLA) and Acute Care Surgery (ACS) will be consulted for all symptomatic snakebites. Patients with local reaction which require admission will be admitted to the Plastic Surgery service. Patients developing systemic signs of illness, coagulopathy, or requiring ICU level of care will be admitted to the ACS Service with Plastic Surgery consulting.

When treating a patient post-envenomation, follow these steps:

A. Identify type of snake if possible. (*See below for identification resources*)

B. Keep affected extremity in neutral position for pre-hospital care. Once antivenom has been administered the extremity should be elevated as much as possible.

C. Assess local reaction and grade using snake bite grading scale (*see below*)

D. For all symptomatic bites initiate IV access, laboratory testing, and diagnostic imaging.
   a. Patients without local reaction, (pain, swelling, and erythema) do not require laboratory testing.
      i. This applies to all North American Crotalidae envenomations with the exception of the Canebrake and Mohave rattlesnakes.

E. Recommended agents for pain management are hydromorphone and fentanyl. Histamine release from morphine may worsen swelling; ketoralac should be avoided for potential anti-platelet effects.

F. Recommended Laboratory testing for patients with envenomation grades I-IV.
   - CBC
   - Platelets
   - Basic metabolic panel
   - Calcium
   - Phosphorus
   - CPK
   - PT, PTT, fibrinogen, fibrin split products.
   - Type and Screen
   - U/A

G. Obtain X-ray to rule out retained foreign body (fang).

H. Assess the patient's tetanus status and administer vaccination as indicated.

Snake Bite Envenomation Policy (cont'd)

I. Prophylactic antibiotics for snake bite wounds are usually not indicated, though significant tissue necrosis or species specific considerations may warrant treatment at the discretion of the attending physician.

J. Based on snake species identified, initiate appropriate antivenom therapy. Supportive care and the timely administration of antivenom for symptomatic bites are the mainstays of treatment.

K. Note that for all North American Crotalidae (Pit Vipers, including rattlesnakes and the Massasauga Rattlesnake) CroFAB, the monoclonal FAB fragment is the recommended treatment. Refer to attachment B for antivenom recommendations by snake species.

L. Consult SPLA and ACS for all symptomatic snakebites.

M. Patients with local reaction which require admission will be admitted to the SPLA Service, with ACS consulting.

N. Patients developing systemic signs of illness, coagulopathy, or requiring ICU level care will be admitted to ACS with PS consulting.

O. Development of compartment syndrome is rarely secondary to increased pressures and represents a direct myonecrotic effect of the venom on muscle. Most snakes envenomate the subcutaneous tissue and do not get down into the myofascial plane. Therefore, the first step in treating an apparent compartment syndrome should be elevation of the limb to 90 degrees and administration of more antivenom and Mannitol. If the limb appears compromised, fasciotomy is recommended for measured pressures greater than 30-40 mmHg after aggressive antivenom therapy given adequate time (maximum 4 hours), at the discretion of the attending physician.

P. Contact Poison Control early as possible in the treatment of the patient for additional expertise and assistance in guiding specific treatment. Poison Control has toxicologists experienced in the treatment of local and exotic snake envomations. In addition they track available supplies of antivenom, and can assist in rapidly obtaining appropriate antivenom.
   a. Michigan Poison Control: 1-800-222-1222
      i. Ask specifically to speak with the toxicologist.

Snake Bite Envenomation Policy (cont'd)

LOCAL EXPERTS TO ASSIST WITH SNAKE IDENTIFICATION

Greg Schneider Division of Reptiles and Amphibians Museum of Zoology University of Michigan Ann Arbor, Michigan 48109-1079 734 647 1927 734 763 4080 (FAX) 734 763 0740 (Biodiversity Research Center at Varsity Drive) 734 424 2788 (home) 734 649 8112 (cell) ges@umich.edu	**Dr. Ronald Nussbaum** Division of Reptiles and Amphibians Museum of Zoology University of Michigan Ann Arbor, Michigan 48109-1079 734 647 2201 734 763 4080 (FAX) nuss@umich.edu	**Dr. Fred Kraus** Division of Reptiles and Amphibians Museum of Zoology University of Michigan Ann Arbor, Michigan 48109-1079 734 647 1927 734 763 4080 (FAX) fkraus@umich.edu
Dr. Daniel Rabosky Assistant Professor & Curator of Herpetology Museum of Zoology & Department of Ecology and Evolutionary Biology University of Michigan Ann Arbor, MI 48109-1079 734 615 4915 drabosky@umich.edu	**Dr. Alison R. Davis Rabosky** Research Faculty Department of Ecology and Evolutionary Biology and Museum of Zoology University of Michigan 1089 Ruthven Museums Building 1109 Geddes Ave. Ann Arbor, MI 48109-1079 Work phone: (734) 763-8694 Fax: (734) 763-4080 ardr@umich.edu	

SNAKE BITE SEVERITY SCORE

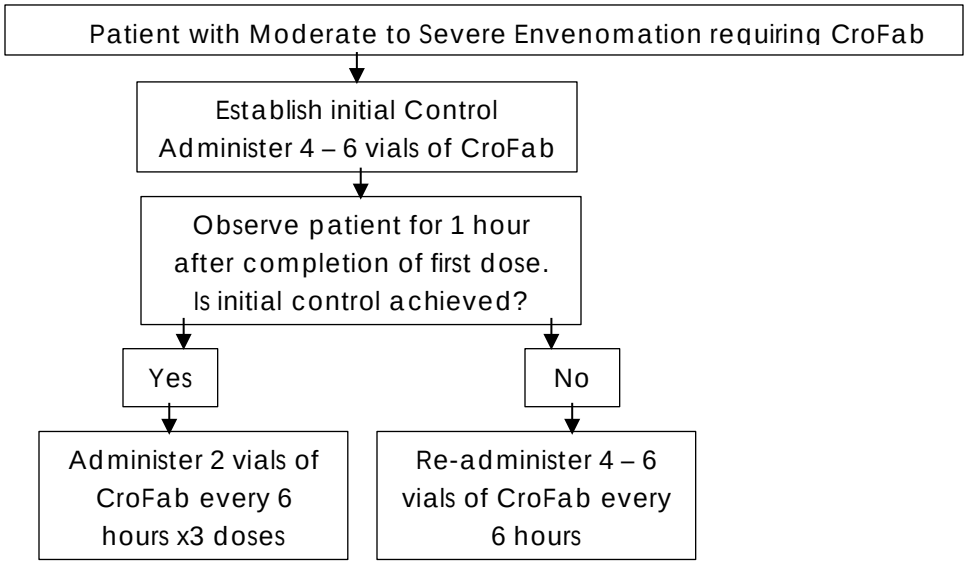
Patients are eligible for therapy with Crotalidae polyvalent antivenom if the envenomation is classified as moderate or severe.

Type of Signs or Symptoms	Severity of Envenomation		
	Minimal	***Moderate***	***Severe***
Local	Swelling, pain, or ecchymosis limited to the immediate bite site	Swelling, pain and ecchymosis involving less than a full extremity or, if bite was sustained on the trunk, head or neck extending less than 50 cm	Swelling, pain and ecchymosis involving more than an entire extremity or threatening the airway
Systemic	Absent	Non-life threatening , including but not limited to nausea, vomiting, oral parasthesia or unusual tastes, mild hypotension (SBP > 90 mmHg), mild tachycardia (heart rate < 150), and tachypnea	Markedly abnormal, including severe alterations of mental status, severe hypotension, severe tachycardia, tachypnea or respiratory insufficiency
Coagulation	Coagulation parameters normal with no clinical evidence of bleeding	Coagulation parameters may be abnormal, but no clinical evidence of bleeding present. Minor hematuria, gum bleeding and nosebleeds are allowed if they are not considered severe in the investigator's judgment	Abnormal with serious bleeding or severe threat of bleeding
Snakebite Severity Score (SSS)*	0 - 3	4 - 7	8 - 20

*The Snakebite Severity Score (SSS) is a validated and objective scale to assess severity of envenomation including six body categories: local wound, pulmonary, cardiovascular, gastrointestinal, hematologic, and nervous system effects (Table 1). The total score ranges from 0-20. This score can help with the interpretation of clinical effects following initial and subsequent doses of CroFab™

Snake Bite Envenomation Policy (cont'd)

CROFAB™ TREATMENT ALGORITHM
(Rattlesnakes, Copperheads and Water Moccasins/Cottonmouth)



*Initial control: Cessation of progression of local effects, systemic effects, and coagulopathy from envenomation.
**Patients should be evaluated for scheduled maintenance dosing to prevent recurrence of envenomation. Additional 2 vial doses may be administered based on patient's clinical course, per treating physician.

CROTALID SNAKEBITE ORDERS - CroFab™ (FabAV)
The following orders are for crotalidae snakebites ONLY (rattlesnakes, copperheads and water moccasins) with suspected envenomation from the bite
NOT TO BE USED FOR NONVENOMOUS (DRY) BITES

Please note that CroFab (FabAV) may take up to 60 minutes to reconstitute.

1. Antivenom Therapy
IV Fluid: □ 0.9% Sodium Chloride
OR □ _____ infuse @ 20 mL/hour
OR □ _____mL/hour IV

- Begin separate peripheral IV site for CroFab™ (FabAV) Infusion – DO NOT piggyback CroFab™ (FabAV) with other medications or fluids

CroFabTM (FabAV) Dosing
A. Initial Dosing (NOT weight or age based; NO adjustment is required for renal or hepatic dysfunction; NO skin test required)
   □ CroFab™ (FabAV) _____vials (normal dose 4 – 6 vials) diluted to a final volume of 250 mL in 0.9% Sodium Chloride
- Initial infusion is 25 – 50 mL/hour for 10 minutes, if no hypersensitivity reaction apparent, increase the rate to 250 mL/hour)
- Continue until initial control is achieved (defined as complete arrest of local manifestations and normalization of coagulation test results and systemic signs)

Snake Bite Envenomation Policy (cont'd)

B. Maintenance Dosing (To be ordered when/if needed)

- Recurrence Prevention – begin after initial control is achieved in all patients except those who are post-copperhead envenomation.
  - □ 2 vials CroFab™ (FabAV) diluted to a final volume of 250 mL in 0.9% Sodium Chloride
    - – Infusion to be 250 mL/hour at 6, 12 and 18 hours after initial control established)

C. Local or Coagulopathy Recurrence Treatment (To be ordered on separate order sheet when/if needed)

- Local Recurrence – Return of progressive swelling
- Coagulopathy Recurrence – INR > 3, platelets < 25 x 103/µL, fibrinogen < 50mg/dL, worsening trend with prior coagulopathy, or abnormal bleeding (these symptoms have been found to occur up to 2 weeks after envenomation)

2. Hypersensitivity Reaction Treatment (Contact treating physician to report situation, & obtain additional orders)

- Immediately stop the infusion of CroFab™ (DO NOT discard the prepared solution; continuing the antivenom may be warranted if benefit of the antivenom therapy exceeds the risk) – determined by the treating physician and AFTER controlling the hypersensitivity
  - o Infuse 0.9% Sodium Chloride at a minimum of a KVO rate to maintain IV line access
  - o Evaluate respiratory and cardiovascular status
  - o Monitor vital signs every 2 minutes until stable
  - o Monitor O2 saturation continuously (pulse oximetry) until otherwise advised by the treating physician
  - o Maintain saturation > 90% (may use nasal cannula or non-rebreather mask)

3. Other considerations

- Contact the department of pharmacy or pharmacist for assistance with medication dosing and status of CroFab™ (i.e. – discontinuation)
- Avoid NSAIDs for 2 weeks post envenomation, this can complicate evaluation of coagulopathy recurrence and increase bleeding occurrence
- Update tetanus/diphtheria vaccination as needed

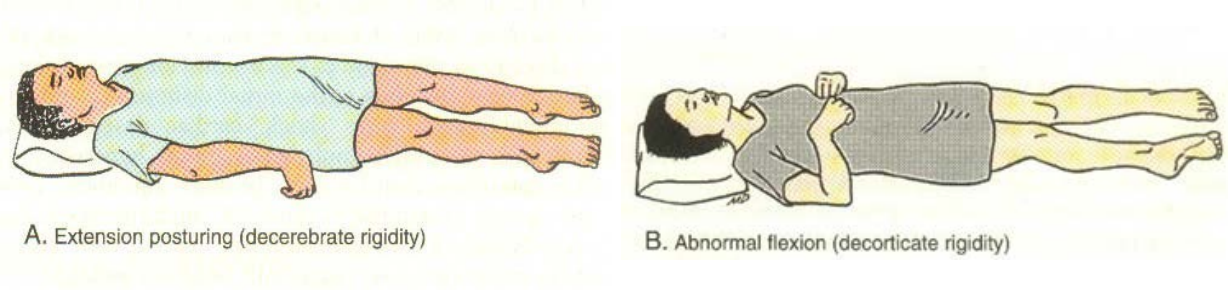
REFERENCES

- Weed HG. Nonvenomous snakebite in Massachusetts: prophylactic antibiotics are unnecessary. *Ann Emerg Med* 1993;22:220-4.
- Blaylock RS. Antibiotic use and infection in snakebite victims. *South African Med J* 1999;89:874-6.
- Kuzon, W.M., Marcus, J.R., Kerluke, L.D., Phillips, J.H. African spitting cobra (Naja nigricolis) bite of the hand. Canadian Journal of Plastic Surgery, Vol. 2, No. 2:90-92, 1994.
- Madsen, W., Elfar, J. Snake Bites. Journal of Hand Surgery, Vol. 35A, October 2010

Glasgow Coma Scale & TBI

Mild TBI: GCS 13-15
Moderate TBI: GCS 9-12
Severe TBI: GCS 3-8

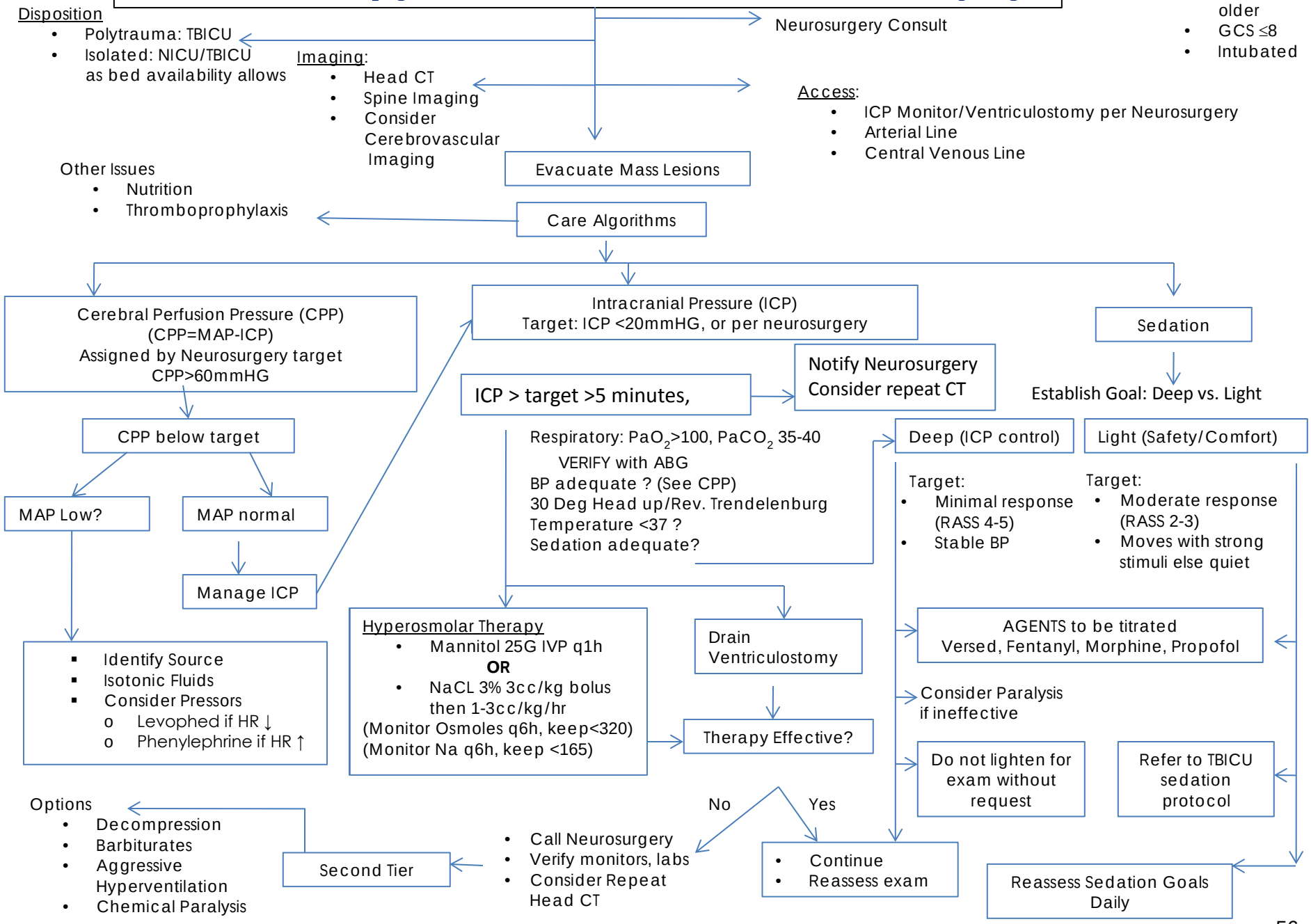
Category		Best Response
Eye Opening		
Spontaneous		4
To Speech		3
To Pain		2
None		1
Verbal	(Modified for Infants)	
Oriented	*Babbles*	5
Confused	*Irritable*	4
Inappropriate Words	*Cries to Pain*	3
Moans	*Moans*	2
None	*None*	1
Motor		
Follows Commands		6
Localizes to Pain		5
Withdraws to Pain		4
Abnormal Flexion (Decorticate)		3
Abnormal Extension (Decerebrate)		2
None		1
GCS		
Best Possible Score		15
Worst Possible Score		3
Tracheally intubated: verbal score is designated with a "T"		10T
Best Possible Score While Intubated		3T
Worst Possible Score While Intubated		



A. Extension posturing (decerebrate rigidity)

B. Abnormal flexion (decorticate rigidity)

Initial Therapy for Adult Traumatic Brain Injury



See Scores/Scales section for RASS (page 244)

Traumatic Intracranial Hypertension Treatment

Guidelines advocate the early treatment of increased intracranial pressure (ICP), since increased severity and longer duration of raised ICP are associated with poor outcomes. The accepted threshold for treatment is an ICP of 20mm Hg. In all patients with increased ICP a repeat CT scan should be done to exclude surgically treatable lesions. Before initiating treatment for increased ICP, exclude erroneous measurements.

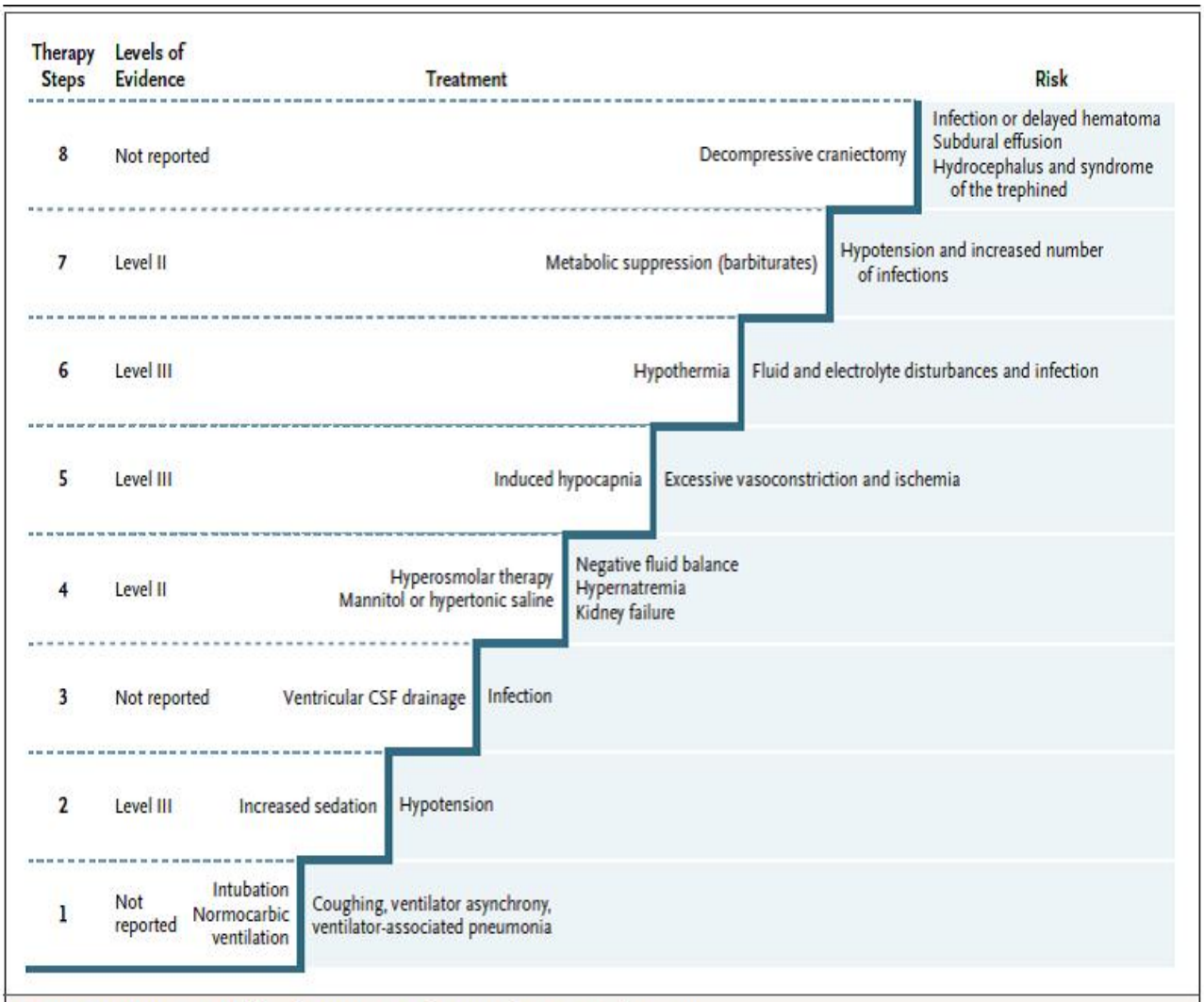


Figure 3. Staircase Approach to the Treatment of Increased Intracranial Pressure.

The level of therapy in patients with raised intracranial pressure is increased step by step, with more aggressive interventions when there is no response. The sequence of interventions may vary among different institutions; every intervention is associated with adverse effects. Shown are the levels of evidence that underpin various approaches to treatment. Levels of evidence are based on the criteria for classification of evidence, as used in international guidelines.[24] The revised guidelines for the management of severe traumatic brain injury and the surgical guidelines for the management of such injury do not contain any evidence on ventricular drainage of cerebrospinal fluid (CSF) or the use of decompressive craniectomy. Level I evidence[25] shows that decompressive craniectomy is effective in reducing intracranial pressure but may worsen the long-term outcome and is associated with several complications. Among them is the syndrome of the trephined, in which a sunken skull flap develops with a (poorly understood) neurologic deterioration.

From: Stocchetti N and Maas AIR. New Engl J Med 2014;370:2121-30.

Figure 1 (facing page). Intracranial Pressure under Normal and Abnormal Conditions.

Under normal conditions, the intracranial pressure (ICP) remains constant at 10 to 15 mm Hg, fluctuating with cardiac and respiratory cycles, as shown in the normal trace recording (Panel A). Since the cranium is a rigid container, the sum of the various intracranial volumes (brain tissue, cerebrospinal fluid, and blood) must remain constant. Cerebrospinal fluid is continuously formed and reabsorbed, with the circulation indicated by blue arrows. Several intracranial and systemic causes may alter the intracranial components and cause pathologic increases in intracranial pressure — for example, a traumatic left subdural hematoma that compresses the brain and shifts the lateral ventricles to the right, as shown on computed tomography (Panel B). The hematoma volume cannot be compensated by buffering systems, and there is a corresponding increase in intracranial pressure, which can be recorded through a catheter inserted in a lateral ventricle (also allowing the withdrawal of cerebrospinal fluid) (Panel C). The catheter is connected to a collecting system, to which cerebrospinal fluid can be drained, and to a monitor, where the trace recording of intracranial pressure is displayed. Intracranial hypertension may cause compression and displacement of the cerebral tissue from areas of higher pressure toward areas of lower resistance (Panel D). Brain herniation occurs in three main ways. First, a hemisphere is displaced medially against the falx, resulting in falcine herniation. Second, a monolateral pressure gradient pushes the medial edge of the temporal lobe (uncus) through the tentorial foramen, resulting in uncal herniation. In this syndrome, the third cranial nerve and the posterior cerebral artery are compressed, causing unilateral pupillary dilation, a lack of reactivity to light, and infarction. The brain stem is distorted and compressed, with early impairment of consciousness. Third, a bilateral, homogeneous increase in intracranial pressure in the supratentorial space displaces the brain downward through the tentorial foramen, resulting in central transtentorial herniation. The brain stem is compressed and displaced downward without signs of lateralization and with bilateral pupillary abnormalities.

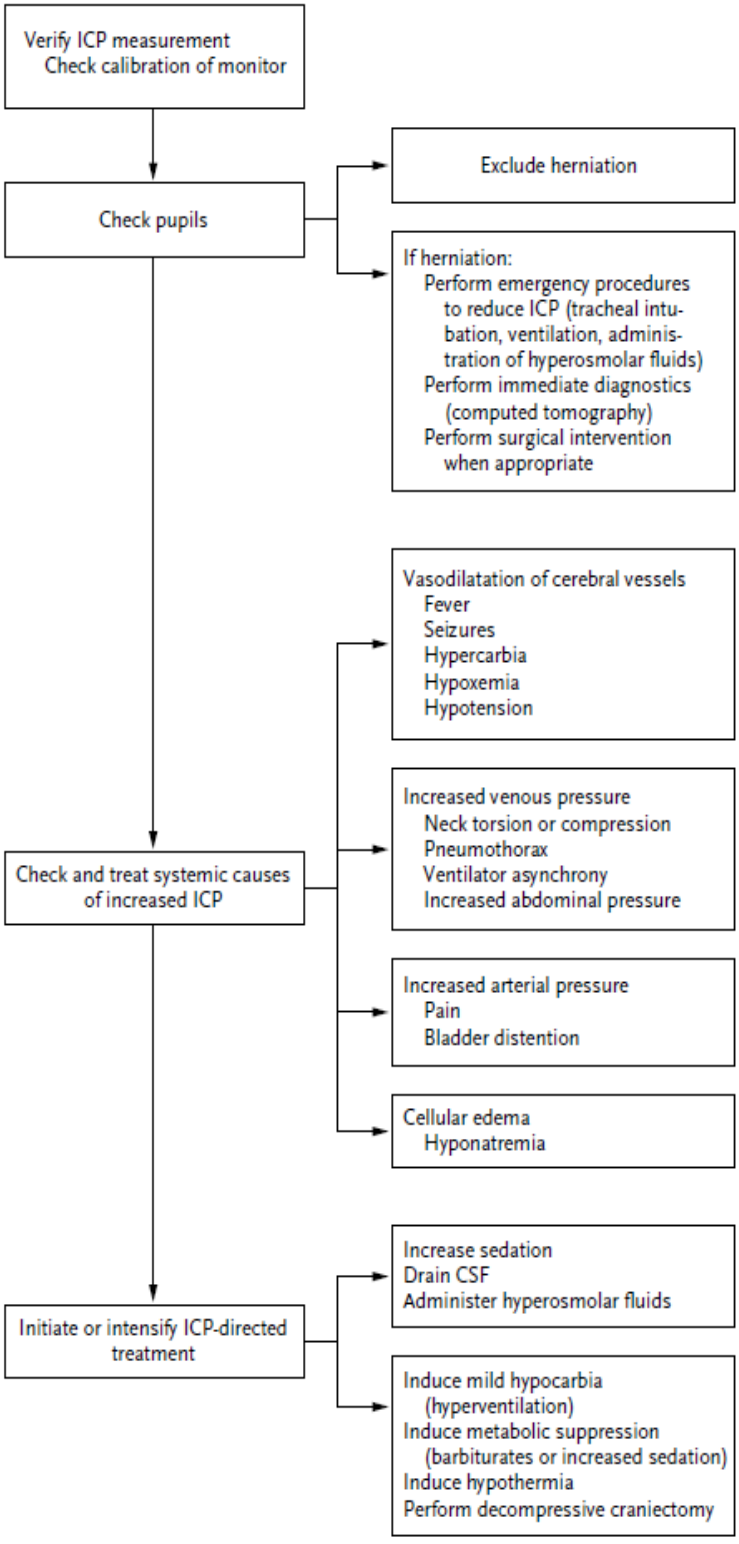
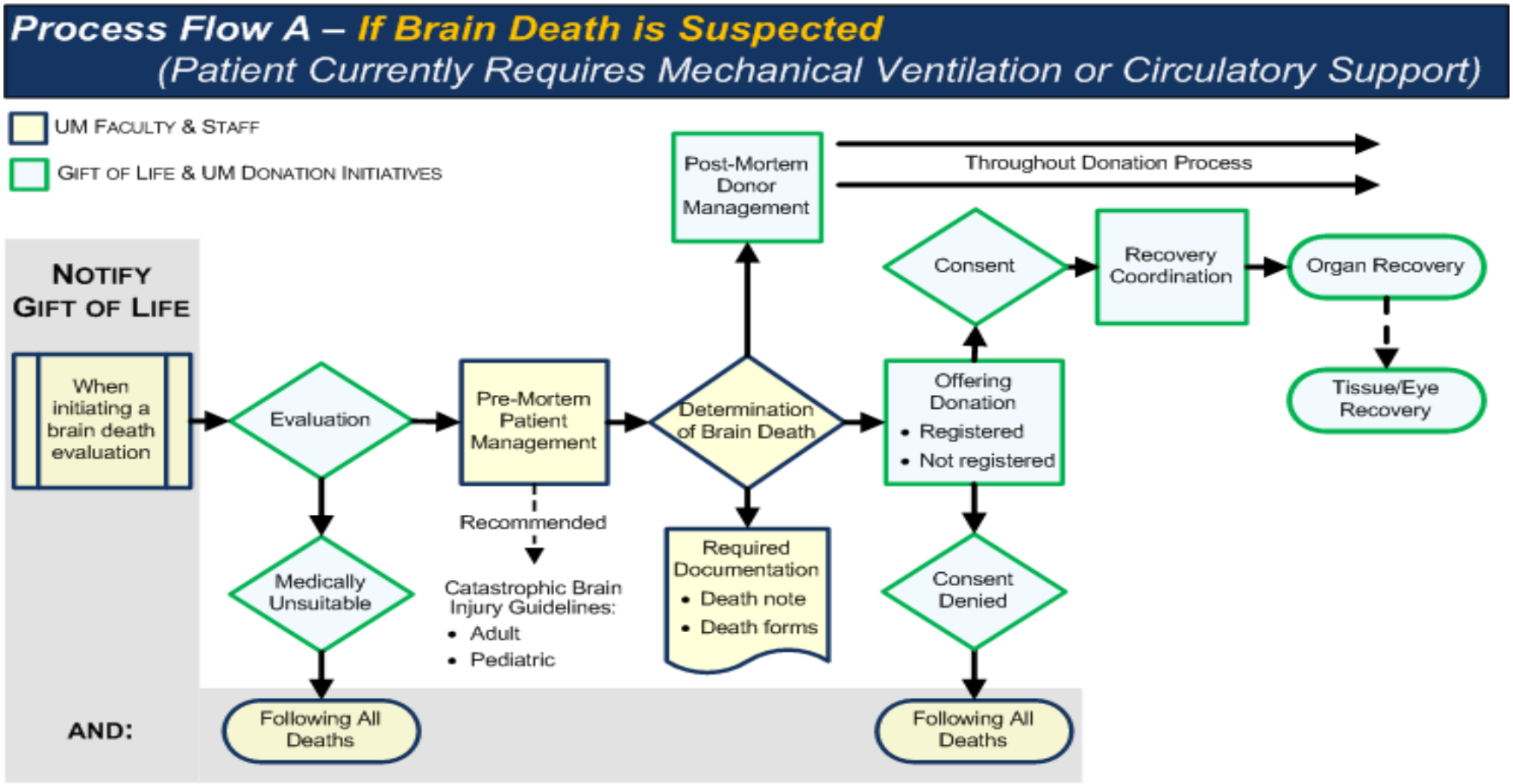


Figure 2. Algorithm for the Treatment of Increased Intracranial Pressure (ICP).

CSF denotes cerebrospinal fluid.

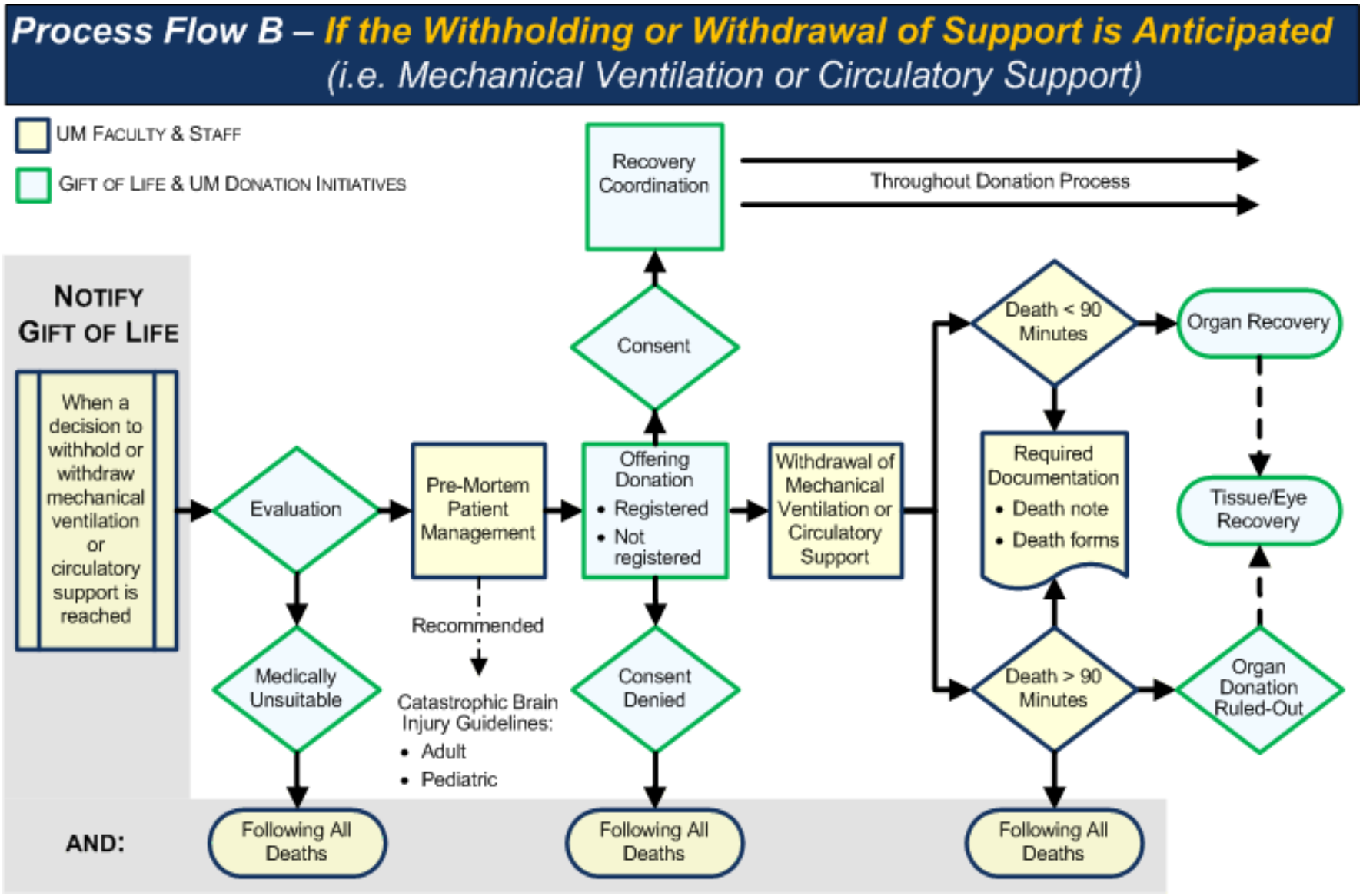
Brain Death Protocol Process Flow A



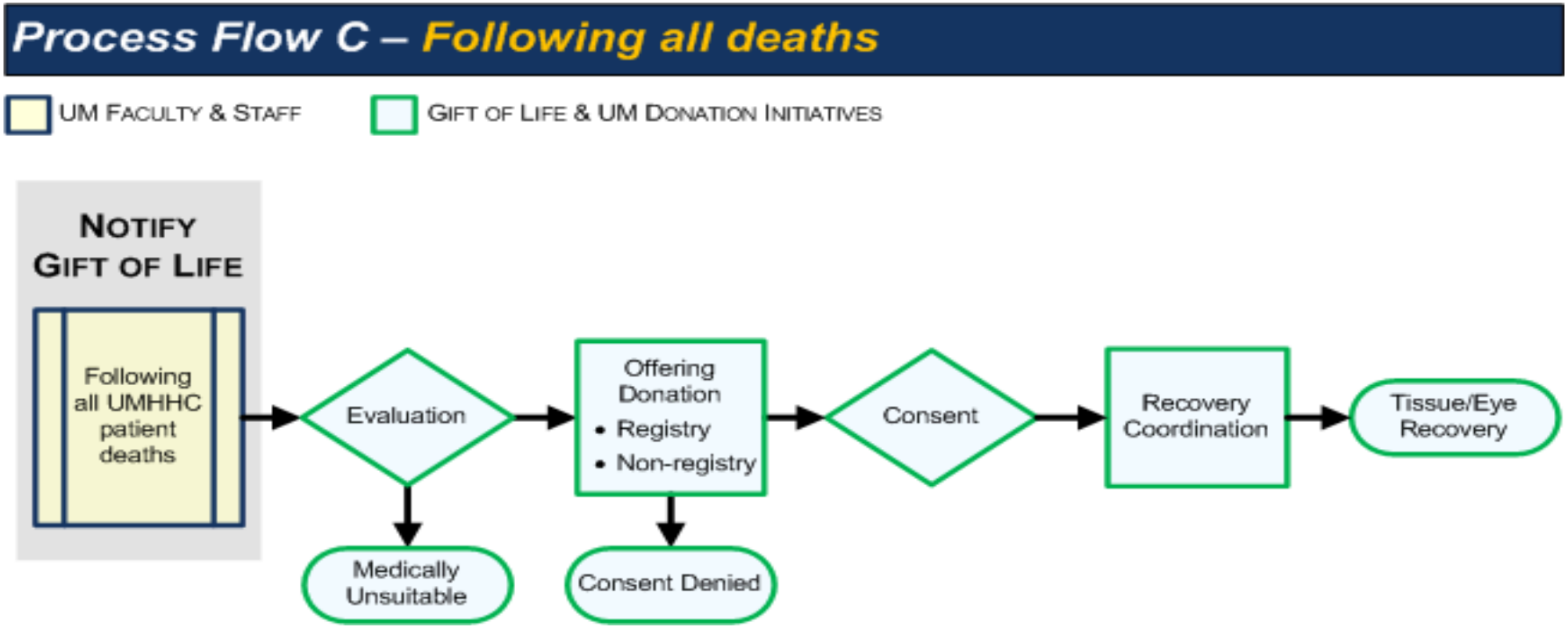
Process Flow A - Quick Reference Guidelines for Faculty & Staff

- Should notify Gift of Life of a potential organ donor by calling 1-800-482-4881 if brain death is suspected.
- Must notify Gift of Life of potential organ donors by calling 1-800-482-4881 within 60 minutes of the patient's meeting the notification trigger.
- Notify Gift of Life if family initiates discussion regarding withdrawal of support or their donation options.
- Gift of Life will determine if the patient had joined the Michigan Donor Registry.
- Gift of Life will establish the medical suitability of all potential donors, in collaboration with UM Donation Initiatives.
- Support may not be withheld or withdrawn prior to providing adequate time for Gift of Life to complete the evaluation and donation process.
- Only Gift of Life and UM Donation Initiatives may offer the option of organ donation to potential donors/families.
- All potential organ donors must be maintained while necessary testing and placement of donated organs takes place.
- Gift of Life can be contacted at any time if you or a potential donor's family has any questions.

Brain Death Protocol Process Flow B



Brain Death Protocol Process Flow C

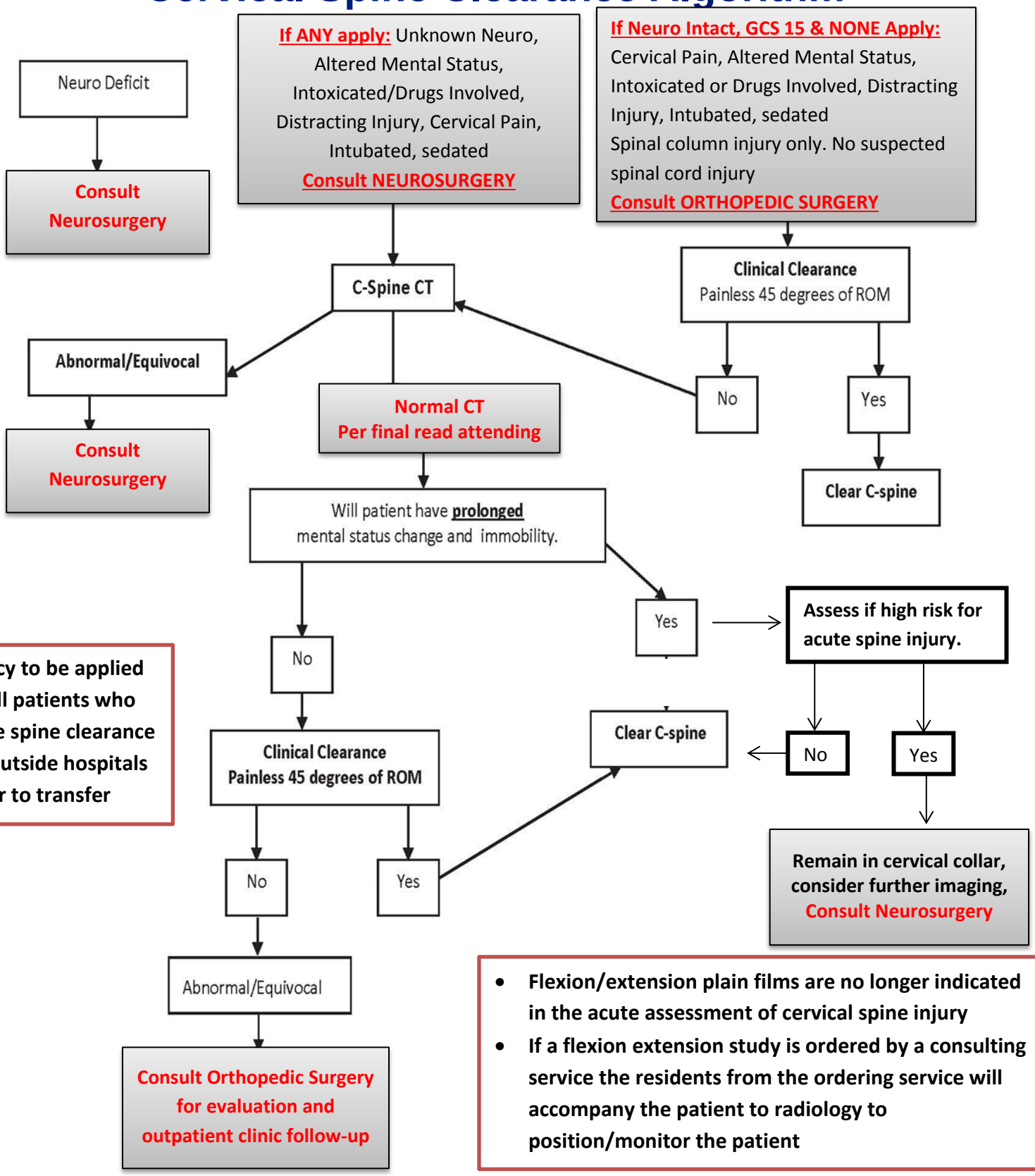


Process Flow C - Quick Reference Guidelines for Faculty & Staff

- Notify Gift of Life of all UMHHC patient deaths by calling 1-800-482-4881 within 60 minutes of the patient meeting the notification trigger.
- Notify Gift of Life if family initiates discussion regarding their donation options.
- Gift of Life will determine if the patient had joined the Michigan Donor Registry.
- Gift of Life will establish the medical suitability of all potential tissue and eye donors, in collaboration with the Michigan Eye Bank.
- Gift of Life may access and/or copy the medical records of patients, including receive facsimiles.
- Only Gift of Life and UM Donation Initiatives may offer the option of tissue and eye donation to potential donor family.
- Gift of Life can be contacted at any time if you or a potential donor's family has any questions

Initial CT Imaging of Spine by Trauma Service

Cervical Spine Clearance Algorithm



Policy to be applied to all patients who have spine clearance by outside hospitals prior to transfer

- **Flexion/extension plain films are no longer indicated in the acute assessment of cervical spine injury**
- **If a flexion extension study is ordered by a consulting service the residents from the ordering service will accompany the patient to radiology to position/monitor the patient**

Patel MB et al. Cervical spine collar clearance in the obtunded adult blunt trauma patient: A systematic review and practice management guideline from the Eastern Association for the Surgery of Trauma. Journal of Trauma and Acute Care Surgery. 78(2):430-441, February 2015.

Blunt Cerebrovascular Injuries (BCVI)

BCVI: Collective incidence approximately 1% of blunt trauma admissions. Trauma patients with any of the following signs/symptoms should be considered to have BCVI until proven otherwise:

- Arterial hemorrhage from neck, mouth, nose, ears
- Large or expanding cervical hematoma
- Cervical bruit in patient < 50 years old
- Focal or lateralizing neurologic deficit, including hemiparesis
- Transient ischemic attack
- Horner's syndrome (Oculosympathetic paresis)
- Vertebrobasilar insufficiency
- Evidence of cerebral infarction on CT or MRI
- Neurologic deficit that is incongruous with CT or MRI findings

1. No published prospective randomized clinical trials in BCVI that have generated class I data.
2. Recommendations therefore based on observational studies and expert opinion.

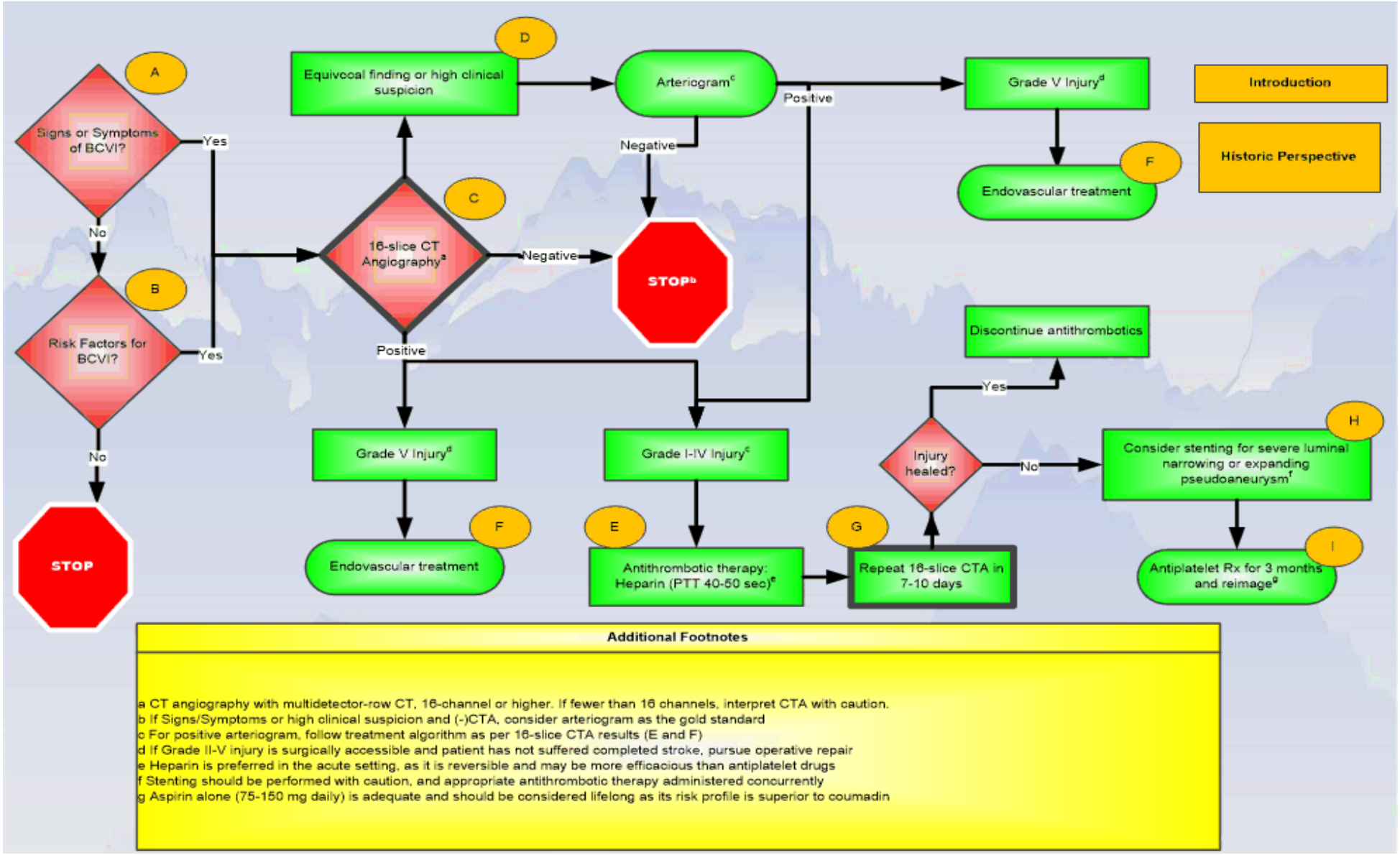
TABLE 1. Blunt Carotid and Vertebral Arterial Injury Grading Scale[32]

Injury Grade	Description
I	Luminal irregularity or dissection with <25% luminal narrowing
II	Dissection or intramural hematoma with ≥25% luminal narrowing, intraluminal thrombus, or raised intimal flap
III	Pseudoaneurysm
IV	Occlusion
V	Transection with free extravasation

References:
Biffl WL, et al. Western Trauma Association Critical Decisions in Trauma: Screening for and Treatment of Blunt Cerebrovascular Injuries. J Trauma 2009;67:1150-1153.
Bromberg WJ, et al. Blunt Cerebrovascular Injury Practice Management Guidelines, Eastern Association for the Surgery of Trauma, 2007

Blunt Cerebrovascular Injuries (BCVI)

http://www.westerntrauma.org/algorithms/WTAAlgorithms_files/gif_4.htm



Initial Management of Spinal Cord Injury

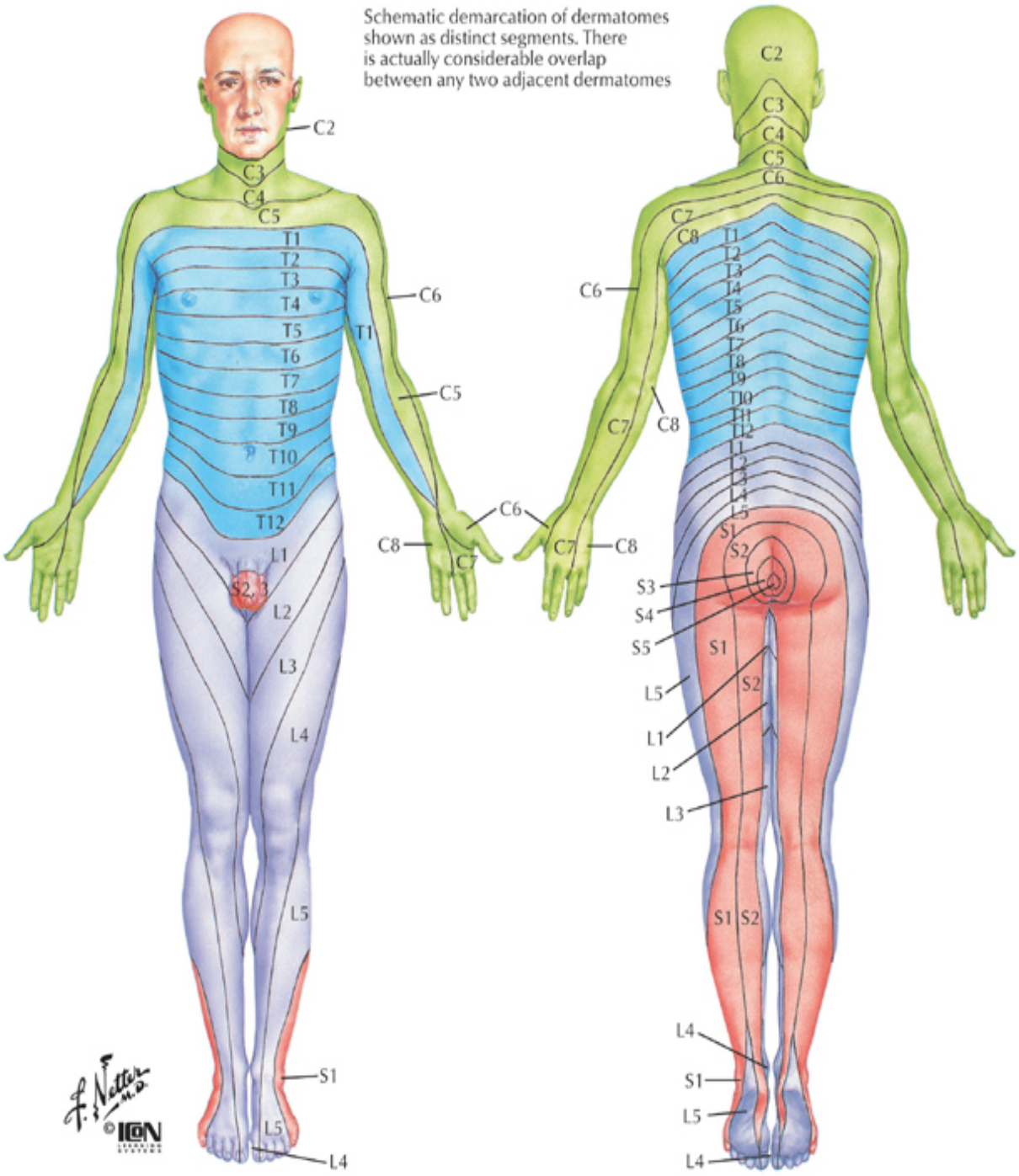
A. Class I and II Patients

a. Class I and II patients admitted to the Emergency Department (ED) with a suspected spine and/or spinal cord injury will have the following evaluation:
   i. Complete neurological evaluation
   ii. Appropriate plain X-rays
   iii. Neurosurgery consult
   iv. PM&R consult
   v. CT or MRI of the spine, if indicated. (Policies 28 & 31 Cervical & TLS Spine)

b. If there is a suspected spinal cord injury with a blunt mechanism, the Blunt Spinal Cord Injury Protocol should be instituted immediately. It is as follows:
   i. Solu-Medrol protocol **may be considered**. Solumedrol is not indicated in all cases of spinal cord injury. The decision to start this agent should be made in conjunction with Neurosurgery and may be discontinued after being started if, upon further consideration, it is felt that the risks outweigh the benefits. Recommended dosing is Solu-Medrol 30 mg/kg/hr bolus for patients 0-3 hours post injury, then 5.4 mg/kg/hr x 24. 3-8 hours post injury, give 5.4 mg/kg/hr for 47 hours. Solumedrol is contraindicated > 8 hours after injury and in TBI
      - Attempt to maintain blood pressure with a MAP >80 for one week if appropriate. If the patient is hypotensive, evaluation for associated traumatic injuries and potential sources of hemorrhage is mandatory
      - Initiate PM&R (Physical Medicine & Rehab) consult
      - Maintain spine precautions refer to Adult Spine Precautions
      1. If the referring institution asks whether or not to start steroids prior to transfer, use the following guidelines:
         - If complete spinal cord injury (SCI,) do not administer steroids.
         - If incomplete SCI, evaluate for risk of complications due to steroid use
            - Young, healthy, few co-morbidities – initiate solumedrol bolus/infusion
            - Elderly, multiple co-morbidities, do not initiate solumedrol
   ii. Plain film, and/or CT and/or MRI should be performed as indicated, immediately after resuscitation and abdomen/head CT as indicated by the ACS Service. If aortogram is indicated, it should be done after MRI.
   iii. These patients will be admitted to the ACS Service with Neurosurgery or Orthopedic Surgery following as a consult. If after evaluation of all their injuries and a 48-hour observation period these patients are found to have an isolated spine injury, they may be transferred to the appropriate service.
   iv. Adult patients that appear to have an isolated spinal cord injury following initial evaluation may be admitted to either the TBICU or the Neurosurgery ICU. PM&R will also be consulted in the first 48 hours of admission.
   v. On discharge from the Neurosurgery or Orthopedic Surgery Service, these patients will be given F/U apt in spine service and ACS clinic within two weeks.

B. Class III Patients

a. Class III patients admitted to the ED may have same evaluation as Class I/II; any patient with suspected isolated spine and/or SCI should be upgraded to Class I.
b. If admission is not required, patients will be D/C from the ED with instructions and a follow-up appointment to the appropriate Neurosurgery or Orthopedic Surgery clinic within one month. If admission required, the patient will be admitted to the appropriate spine service. On discharge, these patients will have a follow-up appointment to the appropriate spine clinic one month.



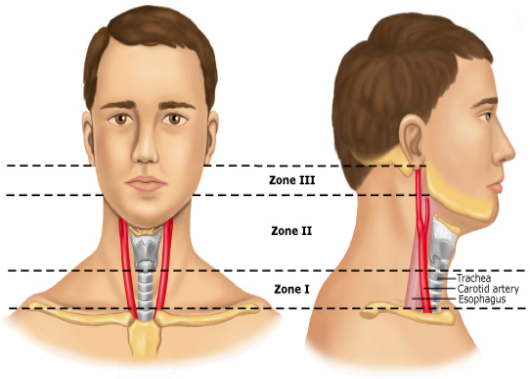
Levels of principal dermatomes

C5	Clavicles
C5, 6, 7	Lateral parts of upper limbs
C8, T1	Medial sides of upper limbs
C6	Thumb
C6, 7, 8	Hand
C8	Ring and little fingers
T4	Level of nipples
T10	Level of umbilicus
T12	Inguinal or groin regions
L1, 2, 3, 4	Anterior and inner surfaces of lower limbs
L4, 5, S1	Foot
L4	Medial side of great toe
S1, 2, L5	Posterior and outer surfaces of lower limbs
S1	Lateral margin of foot and little toe
S2, 3, 4	Perineum

Penetrating Neck Injuries

http://www.uptodate.com/contents/penetrating-neck-injuries

- Penetrating neck injury (PNI) comprises 5-10% of traumatic injuries in adults, with injuries to Zone II being most common, followed by zone I, then zone III.
- Overall mortality ranges from 3 to 10 percent. Exsanguination is the most common cause of death, and the carotid artery is the structure most often involved. The incidence of carotid artery injury in PNI ranges from 6-17%.
- Common injuries –
    - 9% internal jugular vein
    - 6.7% carotid artery injury
    - 3% Spinal cord injury
    - 2.2% subclavian artery
- Initial evaluation should be rapid and prioritize establishing a secure airway, after which control of hemorrhage is the immediate concern
- Further evaluation and management is determined by the extent of injury on physical examination and patient symptoms



For purposes of evaluation and therapy, the neck is divided into three zones

Zone I: Sternal notch and clavicles to the cricoid cartilage

- Most caudal and includes the base of the neck and thoracic inlet
- Contains the thoracic outlet vasculature, vertebral and proximal carotid arteries, apices of the lungs, trachea, esophagus, spinal cord, and thoracic duct

Zone II (midneck): Cricoid cartilage to the angle of the mandible

- Contains the jugular veins, vertebral and common carotid arteries, and internal and external branches of the carotid arteries, as well as the trachea, esophagus, larynx, and spinal cord

Zone III (upper neck): Region above the angle of the mandible up to the base of the skull

- Contains the pharynx along with the jugular veins, vertebral arteries, and the distal portion of the internal carotid arteries

Zone designation carries implications for management and prognosis. Zone I injuries can involve the mediastinum and control of vascular injuries can be difficult. Zone III vascular injuries, especially those more cephalad, pose a surgical challenge.

The Patient in Shock

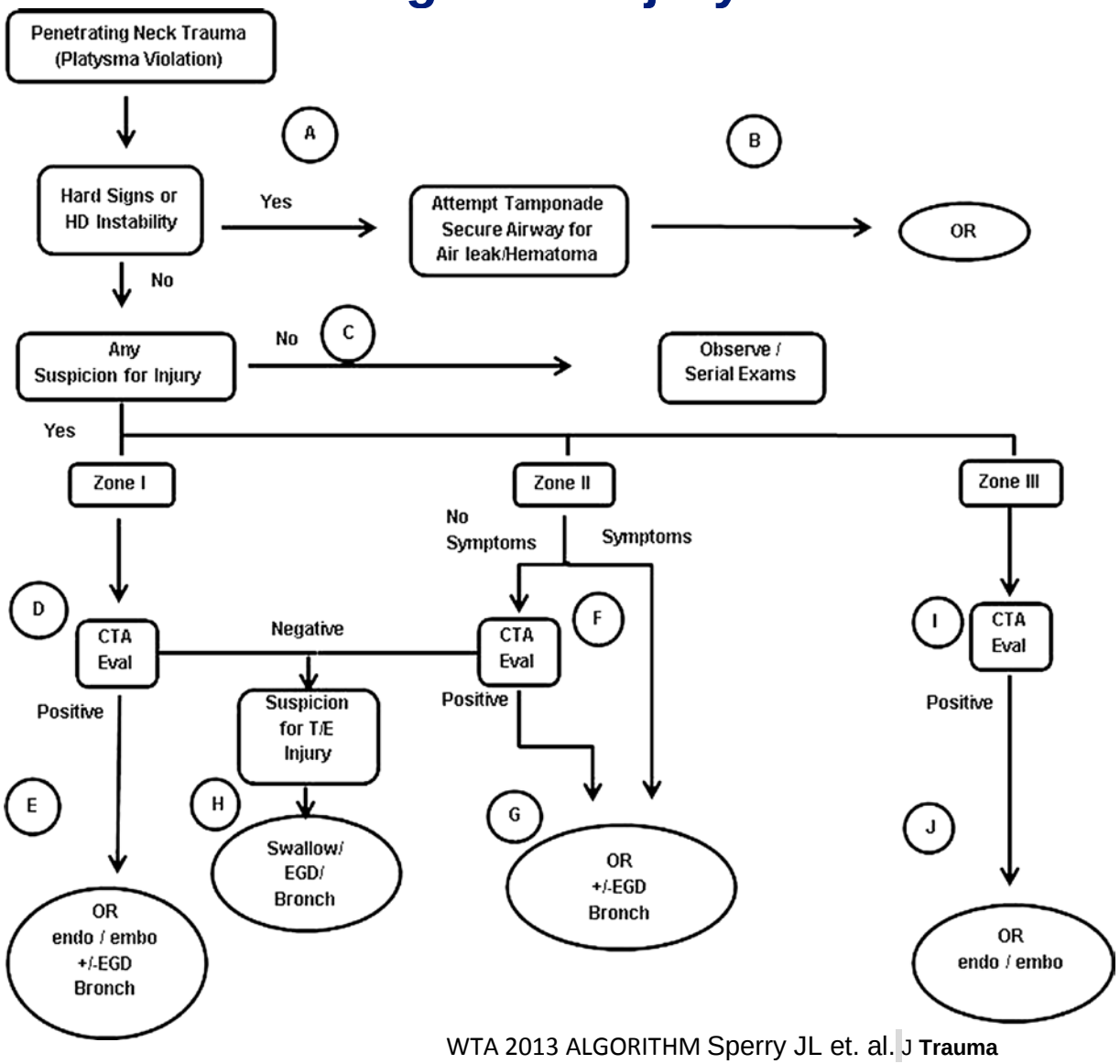
Any patient with a penetrating neck injury presenting in **shock**, **expanding or pulsatile hematoma** or obvious **arterial bleeding** requires prompt cervical exploration **in the operating room** after the airway has been secured and hemorrhage controlled with direct pressure. If direct pressure is unable to minimize significant active bleeding, focused attempts with balloon catheter tamponade in the OR. No further diagnostic studies should be performed prior to the OR apart from a screening chest x-ray to detect PTX or widened mediastinum.

The Hemodynamically Stable Patient

When shock / hemorrhage are **not** an issue, principles of selective management may be employed to reduce the incidence of nontherapeutic neck explorations. This approach relies on careful determination of the zone of injury **and** a detailed physical examination to elicit signs and symptoms associated with vascular and aerodigestive injuries.

Signs and **symptoms** requiring further diagnostic procedures (or in the case of zone II injuries, surgery) include: stridor, dysphonia, dysphagia, cranial nerve deficits, history of significant blood loss, significant subcutaneous emphysema, and abnormal chest x-ray (including widened or indistinct mediastinum).

Penetrating Neck Injury Protocol



WTA 2013 ALGORITHM Sperry JL et. al. J **Trauma** Acute Care Surg. 2013 Dec;75(6):936-40.

Zone I (15%)

- Adequate exposure for repair may require sternotomy, clavicle resection, or thoracotomy.
- High morbidity of exploration, thus suspicion must be great before taking the patient to OR.
- Vascular surgery consultation for possible endovascular approach.
- CT Angiography (CTA) is essential; great vessel injury must be ruled out.

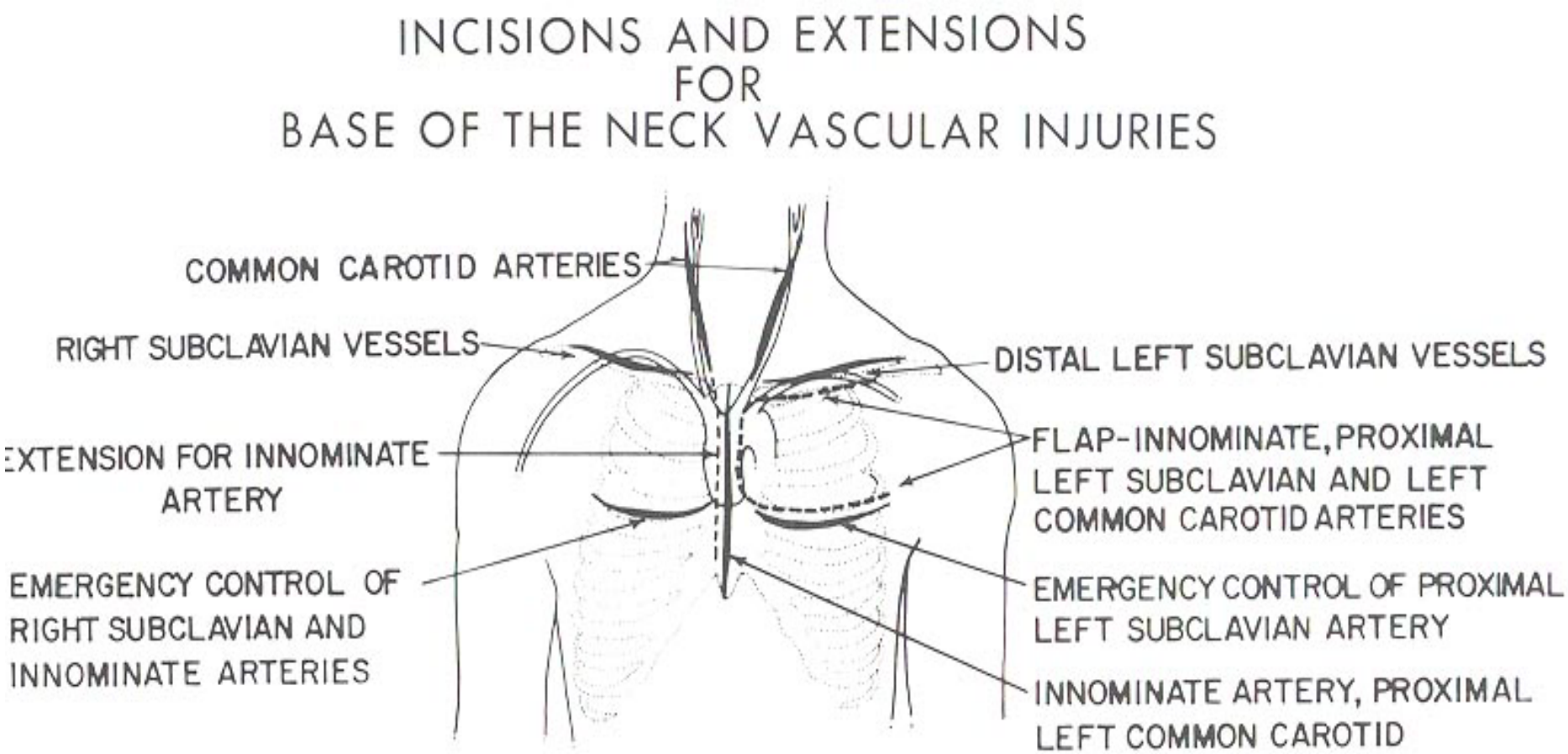
Zone II (65%)

- Most carotid injuries occur here, anterior SCM incision vs. collar incision.
- Adjunctive studies (EGD, swallow, bronchoscopy) may be indicated.
- Asymptomatic zone II injuries can generally be safely managed by observation.

Zone III (20%)

- High rate of vascular injury; consider endovascular approach, vascular surgery consult.
- Often difficult to obtain proximal and distal vessel control.
- Exploration has high rate of injury to cranial nerves.
- Adequate exposure may require mandibular subluxation or mandibulotomy.
- CTA needed to delineate site of injury; embolization of greatest value here.

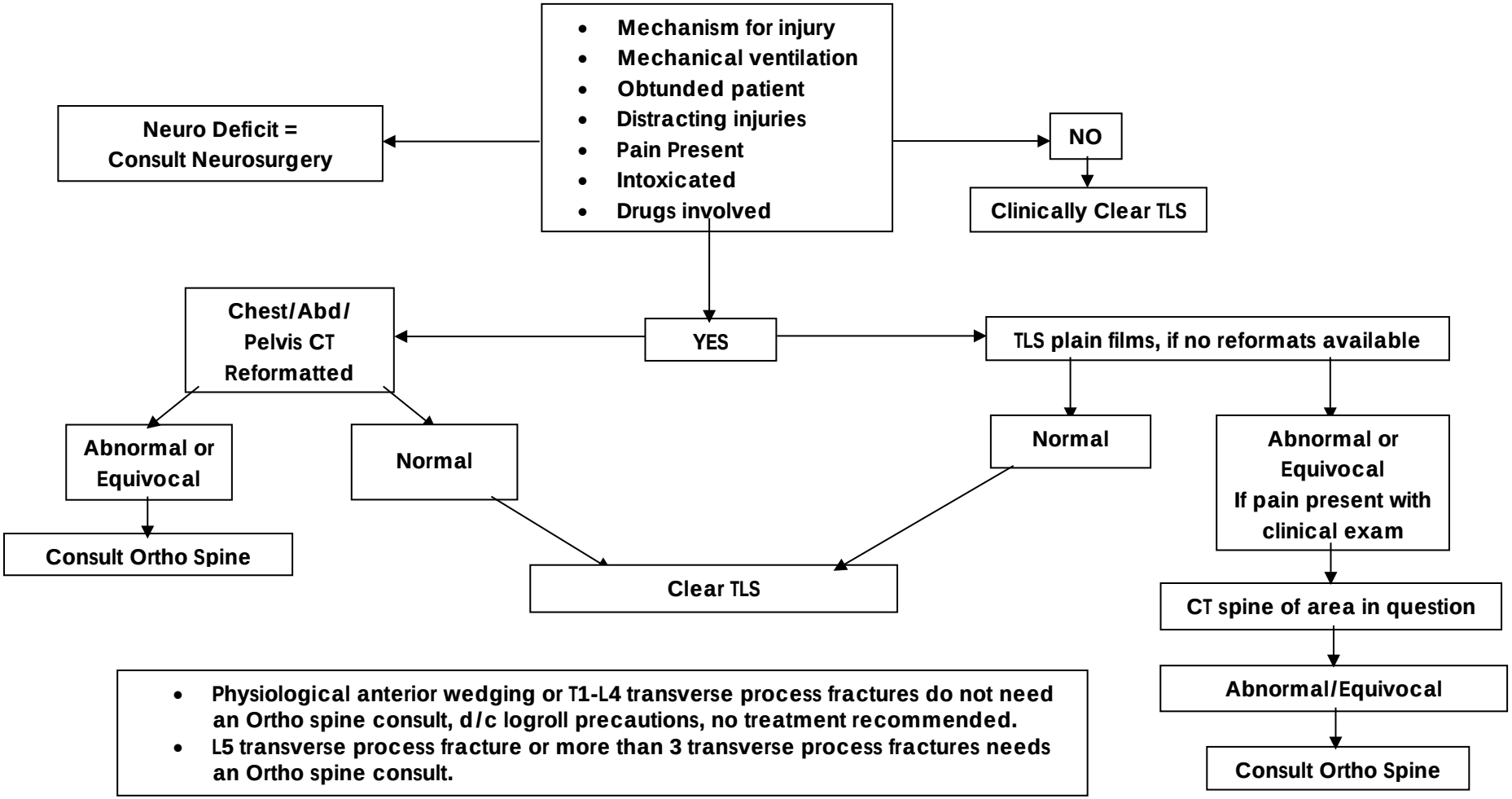
Penetrating Neck Injury Protocol



References:

- Sperry JL et al. Western Trauma Association critical decisions in trauma: penetrating neck trauma. J Trauma Acute Care Surg. 2013 Dec;75(6):936-40.
- Osborn TM1, Bell RB, Qaisi W, Long WB. Computed tomographic angiography as an aid to clinical decision making in the selective management of penetrating injuries to the neck: a reduction in the need for operative exploration. J Trauma. 2008 Jun;64(6):1466-71.
- Mansour M, et al. Validating the selective management of penetrating neck wounds. Am J Surg 1991;162:517-21.
- Demetriades D, et al. Evaluation of penetrating injuries of neck: prospective study 223 patients. World J Surg 1997;21:41-8.

Guidelines for the Initial Evaluation and Clearance of Thoracic/Lumbar/Sacral Spine Injury



- Physiological anterior wedging or T1-L4 transverse process fractures do not need an Ortho spine consult, d/c logroll precautions, no treatment recommended.
- L5 transverse process fracture or more than 3 transverse process fractures needs an Ortho spine consult.

Management of Patients with Rib Fractures

Rib fractures (fx) are common with blunt force injury and are associated with significant morbidity. Rib fx are present in 10% of all trauma patients and 30% of patients with significant chest trauma. Always consider injury to underlying thoracic and abdominal organs in patients with rib fractures. Pain management and respiratory hygiene are the cornerstones of clinical management.

Diagnosis

Diagnosis of rib fx can be made by clinical exam supported by plain and CT imaging. Plain radiographs may underestimate the number of rib fx and poorly identify non-displaced fxs.

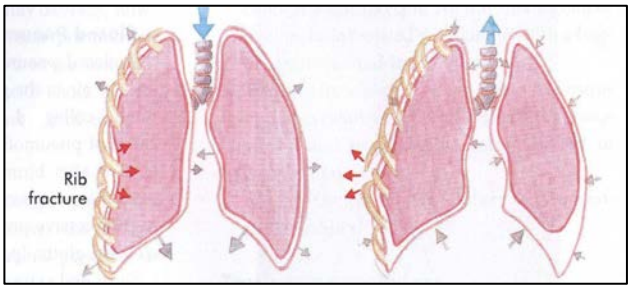
Flail chest

Flail chest is defined as 3 or more consecutive ribs fs in two or more places. Flail chest may present with chest wall deformity and paradoxical chest wall movement with respiration.

Potential Complications of Rib Fractures

- Pneumothorax/Hemothorax
- Great vessel injury
- Pneumonia
- Pulmonary contusion
- Cardiac contusion/ arrhythmia
- Empyema
- Non-Union of Fractures
- Respiratory Failure
- Disability/Chronic Pain

Paradoxical Chest Wall Movement with Flail



Admission Criteria

Patients with 3 or more rib fx should be admitted to ICU or monitored unit with cardiac and pulse oximetry monitoring. Incentive spirometry and pulmonary toilet should be provided

Pain Management

Pain management is based on patient age, severity of injury, and co-morbidities. Consultation with the Acute Pain Service (APS) (pager number 9031) is warranted in patients with severe injury or intractable pain.

- Epidural analgesia is the optimal modality and is preferred technique after severe blunt injury (1). Epidural analgesia is associated with less respiratory depression, less somnolence and fewer GI symptoms when compared to IV narcotics.
- Patients > 65 years of age with 4 or more rib fractures should be provided with epidural analgesia unless this therapy is contraindicated; presence of cardiopulmonary disease or diabetes should provide additional impetus for epidural analgesia as these co¬morbidities may increase mortality once respiratory complications have occurred (1)
- Patients < 65 years of age with 4 or more rib fx should be strongly considered for epidural analgesia; Regional anesthesia with paravertebral nerve block or continuous bipuvacaine infusion (elastomeric pump) may offer improved pain perception and improved pulmonary function (Level II evidence)
- For less severe injury intravenous narcotics in divided doses or by demand modalities may be considered

Respiratory support

- Tube thoracostomy may be indicated for management of pneumothorax/hemothorax
- Incentive spirometry
- Mechanical ventilation may be required for patients with flail chest or multiple rib fractures with related pulmonary injury
- Surgical Fixation should be considered in patients unable to wean from the ventilator, fracture non-union, chronic pain, or chest wall instability/deformity

4 or more rib fractures

Admit to Trauma Service
Cardiac monitoring
Continuous pulse oximetry
Supplemental oxygen as needed
Goal arterial oxygen saturation > 92%
Consider BiPAP Noninvasive ventilation
Repeat CXR in 24h to evaluate for hemopneumothorax

Pain control:

PCA + NSAID if no contraindication(e.g. splenic laceration, TBI)
Acute Pain Service (APS) consult for epiduralanalgesia for age >64
Consider for age >64 with lesser injuries or age <64 with >3 rib fractures
Frequent assessment of:
Pain (pain scale)
Respiratory mechanics (incentive-spirometry)

At discharge:

Oxycodone/Tylenol + NSAID x 3-4 weeks if no contraindications

Open Reduction Internal Fixation (ORIF) of Chest Wall Injuries

(Potential indications and inclusion criteria for rib fracture repair)

1. Flail chest

a) Failure to wean from ventilator
b) Paradoxical movement visualized during weaning
c) No significant pulmonary contusion
d) No significant brain injury

2. Reduction of pain and disability

a) Painful, movable rib fractures
b) Failure of narcotics or epidural pain catheter
c) Fracture movement exacerbates pain
d) Minimal associated injuries (AIS B 2)

Management of Patients with Rib Fractures

3. Chest wall deformity/defect
a) Chest wall crush injury with collapse of the structure of the chest wall and loss of thoracic volume
b) Severely displaced, multiple rib fractures or tissue defect that may result in permanent deformity or pulmonary hernia
c) Severely displaced fractures significantly impeding lung expansion
d) Rib fractures impaling the lung
e) Patient is expected to survive any other injuries

4. Symptomatic rib fracture non-union
a) CT scan evidence of fracture nonunion ([2 months after injury)
b) Patient reports persistent, symptomatic fracture movement

5. Thoracotomy for other indications (i.e., ‘‘on the way out’’)

6. CONTRAINDICATIONS: Pneumonia, other bacterial infections

References

1.The Eastern Association for the Surgery of Trauma; Pain management in blunt thoracic trauma.

http://www.east.org/resources/treatment-guidelines/blunt-thoracic-trauma-(btt),-pain-management-in

2.EAST Guidelines Management of Pulmonary Contusion and Flail Chest

http://www.east.org/resources/treatment-guidelines/pulmonary-contusion-and-flail-chest,-management-of

3.Acute Innovations RIbLoc System http://www.acuteinnovations.com/files/product_pdfs/RibLoc_IFU.pdf

4.Synthes MatrixRib System http://us.synthesmatrixrib.com/

5.Leinicke JA, Elmore L, Freeman BD, Colditz GA. Operative management of rib fractures in the setting of flail chest: a systematic review and meta-analysis. Ann Surg. 2013 Dec;258(6):914-21.

6.Dehghan N, de Mestral C, McKee MD, Schemitsch EH, Nathens A. Flail chest injuries: a review of outcomes and treatment practices from the National Trauma Data Bank. J Trauma Acute Care Surg. 2014 Feb;76(2):462-8.

7.Slobogean GP, MacPherson CA, Sun T, Pelletier ME, Hameed SM. Surgical fixation vs nonoperative management of flail chest: a meta-analysis. J Am Coll Surg. 2013 Feb;216(2):302-11.e1.

Management of Patients with Rib Fractures

Appendix A-Management of Patients with Rib Fractures; Epidural Analgesia

Guidelines for Epidural Therapy in the Trauma Patient

Indications

Any patient with flail chest, 3 or more rib fractures resulting in splinting or clinical concern for compromised pulmonary status should be considered for epidural therapy. Page APS at #9031 for a consult request.

Contraindications

1. **Coagulation:**

Placement: For consideration of epidural placement, the patient must have no coagulopathy or thrombocytopenia. They should be off of antiplatelet and anticoagulant medications in accordance with institutional guidelines.[1] *Maintenance of therapy:* Prophylactic anticoagulation must be done in accordance with ASRA guidelines (Lovenox not to exceed 40 mg daily) or heparin 5,000 units BID or TID. [2] Epidural therapy is contraindicated in patients who will need systemic or therapeutic anticoagulation. *Removal:* epidural removal will be coordinated by the Acute Pain Service (APS). Removal is contraindicated in patients with thrombocytopenia.

2. **Infection:**

Active systemic infection or evidence of bacteremia contraindicate epidural placement. Evidence of bacteremia with an indwelling catheter requires removal of catheter due to increased risk of abscess formation. Skin breakdown at catheter insertion site also contraindicate placement of an epidural. If any evidence of superficial skin infection develop while the catheter is in place, it will be removed at the discretion of APS.

3. **Sedation/Neurological Status:**

Placement: during neuraxial block the needle and catheter are placed in close proximity to the spinal cord and its surrounding structures; the dura and nerve root. It is critical that a patient is able to communicate any change in neurological status or new sensation at this time. Placement of epidural catheters in heavily sedated patients has resulted in devastating neurological complication and for this reason a patient must be able to communicate during the procedure. If they are intubated, sedation should be weaned and the patient should be able to cooperate with the procedure.

New neurologic defect that requires ongoing neuro checks are considered a contraindication to epidural placement. *Maintenance:* patient must be alert enough to follow neuro commands and indicate efficacy of epidural therapy.

Management of Patients with Rib Fractures

4. **Hemodynamic:**

   Epidural therapy is contraindicated in the following clinic situations:

   - Hypotension
   - Need for vasopressor infusion
   - Unstable hemodynamic status
   - Critical Aortic Stenosis

5. **Positioning/patient anatomy/chronic medical condition:**

   Epidurals can be placed with the patient in the sitting or lateral position. The patient should be free of trauma that would preclude them from remaining in this position for duration of the placement (about 20 min. in most cases). Uncooperative patients are a contraindication to epidural placement given the proximity of the needle to the spinal cord during placement. Patient must have a clear C-spine prior to placement of epidural.

   History of severe scoliosis, neural tube defect, advanced peripheral neuropathy or advanced neurodegenerative disease is a contraindication to epidural therapy.

   Intracranial mass or bleed with elevated ICP is an absolute contraindication to epidural therapy.

6. **NPO status:**

   Patient must be NPO (solids 8 hrs. clears 2 hrs.) prior to epidural placement.

7. **Pain well controlled:**

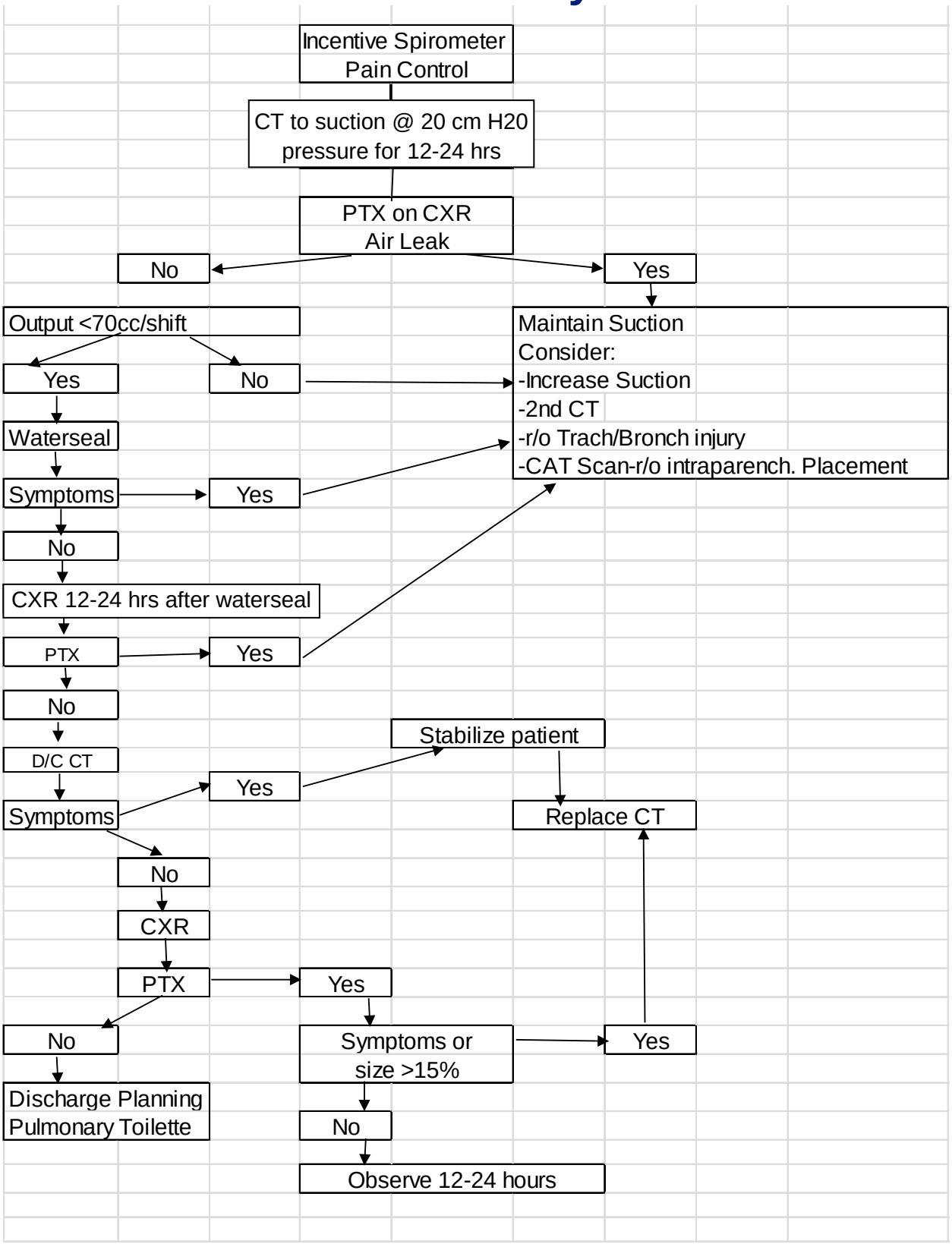
   If chest wall pain is well controlled at the time of APS consult and the patient is performing well with Incentive Spirometry, the risk of neuraxial analgesia may outweigh the benefits. Pain may be due to other sources and with this clinical picture an epidural would not be indicated.

   Duration of Therapy: By epidural catheter day 5 a plan should be in place for alternative analgesia. If the patient continues to benefit from therapy, and there are no concerns for infection at the entry site of the catheter or evidence of meningitis, therapy may continue for up to 72 hrs. more. No epidural catheter should be extended beyond catheter day 7. For record keeping purposes, the day a catheter is placed is considered catheter day 1.

References

1. http://ummcpharmweb.med.umich.edu/i/docs?xsdid=3757&file=AnticoagAntipltNeuraxialBlockade.pdf
2. **Horlocker *et al.* Regional Anesthesia in the Patient Receiving Antithrombotic or Thrombolytic Therapy *Regional Anesthesia & Pain Medicine* January/February 2010 Volume 35 - Issue 1 - pp 64–101**

Tube Thoracostomy Protocol



Updated
8/15/2015

Chest Tube Removal Procedure

A. <u>Make sure chest tube is ready to be pulled out.</u>

1. No air leak with coughing or mechanical breath.
2. Successful water seal trial.
3. No pneumothorax on CXR taken 12-24 hrs after chest tube placed to water seal.

B. <u>Preparation</u>

1. Remove dressing covering chest tube entry site.
2. Undue or cut holding stitch.
3. If a purse string suture is in place make sure it is able to be tied down after tube is removed. Not all chest tubes are placed with a purse string suture. If the patient's chest wall is appropriately thick and the chest tube has been tunneled properly a purse string suture may not be necessary.
4. Obtain piece of petroleum gauze or Xeroform and sterile 4x4.
5. For patients on the mechanical ventilator you want to time your pulling so you are on the inspiratory phase of positive pressure phase of the ventilator cycle.
6. Clamp chest tube with a Kelly clamp prior to pulling.

C. <u>Pulling chest tube</u>

1. Make sure if purse string suture is used, it has one loose throw in it and is ready to tie.
2. Have nurse or assistant hold Vaseline gauze and 4x4 dressing over superior aspect of chest tube entry site.
3. Pull chest tube quickly and forcefully with appropriate timing.
4. Tie down purse string suture, if present.
5. Release pressure on the gauze dressing and tape in place.
6. Obtain post pulling CXR and check results as soon as film is done.

D. <u>Dispose of chest tube and pleurovac.</u>

1. Tie pleur-evac line in a knot so fluid will not drain out.
2. Place entire apparatus in red biohazard disposal bag.

E. <u>Remove stitches.</u>

1. Chest tube stitches left behind after pulling chest tube should be removed within 48 hours.

ED Resuscitative Thoracotomy for Trauma

http://westerntrauma.org/algorithms/ResuscitativeThoracotomy/References.html

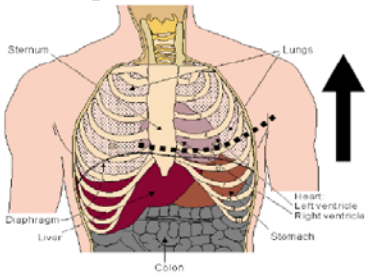
Indications: CPR in progress for: (1) Penetrating thoracic injuries for < 15 minutes
(2) Extremity trauma < 15 minutes (attending discretion)
(3) Blunt trauma < 5 minutes (attending discretion)

Penetrating thoracic injury has best outcomes (21% survival, 11% neuro intact survival). In patients with penetrating extrathoracic injury outcome is more favorable with signs of life (15.6% survival, 16.5% neuro intact survival) than without (2.9% survival, 5.0% neuro intact survival). Blunt injury has poor outcomes (0.7% without signs of life, 2.4% with signs of life).
[Signs of life: pupillary response, spontaneous breathing, carotid pulse, BP, extremity movement, cardiac activity]

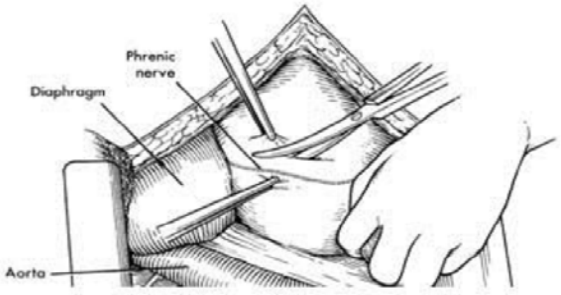
Thoracotomy tray on shelving directly across from Resuscitation Bay "B" in the ED

Steps

1) **Stretch left arm** above head to fully expose left thorax
2) Prep area with betadine (if not available do not wait)



3) Start incision at **inframammary** fold (5th intercostal space)
   a. Start incision from contra- lateral side (**right**) of sternum
   b. Extend incision to left axilla following the curve of the rib
   c. Depth of incision should be to level of rib periosteum
4) **Open pleural space** by inserting curved Mayos at sternal costal boarder and extend along the superior aspect of underlying rib into axilla to maximally expose pleural space
5) Place retractor with ratchet ends facing towards the axilla and open

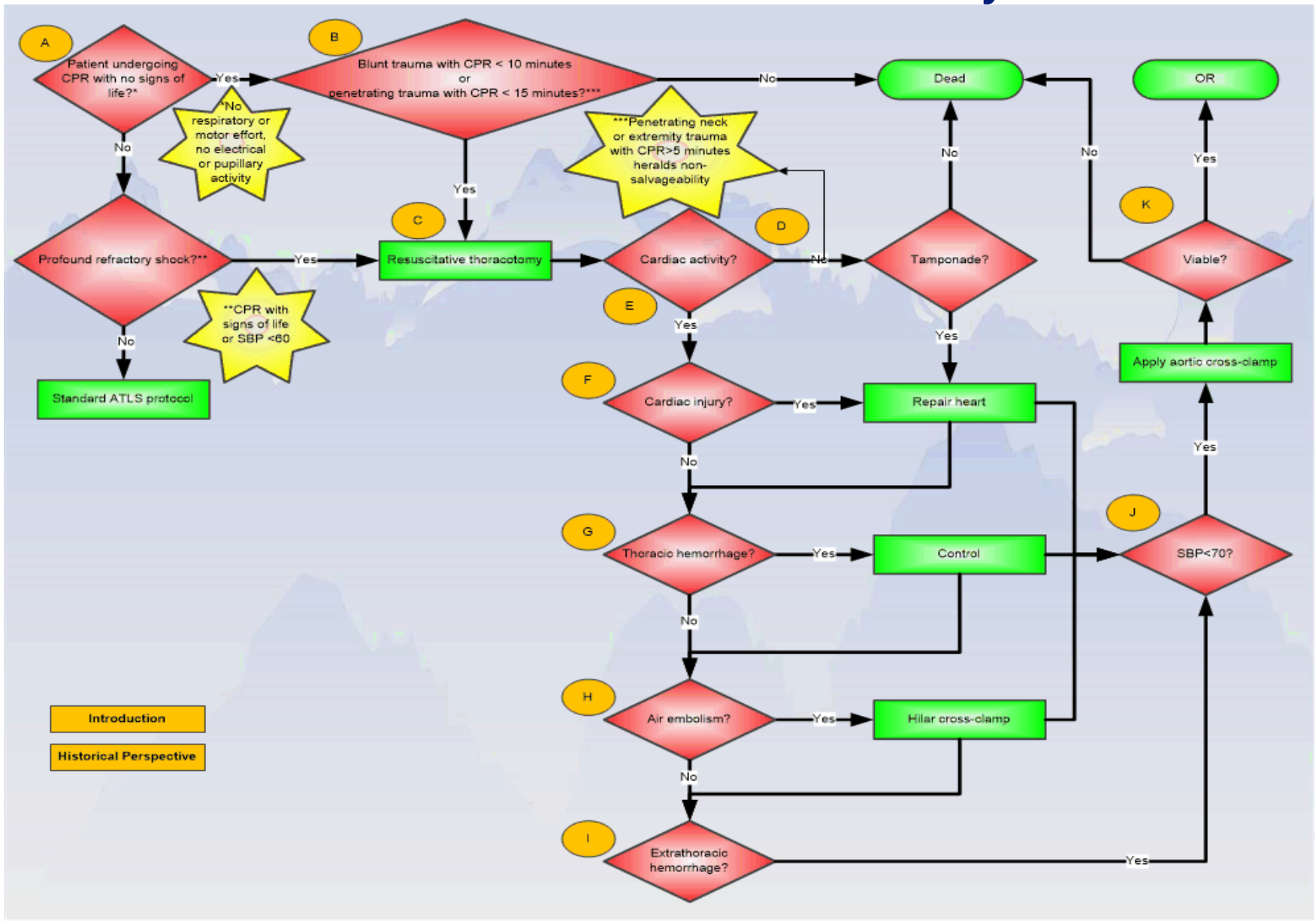


6) **Open the pericardium anterior to the phrenic nerve** by picking up pericardium with toothed pick ups and making a longitudinal incision.
7) Evacuate hemopericardium and repair cardiac defect with 3-0 prolene and Teflon pledgets
8) If cardiac activity present and patient remains hypotensive proceed to descending thoracic aortic cross clamping
9) Use fingers to bluntly dissect the pleural space above the level of the diaphragm to isolate aorta (anterior to spine). Cross clamp avoiding esophagus
10) If patient's **BP is greater than 70 systolic** emergently transfer to operating room

References:

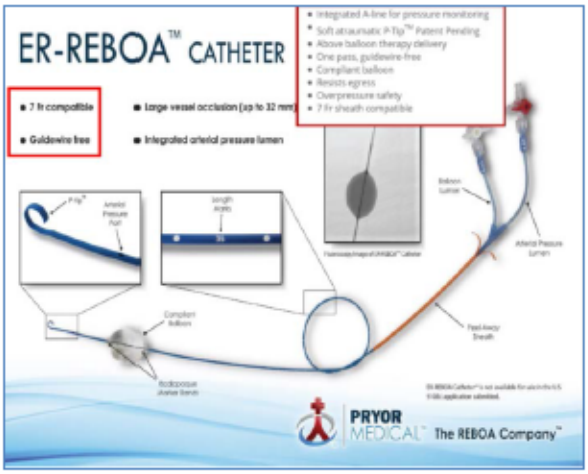
1. Seamon MJ et al. Emergency dept thoracotomy. EAST Practice Management Guideline, J Trauma ACS 2015;79:159-73.
2. Burlew CC et al. Western Trauma Association Critical Decision: Resuscitative thoracotomy. J Trauma ACS 2012;73:1359.
3. Mattox K, Moore E, Feliciano D, Trauma 7th Edition, McGraw Hill 2013

Resuscitative “ED” Thoracotomy



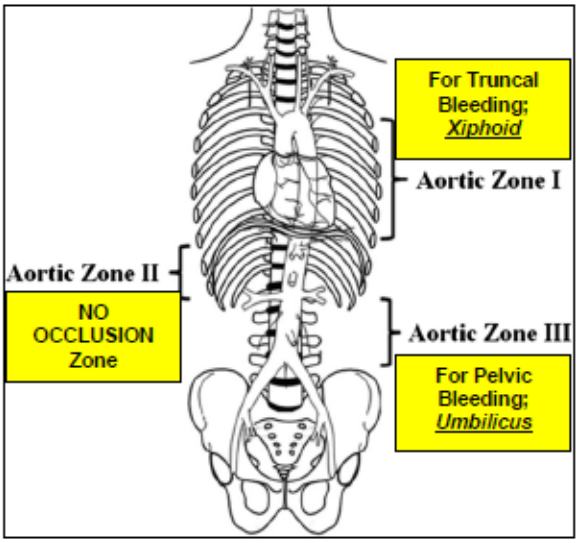
Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) as Adjunct for Hemorrhagic Shock

Similar to resuscitative thoracotomy with aortic clamping for traumatic arrest due to hemorrhagic shock, REBOA is used for temporary aortic occlusion. REBOA supports proximal aortic pressure and minimizes hemorrhage until hemorrhage control and definitive hemostasis are obtained.



REBOA Steps:

1. **Arterial access and Sheath Placement**
   a. Ultrasound-guided common femoral arterial access with Micropuncture kit (21 gauge needle, 4 or 5 French catheter and dilator, 0.018 inch guidewire)
   b. Or Cook single lumen arterial line; or Femoral artery cut-down, proximal/distal control for direct puncture
   c. Insert 7-French Sheath (can upsize arterial line)
2. **Balloon selection and positioning**
   a. ER-REBOA catheter (32mm max balloon diameter)
   b. Flush ER-REBOA catheter with saline; connect arterial line to transduce while inserting
   c. Measure sheath to balloon (not P-tip) distance in cm marks on REBOA catheter:
   d. Zone 1 Xiphoid; Zone 3 Umbilicus
   e. Insert ER-REBOA to pre-measured distance
   f. Digital Xray to confirm REBOA balloon location
3. **Balloon inflation**
   a. Inflate balloon, hand-injection, tactile feedback
   b. 30cc syringe; NS or ½ NS/Contrast; Max 24cc
   c. Mark Inflation time; Minimize time of balloon inflation
   d. Suture catheter and sheath; transduce arterial line
   e. Must go to OR/IR for definitive hemorrhage control
4. **Balloon deflation – Partial REBOA**
   a. Intermittent deflation of REBOA can be used to optimize visceral perfusion, goal SBP > 90 mm Hg
5. **Femoral Artery Sheath removal**
   a. HD stable, normal coagulation, withdraw balloon saline w/ 30cc empty syringe
   b. 30 min digital pressure at sheath site, keep patient supine for 6 hrs, no hip flexion
   c. Femoral arterial duplex at 24-72 hrs to evaluate patency of femoral artery



REBOA Intra-Aortic Balloon Placement for Hemorrhagic Shock

Balloon placement determined by injury/hemorrhage location:

Zone 1 Descending Thoracic Aorta (origin of left subclavian artery to celiac artery) for truncal hemorrhage control

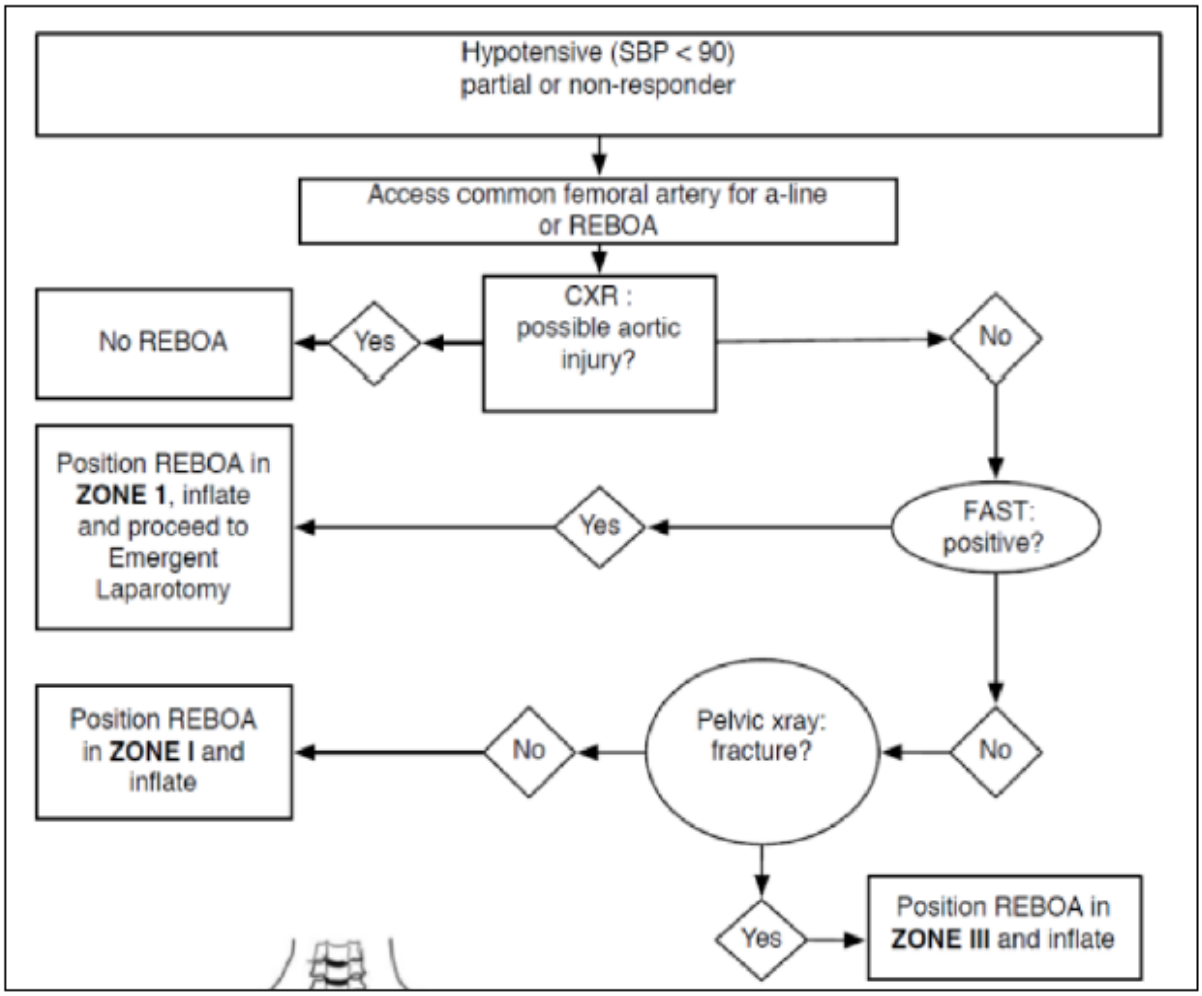
Zone 2 Para-visceral Aorta (celiac artery to lowest renal artery): **NO-OCCLUSION ZONE**

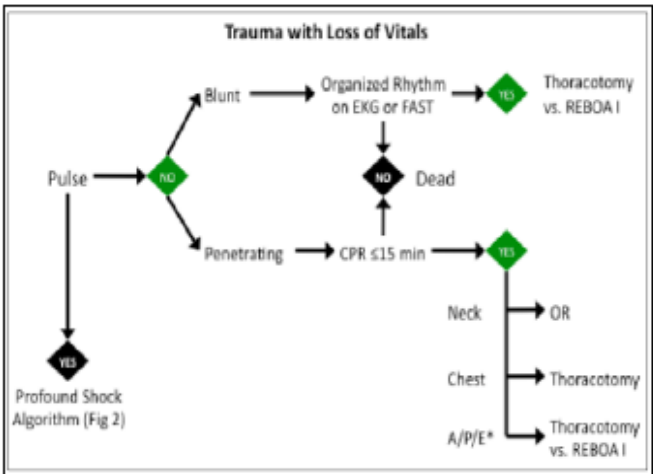
Zone 3 Infra-renal Aorta (lowest renal artery to aortic bifurcation) for pelvic/junctional bleeding.

References:

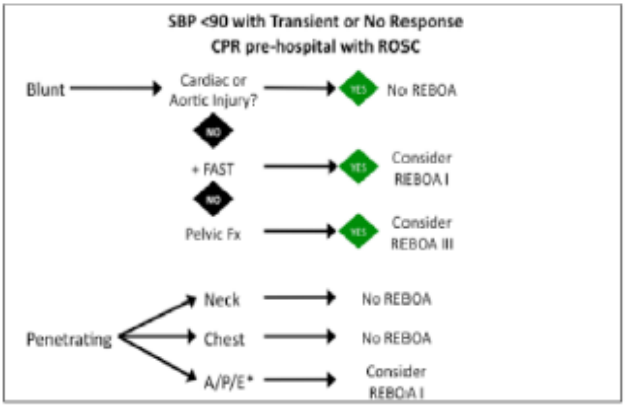
1. Stannard A, Eliason JL, Rasmussen TE. Resuscitative endovascular balloon occlusion of the aorta (REBOA) as an adjunct for hemorrhagic shock. J Trauma. 2011 Dec;71(6):1869-72
2. Brenner ML, Moore LJ, Dubose JJ, Tyson GH, et al. A clinical series of resuscitative endovascular balloon occlusion of the aorta for hemorrhage control and resuscitation. J Trauma Acute Care Surg. 2013 Sep;75(3):506-511.
3. Villamaria CY, Eliason JL, Napolitano LM, Stansfield B, Spencer JR, Rasmussen TE. An Endovascular Skills for Trauma and Resuscitative Surgery (ESTARS™) Course: Curriculum Development, Content Validation and Program Assessment. American Association for the Surgery of Trauma; J Trauma Acute Care Surg 2014 Apr;76(4):929-35.
4. Dubose JJ, Scalea TM, Brenner M, et al. AAST AORTA Registry; Utilization/outcomes of REBOA. J Trauma 2016 Sep;81(3):409
5. Johnson MA, Neff LP, Williams TK, DuBose JJ, et al. P-REBOA: Clinical technique & rationale. J Trauma 2016 Nov;92:S133.

Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) as Adjunct for Hemorrhagic Shock





*Abdomen/Pelvis/Extremity; REBOA I=Placement of aortic balloon in the thoracic aorta (2-8 cm above the xyphoid)



*Abdomen/Pelvis/Extremity; ROSC, Return of Spontaneous Circulation; REBOA I Placement of aortic balloon in the thoracic aorta (2-8 cm above the xyphoid); REBOA III Placement of aortic balloon directly above the aortic bifurcation (1-2 cm above the umbilicus)

Joint Theater Trauma System Clinical Practice Guideline: REBOA for Hemorrhagic Shock. http://www.usaisr.amedd.army.mil/assets/cpgs/REBOA_for_Hemorrhagic_Shock_16Jun2014.pdf

Blunt Thoracic Aortic Injury (BTAI) Protocol

Blunt traumatic aortic injury (BTAI) is the second most common cause of death in trauma patients. 80% of BTAI patients will die before reaching a trauma center. For patients who survive to hospital, 50% will die within 24 hrs. This high mortality rate is related to the high incidence (40%) of severe associated injuries.

For patients with very suspicious CXR with hypertension OR BTAI diagnosis on helical chest CT or angiogram:

I. **Start antihypertension regimen:**
   a. Infuse esmolol bolus then maintenance rate for a goal BP (syst) 100-120 mmHg, HR < 100
   b. Add second agent such as Nitroprusside if BP (syst) still elevated despite esmolol

II. Treat ongoing life-threatening hemorrhage from other injuries prior to BTAI treatment (unless patient actively bleeding from aorta).

III. Treat pneumothorax and hemothorax in ED as you would for any trauma patient. For stable untreated hemothoraces beyond the emergent/resuscitation period check with Cardiac Surgery prior to drainage (patient may not need a chest tube if going to the OR soon for open repair).

IV. Treat coagulopathy if present.

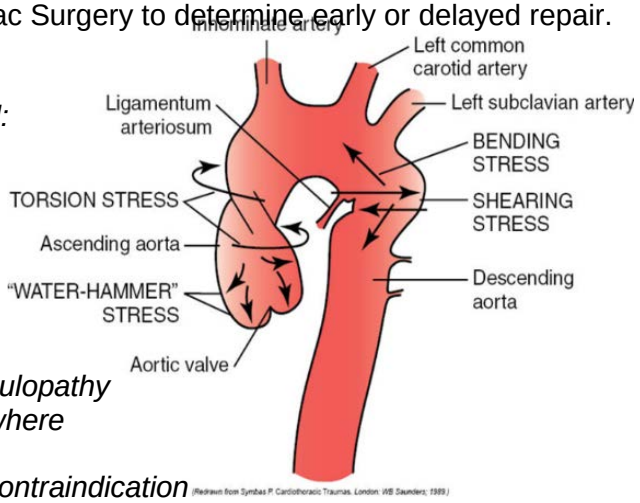
V. Once diagnosis of BTAI established consult Cardiac Surgery to determine early or delayed repair.

Reasons for delayed repair:

A. *Pa02/Fi02 ratio less than 150*

B. CNS injuries for which repair should be delayed:

1. massive contusion
2. evidence of shift on Head CT
3. large areas of intracerebral blood
4. high ICP (consistently >20)
5. need for systemic heparinization for full bypass felt to be contraindicated by Neurosurgery.



C. Ongoing major transfusion requirement or coagulopathy

D. Massive, open, contaminated wounds or burn where likelihood of wound sepsis is high.

E. Begin DVT prophylaxis at 24 hours if no other contraindication

VI. Patients with BTAI who Cardiac Surgery is considering a stent-graft need a "Thoracic pre-endograft CT scan of the neck, chest, abdomen, and pelvis". This should be performed 48-72 hrs post-injury once the patient is stable and resuscitation has ceased. Goal is to evaluate the aorta in a euvolemic (not hypovolemic) state to allow assessment of the circle of Willis/vertebral art for endograft technique.

VII. **If BTAI repair to be delayed for longer than 48 hours:**

A. Continue beta-blocker therapy, convert to long-acting agent (metoprolol or atenolol)
B. Add secondary long acting antihypertensives as necessary (clonidine, diuretic). Use diuretic if clinically safe and beyond resuscitative period to achieve euvolemia in fluid overloaded patients.
C. BP (systolic) may be liberalized at 7 days to 150-160 mmHg
D. Physical therapy may begin at day 5

VIII. Any concerns or problems should be discussed between ACS and CT surgery attendings. The following communication algorithm will be used for BTAI trauma patients requiring emergent operative intervention:

1. Direct communication between Trauma Attending to Cardiothoracic CT Attending will take place immediately upon request for patient transfer/identification of BTAI in the ED
2. Direct attending (ACS) to attending (CT Surgery) discussion will occur whenever emergent operative intervention is anticipated for BTAI.
3. Pertinent images will be reviewed by the Trauma ACS attending physician and the Cardiothoracic Surgery attending physician to confirm optimal plan for patient care (operative vs. non-operative). If available, images via VPN will be reviewed for transfer patients.
4. **If plan is for emergent operative management** a call, by the CT Surgery attending, will be made to the CVC-OR (**232-4553**) to request a hybrid OR. If not available, the next option will be the first available open CVC OR with a fluoroscopy table vs. Interventional Radiology Suite vs. OR at University Hospital.

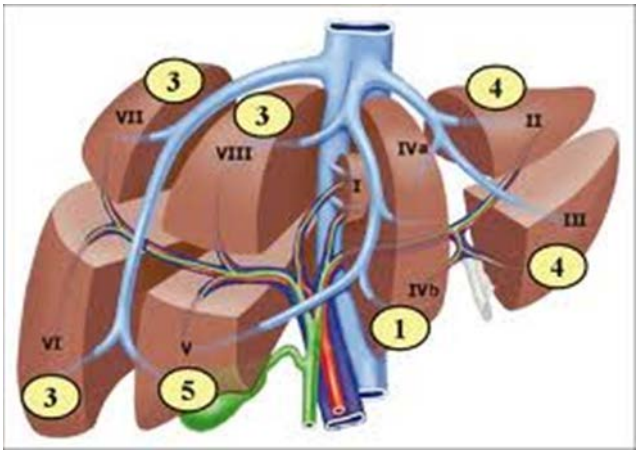
Blunt Hepatic Trauma (BHT)

- Liver injury occurs in approximately 5% of trauma admissions
- MVC is most common etiology for BHT
- FAST is key to rapid diagnosis of hemoperitoneum in the unstable patient but unreliable in determining grade of liver injury
- CT scan allows further evaluation and grading of hepatic injury in a **stable patient**
- Blunt hepatic injury typically traverses along segments of liver
- Hepatic veins most commonly injured in BHT
- Non-operative management has become standard for **stable** patients with BHT (approx. 85% of patients w/BHT are stable) with embolization and/or drainage by IR an important adjunct
- High-grade injury, large hemoperitoneum, contrast extravasation, and pseudoaneurysm are not contraindications for non-operative management, however at higher risk for non-op failure
- Complications can include: compartment syndrome, bile leak, abscess, hemobilia, delayed hemorrhage, devascularization
- No evidence to keep stable patients on bed rest
- No evidence for routine f/u CT scans, only scan if clinical change
- Most patients can resume full activity in 1 month (consider f/u CT scan for grade III-V before resume full activity) - (No level I evidence, based on level II and III data)

Grade*		Description
I	Hematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, <1cm parenchymal depth
II	Hematoma	Subcapsular, 10-50% surface area
	Laceration	Capsular tear, 1-3cm parenchymal depth, <10cm length
III	Hematoma	Subcapsular, >50% surface area or expanding Ruptured subcapsular or parenchymal hematoma Intraparenchymal hematoma >10cm or expanding
	Laceration	>3cm parenchymal depth
IV	Laceration	Parenchymal disruption involving 25-75% of hepatic lobe or 1-3 Couinaud's segments within a single lobe
V	Laceration	Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud's segments within single lobe
	Vascular	Juxtahepatic venous injuries (i.e. retruhepatic vena cava/central major hepatic veins)
	Vascular	Hepatic avulsion

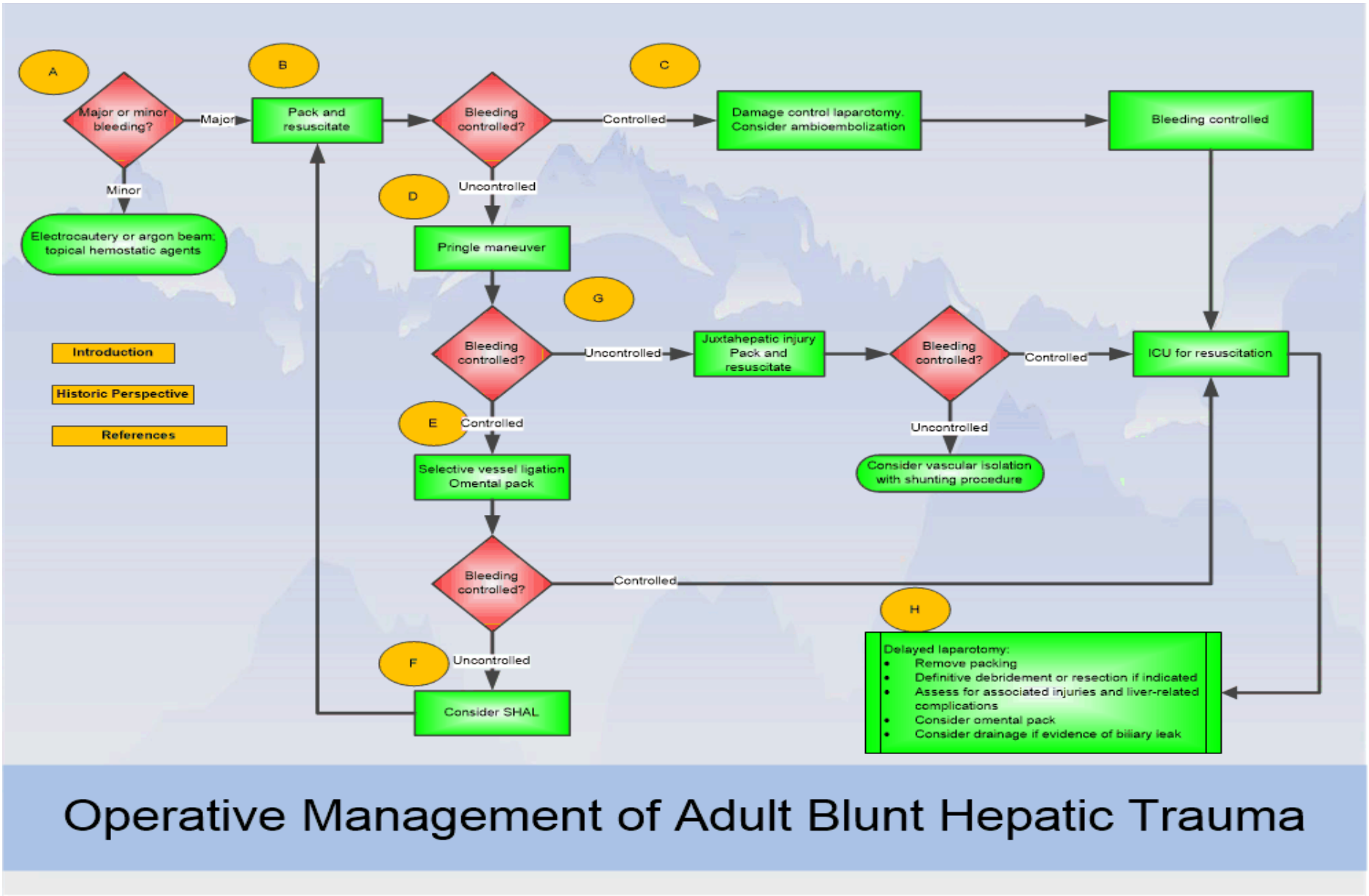
*Advance one grade for multiple injuries up to Grade III

Day 2-3 after admission for Liver AIS ≥ 4: Consider HIDA scan to rule out bile leak. If positive laparoscopic washout with drain placement. If negative repeat only as indicated. Consider ERCP if bile drain output remains >200cc/day after a week.



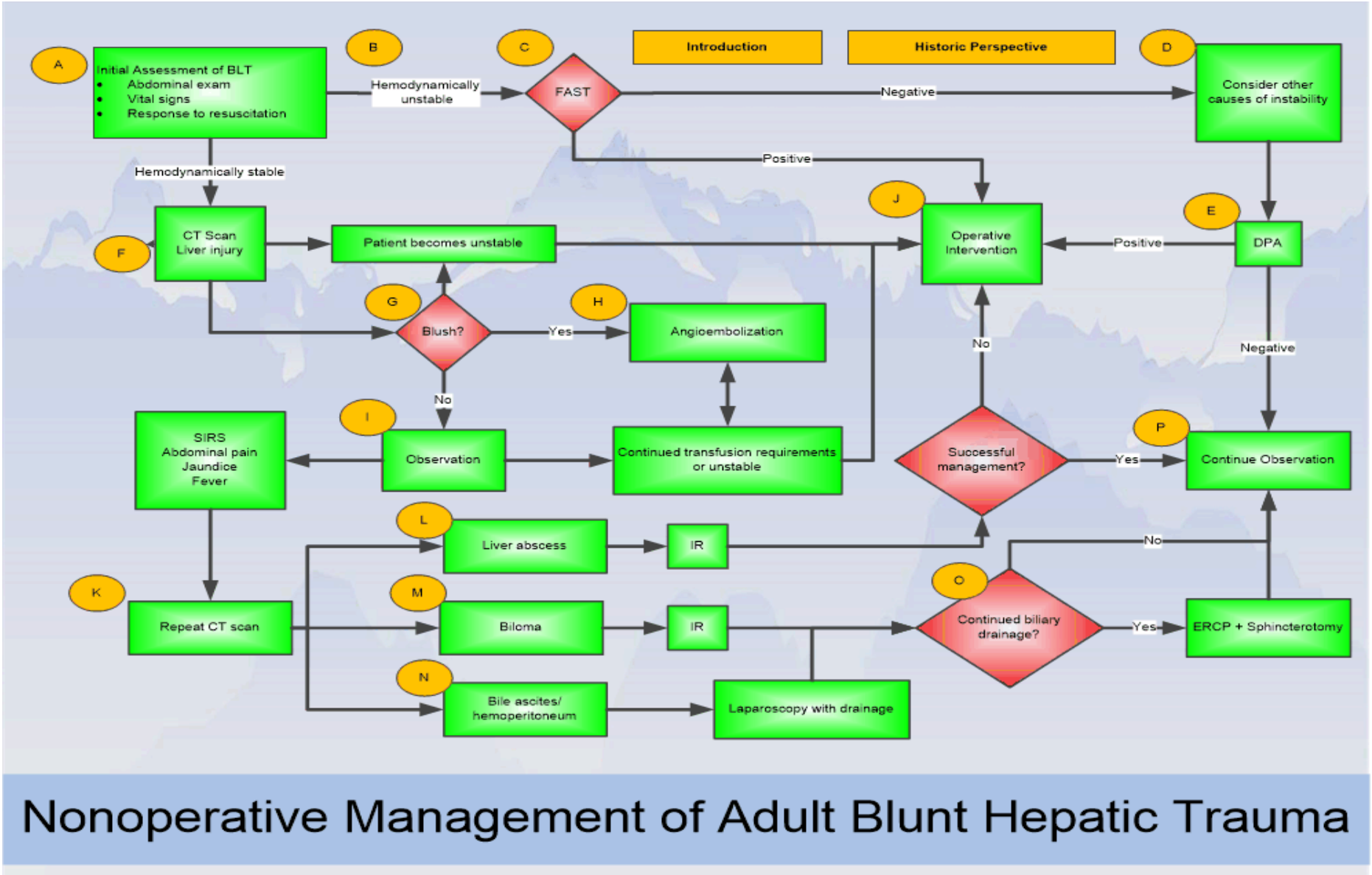
Blunt Hepatic Trauma (BHT) (cont'd)

http://westerntrauma.org/algorithms/WTAAlgorithms_files/gif_3.htm



Blunt Hepatic Trauma (BHT) (cont'd)

http://westerntrauma.org/algorithms/WTAAlgorithms_files/gif_5.htm



Nonoperative Management of Adult Blunt Hepatic Trauma

Blunt Renal Trauma

Blunt renal injury is often the result of a rapid deceleration event (fall, high-speed motor vehicle accident) or a direct blow to the flank.

Following a blunt trauma event, the following physical exam findings should raise concern for possible renal injury:

- Hematuria
- Flank pain
- Flank ecchymoses or abrasions
- Fractured ribs
- Abdominal distension or mass
- Abdominal tenderness

Urinalysis, hematocrit, and baseline creatinine are the most important tests for evaluating renal trauma.

*Hematuria is a hallmark sign of renal injury, but does not necessarily correlate with the degree of injury. Further, its absence does not rule out renal injury.

*Since most trauma patients are evaluated within 1 hour of injury, creatinine measurement will reflect renal function prior to the injury. An increased creatinine generally reflects pre-existing renal pathology.

*Indications for radiographic evaluation with CT include gross hematuria, microscopic hematuria and shock, or the presence of major associated injuries. Any patient with a rapid deceleration injury or any of the above clinical indicators of renal injury should also undergo CT imaging, regardless of the presence of hematuria.

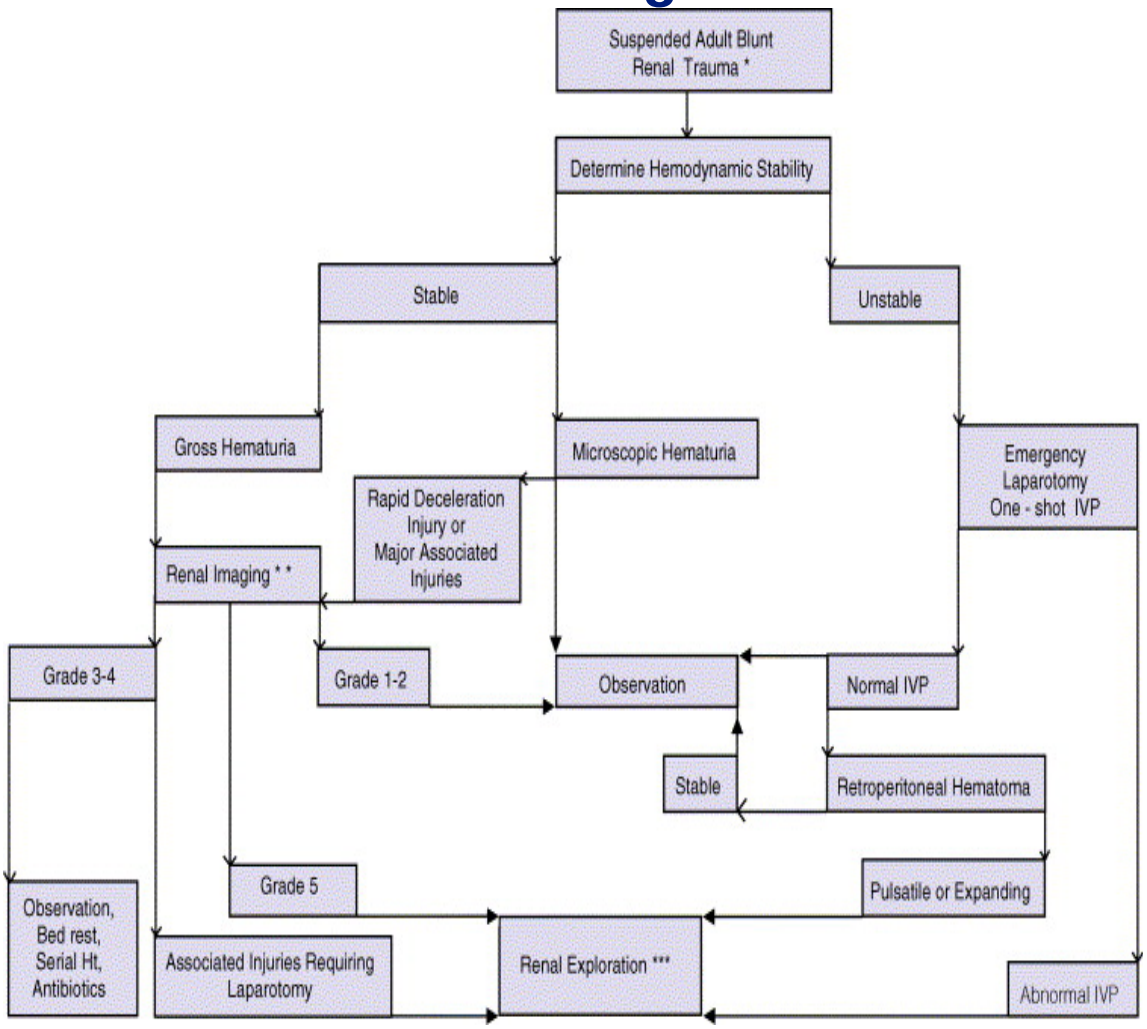
The AAST renal injury grading scale has been widely adopted:

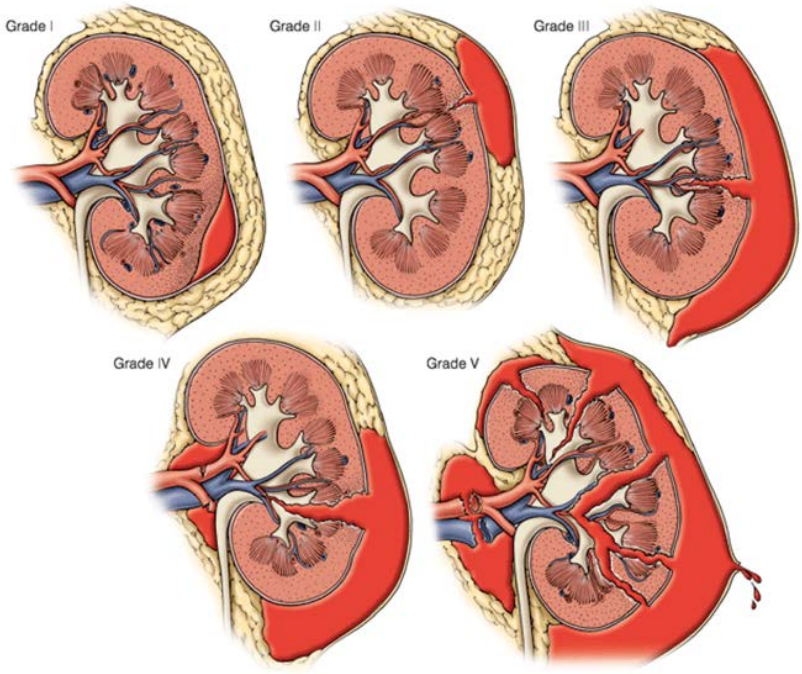
Grade*	Description of Injury
1	Contusion or non-expanding subcapsular hematoma without parenchymal laceration
2	Non-expanding peri-renal hematoma
	Cortical laceration <1cm deep without extravasation
3	Cortical laceration >1cm without urinary extravasation
4	Laceration: through corticomedullary junction into collecting system
	or
	Vascular: segmental renal artery or vein injury with contained hematoma, or partial vessel laceration, or vessel thrombosis
5	Laceration: shattered kidney
	or
	Vascular: renal pedicle avulsion

**Advance one grade for bilateral injuries up to grade 3.*

Sources:
-Lynch TH, et al. EAU guidelines on urological trauma. Eur Urol. 2005 Jan; 47(1):1-15.
-Santucci RA, et al. Evaluation and management of renal injuries; consensus statement of the renal trauma subcommittee. BJU Int. 2004 May; 93(7):937-954.
-Santucci RA, Fisher MB. The literature increasingly supports expectant (conservative) management of renal trauma – a systemic review. J Trauma. 2005 Aug; 59(2):493-503.

Blunt Renal Algorithm





Blunt Splenic Trauma

- CT findings of active contrast extravasation or spleen AIS grade 4-5 with large hemoperitoneum:
  Tx: Fluid resuscitation on IV warmers and external warming device.
  Consider all of these patients for angiographic embolization unless:
  Ongoing hypotension despite fluid resuscitation (not tachycardia).
  Need for exploration for other injuries.
- Hypotension in ED is strongly predictive of failure of non-operative management (NOM)
- Criteria for NOM includes: HD stability, negative abdominal exam, absence of contrast extravasation on CT, absence of other clear indication for exploratory laparotomy, absence of conditions associated with bleeding (coagulopathy, use of anticoagulants, cardiac failure)
- Non-operative Management Protocol:
  Bedrest algorithm:
  - AIS solid organ score – 1 = days of bed rest, up to a maximum of 3 days of bed rest
  - If embolized, bed rest for 24 hours only.
  - Start Lovenox (if no other contraindication) same day as bed rest restrictions end.

  For patients with AIS score >3
  - Telemetry monitoring – admit to either stepdown (no vent or pressors) or ICU status for 24 hours of hemodynamic monitoring.
  - Hct check q8 hours x 24 hours
  - Serial abdominal exams x 24 hours
  - A sudden change in hemodynamics, decrease in Hb/Hct or significant change in the abdominal exam should prompt a repeat CT/angio, unless the patient is HD unstable

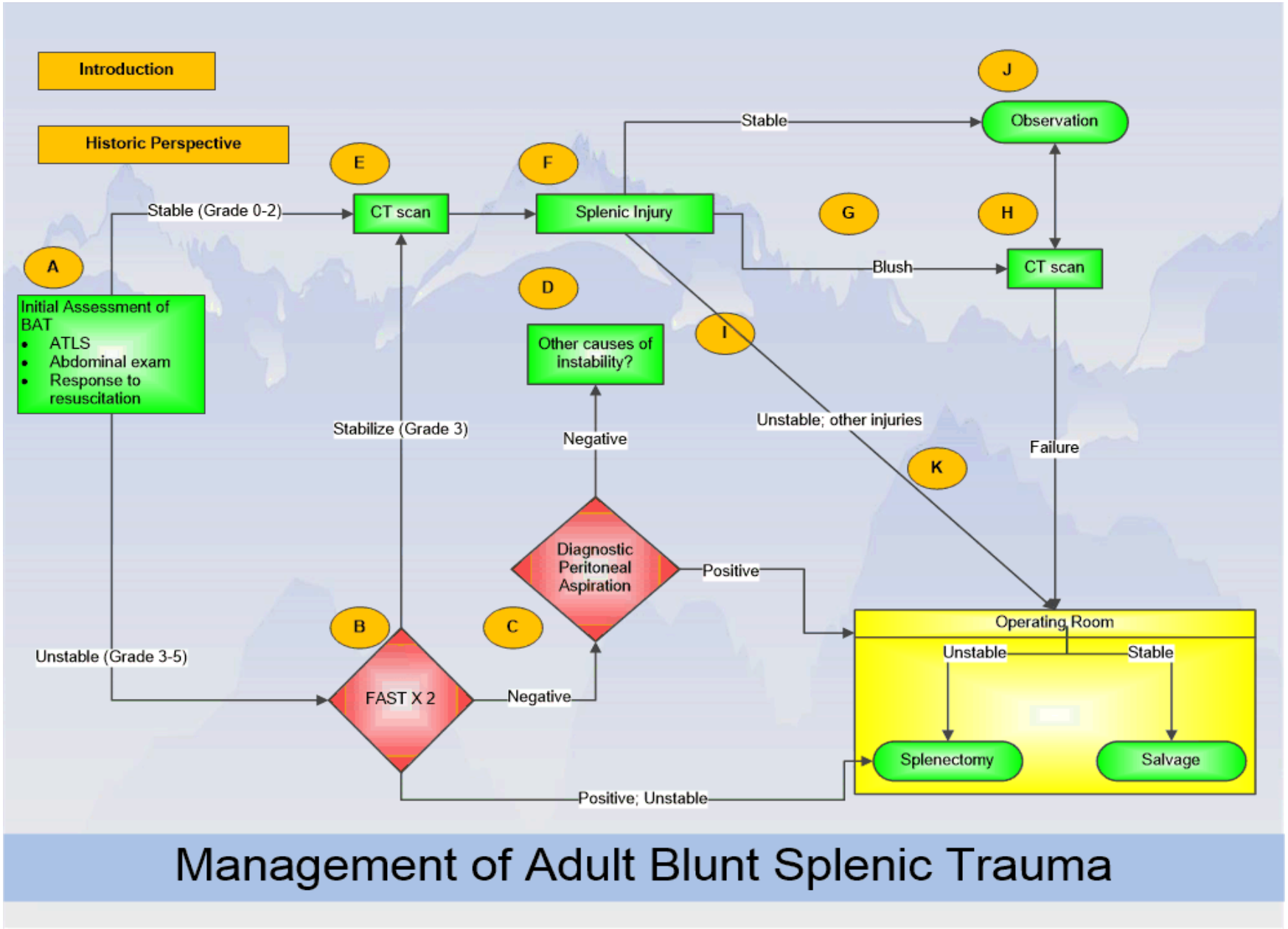
- 95% of NOM failures happen within 72 hours of injury, regardless of grade.
- Abdominal CT scanning is the gold standard diagnostic test if NOM is to be pursued.
- Splenectomized patients and those who undergo main splenic artery embolization should have vaccines 14 days post splenectomy. If there is any concern for patient follow-up, vaccinate on the day of discharge from the hospital.
  Vaccines (see med section for details)
  Pneumococcal vaccine - PPSV23[3]
  Meningococcal vaccine - MCV4[4] (2 – 55 years old), MPSV4 (>55 years old)
  Haemophilus influenza type b vaccine - Hib[5]

Table 1. Splenic Injury Scale

Organ, grade*	Injury type	Description of injury	AIS
Spleen			
I	Hematoma	Subcapsular, < 10% surface area	2
	Laceration	Capsular tear, < 1 cm parenchymal depth	2
II	Hematoma	Subcapsular, 10% to 50% surface area; intraparenchymal, < 5 cm in diameter	2
	Laceration	Capsular tear, 1 to 3 cm parenchymal depth that does not involve a trabecular vessel	2
III	Hematoma	Subcapsular, > 50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma ≥ 5 cm or expanding	3
	Laceration	> 3 cm parenchymal depth or involving trabecular vessels	3
IV	Laceration	Laceration involving segmental or hilar vessels producing major devascularization (> 25% of spleen)	4
V	Hematoma	Completely shattered spleen	5
	Laceration	Hilar vascular injury devascularizes spleen	5

***Advance one g**Advance one grade for multiple injuries, up to Grade III.**

Blunt Splenic Injury Algorithm



Retroperitoneal Hematoma

Resuscitate first (ATLS). If unstable, proceed to OR immediately.

Thoracic Vascular Control

Left anterolateral thoracotomy if patient in extremis. Extend trans-sternally for clamshell if cardiac or right-sided injuries.

Abdominal Vascular Injuries

Abdominal Vascular Injury incidence: blunt – 5-10%, stab wound – 10%, gunshot wound – 25%

Zone 1 : midline retroperitoneum

- Supramesocolic – suprarenal abdominal aorta, celiac axis, proximal SMA, proximal renal artery, SMV
- Inframesocolic – infrarenal abdominal aorta, infrahepatic IVC

Zone 2: upper lateral retroperitoneum, renal artery/vein

Zone 3: pelvic retroperitoneum, iliac artery/vein

- Portal-retrohepatic: portal vein, hepatic artery, retrohepatic IVC

Explore – Zone I Central RP Hematoma, Expanding, or Penetrating Hematomas
Do Not Explore – retrohepatic, blunt or nonexpanding Zone 2/3 hematomas (consider endovascular)

Exposure

Supramesocolic and Zone 2 left:

- ? left thoracotomy and cross-clamp aorta (unstable pt with suprarenal injury)
- Divide peritoneal reflection left of colon along splenic flexure
- Rotate fundus of stomach, spleen, and tail of pancreas (and L kidney if necessary)

IVC, and Zone 2 right:

- Divide peritoneal reflection right of colon along hepatic flexure
- Kocher mobilization of duodenum and pancreas

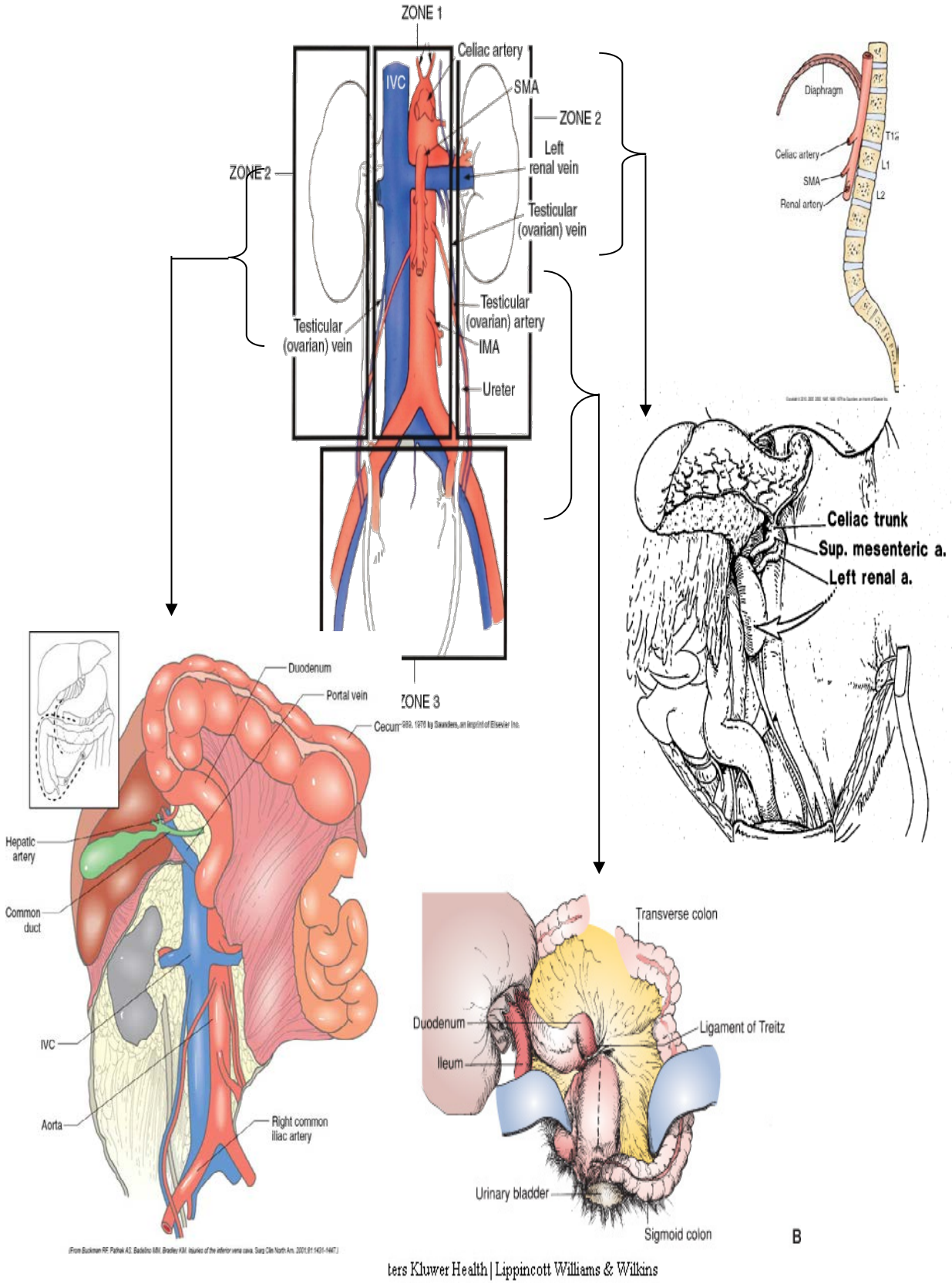
Inframesocolic and pelvis:

- Reflect mesocolon cephalad and eviscerate small bowel to right
- Open midline retroperitoneum cephalad until L renal vein exposed (proximal control) and caudad to bifurcation (avoid IMA origin)
- ? compartment fasciotomies

References:

- Demetriades, Inaba. Vascular Trauma: Abdominal. 2343-60. In: Cronenwett. Rutherford's Vascular Surgery, 7th Ed., 2010.
- Dente and Feliciano. Abdominal Vascular Injury. In: Moore, Felicano, Mattox (Ed.): Trauma, 5th Ed. 2004.
- Feliciano, D. Management of Traumatic Retroperitoneal Hematoma. Ann Surg 1990. 211(2): 109-123.
- Starns and Arthurs. Perspect Vasc Surg Endovasc Ther. 2006 Jun;18(2):114-29.

Retroperitoneal Hematoma Algorithm



Rectal Injuries

Rectal Injury

- Requires a high index of suspicion.
- Missed rectal injuries carry a mortality rate of up to 50%.

Penetrating Rectal Injury

- Maintain a high index of suspicion with any penetrating injuries of the lower abdomen, pelvis, perineum, or upper thigh.

Blunt Rectal Injury

- Should be suspected in any patient with pelvic fracture and/or perineal injury.
- Often complex, with high morbidity and mortality rates, due to frequent association with concomitant injuries to the pelvic vasculature, bladder, and urethra.

Elements of Diagnosis

- Digital Rectal Exam
- Rigid proctosigmoidoscopy (may miss occult injuries; not sufficient by itself to exclude injury)
- CT abdomen/pelvis with rectal contrast
- +/- Gastrografin enema

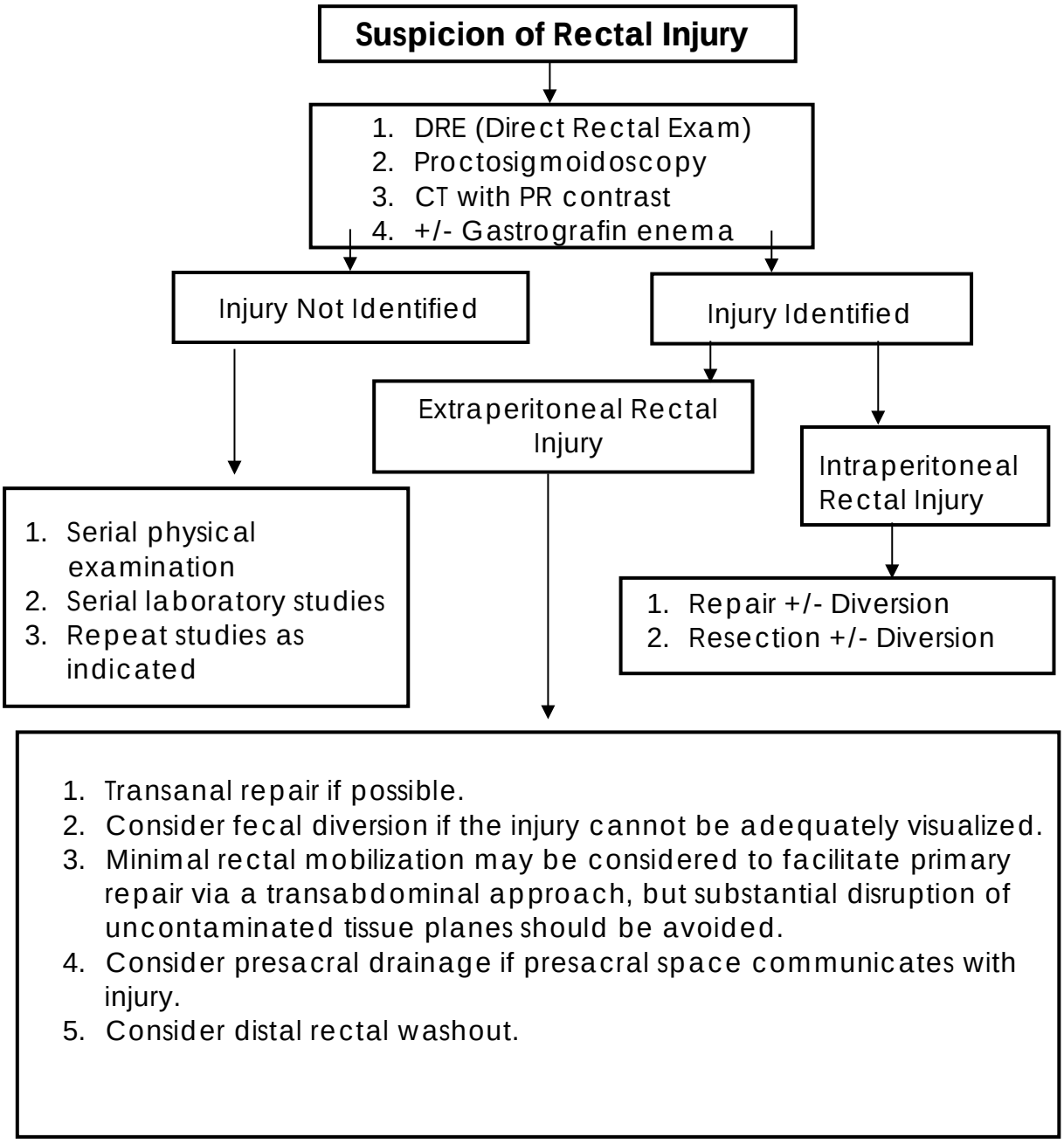
Principles of Management

- Rectal injuries above the peritoneal reflection should be treated like colon injuries. The vast majority should be repaired primarily.
    - Several prospective RCTs have shown either no difference or lower complication rates with primary repair compared to colostomy formation.
- Damage control operations should consist in resection of damaged bowel with stapling off of ends, without colostomy formation. Colostomy formation unnecessarily prolongs the operation, and the presence of a colostomy in the setting of abdominal compartment syndrome can be disastrous (may retract into the abdomen).
- Low rectal injuries should be repaired transanally when possible.
- Aggressive attempts to repair extraperitoneal rectal injuries, while risking the exposure of uncontaminated pararectal planes through excessive mobilization, should be discouraged.
- Debate exists in the literature over the need for fecal diversion with primary repair. Significant delay in repair (>24 hours from the time of injury) and perioperative shock both increase the risk of leak, and should prompt a consideration of fecal diversion.
- The literature suggests that presacral drainage may decrease the rate of septic complications from rectal injury, particularly in the case of injuries that communicate with and contaminate presacral and pararectal soft tissues. Dissecting uncontaminated planes to place presacral drains, however, may not be prudent or warranted.
- The literature is inconclusive on the issue of distal rectal washout.

References:

- Cleary RK, et al., Colon and Rectal Injuries. Dis Colon & Rectum. 2006 Aug;49(8):1203-22.
- Herr MW, Gagliano RA. Historical perspective and current management of colonic and intraperitoneal rectal trauma. Curr Surg. 2005 Mar-Apr;62(2):187-92.
- Herr MW, Wascher RA, Gagliano RA Jr. Historical perspective and current management of traumatic injury to the extraperitoneal rectum and anus. Curr Surg. 2005 Nov-Dec;62(6):625-32.

Rectal Injuries Algorithm



Guidelines for Initial Management of the Adult Patient with a Suspected Pelvic Fracture

A. Class I and II Patients
   a. Class I and II patients admitted to the Emergency Department (ED) with a pelvic fracture must have the following evaluations:
      i. A complete neuro-vascular examination of both lower extremities
      ii. Appropriate radiographic images
      iii. An Orthopedic Service consult

   b. These patients will be admitted to the Acute Care Surgery Trauma/Burn (ACS) Service with the Orthopedic Service following as a consult. Pelvic fractures, regardless of their anatomical grade, can be a source of major hemorrhage. The Orthopedic Surgery Service will decide if a pelvic fixator is indicated. If continued blood transfusions are required, the patient will proceed to angiography for embolization of pelvic vessels. (See below for the algorithm for the evaluation and treatment of suspected pelvic fractures.)

   c. If after evaluation of all their injuries these patients are found to have an isolated pelvic fracture, and do not require blood transfusions, they may be transferred to the Orthopedic Surgery Service. Upon discharge from the Orthopedic Surgery Service, these patients will be given a follow-up appointment (to occur within two weeks of discharge) in both the Orthopedic Surgery Service and ACS clinic

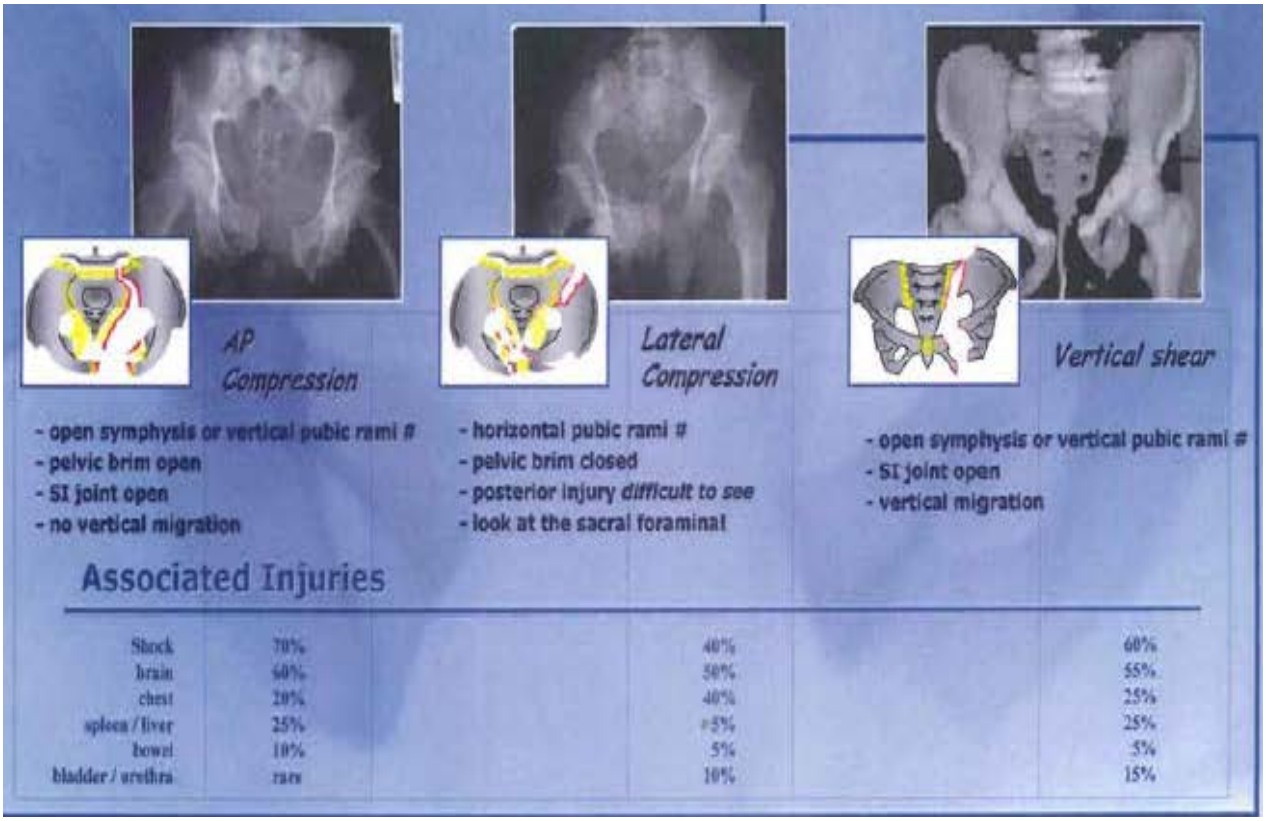
   d. If these patients are found to have other injury in addition to their orthopedic injury, they will remain on the Trauma Burn Service with the Orthopedic Surgery Service following as a consult. Upon discharge, these patients will receive follow-up appointments (to occur within two weeks of discharge) in the ACS and Orthopedic Surgery clinics

B. Class III Patients
   a. Class III patients admitted to the ED with a suspected pelvic isolated fracture may have the same evaluation as the Class I and II patient

      Class III patients with an isolated pelvic fracture and no evidence of blood loss may be directly admitted to the Orthopedic Surgery Service. Upon discharge, these patients will receive follow-up appointments within two weeks to the orthopedic surgery clinic. If admission is not required, patients will be discharged from the ED with discharge instructions with a follow-up appointment to the Orthopedic Surgery Clinic within one week.

Management of Severe Pelvic Fractures

1. Follow ATLS Protocol – ABC's first
2. Protect the spine and pelvis at all times
3. Pelvis fracture suspected – immediately splint with sheet or binder
4. Early pelvis x-ray is essential
5. Do **NOT** test pelvis for mechanical stability
6. Do **NOT** log-roll patient until pelvis cleared
7. Do **NOT** pass urinary catheter until pelvis cleared
8. "The first clot is the best clot." Reduce bleeding by:
    a. Careful patient handling
    b. Early pelvis immobilization
    c. Early blood and blood product transfusion, normalize coags, consider TXA if active hemorrhage, thromboelastometry
9. **Recognize injury patterns:**



Guidelines for Initial Management of the Adult Patient with a Suspected Pelvic Fracture (cont'd)

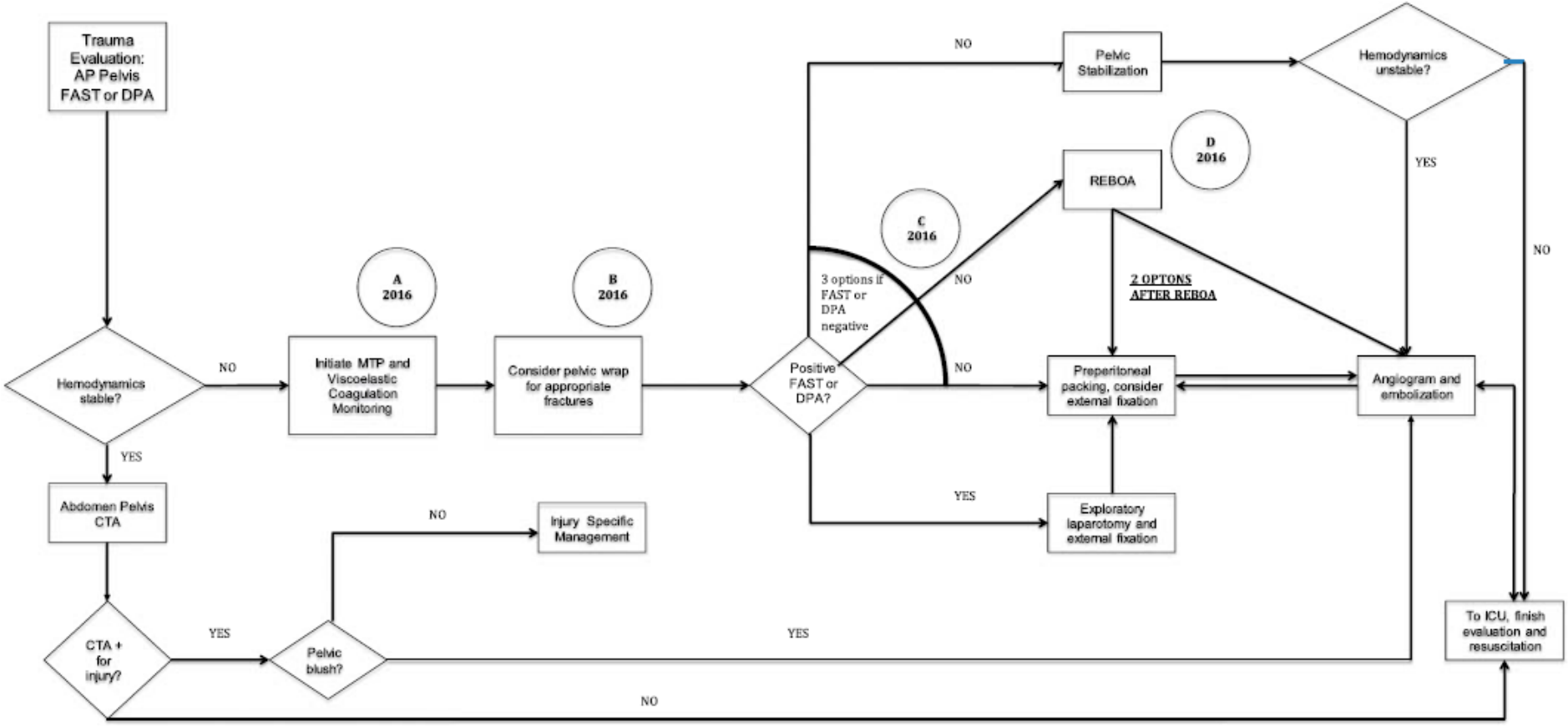
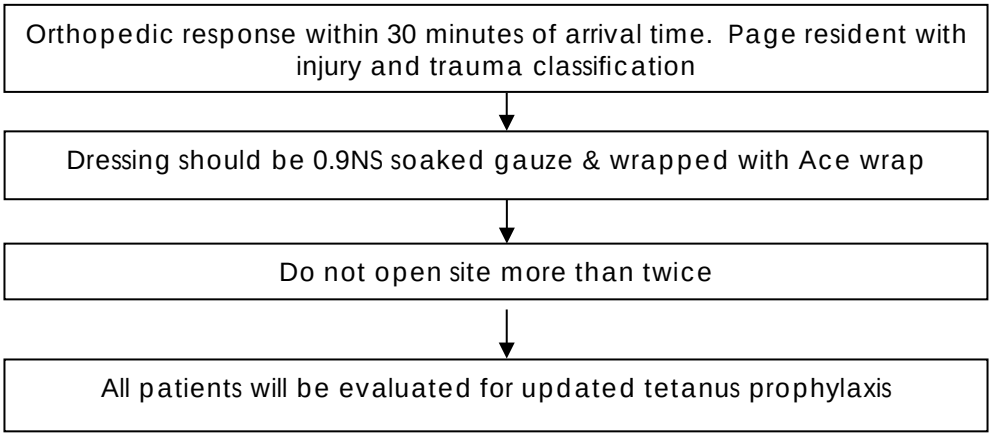


Figure 1. Management of pelvic fracture with hemodynamic instability.

Thai Lan N. Tran, MD, et al. Western Trauma Association Critical Decisions in Trauma: Management of pelvic fracture with hemodynamic instability—2016 update. *J Trauma Acute Care Surg, 2016;81(6)*.

Guidelines for the Initial Evaluation of the Adult Trauma Patient with Open Extremity Fractures

The Open Fracture Algorithm is as follows:



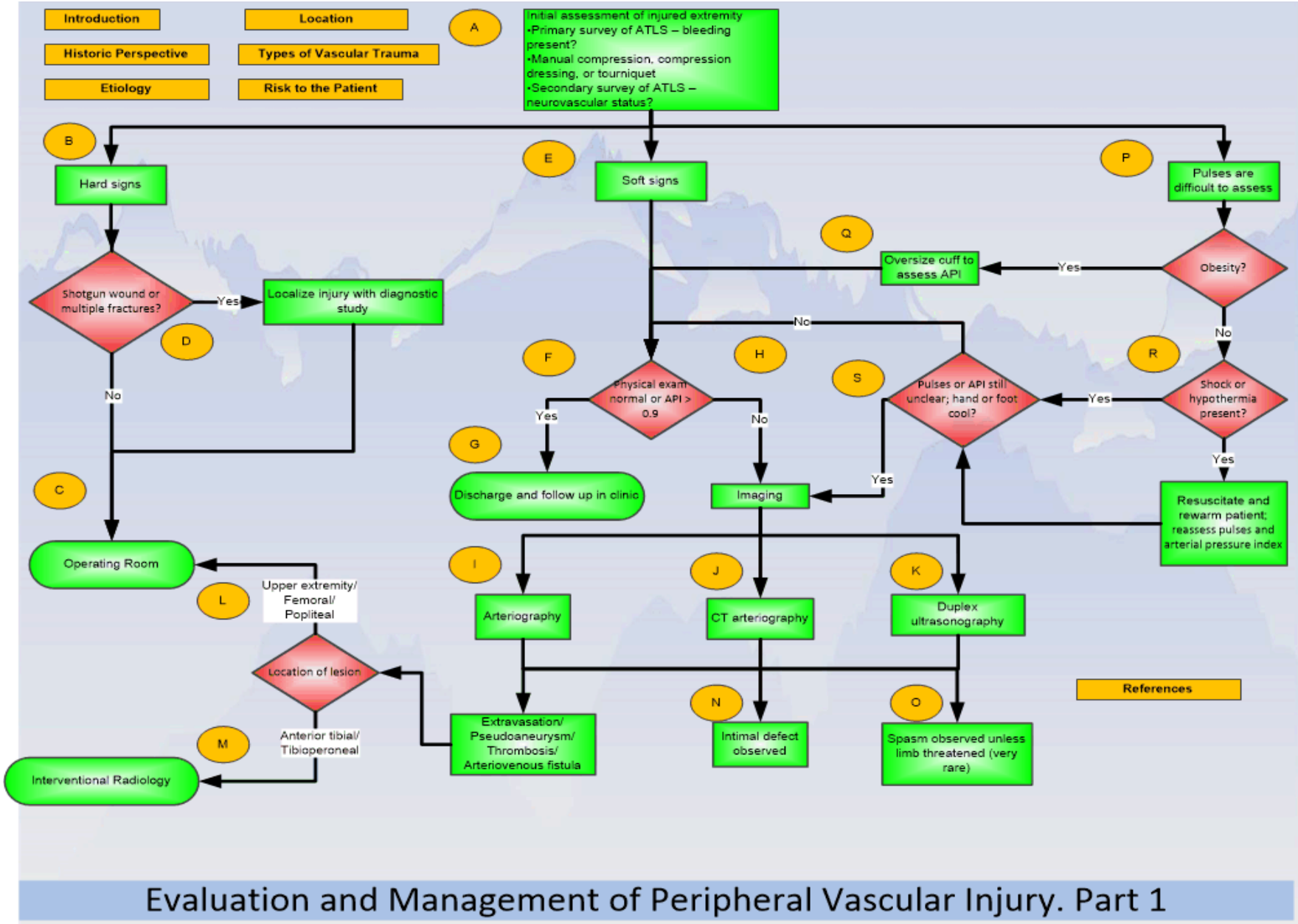
Open fracture grade	Characteristics of Gustilo Grade Open Fracture	Infection Rate	Amputation Rate
Grade I	Clean wound smaller than 1 cm in diameter, simple fracture pattern, no skin crushing.	0-2%	0%
Grade II	A laceration larger than 1 cm but without significant soft tissue crushing, including no flaps, degloving, or contusion. Fracture pattern may be more complex.	2-7%	0%
Grade III	An open segmental fracture or a single fracture with extensive soft tissue injury. Type III injuries are divided into three subtypes:		
Grade III A	Adequate soft tissue coverage of the fracture despite high energy trauma or extensive laceration or skin flaps.	5-10%	2.5%
Grade III B	Inadequate soft tissue coverage with periosteal stripping. Soft tissue reconstruction is necessary.	10-50%	5.6%
Grade III C	Any open fracture that is associated with an arterial injury that requires repair.	25-50%	25%

Grade of Open Fx	Recommended Antibiotic	Alternate if PCN Allergy
I or II	Kefzol 1-2 g load then 1g IV q8h for 48 hrs	Clindamycin 900 mg IV q8h for 48 hrs
III	Ceftriaxone 1g IV then repeat q24h for 48 hrs	Clindamycin 900 mg IV q8h and Aztrenonam 1g IV q8h for 48hrs

References:

- Hauser CJ, Adams AA, Eachempati SR. Prophylactic Antibiotic Use in Open Fractures: An Evidence-Based Guideline. Surgical Infections 2006;7,4. 379-405.
- Luchette FA, Bone LB, Born CT, et al. EAST Practice management guidelines for prophylactic antibiotic use in open fractures. www.east.org/tpg/openfrac.pdf.
- Okike K, Bhattachyaryya T. Trends in the management of open fractures. A critical analysis. J Bone Joint Surg Am 2006;88:2739-2748.
- Holtom PD. Antibiotic prophylaxis: Current recommendations. J Am Acad Orthop Surg 2006;14:S98-100.
- Gustilo RB, Anderson JT. J Bone Joint Surg Am 1976 Jun;58(4):453-8

Peripheral Vascular Injuries

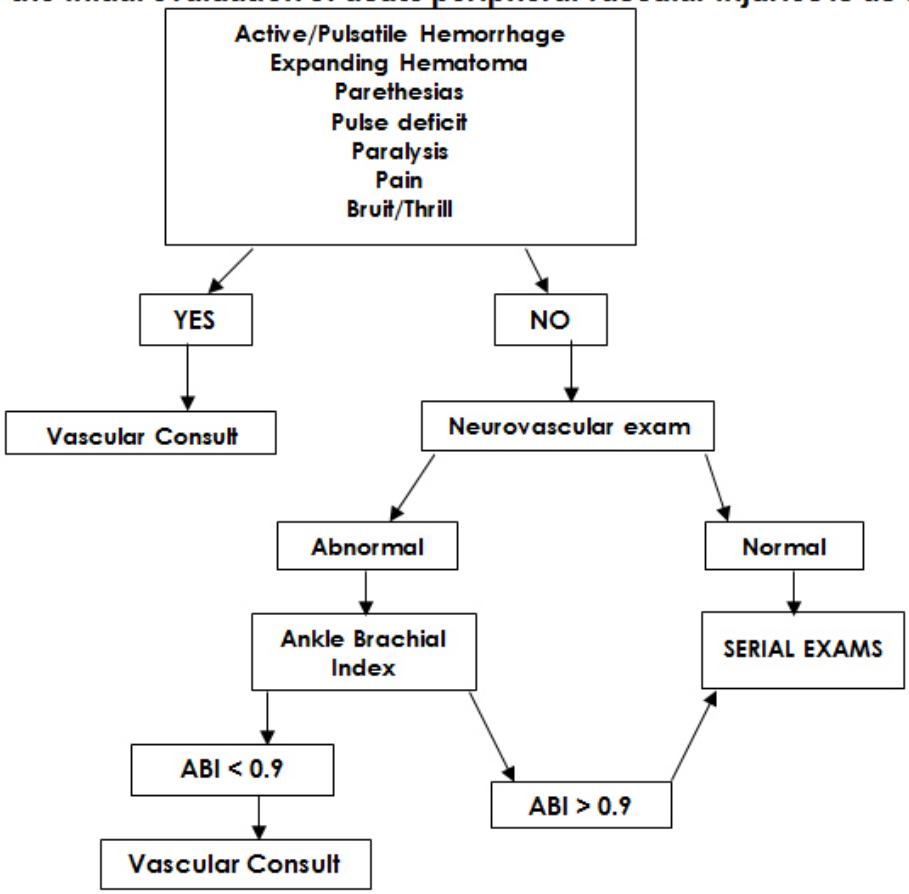


Evaluation and Management of Peripheral Vascular Injury. Part 1

Guidelines for Initial Evaluation of Acute Peripheral Vascular Injuries

A vascular surgery consult will be requested based on the below algorithm. Serial neurovascular exams hourly will be performed in the ED and charged in MiChart. An order for serial neurovascular exams will be required to initiate this process.

The algorithm for the initial evaluation of acute peripheral vascular injuries is as follows:



ABI Procedure:

1. On the lower extremity, a manual BP cuff is placed on the calf. A hand-held Doppler is used to find either the PT or DP pulse. While listening to the Doppler, the cuff is slowly inflated. The "closing" or occlusion pressure (where the Doppler pulse signal disappears) is recorded
2. The identical technique is used to measure the closing pressure in the arm.
3. A comparison of ankle to brachial closing pressures is calculated (ankle/brachial) and recorded. (Normal is 1.0 or greater)

References:

- Lynch K., Johansen K. Can Doppler Pressures Measurement Replace "Exclusion" Arteriography in the Diagnosis of Occult Extremity Arterial Trauma. *Ann Surg*, 1991:214, 737-741.
- Rathlev, N., Peak, D.A., Talavera, F., Levy, D., & Halamka, J. (01/02/07). Peripheral Vascular Injuries. *Peripheral Vascular Injuries*, Retrieved August 15, 2007, from http://www.emedicine.com/emerg/topic770.htm.
- Graves M, & Cole PA. Diagnosis of Peripheral Vascular Injury in Extremity Trauma. *Orthopedics*. 2006:*29*, 35.
- Peck MA, & Rasmussen TE. Management of Blunt Peripheral Arterial Injury. *Perspectives in Vascular Surgery and Endovascular Therapy* 2006:*18*, 159-173.

Mangled Extremity Protocol

I. Policy

Guideline for the Initial Management of Adult patients with Mangled and/or Amputated Extremity/Extremities

II. Purpose

To coordinate the initial management of adult patients with mangled and/or amputated extremity/extremities

III. Policy Statement

A. Mangled Extremity Definition: Any extremity sustaining sufficiently severe injury to a combination of vascular, bony, soft tissue and/or nerve structures that results in subsequent concern for viability of the limb should be considered a mangled extremity and evaluated appropriately to optimize the potential for functional outcome.

B. Service Response for Mangled and/or Amputated Extremity (Attending presence is required):

- Trauma Surgery – Class I Activation
- Plastic Surgery
- Vascular Surgery
- Orthopedic Surgery

It is important to examine the patient for associated injuries that may be of higher priority. Hemostasis must be ensured. Intravenous resuscitation and the need for tetanus prophylaxis must be assessed. In the case of incomplete amputation, splint the extremity in a physiologic position.

The decision whether to attempt limb salvage or amputate a mangled extremity is very challenging, and requires the multidisciplinary input of vascular, plastic, orthopedic, and general trauma surgery. This is particularly true when multiple extremities are involved. This is best accomplished in the operating room, where optimal lighting, magnification, and anesthesia are optimal. Review of pictures of the injury and/or a report of a vascular exam by a resident or fellow is not sufficient for this complex decision-making.

For traumatic extremity amputations, the replantation team is activated, and decision regarding replantation is made with multidisciplinary input of plastic, vascular, orthopedic and general trauma surgery.

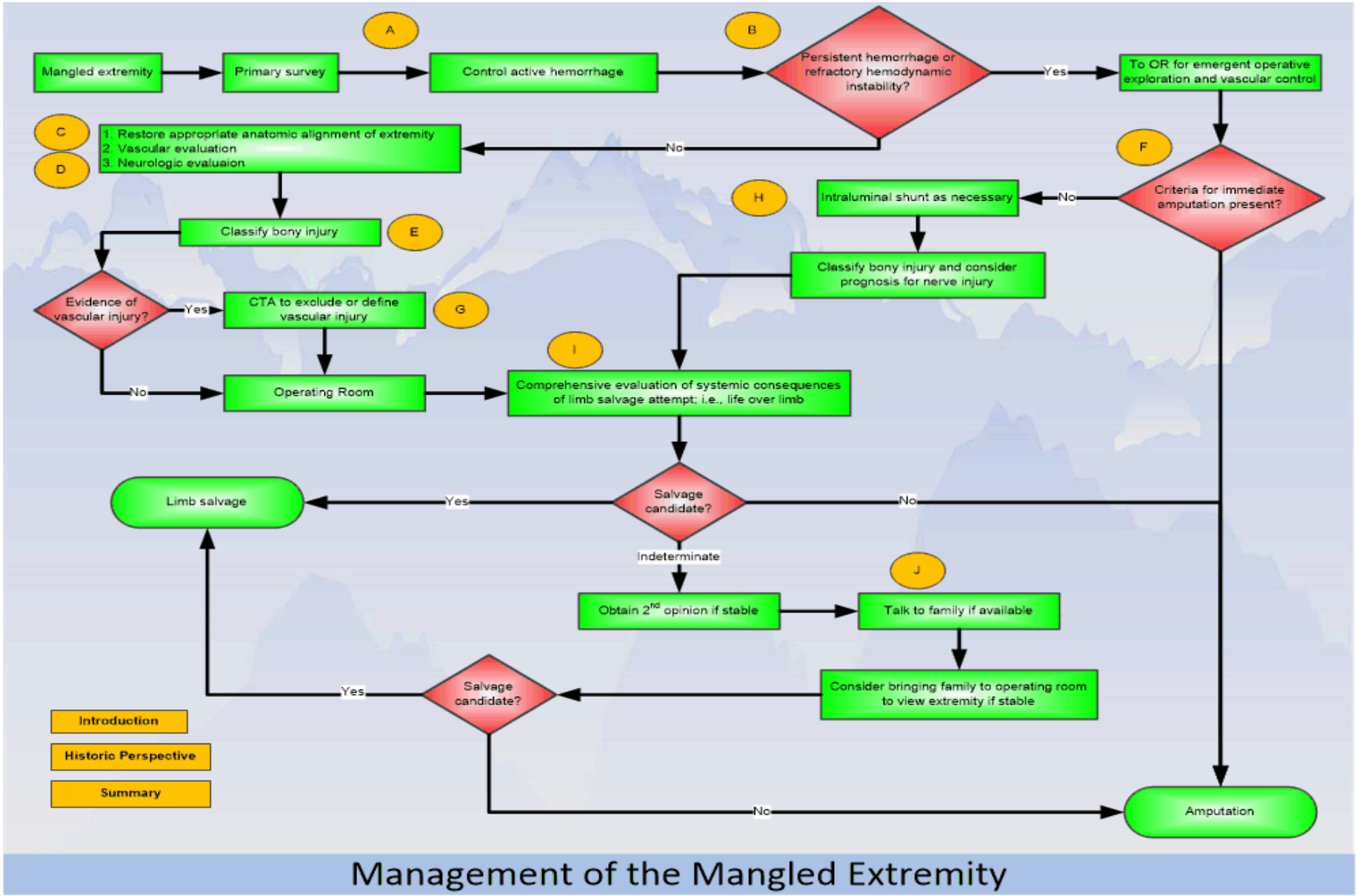
C. Service Admission

If the patient has multiple injuries, other than the mangled/amputated extremity, the patient will be admitted to the ACS/Trauma Burn Service with the other services following as consult services. If the patient requires repair or replantation of the mangled or amputated extremity, and no other traumatic injuries have been identified, the patient will be admitted to the surgical service that performed the operative procedure.

References:

1. Scalea TM, DuBose J, Moore EE, et al. Western Trauma Association Critical Decisions in Trauma: Management of the mangled extremity. J Trauma. 2012;72: 86–93
2. Ly TV, Travison TG, Castillo RC, Bosse MJ, MacKenzie EJ; LEAP Study Group. Ability of lower-extremity injury severity scores to predict functional outcome after limb salvage. J Bone Joint Surg Am. 2008;90:1738–1743.
3. Amputated Body Parts Guideline. University of Michigan Health System Emergency Department. www.med.umich.edu/i/em/policies/Amputated%20Parts.pdf

Mangled Extremity Protocol (cont'd)



Extremity Compartment Syndrome

Diagnosis: The diagnosis of acute compartment syndrome requires a high degree of clinical suspicion, a full understanding of the mechanism of injury, and careful serial physical examination.

The presence of distal pulses and the absence of pallor cannot exclude the diagnosis of compartment syndrome because tissue perfusion in a compartment is dependent on both arterial and capillary perfusion gradients. Paralysis and paresthesias are unreliable because studies have shown that peripheral nerves can conduct impulses after 1 hour or more of total ischemic time. Ischemia of muscles, however, causes pain. Patients are typically said to have “pain out of proportion to that expected for the injury.” Unusual requests for frequent narcotic analgesics can be reflective of ischemic pain. Passive stretching of the ischemic muscle of the compartment in question causes exquisite pain and is the most sensitive clinical finding in a developing compartment syndrome. Clinical palpation of the compartment in question plus comparison with the contralateral limb is useful in evaluating a compartment at risk, and any evidence of increased tension or fullness of the compartment should raise clinical suspicion.

Although pain out of proportion to the injury is a cardinal clinical finding of an impending compartment syndrome, it must be emphasized that this pain will diminish as further ischemia occurs. In addition, the clinical findings may be obscured in patients medicated with narcotics, and therefore narcotic administration should be closely monitored.

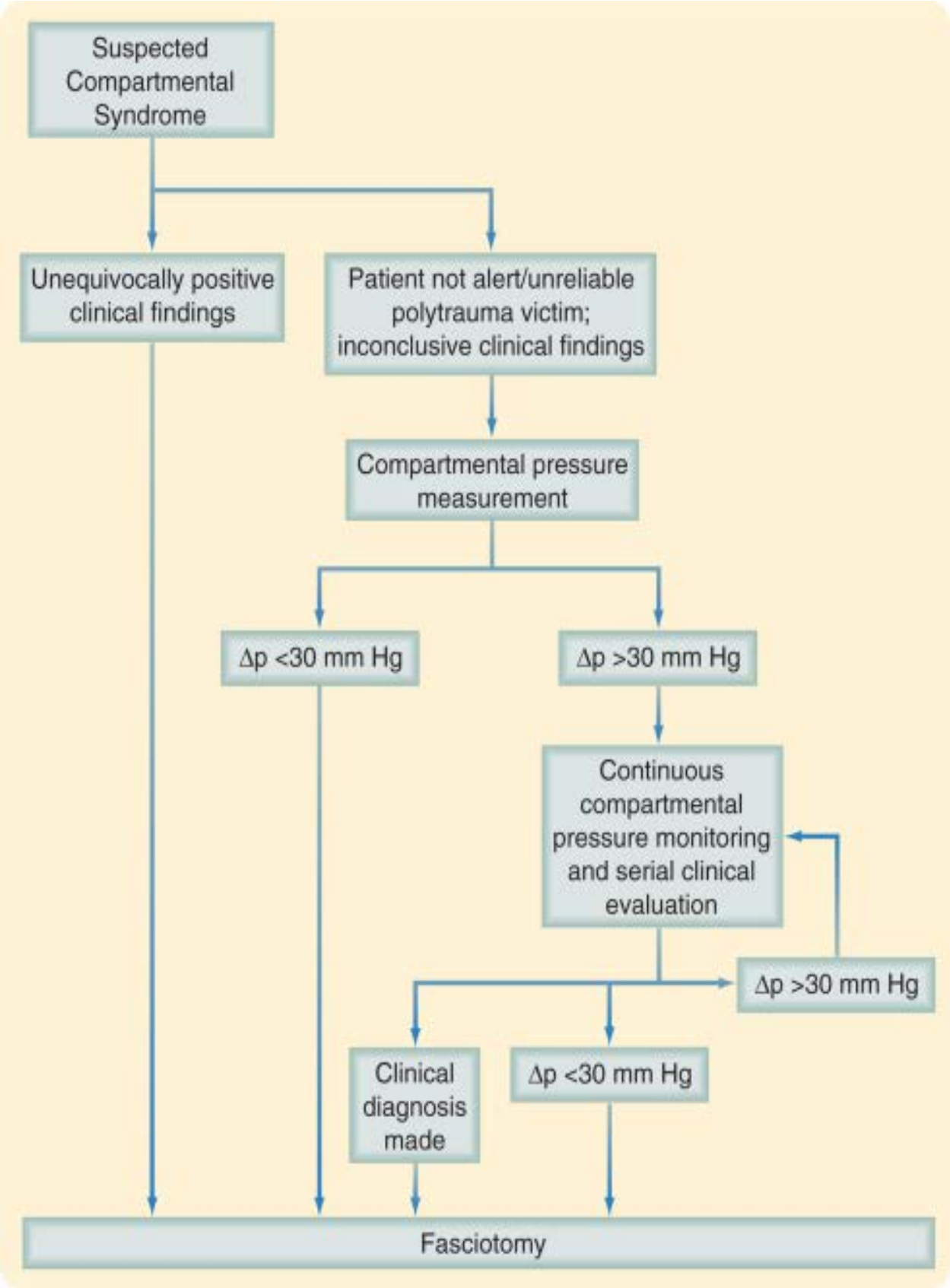
Systemic hypotension, vascular injury, external limb compression, coagulopathy, and deep venous thrombosis predispose trauma patients to the development of compartment syndrome. In an uncooperative, intoxicated, intubated, or neurologically impaired patient, the diagnosis of compartment syndrome may depend more on measurement of compartment pressures.

Tissue Pressure Measurements

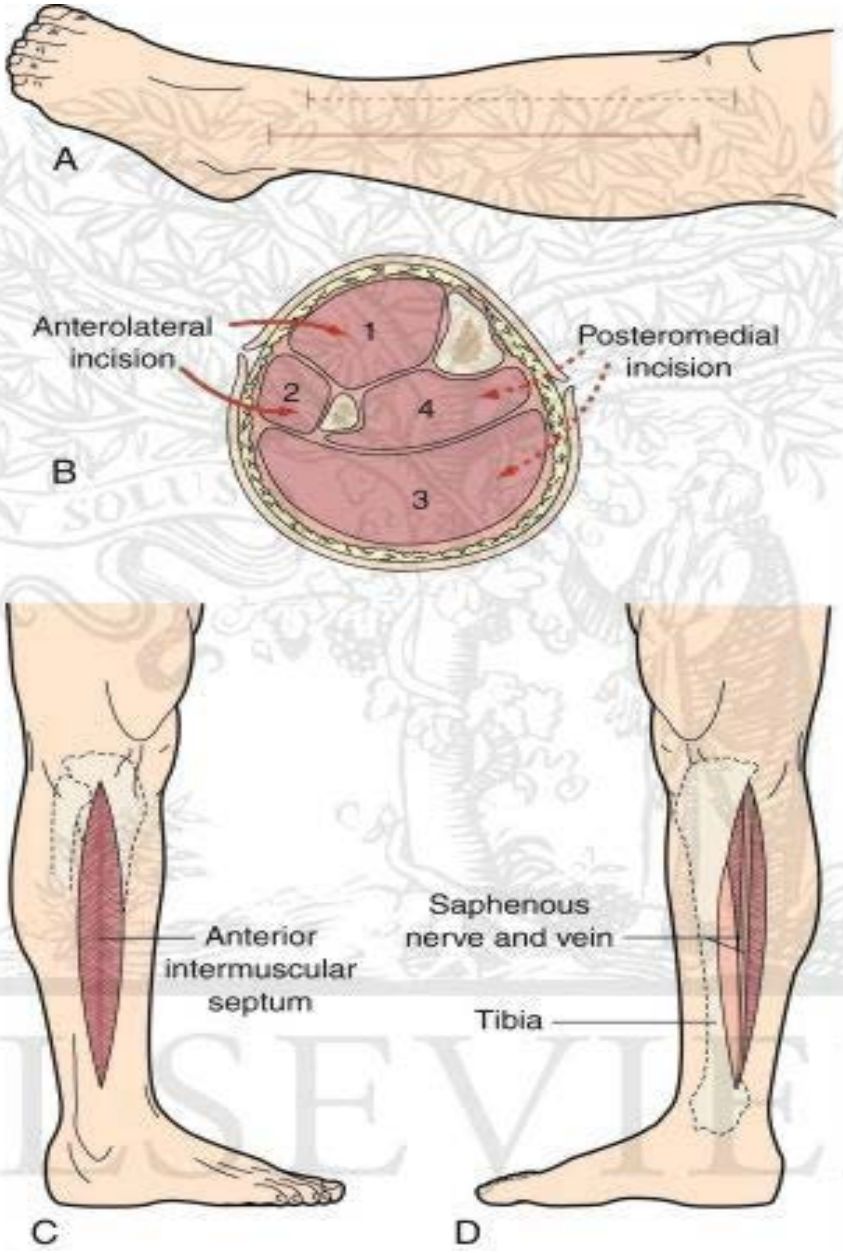
The most common method of measurement is the Stryker Stic device. This hand-held electronic device is easily calibrated and used. Pressures are obtained by inserting the needle into each compartment. It is generally used to make measurements at one point in time and is not an indwelling device.

The highest compartment pressures are usually found at the level of the fracture or within 5 cm of it. Tissue pressure decreased at an increasing distance proximal and distal to the fracture site. It is important to take this into consideration when using the Stryker Stic device to measure compartment pressure in the presence of a long bone fracture.

Compartment Syndrome Algorithm



Lower Extremity Fasciotomy



A.) The double-incision technique for performing fasciotomies of all four compartments of the lower extremity.
B.) Cross section of the lower extremity showing a position of anterolateral and posteromedial incisions that allows access to the anterior and lateral compartments (1 and 2) and the superficial and deep posterior compartments (3 and 4).
C.) A vertical anterior incision is centered midway between the tibia and fibula. The anterior intermuscular septum is identified, and two fasciotomy incisions are made: one anterior and one posterior to the septum.
D.) A vertical posteromedial incision is centered 2 cm to the rear of the tibia. Care is taken to avoid injury to the saphenous vein and nerve.

To Ligate/To Not Ligate

Injury	Best Action	
Infrarenal vena cava	Repair	Can Ligate
Suprarenal vena cava	Repair	Cannot Ligate- at least 50% mortality
Internal jugular vein	Repair	Can ligate unilaterally
Brachiocephalic vein	Repair	Can ligate unilaterally
Subclavian vein and artery	Repair	Can ligate
Superior vena cava	Repair	Can ligate in life-threatening situations
Carotid artery	Repair	Can ligate in life-threatening situations
Mesenteric veins	Ligate	
Portal veins		
Repair	Can ligate if isolated injury, but at least 50% mortality rate secondary to massive fluid sequestration in splanchnic vascular bed and bowel necrosis	
Right renal vein	Repair	Cannot ligate- fewer collateral than left renal vein
Popliteal vein	Repair	Cannot ligate
Femoral vein	Repair	Can ligate
Lobar bile duct	Ligate	
Celiac artery	Ligate	
Left gastric artery	Ligate	
Common/Proper hepatic arteries	Ligate	Especially if proximal to gastroduodenal branch
Right/Left hepatic arteries	Ligate	Especially if portal vein is intact
Splenic artery	Ligate	Short gastric a from left gastroepiploic
Iliac vein-common/ext	Ligate	
Iliac artery-comm/ext	Repair	
Femoral/Popliteal arteries	Repair	
Tibial arteries	Repair	Can ligate but need to ensure patency of other leg arteries
Brachial artery	Repair	Can ligate if distal to profunda brachi branch since the elbow has a rich collateral of blood flow

Initial Maternal and Fetal Assessment

#1 cause of non-obstetric death in pregnancy= trauma with 6-7% maternal mortality, as high as 60-80% fetal mortality. Affects 7% of all pregnancies, 50% occur during 3rd trimester. Etiologies are 50% MVC, 22% falls, 22% assault, 2% other. ***Treat mother 1st and fetus 2nd.***

Consider physiologic changes of pregnancy:

- ↑ blood volume/HR/CO; ↓ SVR/BP (hypervolemia leads to delayed signs of shock)
- ↑ TV/MV; ↓ FRC/PaCO2
- ↑ RBF/GFR; ↓ BUN/Cr
- ↑ GI motility; ↓ GB emptying
- ↑ WBC volume/hypercoaguability; ↓ RBC volume

Concerning obstetric signs:

- vaginal bleeding, ruptured membranes, bulging perineum, contractions, and abnormal fetal heart rate/rhythm

Obstetric complications:

- uterine rupture, placental abruption, fetomaternal hemorrhage/Rh incompatibility, and amniotic fluid embolism

Level 1 Recommendations

- None

Level 2 Recommendations

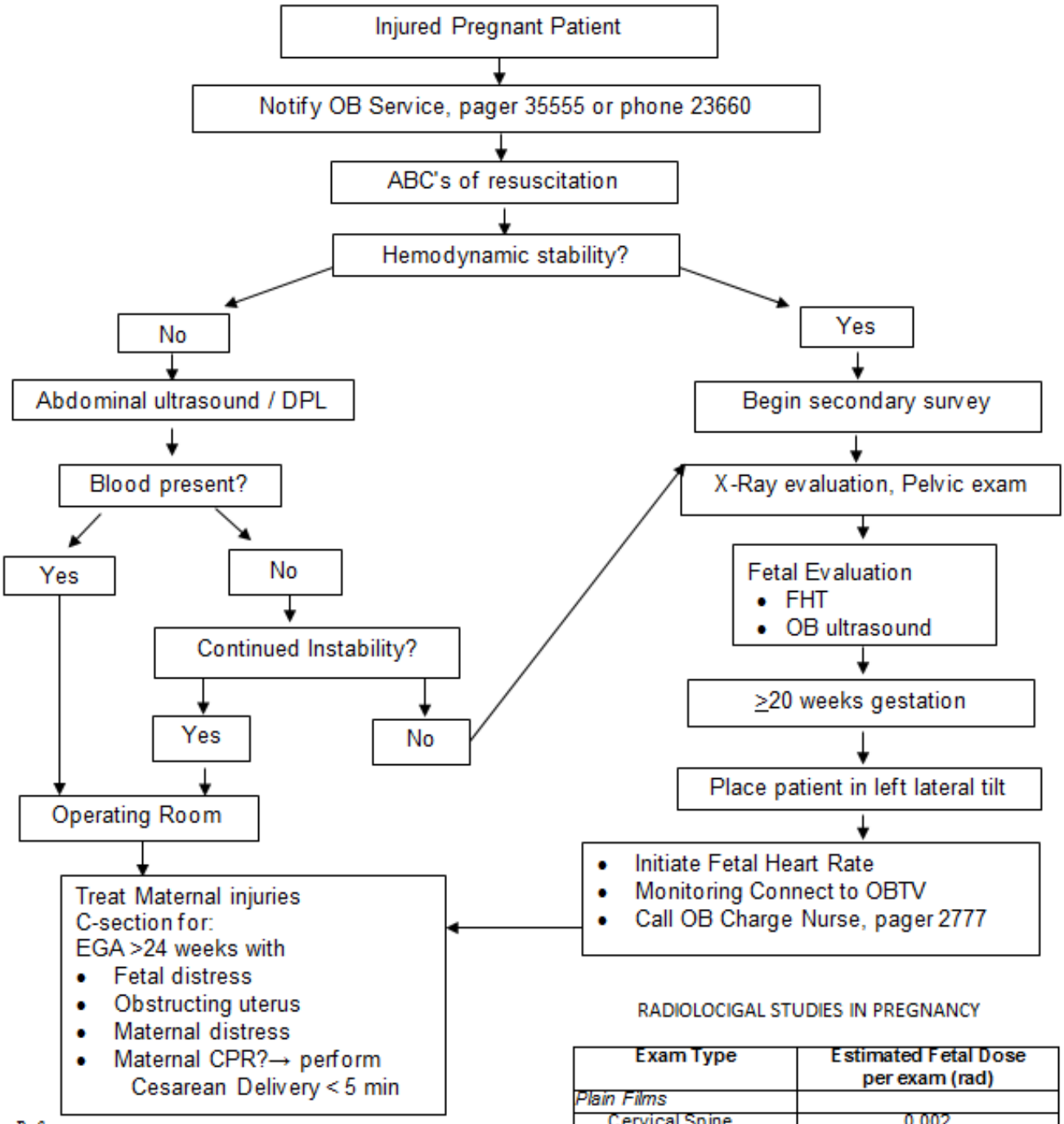
- All pregnant pts > 12 wks gestation (GA) should have Kleihauer-Betke analysis
    - 72 hr window to prevent alloimmunization; Rh immune globulin dose is 300 mcg per 30 ml fetomaternal hemorrhage
- All pregnant pts > 20 wks GA should have cardiotocographic monitoring for ≥ 6 hrs. Continue evaluation/monitoring for uterine contractions, a non-reassuring fetal heart rate pattern, vaginal bleeding, significant uterine tenderness, serious maternal injury, or rupture of the amniotic membranes.

Level 3 Recommendations

- Best initial treatment for fetus is resuscitation of mother and early fetal assessment
- All female pts of childbearing age with significant trauma should have β-HCG and be shielded for all X-rays except pelvic/lumbar imaging.
- Concern for radiation exposure should not prevent medically indicated maternal diagnostic studies, however alternatives should be considered when possible
- Exposure <5 rad has not been associated with an increase in fetal anomalies or pregnancy loss and is therefore deemed safe at any gestational age.
- US/MRI is not associated with known adverse fetal effects, however MRI not recommended in 1st trimester due to limited experience
- Consult radiology to calculate estimated fetal dose when multiple X-rays performed
- Perimortem cesarean section should be considered in any moribund pregnant pt ≥ 24 wks GA, should ideally start within 4 min of maternal arrest, must occur within 20 min of maternal death
- Tilt left side down 15° to prevent supine hypotension syndrome
- Consult OB for all trauma in pregnancy

J Trauma. 2010;69: 211–214.

Algorithm for Initial Maternal and Fetal Assessment



References:
Feliciano DV, Mattox KL, Moore EE. Chapter 34 Reproductive System Trauma. *Trauma Manual*. 4th Edition; 303-310; Barraco RD, et al. Practice Management

Guidelines for the Diagnosis and Management of Injury in the Pregnant Patient: The EAST Practice Management Guidelines Work Group, J Trauma. 2010;69: 211–214.

RADIOLOCIGAL STUDIES IN PREGNANCY

Exam Type	Estimated Fetal Dose per exam (rad)
Plain Films	
Cervical Spine	0.002
Chest (two view)	0.00007
Pelvis	0.040
Thoracic Spine	0.009
Lumbosacral Spine	0.359
CT Scans	
Head	<0.050
Chest	<0.100
Abdomen	2.60

Tertiary Survey

UNIVERSITY OF MICHIGAN HEALTH SYSTEMS TRAUMA TERTIARY SURVEY

To be completed within 24 hours of admission

If the patient is unconscious, intoxicated, or sedated, the tertiary survey will be repeated once the patient regains consciousness

Substance Abuse Screening: □**Negative** (No Further Intervention Needed)
□**Positive** - Social Work Substance Abuse Consult Ordered: □**YES** □**NO**

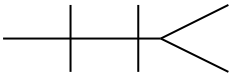
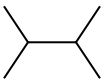
Blood Acohol Level: ____ **UTOX performed:** □**YES** □**NO**

Subjective:_____

VS: T_____HR:_____RR:_____BP:_____O2Sat:_____

GENERAL	**YES**	**NO**
Alert	□	□
Oriented	□	□
GCS 15	□	□
HEENT		
Pain/Tenderness	□	□
Lacerations/Abrasions	□	□
Swelling/Ecchymosis	□	□
Numbness/Tingling	□	□
Malocclusion	□	□
Abnormal visual acuity	□	□
Contact lenses / Glasses	□	□
Dentures	□	□
Abnormal hearing	□	□
NECK		
Cleared C-Spine	□	□
Pain/Tenderness	□	□
CHEST		
Asymmetrical	□	□
Pain/Tenderness	□	□
Lacerations/Abrasions	□	□
Swelling/Ecchymosis	□	□
Air/Bony Crepitus	□	□
Abnormal Heart sound	□	□
Arrhythmia	□	□
Unclear Breath sounds	□	□
Chest Tubes	□	□
OTHER:		

ABDOMEN	**YES**	**NO**
Lacerations/Abrasions	□	□
Swelling/Ecchymosis	□	□
Absent Bowel sounds	□	□
Pain/Tenderness	□	□
Rigidity/Guarding	□	□
Distended	□	□
Unstable Pelvis	□	□
Drains	□	□
BACK		
Lacerations/Abrasions	□	□
Swelling/Ecchymosis	□	□
Pain/Tenderness	□	□
Step-offs	□	□
EXTREMITIES (UPPER)		
Deformity	□	□
Lacerations/Abrasions	□	□
Swelling/Ecchymosis	□	□
Pain/Tenderness	□	□
Absent Pulses	□	□
Extremity involved	□Rt	□Lt
EXTREMITIES (LOWER)		
Deformity	□	□
Lacerations/Abrasions	□	□
Swelling/Ecchymosis	□	□
Pain/Tenderness	□	□
Pulses	□	□
Extremity involved	□Rt	□Lt

Labs:  **Ca** **Mg** **PO_4**  **PT** **INR** **PTT** **Other pertinent labs:**

Operative, interventional Procedures: _____
_____

Radiology: ("D" if study done, "F": final report, "P" if study pending)
CT scan: **Head:** ____ **C-Spine:** ____ **Face:** ____ **Chest:** ____ **A/P:** ____ **other:**

X-ray: Chest: ____ **Pelvis:** ____ **other:**

Tertiary Survey (cont'd)

Identified Injuries: (list all injuries and OR/IR Findings)

Injury type	Consultant	Plan for specific injury

IS THE WORK-UP FINAL? **YES: ____** **NO: ____**

Studies to Follow: _____

_____

New findings / Unresolved:_____

_____

Post survey add-on Plan: _____

_____

_____ _____ _____ _____

Signature / Title **Pager** **Date** **Time**

Adult ICU Overflow Guidelines

These are guidelines endorsed by Critical Care Committee for placing patients when the home unit is full. Please consult the UH Patient flow coordinator on Nextel phone 216-9049 or pager 33159 if unable to obtain a bed on the first overflow unit.

Service	First Use	1st Overflow	2nd Overflow	3rd Overflow
General Surgery	SICU	NICU	TBICU	CCMU/CCU/CVC
Neurosurgery	NICU	SICU	TBICU	CCMU/CCU/CVC
Thoracic/Cardiac Surgery	CVC-ICU	SICU	NICU	CCU/CCMU
Vascular Surgery	CVC-ICU	SICU	NICU	CCU/CCMU
Acute Care Surgery, Trauma/Burn	TBICU	SICU	NICU	CCMU/CCU
Other Surgical Specialties	SICU	NICU	TBICU	CCU/CCMU/CVC
Otolaryngology	NICU	SICU	TBICU	CCU/CCMUCVC
Critical Care Medicine SVC	CCMU	SICU	CCU	NICU/TBICU
Cardiology	CCU	CCMU	NICU/SICU	TBICU
Neurology	NICU	CCMU/CCU	SICU	TBICU/CVC
Interventional Neuroradiology (Intracranial/Skull Base)	NICU	SICU	- - -	- - -
Interventional Neuroradiology (Extracranial)	SICU	NICU	- - -	- - -

NOTE: Patients with overflow to SICU will be managed by the Surgical Critical Care (SCC) service (except CCMU, CICU and Neuro patients). Any ICU patient accommodated in an off-service unit is initially the responsibility of the primary ICU service. It is recommended that patient care responsibility be transferred to the receiving ICU team of that unit if this has been agreed upon by both ICU teams. Every effort will be made to keep patients within their primary ICUs.
http://www.med.umich.edu/i/policies/umh/Adult%20ICU%20Overflow%20GuidelinesApril2009.pdf
http://www.med.umich.edu/i/policies/umh/02-01-002.html

TBICU Rounding Presentation

Post injury Day # or Postop Day #
Catalog of Injuries if trauma patient
Operative Procedures

Events of last 24 hours
T-max, T-current, Vital signs (HR, RR, BP)

System-based Plan & Exam
Neurologic/Psych
HEENT
Cardiovascular
Pulmonary
Gastrointestinal/Nutrition
GU/FEN
Hematology
Infectious Disease
Endocrine
Musculoskeletal/Mobility
Wounds/Incisions/ Skin Issues (Decubitus)
Prophylaxis (GI/VTE/VAP)
Lines
Disposition
Code Status
Green Sheets
Additional Issues from Team

Order Sets Available

MAWS protocol
http://ummcpharmweb.med.umich.edu/i/portals/0/documentlibrary/DI/Medication%20Use%20Guidelines/overdose/MichiganAlcoholWithdrawalGuidelines.pdf
MiChart ICU Order Sets
TBICU Admission
ICU End of Life Orders
Trauma Burn Fluid Resuscitation
SICU HAP/VAP/Sepsis/Fever
Medications in NS (Consider for head trauma)
ICU Neuromuscular Blocking Agents
Trauma Burn Serial Procedural Sedation (Includes Elderly, Adult, Pediatric order sets)
Trauma Burn Wound Care
Adult Medication Infusions
Adult ICU Electrolyte Guideline (Consider for ICU or moderate care status patients without acute or chronic renal failure with creatinine < 2.0 or when creatinine not precipitously rising)

Restraints - Non-violent and Violent

- The need for Non-violent and violent restraints should continuously be assessed by physicians/providers and nurses.
    - Non-violent restraint orders and restraint assessment note must be renewed every 24 hours.
    - Violent restraint orders and restraint assessment note must be renewed every 4 hours.
- A physician/provider order and restraint assessment note are required for all restraint use.
- Restraint orders must be placed in MiChart within **30 minutes** of placing a patient in restraints. A verbal order may be given to the nurse if the MD/provider is unable to place the order within the prescribed time. Restraints cannot be applied without a physician/provider order except in an emergency when an order is obtained immediately following application. If the patient has been removed from restraints and again exhibits behavior requiring restraints, this is a NEW episode and a NEW order and note are required

Violent Restraint Policy: http://www.med.umich.edu/i/policies/umh/62-01-002.html
Non-Violent Restraint Policy: http://www.med.umich.edu/i/policies/umh/62-01-001.html

TBICU AM Labs/CXR/CVL Change Guidelines

Labs for ICU/moderate care status only:

- VRE & MRSA swab on admission, Thursdays, transfer to another unit, and discharge-for TBICU patients (BACU patients do not receive VRE swabs)
    - Patients admitted from OSH or care facilities are placed in contact precautions until MRSA and VRE swab and other culture results are final
    - Note- MRSA swabs are only completed for screening in the TBICU, all other ICUs only isolate for MRSA when there is an open draining wound with MRSA
- ABG daily when on vent & PRN with status change
- CBCP, BMP, Magnesium, Phosphorus, ICal daily for bleeding, coagulopathy, postoperative status, Platelets < 80K. If none of these clinical indications, draw labs every Mon/Wed/Fri
- CMP, Prealbumin, PT, PTT, Triglycerides - every Monday
- *All labs above should be drawn at admission*

Chest X-rays

- Admission if one was not done in ER.
- After intubation
- After central line placement/changes (consider delaying routine AM until after line change)
- After performing tracheostomy or bronchoscopy
- Daily if chest tube present
- Consider daily if ETT present. Use clinical judgement if patient stable on vent with no clinical changes or indication.
- Order anytime there is a question of tube placement, sudden unexplained respiratory decompensation, part of a fever work up

Central Line Change Protocol

- Track the age of any central line placed.
- If no signs of line infection or sepsis (normal WBC, no fever, skin site clean) keep the line as needed, but remove as soon as line not needed.
- Protective equipment and precautions for line placement/changes include a hat, mask, sterile gown and gloves with a wide sterile field. Wash site and hands with chlorhexidine.
- The central line insertion checklist should be used and completed on all central line insertions.
- Replace all lines placed in the field.
- Use chlorhexidine to prep skin for all line placements
- If line change is deemed necessary as part of a fever work-up, send two sets of peripheral blood cultures (label each set as to the source) and send the tip for quantitative culture. Do not send cultures from a line unless there is high clinical suspicion of a line infection.

Pediatric References and Resources

PICU Charge pager# 9473 **PICU Fellow on-call pager** # 6893

PICU Unit Phone # 32401 **Peds Anesthesia Airway pager** # 1534

Available in TBICU:

- General Care (red) crash cart that contains pediatric sized equipment

- Broselow Tape and BAGS (weight based tape with medications and appropriate sized equipment) available on the red crash cart and in BICU break room.

Bags kept in supply room, and should be kept at patient bedside.

Pediatric References and Resources

PICU Charge pager# 9473 **PICU Fellow on-call pager** # 6893

PICU Unit Phone # 32401 **Peds Anesthesia Airway pager** # 1534

- CPR Cards printed and kept at bedside (weight based code meds, and normal range vital signs)
- Pediatric Airway Emergency Box (kept in the tub room)

- Infant and Adult Trach Trays in the Supply Room

Geriatric Patient Protocol

All trauma patients ≥ 65 years old who are admitted to the ACS Trauma/Burn Service will have a Geriatrics consult placed on admission. The Geriatrics physician will perform and complete a comprehensive geriatric assessment, VES-13 Survey, and a medication consolidation.

On Admission

- ☐ Trauma team to order Geriatrics Inpatient Consult on admission. Discharge will not be delayed for consult.
- ☐ Trauma team to identify Advance Directives, preferences/decision makers
- ☐ Trauma team to contact social work, practice management, and discharge planning to evaluate resources needed for caregiving
- ☐ Trauma/Burn nursing staff to perform delirium evaluation and prevention – sleep protocol, delirium screen (CAM-ICU) & document in Centricity
- ☐ Trauma team to initiate the Early Mobility Protocol

During Admission

- ☐ Communication between Geriatrics and Trauma team
- ☐ Geriatrics team to determine the need to continue following the patient transferred from the Trauma/Burn Service to other services
- ☐ Daily CAM-ICU screen will be done by Trauma/Burn nursing staff and reviewed by geriatric team. If very vulnerable on VES-13 score is 7 or greater with severe injury, then consider poor prognosis
- ☐ Trauma team to consult PT and OT – evaluate caregiving needs, fall risk, home safety, consider driving rehab

On Discharge Planning

- ☐ Trauma team, in collaboration with Geriatrics team to reevaluate the patient's ability to drive and consider recommending Older Driver Evaluation
- ☐ Trauma team, in collaboration with Geriatrics team to consider Geriatric Transitional Care follow-up appointment to provide assistance with meds and reassess caregiving needs as appropriate
- ☐ Trauma team and Geriatrics team to review PT/OT documentation of pre-discharge functional status prior to patient discharge
- ☐ Trauma team to perform medication reconciliation and nursing will provide clear list of medications to the patient/next of kin in addition to D/C summary, as well as Older Driver Evaluation information, when recommended
- ☐ Trauma team physician will plan for PCP follow up – send letter to PCP to include discharge summary, medication reconciliation, recommendations for Older Driver Evaluation, and any other pertinent documentation from hospital admission. Consider direct contact with PCP office prior to patient discharge to if appropriate

In Trauma Clinic Post-Discharge

- ☐ If the patient does not have a PCP or Functional impairment, Inadequate care giving/social support, mobility impairment, falls, unintentional weight loss/failure to thrive, cognitive impairment, urinary incontinence, poly pharmacy or multiple chronic conditions, sensory impairment, fatigue, end of life counseling, or issues with pain management are noted, refer patient to Geriatrics Clinic for further assessment and possible Neuropsychiatric evaluation. If a patient is noted to have severe psychiatric disease without the above symptoms, refer the patient to psychiatry. Patients with substance abuse issues without the above symptoms, refer to psychiatry's substance abuse program
- ☐ Follow-up on PT/OT discharge recommendations regarding falls/fracture evaluation & treatment plan, resumption of self-care, baseline functional status and transportation. Consider additional PT/OT referrals as appropriate

3, 6, and 12 months Post-discharge (telephone calls, from Geriatrics)

- ☐ Repeat Vulnerable Elders Survey (VES-13), evaluate living situation and caregiving needs, and review whether patient is self-managing medications and transportation (if the patient is not, identify who is)

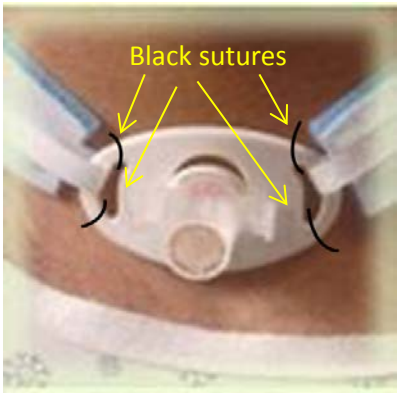
Tracheostomy Care in the TBICU (Uncomplicated/Routine)

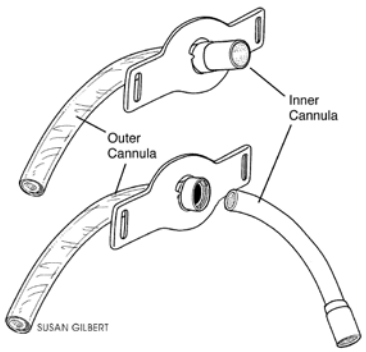
Percutaneous Tracheostomy-"Shiley Cuffed"

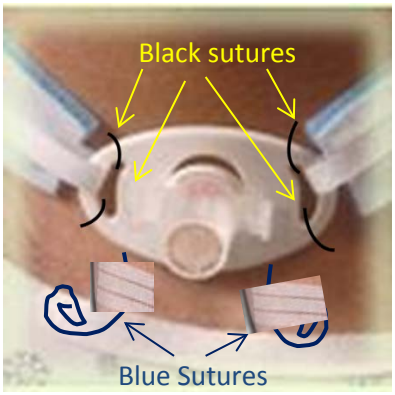
1. Tracheostomy Tube Features Outer and Inner Cannula.
2. Black sutures are often placed on the plastic phalange to prevent accidental dislodgement in addition to the Trach "ties"/ Velcro
3. RN to remove black sutures on POD#7 unless otherwise specified by the TBICU team or operating physician
4. Check the skin daily. If ulceration, cellulitis, or significant drainage is present, discuss with physician

Open Tracheostomy-"Shiley Cuffed"

1. Tracheostomy Tube Features Outer and Inner Cannula.
2. Black sutures are often placed on the plastic phalange to prevent accidental dislodgement in addition to the Trach "ties"/ Velcro
3. RN to remove black sutures on POD#7 unless otherwise specified by the TBICU team or operating physician
4. Blue sutures are often placed on the TRACHEAL RINGS to facilitate replacement of the tracheostomy in the event of accidental dislodgement.
5. If the Blue sutures have not been removed by Post Op Day 14 , review the Operative/Procedure Note for instructions. If no instructions given, discuss with physician.
6. Check the skin daily, if ulceration, cellulitis, or significant drainage Is present, discuss with physician.







Difficult Airway Policy

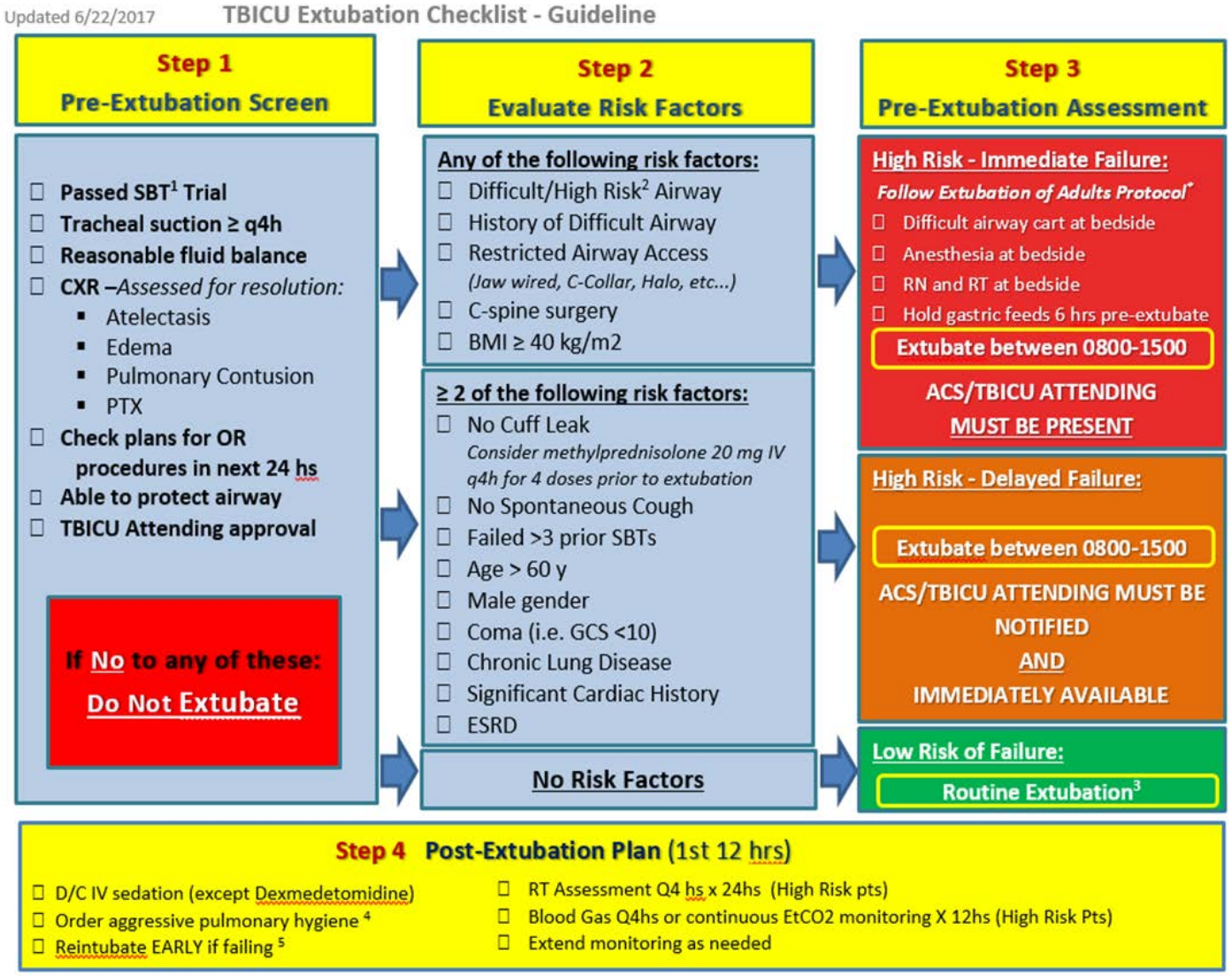
MD/providers will assess all patients for a "Difficult Airway" based on specific risk factors. If a "Difficult Airway" is identified:

All patients identified as difficult airway patients will have:

- Airway evaluation note in MiChart describing why patient is a difficult airway (written by Anesthesia)
- Admitting providers will place a Difficult Airway order set in MiChart
- Hang airway sign above bed and outside patient's room
  - http://www.med.umich.edu/i/nursing-documentation/docs/difficultAirwaySign.pdf
- Contact numbers for primary service posted in room
- Interventions (completed by Nursing)
- Nursing Handoffs
- Difficult airway to be discussed at all ICU to OR handoffs with anesthesia

Evaluation for extubation:

http://www.med.umich.edu/i/policies/umh/62-01-014.html



UMHHC Policy 62-01-014 Extubation of Adults*

Updated 6/22/2017

TBICU Extubation Checklist - Guideline

UMHHC Policy 62-01-014 Extubation of Adults*
http://www.med.umich.edu/i/policies/umh/62-01-014.html

1.Spontaneous Breathing Trial (SBT) Parameters: *(To be routinely performed between 0800 and noon)*

- Vent Settings Low (FIO ≤ 40%, PEEP ≤ 8)
- ABG adequate PaO2 and PaCO2
- Negative Inspiratory Force (NIF) <-30 cm H2O
- Tidal Volume (VT) > 5 cc/kg
- Vital Capacity (Vcap) >10 ml/kg
- Respiratory Rate < 30
- Frequency Tidal Volume Index or Rapid Shallow Breathing Index (RSBI) < 104

2.Difficult/High Risk Airway:

- **Difficult or impossible face mask ventilation**
- **Difficult laryngoscopy**
- **Difficult or failed tracheal intubation**
- **Known/History of Difficult Airway**
    - Oral, pharyngeal, laryngeal, or tracheal abnormality (e.g. subglottic stenosis, tracheomalacia, peritonsillar deep space neck and retropharyngeal abscess, craniofacial abnormalities, Down's Syndrome, macroglossia, teratomas, lymphangiomas)
    - Oral, pharyngeal, laryngeal, or tracheal surgery requiring special airway management (wired jaw)
    - Limited neck movement (cervical fixation, immobilization, **halo, cervical collar,** or physically limited)
    - Small mouth opening (less than 2 fingerbreadths)
    - Inability to see uvula with the mouth open, tongue fully protruded
    - Steven's Johnsons Syndrome (SJS) or TENS

3. Routine Extubation:

- Notify TBICU attending by page **prior** to extubation
- Perform extubation between 0800 and 1500, unless exempted by attending

4. Aggressive Pulmonary Hygiene Modalities

- Incentive Spirometry (IS)
- Cough Assist
- Heated High Flow Nasal Cannula (HHFNC)
- HFCWC Airway Clearance (Vest)
- Intermittent Positive Pressure Breathing (IPPB)
- Non-Invasive Positive Pressure Ventilation (NiPPV)

5. Indicators a patient is Failing Extubation

- Respiratory Distress
- Dyspnea
- Increased work of breathing (eg "belly breathing")
- Increased or decreased Respiratory Rate
- Somnolence
- Hypercapnea (CO2 retention)
- Hypoxia
- Increased suction requirements
- Inability to protect airway
- Feeling of inability to breath or "impending doom"

Approved by: Dr. Jill R. Cherry-Bukowiec MD, MS, PNS, FACS, FCCM Medical Director TBICU and TBICU QA committee 6/22/2017

Bring Equipment to Bedside:

☐ Airway Cart

- Drawer #1
  - 18 Ga blunt needles
  - 3cc syringes
  - 10 cc syringes
  - 20 cc syringes
  - 100 ML bag 0.9% NS
  - Lubricant
  - Drug labels
  - Difficult airway labels
  - Yellow plastic lock
  - Drug box
    - Etomidate
    - 2% Lidocaine
    - Vecuronium
    - Succinylcholine
    - Racemic epinephrine
    - Phenylephrine (pre-filled syringes)
    - 4% neostigmine
    - Atropine
- Drawer #2
  - Oral airways of various sizes
  - Nasopharyngeal airways of various sizes
  - Jackson Ress 3 liter circuit
  - Non-rebreather facemask
  - Nebulizer circuit
- Drawer #3
  - Laryngoscope Handles
  - Laryngoscope blades of various sizes both Miller and Macintosh
  - Tracheal introducer
  - Magill forceps
  - Scissors
  - Hemostats
  - Pink and clear tape
  - ET CO2 detector
- Drawer #4
  - Endotracheal tubes of various sizes
  - Laryngeal Masks of various sizes
- Drawer #5
  - Emergency cricothyrotomy catheter set
  - Ambu bag

Extubation:

☐ See above for TBICU Extubation Checklist for guidelines on appropriate timing of extubation
☐ Coordinate time
☐ Primary or ICU Attending **and** Anesthesiology (Airway or ICU) team MUST be present at the bedside for extubation
☐ Preoxygenation with 100% Oxygen
☐ Suction and bag-mask ready
☐ Consider use of airway guide

Daily Spontaneous Awakening Trial (SAT)

A. Nursing, respiratory therapy, and physicians will collaborate daily for the application and evaluation of the sedation holiday.
B. Daily wake-up applies to all patients *unless determined to be clinically inappropriate by the collaborative team.*
C. Daily interruption of sedation for neurosurgery patients is to be coordinated with the neurosurgery team.
D. Timing of the daily wake-up will be determined as appropriate for shift resources, Patients most likely to meet weaning parameters for expected extubation should be prioritized to the sedation holiday at 0800.

Exclusion Criteria

A. Active seizures
B. Benzodiazepine use for ETOH withdrawal
C. Escalating sedative dose due to ongoing agitation
D. Patient in cooling/warming phase of Therapeutic Hypothermia
E. Evidence of acute myocardial infarction
F. Increased ICP
G. Unstable airway
H. Use of sedation for comfort/palliative care
I. Use of paralytic medications

Process for Daily Wake-Up

A. Turn sedation off
B. Continually monitor for Signs Indicating Need for Re-Sedation
    - Cardiac arrhythmia
    - Sustained anxiety or agitation for 5 minutes or more
    - Sustained respiratory rate >35 breaths per minute
    - SpO_2 <88%
    - Sustained tachycardia
    - Bradycardia
    - Increased use of accessory muscles
    - Inability to ventilate, due to ventilator dysynchrony
C. Assess mental status
    - Use Richmond Agitation Sedation Scale (RASS) [*pg. 244*] to assess level of consciousness and psychomotor activity
    - Assess patient's ability to follow commands at beginning of SAT and throughout
D. Act on patient's response to SAT
    - If your RASS is a -2 or higher, a daily delirium screening should take place via CAM-ICU [*pg. 243*]
    - Coordinate a spontaneous breathing trial with your Respiratory Therapist, if patient meets inclusion criteria (see Spontaneous Breathing Trial Protocol) [*pg. 111*]
    - SAT Failed (sustained agitation or sign of physiologic instability)
        - Consider if pain is the cause for sustained agitation
        - Consider if intermittent dosing would meet sedation needs

Daily SAT (cont'd)

E. Recommendations following SAT
- The multidisciplinary team should have a discussion and determine the RASS goal for the patient within the next 24 hours if the patient needs to be re-sedated
- Consider achieving this goal by using intermittent medications first
- During episodes of pain and/or agitation, bolus dosing should be utilized before titrating up on a continuous sedative infusion
- Consider use of antipsychotic medication if CAM-ICU screen positive for delirium
- Pain management is to include a scheduled oral opioid (oxycodone) dose post-extubation if the patient has been on a continuous opioid infusion and is able to tolerate oral medications
- If no contraindications, consider scheduled dosing of a non-opioid analgesic (acetaminophen or ibuprofen.) Consider contraindications such as a spine or major pelvic injury or GI bleeding

Difficult To Wean Protocol

Policy and Procedure:

I. Indications for the protocol
- A. The patient must have the following indications for weaning:
  1. $SpO_2 \geq 90\%$
  2. $FIO_2 \leq 0.40$
  3. PEEP $\leq$ 5 cm H_2O
  4. Compliance >30 mL/cm H_2O
  5. NIF (Negative Inspiratory Force) $\leq$ -20 cm H_2O, and
- B. Patient failed two current and consecutive flow-by trials or spontaneous breathing parameter attempts.

II. Weaning Steps:
- A. Once the above criteria are met, the patient can be placed on pressure support at the level of the plateau pressure, IMV of 2 with a VT of 6-8 mL/kg.
- B. Reassess the patient on these settings. If the SpO_2 is >90% and the respiratory rate is <30, then decrease the pressure support by 2 cm H_2O every 3 hours. When the pressure support needed to sustain these parameters is ≥ 15the patient will be placed on an IMV rate of 8. If the SpO_2 decreases <90% or the respiratory rate increases >30, increase the pressure support to the previous setting and maintain at this level (baseline). Respiratory rates > 30 will be accepted in cases of centrally driven tachypnea. The Respiratory Care Practitioner will make this decision with the approval of the ICU Attending Physician. Centrally driven tachypnea is defined by a $PaCO_2$ < 35 and pH > 7.45.
- C. Once baseline level is obtained, decrease the pressure support level daily, by 2 cm H_2O, unless the patient's condition abruptly changes.
- D. When the patient is stable on a pressure support of 5 cm H_2O, initiate a flow-by trial (refer to policy "TBE Standing Ventilator Orders," Chapter 5, Section 3.1) Weaning parameters will be obtained each morning and a flow by will be attempted for patients on > 5 cm H_2O of pressure support.

Spontaneous Breathing Trial (SBT) Protocol

http://i.surgery.med.umich.edu/acs/files/SICU%20PECC%20SBT%20flow,%207-20-07_1_0.pdf

BEST (Breathing Spontaneous Trial) Protocol

To occur daily on all mechanically ventilated SICU patients

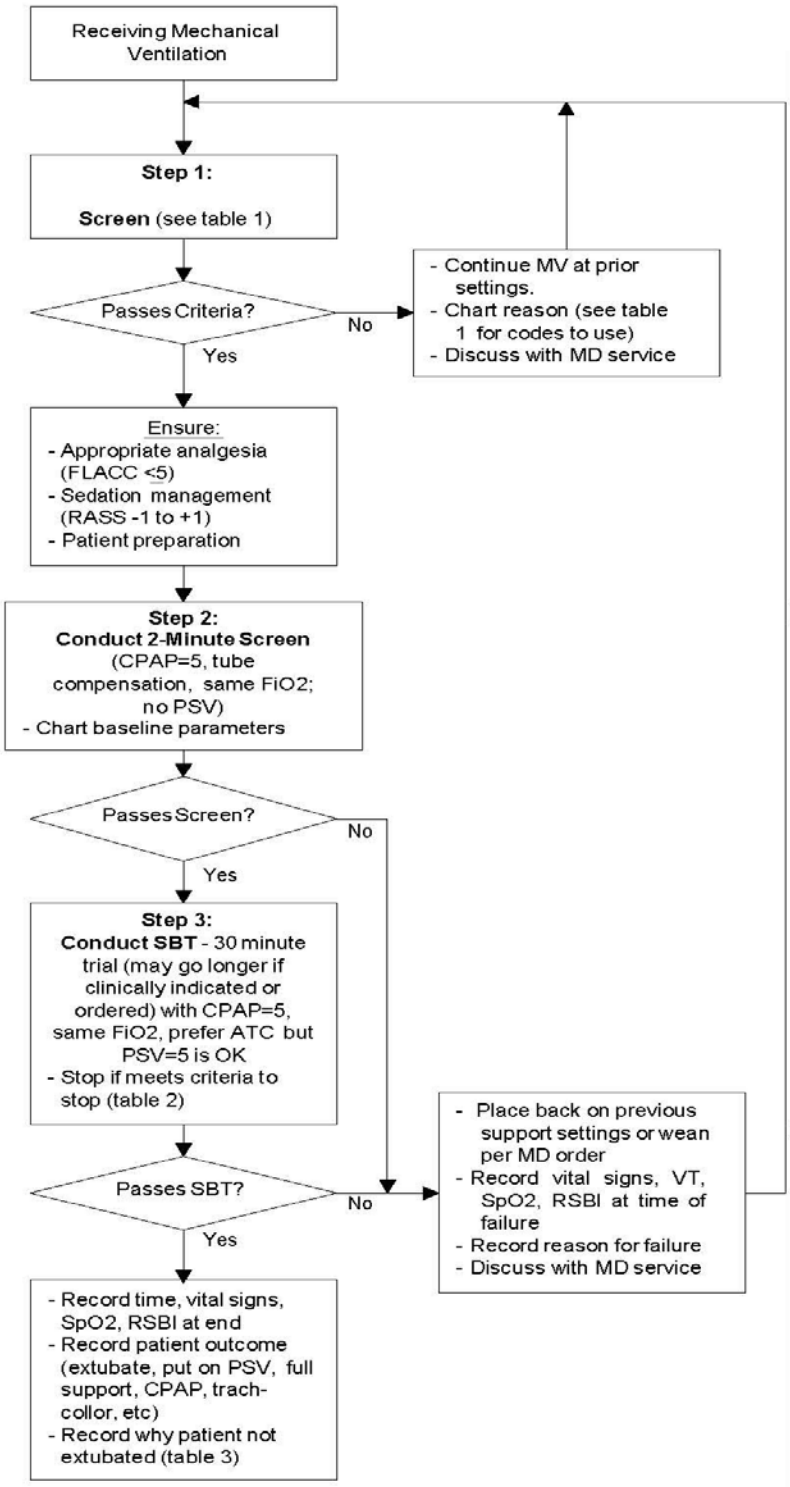


Table 1. Safety Screen Criteria No trial if:

ICP	Brain death, ICP>15, suspected high
NMB	Neuromuscular blockade
HPTS	significant hemoptysis (significant amounts of blood from ETT or tracheostomy)
GIB	Active GI bleed with hemodynamic instability or hematocrit drop
MI	ECMO or evolving MI
PRSR	On pressors (may be on dobutamine ≤5 mcg/kg/min)
ARWY	Unstable/unsafe airway BP
MAP	< 60mm Hg
FIO2	FiO_2 >0.50 (50%)
PEEP	PEEP >10 cm H_2O
DP	Drive pressure (delta-P) >25 cm H_2O VE
	Minute Ventilation >15 L/min
MD	Physician Cancels

Table 2. Criteria for Stopping SBT:

APNC	Allow up to 60 seconds of apnea in first 2 min
SOB	Use of accessory muscles, nasal flaring present, subjective dyspnea
RR	Tachypnea (rate > 35 bpm for > 5 min)
RR	↓Slow breathing (rate ≤ 6/min)
SpO2	↓SpO_2 < 92% (altitude adjusted)
HR	Tachycardia (HR 25 bpm > baseline)
HR	↓Bradycardia (HR<50)
BP	↑Hypertension (SBP 40mm Hg > baseline)
BP	↓Hypotension (SBP < 90 mm Hg)
RTHM	↑New or worsening arrhythmia
AGIT	Significant agitation or anxiety unresolved with reassurance
RSBI	Rapid Shallow Breathing Index > 100

Table 3. Reasons to Pass SBT w/o Extubation:

WET	Fluid overload
SECR	Secretions
WEAK	Pt too weak
MS	Mental Status
SED	Oversedated
ARWY	Unstable, unsafe, swollen airway
PCDR	Imminent/awaiting procedure
FMLY	Family Issues
WORS	MD thinks patient will get worse
RFSE	MD refuses answer
OTHR	No reason above applies

7/20/07-ch

Ventilator Management

I. Initial Settings - Initial ventilator settings (mode of ventilation, FIO_2, respiratory rate, VT, PEEP, and if applicable, pressure support or pressure control level) are to be set as ordered by the physician.

II. Ventilator adjustments:

A. Oxygenation - Maintain $SpO_2 \geq 90\%$ and $PaO_2 \geq 60$ torr (or physician specified).

1. FIO_2 - Increase or decrease to maintain the therapeutic goal as listed above.
2. PEEP - Changes in PEEP will be made in increments of two while maintaining the specified SpO_2 and PaO_2.
3. I:E - When applicable, a patient may require pressure control, inverse-ratio ventilation (PC IRV) to increase oxygenation while maintaining low airway pressures. During this mode of ventilation, the physician will specify the desired I:E ratio to initiate ventilation. The RCP may then adjust the I:E to optimize oxygenation. I:E may not exceed 3:1 without further physician order.

B. Ventilation (acid-base) — Manipulate the components of minute ventilation to maintain a pH of 7.35-7.45 (or physician specified) and $PaCO_2$ between 35-45 torr (or physician specified).

1. VT - May be adjusted to obtain the desired parameters listed above. VT should remain 6 mL/kg.
2. RR - Changes should be made in increments of two to achieve the specified pH and $PaCO_2$.
3. PIP (PCV) - A patient on PCV may require changes in the set PIP to obtain adequate ventilation according to the desired parameters listed above. (The difference between PIP and PEEP, referred to as ▲P, determines VT.)
4. PS - When applicable, pressure support should be adjusted to maintain a spontaneous VT of at least 5-8 mL/kg with a RR < 30.

III. Weaning/Ventilator Liberation:

A. Patients will be screened to determine whether they meet the "Wean Assessment Criteria". The criteria consist of:

1. PEEP ≤8cm H2O (unless increased to help trigger with auto-PEEP or to treat atelectasis)
2. FI02.≤ 50%
3. Hemodynamic stability
4 no neuromuscular blockers

B. Weaning parameters will be performed each morning (prior to 07:00) when the patient is on $FIO_2 \leq 0.50$ and PEEP $\leq$ 8 cm H_2O. (Unless increased to help trigger with auto-PEEP or to treat atelectasis)

C. Weaning parameters include the measurement and documentation of these values:

1. VT – tidal volume
2. RR – respiratory rate
3. V_E – minute ventilation
4. NIP (Negative Inspiratory Pressure)
5. VC (Vital Capacity)
6. f/V_t

D. Weaning: (30) minute Spontaneous breathing trial) See UHRC Wean Algorithm

E. Patients should be placed on CPAP =5cmH_2O w/o tube compensation (may use PS=5). The FIO_2 may be increased by 5-10%, up to 50% if necessary.

F. Respiratory and hemodynamic parameters are monitored closely throughout the duration of the wean. The wean is discontinued and the patient returned to the previous ventilator settings if any of the following occur:

1. RR ≥ 36
2. HR increases > 140 bpm.
3. $SpO_2 < 90\%$

G. After 30 minutes, another set of weaning parameters are obtained and the wean ends. Mechanical ventilation can be discontinued under the following conditions:

1. RR ≤ 35
2 .HR < 120
3. $SpO_2 > 90\%$, with $FIO_2 \leq 0.40$
4. NIP < 30 cm H_2O.
5. Absence of metabolic alkalosis ($HCO_3 < 32$ mEq/L).
6. Absence of the patient's use of accessory muscles or nasal flaring
7. Vital signs and hemodynamic parameters are within normal limits.
8. Patient is able to clear own secretions.

H. If the patient is trached, then place on T-Collar of appropriate FIO_2. If the patient is intubated, then inform physician of successful wean and obtain a verbal order to extubate. If the patient does not meet the criteria list in section III. Above, an ABG is obtained and a physician is consulted for determination of extubation or reinstitution of mechanical ventilation

I. If the patient does not meet the criteria listed above, an ABG is obtained and a physician is consulted for determination of extubation or reinstitution to mechanical ventilation.

IV. Extubation:

A. Extubation can be performed by the Respiratory Care Practitioner upon receiving an order from the physician. (A verbal order must be documented prior to performing the procedure). A physician does not need to be present for extubation but must be identified in case of reintubation. A physician must be present in the ICU at time of extubation for all patients identified as having a difficult airway. (see Difficult Airway Policy)

TBICU Bronchoscopy Practice Guidelines

Before the Procedure

- ✓ Notify Family
- ✓ Gather all required personnel and equipment
- ✓ Perform a Time out*** *Prior to starting the procedure a "Time out" must be performed and documented!*

Required Personnel:

- Experienced Bronchoscopist (Physician/PA)
- Respiratory Therapist
- Nurse
- Page TBICU attending to let them know you are about to start the Procedure

Protective Gear: Bronchoscopist *(The following protective gear **must** be worn by bronchoscopist and trainees to prevent transmission of infectious organisms from bronchoscopist to the patient, and from the patient to bronchoscopist and their clothing.)*

- Sterile gloves
- Mask
- Hat
- Eye Protection
- Blue gown
- Clean Bronchoscope

Suspect Pneumonia? Bronchoalveolar Lavage (BAL), Bronchoscopy Aspirates / Washings preferred over mini BAL when possible, feasible, and safe, however, mini-BAL is often an acceptable alternative- discuss with attending.

Protective Gear: Other Personnel *(The following protective gear **must** be worn by all in close proximity to the patient during the procedure)*

- Mask and Hat
- Eye Protection

Bronchoscopy Elbow Adapter

In-line sterile specimen trap

Equipment:

- Sterilized Bronchoscope
- Monitor
- Bite Block
- 20cc Sterile irrigation
- Blue "Chuck" to cover patient's gown and create a clean field to work from
- Toomey syringe (for irrigation)
- Bronchoscopy Elbow Adapter
- In-line sterile specimen trap
- Suction
- Mechanical Ventilator
- Sedation (Administered by Nursing Staff)
- Lidocaine spray (Optional)
    - *(if used **methylene blue 1%** solution should be available in the event the patient develops Methemoglobinemia. Tx: Administer methylene blue 1% solution (10 mg/ml) 1 to 2 mg/kg intravenously slowly over five minutes followed by IV flush with normal saline.)*

After the procedure

- Clean cart thoroughly between each use
- Obtain CXR
- Place Procedure note in the Electronic Medical Record
- Notify family of findings

Diagnosis and Treatment of Pneumonia

Intubated Patients:

A. Identify patient with suspected pneumonia (need 3 of 6 criteria)
    1. Patient on mechanical ventilation >2 days
    2. Baseline period of stability or improvement, followed by sustained period of worsening oxygenation
    3. Ventilator-Associated Condition (VAC)
    4. General, objective evidence of infection/inflammation
    5. Infection-Related Ventilator-Associated Complication (IVAC)
    6. Positive results of laboratory/microbiological testing

B. When performing quantitative BAL (Mini BAL is an acceptable alternative when BAL is contraindicated or not feasible – but if left lower lobe infiltrate, prefer formal bronch with BAL since mini-BAL goes down right lower lobe only)
    1. Review CXR, determine which side the infiltrate is on (left vs. right)
    2. Flexible bronchoscopy with BAL on non-infected side first
    3. Lavage with 20 cc of nonbacteriostatic saline on each side, suction as much as possible
    4. Send specimen for Gram stain and quantitative culture
    5. For hospitalized patients start Zosyn, Vancomycin, and Tobramycin empirically. If allergic to any of these agents, or has a history of resistant organisms, use ICU HAP/VAP/Sepsis order set for guidance on alternative antibiotic selection. Narrow antibiotics to singe agent when cultures available.

C. Culture results
    1. if 10^4 or greater, then continue antibiotic coverage based on sensitivities
        a) Treat for 8 days total with the correct antibiotics
    2. If patient has recurrent pneumonia with same organism or MDR pneumonia, treat for 15 days.

Extubated Patients (without tracheostomy):

A. Identify patient with suspected pneumonia (need 3 of 5 criteria)
    1. new or changing infiltrate on CXR
    2. increasing WBC
    3. hypoxia
    4. fever
    5. increasing sputum production

B. Follow antibiotic guidelines as above for the specific organisms and duration of therapy

Esophageal Doppler Monitor

Placed by Respiratory therapists much like a Naso-gastric tube

Principles:

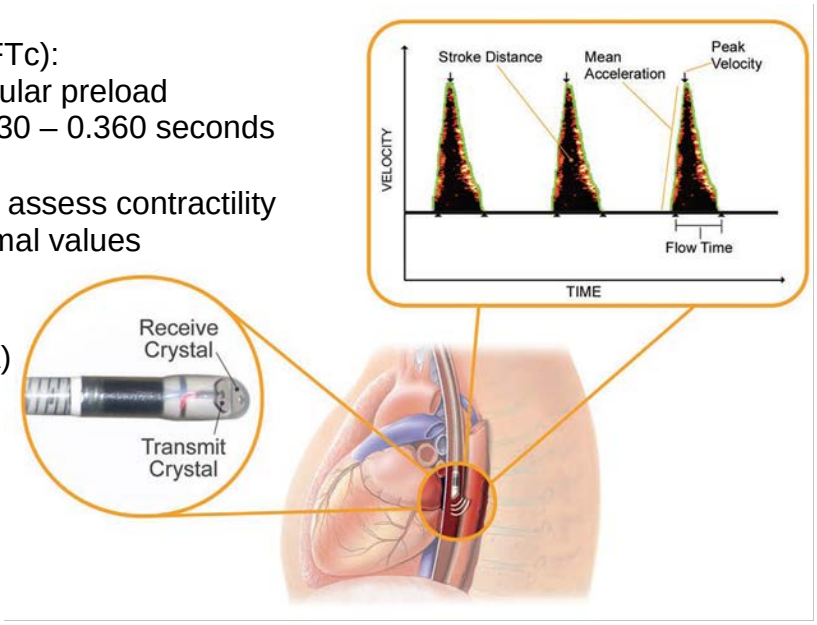
- Ultrasound technology used to give real time information about the left ventricular flow based on waveform analysis of descending aortic pulse.

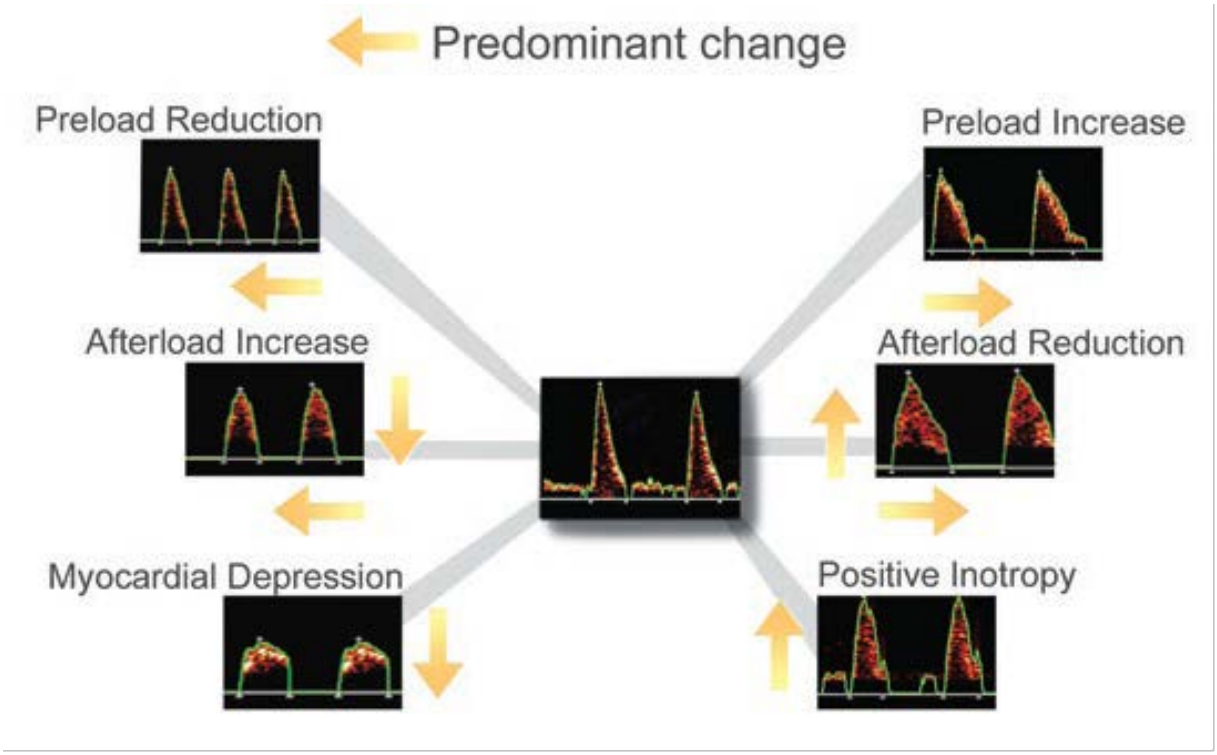
Direct flow measurements:

- Corrected Flow Time (FTc):
  - Indicates left ventricular preload
  - Normal range is 0.330 – 0.360 seconds
- Peak Velocity (PV):
  - Used as an index to assess contractility
  - Age dependent normal values
- Stroke Distance (SD)
- Minute distance (MD)
- Mean Acceleration (MA)

Calculated measurements:

- Cardiac output (CO)
- Stroke volume (SV)
- Cardiac Index (CI)





$ScVO_2$ Catheter Protocol

Policy and Procedure:

I. Indications for Fibrotic Catheter Insertion and $ScvO_2$ Monitoring in TBICU:
Patients who require pulmonary artery catheterization for optimization of hemodynamic or oxygen kinetic balance shall be considered for a fibrotic pulmonary artery catheter ($ScvO_2$). No fibrotic PA catheter ($ScvO_2$) will be placed unless the patient meets appropriate indications as defined by this policy. The physician staff may decide to treat any patient even if they do not meet the criteria defined by this policy. Continuous $ScvO_2$ monitoring may be indicated under the following conditions for patients treated by the Trauma/Burn (ACS) Surgery Service.

A. On admission, any TBE patient who meets any of the following conditions:
   1. Systemic acidosis (pH < 7.30, and/or persistent hypotension with SBP < 100, and/or UO < 30-50 mL/hr) not corrected by what appears to be appropriate fluid resuscitation (ATLS guidelines).
   2. An associated head injury undergoing aggressive ICP therapy (mannitol, diuretics, phenobarbital)
   3. Associated major trauma with a history of heart (i.e., ischemic, valvular) liver (i.e. cirrhosis), pulmonary disease (i.e., COPD), or chronic renal failure requiring renal replacement therapy.
   4. Thermally injured patients who have a major inhalation injury documented by bronchoscopy regardless of the total surface area of the injury.
   5. Pulmonary failure defined by any of the following conditions:
      a) PaO_2 / FIO_2 ratio < 200.
      b) SaO_2 < 0.90 with FIO_2 > 0.50 and PEEP > 10 cmH_20.
      c) Static compliance < 30 mL / cmH_20.
      d) Intrapulmonary shunt > 25%.
   6. Massive fluid resuscitation (> 10 Liters crystalloid or 10 units blood products) with any of the preceding conditions.

B. Following admission all ACS Service patients will be monitored daily for the development of conditions which would warrant pulmonary artery catheterization. The conditions which would indicate a possible need for invasive PA-$ScvO_2$ monitoring are:
   1. Pulmonary failure as defined by any of the following:
      a) PaO_2 / FIO_2 ratio < 250.
      b) SaO_2 < 0.90 with FIO_2 > 0.50 and PEEP > 10 cmH_20.
      c) Static compliance < 30 ml / cmH_20.
      d) Intrapulmonary shunt > 25%
   2. Cardiovascular failure as defined by:
      a) Evidence of ischemic dysfunction.
      b) Systemic acidosis (as previously defined).
   3. Renal failure defined by:
      a) UO < 30-50 cc/hr (for adults) following fluid challenge.
      b) Creatinine > 2x baseline admission value.

II. $ScvO_2$ catheters will be changed for any of the following reasons:
   A. If no evidence of infection.
   B. Non-functional $ScvO_2$.

III. Goals of Monitoring
   A. Optimize cardiac and pulmonary function as evidenced by:
      1. SaO_2 > 0.90.
      2. Cardiac index > 2.5 L/min/M_2.
      3. Urine output > 30-50 cc/hr for adults.
      4. SvO_2 > 0.65.
      5. VO_2 (I) < 170 ml/min/M_2.
      6. PaO_2 / FIO_2 ratio > 250.
   B. Decrease unwarranted ancillary hemodynamic testing (thermal dilution cardiac output).

Adult Enteral Feeding Tube Placement Guidelines

Gastric feeding via an NG or OG tube is acceptable in patients who are at low risk for aspiration. For patients with contraindication to gastric feeding, post-pyloric placement of an enteric tube should be considered (See Section B – Indications for small bowel feeding).
All patients receiving enteral nutrition (EN) must have head of bed elevation ≥ 30 degrees.

A. Benefits of gastric feeding:

Gastric feeds allow for early feeding initiation, ease of tube placement, stress ulcer prophylaxis, and more natural feeding with various feeding options (bolus, gravity, continuous).

B. Indications for small bowel feeding: (Not all-inclusive) Enteric Feeding Tube=Small Bore=DHT

- Previous gastric feeding intolerance
- High risk for aspiration (See Section C – Risk factors for aspiration)
- Repeated high gastric residual volumes
- Gastric outlet obstruction
- Proximal Fistula
- Need for multiple operations, procedures and/or tests with plan to feed during procedures (ie. Burn patients)
- Prone position

NOTE: Although pancreatitis is not an absolute indication for small bowel feeding, post-pyloric feeding tube placement may be considered to improve EN tolerance. Ideal location of feeding tube tip is ≥ 60cm beyond the Ligament of Treitz.

C. Risk factors for aspiration: If a patient is at risk for one or more of the following, small bowel feeding tube placement is indicated. Post-pyloric goal is second portion of duodenum or distal.

- Vomiting
- Gastroparesis - If associated with high gastric output*
- History of aspiration
- Medications - Narcotics with high gastric output*

** When evaluating high gastric output, more than 1 liter /day may indicate small bowel feeding tube placement. If gastric output is between 500ml and 1liter use clinical judgment on whether to proceed with gastric or small bowel feeding.*

D. Gastric Residual Volumes (GRV):

- Should only be measured in patients receiving gastric feeds
- With one gastric residual measurement > 300ml, if medically feasible, attempt to move patient onto right side for 15-20 minutes before rechecking level
- Ensure patient is having bowel movements

E. Prokinetics:

In the presence of gastric feeding intolerance, gastric motility agents (prokinetics) may be indicated. Special consideration and caution should be used when choosing a prokinetic. Discuss use of any prokinetic with multidisciplinary team.

The use of both Erythromycin and Metoclopramide is more effective than either alone.
Erythromycin 200mg IV q 12 h and Reglan 5 mg IV q 6 h

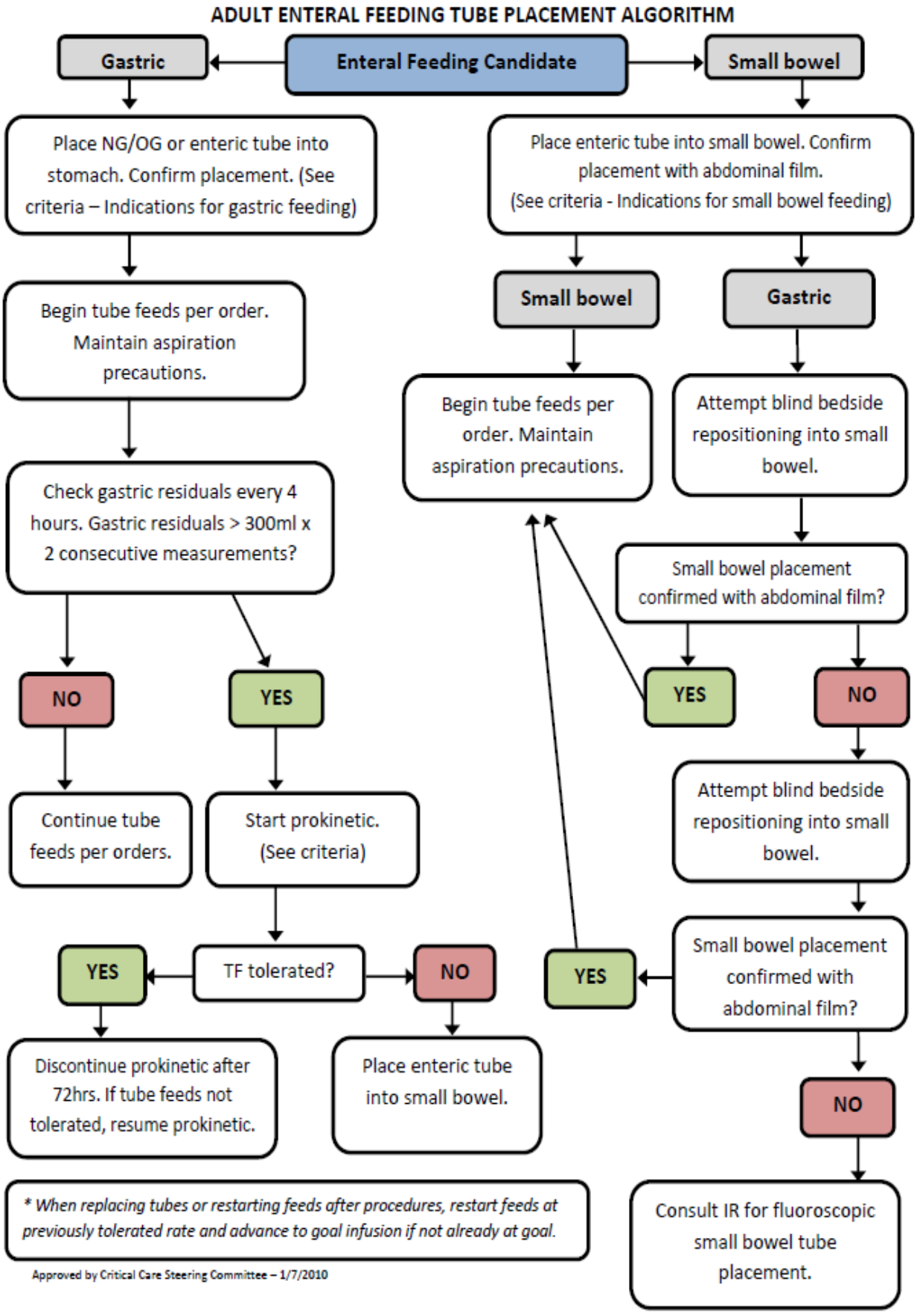
Nguyen NQ1, Chapman M, Fraser RJ, Bryant LK, Burgstad C, Holloway RH. Prokinetic therapy for feed intolerance in critical illness: one drug or two? Crit Care Med. 2007 Nov;35(11):2561-7

See prokinetic dosing below:

- **Erythromycin****: 200mg IV every 12 hours OR oral tablet 250mg every 6 to 8 hrs OR oral suspension 400mg every 6-8 hours
- **Metoclopramide (Reglan)*****: 10mg IV every 6 hours OR oral 10mg every 6 hrs

For patients with CrCl < 50ml/min, adjust Metoclopramide dose to 5mg every 6hrs

*** Erythromycin Drug Interactions: Carbamazepine, Cyclosporine, Theophylline, Aminophylline, Digoxin, oral Anticoagulants, Fluconazole, Amiodarone, Dofetilide, Diltiazem, Voriconazole, Sotalol, Valproic Acid, Haloperidol.* ***Not an all-inclusive list.***
**** Extraparamidal side effects have been reported with use of Metoclopramide and patients should be monitored closely.*


ADULT ENTERAL FEEDING TUBE PLACEMENT ALGORITHM
Enteral Feeding Candidate
Gastric
Small bowel
Place NG/OG or enteric tube into stomach. Confirm placement. (See criteria – Indications for gastric feeding)
Begin tube feeds per order. Maintain aspiration precautions.
Check gastric residuals every 4 hours. Gastric residuals > 300ml x 2 consecutive measurements?
NO
YES
Continue tube feeds per orders.
Start prokinetic. (See criteria)
TF tolerated?
YES
NO
Discontinue prokinetic after 72hrs. If tube feeds not tolerated, resume prokinetic.
Place enteric tube into small bowel.
Place enteric tube into small bowel. Confirm placement with abdominal film. (See criteria - Indications for small bowel feeding)
Small bowel
Gastric
Begin tube feeds per order. Maintain aspiration precautions.
Attempt blind bedside repositioning into small bowel.
Small bowel placement confirmed with abdominal film?
YES
NO
Attempt blind bedside repositioning into small bowel.
Small bowel placement confirmed with abdominal film?
YES
NO
Consult IR for fluoroscopic small bowel tube placement.
* When replacing tubes or restarting feeds after procedures, restart feeds at previously tolerated rate and advance to goal infusion if not already at goal.
Approved by Critical Care Steering Committee – 1/7/2010

Uncomplicated/Routine PEG and G-TUBE Care in the TBICU

Percutaneous Endoscopic Gastrostomy Tubes (PEGs)

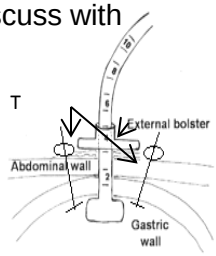
Tube features one port with a round or oblong disk on the patient's abdomen.

1. If tube feeds have not been initiated by 24 hours post op, review the Operative/Procedure Note for instructions. If no instructions given, discuss with physician.
2. Keep External Bolster with ~0.5 – 1.0 cm laxity next to skin to prevent breakdown.
3. If the External Bolster sutures to the skin have not been removed by Post Op Day 7, review the Operative/Procedure Note for instructions.
   If no instructions given, discuss with physician.
4. If ulceration occurs before the 7 days, discuss with physician.

T-fastener PEGs & surgically placed Gastrostomy Tubes (G-Tubes)

Tube features two main ports (A balloon port and an infusion port).
The Infusion port consists of a Feeding Adapter and Medport.

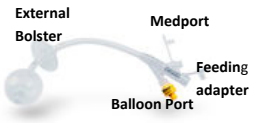
1. If T-fasteners have not been removed by Post Op Day 14 , review the Operative/Procedure Note for instructions. If no instructions given, discuss with physician.
2. If tube feeds have not been initiated by 24 hours post op, review the Operative/Procedure Note for instructions. If no instructions given, discuss with physician.
3. Keep External Bolster with ~0.5 – 1.0 cm laxity next to skin to prevent breakdown.
4. If the External Bolster sutures to the skin have not been removed by Post Op Day 7, review the Operative/Procedure Note for instructions. If no instructions given, discuss with physician.
5. If ulceration occurs before the 7 days, discuss with physician.



Percutaneous Endoscopic Gastrostomy- Jejunostomy Tubes (PEG-J) and surgically placed G-J tubes

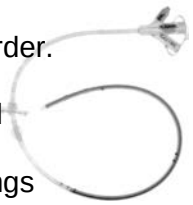
Tube features three ports: (A balloon port; a gastric port; and a jejunal port) Tube features one port with a round disk on the patient's abdomen.

1. If tube feeds have not been initiated by 24 hours post op, review the Operative/Procedure Note for instructions. If no instructions given, discuss with physician.
2. Keep External Bolster with ~0.5 – 1.0 cm laxity next to skin to prevent breakdown.
3. If Bolster is sutured to the skin, may remove sutures at 7 days .
4. If ulceration occurs before the 7 days, discuss with physician.



General care of Enteral Feeding Tube (PEG, PEG-J, and G-Tubes)

1. Record length of the tube where bumper base is located every shift.
2. If bumper is not properly placed with regards to the physician order, nursing is to reposition for proper placement of the bumper base with regards to that physician order.
3. Cleanse site every shift with NS moist gauze to remove crust or drainage.
4. If breakdown or macerated skin at the gastrostomy tube entrance site, apply wound barrier and dry gauze daily. Change gauze PRN. Discuss with physician.
5. Flush tube with 30 milliliters of water every 4 hours, after giving medication or feedings per the tube, and PRN unless otherwise instructed.
6. Secure tube from hanging and pulling on skin and to prevent accidental dislodgement of tube.
   **** Note:** Consider abdominal binder placement to ensure patient safety



Uncomplicated/Routine PEG and G-TUBE Care in the TBICU (cont'd)

Inadvertent or Accidental Tube Removal

1. In the event a gastrostomy tube is pulled out of the abdomen within 6 weeks of placement, call the physician immediately. It is possible the patient will need emergent surgery. A contrast study must be ordered to verify the integrity of the ostomy site.
2. In the event a gastrostomy tube is pulled out of the abdomen after 6 weeks of placement, place a Foley catheter or replacement G-tube in the tract **if no resistance is met**, and call the physician immediately. A contrast study may be necessary to verify the integrity of the ostomy site. If any resistance is encountered when placing the tube, ***STOP*** and call the physician immediately. A contrast study will likely be required to verify the integrity of the ostomy site.

References

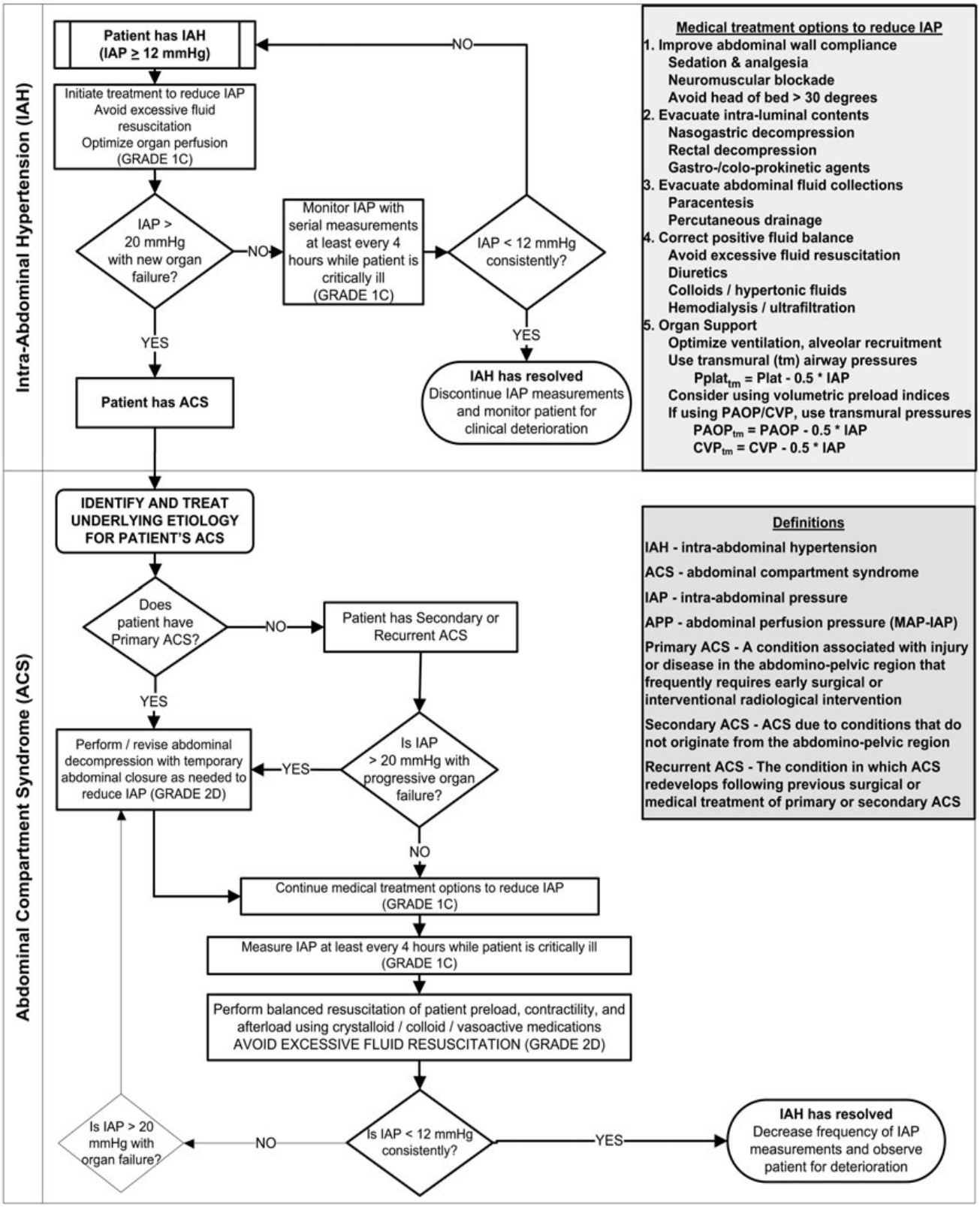
1. McClave SA, Neff RL. Care and long-term maintenance of percutaneous endoscopic gastrostomy tubes. JPEN J Parenter Enteral Nutr. 2006 Jan-Feb;30(1 Suppl):S27-38.
2. Schrag SP, Sharma R, Jaik NP, Seamon MJ, Lukaszczyk JJ, Martin ND, Hoey BA, Stawicki SP. Complications related to percutaneous endoscopic gastrostomy (PEG) tubes. A comprehensive clinical review. J Gastrointestin Liver Dis. 2007 Dec;16(4):407-18.
3. Bankhead R, Boullata J, Brantley S, Corkins M, Guenter P, Krenitsky J, Lyman B, Metheny NA, Mueller C, Robbins S, Wessel J; A.S.P.E.N. Board of Directors. Enteral nutrition practice recommendations. JPEN J Parenter Enteral Nutr. 2009 Mar-Apr;33(2):122-67
4. C. R. Bard, Inc. Bard Access Systems: Feeding Devices. *Percutaneous Endoscopic Gastrostomy (PEG) Feeding Devices Resources.* 2012. Available at http://www.bardaccess.com/feed-peg.php?section=Resources Accessed Sept 25, 2012
5. Lynch, C.R., Fang J.C. Practical Gastroenterology. Nutrition Issues in Gastroenterology, Series #22: *Prevention and Management of Complications of Percutaneous Endoscopic Gastrostomy (PEG) Tubes. Nov 2004.* http://www.medicine.virginia.edu/clinical/departments/medicine/divisions/digestive-health/nutrition-support-team/nutrition-articles/LynchArticle.pdf Accessed Sept 25, 2012.
6. Löser C, Aschl G, Hébuterne X, Mathus-Vliegen EM, Muscaritoli M, Niv Y, Rollins H, Singer P, Skelly RH. ESPEN guidelines on artificial enteral nutrition--percutaneous endoscopic gastrostomy (PEG). Clin Nutr. 2005 Oct;24(5):848-61.

Intra-Abdominal Hypertension Algorithm

http://icmjournal.esicm.org/journals/abstract.html?v=39&j=134&i=7&a=2906_10.1007_s00134-013-2906-z&doi=

Adapted from Intensive Care Med 2013 7:1190-1206. 2014 World Society of the Abdominal Compartment Syndrome.

INTRA-ABDOMINAL HYPERTENSION (IAH) / ABDOMINAL COMPARTMENT SYNDROME (ACS) MANAGEMENT ALGORITHM



Intra-Abdominal Hypertension Algorithm

(cont'd)

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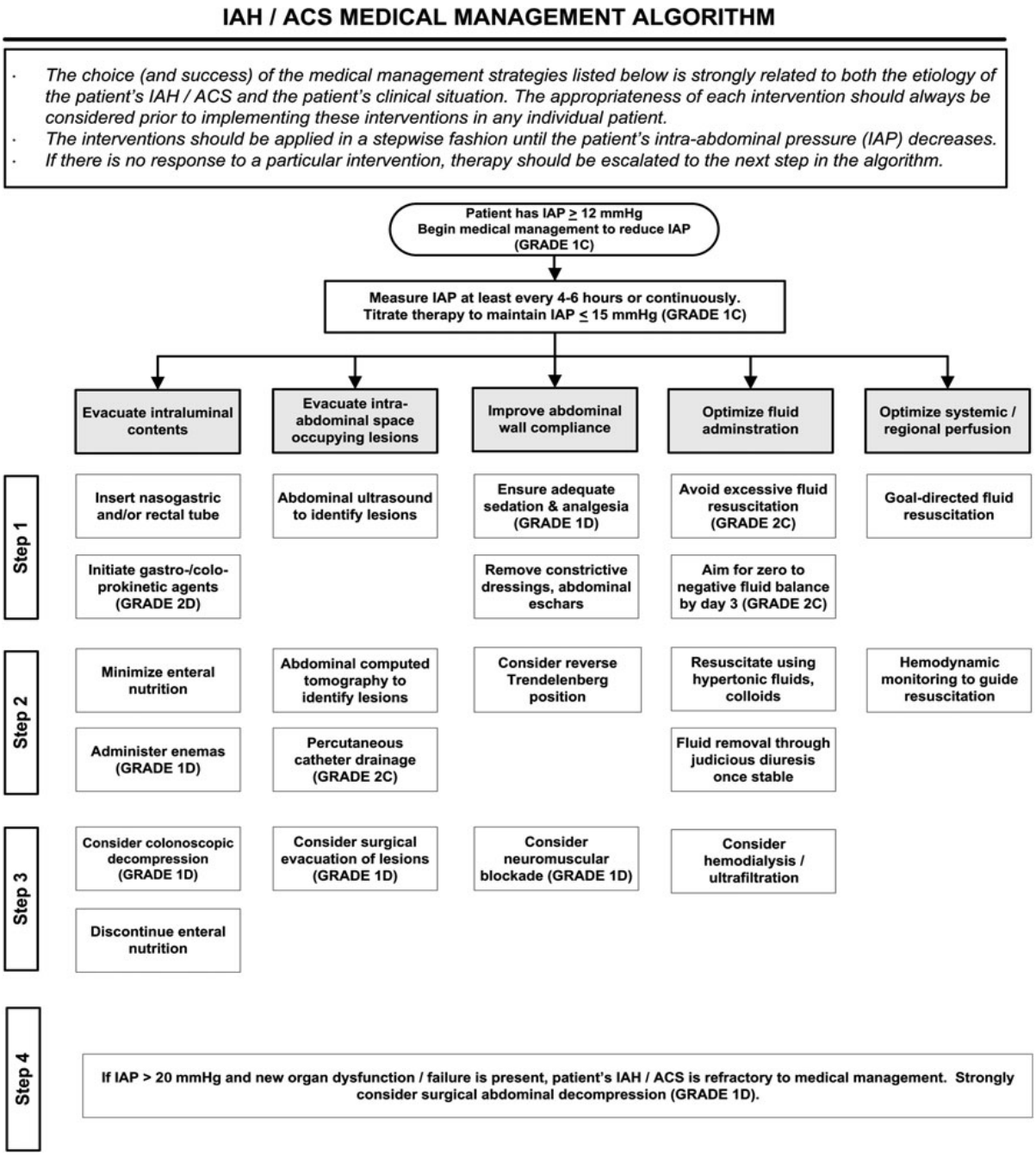
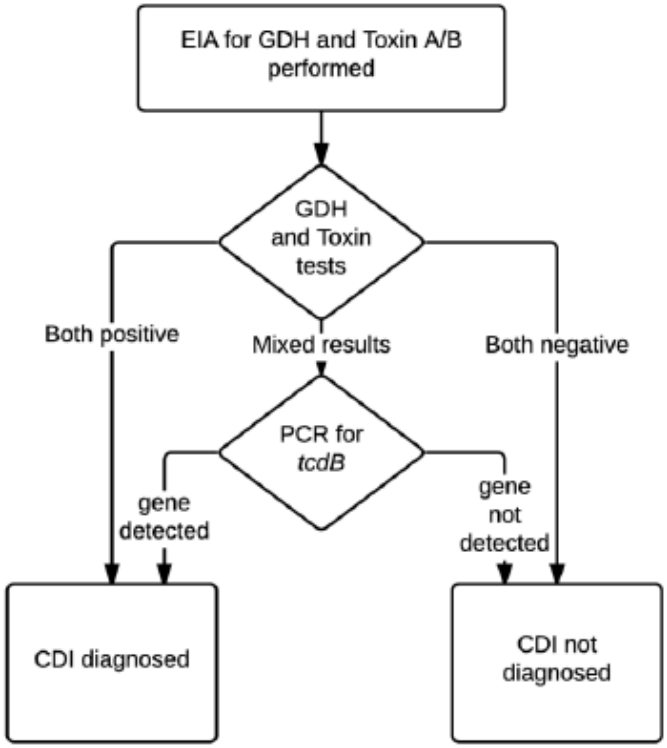


Heparin-Induced Thrombocytopenia

https://pharmwebsp.med.umich.edu/_layouts/15/WopiFrame.aspx?sourcedoc=/GuideLines/Anticoagulation/HITGuideline.docx&action=default&DefaultItemOpen=1

Guideline: Diagnosis & Rx of C. Difficile Colitis

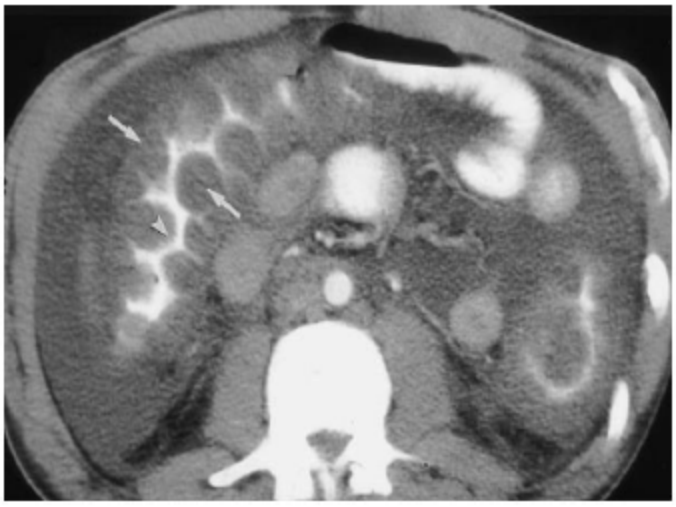
Figure 2. University of Michigan Health System Multistep Algorithm* for the Rapid Diagnosis of *C. difficile* Infection

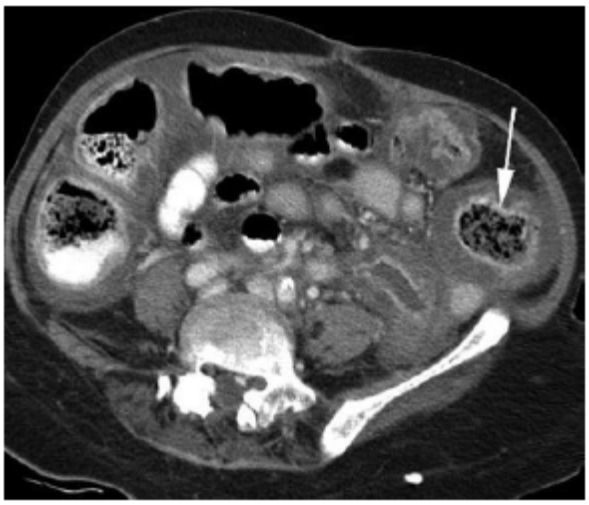


CDI: *Clostridium difficile* infection; EIA: enzyme immunoassay; GDH: glutamate dehydrogenase; PCR: polymerase chain reaction.

* Adapted under Creative Commons License from Rao K, Erb-Downward JR, Walk ST, et al. The Systemic Inflammatory Response to *Clostridium difficile* Infection. PLoS ONE. 2014;9(3):e92578.

CT Scan Imaging can be helpful:
Left: Accordion sign, marked submucosal edema in right colon, causing "thumbprint" appearance
Right: Target sign, concentric circles due to edema and inflammation in colon wall.





Clostridium Difficile Infection Guideline December 2016:
http://www.med.umich.edu/1info/FHP/practiceguides/InptCDiff/CDiff.pdf

Adult*	
Severity	Treatment
Mild/ Moderate • Diagnosis of CDI (see **Table 2**) AND • None of the criteria in the "severe" or "complicated" columns below	Patient does not meet criteria for "severe" or "complicated" CDI • metronidazole 500 mg PO TID for 10-14 days OR Patients with metronidazole allergy, pregnant, nursing, or on warfarin therapy: • vancomycin 125 mg PO QID for 10-14 days
Severe (ANY of the following) • Age ≥ 65 • WBC ≥ 15K • Cr ≥ 1.5x baseline • ANC ≤ 500 • ALB ≤ 2.5 • SOT/BMT < 100 days • Small bowel CDI • Inflammatory Bowel Disease • Treatment of rejection in the preceding 2 months (SOT) • Chronic GVHD (BMT)	•vancomycin 125 mg PO QID for 10-14 days
Complicated (ANY of the following) • Septic shock –Sepsis with persistent hypotension, requiring vasopressors to maintain MAP ≥ 65 mm Hg and having a serum lactate level > 2 mmol/L despite adequate fluid resuscitation • Severe sepsis –Life-threatening organ dysfunction caused by a dysregulated host response to infection. Suspected or documented infection and an acute increase of ≥ 2 SOFA points • Ileus or bowel obstruction • Toxic megacolon • Peritonitis • Bowel perforation	• vancomycin 500 mg PO QID • metronidazole 500 mg IV every 8 hours • vancomycin enema 500 mg in 1000 mL of normal saline every 6 hours (in patients with ileus, bowel obstruction or toxic megacolon) • Consult infectious diseases and surgery to assist in management including possible surgical intervention (**Table 4**). Operative management strategies for CDI may include exploratory laparotomy, diverting loop ileostomy with lavage, total or subtotal abdominal colectomy with end ileostomy (**Figure 5**).

Recurrent CDI: Recurrent symptoms and positive testing for toxigenic *C. difficile* within 8 weeks of prior episode

First recurrence:
• Classify as "mild-moderate" "severe," or "complicated," and treat accordingly

Second or multiple recurrences (third or more episode of CDI):
• Consult infectious diseases
• vancomycin PO (dose, need for concurrent IV metronidazole/vancomycin enemas depends on disease classification as noted above) for 10-14 days then taper to 125 mg PO BID for 7 days, 125 mg PO daily for 7 days, and then pulse with 125 mg PO once every 2-3 days for 2-8 weeks.

OR
• **fidaxomicin** 200 mg PO BID for 10 days (with approval from the infectious diseases consult service).

Consider new monoclonal antibody: **Bezlotuxomab**

Consider fecal microbiota transplantation (FMT):

Initiated in the outpatient ID clinic and requires a referral

Inpatient FMT is initiated through consultation with inpatient ID and GI consult services

Clostridium Difficile Infection Guideline December 2016:
http://www.med.umich.edu/1info/FHP/practiceguides/InptCDiff/CDiff.pdf

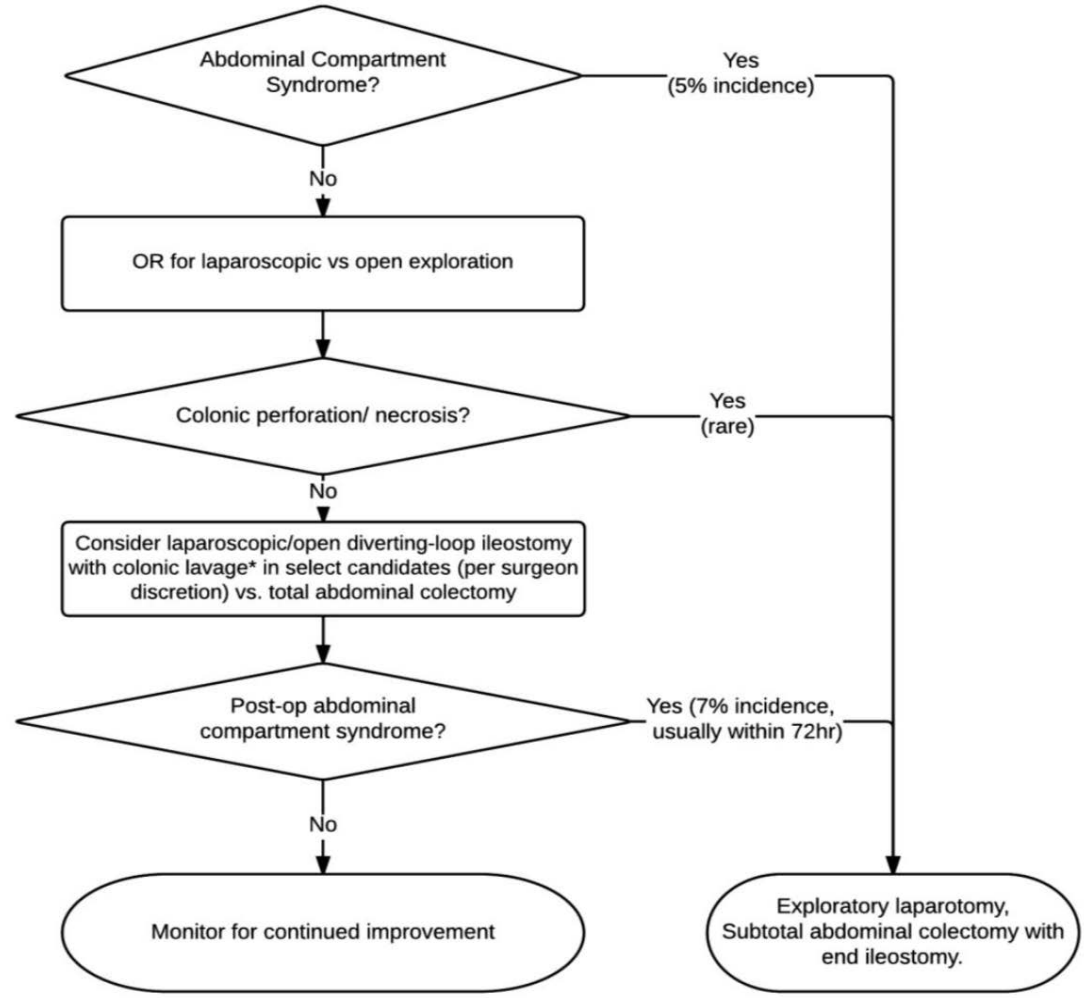
Surgery for C. difficile Colitis

Surgical consultation is appropriate for *C. difficile* infected patients in these situations:

- Any patient with complicated CDI (see **Table 3**)

- Any patient with CDI and clinical deterioration attributable to CDI, including the following:
  - Worsening abdominal distention/pain and/or peritonitis
  - Bowel obstruction
  - Intubation
  - Vasopressor requirement
  - Mental status changes
  - New or worsening Acute Kidney Injury
  - Worsening Lactate > 5mmol/L
  - Persistent or worsening leukocytosis (WBC ≥35,000 cells/mm^3)
  - Hirschsprung's disease
- Any patient with failure to improve with standard therapy within 5 days as determined by resolving symptoms and physical exam, resolving WBC/band count

Figure 5. Operative Management Strategy for CDI



* continue q6h antegrade vancomycin enemas via the distal ileostomy opening, to be done in the ICU

Loop Ileostomy for Severe C. Difficile Colitis

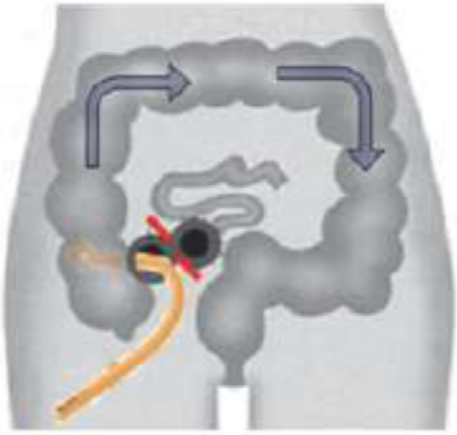
Diverting Loop Ileostomy and Colonic Lavage for Severe C. difficile Colitis

Before surgery is started:

1. Place patient in lithotomy position with easy access to rectum
2. Place a fluid collection bag (one used for Urology) under the patient for drainage collection
3. Place a rectal drainage tube (large Malecot catheter, large foley catheter, #9 or 10 endotracheal tube or other large catheter)
4. Have 8 Liters of warmed polyethylene glycol 3350/electrolyte solution (GoLytelely; Braintree Laboratories) available in OR for intraoperative colonic irrigation, and dulcolax suppository .

Intraoperatively:

1. Ensure that the colon is viable and without perforation
2. Create a loop ileostomy (laparoscopic or open)
3. Place a 24 French Malecot catheter into the efferent limb of the ileostomy and advance into the right colon through the ileocecal valve.
4. Infuse 8 Liters of warmed polyethylene glycol 3350/electrolyte solution (GoLytelely; Braintree Laboratories) into the 24 French Malecot catheter via the efferent limb of the ileostomy.
5. Once colonic lavage completed, perform rectal exam to empty rectum, place dulcolax suppository in rectum to encourage colonic emptying.
6. Instill antegrade colonic enema with vancomycin (500mg in 500ml) via ileostomy efferent limb



1. Creation of diverting loop ileostomy.
2. Intraoperative antegrade colonic lavage with 8 liters of warmed PEG3350/electrolyte solution via ileostomy.
3. Postoperative antegrade colonic enemas with vancomycin (500 mg in 500 mL X 10 days) via ileostomy.

FIGURE 1. Operative treatment strategy for loop ileostomy and colonic lavage for severe, complicated *C. difficile*-associated disease. When possible laparoscopic exploration of the colon and abdominal cavity is performed and a diverting loop ileostomy is created. The colon is then lavaged in an antegrade fashion through the ileostomy with a high volume (8 L) of polyethylene glycol 3350 or balanced electrolyte solution and the effluent is collected via a rectal drainage tube. A catheter is placed in the efferent limb of the ileostomy to deliver vancomycin flushes in an antegrade fashion in the postoperative period.

Neal MD, et al. Diverting loop ileostomy and colonic lavage. An alternative to total abdominal colectomy for the treatment of severe, complicated clostridium difficile-associated disease. *Ann Surg* 2011 Sept;254(3):423-429.

Fever Work-up

Admission for possible sepsis or Inpatient with temp ≥39, clinical signs of sepsis, and >48 hours since last culture

- Examine patient for obvious source of infection
- Blood cultures x 2. Obtain both cultures from 2 different peripheral sites. If bacteremic, repeat blood cultures every 48 hours (peripherals from 2 sites) until clear
- Urine analysis with reflex urine culture
- BAL quantitative culture if intubated. Consider mini-BAL if unable to complete formal bronchoscopy.
- Quantitative wound biopsy if large open wound/burn
- Evaluate other possible sites for infection:
    - IV and line sites
    - Operative wounds
    - Pressure ulcer sites
    - DVT
    - Intraabdominal abscess
    - Sinusitis
    - Drug fever

Sepsis

Surviving Sepsis Campaign Bundle

http://survivingsepsis.org/Bundles/Documents/SSC_Bundle.pdf

TO BE COMPLETED WITHIN 3 HOURS:

1. Measure lactate level
2. Obtain blood cultures prior to administration of antibiotics
3. Administer broad spectrum antibiotics
4. Administer 30ml/kg crystalloid for hypotension or lactate ≥4mmolL

TO BE COMPLETED WITHIN 6 HOURS:

5. Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain a MAP ≥65mm Hg
6. In the event of a persistent arterial hypotension despite volume resuscitation (septic shock) or initial lactate ≥4mmol/L:
    i. Measure central venous pressure (CVP)
    ii. Measure central venous oxygen saturation ($ScvO_2$)
7. Remeasure lactate if initial lactate was elevated*

*Target for quantitative resuscitation included in the guidelines is CVP of ≥8mm Hg, $ScvO_2 \geq 70\%$, and normalize lactate

DOCUMENT REASSESSMENT OF VOLUME STATUS AND TISSUE PERFUSION WITH:

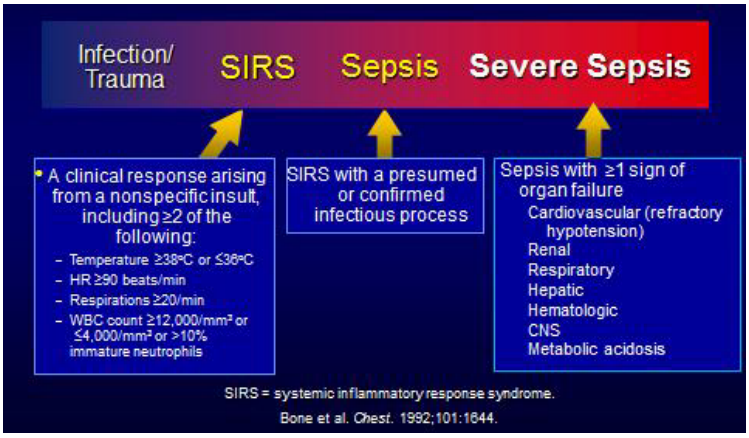
EITHER

• Repeat focused exam (after initial fluid resuscitation) by licensed independent practitioner including vital signs, cardiopulmonary, capillary refill, pulse, and skin findings.

OR TWO OF THE FOLLOWING:

• Measure CVP
• Measure ScvO2
• Bedside cardiovascular ultrasound
• Dynamic assessment of fluid responsiveness with passive leg raise or fluid challenge

Definitions



Septic Shock Refractory to Fluid Resuscitation:

1. Initiate norepinephrine infusion
2. Supplement calcium, ionized calcium target 1.2 – 1.3
3. Add vasopressin 0.04 units per minute infusion
4. Evaluate cardiac function by echo (TTE or TEE,) consider EDM or PA catheter, check $ScvO_2$,
5. Add steroids – hydrocortisone continuous infusion – 8.3 mg per hour via continuous infusion (200mg over 24 hours)
6. Add epinephrine continuous infusion

Recommendations: Initial Resuscitation and Infection Issues

http://www.survivingsepsis.org/Guidelines/Documents/Initial%20Resus%20Table.pdf

Recommendations: Initial Resuscitation and Infection Issues*

A. Initial Resuscitation

1. Protocolized, quantitative resuscitation of patients with sepsis-induced tissue hypoperfusion (defined in this document as hypotension persisting after initial fluid challenge or blood lactate concentration ≥ 4 mmol/L). Goals during the first 6 hrs of resuscitation:
 a) Central venous pressure 8–12 mm Hg
 b) Mean arterial pressure (MAP) ≥ 65 mm Hg
 c) Urine output ≥ 0.5 mL/kg/hr
 d) Central venous (superior vena cava) or mixed venous oxygen saturation 70% or 65%, respectively (grade 1C).

2. In patients with elevated lactate levels targeting resuscitation to normalize lactate (grade 2C).

B. Screening for Sepsis and Performance Improvement

1. Routine screening of potentially infected seriously ill patients for severe sepsis to allow earlier implementation of therapy (grade 1C).

2. Hospital–based performance improvement efforts in severe sepsis (UG).

C. Diagnosis

1. Cultures as clinically appropriate before antimicrobial therapy if no significant delay (> 45 mins) in the start of antimicrobial(s) (grade 1C). At least 2 sets of blood cultures (both aerobic and anaerobic bottles) be obtained before antimicrobial therapy with at least 1 drawn percutaneously and 1 drawn through each vascular access device, unless the device was recently (<48 hrs) inserted (grade 1C).

2. Use of the 1,3 beta-D-glucan assay (grade 2B), mannan and anti-mannan antibody assays (2C), if available, and invasive candidiasis is in differential diagnosis of cause of infection.

3. Imaging studies performed promptly to confirm a potential source of infection (UG).

Recommendations: Initial Resuscitation and Infection Issues (cont'd)

D. Antimicrobial Therapy

1. Administration of effective intravenous antimicrobials within the first hour of recognition of septic shock (grade 1B) and severe sepsis without septic shock (grade 1C) as the goal of therapy.

2a. Initial empiric anti-infective therapy of one or more drugs that have activity against all likely pathogens (bacterial and/or fungal or viral) and that penetrate in adequate concentrations into tissues presumed to be the source of sepsis (grade 1B).

2b. Antimicrobial regimen should be reassessed daily for potential deescalation (grade 1B).

3. Use of low procalcitonin levels or similar biomarkers to assist the clinician in the discontinuation of empiric antibiotics in patients who initially appeared septic, but have no subsequent evidence of infection (grade 2C).

4a. Combination empirical therapy for neutropenic patients with severe sepsis (grade 2B) and for patients with difficult-to-treat, multidrug-resistant bacterial pathogens such as *Acinetobacter* and *Pseudomonas* spp. (grade 2B). For patients with severe infections associated with respiratory failure and septic shock, combination therapy with an extended spectrum beta-lactam and either an aminoglycoside or a fluoroquinolone is for *P. aeruginosa* bacteremia (grade 2B). A combination of beta-lactam and macrolide for patients with septic shock from bacteremic *Streptococcus pneumoniae* infections (grade 2B).

4b. Empiric combination therapy should not be administered for more than 3–5 days. De-escalation to the most appropriate single therapy should be performed as soon as the susceptibility profile is known (grade 2B).

5. Duration of therapy typically 7–10 days; longer courses may be appropriate in patients who have a slow clinical response, undrainable foci of infection, bacteremia with *S. aureus;* some fungal and viral infections or immunologic deficiencies, including neutropenia (grade 2C).

6. Antiviral therapy initiated as early as possible in patients with severe sepsis or septic shock of viral origin (grade 2C).

7. Antimicrobial agents should not be used in patients with severe inflammatory states determined to be of noninfectious cause (UG).

Recommendations: Initial Resuscitation and Infection Issues (cont'd)

E. Source Control

1. A specific anatomical diagnosis of infection requiring consideration for emergent source control be sought and diagnosed or excluded as rapidly as possible, and intervention be undertaken for source control within the first 12 hr after the diagnosis is made, if feasible (grade 1C).

2. When infected peripancreatic necrosis is identified as a potential source of infection, definitive intervention is best delayed until adequate demarcation of viable and nonviable tissues has occurred (grade 2B).

3. When source control in a severely septic patient is required, the effective intervention associated with the least physiologic insult should be used (eg, percutaneous rather than surgical drainage of an abscess) (UG).

4. If intravascular access devices are a possible source of severe sepsis or septic shock, they should be removed promptly after other vascular access has been established (UG).

F. Infection Prevention

1a. Selective oral decontamination and selective digestive decontamination should be introduced and investigated as a method to reduce the incidence of ventilator-associated pneumonia; this infection control measure can then be instituted in health care settings and regions where this methodology is found to be effective (grade 2B).

1b. Oral chlorhexidine gluconate be used as a form of oropharyngeal decontamination to reduce the risk of ventilator-associated pneumonia in ICU patients with severe sepsis (grade 2B).

*Reprinted from Dellinger RP, Levy MM, Rhodes A, et al: Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock: 2012. *Crit Care Med.* 2013; 41:580-637

Recommendations: Hemodynamic Support and Adjunctive Therapy

http://www.survivingsepsis.org/Guidelines/Documents/Hemodynamic%20Support%20Table.pdf

Recommendations: Hemodynamic Support and Adjunctive Therapy*

G. Fluid Therapy of Severe Sepsis

1. Crystalloids as the initial fluid of choice in the resuscitation of severe sepsis and septic shock (grade 1B).

2. Against the use of hydroxyethyl starches for fluid resuscitation of severe sepsis and septic shock (grade 1B).

3. Albumin in the fluid resuscitation of severe sepsis and septic shock when patients require substantial amounts of crystalloids (grade 2C).

4. Initial fluid challenge in patients with sepsis-induced tissue hypoperfusion with suspicion of hypovolemia to achieve a minimum of 30 mL/kg of crystalloids (a portion of this may be albumin equivalent). More rapid administration and greater amounts of fluid may be needed in some patients (grade 1C).

5. Fluid challenge technique be applied wherein fluid administration is continued as long as there is hemodynamic improvement either based on dynamic (eg, change in pulse pressure, stroke volume variation) or static (eg, arterial pressure, heart rate) variables (UG).

H. Vasopressors

1. Vasopressor therapy initially to target a mean arterial pressure (MAP) of 65 mm Hg (grade 1C).

2. Norepinephrine as the first choice vasopressor (grade 1B).

3. Epinephrine (added to and potentially substituted for norepinephrine) when an additional agent is needed to maintain adequate blood pressure (grade 2B).

4. Vasopressin 0.03 units/minute can be added to norepinephrine (NE) with intent of either raising MAP or decreasing NE dosage (UG).

5. Low dose vasopressin is not recommended as the single initial vasopressor for treatment of sepsis-induced hypotension and vasopressin doses higher than 0.03-0.04 units/minute should be reserved for salvage therapy (failure to achieve adequate MAP with other vasopressor agents) (UG).

6. Dopamine as an alternative vasopressor agent to norepinephrine only in highly selected patients (eg, patients with low risk of tachyarrhythmias and absolute or relative bradycardia) (grade 2C).

Recommendations: Hemodynamic Support and Adjunctive Therapy (cont'd)

7. Phenylephrine is not recommended in the treatment of septic shock except in circumstances where (a) norepinephrine is associated with serious arrhythmias,
(b) cardiac output is known to be high and blood pressure persistently low or (c) as salvage therapy when combined inotrope/vasopressor drugs and low dose vasopressin have failed to achieve MAP target (grade 1C).

8. Low-dose dopamine should not be used for renal protection (grade 1A).

9. All patients requiring vasopressors have an arterial catheter placed as soon as practical if resources are available (UG).

I. Inotropic Therapy

1. A trial of dobutamine infusion up to 20 micrograms/kg/min be administered or added to vasopressor (if in use) in the presence of (a) myocardial dysfunction as suggested by elevated cardiac filling pressures and low cardiac output, or (b) ongoing signs of hypoperfusion, despite achieving adequate intravascular volume and adequate MAP (grade 1C).

2. Not using a strategy to increase cardiac index to predetermined supranormal levels (grade 1B).

J. Corticosteroids

1. Not using intravenous hydrocortisone to treat adult septic shock patients if adequate fluid resuscitation and vasopressor therapy are able to restore hemodynamic stability (see goals for Initial Resuscitation). In case this is not achievable, we suggest intravenous hydrocortisone alone at a dose of 200 mg per day (grade 2C).

2. Not using the ACTH stimulation test to identify adults with septic shock who should receive hydrocortisone (grade 2B).

3. In treated patients hydrocortisone tapered when vasopressors are no longer required (grade 2D).

4. Corticosteroids not be administered for the treatment of sepsis in the absence of shock (grade 1D).

5. When hydrocortisone is given, use continuous flow (grade 2D).

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*Reprinted from Dellinger RP, Levy MM, Rhodes A, et al: Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock: 2012. *Crit Care Med.* 2013; 41:580-637

Recommendations: Other Supportive Therapy of Severe Sepsis

http://www.survivingsepsis.org/Guidelines/Documents/Other%20supportive%20therapy.pdf

Recommendations: Other Supportive Therapy of Severe Sepsis*

K. Blood Product Administration

1. Once tissue hypoperfusion has resolved and in the absence of extenuating circumstances, such as myocardial ischemia, severe hypoxemia, acute hemorrhage, or ischemic heart disease, we recommend that red blood cell transfusion occur only when hemoglobin concentration decreases to <7.0 g/dL to target a hemoglobin concentration of 7.0 –9.0 g/dL in adults (grade 1B).

2. Not using erythropoietin as a specific treatment of anemia associated with severe sepsis (grade 1B).

3. Fresh frozen plasma not be used to correct laboratory clotting abnormalities in the absence of bleeding or planned invasive procedures (grade 2D).

4. Not using antithrombin for the treatment of severe sepsis and septic shock (grade 1B).

5. In patients with severe sepsis, administer platelets prophylactically when counts are <10,000/mm3 (10 x 109/L) in the absence of apparent bleeding. We suggest prophylactic platelet transfusion when counts are < 20,000/mm3 (20 x 109/L) if the patient has a significant risk of bleeding. Higher platelet counts (≥50,000/mm3 [50 x 109/L]) are advised for active bleeding, surgery, or invasive procedures (grade 2D).

L. Immunoglobulins

1. Not using intravenous immunoglobulins in adult patients with severe sepsis or septic shock (grade 2B).

M. Selenium

1. Not using intravenous selenium for the treatment of severe sepsis (grade 2C).

N. History of Recommendations Regarding Use of rhAPC

A history of the evolution of SSC recommendations as to rhAPC (no longer available) is provided.

Recommendations: Other Supportive Therapy of Severe Sepsis (cont'd)

O. Mechanical Ventilation of Sepsis-Induced ARDS

1. Target a tidal volume of 6 mL/kg predicted body weight in patients with sepsis-induced ARDS (grade 1A vs. 12 mL/kg).

2. Plateau pressures be measured in patients with ARDS and initial upper limit goal for plateau pressures in a passively inflated lung be ≤30 cm H2O (grade 1B).

3. Positive end-expiratory pressure (PEEP) be applied to avoid alveolar collapse at end expiration (atelectotrauma) (grade 1B).

4. Strategies based on higher rather than lower levels of PEEP be used for patients with sepsis-induced moderate or severe ARDS (grade 2C).

5. Recruitment maneuvers be used in sepsis patients with severe refractory hypoxemia (grade 2C).

6. Prone positioning be used in sepsis-induced ARDS patients with a Pao2/Fio2 ratio ≤100 mm Hg in facilities that have experience with such practices (grade 2B).

7. That mechanically ventilated sepsis patients be maintained with the head of the bed elevated to 30-45 degrees to limit aspiration risk and to prevent the development of ventilator-associated pneumonia (grade 1B).

8. That noninvasive mask ventilation (NIV) be used in that minority of sepsis-induced ARDS patients in whom the benefits of NIV have been carefully considered and are thought to outweigh the risks (grade 2B).

9. That a weaning protocol be in place and that mechanically ventilated patients with severe sepsis undergo spontaneous breathing trials regularly to evaluate the ability to discontinue mechanical ventilation when they satisfy the following criteria:
a) arousable; b) hemodynamically stable (without vasopressor agents); c) no new potentially serious conditions; d) low ventilatory and end-expiratory pressure requirements; and e) low Fio2 requirements which can be met safely delivered with a face mask or nasal cannula. If the spontaneous breathing trial is successful, consideration should be given for extubation (grade 1A).

10. Against the routine use of the pulmonary artery catheter for patients with sepsis induced ARDS (grade 1A).

11. A conservative rather than liberal fluid strategy for patients with established sepsis-induced ARDS who do not have evidence of tissue hypoperfusion (grade 1C).

Recommendations: Other Supportive Therapy of Severe Sepsis (cont'd)

12. In the absence of specific indications such as bronchospasm, not using beta 2-agonists for treatment of sepsis-induced ARDS (grade 1B).

P. Sedation, Analgesia, and Neuromuscular Blockade in Sepsis

1. Continuous or intermittent sedation be minimized in mechanically ventilated sepsis patients, targeting specific titration endpoints (grade 1B).

2. Neuromuscular blocking agents (NMBAs) be avoided if possible in the septic patient *without ARDS* due to the risk of prolonged neuromuscular blockade following discontinuation. If NMBAs must be maintained, either intermittent bolus as required or continuous infusion with train-of-four monitoring of the depth of blockade should be used (grade 1C).

3. A short course of NMBA of not greater than 48 hours for patients *with* early sepsis-induced ARDS and a Pao2/Fio2 < 150 mm Hg (grade 2C).

Q. Glucose Control

1. A protocolized approach to blood glucose management in ICU patients with severe sepsis commencing insulin dosing when 2 consecutive blood glucose levels are >180 mg/dL. This protocolized approach should target an upper blood glucose ≤180 mg/dL rather than an upper target blood glucose ≤ 110 mg/dL (grade 1A).

2. Blood glucose values be monitored every 1–2 hrs until glucose values and insulin infusion rates are stable and then every 4 hrs thereafter (grade 1C).

3. Glucose levels obtained with point-of-care testing of capillary blood be interpreted with caution, as such measurements may not accurately estimate arterial blood or plasma glucose values (UG).

R. Renal Replacement Therapy

1. Continuous renal replacement therapies and intermittent hemodialysis are equivalent in patients with severe sepsis and acute renal failure (grade 2B).

2. Use continuous therapies to facilitate management of fluid balance in hemodynamically unstable septic patients (grade 2D).

S. Bicarbonate Therapy

1. Not using sodium bicarbonate therapy for the purpose of improving hemodynamics or reducing vasopressor requirements in patients with hypoperfusion-induced lactic acidemia with pH ≥7.15 (grade 2B).

Recommendations: Other Supportive Therapy of Severe Sepsis (cont'd)

T. Deep Vein Thrombosis Prophylaxis

1. Patients with severe sepsis receive daily pharmacoprophylaxis against venous thromboembolism (VTE) (grade 1B). This should be accomplished with daily subcutaneous low-molecular weight heparin (LMWH) (grade 1B versus twice daily UFH, grade 2C versus three times daily UFH). If creatinine clearance is <30 mL/min, use dalteparin (grade 1A) or another form of LMWH that has a low degree of renal metabolism (grade 2C) or UFH (grade 1A).

2. Patients with severe sepsis be treated with a combination of pharmacologic therapy and intermittent pneumatic compression devices whenever possible (grade 2C).

3. Septic patients who have a contraindication for heparin use (eg, thrombocytopenia, severe coagulopathy, active bleeding, recent intracerebral hemorrhage) not receive pharmacoprophylaxis (grade 1B), but receive mechanical prophylactic treatment, such as graduated compression stockings or intermittent compression devices (grade 2C), unless contraindicated. When the risk decreases start pharmacoprophylaxis (grade 2C).

U. Stress Ulcer Prophylaxis

1. Stress ulcer prophylaxis using H2 blocker or proton pump inhibitor be given to patients with severe sepsis/septic shock who have bleeding risk factors (grade 1B).

2. When stress ulcer prophylaxis is used, proton pump inhibitors rather than H2RA (grade 2D)

3. Patients without risk factors do not receive prophylaxis (grade 2B).

V. Nutrition

1. Administer oral or enteral (if necessary) feedings, as tolerated, rather than either complete fasting or provision of only intravenous glucose within the first 48 hours after a diagnosis of severe sepsis/septic shock (grade 2C).

2. Avoid mandatory full caloric feeding in the first week but rather suggest low dose feeding (eg, up to 500 calories per day), advancing only as tolerated (grade 2B).

3. Use intravenous glucose and enteral nutrition rather than total parenteral nutrition (TPN) alone or parenteral nutrition in conjunction with enteral feeding in the first 7 days after a diagnosis of severe sepsis/septic shock (grade 2B).

4. Use nutrition with no specific immunomodulating supplementation rather than nutrition providing specific immunomodulating supplementation in patients with severe sepsis (grade 2C).

Recommendations: Other Supportive Therapy of Severe Sepsis (cont'd)

W. Setting Goals of Care

1. Discuss goals of care and prognosis with patients and families (grade 1B).

2. Incorporate goals of care into treatment and end-of-life care planning, utilizing palliative care principles where appropriate (grade 1B).

3. Address goals of care as early as feasible, but no later than within 72 hours of ICU admission (grade 2C).

*Reprinted from Dellinger RP, Levy MM, Rhodes A, et al: Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock: 2012. *Crit Care Med.* 2013; 41:580-637

Blood Transfusion Guidelines

Red Blood Cells

- Hemodynamically stable anemia without acute coronary syndrome: hemoglobin trigger less than 7 g/dL, with a transfusion goal to maintain hemoglobin 7 – 9 g/dL.
- Acute hemorrhage with evidence of hemodynamic instability or inadequate oxygen delivery
- Symptomatic (including tachycardia, tachypnea, postural hypotension) anemia (hemoglobin less than 10 g/dL) not explained by other causes
- Chronic transfusion dependent bone marrow syndromes: hemoglobin less than 10 g/dL.
- Transfusion or exchange transfusion for severe sickle syndromes.
- Hemodynamically stable anemia with ischemic heart disease: current evidence does not support routine transfusion in non-ST segment elevation acute coronary syndromes; although in ST-segment elevation myocardial infarction transfusion may be beneficial.

Platelets

- Platelet count less than or equal to 10,000/uL
- Increased risk of hemorrhage due to mucosal solid tumors, graft vs. host disease, or associated coagulopathy with platelet count less than or equal to 20,000/uL.
- Active hemorrhage with platelet count less than or equal to 50,000/uL.
- Invasive procedure with significant risk of bleeding with platelet count less than or equal to 50,000/uL.
- Intracranial or intraocular hemorrhage with platelet count less than or equal to 100,000/uL.
- Massive transfusion, replacement of more than 1 estimated blood volume.
- Acute trauma resuscitation in conjunction with red cell and plasma transfusion.
- Microvascular hemorrhage with evidence of platelet dysfunction.
- Relative contraindications to platelet transfusion, regardless of platelet count include: thrombotic thrombocytopenic purpura, hemolytic uremic syndrome, heparin induced thrombocytopenia, immune thrombocytopenic purpura and transfusion refractoriness due to alloantibodies.

Plasma

- Hemorrhage with coagulation factor deficiency (factor level < 50% or INR > 1.5)
- Invasive procedure with significant risk of bleeding and coagulation factor deficiency (factor level < 50% or INR > 1.5)
- Massive transfusion, replacement of more than 1 estimated blood volume.
- Acute resuscitation in trauma
- Thrombotic thrombocytopenic purpura
- Acute reversal of warfarin

Cryoprecipitate

- Hypofibrinogenemia (fibrinogen less than 100 mg/dL) without other indication for plasma transfusion.
- Hemorrhage with evidence of dysfibrinogenemia.
- Factor XIII deficiency.
- Uremic bleeding.

Blood Transfusion Guidelines (cont'd)

Clinical considerations in transfusion decision making

All transfusions

- Transfusion decisions are clinical judgments that should be based on the overall clinical assessment of the individual patient. Transfusion decisions should not be based on laboratory parameters alone.
- Routine premedication is not advised unless the patient has a history of previous transfusion reactions. Premedication has not been shown to reduce the risk of transfusion reactions

Red Blood Cells

- RBCs should be administered as single units for most operative and inpatient indications (transfuse and reassess strategy) except for ongoing blood loss with hemodynamic instability.
- Considerations in ordering RBC transfusions include:
    - Etiology of anemia. Patients with hemoglobinopathies may have greater transfusion requirements. Hemolysis may be due to a transfusion reaction.
    - Chronicity of anemia. In longstanding anemia, physiologic compensations may ameliorate some of the symptoms of anemia; whereas in acute blood loss there may not be time for compensations to take place.
    - Current hemoglobin level, prior hemoglobin levels, and rate of decline
    - Evidence for decreased oxygen delivery and the ability of increased Hb/Hct to alleviate this condition: Oxygen delivery to tissues is dependent on hemoglobin, oxygenation, and cardiac output.
    - Ability to compensate for anemia without unacceptable risk of adverse outcomes as a result of compensatory mechanisms, such as impact of underlying cardiac disease.
    - Expectation of continued blood loss. If blood loss is ongoing or likely then transfusion may be indicated at a higher hemoglobin level then when there is no expectation of further blood loss.
    - Expectation for hemoglobin recovery from ongoing hematopoiesis.
    - Potential adverse events associated with blood product transfusions including: hemolytic, allergic and febrile reactions; volume overload, and iron overload.
    - Need to acutely reverse anemia and the ability of other longer acting treatment regimens (i.e. iron or ESAs) to treat underlying cause of anemia
    - Transfusions should not be used solely for volume expansion

Platelets

- Considerations in ordering platelet transfusions include:
    - Current platelet count.
    - Etiology of thrombocytopenia. Consumptive processes such as DIC, bleeding, and GVHD will shorten post-transfusion platelet survival.
    - Current platelet function. Some medications (i.e. aspirin, Plavix) or some disease processes (i.e. uremia) may decrease platelet function.
    - Body size. Patients with body surface area greater than 2m2 may require a larger platelet dose.
    - Spleen size. Splenomegaly for any reason will significantly decrease the effectiveness of platelet transfusions. Splenectomized patients may have larger post-transfusion platelet increments than individuals with normal spleens.
    - Underlying conditions that may increase risk of critical hemorrhage.

Blood Transfusion Guidelines (cont'd)

  - Alloimmunization to platelet or HLA antigens.
  - Antiplatelet medications. Medications such as aspirin or clopidogrel may, but do not necessarily, contribute to hemorrhage risk. Factors influencing bleeding risk include dose, time since last dose, and individual response or drug resistance.
  - Potential adverse effects associated with platelet transfusion include: allergic reactions, bacterial contamination, transfusion-related acute lung injury and immunization to platelet antigens.
- A post-transfusion platelet count should be obtained 10 minutes to 1 hour after transfusion for best assessment of transfusion effectiveness
- Transfusion of one platelet pool (i.e. 5-pack) or one unit of apheresis platelets will typically increase the platelet count of an adult by 20,000 – 40,000/µL.
- The patient should be reassessed after each platelet unit transfused before ordering additional units

Plasma

1. A plasma dose of 10 ml/kg will typically provide sufficient coagulation factors to achieve hemostasis. Factor levels in donor plasma are variable, but can be assumed to be approximately 1 U/ml.
2. Plasma may be provided as Fresh Frozen Plasma, Plasma Frozen Within 24 Hours Of Phlebotomy, or Plasma interchangeably.
3. Plasma transfusion has very little effect on mild coagulopathies (INR ≤ 1.5).
4. Potential adverse effects of plasma transfusion include: allergic reactions, transfusion-related acute lung injury, and volume overload

Cryoprecipitate

- Cryoprecipitated antihemophilic factor (CAF or "cryo") contains Factor VIII, von Willebrand's factor, fibrinogen, and Factor XIII. Each unit contains a minimum of 80 U of Factor VIII and typically 250 mg of fibrinogen

Transfusion Utilization Review

The Office of Clinical Affairs, with the approval of ECCA, will establish a process for peer review of the appropriateness of transfusions. The process will include:

- A process for data collection
- A process for screening transfusion events according to these guidelines
- A process for peer review of transfusion events according to these guidelines
- A process for reporting transfusion review results to ordering physicians, the medical staff leadership, and the Transfusion Committee

Approved by ECCA, March 24, 2009, University of Michigan.
Authors: Bahl V, Davenport R, Dwyer S, Laing T, Napolitano L, Picton P, Rosenberg A, Rohde J.
http://i.surgery.med.umich.edu/acs/files/Adult%20Blood%20Transfusion%20Clinical%20Guidelines%20final%202009.pdf

Treatment of Severe Anemia in Jehovah's Witness Patients

1. **Epo 40,000 units IV daily** until hemoglobin increases to at least 7 g/dL
    a. Then decrease dose by 50% daily if continuing to improve
    b. Ideally would like to see hemoglobin increase to 8 g/dL
    c. Mortality in JH is very high if hemoglobin decreases to < 5 gm/dL

2. **Iron Sucrose 100 mg IV daily** until hemoglobin is > 7 gm/dL
    a. Re-evaluate at 10days, if still anemic, and still on ESA, continue IV iron therapy

3. **Minimize blood loss** with daily ABG which is 1cc blood with Hbg/lytes (preferred for severe anemia) or alternatively with pediatric testing tubes

4. **Avoid hemodilution** with crystalloid
    a. Heplock IV and continue with PO diet only
    b. Diuresis if fluid balance significantly positive to allow hem concentration

5. If continued life-threatening anemia (hemoglobin <5g/dL or signs of critical anemia) consider transfusion of Hemopure (bovine hemoglobin substitute) on compassionate use basis with Emergency IND by FDA – call Dr. Robert Davenport, Hemopure obtained from Investigational Drug Pharmacy for transfusion (not Blood Bank)

References:

- Gannon, CJ, Napolitano, LM. Severe anemia after gastrointestinal hemorrhage in a Jehovah's Witness: new treatment strategies. *Crit Care Med.* 2002 Aug: 30(8): 1893-5.
- Charles A, Purtill M, Napolitano LM. Recombinant human erythropoietin in severe anemia: issues of dosing and duration. Anesth Intensive Care. 2006 Dec; 34(6): 793-6.
- Donahue LL, Shapira I, Shaneer A, Kolitz J, Allen S, Greengerb G. Management of acute anemia in a Jehovah's Witness patient with acute lymphoblastic leukemia with polymerized bovine hemoglobin-based oxygen carrier: a case report and review of literature. Transfusion. 2010 Jul; 50(7): 1561-7.

Hemopure

Hemoglobin-based Oxygen Carrier (HBOC) from bovine source

Hemopure Attributes

Ready to Use
Hemopure requires no preparation prior to use due to the following attributes:

- **Stable for three years at room temperature** (2° to 30° C) and does not require refrigeration, warming or reconstitution;
- **Compatible with all blood types** and does not require blood typing, testing or cross-matching;
- **Ultra-purified** through a patented pharmaceutical manufacturing process that has been demonstrated to remove or inactivate potential contaminants, including infectious agents (e.g. viruses, bacteria and TSE agents).

Carries Oxygen
To date, more than 200 preclinical animal and laboratory studies have been conducted. This body of data suggests that Hemopure transports oxygen to tissues more efficiently and more uniformly than red blood cells and increases the oxygen-carrying efficiency of circulating red blood cells.

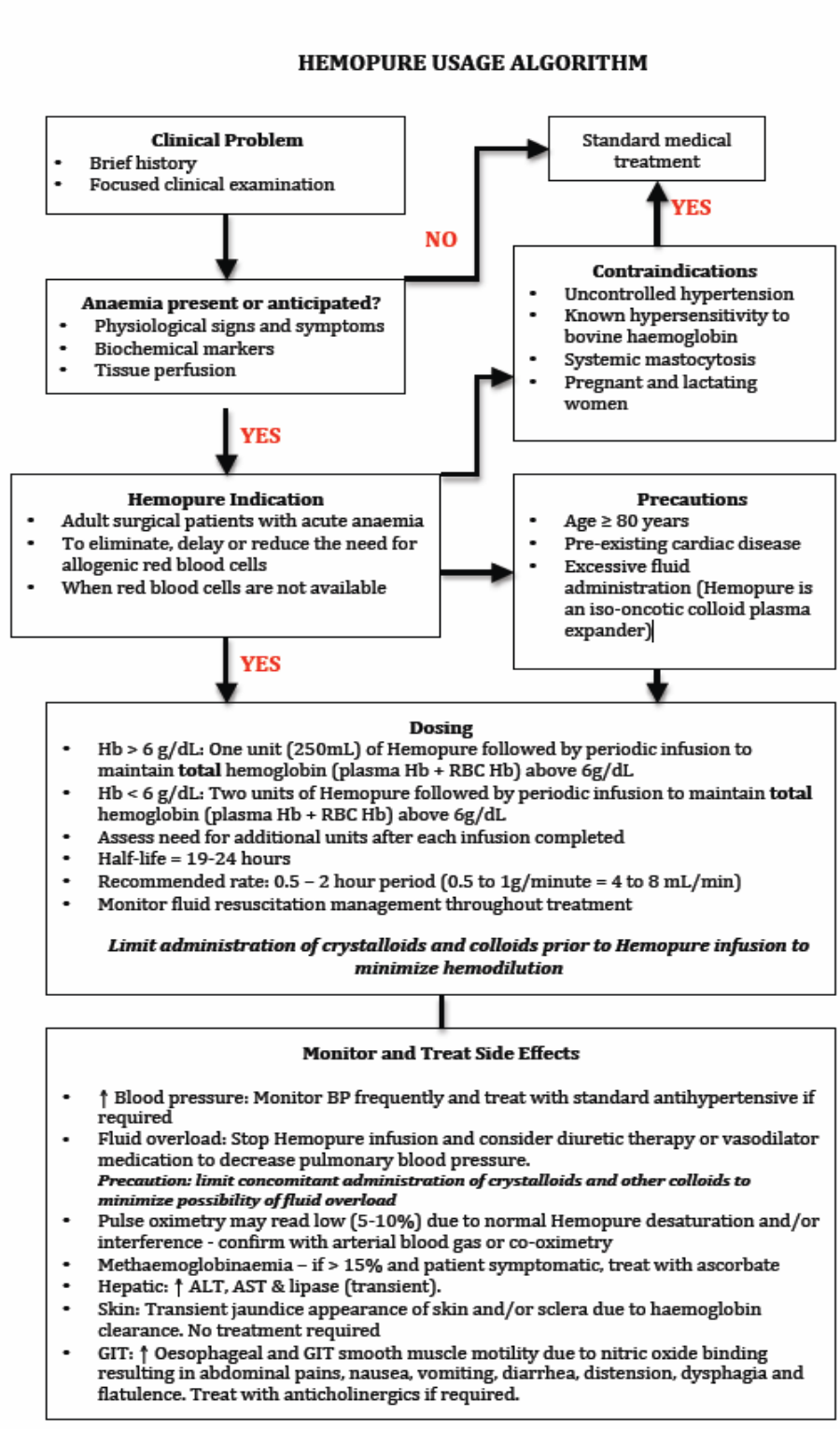
- Preclinical data have shown that the stabilized hemoglobin molecules in Hemopure are three times more efficient than natural red blood cells in their ability to oxygenate tissues.
- Hemopure transports oxygen immediately upon administration and under ambient conditions (i.e., works with room air and does not require an oxygen mask).
- In vitro studies suggest that the stabilized hemoglobin in Hemopure further facilitates oxygen transport by increasing the loading of oxygen to red blood cells in the lungs and by improving oxygen off-loading from red blood cells to tissues. In this capacity, the plasma hemoglobin acts as a "shuttle" that carries oxygen between the red blood cell and the capillary wall.

How to administer:

1. Administer 1 unit Hemopure over 1 hour IV.
2. Measure free hemoglobin (effect of Hemopure transfusion) and patient hemoglobin, add together for total hemoglobin, aim for total hemoglobin > 7 g/dL
3. Adverse effects include hypertension (slow infusion) and methemoglobinemia (seen with large volume of Hemopure transfusion, consider methylene blue if patient symptomatic).
4. Lab assays may be affected, since patient blood will look hemolyzed, make lab aware that you are administering a hemoglobin-based oxygen carrier.

Please call Dr. Lena Napolitano (Page #15324) if any questions.
Additional Information available at:
http://opkbiotech.com/

Hemopure Use Algorithm



Practical guidelines

- Hemopure is stable at room temperature for up to 3 years
- Remove overwrap prior to use and use within 24 hours once opened
- Standard IV infusion set through central or peripheral vein
- Do not use blood transfusion filter
- Do not administer fluids or medications in the same infusion set
- Do not add medications or solutions to the bag

Laboratory interference

- Serum/plasma samples should be identified as containing Hemopure to avoid confusion with hemolysis
- Hemopure's intense red coloration can interfere with laboratory tests based on colorimetric / optical methodologies and protein measurements
- Exact interference levels varies from one instrument type to another but in general results will be accurate for BUN, Calcium, Ionized Calcium, Chloride, CK-MB, Creatinine, Glucose, Potassium, Sodium
- In general results in the presence of Hemopure will **NEVER BE ACCURATE** for Albumin, Alkaline Phosphatase, ALT, Amylase, AST, Bilirubin, GGT, LDH, Magnesium, Phosphorous, Total Protein, Uric Acid
- Results for Cholesterol, CRP, lactate, LDH, lipase, Troponin I, Troponin T can be accurate in the presence of moderate Hemopure levels (1g/dL)
- PT and aPTT accurate using magnetic and light scattering methods
- Optical methods not reliable for coagulation assays
- No interference with haematology except that Haematocrit **MUST NOT** be calculated from Total Haemoglobin (combination of RBC haemoglobin and Hemopure)
- No interference with urinalysis testing
- No interference 4 days after the last infusion of Hemopure

ICU Electrolyte Replacement Protocol

https://pharmwebsp.med.umich.edu/GuideLines/Nutrition%20and%20Electrolytes/AdultICUElectrolyteProtocol.pdf

UNIVERSITY OF MICHIGAN HEALTH-SYSTEM
Adult Intensive Care Unit Electrolyte Dosing Guidelines

WARNINGS AND PRECAUTIONS

- Patients with renal insufficiency are exempt from these guidelines (e.g., serum creatinine ≥ 2 mg/dL, or patients on any form of renal replacement therapy (intermittent or continuous)).
- These guidelines are meant to assist with empiric dosing of electrolytes for ICU patients; doses may need to be adjusted based on patient-specific factors and responses to initial doses.
- Goal serum concentrations may also need to be adjusted based on patient-specific factors.
- These guidelines are for routine supplementation of electrolytes; **they are not meant for treatment in urgent or emergent situations**.

POTASSIUM

Goal serum potassium concentration 4.0 – 5.0 mEq/L

Treatment of Hypokalemia

*RN to decide route based on available access.

Any dose above 20 mEq may be administered as a combination of oral & intravenous.

Serum potassium concentration	Intravenous potassium dose† Max IV is 20 mEq/hour	Oral potassium dose	Recheck serum potassium concentration
3.8 – 3.9 mEq/L	20 mEq IVPB	20 mEq (1 packet)	Within 2-4 hours of completing dose
3.5 – 3.7 mEq/L	40 mEq IVPB	40 mEq (2 packets)	Within 2-4 hours of completing dose
3.2 – 3.4 mEq/L	60 mEq IVPB	60 mEq (3 packets)	Within 2-4 hours of completing dose
< 3.1 mEq/L	80 mEq and **notify MD**	80 mEq (4 packets) and **notify MD** Must be administered in combination with IV	Immediately after completing dose

† **Rate of Intravenous Potassium Infusion**	10 mEq potassium/hour; can increase to 20 mEq/hour, but continuous cardiac monitoring and infusion via a central venous catheter are recommended for infusion rates > 10 mEq potassium/hour. Maximum of 40 mEq potassium/hour in emergency situations.
Maximum Potassium Concentration	80 mEq/L via a peripheral vein; up to 120 mEq/L via a central vein (admixed in NS or ½ NS)

****Consider adding scheduled oral potassium chloride as indicated****

References:
Kruse JA, Carlson RW. Rapid correction of hypokalemia using concentrated intravenous potassium chloride infusions. *Arch Intern Med.* 1990; 150:613-617.
Kruse JA, Clark VL, Carlson RW, et al. Concentrated potassium chloride infusions in critically ill patients with hypokalemia. *J Clin Pharmacol.* 1994; 34:1077-1082.
Hamill RJ, Robinson LM, Wexler HR, et al. Efficacy and safety of potassium infusion therapy in hypokalemic critically ill patients. *Crit Care Med.* 1991; 9:694-699.

CALCIUM

Goal serum ionized calcium concentration 1.12 – 1.3 mmol/L

Treatment of Hypocalcemia

Oral treatment preferred when possible.

IV treatment preferred whenever patient is symptomatic.

Serum ionized calcium concentration	Oral Calcium Citrate dose	Intravenous Calcium Gluconate dose	Recheck serum calcium concentration
1.05 – 1.11 mmol/L	2 tablets	1 g over 30 – 60 minutes	With next AM lab draw
0.99 – 1.04 mmol/L	3 tablets	2 g over 30 – 60 minutes	Within 4 – 6 hours of completing dose
0.93 – 0.98 mmol/L	Not recommended	3 g over 60 minutes	Within 4 – 6 hours of completing dose
<0.93 mmol/L	Not recommended	4 g over 60 minutes and **notify MD**	Within 4 – 6 hours of completing dose

1 g calcium citrate = 10.5 mEq calcium.

Each tablet of calcium citrate + vitamin D contains 315 mg of calcium citrate (66 mg elemental calcium, 3.3 mEq calcium) and 250 units of vitamin D (cholecalciferol).

1 g calcium gluconate = 4.56 mEq calcium

Maximum rate of intravenous infusion = 1.5 mEq calcium/minute

Corrected serum [Ca^{++}] (mg/dL) = measured serum [Ca^{++}] (mg/dL) + [0.8 x (4 – serum albumin (g/dL))]

References:
Olinger ML. Disorders of calcium and magnesium metabolism. *Emerg Med Clin North Am.* 1989; 7:795-822.
Joy MS, Hladik GA. Disorders of sodium, water, calcium, and phosphorus homeostasis. In: Dipiro JT, Talbert RL, Yee GC, et al, eds. Pharmacotherapy: A Pathophysiologic Approach. 5th ed. New York, NY: McGraw-Hill; 2002:953-979.
Lacy CH, Armstrong LL, Goldman MP, et al. eds. Drug Information Handbook. 11th ed. Hudson, OH: Lexi-Comp Inc; 2003.

ICU Electrolyte Replacement Protocol (cont'd)

MAGNESIUM

Goal serum magnesium concentration 2.0 – 2.4 mg/dL

Intravenous Treatment of Hypomagnesemia

Serum magnesium concentration	Intravenous magnesium sulfate dose†	Oral magnesium oxide dose	Recheck serum magnesium concentration
1.6 – 1.9 mg/dL	2 g	800 mg	4 to 6 hours after dose if symptomatic otherwise with next AM lab draw
1.0 – 1.5 mg/dL	4 g	Not recommended	4 to 6 hours after dose if symptomatic otherwise with next AM lab draw
< 1.0 mg/dL	6 g and **notify MD**	Not recommended	4 to 6 hours after dose if symptomatic otherwise with next AM lab draw
Rate of intravenous infusion of magnesium	Recommend infusing 1 g magnesium sulfate/hour (~8 mEq magnesium/hour), up to maximum of 2 g magnesium sulfate/hour (doses of up to 32 mEq magnesium can be given over 4 – 5 minutes in **severe symptomatic hypomagnesemia** (urgent or emergent situation))		

† 1 g magnesium sulfate = 8.1 mEq magnesium

****Consider adding scheduled oral magnesium oxide as indicated****

References:

Heaton FW. The kidney and magnesium homeostasis. *Ann NY Acad Sci.* 1969; 162:775-785.

Martin HE. Clinical magnesium deficiency. *Ann NY Acad Sci.* 1969; 162:891-900.

Salem M, Munoz R, Chernow B. Hypomagnesemia in critical illness: a common and clinically important problem. *Crit Care Clin.* 1991; 7:225-252.

Dickerson RN, Brown RO. Hypomagnesemia in hospitalized patients receiving nutritional support. *Heart & Lung.* 1985; 14:561-569.

Rasmussen HS, McNair P, Norregard P, et al. Intravenous magnesium in acute myocardial infarction. *Lancet.* 1986 Feb 1; 1(8475):234-236.

Ceremuzynski L, Hao NV. Ventricular arrhythmias late after myocardial infarction are related to hypomagnesemia and magnesium loss: preliminary trial of corrective therapy. *Clin Cardiol.* 1993; 16:493-496.

Flink EB. Therapy of magnesium deficiency. *Ann NY Acad Sci.* 1969; 162:901-905.

Oster JR, Epstein M. Management of magnesium depletion. *Am J Nephrol.* 1988; 8:349-354.

Sacks GS, Brown RO, Dickerson RN, et al. Mononuclear blood cell magnesium content and serum magnesium concentration in critically ill hypomagnesemic patients after replacement therapy. *Nutrition.* 1997; 13:303-307.

Hebert P, Mehta N, Wang J, et al. Functional magnesium deficiency in critically ill patients identified using a magnesium-loading test. *Crit Care Med.* 1997; 25:749-755.

Huycke MM, Naguib MT, Stroemmel MM, et al. *Antimicrob Agents Chemother.* 2000; 44:2143-2148.

ICU Electrolyte Replacement Protocol (cont'd)

PHOSPHORUS / PHOSPHATE
Goal serum phosphorus concentration 2.7 – 4.6 mg/dL

Intravenous Treatment of Hypophosphatemia

Serum phosphorus concentration	Intravenous phosphate dose*†	Oral phosphate dose	Recheck serum phosphorus concentration
2.0 – 2.6 mg/dL	15 mmol over 2 hours	500 mg (16 mmol, 2 packets)	With next AM lab draw
1.5 – 2.0 mg/dL	30 mmol over 4 hours	1000 mg (32 mmol, 4 packets)	Within 4 – 6 hours of completing dose
< 1.5 mg/dL	45 mmol over 6 hours	Not recommended	Within 4 – 6 hours of completing dose

*Maximum infusion rate = 7 mmol phosphate/hour.

Per protocol all intravenous doses will be replaced as sodium phosphate. If patient is hypernatremic or hypokalemic, contact physician regarding possibly replacing as potassium phosphate instead. A separate order will be needed for potassium phosphate.

1 mMol sodium phosphate = 1.33 mEq sodium

1 mMol potassium phosphate = 1.47 mEq potassium

Each packet of oral phosphate replacement contains 8 mmol phos, 7 mEq potassium, 7 mEq sodium

References:
Lentz RD, Brown DM, Kjellstrand CM. Treatment of severe hypophosphatemia. *Ann Intern Med.* 1978; 89:941-944.
Vannatta JB, Whang R, Papper S. Efficacy of intravenous phosphorous therapy in the severely hypophosphatemic patient. *Arch Intern Med.* 1981; 141:885-887.
Andress DL, Vannatta JB, Whang R. Treatment of refractory hypophosphatemia. *South Med J.* 1982; 75:766-767.
Vannatta JB, Andress DL, Whang R, et al. High-dose intravenous phosphorus therapy for severe complicated hypophosphatemia. *South Med J.* 1983; 76:1424-1426.
Kingston M, Al-Siba'i MB. Treatment of severe hypophosphatemia. *Crit Care Med.* 1985; 13:16-18.
Rosen GH, Boullata JI, O'Rangers EA, et al. Intravenous phosphate repletion regimen for critically ill patients with moderate hypophosphatemia. *Crit Care Med.* 1995; 23:1204-1210.
Clark CL, Sacks GS, Dickerson RN, et al. Treatment of hypophosphatemia in patients receiving specialized nutrition support using a graduated dosing scheme: results from a prospective clinical trial. *Crit Care Med.* 1995; 23:1504-1510.

Early Mobility Program

Phase 0	Phase 1	Phase 2
Range of Motion Passive (3x/day, 10 repetitions) Active (3x/day, 10 repetitions)	Range of Motion Passive (3x/day, 10 repetitions) Active (3x/day, 10 repetitions)	Range of Motion Resistance (3x/day, 10 repetitions)
HOB Elevated 30-45 degrees Or Reverse Trendelenberg	HOB Elevated 30-45 degrees Or Reverse Trendelenberg	HOB Elevated 30-45 degrees Reposition (every 2 hours)
Reposition (every 2 hours)	Reposition (every 2 hours)	Standing (3x/day)
Continuous Lateral Rotation (18-24 hours per day)	Chair position or OOB with sling (3x/day)	OOB (bear own weight) (3x/day)
If patient tolerates these activities, advance to next phase	Dangling (3x/day)	Walking (3x/day)

Adult Guidelines for Continuous Infusions in the Intensive Care Unit

(Order set found under MiChart "Adult Medication Infusions")

https://pharmwebsp.med.umich.edu/_layouts/15/WopiFrame.aspx?sourcedoc=/GuideLines/Critical%20Care%20-%20Cardiology/Adult%20Guidelines%20for%20Continuous%20Infusions%20in%20ICU%20ED%20and%20%20Progressive%20Care%20Units.docx&action=default&DefaultItemOpen=1

University of Michigan Health System
Department of Pharmacy Services
Adult Guidelines for Continuous Infusions in the Intensive Care Unit (includes 8D) and Emergency Department*

MEDICATION	UMHS STANDARD CONCENTRATION	STARTING DOSE/TITRATION	MAXIMUM DOSE	NOTES
SEDATIVE AGENTS				
Midazolam (Versed ®)	1 mg/ml (50 mg/50 ml or 100 mg/100 ml)	2-4 mg/hour May increase by 1 mg every 10 minutes to desired level of sedation (RASS) or max dose	20 mg/hour	Wean as tolerated each shift. May observe loss of short duration/rapid offset of sedative effect with prolonged (> 48 hours) use as continuous infusion without interruption. Taper benzodiazepine drips over at least 3 days if at high doses or used continuously >7 days to avoid withdrawal. Elderly: Start 30% lower & titrate slowly to avoid accumulation. Central or peripheral administration
Lorazepam (Ativan ®)	2 mg/ml (100 mg/50 ml)	1 – 2 mg/hour May increase by 1 mg every 30 minutes to desired level of sedation (RASS) or max dose	10 mg/hour	Wean as tolerated each shift. Potential polyethylene glycol and propylene glycol accumulation and toxicity with prolonged use of high doses. Taper benzodiazepine drips over at least 3 days if at high doses or used continuously >7 days to avoid withdrawal. Elderly: Start 30% lower & titrate slowly to avoid accumulation. Central or peripheral administration
Propofol (Diprivan ®)	10 mg/ml (1000 mg/100 ml; 500 mg/50 ml)-PREMIX	5-10 mcg/kg/min IV for 5 min then titrate in 5-10 mcg/kg/min increments every 5 min until desired effect (RASS) or max. dose	80 mcg/kg/minute	Prepared in 10% lipid emulsion, monitor serum triglyceride (TG) concentration every 3 – 7 days, consider alternative agent if serum TG ≥ 400 mg/dL. Prolonged use (> 48 hours) of doses > 80 mcg/kg/minute has been associated with an increased risk of cardiac arrest. Use when rapid awakening desired or short term intubations <48 hr. Central or peripheral administration; peripheral has risk of thrombophlebitis
Haloperidol (Haldol ®)	5mg/ml	4 mg/hour; May increase by 2mg/hour until max dose.	10 mg/hour or 100 mg in 24 hours (Elderly 50 mg/24 hrs)	Used for the treatment of delirium. Lowers seizure threshold; baseline EKG suggested; may prolong QT interval. Continuous infusion (100 mg/100ml) rarely used; Elderly: start at 50% lower dose. Central or peripheral administration
Dexmedetomidine (Precedex ®)	4 mcg/ml (200 mcg/50 ml)	0.2 mcg/kg/hour. Titrate in increments of 0.1-0.2 mcg/kg/hour every 20 minutes to RASS. If used for >3-5 days, should be titrated down in increments of 0.1-0.2 mcg/kg/hour every 6-12 hours, due to risk of withdrawal (rebound hypertension)	1.5 mcg/kg/hour	**RESTRICTIONS:** 1. Inadequate sedation, intolerance, or adverse effects with benzodiazepines and propofol 2. Severe agitation when other sedative agents are discontinued, to facilitate extubation 3. Adjunct to opioids for pain control in patients who have previously been maintained on buprenorphine, in accordance with UMHS Guidelines for the Perioperative Management of Buprenorphine Requires ICU attending or fellow approval for 1 & 2, APS attending approval for number 3; Central or peripheral administration.

*** Doses listed above are suggested maximum doses for patient safety; start at lowest dose when titrating unless clinical condition requires higher dose. Some clinical conditions may warrant the use of doses higher than those listed above. Unless otherwise specified, the same concentration is used in UH and CVICU.**

MEDICATION	UMHS STANDARD CONCENTRATION	STARTING DOSE/TITRATION	MAXIMUM DOSE	NOTES
ANALGESIC AGENTS				
Morphine sulfate	1 mg/ml (100 mg/100 ml)	2-4 mg/hour (0.02-0.05 mg/kg/hr). May titrate by 1-2 mg/hr every 30 minutes to pain scale or RASS scale.	20 mg/hour	Titrate based on patient's level of pain Central or peripheral administration
Hydromorphone (Dilaudid ®)	0.5 mg/ml (50 mg/100 ml)	0.2-0.4 mg/hour (0.002-0.005 mg/kg/hr) May titrate by 0.1 – 0.2 mg/hr every 30 minutes to pain scale or RASS scale.	3 mg/hour	1 mg hydromorphone = 7-10 mg of morphine Titrate based on patient's level of pain Central or peripheral administration
Fentanyl citrate	10 mcg/ml (1000mcg/100ml) UH 50 mcg/ml (2000 mcg/40 ml) CVICU	12.5-25 mcg/hour May titrate by 25 mcg/hr every 15 minutes based on patient's level of pain or RASS score.	200 mcg/hour	Central or peripheral administration
NEUROMUSCULAR BLOCKING AGENTS – Requires patient intubation & sedation				
Vecuronium	200 mcg/ml (50 mg/250 ml)	Bolus 0.1 mg/kg x 1, then start infusion at 1 mcg/kg/min. May titrate by 0.1 mcg/kg/min every 10 minutes.	2 mcg/kg/min	Monitor with peripheral nerve stimulation (Train-of Four) q 4 hrs. Titrate to goal of 1-2 twitches out of 4 or desired effect. Avoid in patients with severe renal and/or hepatic impairment Central or peripheral administration
Atracurium	10 mg/ml (1000 mg/100 ml)	Bolus 0.3 mg/kg x 1, then start infusion at 5 mcg/kg/min. May titrate by 2.5-5 mcg/kg/min every 10 minutes.	30 mcg/kg/min	Consider omitting bolus dose in hypotensive patients; if bolus used give bolus over at least 2 minutes, faster rates may lead to hypotension Monitor with peripheral nerve stimulation (Train-of Four) q 4 hrs. Titrate to goal of 1-2 twitches out of 4 or desired effect. Central or peripheral administration.
Cisatracurium (Nimbex ®)	2 mg/ml (200 mg/100 ml) UH 4 mg/ml (200 mg/50 ml) CVICU	Bolus: 0.1 mg/kg Infusion: 3 mcg/kg/min May titrate by 1 mcg/kg/min every 10 minutes.	10 mcg/kg/minute	Monitor with peripheral nerve stimulation (Train-of Four) q 4 hrs. Titrate to goal of 1-2 twitches out of 4 or desired effect. Safe to use in renal or hepatic dysfunction. Central or peripheral administration.
VASOPRESSOR AGENTS				
Epinephrine	20 mcg/ml (5 mg/250 ml) UH (1 mg/50 ml) CVICU	0.1 mcg/kg/min Titrate by 0.01- 0.05 mcg/kg/min every 5 minutes. Titrate to SBP or MAP.	1 mcg/kg/minute	Central preferred; peripheral in emergency situation (risk of extravasation).
Norepinephrine (Levophed ®)	64 mcg/ml (16 mg/250 ml) UH 80 mcg/ml (4 mg/50 ml) CVICU	0.1 mcg/kg/min Titrate by 0.01-0.05 mcg/kg/min every 5 minutes. Titrate to SBP or MAP.	1 mcg/kg/minute	Central preferred; peripheral in emergency situation (risk of extravasation).

*** Doses listed above are suggested maximum doses for patient safety; start at lowest dose when titrating unless clinical condition requires higher dose. Some clinical conditions may warrant the use of doses higher than those listed above. Unless otherwise specified, the same concentration is used in UH and CVICU.**

MEDICATION	UMHS STANDARD CONCENTRATION	STARTING DOSE/TITRATION	MAXIMUM DOSE	NOTES
VASOPRESSOR AGENTS (CONT)				
Dopamine	1.6 mg/ml (400 mg/250 ml) PREMIX - UH 3.2 mg/ml (800mg/250 ml) PREMIX - UH 4 mg/ml (200 mg/50 ml) CVICU	2-5mcg/kg/min Titrate by 1- 5 mcg/kg/min every 5 minutes until desired response or max dose. Titrate to SBP or MAP.	20 mcg/kg/minute	Central preferred; peripheral in emergency situation (risk of extravasation); less than 5 mcg/kg/min peripheral is allowed.
Phenylephrine (NeoSynephrine®)	200 mcg/ml (50 mg/250 ml) UH (10 mg/50 ml) CVICU	Initial: 50-180 mcg/min until BP stable; then reduce rate as tolerated Titrate by 20 mcg/min every 5 minutes to SBP or MAP.	300 mcg/minute	Bolus dose: 50-200 mcg,(maximum 500 mcg) Central preferred; peripheral in urgent situation (risk of extravasation)
Vasopressin (Pitressin ®)	1 Unit/ml (50 Units/50 ml) UH (50 Units/50 ml) CVICU	0.01-0.04 Units/min (sepsis). May titrate off in sepsis patients. 1 unit/hour (cardiac)	0.04 Units/minute (sepsis) 5 units/hour (cardiac)	Used for the treatment of refractory hypotension in sepsis. Reports suggest that use of doses > 0.04 Units/minute is associated with an increased incidence of adverse effects (e.g., cardiac arrest). Central preferred; peripheral in emergency situation (risk of extravasation). Titrate other pressors as able. Titration by prescriber order only.
ANTIHYPERTENSIVE/RATE CONTROL AGENTS				
Nitroprusside (Nipride ®)	200 mcg/ml (50 mg/250 ml) 400 mcg/ml (100 mg/250ml)	Initial: 0.5 mcg/kg/min Titrate in increments of 0.5 mcg/kg/min to desired hemodynamic effect (SBP or MAP).	10 mcg/kg/minute	Requires arterial line for BP monitoring. 0.9% NaCl is the preferred base solution. 500 mg sodium thiosulfate added to each bag to bind cyanide. Monitor thiocyanate levels every 2 – 5 days, especially in patients with renal dysfunction, receiving high doses and/or a longer duration of therapy. Monitoring of cyanide levels is not recommended. Central or peripheral administration.
Nitroglycerin	0.4 mg/ml (100 mg/250 ml) PREMIX - UH 1 mg/ml (50 mg/50 ml) CVICU	Initial: 10 mcg/min; Titrate in 5-10 mcg/min increments every 5 min to desired response	200 mcg/minute	Titrate to chest pain free, SBP or MAP. Central or peripheral administration; peripheral has risk of thrombophlebitis.
Esmolol (Brevibloc ®)	20 mg/ml (2000 mg/100 ml)-PREMIX	Initial: 50mcg/kg/min Titrate by 50 mcg/kg/min in 4 minute intervals to desired effect (HR, SBP or MAP).	300 mcg/kg/minute	Loading doses are not necessary due to rapid onset of action. Central or peripheral administration.
Labetalol (Normodyne ®)	2 mg/ml (500 mg/250 ml)	Initial: 20 mg IV over 2 minutes followed by IV infusion at 1 mg/min. Titrate by 0.5 mg/minute every 30 minutes to BP goal.	3 mg/minute	**Continuous infusion is not generally recommended** due to long duration of action and possibility for prolonged bradycardia and/or hypotension even after discontinuation of infusion. Central or peripheral administration.
Metoprolol (Lopressor ®)	1 mg/mL (50 mg/50 ml)	Initial: 1 mg/hr, titrate in increments of 0.5 – 1 mg/hr **every 30 minutes**	20 mg/hour	**Continuous infusion is not generally recommended**. Used for control of heart rate in patients who cannot tolerate large fluid load associated with esmolol administration, and who cannot tolerate potential decrease in BP due to alpha-blockade associated with labetalol use. Central or peripheral administration.

*** Doses listed above are suggested maximum doses for patient safety; start at lowest dose when titrating unless clinical condition requires higher dose. Some clinical conditions may warrant the use of doses higher than those listed above. Unless otherwise specified, the same concentration is used in UH and CVICU.**

MEDICATION	UMHS STANDARD CONCENTRATION	STARTING DOSE/TITRATION	MAXIMUM DOSE	NOTES
ANTIHYPERTENSIVE/RATE CONTROL AGENTS (CONT)				
Fenoldopam (Corlopam ®)	80 mcg/ml (20 mg/250 ml)	Initial: 0.1 mcg/kg/min IV Increase every 15 min by 0.05-0.1 mcg/kg/min to desired response or max. rate	0.4 mcg/kg/min	**RESTRICTIONS**: Approval by CVICU or ED attending (for aortic dissection or heart transplantation. It is restricted to use in the ED, OR or the ICU. NOTE: Fenoldopam should be limited to a maximum of **48 hours of therapy**, and to a maximum infusion rate of 0.4 mcg/kg/min due to a ceiling effect of the drug. Central or peripheral administration.
Nicardipine (Cardene ®)	0.2 mg/ml (40 mg/200 ml) PREMIX	5 mg/hour May titrate by 2.5 mg/hour every 15 minutes.	15 mg/hour	**RESTRICTIONS**: Adult patients in the ICU or ED who have failed other therapies, have contraindications or side effects. Central administration; if peripheral administration is utilized change the infusion site every 12 hours.
Clevidipine (Cleviprex)	0.5 mg/mL (25 mg/50 mL) PREMIX	Initial: 1 – 2 mg/hour; usual dose is 4 – 6 mg/hour. May titrate every 90 seconds by doubling the dose	16 mg/hour 1,000 mL/24 hour due to lipid base	**RESTRICTIONS:** Peri-operative or peri-precedural hypertension following cardiovascular procedures, ICU management of hypertension that is refractive to other therapies. Bottle and tubing MUST be changed every 12 hours; dedicated line is required. Central or peripheral administration.
Diltiazem (Cardizem ®)	1 mg/ml (100 mg/100 ml) UH (50 mg/50 ml) CVICU	Loading dose: 0.25 mg/kg (or 20mg) IV over 2 minutes followed by continuous infusion starting at 5mg/hour. May increase by 2.5 mg/hour every 30 minutes.	15 mg/hour	Used for rate control in patients with atrial arrhythmias with rapid ventricular response or PSVT. Use of continuous infusion for > 24 hours is not recommended. Central or peripheral administration.
ANTIARRHYTHMIC AGENTS				
Amiodarone (Cordarone ®)	1.2 mg/ml (600mg/500 ml) **Mix in D5W only**	300 mg rapid IV push (pulseless VT) or 150 mg **over 10 minutes** (VT with a pulse or AFib) Followed by an infusion of 1 mg/minute x 6 hours, then 0.5 mg/minute x 18 hours (or until able to transition to oral).	1 mg/minute MAX. daily dose 2 gm	Intravenous amiodarone is given for the short-term treatment of ventricular fibrillation and for hemodynamically unstable ventricular tachycardia **or** in critically ill patients who develop atrial fibrillation with a rapid ventricular response For patients with a pulse, the 150 mg bolus may be repeated for total of 300 mg if first 150 mg bolus ineffective. Central line whenever possible; risk of extravasation with peripheral administration. Requires the use of a 0.22 micron in line filter.
Lidocaine	8mg/ml (2000mg/250ml) PREMIX – UH 20 mg/ml (1000 mg/50 ml) CVICU	Loading dose: 1-1.5mg/kg Maintenance dose: 0.5mg/min. Increase maintenance infusion in 0.5mg/min increments based upon rhythm and/or serum concentration.	4 mg/min	Administer loading dose at 25-50mg/min, may repeat in 5 min to max 3mg/kg. Monitoring of serum lidocaine levels 12-24h after initiation (goal 1.5-6mg/L) is recommended, and may be elevated in hepatic dysfunction. Central or peripheral administration.
Procainamide	8mg/ml (2000mg/250ml) UH 40 mg/ml (2000 mg/50 ml) CVICU	Loading dose: 15-18mg/kg over 25-30min or 100-200 mg/dose repeated every 5 minutes as needed to a total dose of 1 gram. Maintenance dose: 1 mg/min	4 mg/min	Procainamide is no longer available for oral administration so patients can not be transitioned off of continuous infusion. Reduce loading dose to 12mg/kg in severe renal or cardiac impairment. Central or peripheral administration.

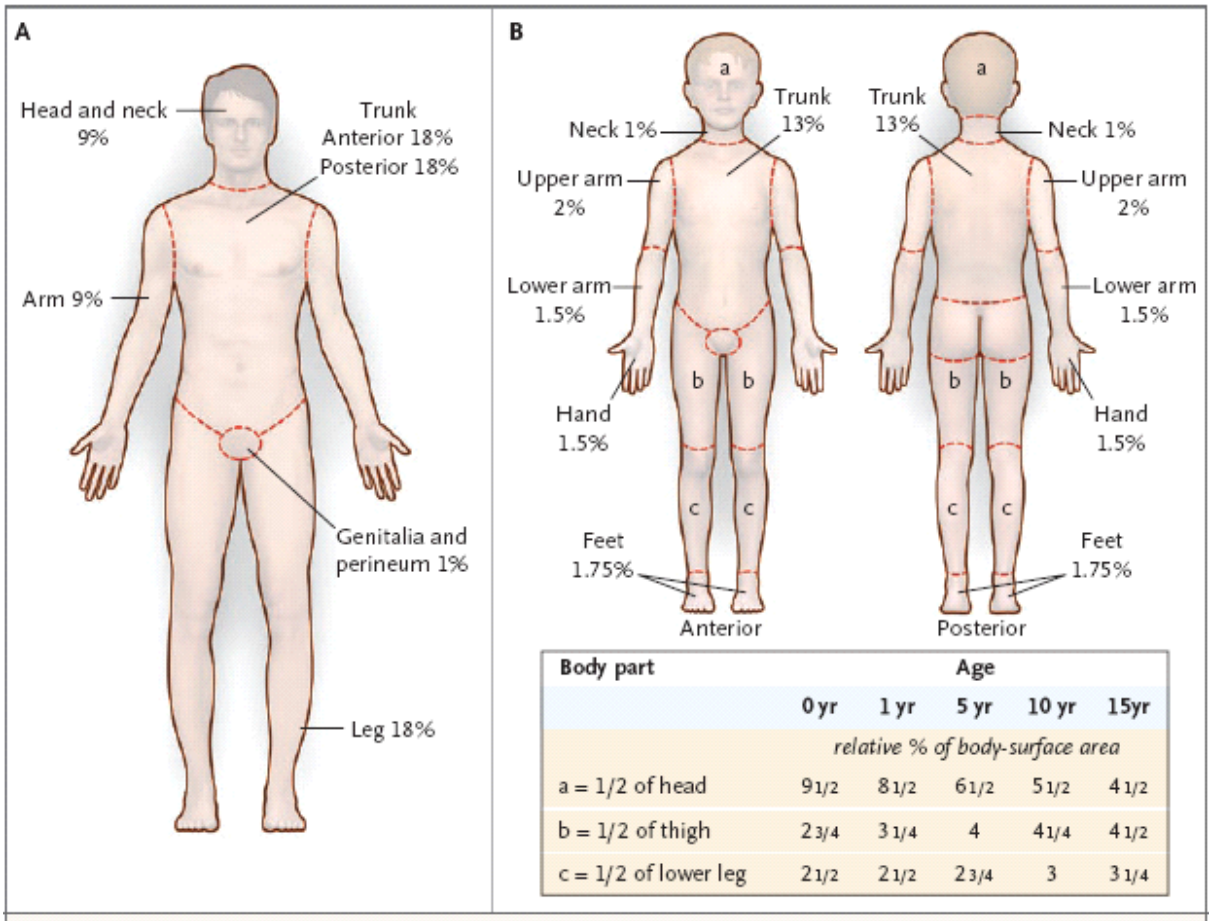
*** Doses listed above are suggested maximum doses for patient safety; start at lowest dose when titrating unless clinical condition requires higher dose. Some clinical conditions may warrant the use of doses higher than those listed above. Unless otherwise specified, the same concentration is used in UH and CVICU.**

MEDICATION	UMHS STANDARD CONCENTRATION	STARTING DOSE/TITRATION	MAXIMUM DOSE	NOTES
DIURETIC AGENTS				
Furosemide (Lasix ®)	10 mg/ml (500 mg/50 ml) UH (500 mg/50 ml) CVICU	Bolus with 2 -4 times the starting rate; Initiate with 5 mg/hour May increase rate by 5-10 mg/hour with bolus dose every 4 hours until desired response or max. dose	80 mg/hour	Patients with heart failure and significant previous exposure to loop diuretics may require higher doses, as there is no ceiling effect for loop diuretics; doses up to 160 mg/hour may be appropriate per prescriber order. Central or peripheral administration.
Bumetanide (Bumex ®)	0.25 mg/ml (12.5 mg/50 ml)	Bolus with 2-4 times the starting rate of 0.25 mg/hour; may titrate by 0.25 mg/hour every 4 hours with bolus dose.	4 mg/hour	1 mg bumetanide = 40 mg furosemide Patients with heart failure and significant previous exposure to loop diuretics may require higher doses, as there is no ceiling effect for loop diuretics. Central or peripheral administration.
Torsemide (Demadex)	2 mg/mL (200 mg/100 mL)	Bolus with 2-4 times the starting rate of 2.5 mg/ hour May increase rate by 2.5-5 mg/hour every 4 hours with bolus dose until desired response or max dose	40 mg/hour	Patients with heart failure and significant previous exposure to loop diuretics may require higher doses, as there is no ceiling effect for loop diuretics. Central or peripheral administration.
INOTROPIC AGENTS				
Dobutamine (Dobutrex ®)	4 mg/ml (1000 mg/250 ml)- PREMIX – UH 5 mg/ml (250 mg/50 ml) CVICU	Initial infusion 1 mcg/kg/minute increasing to a maintenance of 2.5-20 mcg/kg/minute as needed to maintain desired cardiac output. Titrate by 2.5 mcg/kg/min every 5 minutes to goal of CI.	10 mcg/kg/minute	Central preferred; peripheral has risk of thrombophlebitis.
Milrinone (Primacor ®)	0.2 mg/ml (20 mg/100 ml)- PREMIX – UH 0.4 mg/ml (20 mg/50 ml) CVICU	Loading dose: 50 mcg/kg IV over 10 minutes Maintenance dose: 0.25 mcg/kg/minute May start as low as 0.125 mcg/kg/min	0.75 mcg/kg/minute	Central preferred; peripheral has risk of extravasation. Titration per physician order. Caution in renal dysfunction, consider lower initial dose and slower titration.
Isoproterenol (Isuprel ®)	8 mcg/ml (2000 mcg/250 ml) UH 20 mcg/ml (1000 mcg/50 ml) CVICU	0.5 mcg/minute	10 mcg/minute	Central or peripheral administration.

*** Doses listed above are suggested maximum doses for patient safety; start at lowest dose when titrating unless clinical condition requires higher dose. Some clinical conditions may warrant the use of doses higher than those listed above. Unless otherwise specified, the same concentration is used in UH and CVICU.**

Approved by the UMHS Critical Care Committee, 5/03, 1/13
Approved by the Medication Safety Committee, 12/12
Approved by the Pharmacy & Therapeutics Committee, 1/13
Revised 3/08, 2/3/09, 12/12

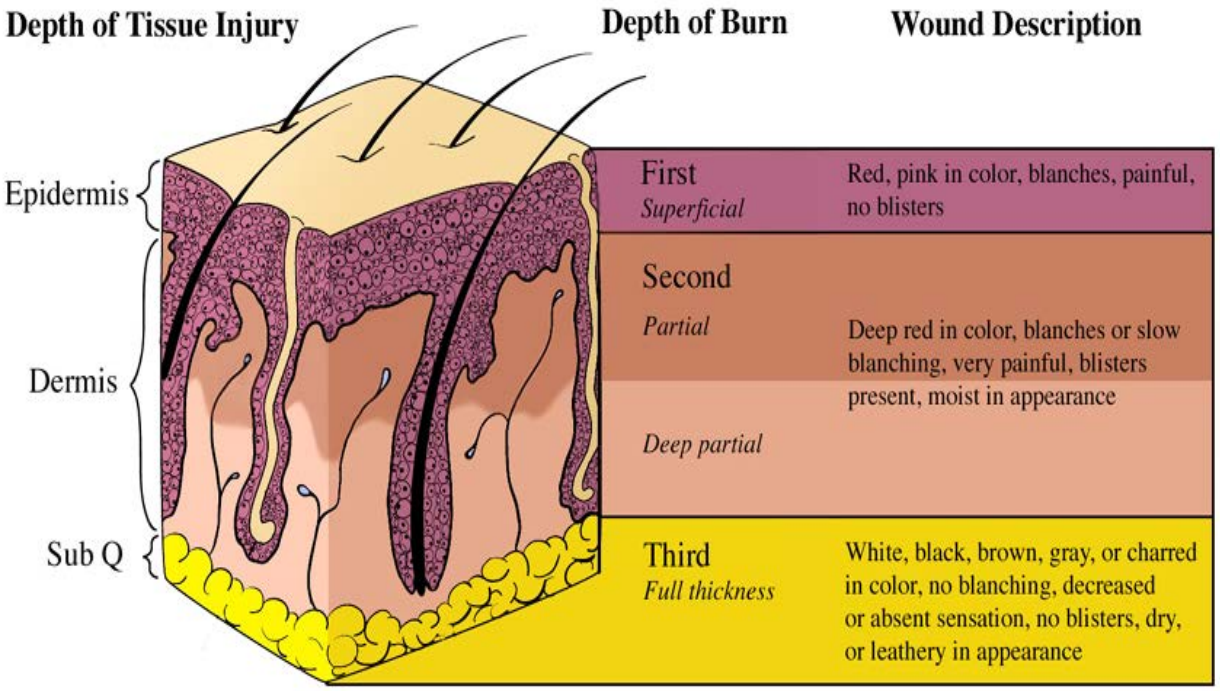
Burns: TBSA Percentage and Degree Reference



Body part	Age				
	0 yr	1 yr	5 yr	10 yr	15yr
	relative % of body-surface area				
a = 1/2 of head	9 1/2	8 1/2	6 1/2	5 1/2	4 1/2
b = 1/2 of thigh	2 3/4	3 1/4	4	4 1/4	4 1/2
c = 1/2 of lower leg	2 1/2	2 1/2	2 3/4	3	3 1/4

Figure 2. The Rule of Nines and Lund–Browder Charts.

The Rule of Nines (Panel A) is often used to estimate the surface area of a burn in adults. However, this approach is less accurate in children. Lund–Browder charts (Panel B) use values for the legs and head that vary according to a patient's age.



Guidelines for the Initial Management of the Adult Patient with a Burn Injury

A. Adult burn patients admitted to the Emergency Department (ED) will have the following evaluation, done by a burn surgeon:
   a. Determination of type/source of burn injury with appropriate treatment initiated (i.e. intubation or oxygen with inhalation injury, chemical burns irrigated, cardiac monitoring with electrical burns, etc.

   b. Estimation of extent and severity of burn injury

   c. Adequacy of fluid resuscitation (as appropriate)

   d. Neurovascular examination of circumferential burns

B. These patients will be admitted to the Surgery Burn (SBUR) Service with other services following as consults as patient condition and injuries warrant (i.e. ophthalmology; cardiology; orthopedics; etc.). Ancillary support services (i.e. OT, PT, SW, and nutrition) will follow as automatic consults within 24 hours of patient admission. As outlined in Trauma Response Policy 19, burn patients will have first priority for admission to the Trauma/Burn Center (TBC.)

C. The Burn Director will monitor the progress and plan of care for all admissions. Additionally, the Burn Director will provide clinical oversight and consultation, as necessary, to Trauma Burn Attending Physicians.

D. On discharge, these patients will receive a follow-up appointment in the ACS Clinic within one week.
   a. If admission is not required, these patients will receive a follow-up appointment in the ACS Clinic within 72 hours.

Guidelines for Adult Burn Resuscitation

Documentation must include patient's TBSA burn using Lund-Browder diagram (including only partial and full-thickness burns) and a weight in kilograms prior to initiating the protocol.

FIRST 24 HOURS POST INJURY

A. TBSA less than 20%
    a. Maintenance IVF only, until the patient is taking adequate oral intake.

B. TBSA greater than or equal to 20% and weight greater than or equal to 30kg
    b. Calculate estimated fluid needs:
        i. 2cc of LR x weight x TBSA (can increase to 4cc depending on urine output):
            1. Administer half of calculated amount over the first 8 hours post burn
            2. Administer half of calculated amount over next 16 hours
        ii. If urine output less than 0.5cc/kg/hour (goal: 30cc/hour):
            1. Increase LR infusion by 33% of the hourly calculated fluid requirement
        iii. If urine output greater 70 cc/hour for two consecutive hours:
            1. Dip urine to exclude glycosuria
            2. Decrease LR infusion by 33% of the hourly calculated fluid requirement
            3. Do not decrease IVF rate below 175cc/hr.

C. Place enteral feeding tube as soon as possible for all burns greater than or equal to 20% TBSA

D. Consider Esophageal Doppler monitor for intubated patients with TBSA >/= 30%, age >50, and/or inhalation injury to measure fluid status and cardiac output. Swan-Ganz catheter placement should only be used as last resort on patients who are not responding to fluid resuscitation and other methods of measurement have failed.

E. At 12 hours post burn injury, assess IVF administered and calculate the projected 24 hour total IVF if fluid rates are kept constant. If the projected 24 hour IVF requirement exceeds 6cc/kg/%TBSA burn, then switch to the difficult fluid resuscitation guideline (*see below.)*

TREATMENT OF LOW URINE OUTPUT

A. If urine output falls below the low limit for one hour, increase the current IVF infusion rate by 33% of the calculated hourly requirement.

B. If urine output falls below the low limit for a second consecutive hour, increase the current IVF infusion rate by 33% of the calculated hourly requirement.

C. If urine output remains below target for a third consecutive hour, notify the burn physician

AFTER INITIAL 24 HOURS POST INJURY

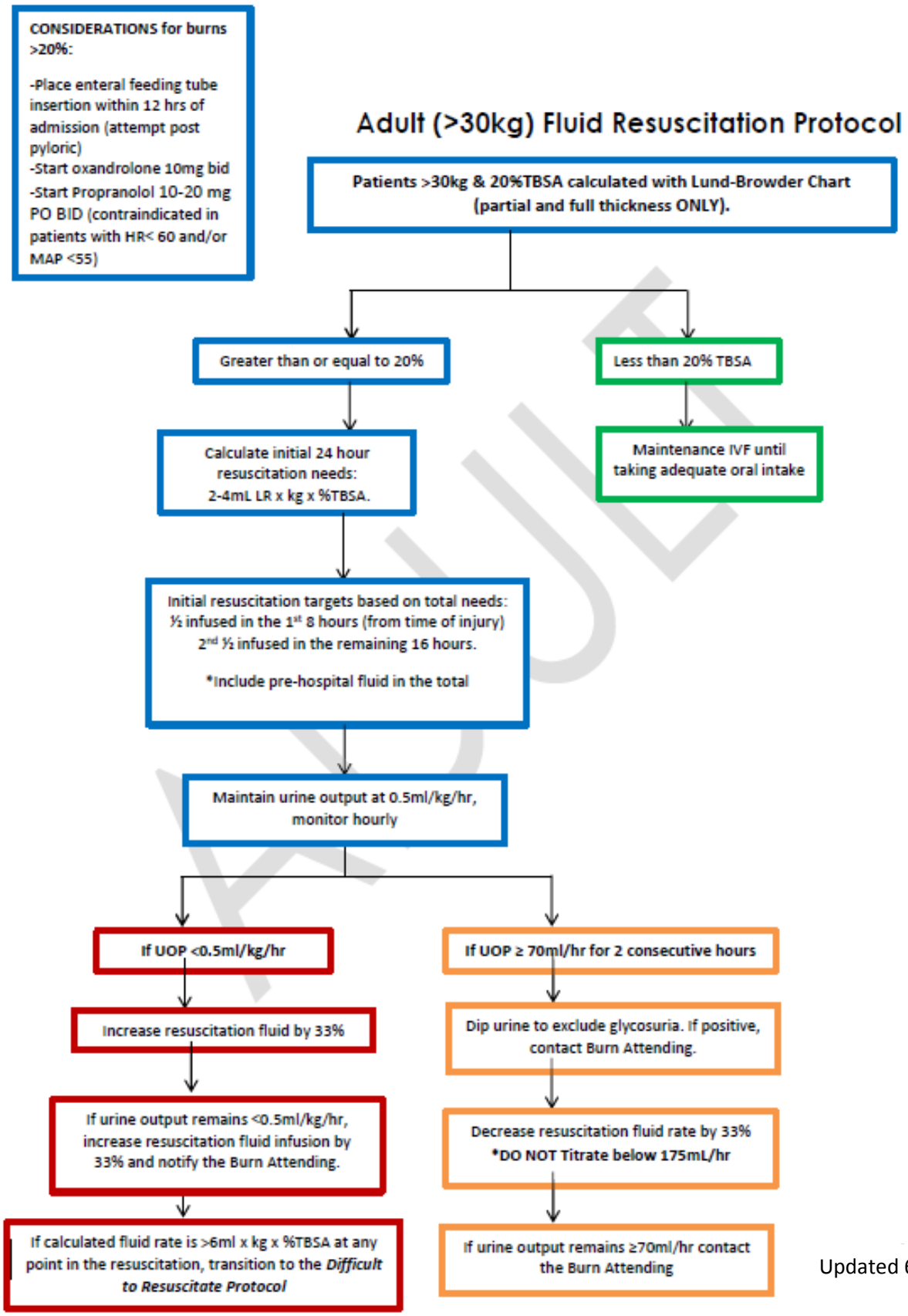
A. Serum sodium and potassium must be checked every 12 hours on the second burn day.
B. Adjust type of fluid according to the serum sodium level.
C. After 24 hours of crystalloid, if fluid requirements high, consider 5% albumin infusion
D. Goal is to decrease IVF rate to one half of rate infused over the previous 16 hours.

a. If the patient is greater than 30 kg, urine output goal is 0.5cc/kg/hour (maximum 70cc/hr)
b. If the patient less than or equal to 30 kg, urine output goal of 1 cc/kg/hour (maximum 2cc/kg/hr)

ADDITIONAL MEDICATIONS:

A. BETA-BLOCKERS

a. Start Propranolol 10-20 mg PO BID (contraindicated in patients with HR< 60 and MAP <55)
b. Titrate as tolerated to a maximum dose of 1-4mg/kg/day (Max 640mg/day)
c. Dosing can be divided BID or TID



Updated 6/2017

Adult Difficult to Resuscitate Protocol

Switch from lactated ringers to 5% albumin. This is a standard concentration that comes pre-mixed from Pharmacy.

A. Check bladder pressures every 4 hours.

B. If urine output is less than 30ml/hr, strongly consider the placement of an invasive hemodynamic monitoring. Options include:
   a. The FloTrac sensor is a less invasive hemodynamic monitoring device that continuously measures and displays key flow parameters. With the Flotrac sensors, cardiac output, stroke volume, stroke volume variation, and SVR (derived from CVP) are available using a standard arterial pressure line and central line.
   b. The PreSep catheter is a triple lumen central venous oximetry catheter with an added capability for continuously monitoring central venous oxygen saturation (ScvO2).
   c. Pulmonary artery (PA) catheter to guide resuscitation with specific pulmonary capillary wedge pressure (PCWP) and mixed venous saturation (SvO2) goals.
   d. Esophageal Doppler Monitor (EDM)

C. Titration of fluids should be guided by the Burn Attending with input from the following available parameters.

   a. If CVP or PCWP is not at goal then increase fluid rate by 33%
   b. If CVP or PCWP is at goal then consider levophed to augment mean arterial pressure (and thus UOP) or dobutamine 5mcg/kg/min (titrate until SvO2 or ScvO2 at goal.) Maximum dose of dobutamine is 20mcg/kg/min.
   c. If both CVP or PCWP and SvO2 or ScvO2 are at goal, then do not increase IVF rate any further (even if UOP<30ml/hr.) The patient should be considered hemodynamically optimized and the oliguria is likely a result of established renal insult. Some degree of renal failure is expected and should be tolerated. Continued increases in fluid administration despite optimal hemodynamic parameters will only result in "resuscitation morbidity," that is oftentimes more detrimental than renal failure.
   d. Target Cardiac Output (CO) HRxSV/1000 = 4.0-8.0L/min
   e. Target Cardiac Index (CI) CO/BSA = 2.5-4.0L/min/m^2
   f. Stroke Volume Variation (SVV) (SVmax – SVmin)/SVmean x 100 =10- 15% (>13% consider additional volume, patient is dry)
   g. Target Mixed venous saturation (SvO2) 60-80%
   h. Target Central Venous Pressure (CVP) 10-12mmHg
   i. Target Pulmonary Capillary Wedge Pressure (PCPW) 10-12mmHg
   j. Target Central venous saturations (Scvo2) 70%

D. Every attempt should be made in minimize fluid administration while maintaining organ perfusion. If urine output is greater than 50ml/hr, decrease the fluid rate by 20%. Do not decrease the IVF rate below the calculated maintenance rate (175cc/hr).

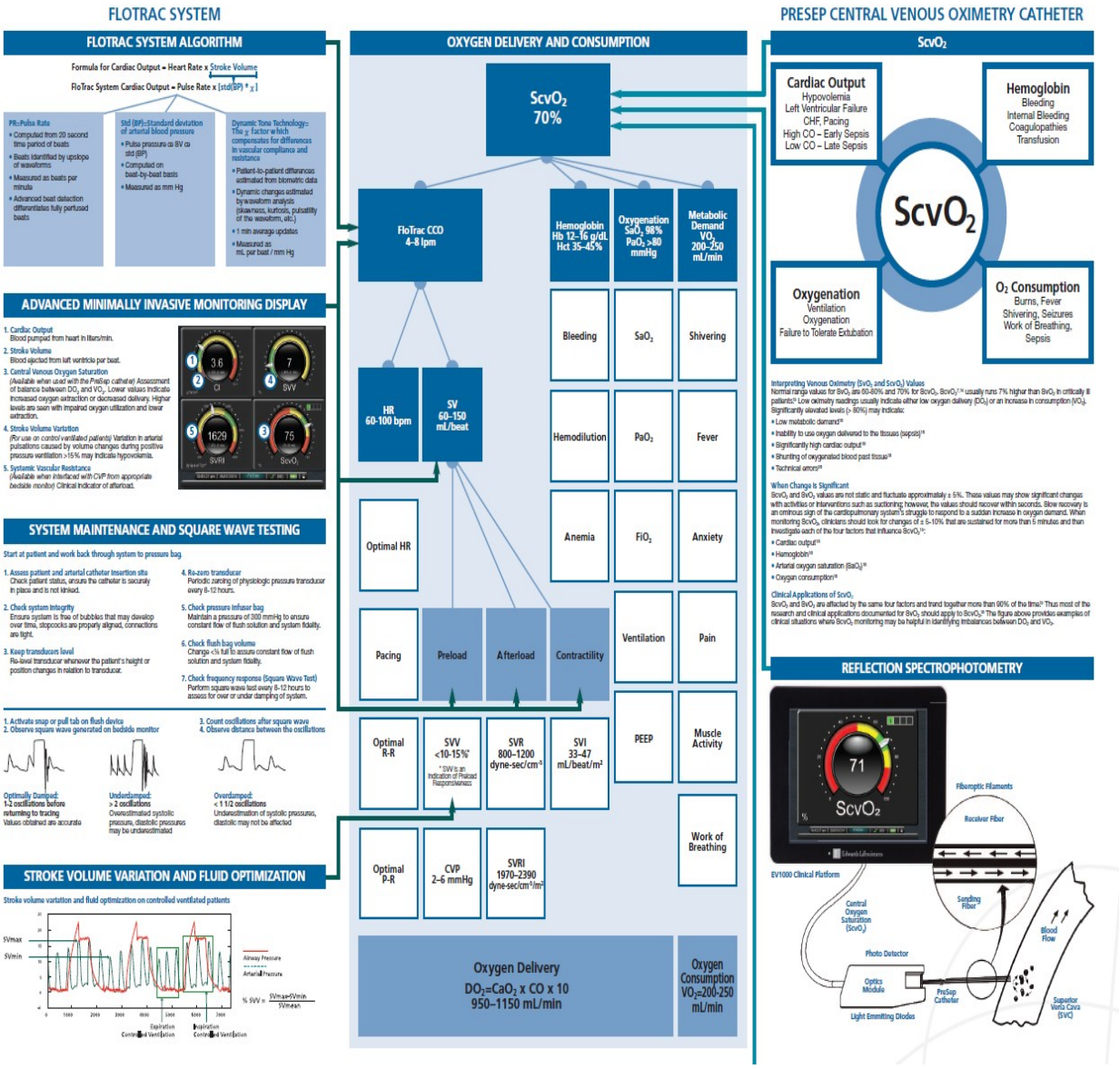
If the patient switches to Difficult to Resuscitate and does not respond to colloid resuscitation, the resuscitation is no longer RN driven. Hourly monitor variables (e.g. CO, CI, SVV, $ScvO_2$, CVP, urine output) will be communicated to the SBUR Attending and hourly fluid rate decided by the MD. These patients will be deemed Severely Difficult to Resuscitate and should be managed in close collaboration with the SBUR Attending and TBICU Critical Care Team.

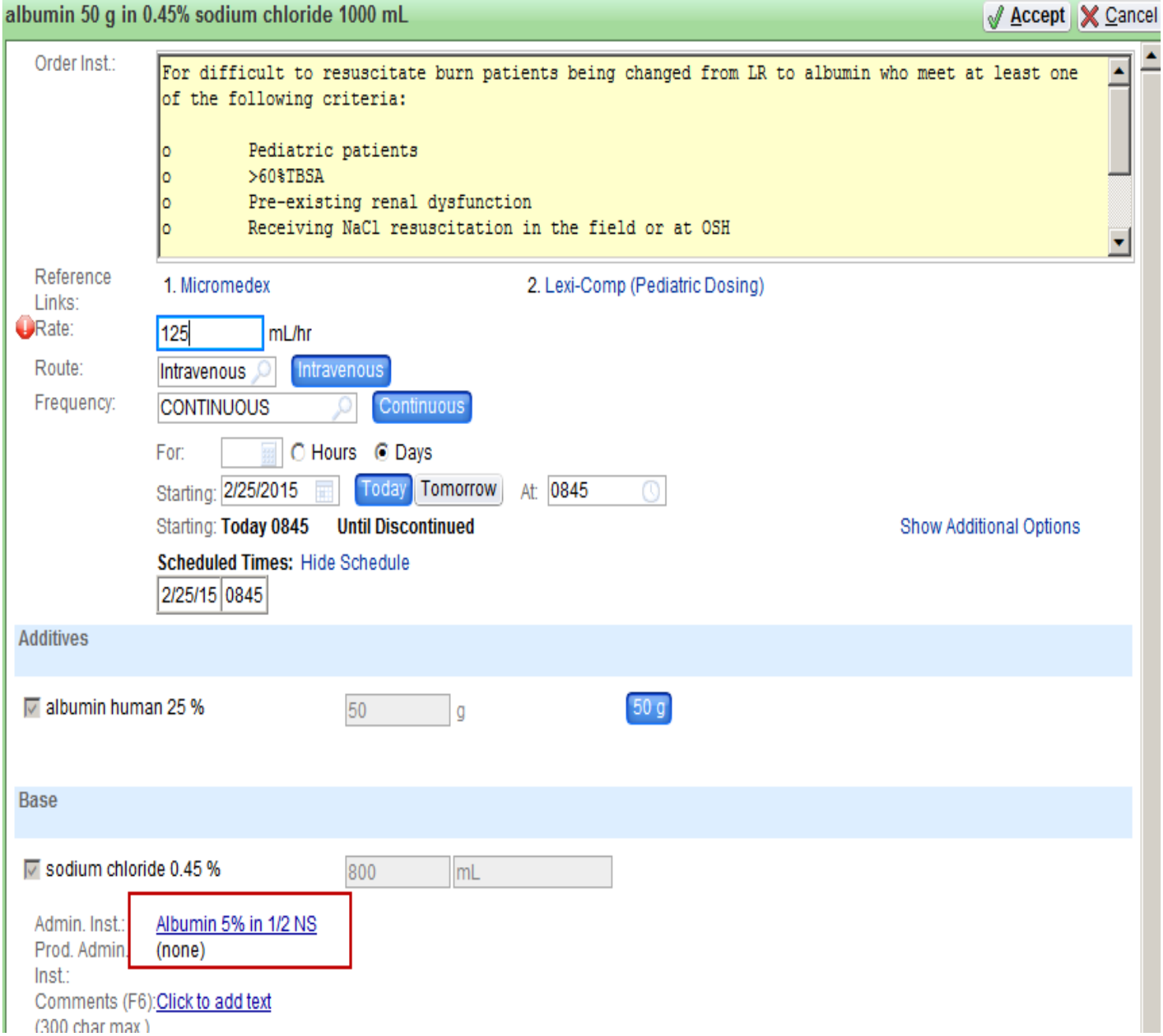
Note: After 24 hours, infusion of LR should be titrated down to maintenance levels and albumin continued until the 48-hour mark at 0.5mL/kg/24hours 5% albumin.

DIFFICULT TO RESUSCITATE 5% ALBUMIN IN 0.45%NS

For difficult to resuscitate burn patient being changed from LR to albumin who meet at least one of the following criteria:

- Pediatric Patients
- >60% TBSA
- Pre-existing renal dysfunction
- Receiving NaCl resuscitation in the field or at the OSH


FLOTRAC SYSTEM
FLOTRAC SYSTEM ALGORITHM
Formula for Cardiac Output = Heart Rate x Stroke Volume
FloTrac System Cardiac Output = Pulse Rate x [std(BP) * χ]
PR=Pulse Rate
• Computed from 20 second time period of beats
• Beats identified by upslope of waveforms
• Measured as beats per minute
• Advanced beat detection differentiates fully perfused beats
Std (BP)=Standard deviation of arterial blood pressure
• Pulse pressure as BV as std (BP)
• Computed on beat-by-beat basis
• Measured as mm Hg
Dynamic Tone Technology= The χ factor which compensates for differences in vascular compliance and resistance
• Patient-to-patient differences estimated from biometric data
• Dynamic changes estimated by waveform analysis (skewness, kurtosis, pulsatility of the waveform, etc.)
• 1 min average updates
• Measured as mL per beat / mm Hg
ADVANCED MINIMALLY INVASIVE MONITORING DISPLAY
1. Cardiac Output
Blood pumped from heart in liters/min.
2. Stroke Volume
Blood ejected from left ventricle per beat.
3. Central Venous Oxygen Saturation
(Available when used with the PreSep catheter) Assessment of balance between DO2 and VO2. Lower values indicate increased oxygen extraction or decreased delivery. Higher levels are seen with impaired oxygen utilization and lower extraction.
4. Stroke Volume Variation
(For use on control ventilated patients) Variation in arterial pulsations caused by volume changes during positive pressure ventilation >15% may indicate hypovolemia.
5. Systemic Vascular Resistance
(Available when interfaced with CVP from appropriate bedside monitor) Clinical indicator of afterload.
SYSTEM MAINTENANCE AND SQUARE WAVE TESTING
Start at patient and work back through system to pressure bag
1. Assess patient and arterial catheter insertion site
Check patient status, ensure the catheter is securely in place and is not kinked.
2. Check system integrity
Ensure system is free of bubbles that may develop over time, stopcocks are properly aligned, connections are tight.
3. Keep transducer level
Re-level transducer whenever the patient's height or position changes in relation to transducer.
4. Re-zero transducer
Periodic zeroing of physiologic pressure transducer every 8-12 hours.
5. Check pressure infusor bag
Maintain a pressure of 300 mmHg to ensure constant flow of flush solution and system fidelity.
6. Check flush bag volume
Change <¼ full to assure constant flow of flush solution and system fidelity.
7. Check frequency response (Square Wave Test)
Perform square wave test every 8-12 hours to assess for over or under damping of system.
1. Activate snap or pull tab on flush device
2. Observe square wave generated on bedside monitor
3. Count oscillations after square wave
4. Observe distance between the oscillations
Optimally Damped:
1-2 oscillations before returning to tracing
Values obtained are accurate
Underdamped:
> 2 oscillations
Overestimated systolic pressure, diastolic pressures may be underestimated
Overdamped:
< 1 1/2 oscillations
Underestimation of systolic pressures, diastolic may not be affected
STROKE VOLUME VARIATION AND FLUID OPTIMIZATION
Stroke volume variation and fluid optimization on controlled ventilated patients
SVmax
SVmin
Airway Pressure
Arterial Pressure
% SVV = SVmax-SVmin / SVmean
Expiration Controlled Ventilation
Inspiration Controlled Ventilation
OXYGEN DELIVERY AND CONSUMPTION
ScvO2 70%
FloTrac CCO 4–8 lpm
Hemoglobin Hb 12–16 g/dL Hct 35–45%
Oxygenation SaO2 98% PaO2 >80 mmHg
Metabolic Demand VO2 200–250 mL/min
HR 60-100 bpm
SV 60–150 mL/beat
Optimal HR
Optimal R-R
SVV <10-15%*
* SVV is an indication of Preload Responsiveness
SVR 800–1200 dyne-sec/cm5
SVI 33–47 mL/beat/m2
Optimal P-R
CVP 2–6 mmHg
SVRI 1970–2390 dyne-sec/cm5/m2
Bleeding
SaO2
Shivering
Hemodilution
PaO2
Fever
Anemia
FiO2
Anxiety
Ventilation
Pain
PEEP
Muscle Activity
Work of Breathing
Pacing
Preload
Afterload
Contractility
Oxygen Delivery DO2=CaO2 x CO x 10 950–1150 mL/min
Oxygen Consumption VO2=200-250 mL/min
PRESEP CENTRAL VENOUS OXIMETRY CATHETER
ScvO2
Cardiac Output
Hypovolemia
Left Ventricular Failure
CHF, Pacing
High CO – Early Sepsis
Low CO – Late Sepsis
Hemoglobin
Bleeding
Internal Bleeding
Coagulopathies
Transfusion
ScvO2
Oxygenation
Ventilation
Oxygenation
Failure to Tolerate Extubation
O2 Consumption
Burns, Fever
Shivering, Seizures
Work of Breathing,
Sepsis
Interpreting Venous Oximetry (SvO2 and ScvO2) Values
Normal range values for SvO2 are 60-80% and 70% for ScvO2. ScvO2[14] usually runs 7% higher than SvO2. In critically ill patients[12] Low oximetry readings usually indicate either low oxygen delivery (DO2) or an increase in consumption (VO2). Significantly elevated levels (> 80%) may indicate:
• Low metabolic demand[10]
• Inability to use oxygen delivered to the tissues (sepsis)[14]
• Significantly high cardiac output[10]
• Shunting of oxygenated blood past tissue[10]
• Technical errors[10]
When Change Is Significant
SvO2 and ScvO2 values are not static and fluctuate approximately ± 5%. These values may show significant changes with activities or interventions such as suctioning; however, the values should recover within seconds. Slow recovery is an ominous sign of the cardiopulmonary system's struggle to respond to a sudden increase in oxygen demand. When monitoring ScvO2, clinicians should look for changes of ± 5-10% that are sustained for more than 5 minutes and then investigate each of the four factors that influence ScvO2[15]:
• Cardiac output[10]
• Hemoglobin[10]
• Arterial oxygen saturation (SaO2)[10]
• Oxygen consumption[10]
Clinical Applications of ScvO2
ScvO2 and SvO2 are affected by the same four factors and trend together more than 90% of the time[12] Thus most of the research and clinical applications documented for SvO2 should apply to ScvO2.[8] The figure above provides examples of clinical situations where ScvO2 monitoring may be helpful in identifying imbalances between DO2 and VO2.
REFLECTION SPECTROPHOTOMETRY
71
ScvO2
Fiberoptic Filaments
Receiver Fiber
Sending Fiber
EV1000 Clinical Platform
Central Oxygen Saturation (ScvO2)
Photo Detector
Optics Module
PreSep Catheter
Light Emmiting Diodes
Blood Flow
Superior Vena Cava (SVC)


albumin 50 g in 0.45% sodium chloride 1000 mL
Accept
Cancel
Order Inst.:
For difficult to resuscitate burn patients being changed from LR to albumin who meet at least one of the following criteria:
o Pediatric patients
o >60%TBSA
o Pre-existing renal dysfunction
o Receiving NaCl resuscitation in the field or at OSH
Reference Links:
1. Micromedex
2. Lexi-Comp (Pediatric Dosing)
Rate:
125
mL/hr
Route:
Intravenous
Intravenous
Frequency:
CONTINUOUS
Continuous
For:
Hours
Days
Starting:
2/25/2015
Today
Tomorrow
At:
0845
Starting: Today 0845
Until Discontinued
Show Additional Options
Scheduled Times:
Hide Schedule
2/25/15
0845
Additives
albumin human 25 %
50
g
50 g
Base
sodium chloride 0.45 %
800
mL
Admin. Inst.:
Albumin 5% in 1/2 NS
Prod. Admin. Inst.:
(none)
Comments (F6):
Click to add text
(300 char max.)

Adult (>30kg) Difficult to Resuscitate Protocol

Patients >30kg & 20 %TBSA calculated with Lund-Browder Chart (partial and full thickness ONLY) with persistent oliguria (<0.5mL/kg/hr) or calculated 24 hour resuscitation >6mL x kg x %TBSA.

Contact Burn Attending

TARGETS: Urine Output (UOP) 0.5mL/kg/hr (30mL/hr)
CVP 8-10
Bladder Pressure <20
Mixed venous saturation (SvO_2) 60-80%
Pulmonary Capillary Wedge Pressure (PCWP) 10-12mmHg
Central venous saturations ($ScVo_2$) 70%
MAP ≥55

Replace resuscitation fluid with 5% albumin at current hourly resuscitation rate

Initiate ScvO2 and CVP monitoring via the PreSep Catheter and CO/CI/SVV monitoring via FloTrac. PA Catheter or Esophageal Doppler Monitor (EDM) are alternatives.

Monitor Bladder Pressure q4h. Contact Burn Attending if Bladder Pressure ≥20mmHg

If UOP <0.5ml/kg/hr and the patient is normotensive after 1 hr.

If CVP ≥10 or PCWP >12, SVV≤ 12%

Consider norepinephrine (titrate to MAP ≥55) OR dobutamine 5mcg/kg/min (titrate to CO/CI goals) *Max dobutamine 20mcg/kg/min

Do not increase5% albumin infusion

Check UOP q 30 min; If UOP does not improve, notify Burn Attending.

Consider: Missed injury, ECHO and/or CRRT. Consider hypotension protocol

If CVP <8 PCWP <12, SVV >12%

Increase 5% Albumin by 33%

Check UOP q30 minutes

At 30 min. checks if UOP <30cc increase 5% albumin rate by 33%

If CVP remains <10 or SVV >12% for 2 consecutive hours, contact the Burn Attending

If UOP is <0.5mL/kg/hr and the patient is hypotensive after 1 hr., follow the hypotension guidelines and notify Burn Attending

If UOP is 0.5-1mL/kg/hr after 1 hr., and patient is normotensive

Continue Difficult to Resuscitation Protocol

After 24 hrs of albumin infusion, IVF type and rate to be determined by Burn Attending

If UOP is ≥50mL/hr after 1 hr., decrease the albumin infusion rate by 20%

DO NOT Titrate below 175mL/hr

After 24 hrs of albumin infusion, IVF type and rate to be determined by Burn Attending

Revised 6/17

Guidelines for the Treatment of Hypotension in Adult Burn Patients

The optimal minimum blood pressure for burn patients must be individualized. Some patients will maintain adequate organ perfusion (and thus have adequate urine output) at mean arterial blood pressures (MAP) lower than 70. True hypotension must be correlated with urine output. If a MAP (generally less than 55mmHg) is not adequate to maintain the urine output goal of at least 30ml/hr, the following steps are recommended:

A. Start with Vasopressin 0.04 units/min IV (do not titrate)

B. Monitor CVP (goal 8-10)

C. If the CVP is not at goal, increase fluid rate by 33%

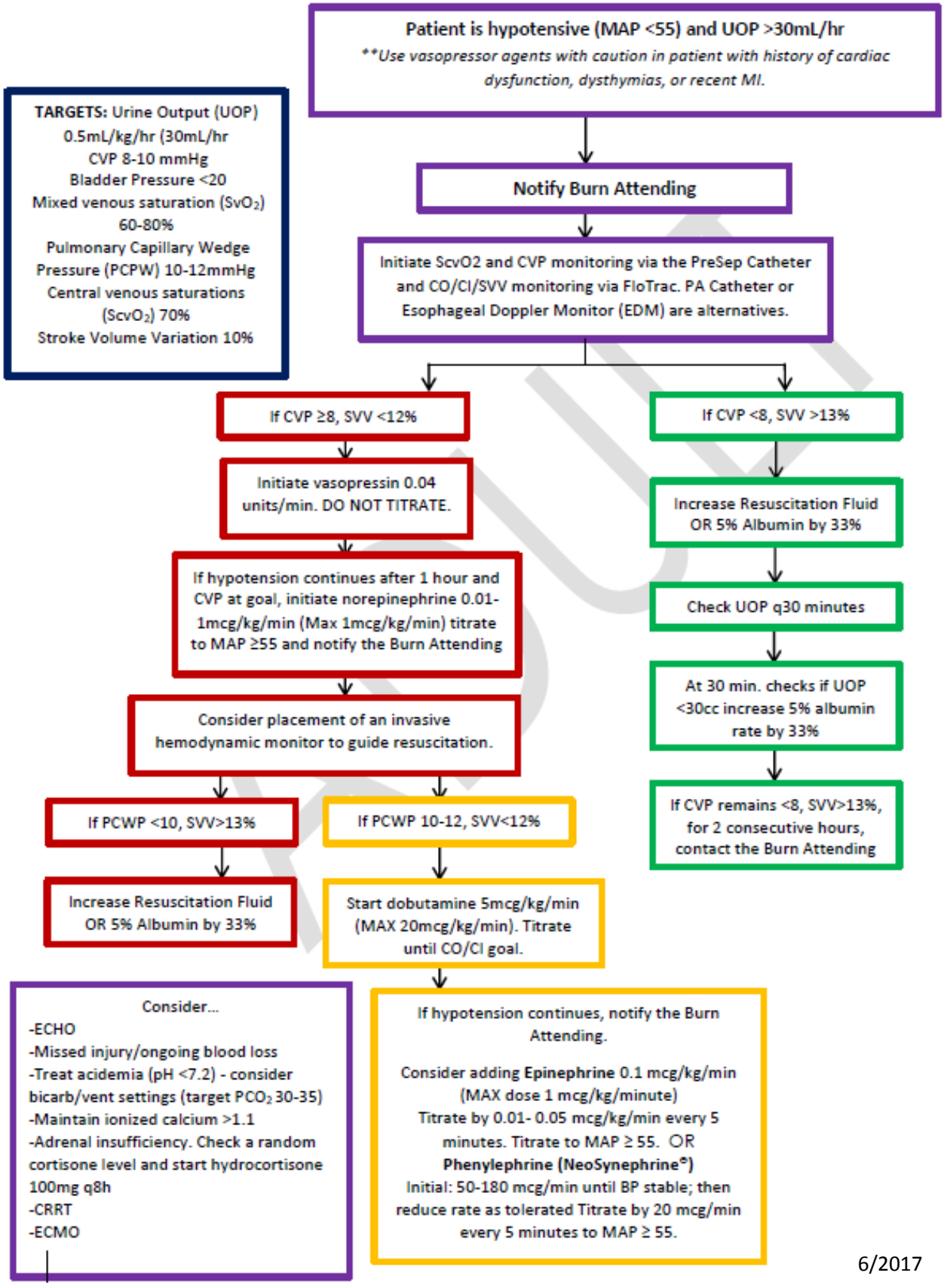
D. If the CVP is at goal, then add norepinephrine IV 0.1 mcg/kg/min, titrate by 0.01-0.05 mcg/kg/min every 5 minutes to a SBP or MAP goal. Max dose is 1mcg/kg/min.

E. If additional vasopressors are needed, consider the placement of an invasive hemodynamic monitor. These patients may be volume depleted but a missed injury should be suspected.
    a. If hypotension persists, assess for missed injury.
    b. Consider adding epinephrine or neosynephrine as a last resort.

F. If the patient is exhibiting catecholamine-resistant shock, consider the following diagnoses:
    a. Missed injury and ongoing blood loss.
    b. Acidemia. If pH is less than 7.2, then adjust ventilator settings to optimize ventilation (target PCO_2 30-35.) If, despite optimal ventilation, patient still has a pH less than 7.2, consider bicarbonate administration.
    c. Adrenal insufficiency. Check a random cortisol level and start hydrocortisone 100mg every 8 hours.
    d. Hypocalcemia. Maintain ionized calcium greater than1.1

Note: use vasopressor agents with caution in patients with history of cardiac dysfunction, dysrhythmias, or recent (within in the last 6 months) MI.

Adult (>30kg) Hypotension with Adequate Urine Output



Trauma Burn Center (TBC)
Pediatric Admission Policy

ADMISSION CRITERIA

A. TBC beds must be allocated to:
   a. All pediatric patients requiring hospitalization for a burn injury (including patients with extensive skin injury secondary to non-burn injury)
   b. Accommodation for non-ACS service pediatric patients, can be made on a bed-availability basis

B. Priority for TBC Admission:
   a. Priority for admission to a TBC Intensive Care Unit (TBICU) bed will be as follows:
      i. All burn-injured patients requiring intensive care will take precedence for admission to the TBICU. Burn-injured patients who require intensive care are the following:
         1. Pediatric patients with a TBSA greater than or equal to 20% (including patients with frostbite, TENS, SJS, necrotizing fasciitis)
         2. Patients who sustained an electrical burn injury
         3. Patients with a known or suspected isolated inhalation injury
         4. Any burn injured patient requiring mechanical ventilation, cardiac, pulmonary, or hemodynamic monitoring
   b. Patients recovering from acute or reconstructive burn surgery
      i. Acute or reconstructive burn surgery patients requiring intensive care are defined as patients requiring mechanical ventilation, cardiac, pulmonary, hemodynamic or neurological monitoring.

Note: The Pediatric Surgery Critical Care Team will follow as a consulting service for all pediatric patients requiring intensive care while in the TBICU.

C. Priority for admission to a TBC acute care/floor status bed will be for the following patients:
   a. Pediatric patients with <20% TBSA burns who require hospitalization for acute burn injury, but do not require the acuity and intensity of the TBICU
   b. Patients receiving burn reconstructive surgery that does not require intensive care

PROCEDURE FOR ADMISSION

A. Patients presenting to the CS Mott Children's Emergency Department (ED)
   a. ED staff will notify the Acute Care Surgery (ACS) Trauma/Burn Service by the Trauma Radio and paging system for Class I and II burn patients and by the paging system for Class III patients.
   b. The ACS Service chief resident on-call, or his/her designate, in conjunction with the ACS Burn attending, will decide on the treatment plan for the patient, and the need for admission.
   c. The ACS chief resident, or his/her designee, will notify the TBC Charge Nurse of the admission including the patient's injuries and the estimated length of time prior to patient transport to the TBC.
   d. The TBC Charge Nurse will assess staffing assignments and adequacy, make staffing changes if indicated, and prepare a room for the patient.
   e. Transfer of the patient will be arranged collaboratively by the TBC Charge Nurse, the ED charge nurse, and/or the operating room charge nurse. At no time will a patient be transferred to the TBC prior to nursing report being called

and a physician handoff form being completed. The patient will be transported to the TBC by ED staff or OR staff.

B. Patients Transferred from Referring Institutions
   a. All calls or requests for transfer from a referring hospital physician will be directed to the ACS chief resident on-call. If the referral call is fielded by the Charge Nurse, she/he will gather as much information about the patient's condition as possible (refer to Trauma Response policy #21) and notify the referring institution that a ACS physician will call them within 10 minutes. The Charge Nurse will immediately notify the chief trauma resident on-call, utilizing the Trauma Radio/Paging System.
   b. Upon notification of a potential admission, the ACS chief resident will notify the on-call Burn Attending and discuss the acceptance/admission and stabilization/transport of the patient.
   c. The ACS chief resident will call the referring physician to accept the patient, obtain an updated condition report, discuss stabilization of the patient, arrange transport (if necessary,) and determine the estimated time of arrival.
   d. If the referring institution/physician requests that Survival Flight transports the patient, the ACS resident will contact Survival Flight and provide patient information. Survival Flight will then be responsible for setting up the transport. For those patients requiring evaluation in the ED, the admission will proceed according to the procedure established for patients presenting directly to the ED.
   e. If the patient is to be a direct admission to the TBC and the referring institution or physician does not request transport by Survival Flight, the ACS resident will notify the ED and the TBC Charge Nurse of the admission, provide information on the patient's condition, and any treatment initiated at the referring institution. Upon arrival of the patient in the ED, ED staff will notify the on-call ECR and the TBC Charge Nurse. Those patients not requiring additional evaluation will have an initial set of vital signs taken by the ED nursing staff to ensure patient stability. The patient will then be transported directly to the TBC.

C. Multiple Admissions
   a. Patients will be transferred to the TBC individually, beginning with the most critically ill patient.
   b. The timing of each successive transfer will be arranged collaboratively between the TBC Charge Nurse, the ED charge nurse, and/or the OR charge nurse.

D. Transfers from Other Services Within CS Mott Children's Hospital
   a. Requests for transfer will be initiated by a formal written consult to the ACS Service.
   b. The ACS chief resident, in collaboration with the on-call attending physician, will evaluate the patient to determine whether admission to the TBC is warranted.
   c. Upon acceptance of the patient transfer to the TBC, the chief resident will notify the TBC Charge Nurse of the desired day, estimated time of transfer, and give a brief report.
   d. The TBC Charge Nurse will proceed to prepare the unit for the transfer. The exact time of transfer will be arranged collaboratively between the TBC Charge Nurse and the transferring unit's charge nurse. The transferring unit shall call report prior to transporting the patient to the TBC.

TBC Pediatric Admission Policy (cont'd)

e. Upon arrival in the TBC, the patient will be taken to the patient room or hydrotherapy room, dependent upon the type of patient injury. The TBC nurses will proceed according to the accepted admission policy.

E. Admission from Trauma Burn Clinic
   a. Upon identification of a patient requiring admission to the TBC, the Trauma Burn Clinic secretary will notify the following departments/personnel:
      i. Admitting
      ii. TBICU Fellow or TBICU call resident +/- ACS chief resident on-call
      iii. TBC Charge Nurse
   b. The family member accompanying the patient will be sent to admitting to complete the necessary processing.
   c. If the patient is being admitted for burns, the wounds will be placed in a normal saline dressing.
   d. The actual time of transfer will be arranged collaboratively between the Trauma Burn Clinic staff and the TBC Charge Nurse.
   e. Once the patient arrives in TBC, the admission process will proceed according to the accepted procedures.

F. Scheduled Elective Admissions
   a. Patients will have their admission and surgery dates pre-scheduled from the Trauma Burn Clinic.
   b. On the day of admission, the patient will report to Admitting to complete the necessary processing.
   c. Upon patient arrival to the TBC, the admission process will proceed according to the accepted procedure.

G. Bed Allocation in Times of High ACS Census
   a. In the event that a TBICU bed is not available for an acutely burn injured or acutely traumatized patient, one of the following alternatives will be exercised:
      i. Transfer existing patient(s) from a TBICU bed to a TBC floor status/acute care bed, or to a medical/surgical/pediatric acute care unit as appropriate, with nursing consultation if indicated.
      ii. All acutely injured burn and traumatically injured patients have priority admission status to the TBICU at times of high census. When all patients in the TBICU are unable to meet criteria for acute care discharge, and require intensive care, then the most stable patient (judged by both the chief resident, attending staff, and the charge nurse) will be transferred another intensive care unit.
   b. The acute care/floor status burn injured patient has admission priority at time of high census in the TBC. In the event that a TBC acute care/floor status bed is not available for an acute burn admission the following will occur:
      i. Transfer non-burned injured patients from the ACSC to a medical/surgical/pediatric acute care unit or to home, as appropriate.
      ii. Admit the patient to a TBICU bed (if available), until a TBC acute care/floor status bed becomes available. If this occurs, Admitting will be notified that the bed is "floor status."

H. Patients on the ACS Service who are being cared for on other medical/surgical/pediatric units may be transferred to the TBC when warranted or indicated. Patients initially treated by other services may be transferred to the TBC if they meet the criteria for admission, and if the ACS Service accepts them for transfer.

TBC Pediatric Admission Policy (cont'd)

I. If CS Mott Women & Children's Hospital is at maximum capacity or capability, and beds are available in the TBC, CS Mott patients may be transferred/admitted to the TBC.

PRIORITY FOR DISCHARGE

A. Patients who no longer require intensive care of their injuries or intensive monitoring, will be transferred from a TBICU bed to the TBACU upon meeting the following criteria:
   a. Cardiac
      i. Heart rate within normal limits for age
      ii. Systolic blood pressure within normal limits for age
   b. Pulmonary
      i. Stable airway
      ii. Extubated >than 24 hours
      iii. Respiratory rate and S_aO_2 within normal ranges for age
      iv. F_IO_2 requirements <50%
      v. Pulmonary toilet requirement <Q4 hours
   c. Neurological
      i. Stable spine
      ii. Able to maintain and clear airway
      iii. No ongoing neurological changes
   d. Wound Care
      i. Children with < 20% TBSA wounds open
B. Floor status/acute care patients will be discharged from the TBC when ready for home care, placement in a rehabilitation institution, or skill nursing institution. Prior to discharge, all patients will receive discharge education/instructions, and a clinic follow-up appointment.
C. The decision to discharge a patient will be reached in conjunction with the physician team caring for the patient and the TBICU nursing staff. If there is lack of consensus on whether to discharge a patient, the Trauma or Burn Director, or in his absence his designate, will have final authority.

ADMINISTRATIVE RESPONSIBILITY

A. All beds within the TBC are under the direct supervision of the TBICU Medical Director, or in his absence, his designate.
B. All beds within the TBC are under the direct charge of the ACS Service. The ACS chief trauma resident is responsible for all bed accommodations.
C. All admissions to and discharges from the TBC will be arranged through the on call ACS chief resident, in collaboration with the TBC Charge Nurse.
D. The TBICU Medical Director and the Burn Director, or his/her designate, final authority regarding bed allocation disputes.

Guidelines for the Initial Management of the Pediatric Patient with a Burn Injury

A. Pediatric burn patients admitted to the Emergency Department (ED) will have the following evaluation, done by a burn surgeon:
    a. Determination of type/source of burn injury with appropriate treatment initiated (i.e. intubation or oxygen with inhalation injury, chemical burns irrigated, cardiac monitoring with electrical burns, etc.

    b. Estimation of extent and severity of burn injury

    c. Adequacy of fluid resuscitation (as appropriate)

    d. Neurovascular examination of circumferential burns

B. Pediatric burn patients will be admitted to the Acute Care Surgery (ACS2) Service in the Trauma/Burn Center (TBC) with other services following as consults as patient condition and injuries warrant (i.e. ophthalmology; cardiology; orthopedics; etc.) General care pediatric consults will be ordered as needed. STB ancillary support services (i.e. OT, PT, SW, and nutrition) will follow as automatic consults within 24 hours of patient admission. As outlined in Trauma Response Policy #20, burn patients will have first priority for admission to the TBC. ICU patients less than or equal to 12 years of age will have pediatric critical care services following as a consult.

C. If the patient meets criteria (see Trauma Response Policy #21), the patient will be admitted to the Pediatric Intensive Care Unit (PICU) in CS Mott Children's Hospital until clinically appropriate to be transferred to the TBC. The ACS Burn Attending Physician will determine when the transfer will take place.
    a. While admitted to the PICU, overall direction of burn and surgical care will be directed by ACS burn service attending physicians with close collaboration from either the Pediatric Critical Care or Pediatric Surgical Critical Care teams, as appropriate, based on the patient's catalog of injuries. Also while admitted to the PICU, burn surgeries will take place in CS Mott operating rooms and STB ancillary support services will project to CS Mott to manage care according to STB policies and protocols.

    b. If a care needs arise after admission that require the patient to be transferred to the PICU from the TBC (i.e. ECMO,) the burn service attending physicians will continue to direct care related to the burn injuries in close collaboration with the Pediatric Surgical Critical Care team, who will manage the intensive care issues.

c. Burn wounds will be cared for by the TBC Wound Team at all times and burn resuscitation will be managed by TBC Nursing staff.

D. Attending call coverage, operative responsibility, and daily clinical responsibilities for these patients will reside with the burn service attending physicians at all times.

E. The Burn Director will monitor the progress and plan of care for all admissions. Additionally, the Burn Director will provide clinical oversight and consultation, as necessary, to the other burn service attending physicians.

F. On discharge, pediatric burn patients will receive a follow-up appointment in the Burn Clinic within one week.
   a. If admission is not required, these patients will receive a follow-up appointment in the Burn Clinic within 72 hours.

Guidelines for Pediatric Burn Resuscitation

Documentation must include patient's TBSA affected using Lund-Browder diagram (including only partial and full-thickness burns) and a weight in kilograms prior to initiating the protocol. *For patients >30kg, follow the ADULT BURN RESUSCITATION Protocol.*

FIRST 24 HOURS POST INJURY

A. TBSA less than 20%
   a. Maintenance IVF only until the patient is taking adequate oral intake.

B. TBSA greater than or equal to 20% and weight less than or equal to 30kg
   a. Calculate estimated fluid needs, if weight >10kg, fluid should be LR, if <10kg, resuscitation fluid should be D5LR:
      i. 3-4 cc of LR x weight x TBSA
         1. Administer half of calculated amount over the first 8 hours post burn
         2. Administer remaining half of calculated amount over the next 16 hours.
         3. Fluids administered per-hospital should be included in the 24 hour total fluid resuscitation calculation.

***Note:** Hourly fluid resuscitation rate is titrated to urine output; see below.

      ii. In addition to burn fluid requirements, also infuse maintenance IVF (calculated total for 24 hours):
         1. 4cc/kg/hr for the first 10kg of body weight
         2. 2cc/kg/hr for the next10kg of body weight
         3. 1cc/kg/hr for the remaining kg of body weight

***Note:** DO NOT titrate maintenance fluids.

      iii. Target urine output is 1-2cc/kg/hr
      iv. If urine output is less than 1cc/kg/hour:
         1. increase LR infusion by 33% of the hourly calculated fluid requirement
         2. Monitor urine output on an hourly basis
         3. If urine output remains <1cc/kg/hr, increase resuscitation fluid infusion by another 33% of the hourly calculated fluid requirement, and CALL THE BURN ATTENDING
         4. If calculated fluid rate is >6cc/kg/%TBSA, transition to Difficult to Resuscitate Protocol.

      Example: If resuscitation fluid rate is 100cc/hr and urine output is <1cc/kg/hr, increase resuscitation fluid infusion to 133cc/hr. If after one hour, urine output remains <1cc/kg/hr, increase resuscitation fluid infusion to 177cc/hr.

      v. If urine output is greater than 2 cc/kg/hour:
         1. Dip urine to exclude glycosuria. If positive, notify the burn attending. This can falsely elevate urine output.
         2. Decrease resuscitation infusion by 33%.

3. Continue to monitor urine output on an hourly basis.
4. If urine output remains >2cc/kg/hr for 2 consecutive hours, CALL THE BURN ATTENDING.
5. Do not decrease the total IVF rate below calculated maintenance rate

C. Place enteral feeding tube as soon as possible.

D. At 12 hours post burn injury, assess IVF administered and calculate the projected 24 hour total IVF if fluid rates are kept constant. If the projected 24 hour IVF requirement exceeds 6cc/kg/TBSA, switch to the difficult to resuscitate protocol (*see below*)

AFTER 24 HOURS POST INJURY

A. Check serum sodium and potassium every 6 hours on the second day post-injury

B. Adjust type of fluid by the serum sodium level

C. After 24 hours of crystalloid infusion, if fluid requirements remain high, consider changing to 5% albumin. Changing to 5% albumin will only be done at burn service attending physician's discretion.

D. The goal is to decrease IVF rate to one half of the rate infused over the previous 16 hours. IVF rate is estimated based on patient's weight, TBSA burned, response to resuscitation, and estimated losses (seek Burn Attending input on calculating estimated losses)
   a. If patient >30 kg, the urine output goal is 0.5cc/kg/hour (maximum 70cc/hour)
   b. If patient $\leq$30 kg, urine output goal of 1 cc/kg/hour (maximum 2cc/ml/kg/hr)

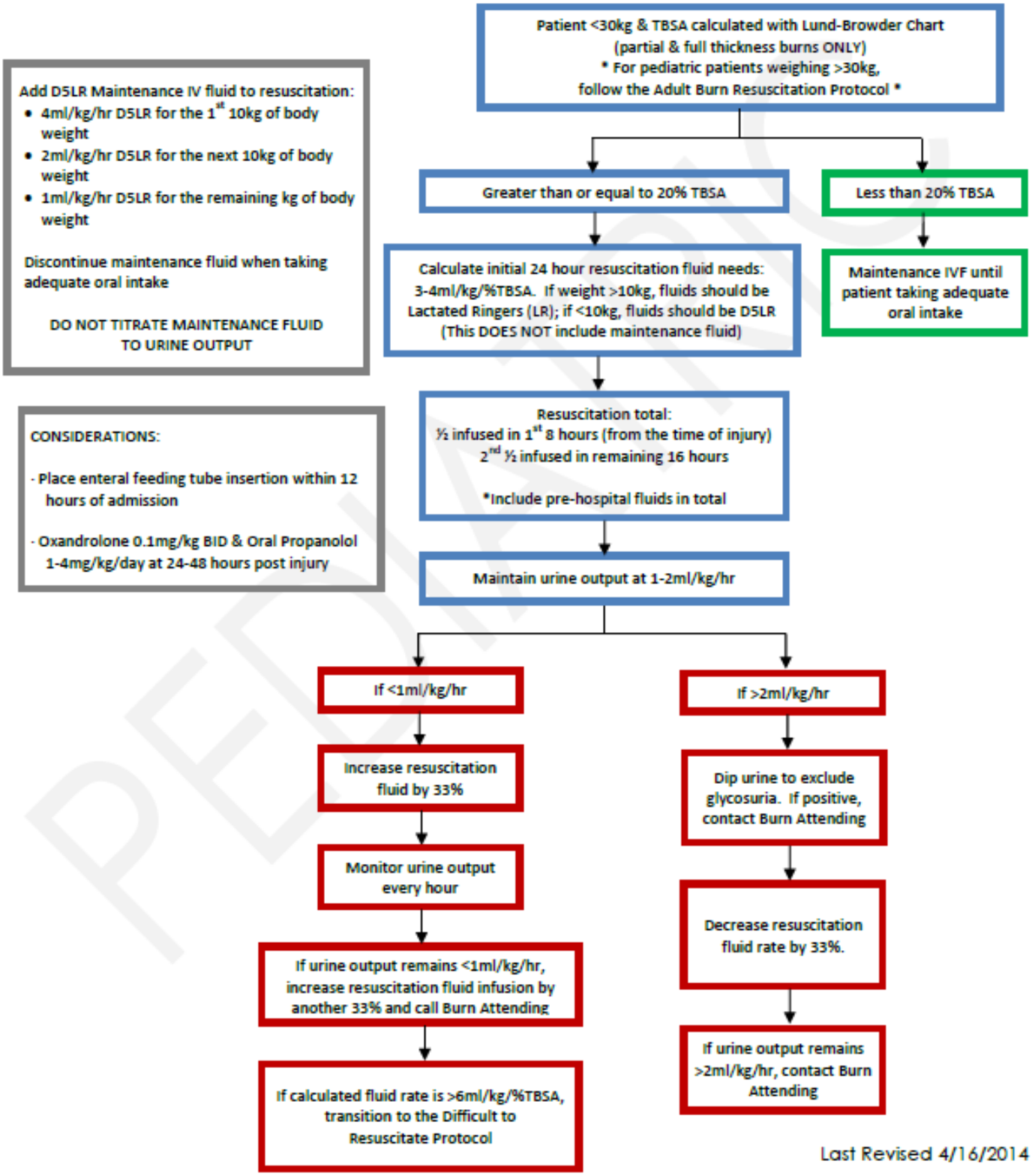
FOR ALL TBSA BURNS GREATER THAN 20%

ADDITIONAL MEDICATIONS

A. Oxandrolone – 0.1mg/kg BID
- Monitor liver function test weekly.

B. Beta Blocker
- PO propranolol 1-4mg/kg/day, can be given in divided doses BID or TID
- Usual starting dose is 1mg/kg/day, can titrate as tolerated to a maximum dosing of 4mg/kg/day

Guidelines for Pediatric Burn Resuscitation (cont'd)



Last Revised 4/16/2014

Pediatric Difficult to Resuscitate Protocol

In patients <30kg with persistent oliguria and estimated fluid resuscitation >6cc/kg/%TBSA, switch from Lactated Ringers (LR) infusion to 5% albumin (isotonic premixed 5% albumin or 200cc of 25% albumin in 800cc 0.45NS).

Note: For patients greater than 30kg, use ADULT DIFFICULT TO RESUSCITATE PROTOCOL.

A. Notify the Burn Attending

B. Initiate 5% albumin infusion at current resuscitation fluid rate. DO NOT titrate maintenance fluid.

C. Initiate CVP and SvO_2 monitoring via central access. Monitor bladder pressures every 4 hours
    a. Contact the Burn Attending for bladder pressures ≥20 mmHg

D. Targets:
    a. Urine output: 1-2cc/kg/hr
    b. SvO_2: ≥60%
    c. CVP: 8-10mmHg
    d. Bladder pressure: <20mmHg

E. If urine output is 1-2cc/kg/hr after 1 hour and the patient is normotensive, continue difficult to resuscitate protocol. Every attempt should be made to minimize fluid administration while maintaining organ perfusion.

F. If urine output >2cc/kg/hr after 1 hours, decrease the albumin infusion rate by 20%.

G. After 48 hours of albumin infusion, IVF type and rate to be determined by BURN ATTENDING.

H. If urine output is less than 1cc/kg/hr and the patient is hypotensive after 1 hour, follow the PEDIATRIC HYPOTENSION GUIDELINE and NOTIFY THE BURN ATTENDING.

I. If urine output is less than 1cc/kg/hr and the patient is normotensive after 1 hour a CVP ≤ 8:
    a. Increase albumin infusion by 33%
    b. Check hemoglobin and hematocrit
    c. Consider albumin bolus 10-20cc/kg
    d. Check urine output q30 minutes
        i. If urine output ≤1cc/kg/hr at 30 minute check, increase albumin infusion by 33%.
    e. If CVP remains <8 for 2 consecutive hours, contact burn attending and consider blood transfusion.

J. CVP = ≥8mmHg
    a. Add milrinone 0.25mcg/kg/min. Titrate to a max of 0.75mcg/kg/min for UOP 1-2cc/kg/hr.
    b. DO NOT increase albumin infusion rate.
    c. If urine output remains <1cc/kg/hr after 1 additional hour, add epinephrine 0.1mcg/kg/min and contact the BURN ATTENDING. Titrate to a maximum dose of 0.25 mcg/kg/min.
    d. Consider ECHO, CRRT
    e. Consider hypotension protocol

K. If CVP, SvO_2 and urine output reach goal, stop increasing fluids and contact burn attending.

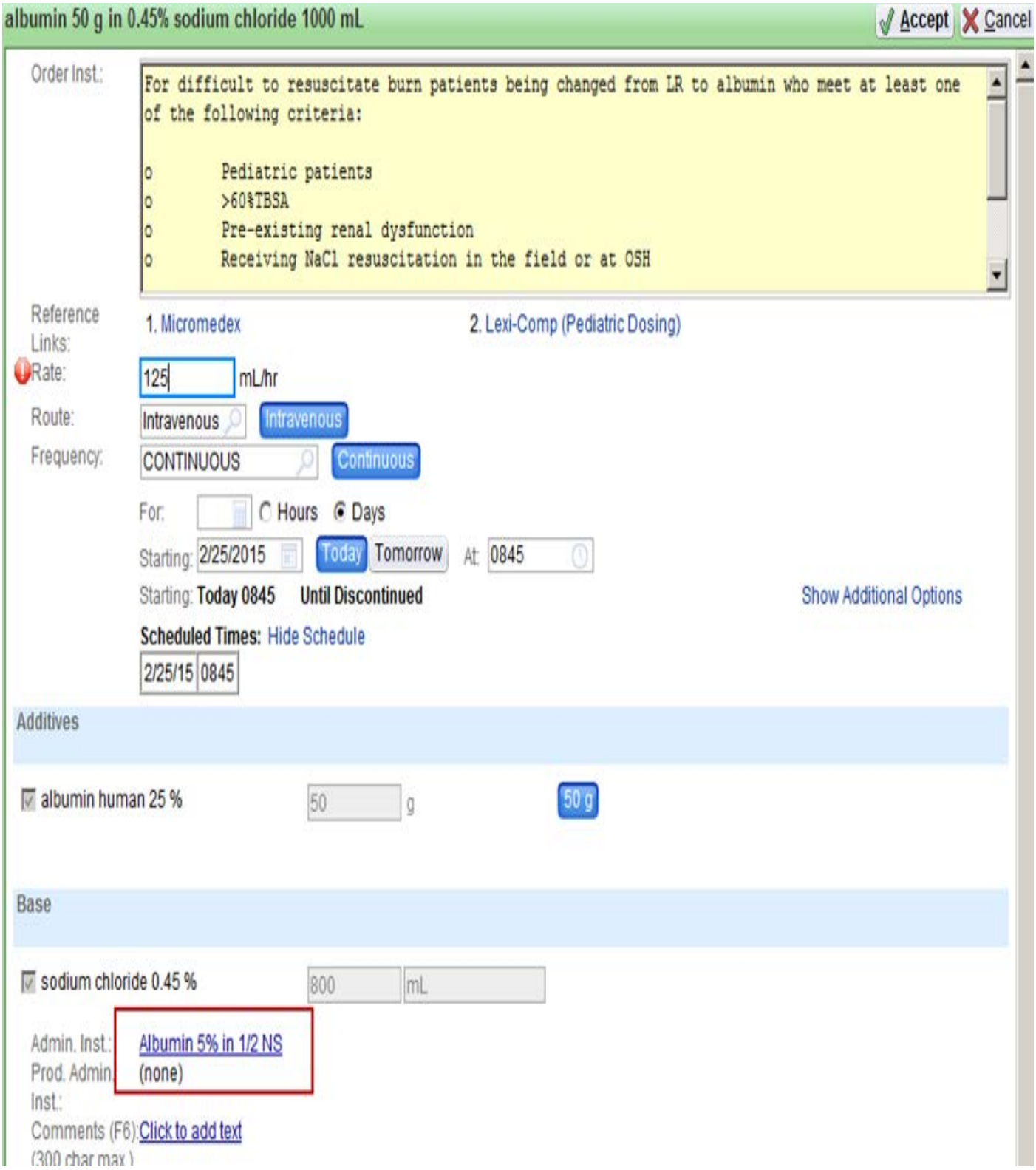
L. If patient becomes hypotensive along with urine output <1cc/kg/hr, follow the pediatric burn hypotensive guideline and notify the burn attending.

M. After 48 hours, infusion of albumin should be titrated down. IV fluid type and rate will be determined and order by the burn attending.

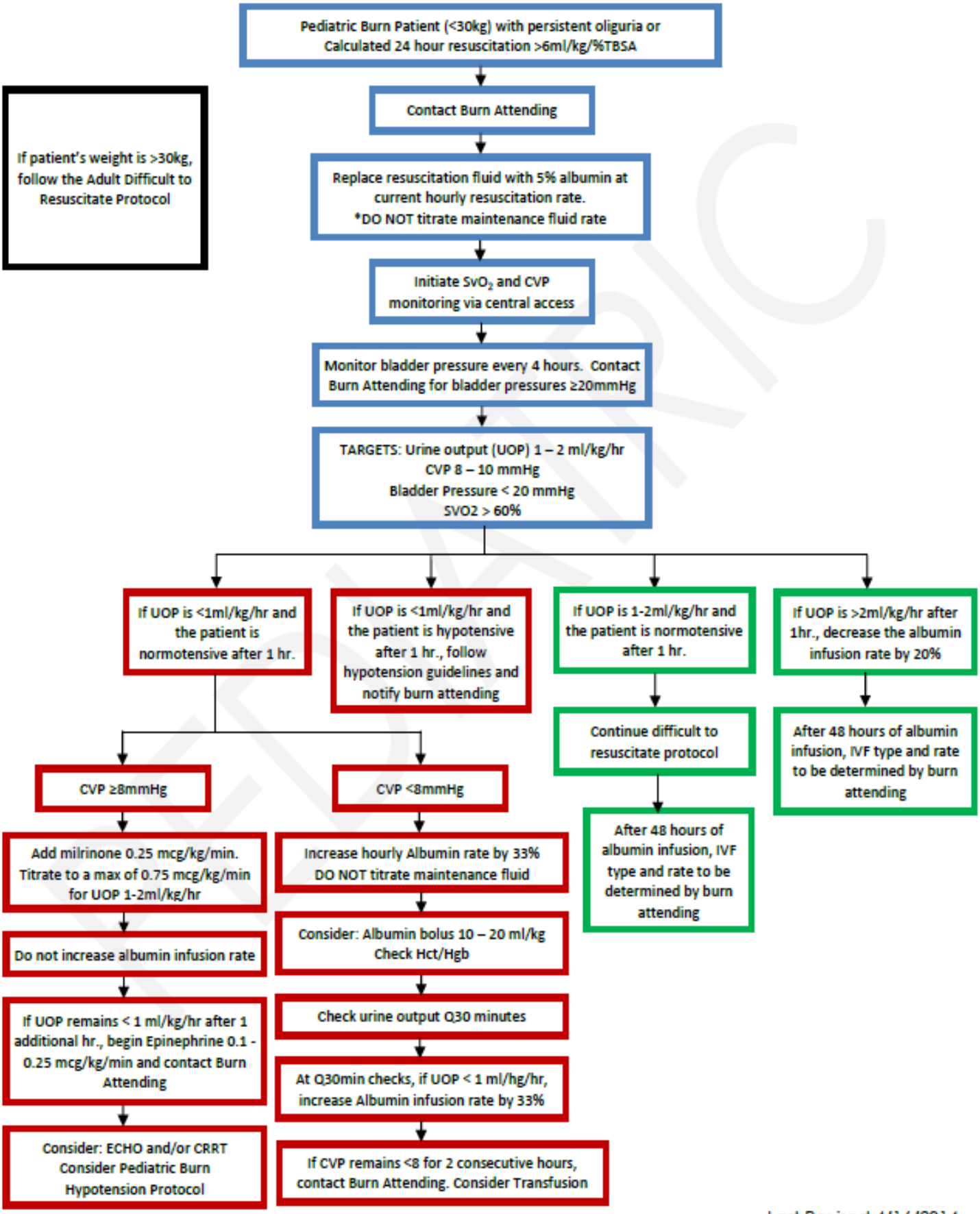
DIFFICULT TO RESUSCITATE FLUID in 0.45% NS

A. For difficult to resuscitate burn patient being changed from LR to albumin who meet at least one of the following criteria:

- Pediatric Patients
- >60% TBSA
- Pre-existing renal dysfunction
- Receiving NaCl resuscitation in the field or at the OSH


albumin 50 g in 0.45% sodium chloride 1000 mL
Accept
Cancel
Order Inst.:
For difficult to resuscitate burn patients being changed from LR to albumin who meet at least one of the following criteria:
o Pediatric patients
o >60%TBSA
o Pre-existing renal dysfunction
o Receiving NaCl resuscitation in the field or at OSH
Reference Links:
1. Micromedex
2. Lexi-Comp (Pediatric Dosing)
Rate:
125
mL/hr
Route:
Intravenous
Intravenous
Frequency:
CONTINUOUS
Continuous
For:
Hours
Days
Starting:
2/25/2015
Today
Tomorrow
At:
0845
Starting: Today 0845 Until Discontinued
Show Additional Options
Scheduled Times: Hide Schedule
2/25/15
0845
Additives
albumin human 25 %
50
g
50 g
Base
sodium chloride 0.45 %
800
mL
Admin. Inst.:
Albumin 5% in 1/2 NS
Prod. Admin. Inst.:
(none)
Comments (F6):
Click to add text
(300 char max.)

Pediatric Difficult to Resuscitate Protocol (cont'd)



Last Revised 4/16/2014

Guidelines for the Treatment of Hypotension in the Pediatric Burn Patient

The optimal minimum blood pressure for burn patients must be individualized. Some patients will maintain adequate organ perfusion (and thus have adequate urine output) with mean arterial pressures (MAP) less than 70mmHg; therefore true hypotension must be correlated with urine output and overall perfusion. If a MAP (generally below < 55mmHg or below appropriate parameter for age) is not adequate to maintain the UOP target, the following steps are recommended:

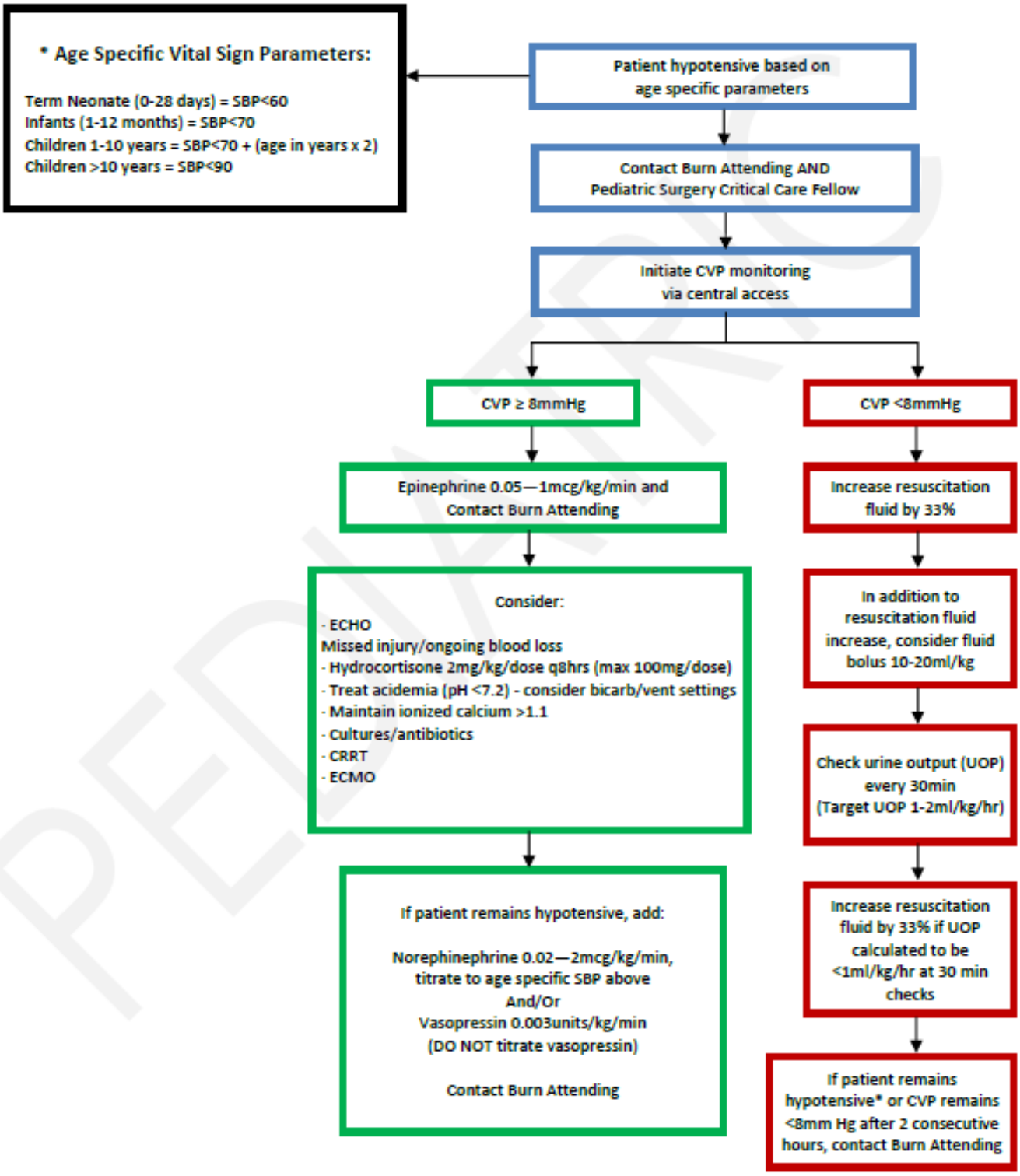
A. Monitor for hypotension:
    a. Term neonate (0-28 days) = SBP <60
    b. Infants (1-12 months) = SBP <70
    c. Children 1-10 years = SBP <70 + (age in years x2)
    d. Children > 10 years = SBP <90

B. Contact the BURN ATTENDING and Pediatric Surgery Critical Care Fellow

C. Initiate CVP monitoring via central access

    a. If CVP ≥ 8mmHg
        i. Add epinephrine 0.05-1mcg/kg/min (titrate to age specific BP targets above0 and call BURN ATTENDING
            1. Consider:
                a. ECHO
                b. Missed injury/ongoing blood loss
                c. Hydrocotisone 2mg/kg/dose q8hours (max 100mg/dose)
                d. Treat acidemia (pH<7.2) – consider bicarb IV push/vent settings
                e. Maintain ionized calcium >1.1 mmol/L
                f. Consider possible infectious source (cultures/ABX)
                g. ECMO
        ii. If persistent hypotension, add norepinephrine 0.05-2mcg/kg/min (titrate to age specific BP targets above) and/or vasopressin 0.003unit/kg/min. DO NOT TITRATE Vasopressin.
            1. Consider ECMO
    b. If CVP <8
        i. Increase resuscitation fluid infusion by 33%
            1. In additional, consider fluid bolus 10-20cc/kg
        ii. Check urine output q30 minutes (target 1-2cc/kg/hr)
            1. Increase IVF rate by 33% every 30 minute until CVP >8, based on q30minute urine output assessment
        iii. If patient remains hypotensive or CVP remains <8 after 2 consecutive hours, contact burn attending.
            1. Consider DIFFICULT TO RESUSCITATE PROTOCOL.

Guidelines for the Treatment of Hypotension in the Pediatric Burn Patient (cont'd)



Last Revised 4/16/2014

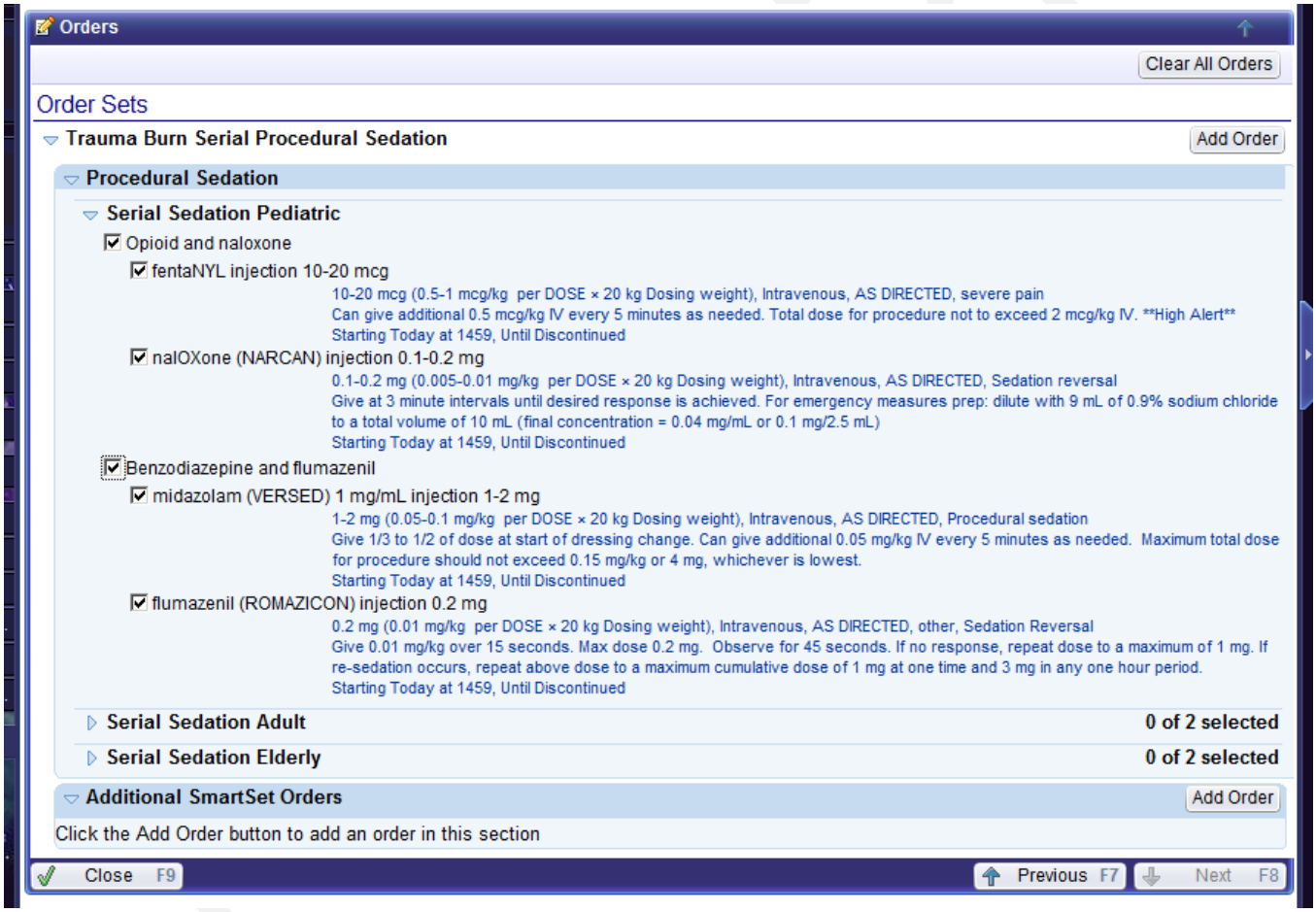
Pediatric Sedation and Analgesia Guidelines

UMHHC Policy 62-11-001
Guidelines for the Use of Moderate Sedation Analgesia For Diagnostic, Therapeutic and Minor Surgical Procedures in Non-Intubated Patients by Non-anesthesiologists

http://www.med.umich.edu/i/policies/umh/62-11-001.html

MiChart Order set: TRAUMA BURN SERIAL SEDATION (Pediatric)

Sedation Plans must be reviewed and updated DAILY per Trauma Burn Serial Sedation Protocol (in revision).



Burn Patient Notes

TBICU daily progress notes:

- *Both Burns and Non-Burns*: Everyday an ICU PROGRESS NOTE should be created and sent to the "TBICU Attending" for all ICU and moderate care patients.
- *Burns:* If the patient is on the SBUR Service, a ***second*** WOUND CARE NOTE should be sent to the "Burn Attending" or if the patient is general status, this is the only note that is written.

TBACU daily progress notes:

- Non-Burns: Everyday a Progress Note should be created and sent to the appropriate ACS team attending
- Burns: Everyday a Progress Note should be created and sent to the "Burn Attending" (only one note needs to be generated)

Adult Moderate Procedural Sedation Policy

UMHHC Policy 62-11-001
Guidelines for the Use of Moderate Sedation Analgesia For Diagnostic, Therapeutic and Minor Surgical Procedures in Non-Intubated Patients by Non-anesthesiologists

http://www.med.umich.edu/i/policies/umh/62-11-001.html

- Consent Signed (must include 'conscious sedation', 'procedural sedation', or 'serial sedations' as descriptors of procedure, and are only in effect for 6 months)
- Sedation Plan (in MiChart- includes airway assessment and ASA score)
  - **Daily** for Pediatric
  - **After OR** *and* **after a change in status** (floor to stepdown/ICU)
  - Reviewed and update **every Monday** for Adults
- Medication orders:
  - Trauma Burn Serial Sedation order set
  - Adult
  - Elderly (>65 years old)
  - Pediatric
- **Pediatric orders are to assessed for appropriateness Daily**

Tub Room Anesthesia for Burn Dressing Changes

- During week hours, anesthesia cases will be booked through the OR scheduler (10/2015 Erin Bubb). ICU PA, or BACU PA/NP will help coordinate.

- If needed during weekends, for adult patients contact the main OR scheduling desk (68470.) For pediatric patient, contact the Mott OR scheduling desk (32430.)

- If sedation is needed for floor patients (e.g.5A) - SWAT is available through a MiChart consult or pager 8000.

Management of Skin Donor Sites

Definition: Skin donor sites are areas that have had split thickness skin grafts harvested for coverage of surgically-excised burn wounds. Depending on availability of donor sites, skin grafts are preferentially harvested away from the recipient sites. In patients with extensive wounds, donor and recipient sites may be in close proximity. The initial management of donor sites differs from graft recipient sites in that it is nearly always preferable for donor sites to keep their original operative dressings until complete donor site healing has occurred (several weeks) while graft recipient sites require dressing changes.

1. Donor skin harvest sites will be documented on the **Burn Post-operative Dressing and Activities Instructions Sheet**. The type of wound dressing material and the need for dressing changes will be noted by the surgical team and is dependent on the Burn Attending.
2. The following are indications the surgical team desires that wound care of new donor sites will differ from that of the other postoperative wound sites:
    a. Mepilex has been placed on the site. Mepilex is kept in place for 7 days, unless saturated and then can be changed out sooner. Kerlix should be removed at 24 hours to assess level of saturation and a burn net applied to keep dressing in place.
    b. Acticoat, Xeroform or other dressing material has been stapled around a site marked as a donor site on the post-op instruction sheet. (Occasionally, staples are used to keep recipient site dressings from shearing away from a skin graft site - these staples will typically be at the upper or outer edge of a large dressing and the staples will be more widely spaced).
3. Donor sites should be kept dry and open to air as much as possible. Post-operative Kerlix dressings should be removed on POD#1 in order to expose the donor site dressing material to air (xeroform or acticoat); the donor site dressing adherent to the wound should then be kept in place and compressed with Bandnet. If there is excessive exudate, a fresh Kerlix dressing can be put on for 12 -24 hours and then removed. Do not moisten donor Acticoat dressings unless there are specific orders by the surgical team.

Note: DO NOT REMOVE adhered xeroform unless noted by the burn attending.

4. If a portion of a donor site has become exposed due to slippage of the dressing material, a new piece of the dressing may be applied to the exposed portion of the donor site.

5. Tight adherence of the donor site dressing material to the wound bed is desired and shearing should be avoided. Poor adherence of the donor site dressing to the wound bed may indicate a wound infection.

6. Donor site dressing materials should become dry and hardened during the post-operative recovery period. If the material (Mepilex, Acticoat, Xeroform, etc) remains or becomes soft, a wound infection may be developing.

Increased pain, redness, swelling and drainage from the donor site are concerning for wound infection; the surgical team should be asked to evaluate

Guidelines for Mobility and Activity Restriction Following Burn Operations

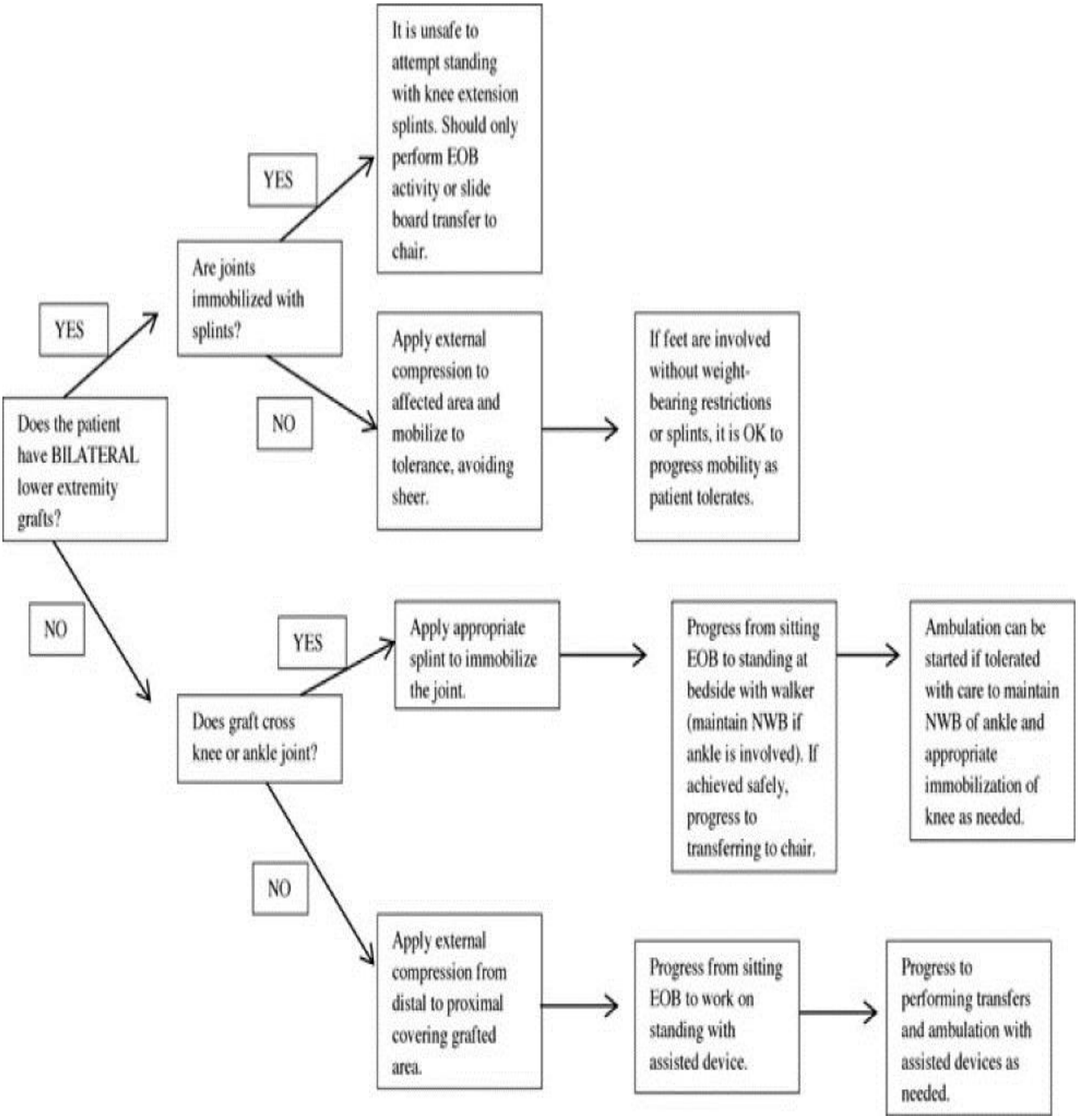
1. Unless activity will cause mechanical disruption or shearing of newly placed skin grafts, patients should be encouraged to get out of bed and participate in physical and occupational therapy activities.

2. The operating surgical team will complete a checklist of activity restrictions on the **Burn Post-operative Dressing and Activities Instructions Sheet**. The list of activity restrictions on this sheet has been vetted by the Physical Therapy, Occupational Therapy and Nursing services and uses common terminology to prevent confusion.

3. Unless specified otherwise by the operating surgical team, patients should get out of bed by POD#1 and have bathroom privileges. Ambulation should be encouraged for pulmonary toilet and to reduce deep venous thrombosis.

4. Unless specified otherwise by the operating surgical team due to concern about endangering fresh grafts, patients with fresh grafts on lower extremity sites with weight-bearing restrictions will get out of bed and into a chair with Nursing or Physical Therapy assistance starting POD#1. **Extremities should remain in post-operative splints and be kept elevated while the patient is seated.**

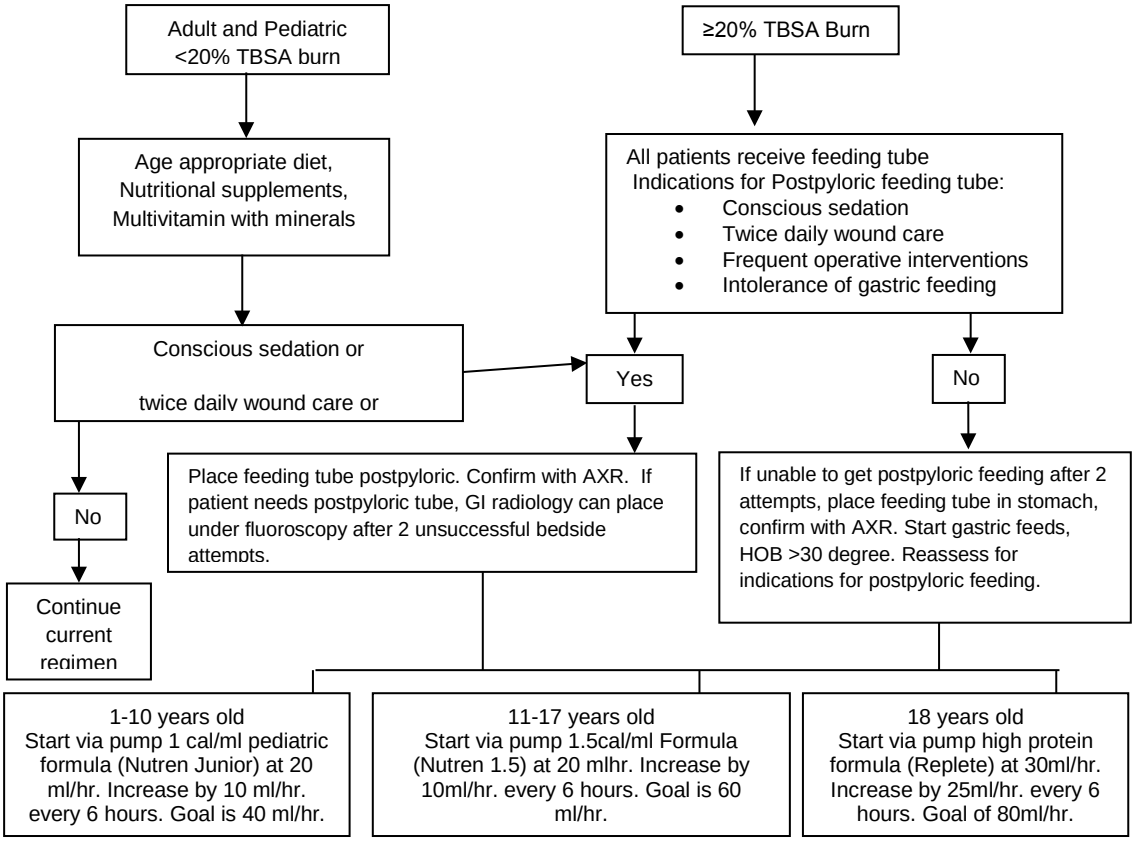
5. Following the takedown of the initial post-operative dressing, the surgical team will assess the graft sites to determine if physical activity can be increased. Changes in patient activity orders will be documented using the standard list of activity restrictions in the **Wound Dressing and Activities Order Sheet.**



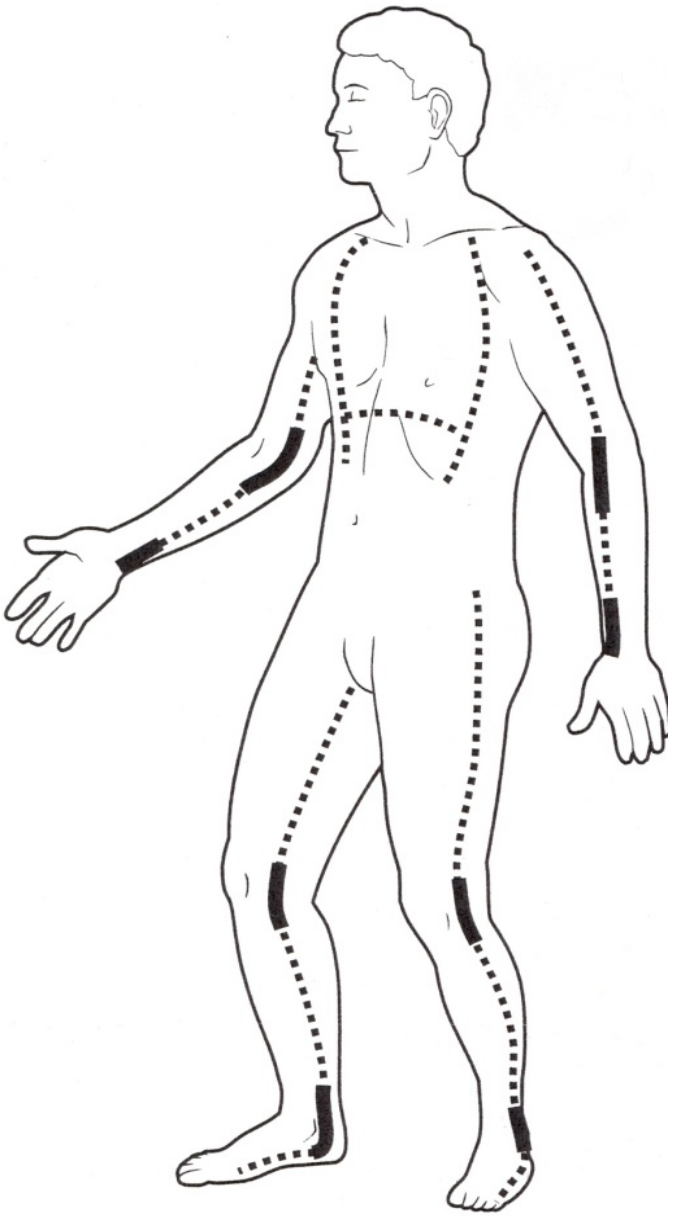
Taylor, Manning, & Quarles 2013

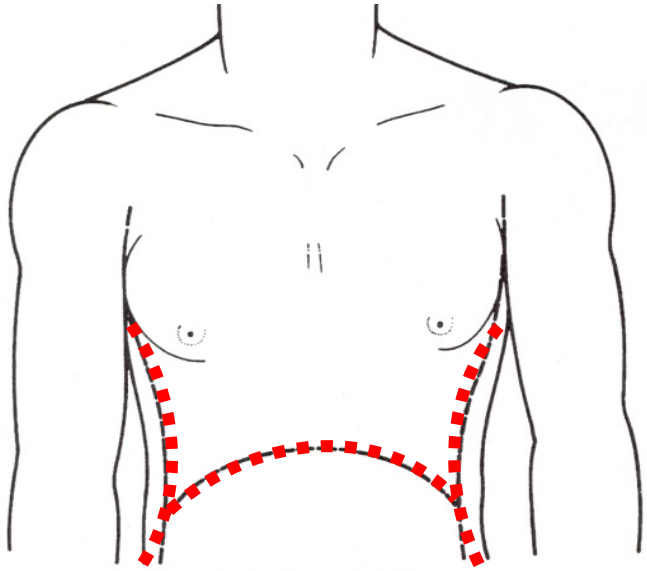
Guidelines for Initiation of Tube Feeding in Burn Patients

- Nutrition service will be consulted on all burn patients.
- Feeding will be accessed and established if appropriate within 12 hours from arrival.

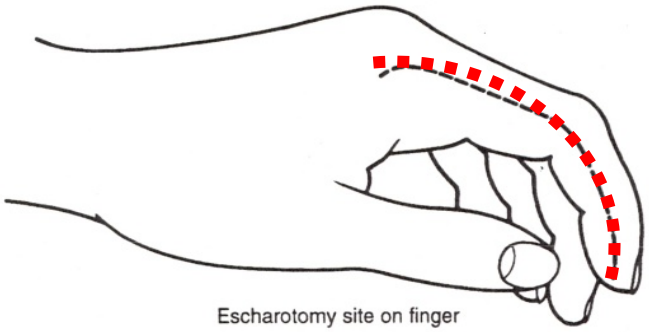


Guideline for Escharotomy Sites





Chest escharotomy sites



Escharotomy site on finger

Fig. 4.1 Possible escharotomy sites.

Procurement of Autograft Skin from Amputated Limbs

Following traumatic amputation, autograft skin may be harvested for later use on that same patient. If possible, skin should be harvested during the initial trauma surgery. Harvested skin can be stored for up to 14 days for later use.

If circumstances do not allow for immediate harvest, the limb may be temporarily stored in the morgue for later retrieval. The exception to this is when there is consideration that the limb itself may be reattached. In that case, it must be stored with the patient in a cooler of wet ice. Refer to the following for harvesting autograft skin:

A. Tissue excision must commence within 24 hours of amputation provided the limb was cooled with sufficient amounts of wet ice or refrigerated within 12 hours. Tissue excision must commence within 15 hours of amputation if the limb has not been cooled or refrigerated. If limb is cooled for a period of time, then not cooled for a period of time, the time period the limb is not cooled cannot exceed 15 cumulative hours.

B. If limb must be stored for later skin retrieval, it may be transported to the morgue for storage on designated limb shelf in one of the refrigerated body storage units. It must be accompanied by a completed requisition form. "No Dissection" must be written on the requisition form. Trauma staff will wrap the limb in sterile towels moistened with saline and place it in a plastic bag. Limb must be labeled with patient information, time and date of amputation, time cooled, physician and service responsible, and clearly marked "Do Not Dissect" on the plastic bag. Call Hospital Security for entrance if morgue is not staffed.

C. Log the specimen in the log book by the morgue entrance. When limb is retrieved from morgue for harvesting of skin, it must be logged out before removal.

D. If not immediately used for grafting, harvested skin may be stored by Trauma Burn Resource Center (Skin Bank) in RPMI 1640 with Glutamine for up to 2 weeks post retrieval.* Media is stored in the Skin Bank as well as in the OR Core Blood Bank Refrigerators in both Main and Mott OR's. No more than ¼ sq. ft. of tissue per 100 ml bottle. Media must cover tissue completely.

E. Return to Skin Bank or OR Refrigerator for refrigeration within 2 hours of harvest. In the event skin retrieval does not take place, notify the morgue for disposal of limb.

*Refrigerated skin is routinely banked for up to 14 days according to current AATB Standards for Tissue Banking, however TBRC has been granted authorization to bank autograft skin for up to 30 days upon request by physician for exceptional release. Notify TBRC of request.

Management of Patients with Toxic Epidermal Necrolysis or Steven's Johnson Syndrome

Toxic epidermal necrolysis syndrome (TENS) is a life-threatening disorder that involves sloughing of the skin at the dermal-epidermal junction; mucosal surfaces are also involved. Erythema multiforme, Stevens-Johnson syndrome (SJS) and TENS share a similar pathophysiology and are distinguished by the extent of cutaneous involvement. SJS involves less than 20% TBSA whereas TENS involves greater than 30% TBSA.

- Unless extenuating medical circumstances require their admission to another ICU, these patients should be admitted to the Burn Center.

- Wound care should provide topical antimicrobial activity while minimizing mechanical shearing forces to the skin at risk (decrease dressing frequency.) No scrubbing should be performed.

- IVIg may provide some benefit in TENS patients. There are several formulations of IVIg differentiated by the amount of sucrose and renal failure occurs mostly on using sucrose-containing products owing to osmotic injury. Immunology/Allergy approval is required for IVIg use. Patients >60 years of age, elevated creatinine, and/or history of diabetes are more at risk for ARF, therefore the risk and benefits of IVIg administration should be carefully examined. Sucrose formula may interfere with bedside glucose checks. For Additional indications and prescribing information, refer to http://ummcpharmweb.med.umich.edu/i/GuidelinesForms/MedicationUseGuidelines/tabid/220/Default.aspx

- Drug exposure is the causative agent in 80% of TENS cases and all possible attempts should be made to identify and remove that inciting drug. Patients and their families should be educated regarding avoidance of that drug class in the future.

- Systemic corticosteroids provide no benefit in the treatment of TENS and may increase infectious complications; their use should be avoided.

- Prophylactic systemic antibiotics are not indicated and may increase the risk of super infection. Antibiotics are indicated for suspected or documented infections. Lactated Ringers is the preferred resuscitation fluid.

- Early and aggressive nutritional support is essential for optimal clinical outcome. Enteral nutrition is preferred to parenteral nutrition.

- Inpatients transferred from other services and other institutions will be placed in isolation and pan-cultured upon admission

Heparin/Albuterol/Mucomyst (HAM) Treatment of Suspected of Known Inhalation Injury

- Control of Airway – Intubation
- Mechanical Ventilation to Maintain Sa02>/=90%
- Obtain carboxyhemoglobin level
- Consider CyanoKit

Flexible bronchoscopy on admission and daily when clinically appropriate

***Patient should receive alternating treatments q2h**

- *Nebulized heparin 10,000IU/3mL 0.9% NS (pre-mixed from pharmacy)*

ALTERNATE WITH

- *Nebulized Mucomyst 3ml of 20% solution AND nebulized Albuterol 2.5mg*

Therapy to continue for 7 days or until patient is extubated

Exclusion Criteria

- Heparin induced thrombocytopenia (<50,000/mm^3)
- Sensitivity to heparin, albuterol, or Mucomyst
- Significant bleeding disorders
- Airway hemorrhage
- Uncontrolled bleeding

Elsharnouby NM et. al. Journal of Critical Care, 29: (2014) 182.e1-182.e4

Frostbite injury

Time of injury < 24 hours

- YES → **≥ 1 of the following parameters positive?**
  - No improvement with rapid rewarming in tepid water (38°C-42°C for 15-20 minutes)
  - Absent Doppler pulses in affected limbs/digits
  - YES → **≥ 1 of the following parameters positive?**
    - Severe HTN *(SBP ≥ 170; DBP ≥ 110)*
    - Concurrent trauma, neurological impairment, stroke
    - Recent surgery or hemorrhage (≤ 48 hrs)
    - Drug or alcohol intoxication
    - Pregnancy
    - Repeated freeze – thaw cycles
    - More than 48 hours of cold exposure
    - NO → **Appropriate Candidate for intra-arterial tPA**

      Proceed with the following:

      1. Placement of arterial catheter into brachial or femoral artery *(per IR)*
      2. Administer papaverine (vasodilator) followed by tPA bolus of 2-4mg *(per IR)*
      3. Administer tPA infusion at 1 mg/hr *(dose divided by number of affected extremities)*
      4. Administer Heparin at 500 U/hr per extremity affected. Continue Heparin for 72-96 hours.

    - YES → NOT a candidate for tPA. *Proceed to general care guidelines.*
  - NO → NOT a candidate for tPA. *Proceed to general care guidelines.*
- NO → NOT a candidate for tPA. *Proceed to general care guidelines.*

Monitoring Parameters

- Doppler pulses checks every 1 hour
- Angiography at 12 hours and 24 hours if perfusion defect persists
- H/H, Plt, Fibrinogen, PTT every 6 hours
- Bone scan on post injury day 3 or 4 *(aid in eval of viability of bone for muscle flap placement)*

Indications for Discontinuation of tPA

- Active bleeding
- Complete perfusion restored
- Completion of 48 hours of therapy
- Fibrinogen < 150mg/dL
- H/H < 7.0/21.0
- Platelets < 100
- PTT > *29.0*

GENERAL CARE GUIDELINES:

- Confirm tetanus prophylaxis

PAIN MANAGEMENT:

- Ibuprofen 400-600mg PO QID
  - *OK to use during tPA treatment*
- IV narcotics in acute phase

WOUND CARE:

- Hemorrhagic blister treatment
  - Do NOT De-roof to relieve pressure
  - Place in dry gauze
- Non-hemorrhagic blister treatment
  - Drain using aseptic technique
  - Place in aloe vera and/or Mepilex
- *NOTE: Blisters may be left in place per MD discretion*
- If no blisters present:
  - Open to air, antimicrobial dressing, and/or topical aloe vera per MD

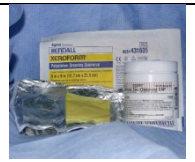
ADJUNCTS TO CONSIDER: *(per MD)*

- Antibiotic prophylaxis to cover Staph, Strep, Pseudomonas
- Pentoxifylline 400mg PO TID (adjust for renal failure)
  - *Contraindications: Intolerance, recent retinal or cerebral hemorrhage, risk factors for hemorrhage*

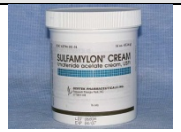
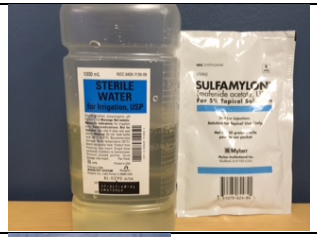
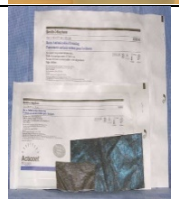
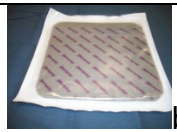
Bruen, et. al. 2007. Reduction of the incidence of amputation in frostbite injury with thrombolytic therapy. *Arch Surg, 142*, 546-553.

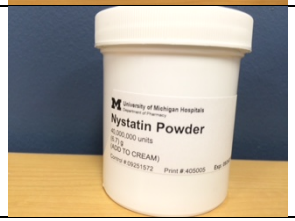
Twomey, Peltier, & Zera. 2005. An open-label study to evaluate the safety and efficacy of tissue plaminogen activator in treatment of severe frostbite. *The Journal of Trauma, Infection, Infection, and Critical Care, 59*(6), 1350-1355.

Wound Care Product Reference

Product	Photo	How Supplied	Advantages	Disadvantages	Notes
Silvadene (SSD) (Silver Sulfadiazine Cream)		50gm jar 400gm jar (pictured)	Easy to afford Easy to find at pharmacies Traditional PT and FT burns	Pain with dressing changes Gauze wrapping might be 2 person job Cost of gauze	SSD is inexpensive Must shower or bathe daily or bid, scrubbing pseudoeschar and old SSD off causing pain
Bacitracin (Bacitracin zinc or triple antibiotic ointment)		30gm tube (OTC) 1# jar	Easy up-keep Superficial & PT burns Non-toxic around mouth, eyes, genitalia Can cover or leave open to air	Gram + only	Must apply often if not covered to prevent wound from drying out >= bid application Must wash off old cream before reapplying new
Xeroform Gauze (Bismuth & petroleum gauze)		1x8” 5x9”	Easy up-keep Superficial & PT burns Gentle on fragile STSGs	Little antimicrobial coverage – use with Bacitracin Difficult to find at pharmacies	Flexible changing schedule; daily, or qod or M-W-F May leave in place like a scab and trim excess if not on STSG, donor site Bacitracin may be applied underneath, on top of or impregnated in Xeroform
Collagenase (Papain Urea Ointment)		30gm tube	Pseudoeschar debridement	Pain with application No antimicrobial coverage	Moisten gauze with H2O or saline if burning sensation occurs Can apply q 12 hours alt. with SSD or q 24 hours alone

Wound Care Product Guideline

Product	Photo	How Supplied	Advantages	Disadvantages	Notes
Sulfamylon (Mafenide Acetate Cream)		4oz tube 400gm jar (pictured)	Deeper penetration Good on cartilage (i.e. ears, nose) PT & FT burns Gram + coverage	Pain with application Expensive	Be sure to protect ear canal with cotton ball prior to application medication can erode ear drum
Sulfamylon (5% Mafenide Acetate solution)		Pwd packet	Soak dressing, less pain Gram + coverage	Expensive, often not covered by insurance out patient	Any un-used solution should be discarded in 48 hours.
Acticoat (Silver impregnated gauze)		4x8", 8x16" or 16x16" 7 day-6x6"	No dressing changes for 3- 5 days PT & FT burns Change outer wrap PRN Double layer to obtain 7 day coverage, Expensive	Can't shower Pain with application Can slip and leave exposed areas Keep damp not soaked	Bacitracin for exposed spots Do not need to scrub pseudoeschar unless soupy Consider leaving like a scab if stuck down
Mepilex (Silver Impregnated foam)		Border (4x4, 6x6, 6x8) Borderless (6x6, 8x8, 8x20)	No need to moisten, absorb wound drainage, antimicrobial coverage, Easy ROM, comes off easy; does not stick	Can't get dressing wet, need to cover wound for shower	 borderless  border

Silverlon (Silver impregnated fabric)		Various size gloves from clinic or lab only	Easy application and maintenance Easy for ROM PT burns only Expensive	Daily dressing changes Keep moisten,	Same glove may be used for prolonged periods. Other forms (i.e. sheets, wraps) occasionally available. Patient must wash wounds and remove/wash gloves daily on PO pain medication.
Silvernitrate Solution (0.5%)		0.5% solution, 1000mL pre-mixed solution	Coverage: Gm + and –, pseudomonas, MRSA, VRE, and fungal. Inexpensive	Stains surfaces and everything that it comes in contact with.	
Silvernitrate Topical Sticks		6” sticks	Use in hypergranulation tissue		
Nystatin pwd		40 million units/400g jar	Anit fungal agent, commonly mixed with SSD		Unused mix should be discarded after 24 hours

VTE Prophylaxis Guidelines for Trauma and Burn

Inpatient Guideline: http://www.med.umich.edu/i/vte/pdfs/TBE.pdf

VTE Prophylaxis Protocol for Surgery Trauma/Burn (STB) Patients

Trauma patients:

1. Inpatient: All trauma admissions will have a Caprini score calculated on admission. Patients with a score of 2 or greater will receive thromboprophylaxis with LMWH (enoxaparin 30mg SQ twice daily) and SCD's while admitted to the hospital unless contraindicated.

2. Contraindications to immediate use of LMWH:

I. Traumatic brain injury with any of the following findings:

a. Intracerebral contusion or hematoma >2 cm in diameter

b. Multiple smaller contusions within one region of the brain

c. Subdural or epidural hematoma >8 mm in thickness

d. Persistent intracranial pressure greater than 20 mm Hg

e. Increased size or number of brain lesions on follow-up CT scan performed 24 hours after admission

II. Ongoing bleeding, transfusion requirement, coagulopathy, or unstable hematocrit

III. Allergy

3. Contraindications to SCDs:

I. Trauma or burn Injury that does not allow device to be placed on lower extremity.

II. Known lower extremity acute or subacute DVT.

4. Operation: Administer nighttime LMWH dose and hold morning dose for routine operations. Resume LMWH with nighttime dose the day of operation unless contra indicated due to excessive bleeding.

5. Special situations:

I. Patients undergoing pelvis, acetabular or spine surgery will receive SCD's for the first 12 hours after operation. If their hematocrit remains stable, they will then proceed to with LMWH (enoxaparin 30mg SQ twice daily) and SCD's. If an alternative plan is desired, the Orthopedic surgery attending will bring it to the attention of the Trauma surgery attending.

II. Patients requiring a ventriculostomy, craniotomy, or who have a traumatic brain injury with a stable head CT scan for 24 hours, will receive LMWH (enoxaparin 30 mg SQ twice daily). If an alternative plan is desired, the Neurosurgery surgery attending will bring it to the attention of the Trauma surgery attending. LMWH will be suspended for 18 hours prior to discontinuation of ventriculostomy catheters. LMWH administration will be resumed 4 hours after ventriculostomy removal if the patient has a stable neurologic exam and no signs of bleeding.

III. Trauma patients who receive an epidural catheter will receive LMWH (enoxaparin 40 mg SQ once daily). Special dose holding instructions apply:

1. In patients with an epidural catheter you must wait 4 hours before starting LMWH. The second dose may be given no sooner than 24 hours after the first dose.

2. LMWH must be suspended 12 hours prior to removing the epidural catheter.

3. May resume LMWH 2 hours after epidural catheter has been removed and change dose to enoxaparin 30 mg SQ twice daily.

VTE Prophylaxis (cont.)

IV. If VTE chemoprophylaxis is unable to be initiated following admission due to a contraindication; patients will receive a lower and upper extremity DVT scan every 48 hours until VTE chemoprophylaxis is initiated.

6. Dosing considerations: In cases of renal failure or pregnancy use UMHS LMWH dosing guidelines. For renal failure or pregnant patients follow monitoring recommendations for anti-factor Xa level and dose adjustment.

I. Renal failure:
If CrCl <10 mL/min use Heparin 5000 units TID.
If CrCl = 10-29 mL/min use LMWH (enoxaparin 30 mg SQ once daily).
II. Pregnant patients: If maternal body weight < 75kg use LMWH enoxaparin 30 mg SQ once daily until 20 weeks and 30mg SQ twice daily after 20 weeks gestation. If maternal body weight ≥ 75kg use LMWH enoxaparin 40 mg SQ once daily until 20 weeks and 40mg SQ twice daily after 20 weeks gestation.

7. Vena Cava Filter: Consider temporary vena cava filter placement in patients at very high risk for VTE whom are unable to receive chemoprophylaxis and are likely to have a prolonged ICU stay (> 4 days). Reassess daily for chemoprophylaxis.

Burn patients:
1. Inpatient: All burn admissions will have a Caprini score calculated on admission. Patients with a score of 2 or greater will receive thromboprophylaxis with LMWH (enoxaparin 30mg SQ twice daily) and SCD's while admitted to the hospital unless contraindicated.
2. Operation: Administer nighttime LMWH dose and hold morning dose for burn operation. Resume LMWH with nighttime dose the day of operation unless contra indicated due to excessive bleeding.
3. Dosing considerations: Use dosing considerations listed above for trauma patients.

General Surgery patients
1. Inpatient or ADP: Perform Caprini score DVT risk assessment. Follow UMHS guidelines for VTE prophylaxis regimen based on risk factor score (0-1 low risk, 2 moderate risk, 3-4 higher risk, 5 or more highest risk).
2. Operation: Administer nighttime LMWH dose and hold morning dose for general surgery operation. Resume LMWH with nighttime dose the day of operation unless contraindicated due to excessive bleeding.
3. Special situations: General Surgery patients who receive an epidural catheter will receive LMWH (enoxaparin 40 mg SQ once daily). Special dose holding instructions apply:

1. In patients with an epidural catheter you must wait 4 hours before starting LMWH. The second dose may be given no sooner than 24 hours after the first dose.
2. LMWH must be suspended 12 hours prior to removing the epidural catheter.
3. May resume LMWH 2 hours after epidural catheter has been removed.

4. Dosing considerations: Use dosing considerations listed above for trauma patients.

Discharge Prophylaxis Guideline:

http://www.med.umich.edu/i/vte/pdfs/501_attachment%2050%20A_guideline_anticoag_DC_Revised%204-15-2014.pdf

Trauma Service Guidelines for DVT/PE Prophylaxis at discharge	***PATIENT CHARACTERISTICS***		
	VTE Score (Caprini score) > 7	**VTE Score (Caprini score) ≤ 7**	**Increased risk for bleeding** (h/o bleeding disorder, recent hemorrhagic stroke or GI bleed)
PROCEDURE CHARACTERISTICS			
High risk (THA -including revision or liner change), TKA, Hip (IT or femoral neck), femur, or any Pelvis fx, Pelvic osteotomy)	# Warfarin (INR 2.0-3.0) x 4 weeks Bridge if not therapeutic with prophylactic LMWH 30 mg twice daily OR If CrCl ≥ 30 ml/min: Rivaroxaban 10 mg PO once daily.† for 4 weeks	# Warfarin (INR 2.0-3.0) x 4 weeks Bridge if not therapeutic with prophylactic LMWH 30 mg twice daily OR If CrCl ≥ 30 ml/min: Rivaroxaban 10 mg PO once daily.† for 4 weeks	Attending discretion; Compression stockings recommended. Initiate pharmacologic prophylaxis once bleeding risk has subsided
Moderate risk (Tibia Diaphyseal Fx IMN, Hip Scopes, Ankle Pilon, Tibial Plateau, Shoulder Arthroplasty)	LMWH (enoxaprin 40mg SQ once daily) (total of 4 weeks)	LMWH (enoxaparin 40mg SQ once daily) (total of 2 weeks) OR Second line: ASA 325mg once daily (2 weeks)**	No discharge prophylaxis; Compression stockings recommended. Initiate pharmacologic prophylaxis once bleeding risk has subsided
Low risk (All UE Fx, except shoulder arthroplasty, Hardware removal, knee scopes, Ankle Fx, Calcaneous, Talus)	LMWH (enoxaparin 40mg SQ QD (total of 2 weeks) OR Second line: ASA 325mg once daily (2 weeks)**	No discharge prophylaxis	No discharge prophylaxis; consider pharmacologic prophylaxis once bleeding risk has subsided if Caprini score > 7

- Warfarin, LMWH, ASA, rivaroxaban duration will be calculated from time of injury.
- **Patients with a pending operative intervention (within 2 weeks of discharge) that are being discharged and per the protocol ASA is indicated will be sent home on prophylactic LMWH for total of 4 weeks.
- Patients with a Caprini score > 7, and if active cancer diagnosis, prior VTE, or known clotting disorder consider discharge prophylaxis.
- # - data driven recommendations
- † - Rivaroxiban is contraindicated if CrCl < 30 ml/min. Start rivaroxaban 0-2 hours before next dose of LMWH was to be administered. No need for bridge.

Anticoagulation and Reversal of Anticoagulation

Emergent Reversal of Anticoagulants:

https://pharmwebsp.med.umich.edu/GuideLines/Anticoagulation/EmergentReversalOfAntithromboticAgents.pdf

University of Michigan Health System
Guidelines for the Emergent Reversal of Antithrombotic Agents

I. General principles of managing emergent bleeding:

a. Supportive care: volume resuscitation, vasoactive agents if needed
b. Blood product transfusion
c. Identify bleeding source
d. Use of local hemostatic agents, mechanical compression, surgical intervention

II. Definitions

a. FFP: Fresh Frozen Plasma
b. FVIIa: Recombinant Factor VIIa
c. DTI: Direct Thrombin Inhibitor
d. PCC: Prothrombin Complex Concentrate
e. LMWH: Low molecular weight heparin
f. DTI: Direct thrombin inhibitor

III. Warfarin (Coumadin)

Pharmacologic Properties

a. Target: Factors II, VII, IX, X
b. Elimination half-life:
    - o 20-60 hours (highly variable)
c. Duration of antithrombotic effect:
    - o 2-5 days (dependent on repletion of clotting factors)

Reversal

d. Vitamin K (Phytonadione)
    - o Oral is the preferred route of administration, time frame for effect: 24 hours
    - o For emergent reversal or if unable to use oral administration, IVPB is the preferred parenteral route of administration, time frame for effect 12-16 hours, max rate 1mg/min
    - o Subcutaneous/IM administration is not recommended due to erratic and/or incomplete absorption and potential for intramuscular bleeding (IM administration)

e. PCC and FVIIa have been shown to be effective in reversing the effect of warfarin but can increase the risk of thrombotic events; onset of INR reversal within 15 minutes.

Anticoagulation and Reversal (cont'd)

III. Warfarin (Coumadin)

f. FFP has been shown to be effective in reversing the effect of warfarin. Limitations of this agent can include potential for transmission of viral illness, longer preparation time, and large volume for administration.

	Recommendations
Minor Bleeding	☐ Omit next dose ☐ Consider 2.5-5mg Vitamin K PO/IV if INR is supratherapeutic
Moderate-Severe Bleeding (Hemodynamically Stable)	☐ Hold warfarin ☐ Provide supportive care ☐ Vitamin K 10mg IV x 1 ☐ Administer Kcentra* based on INR:
	2 – 3.9 | 25 units/kg | Max 2500 units
	4 - 6 | 35 units/kg | Max 3500 units
	Greater than 6 | 50 units/kg | Max 5000 units
Life-threatening Bleeding	☐ Hold warfarin ☐ Vitamin K 10mg IV x 1 ☐ Administer Kcentra* based on INR as outlined above ☐ Consider FFP 10-20ml/kg for volume or

*Use restricted to neurosurgery, stroke team (see member list in PCC guideline), emergency medicine, trauma, and hematology

Monitoring

g. Monitor of signs and symptoms of bleeding
h. Check PT/INR
    - o 15 minutes after administration of FFP, PCC, or Factor VII
    - o At 2 hours and every 6 hours thereafter
i. Repeat dosing not recommended

Anticoagulation and Reversal (cont'd)

IV. Dabigatran (Pradaxa)

Pharmacologic Properties

a. Direct thrombin inhibitor (IIa)

b. Elimination half-life

- Healthy adults: 12-17 hours
- Severe renal dysfunction (CrCl 15-30ml/min): 27 hours

c. Duration of antithrombotic effect

- CrCl greater than 50ml/min: 1-2 days
- CrCl less than 50ml/min: 3-5 days

Reversal

d. No specific antidotes are available

e. It is unclear at this time if blood factor preparations (PCC, FVIIa) or blood products are useful for reversing the effect of dabigatran. Abnormal coagulation lab values may not be corrected with administration of hemostatic agents and may not be representative of clinical effect

f. Administration of PCC has not been shown to reverse abnormal coagulation lab values, however has demonstrated significant clinical hemostatic properties in murine models

g. FVIIa has demonstrated reversal of abnormal coagulation lab values in murine models, but did not demonstrate any significant improvement in clinical hemostasis in these models and is likely ineffective for reversal of this agent.

Anticoagulation and Reversal (cont'd)

IV. Dabigatran (Pradaxa)

	Recommendations
Minor Bleeding	☐ Delay next dose or discontinue treatment is clinically appropriate ☐ Maintain adequate urine output
Moderate-Severe Bleeding	In addition to above measures: ☐ If ingestion was recent (within 1-3 hours), administer activated charcoal 50g PO x 1 ☐ Unproven efficacy—consider Kcentra* 25 units/kg
Life-threatening Bleeding	In addition to above supportive measures/charcoal: ☐ Consider emergent hemodialysis, each session will remove ~65% of remaining dabigatran ☐ Unproven efficacy—consider Kcentra* 50 units/kg x 1 ☐ Based on clinician judgment, if bleeding due to coagulopathy continues despite Kcentra therapy, consider Feiba NF[#] 100 units/kg x 1 ☐ Based on clinician judgment, if bleeding due

*Use restricted to neurosurgery, stroke team (see member list in PCC guideline), emergency medicine, trauma, and hematology

[#]Use restricted to hematology and emergency department

[ł] UMHS Factor VIIa (Novoseven) Guidelines: Adult Patients

Monitoring

h. Monitor of signs and symptoms of bleeding

i. Anti IIa level should be sent on presentation to demonstrate presence of drug

j. PT/INR should not be evaluated given the insensitivity and variability of the assay in response to dabigatran

Anticoagulation and Reversal (cont'd)

V. Rivaroxaban (Xarelto)

Pharmacologic Properties

a. Factor Xa inhibitor
b. Elimination half-life:
    - o Healthy adults: 5-9 hours
    - o Severe renal dysfunction (CrCl less than 30 ml/min): 9.5 hours
    - o Moderate hepatic impairment (Child-Pugh B): 10-12 hours
    - o Severe hepatic impairment (Child-Pugh C): No data
c. Duration of antithrombotic effect:
    - o Effect should dissipate in 4-5 half-lives

Reversal

d. No specific antidotes are available
e. It is unclear at this time if blood factor preparations (PCC, FVIIa) or blood products are useful for reversing the effect of rivaroxaban. There is limited data that suggests administration of PCC is effective at reversing abnormal coagulation lab values
f. There is no role for hemodialysis in the reversal of rivaroxaban

	Recommendations
Minor Bleeding	☐ Delay next dose or discontinue treatment if clinically appropriate ☐ Maintain adequate urine output
Moderate-Severe Bleeding	In addition to above measures: ☐ If ingestion was within past 8 hours, administer activated charcoal 50g PO x 1 ☐ Kcentra* 25 units/kg x 1
Life-threatening Bleeding	In addition to above supportive measures/charcoal: ☐ Kcentra* 50 units/kg x 1 ☐ Based on clinician judgment, if bleeding due to coagulopathy continues despite Kcentra therapy consider Feiba NF# 100 units/kg x 1 ☐ Based on clinician judgment, if bleeding due to coagulopathy continues despite Kcentra therapy consider Factor VIIa‡

*Use restricted to neurosurgery, stroke team (see member list in PCC guideline), emergency medicine, trauma, and hematology
#Use restricted to hematology and emergency department
‡ UMHS Factor VIIa (Novoseven) Guidelines: Adult Patients

Anticoagulation and Reversal (cont'd)

V. Rivaroxaban (Xarelto)

Monitoring

g. Monitor of signs and symptoms of bleeding
h. Check PT 15 minutes after administration of hemostatic agent
i. INR should not be used

VI. Apixaban (Eliquis)

Pharmacologic Properties

a. Factor Xa inhibitor
b. Elimination half-life:
    - o Healthy adults: 9-14 hours
    - o Severe renal dysfunction (CrCl less than 30 ml/min): 17.3 hours
    - o Severe hepatic impairment (Child-Pugh C): No data
c. Duration of antithrombotic effect:
    - o Effect should dissipate about 24 hours after last dose

Reversal

d. No specific antidotes are available
e. It is unclear at this time if blood factor preparations (PCC, FVIIa) or blood products are useful for reversing the effect of apixaban.
f. There is no role for hemodialysis in the reversal of apixaban

	Recommendations
Minor Bleeding	☐ Delay next dose or discontinue treatment if clinically appropriate ☐ Maintain adequate urine output
Moderate-Severe Bleeding	In addition to above measures: ☐ If ingestion was within past 6 hours, administer activated charcoal 50g PO x 1 ☐ Kcentra* 25 units/kg x 1
Life-threatening Bleeding	In addition to above supportive measures/charcoal: ☐ Kcentra* 50 units/kg x 1 ☐ Based on clinician judgment, if bleeding due to coagulopathy continues despite Kcentra therapy consider Feiba NF[#] 100 units/kg x 1 ☐ Based on clinician judgment, if bleeding due to coagulopathy continues despite Kcentra therapy consider Factor VIIa[ǂ]

*Use restricted to neurosurgery, stroke team (see member list in PCC guideline), emergency medicine, trauma, and hematology
[#]Use restricted to hematology and emergency department
[ǂ] UMHS Factor VIIa (Novoseven) Guidelines: Adult Patients

Anticoagulation and Reversal (cont'd)

VI. Apixaban (Eliquis)

Monitoring

g. Monitor of signs and symptoms of bleeding

h. Check PT 15 minutes after administration of hemostatic agent

i. INR should not be used

VII. Unfractionated Heparin

Pharmacologic Properties

a. Utilizes ATIII to inhibit factors II and X

b. Elimination half-life: ~90 minutes (dose-dependent, increases with dose)

c. Duration of antithrombotic effect: 3-6 hours

Reversal

d. Due to the short half-life of heparin, most bleeding events can be managed by discontinuing administration

e. Protamine sulfate 1mg will neutralize the effects of approximately 100 units of heparin.

f. Heparin has a relatively short half-life of about 60–90 min when given as an IV infusion, and therefore only heparin given during the preceding several hours needs to be considered when calculating protamine doses.

g. The risk of severe reactions to protamine sulfate, such as hypotension and bradycardia, can be reduced by slow administration.

h. **Protamine sulfate injection should be given by slow intravenous injection not to exceed a rate of 5mg/min.**

i. Hemodialysis, FFP, vitamin K do not have a role in reversal

Anticoagulation and Reversal (cont'd)

VII. Unfractionated Heparin

	Recommendations	
Heparin Bolus	Administered less than 30 minutes ago	Give protamine 1mg for every 100 units of heparin received (protamine administration rate not to exceed 5mg/min)
	Administered 30 to 60 minutes ago	Give protamine 0.5mg for every 100 units of heparin received (protamine administration rate not
	Administered greater than 60 minutes ago	Give protamine 0.25mg for every 100 units of heparin received (protamine administration rate not to exceed 5mg/min)
Heparin Infusion	Give protamine 1mg for every 100 units of heparin received in previous 2-3 hours (protamine administration not to exceed 5mg/min). *Example: A patient is receiving a heparin infusion at 1,250*	
Heparin Subcutaneous	Give protamine 1mg for every 100 units of heparin received in previous 8 hours (protamine administration rate not to exceed	

Monitoring

j. Monitor for signs and symptoms of bleeding

k. Repeat aPTT 15-30 minutes after protamine dose; subsequent protamine doses should be calculated accordingly

Anticoagulation and Reversal (cont'd)

VIII. Enoxaparin (Lovenox) and Low Molecular Weight Heparins

Pharmacologic Properties

a. Utilizes ATIII to inhibit factors II and X

b. Elimination half-life(enoxaparin):

- o Healthy adults: 4.5 – 7 hours
- o Renal impairment: 15 hours

b. Duration of Antithrombotic effect:

Reversal

d. Protamine sulfate neutralizes the anti-IIa activity, but has incomplete neutralization of anti-Xa activity.

e. Protamine 1mg neutralizes approximately 1mg of enoxaparin.

f. The risk of severe reactions to protamine sulfate, such as hypotension and bradycardia, can be reduced by slow administration.

g. **Protamine sulfate injection should be given by slow intravenous injection at a rate not to exceed 5mg/min.**

h. Hemodialysis, FFP, vitamin K do not have a role in reversal

	Recommendations
Enoxaparin Previous dose given less than or equal to 8 hours ago	Give protamine 1mg for every 1mg of enoxaparin received (protamine administration rate not to exceed 5mg/min). If clinical condition warrants a second dose of protamine 0.5mg for every 1mg of enoxaparin received can be given 30 minutes later.
Enoxaparin Previous dose given greater than 8 hours ago	Give protamine 0.5mg for every 1mg of enoxaparin received (protamine administration rate not to exceed 5mg/min). If clinical condition warrants a second
Dalteparin/Tinzaparin	Give protamine 1mg for every 100 units of dalteparin or tinzaparin received. If clinical condition warrants a

Anticoagulation and Reversal (cont'd)

VIII. Enoxaparin (Lovenox) and Low Molecular Weight Heparins

Monitoring

i. Monitor for signs and symptoms of bleeding

j. PT/INR and aPTT are insensitive measures of therapeutic enoxaparin, however aPTT can be used in cases of overdose or to assess response to protamine as well.

k. Anti-Xa level can be assessed to determine residual anticoagulant effect, however protamine sulfate neutralizes only a variable portion of anti-Xa activity and clinical significance of this is unclear

IX. Direct Thrombin Inhibitors (Parenteral)

Pharmacologic Properties

a. Directly inhibit thrombin (Factor IIa)

b. Elimination half-life

- Argatroban: 45 min, prolonged in liver dysfunction
- Bivalrudin: 25 min, prolonged in renal dysfunction

Reversal

c. No specific antidotes are available

	Recommendations
Minor Bleeding	☐ Consider holding until bleeding resolves or discontinue if clinically
Moderate-Severe Bleeding	☐ Hold argatroban/bivalrudin ☐ Consider hemodialysis
Life-threatening Bleeding	In addition to above measures: ☐ Consider Feiba NF[#] or Factor VIIa[ǂ]

[#] Feiba NF dosing: 50-100 units/kg (maximum 200 units/kg /day), use restricted to Hematology and Emergency Department

[ǂ] UMHS Factor VIIa (Novoseven) Guidelines: Adult Patients

Monitoring

c. aPTT can be monitored to determine duration of anticoagulation effect

Anticoagulation and Reversal (cont'd)

X. Fondaparinux (Arixtra)

Pharmacologic Properties

a. Factor Xa inhibitor

b. Elimination half-life:

- Healthy adults: 17-21 hours
- CrCl less than 30ml/min: 39-46 hours

c. Duration of antithrombotic effect

- 2-5 days, prolonged in kidney dysfunction

Reversal

d. No specific antidotes are available

e. There is limited data to support that Factor VIIa may have some benefit in the reversal of fondaparinux

f. There is no role for Vitamin K, protamine, or hemodialysis in the reversal of fondaparinux

	Recommendations
Minor Bleeding	☐ Hold fondaparinux until bleeding resolves and/or discontinue if clinically appropriate
Moderate-Severe Bleeding	☐ Hold fondaparinux until bleeding resolves and/or discontinue if clinically appropriate ☐ Maintain adequate urine output
Life-threatening Bleeding	In addition to above: ☐ Consider Feiba NF[#] or Factor VIIa[ǂ]

[#] Feiba NF dosing: 50-100 units/kg (maximum 200 units/kg /day), use restricted to Hematology and Emergency Department

[ǂ] UMHS Factor VIIa (Novoseven) Guidelines: Adult Patients

Monitoring

g. Monitor for signs and symptoms of bleeding

h. aPTT and PT/INR are insensitive measures of activity of fondaparinux

Authors: Anticoagulation Subcommittee
Approved: Anticoagulation Subcommittee 8/5/13
P&T approved 8/20/13

-PLEASE SEE "EXTENDED REFERENCES" FOR CITATIONS-

Prothrombin Complex Concentrate (PCC):

https://pharmwebsp.med.umich.edu/GuideLines/Anticoagulation/PCCReversalGuideline.pdf

University of Michigan Health System Anticoagulation Program

Guideline for Prothrombin Complex Concentrate Use for Reversal of Anticoagulation

I. **Purpose:** The purpose of this guideline is to provide recommendations for treatment of inpatients with life threatening bleeding or requiring emergent surgery or procedure with prothrombin complex concentrate (PCC). These guidelines should be used in concert with hematology consultation.

II. **Agent Selection:**

a. Kcentra is the preferred PCC agent for use in management of anticoagulant-associated bleeding.

i. Use is restricted to correction of moderate to severe and life-threatening bleeds induced by warfarin

ii. Use is restricted to Hematology, Trauma Surgery, Emergency Medicine and Neurosurgery Services and the Stroke Team (pager #90004)

iii. Use by all other services requires Hematology approval

b. Kcentra may be used for reversal of warfarin prior to emergent surgery.

i. Use is restricted to the above services or other surgical services

c. No specific antidotes are available for the direct thrombin inhibitor, dabigatran, nor the oral factor Xa inhibitors (e.g. rivaroxaban, apixaban). Due to lack of definitive data, PCC can be considered for patients with the above indications using oral direct thrombin or anti-Xa inhibitors.

d. FEIBA is an activated PCC product that is restricted for use only in concert with hematology consult/approval due to thrombotic risk.

III. **Criteria for use:**

a. Inclusion:

i. Anticoagulant associated major bleeding restricted to neurosurgery, stroke team, emergency medicine, trauma, and hematology

ii. Anticoagulant reversal prior to emergent surgery

iii. Hemophilia patients with inhibitors or other congenital bleeding disorders who currently use PCC at home. These patients do not require approval for use.

b. Exclusion:

i. History of anaphylaxis with exposure to factor IX concentrates

ii. Acute thrombosis or embolism

iii. Signs of disseminated intravascular coagulation (DIC)

c. Caution:

i. Systemic antifibrinolytic (tranexamic acid or aminocaproic acid) or use of other bypasses within previous 12 hours

ii. Synergy may occur if combined with fresh frozen plasma (FFP) or activated factor VIIa

Prothrombin Complex Concentrate PCC (cont'd)

IV. Pharmaceutical components:1-3

Note: Kcentra is the formulary agent of choice and is the first line agent. FEIBA is restricted to use by hematology only as outlined above.

a. Factor and heparin concentrations

	Kcentra™*	**Feiba® NF**
Factor II	0.76 – 1.6 units per 1 unit Kcentra	1.3 units per 1 unit Feiba
Factor IX	0.8 – 1.24 units per 1 unit Kcentra	1.4 units per 1 unit Feiba
Factor X	1 – 2.04 units per 1 unit Kcentra	1.1 units per 1 unit Feiba
Factor VII	0.4 – 1 units per 1 unit Kcentra	1.5 units VIIa and 0.9 units VII per 1 unit Feiba
Heparin	0.016 – 0.08 units per 1 unit Kcentra	None
Protein C	0.84 – 1.64 units per 1 unit Kcentra	1.1 IU/1 unit Feiba
Protein S	0.48 – 1.36 units per 1 unit Kcentra	NA

***Potency of individual factors is labeled on the packaging

V. Dosing:

Note: Kcentra is the formulary agent of choice and is the first line agent. FEIBA is restricted to use by hematology only as outlined above.

a. Recommended dosing

	Kcentra™	**Feiba® NF**
Dosing for warfarin	INR 2-4: 25 units/kg INR 4 – 6 : 35 units/kg INR > 6: 50 units/kg	50 units/kg
Dosing for: Dabigatran, Rivaroxaban, Apixaban	Limited data and experience, a dose of 50 units/kg would be reasonable	Limited data and experience, a dose of 50 units/kg would be reasonable
Additional doses	Repeat dosing is not recommended	May repeat 50 units/kg Q6-12 hours x 1-2 additional doses for inadequate hemostasis
Maximum dose	INR 2 - < 4: 2500 units INR 4 – 6: 3500 units INR > 6: 5000 units	200 units/kg/day
Dosing weight	Total body weight, up to but not to exceed 100 kg	Total body weight

b. Kcentra

i. Dosing is based on body weight

ii. Dose based on actual potency as stated on the carton (varies from 20 – 31 Factor IX units/mL).

iii. Doses will be rounded to the nearest whole vial size by a pharmacist prior to dispensing as the amount of product in each vial varies from vial to vial.

Prothrombin Complex Concentrate PCC (cont'd)

VI. Storage and reconstitution:

a. Characteristics of available PCC products

Characteristic	Kcentra™	Feiba® NF
Source material	Pooled human plasma	Pooled human plasma
How supplied	Single use vials with sterile water, Mix2Vial filter transfer set, alcohol swab	BAXJECT device, sterile water, and single dose vial
Microbial reduction	heat-treated; nonofiltered, lyophilized	Vapor heated; nanofiltered
Preservative	None	None
Latex	Does not contain latex	Rubber stoppers contain latex
Diluent	Sterile water (20 mL)	Sterile water (20 mL)
Reconstitution	Use within 4 hours of reconstitution	Allow drug and diluent to reach room temperature before reconstitution. Use within 3 hours of and do not refrigerate after mixing
Storage	2º – 25º C (36º – 77º F) do not freeze	Room temp ≤ 77°F in original package to protect from light

VII. Administration:

a. Kcentra

i. Administer by intravenous infusion at a rate of 0.12 mL/kg/min (~ 3 units/kg/min)

ii. Maximum infusion rate = 8.4 mL/min (~210 units/min)

b. Feiba

i. Maximum infusion rate = 2 units/kg/min

ii. For a 75 kg patient this corresponds to infusion rate of 2.5-7.5 ml/min depending on units per vial.

Prothrombin Complex Concentrate PCC (cont'd)

VIII. Monitoring:

NOTE: Coagulation tests like INR, aPTT, and whole blood clotting time may not correlate with hemostatic efficacy or clinical improvement when treating with PCC. For this reason, attempts at normalizing these values by increasing doses of PCC may not be successful and may provoke thromboembolic events.

a. Baseline monitoring
   i. aPTT, INR/PT, platelet count, and hemoglobin/hematocrit
b. On-going monitoring
   i. Resolution of bleeding
   ii. Assess efficacy of first dose 15 minutes after the end of the infusion of the dose as there should not be a delayed effect
   iii. INRs should be monitored every 4 hours due to half-lives of therapeutic agents/clotting factors
   iv. Thrombosis or embolism

IX. Use of PCC with additional supportive therapies:

a. Vitamin K
   i. For patients receiving PCC because of warfarin-associated bleeding, administer 10 mg vitamin K slow IVPB x 1 dose over at least 30 minutes
   ii. Consider risk for vitamin K resistance in patients with mechanical heart valves
b. Fresh frozen plasma (FFP)
   i. Could consider in patients deemed to have inadequate response to 1-2 doses of PCC (refer to section V above for Kcentra and Feiba dosing)
c. Recombinant activated Factor VII (NovoSeven) (rfVIIa)
   i. Not routinely recommended
   ii. May consider use in patients who have failed both PCC and FFP administration

X. Drug Interactions:1-3

a. No compatibility studies have been performed with these agents; do not mix with other solvents or products

XI. Management of PCC-associated thrombotic complications:1-3

a. If the patient has signs or symptoms of thromboembolism, discontinue PCC infusion immediately

b. Provide supportive care

-PLEASE SEE "EXTENDED REFERENCES" FOR CITATIONS-

Use of Idarucizumab for Reversal of the Anticoagulant Effects of Dabigatran

I. Purpose

a. The purpose of this guideline is to provide recommendations for use of idarucizumab (Praxbind) for inpatients treated with dabigatran (Pradaxa) presenting with life threatening bleeding or requiring emergent surgery or procedure. These guidelines should be used in concert with hematology consultation.

II. Criteria for use

a. Indications:
    i. Dabigatran-associated major or life-threatening uncontrolled bleeding restricted to neurosurgery, stroke team, emergency medicine, trauma, and hematology
    ii. Dabigatran reversal prior to emergent surgery or procedure that cannot be safely delayed
b. Exclusions:
    i. Undetectable dabigatran anti-IIa activity level (< 0.04 mcg/mL)
    ii. Acute thrombosis or embolism
    iii. Last known dabigatran dose received > 48 hours prior
c. Caution:
    i. Patients with hereditary fructose intolerance have increased risk for adverse effects (4 g of sorbitol contained per 5 g of idarucizumab)

III. Pharmacology

a. Idarucizumab is a monoclonal antibody that binds specifically to dabigatran to neutralize its anticoagulant effect. After binding the complex is eliminated from the system.
b. By the end of the infusion dabigatran free concentrations were undetectable and other surrogate markers of anticoagulant effect of dabigatran (ECT, dTT, aPTT, TT and ACT) were normalized.
c. These effects are sustained for 24 hours after administration.

IV. Dosing

a. The recommended dose is 5 g given intravenously as a single dose (see administration below)
b. There are no data to support the use of an additional dose

V. Storage

a. Store in original package
b. Store in the refrigerator at 2ºC to 8ºC (36ºF to 46ºF), do not freeze or shake
c. Unopened vials may be kept at room temperature 25 ºC (77 ºF) up to 48 hours (only 6 hours if exposed to light)

VI. Administration

a. Product is supplied as 2 single-use glass vials of 2.5 g/50 mL of idarucizumab

b. Flush line with 0.9% NaCl prior to administration
c. Administer by intravenous rapid bolus
    i. Hang vials and administer consecutively, for total dose of 5 g
    ii. Must use dedicated line (no compatibility data exist)
    iii. Must be used within 1 hour of spiking the vial

VII. Monitoring

a. Baseline monitoring
    i. Dabigatran anti-IIa assay for pre-operative indication
    ii. aPTT, platelet count, and hemoglobin/hematocrit

VIII. Use of idarucizumab with additional supportive therapies

a. Prothrombin complex concentrate (PCC)
    i. Not routinely recommended as not known to provide any additional benefit
    ii. See PCC Guidelines for Use for additional information
b. Recombinant activated Factor VII (NovoSeven) (rfVIIa)
    i. Not routinely recommended as not known to provide any additional benefit
    ii. See Factor VIIa Guidelines for Use for additional information
c. Refer to Emergent Reversal of Antithrombotic Agents for additional guidance

IX. Drug Interactions

a. No compatibility studies have been performed; do not mix with other solvents or products

References:

1. Praxbind (idarucizumab) prescribing information. Available at: http://us.boehringer-ingelheim.com/content/dam/internet/opu/us_EN/documents/Media_Press_Releases/2015/Praxbind.pdf. Accessed December 1, 2015.
2. Pollack CV, Reilly PA, Eikelboom J, et al. Idarucizumab for dabigatran reversal. N Engl J Med 2015;373:511-20.

Authors: Anticoagulation Subcommittee
Approved: Anticoagulation Subcommittee (12/7/15)
P&T Committee (12/15/15)

Factor VIIa

https://pharmwebsp.med.umich.edu/GuideLines/Hematology%20-%20Oncology/FactorVIIa(NovoSeven)Guidelines_Adults.pdf

Protocol for Factor VIIa Use in Adult Patients at University of Michigan Hospital

General Comments

Factor VIIa promotes local hemostasis through the extrinsic pathway of the coagulation cascade. Factor VIIa is complexed with tissue factor leading to activation of the coagulation cascade and the generation of thrombin ultimately leading to a stable fibrin clot.

All Factor VII use will be concurrently monitored by the High Impact Drug Monitoring Service. Emergent use of Factor VII in the setting of life-threatening bleed will be reviewed for compliance with guidelines. All non-emergent use of Factor VII will require approval of the Hematology Service.

How supplied and Cost

Vial sizes:	**1000mcg**	**$1,050**
	2000mcg	**$2,100**
	5000mcg	**$5,250**

For 75kg patient and dose of 80mcg/kg = 6000mcg = $6,300
ALL DOSES SHOULD BE ROUNDED TO THE NEAREST 1000MCG DOSE

Indications: See Table 1.

General Contraindications (specific contraindications for each condition listed in Table 1):

1. Hypersensitivity to mouse, bovine, or hamster proteins
2. Hypersensitivity to recombinant factor VIIa or product components

General Exclusions:

1. Pregnancy (Exception: Patients with Factor VII deficiency at delivery)
2. Futile care
3. Normal coagulation profile
4. Prophylaxis for potential bleeds (Exception: Patients with hemophilia and Factor VIII or IX inhibitor)
5. Bleeding tumors in patients who are not surgical candidates for correction
6. Long-standing bleeding such as angiodysplasia or mucositis following chemotherapy
7. Treatment of platelet-related bleeding disorders

Factor VIIa (cont'd)

Warnings/Precautions:

1. Increased risk of thrombotic events
    a. Risk factors include:
        i. History of CAD
        ii. History of venous or arterial thrombosis
        iii. Crush injury
        iv. Disseminated intravascular coagulation (DIC)
        v. Septicemia
        vi. ECMO or VAD
        vii. After cardiac surgery
        viii. Cerebral vascular disease
        ix. Treatment with aPCCs/PCCs (activated ornon-activated prothrombin complex concentrates)
2. Signs or symptoms of coagulation system activation or thrombosis

Drug Interactions:

1. Avoid simultaneous use of activated prothrombin complex concentrates or prothrombin complex concentrates.

Adverse Events:

1. Hemorrhage
2. Fever
3. Hemarthrosis
4. Fibrinogen plasma decreased
5. Hypertension
6. Allergic reaction
7. DIC
8. Fibrinolysis increased
9. Decreased prothrombin
10. Abnormal renal function
11. Thrombosis

*A higher incidence of thromboembolic serious adverse events (myocardial and cerebral infarctions) was reported in patients with intracebral hemorrhage (ICH) who received 40-160 mcg/kg of Factor VIIa compared to placebo-treated patients. **The routine use of Factor VIIa for the reduction of hematoma growth after ICH is not currently recommended,** until the saftety profile of this agent is better established in the setting of ICH.

Monitoring:

1. Platelets, fibrinogen, PT, aPTT
2. Monitor for clinical signs of bleeding such as pain, swelling, joint circumference for hemarthrosis

Factor VIIa (cont'd)

Condition	Indications	Specific Contraindications	Administration
Factor VIII or IX inhibitor	1. Vigorous bleeding, impending compartment syndrome, or bleeding in critical location 2. Persistent bleeding, not life or limb threatening 3. Before invasive procedures	See **General Contraindications & exclusions**	1. Dose: 90 mcg/kg Q2-3hr until patient hemostasis is achieved, then less frequently thereafter, round dose to nearest 1000mcg. 2. Dose frequency and duration of Factor VIIa therapy based on achievement of hemostasis and bleeding risk
Hepatic Failure	1. For urgent intracranial pressure monitor (ICP) placement in patients with acute or chronic liver failure who have a coagulopathy refractory to fresh frozen plasma. 2. For post-operative refractory bleeding in liver failure patients who have received an ICP monitor	1. Budd-Chiari 2. Known or suspected malignancy 3. History of DVT or PE 4. Pregnancy 5. Hypersensitivity to Vitamin K	1. Four units of FFP previously administered with persistent INR > 1.5 2. Cryoprecipitate to be given for patients with fibrinogen < 100mg/dL immediately before Factor VIIa 3. Dose: 80 mcg/kg Factor VIIa IV bolus over 2 to 5 minutes immediately prior to ICP placement (provides up to 4 hour window to place ICP monitor), round dose to nearest 1000mcg.
Closed Space Bleeding (traumatic)	For emergent isolated traumatic head injury with evidence of expanding bleed in patients on coumadin or LMWH	Isolated traumatic head injury without evidence of expanding bleed.	Dose: 40-90 mcg/kg Factor VIIa as IV bolus over 2 to 5 minutes x one dose, round dose to the nearest 1000mcg
Closed Space Bleeding (other)	For emergent retroperitoneal bleed in patients on coumadin or LMWH after significant clotting factor replacement	Retroperitoneal bleed in patients not on coumadin or LMWH	Dose: 40-90 mcg/kg Factor VIIa as IV bolus over 2 to 5 minutes x one dose, round dose to the nearest 1000mcg
Trauma	For severe multiple trauma patients with ongoing bleeding and coagulopathy despite surgical intervention and continued infusions of plasma (>6 units FFP) and ≥10 units of PRBS in 6 hours	1. Active gastrointestinal bleeding 2. Acidosis (pH<7.1) 3. Hypothermia 4. Platelet count < 50,000	1. At least 10 units of PRBC, 8 units of plasma and >6 units of FFP unless patient has known Factor VII deficiency or plasma therapy is likely to be too slow or directly life threatening. 2. Dose: 100 mcg/kg Factor VIIa as IV bolus over 2 to 5 minutes x one dose, round dose to the nearest 1000mcg
Post-partum and Post-hysterectomy	For post-partum and post-hysterectomy bleeding after significant clotting factor replacement	See **General Contraindications & exclusions**	Dose: 60 mcg/kg Factor VIIa as IV bolus over 2 to 5 minutes x one dose, round dose to the nearest 1000mcg
Need for Acute Anticoagulant Reversal	For serious bleed associated with prolonged INR after significant clotting factor replacement	See **General Contraindications & exclusions**	Dose: 1000mcg x one dose
Uncontrolled hemorrhage associated with surgery	For uncontrolled hemorrhage associated with surgery (except for abdominal and large joint replacement orthopedic surgery) after significant clotting factor replacement	See **General Contraindications & exclusions**	Dose: 40-90 mcg/kg Factor VIIa as IV bolus over 2 to 5 minutes x one dose, round dose to the nearest 1000mcg

-PLEASE SEE "EXTENDED REFERENCES" FOR CITATIONS-

Antithrombotic/Antiplatelet Agents & Central Neuraxial Blockade:

Blockade Guidelines for Adult Inpatients 18 years and older

Medication	Time to wait after last dose of medication before neuraxial needle/	Can drug be given when catheter is in place?	Minimum time to wait AFTER
Warfarin	INR < 1.5 and off for 5 days	No#	2 hrs
Heparins			
Heparin (treatment) – IV	6 hrs and aPTT within normal limits	No	2 hrs
Heparin (treatment) – SubQ (>5000 Units)	12 hrs and aPTT within normal limits	No	2 hrs
Heparin (prophylaxis) – SubQt[%] (≤5000 Units)	4 hrs	Yes If catheter is placed for surgery, heparin SubQ can be given 60 min after placement[+ &]	2 hrs
LMWH (treatment)*, [@] Enoxaparin (Lovenox) 1 mg/kg q12h, 1.5mg/kg q24h or 1 mg/kg q24h Dalteparin (Fragmin)[@] 120 units/kg q12h or 200 units/kg q24h Tinzaparin (Inohep) 175 units/kg q24h	CrCl ≥ 30 mL/min: 24 hrs CrCl < 30 mL/min: 48 hrs	No	4 hrs
LMWH (prophylaxis)*, [@] Enoxaparin ≤ 40 mg SubQ q24h	12 hrs	Yes	4 hrs
		Wait 4 hours to restart medication **after** catheter PLACEMENT	
		Wait 12 hours after last dose **before** catheter REMOVAL	
Factor Xa Inhibitors (also consider thrombotic risk, available in Perioperative/procedural Guidelines)[^]			
Fondaparinux (treatment)*	72 hrs	No	12 hrs
Fondaparinux (prophylaxis)*	48 hrs	No	12 hrs
Rivaroxaban (Xarelto) (treatment) 15-20mg Daily*			
CrCl ≥ 50 mL/min	48 hrs	No	6 hrs
CrCl < 50 mL/min[^]	3-5 days	No	6 hrs
Rivaroxaban (Xarelto) (prophylaxis) 10mg Daily	24 hrs	No	6 hrs
Apixaban (Eliquis) (treatment) 2.5-10mg BID*			
CrCl ≥ 50 mL/min	48 hrs	No	6 hrs[$]
CrCl < 50 mL/min[^]	3-5 days	No	6 hrs[$]

Apixaban (Eliquis) (prophylaxis) 2.5mg BID	24 hrs	No	6 hrs[$]
Antiplatelet Agents			
Clopidogrel (Plavix)	7 days[++]	No	2 hrs
Prasugrel (Effient)	7 days	No	6 hrs
Cilostazol (Pletal)	48 hrs	No	6 hrs
Dipyridamole/ASA (Aggrenox)	24 hrs	No	2 hrs
Ticagrelor (Brilinta)	5 days	No	6 hrs
Ticlodipine (Ticlid)	7 days	No	2 hrs
Aspirin (≥ 80mg)	Not necessary	Yes	None
GP IIb/IIIa inhibitors			
Abciximab	48 hrs	No	2 hrs
Eptifibatide*	8 hrs	No	2 hrs
Tirofiban	8 hrs	No	2 hrs
Thrombolytic Agents			
Altepase, Urokinase	12 hrs	No	2 hrs
Alteplase, Urokinase (catheter clearance)	May be given, no time restrictions		
Direct Thrombin Inhibitors (also consider thrombotic risk, available in Perioperative/procedural Guidelines)[^]			
Argatroban, Bilvalirudin	7 hrs or aPTT within normal limits	No	2 hrs
Dabigatran (Pradaxa)			
CrCl ≥ to 50 mL/min	48 hrs	No	6 hrs[$]
CrCl < 50 mL/min[^]	3-5 days	No	6 hrs[$]

LMWH = low molecular weight heparin
[#]For warfarin initiation, catheter may be removed within 24 hours of *first* dose of warfarin.
[+]Not applicable as the Acute Pain Service standardizes times of catheter insertion and removal around medication administration times. [&]If pt. has been on heparin therapy for 5 days, recent platelet count is recommended prior to catheter D/C.
* Longer times may be warranted in patients with renal insufficiency
[%] ASRA recommends against TID dosing while catheter is in place. BID dosing and compression devices recommended.
$ Twenty four hours if traumatic puncture during placement.
++ If pt. is off of clopidogrel 5-7 days, get "Plavix Assay" which should show < = 20% inhibition in order to proceed with neuraxial technique.
@ See link http://anes.med.umich.edu/vault/1007575-AnticoagulationNeuraxialGuidelines.pdf#pagemode=bookmarks for obstetric anesthesia anticoagulation guidelines

References: American Society of Regional Anesthesia and Pain Medicine Evidence-Based Guidelines (third edition). Reg Anesth
Pain Med 2010; 35:64-101. (click here for link to article)
Authors: Pain Committee and Anticoagulation Subcommittee
Approved: Pain Committee (02/2011; 01/2015)
Anticoagulation/VTE Subcommittee (04/2011; 11/2011; 11/2014; 02/2015)
Pharmacy and Therapeutics Committee (04/2011; 11/2011; 6/2015)

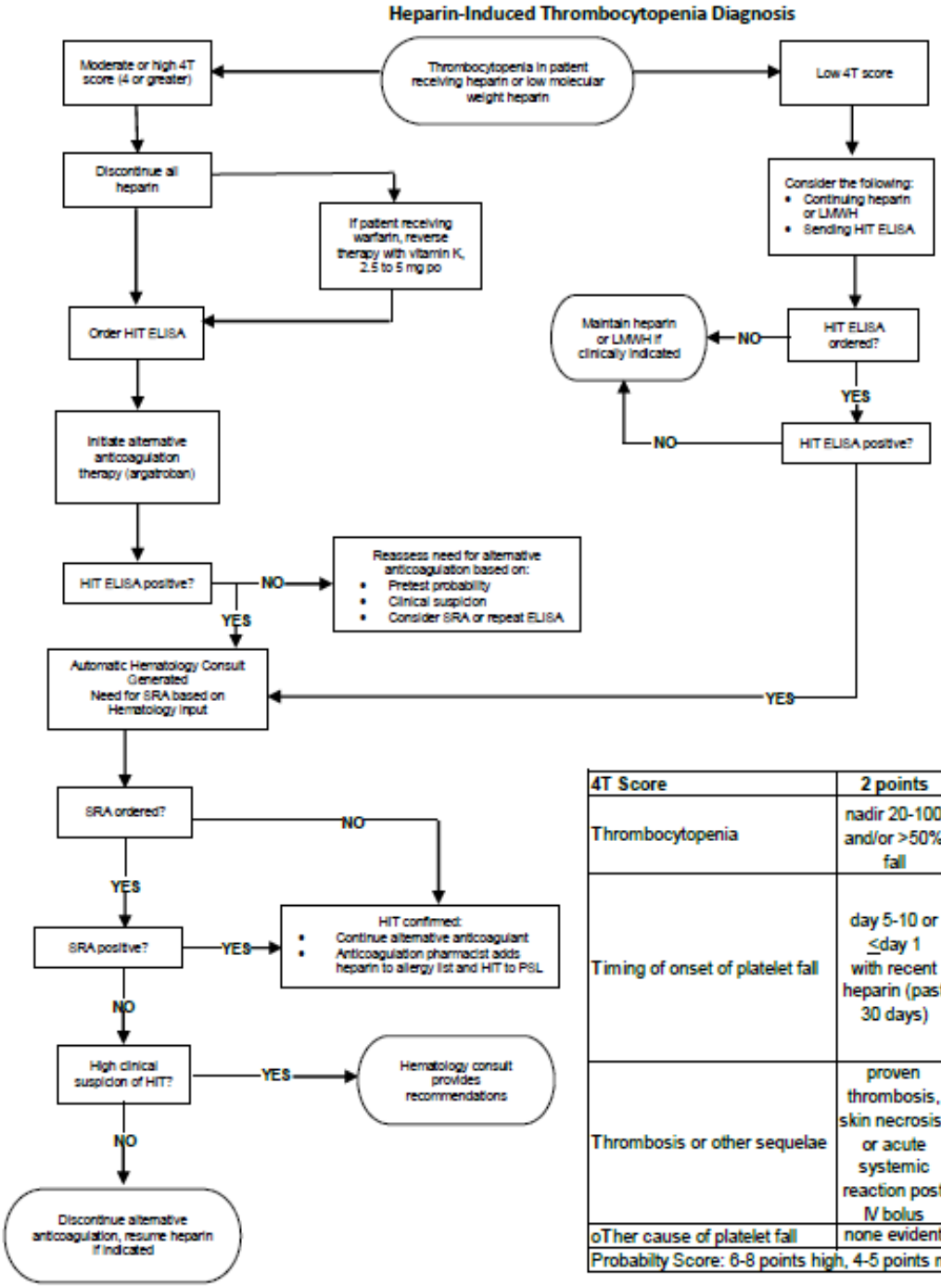
Heparin-Induced Thrombocytopenia:

https://pharmwebsp.med.umich.edu/GuideLines/Anticoagulation/HITGuideline.pdf

University of Michigan Health System
Clinical Guideline
Heparin-Induced Thrombocytopenia in Adult and Pediatric Patients

Purpose:

The purpose of this guideline is to provide assistance in the management of patients with suspected or documented immune mediated heparin-induced thrombocytopenia (HIT). It includes three sections: Diagnosis, Management, and Transition of Therapy.

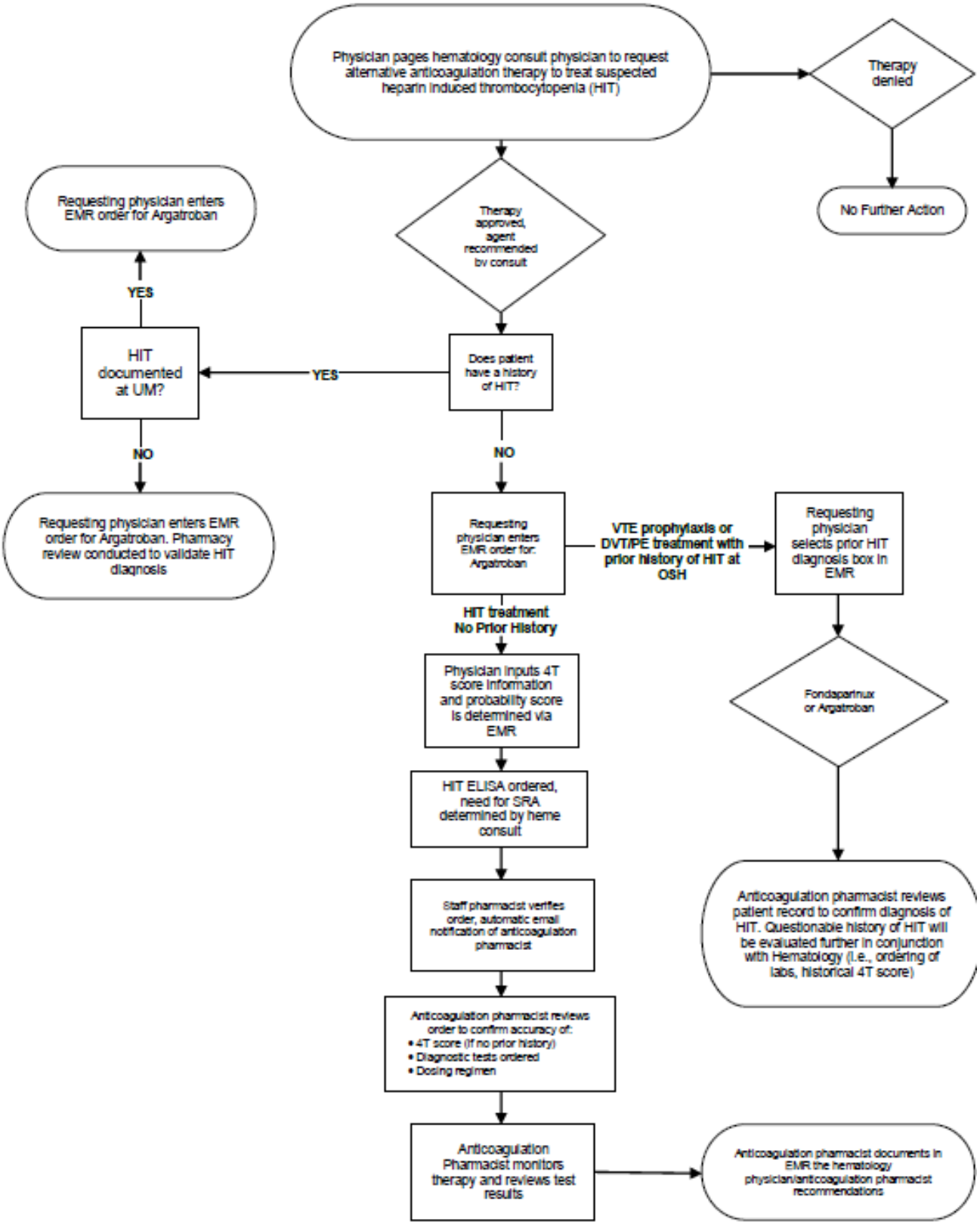


4T Score	2 points	1 point	0 points
Thrombocytopenia	nadir 20-100 and/or >50% fall	nadir 10-19 or 30-50% fall	nadir <10 or <30% fall
Timing of onset of platelet fall	day 5-10 or ≤day 1 with recent heparin (past 30 days)	>day 10, ≤day 1 with recent heparin (past 30-100 days) or timing unclear	≤day 4 with no recent heparin
Thrombosis or other sequelae	proven thrombosis, skin necrosis, or acute systemic reaction post IV bolus	progressive, recurrent or silent thrombosis; erythematous skin lesions	none
oTher cause of platelet fall	none evident	possible	definite
Probabilty Score: 6-8 points high, 4-5 points moderate, 0-3 points low			

Heparin-Induced Thrombocytopenia (cont'd)

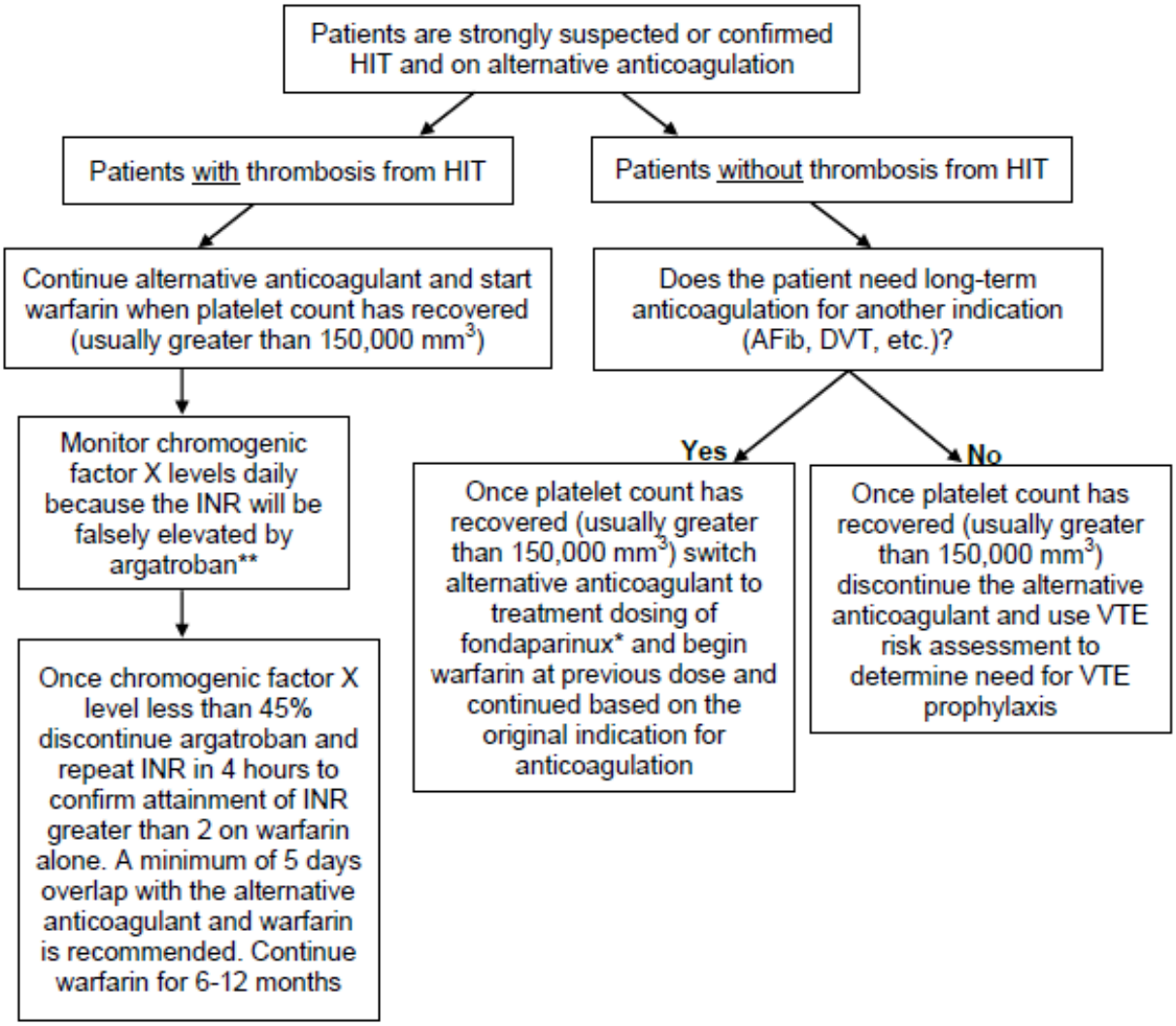
II. Management

Heparin-Induced Thrombocytopenia Workflow



Heparin-Induced Thrombocytopenia (cont'd)

III. Transition of Therapy



*Fondaparinux is chosen as the alternative anticoagulant in this scenario because of the low likelihood of the drug to cause HIT and since direct thrombin inhibitors (DTI) affect the INR, the transition of DTI's to warfarin is difficult.

**Chromogenic Factor X levels should be used daily to monitor warfarin therapy because the INR will be falsely elevated by the DTI. Of note, the correlation between INR and chromogenic factor X is nonlinear, i.e. incremental percent reduction in chromogenic factor X does NOT represent consistent incremental increase in INR. At the lower end of the range, small reductions in chromogenic factor X levels can represent relatively larger increases in INR. Additionally, correlation between chromogenic factor X level and INR is best seen with 5 days of overlap therapy with warfarin because depletion of factor X should be at steady state. While aggressive warfarin dosing can reach a therapeutic INR in less than 5 days, this elevation is likely representative of depletion of factor VII, however depletion of factor X will not be complete at this time resulting in a chromogenic factor X level that is not at goal. This practice can lead to supratherapeutic INR levels once the DTI is discontinued or on the contrary if the DTI is discontinued before the optimal 5 day overlap inadequate anticoagulation can occur despite therapeutic INR (secondary to depletion of factor VII but incomplete depletion of factor X and II).

Heparin-Induced Thrombocytopenia (cont'd)

Definitions:

- HIT: Heparin-induced thrombocytopenia
- SRA: Serotonin release assay
- LMWH: Low-molecular weight heparin
- EMR: Electronic medical record
- VTE: Venous thromboembolism
- INR: International normalized ratio
- DTI: Direct thrombin inhibitor

References:

1. Chong BE, Issacs A. Heparin-induced thrombocytopenia: what clinicians need to know. Thromb Haemost 2009:101(2);279-83.
2. American College Chest Physicians. Chest 2008 Guidelines for Antithrombotic and Thrombolytic Therapy. CHEST. 2008;133 (6):67S-70S
3. Arpino PA, Demirjian Z, Van Cott EM. Use of the chromogenic factor x assay to predict the international normalized ratio in patients transitioning from argatroban to warfarin. Pharmacotherapy 2005;25(2):157-64.
4. Austin JH, Stearns CR, Winkler AM, et al. Use of the chromogenic factor x assay in patients transitioning from argatroban to warfarin therapy. Pharmacotherapy 2012;32(6):493-501.
5. Lo GK, Juhl D, Warkentin TE, et al. Evaluation of pretest clinical score (4 T's) for the diagnosis of heparin-induced thrombocytopenia in two clinical settings. J Thromb Haemost 2006;4:759-65.

Authors: Anticoagulation Subcommittee
Approved: Anticoagulation Subcommittee (October 2010, October 2013)
P&T Committee (October 2010, November 2013)

Heparin drip nomogram for VTE:

https://pharmwebsp.med.umich.edu/GuideLines/Anticoagulation/HeparinAntiFactorXaMonitoring_VTE.pdf\

University of Michigan Health System Anticoagulation Program

Guideline for Managing Unfractionated Heparin for Treatment of Venous Thromboembolism in Adult Patients Based upon Anti-Factor Xa Levels

Purpose: The purpose of this guideline is to provide dosing assistance for unfractionated heparin therapy for the treatment of deep vein thrombosis or pulmonary embolism based on anti-factor Xa values (calibrated for heparin).

Initial Dosing and Dosage Adjustments

Heparin should be dosed based upon actual body weight (kg): ____

1. Bolus doses (round to nearest 10 units) **– Maximum bolus dose = 10,000 units**
   - □ Initial bolus dose **80 units/kg**
   - □ Other initial bolus: _____ units/kg
   - □ No initial bolus
   - □ No bolus EVER
2. Continuous infusion rate (round to nearest 10 units) **– Maximum initial rate = 1,800 units/hour**
   - □ Initiate infusion at **18 units/kg/h**
   - □ Other initial infusion rate : _____ units/kg/h
   - □ **Non-weight based** initial infusion rate : _____ **units/h**
3. Monitoring
   - □ Draw INR/PT, CBC with platelet count and aPTT prior to starting heparin
   - □ Draw STAT anti-factor Xa 6 hours after starting heparin
   - □ Monitor anti-factor Xa and adjust per Weight-Adjusted Heparin Nomogram (target anti-factor Xa 0.3-0.7 units/mL)
   - □ Platelet count should be monitored daily for a minimum of 2 weeks and hemoglobin/hematocrit at least weekly

Heparin drip nomogram (cont'd)

Weight-Adjusted Heparin Nomogram

Anti-Xa (units/mL)	Repeat Heparin Bolus Dose	Hold Infusion (minutes)	Rate Change	Repeat Anti-Xa level
Less than 0.2*	80 units/kg†	0	Increase 1.5 units/kg/h	6 hours
0.2-0.29	40 units/kg†	0	Increase 1 units/kg/h	6 hours
0.3-0.7	None	0	No change	6 hours**
0.71-0.8	None	0	Decrease 1 units/kg/h	6 hours
0.81-0.99	None	30 min	Decrease 1.5 units/kg/h	6 hours
Greater than or equal to 1*	None	60 min	Decrease 3 units/kg/h	6 hours

*Notify physician if 2 consecutive Anti-Xa values are in this range
**When 2 consecutive Anti-Xa values are in therapeutic range (0.3-0.7 units/mL), obtain Anti-Xa assay the next morning and every 24 hours thereafter

† Please ensure physician has not selected "No bolus ever" option above

Authors: Anticoagulation Subcommittee
Approved: Anticoagulation Subcommittee, 2/6/2012, 9/9/2013
Pharmacy and Therapeutics Committee, 10/15/13

Heparin drip Nomogram for ACS/AFib:

https://pharmwebsp.med.umich.edu/GuideLines/Anticoagulation/HeparinAntiFactorXaMonitoring_ACS_AFib.pdf

University of Michigan Health System Anticoagulation Program

Guideline for Managing Unfractionated Heparin for Treatment of Acute Coronary Syndrome or Atrial Fibrillation in Adult Patients Based upon Anti-Factor Xa Levels

Purpose: The purpose of this guideline is to provide dosing assistance for unfractionated heparin therapy for the treatment of acute coronary syndrome (ACS) or atrial fibrillation (AF) based on anti-factor Xa values (calibrated for heparin).

Initial Dosing and Dosage Adjustments

Heparin should be dosed based upon actual body weight (kg): ____

1. Bolus doses (round to nearest 10 units)

Note: DO NOT exceed the following initial bolus limits:

□ ST-segment elevation MI treated with tPA, maximum bolus = 4,000 units

□ Unstable angina or non-ST-segment elevation MI, maximum bolus = 5,000 units

□ Initial bolus dose **60 units/kg**
□ Other initial bolus: _____ units/kg
□ No initial bolus
□ No bolus EVER

2. Continuous infusion rate (round to nearest 10 units)

For unstable angina, non-ST-segment elevation MI or ST-segment elevation MI treated with tPA do not exceed maximum initial rate of 1,000 units/hour.

□ Initiate infusion at **12 units/kg/h**
□ Other initial infusion rate : _____ units/kg/h
□ **Non-weight based** initial infusion rate : _____ **units/h**

3. Monitoring

□ Draw INR/PT, CBC with platelet count and aPTT prior to starting heparin
□ Draw STAT anti-factor Xa 6 hours after starting heparin
□ Monitor anti-factor Xa and adjust per Weight-Adjusted Heparin Nomogram (target anti-factor Xa 0.2-0.5 units/mL)
□ Platelet count should be monitored daily for a minimum of 2 weeks and hemoglobin/hematocrit at least weekly

Heparin drip nomogram for ACS/AFib (cont'd)

Weight-Adjusted Heparin Nomogram

Anti-Xa (units/mL)	Repeat Heparin Bolus Dose	Hold Infusion (minutes)	Rate Change	Repeat Anti-Xa level
Less than 0.1*	70 units/kg†	0	Increase 1.5 units/kg/h	6 hours
0.1-0.19	40 units/kg†	0	Increase 1 units/kg/h	6 hours
0.2-0.5	None	0	No change	6 hours**
0.51-0.6	None	0	Decrease 1 units/kg/h	6 hours
0.61-0.89	None	30 min	Decrease 1.5 units/kg/h	6 hours
Greater than or equal to 0.9*	None	60 min	Decrease 2 units/kg/h	6 hours

*Notify physician if 2 consecutive Anti-Xa values are in this range

**When 2 consecutive Anti-Xa values are in therapeutic range (0.2-0.5 units/mL), obtain Anti-Xa assay the next morning and every 24 hours thereafter

† Please ensure physician has not selected "No bolus ever" option above

Authors: Anticoagulation Subcommittee

Approved: Anticoagulation Subcommittee, 2/6/2012, 9/9/2013
Pharmacy and Therapeutics Committee, 10/15/13

Enoxaparin Use in Adult Patients:

University of Michigan Health System

Anticoagulation Program
Guideline for Dosing and Management of Enoxaparin in Adult Inpatients

Purpose:
The purpose of this guideline is to provide assistance in the dosing and management of the low molecular weight heparin enoxaparin in adult inpatients eighteen years of age or older (>18 years) regardless of location. See the dosing guidelines for pediatric patients for patients < 18 years of age.

DOSING GUIDELINES (see table 1)

I. Route of administration

a. Enoxaparin is administered subcutaneously for all indications outlined in this guideline.

b. The preferred site for administration is the abdomen. Alternate sites include the upper arm or the thigh.

II. Treatment indications

a. The recommended dosing regimen for enoxaparin is 1.5mg/kg every 24 hours, unless a contraindication to this dosing strategy exists.

b. The dose in patients with a creatinine clearance < 30 mL/min (via Cockcroft-Gault) is 1 mg/kg every 24 hours, regardless of indication or comorbidities.

c. In certain circumstances an alternate dosing strategy is recommended (see Table 1).

d. Actual body weight should be used for dose determination.

III. Prophylaxis indications (Prevention of Venous Thromboembolism)

a. Non-Pregnant Patients

i. Dose is determined based upon renal function and actual body weight

b. Pregnant Patients

i. Dose is determined based upon ante-partum gestation or time frame post-partum

Enoxaparin Use in Adult Patients (cont'd)

Table 1: Dosing Guidelines for Enoxaparin

(Note: All doses are to be administered subcutaneously)

TREATMENT	
Indication	**Dose*#**
Usual dose	1.5 mg/kg every 24 hours
Patients with CrCl < 30 mL/min, regardless of indication or comorbidities	1 mg/kg every 24 hours^
Dose alteration if CrCl ≥30 mL/min and:	1 mg/kg every 12 hours
Weight > 150 kg	
Mechanical heart valve	
Active cancer	
Left ventricular assist device (LVAD)	
Hemodynamically unstable PE	
Acute Coronary Syndrome (ACS)	
Pregnancy	
Atrial fibrillation ablation with CrCl ≥30 mL/min	0.5 mg/kg every 12 hours
PROPHYLAXIS/PREVENTION of VTE	
Nonpregnant patients:	
CrCl ≥ 30 mL/min	40 mg every 24 hours (for ABW ≤ 150 kg) 30 mg every 12 hours (for ABW > 150 kg)
CrCl <30 mL/min	30 mg every 24 hours (regardless of ABW)
Trauma patients:	
CrCl ≥ 30 mL/min	30 mg every 12 hours (regardless of ABW)
CrCl <30 mL/min	30 mg every 24 hours (regardless of ABW)
Pregnant patients:	
Less than 20 weeks gestation	40 mg every 24 hours
20 weeks gestation until 1 week post-partum	40 mg every 12 hours
Post-partum weeks 2-6	40 mg every 24 hours

*Actual body weight should be used for dose determination

#Doses will be rounded to the nearest whole syringe size as outlined in Enoxaparin (Lovenox) Dose Rounding Table.

^Creatinine clearance as calculated by Cockcroft-Gault

MONITORING GUIDELINES

I. Treatment Indications

a. Routine Monitoring

i. Baseline and ongoing monitoring of renal function and hematologic parameters should be performed in accordance with UMHHC Policy 07-01-051< UMHHC Inpatient Anticoagulation Monitoring Table>

Enoxaparin Use in Adult Patients (cont'd)

b. Anti-Factor Xa Activity Monitoring

i. **Routine Anti-Factor Xa activity level monitoring is not recommended.**

ii. Anti-Factor Xa activity levels may be considered in the following patients receiving enoxaparin:

1. Obese patients (greater than 200 kg)
2. Renal insufficiency (CrCl less than 30 ml/min)
3. Pregnant patients
4. Patients on long-term therapy

iii. Sample Collection and Timing

1. Sample should be drawn after 3 doses of enoxaparin, at steady state
2. Peak level is recommended and should be drawn 4-6 hours post-dose
3. Trough level is preferred in renal impairment (CrCl less than 30ml/min) on enoxaparin treatment dosing (1mg/kg every 24 hours)

iv. Goal Anti-Factor Xa activity levels

(Note: these levels should be viewed as general guidelines as extensive correlation data lacks with efficacy and safety outcomes)

Regimen	Target Anti-Factor Xa Activity Level (units/mL)
Enoxaparin 1 mg/kg every 12 hours	0.5-1
Enoxaparin 1.5 mg/kg every 24 hours	1-2
Enoxaparin 1 mg/kg every 24 hours	Trough (preferred): less than 0.4

v. Dosing Nomogram for Peak Anti-Factor Xa Activity for Enoxaparin 1 mg/kg every 12 hours (round to nearest available dose)

Anti-Factor Xa Activity Level (units/mL)	Dose Change
Less than 0.35	Increase by 25%
0.35-0.49	Increase by 10%
0.5-1	NO DOSE CHANGE
1.1-1.5	Decrease by 20%
1.6-2	Decrease by 30%
Greater than 2	Hold 1 dose, then decrease by 40%
Repeat anti-Factor Xa activity level with 3rd dose after adjustment	

Enoxaparin Use in Adult Patients (cont'd)

vi. Dosing Nomogram for Peak Anti-Factor Xa Activity for Enoxaparin 1.5 mg/kg every 24 hours (round to nearest available dose):

Anti-Factor Xa Activity Level (units/mL)	Dose Change
Less than 0.5	Increase by 25%
0.5-0.9	Increase by 10%
1-2	NO DOSE CHANGE
2.1-2.5	Decrease by 20%
Greater than 2.5	Hold 1 dose, then decrease by 30%
Repeat anti-Factor Xa activity level with 3rd dose after adjustment	

vii. If dose adjustments are made based upon nomograms and repeat Anti-Factor Xa Activity is desired, sample should be drawn after 3 doses as outlined above.

II. Prophylaxis Indications

a. Routine Monitoring

i. Baseline and ongoing monitoring of renal function and hematologic parameters should be performed in accordance with UMHHC Policy 07-01-051< UMHHC Inpatient Anticoagulation Monitoring Table>

b. Anti-Factor Xa Activity Monitoring

i. Not recommended

CONVERSION TO AND FROM OTHER ORAL OR PARENTERAL ANTICOAGULANT AGENTS FOR TREATMENT INDICATIONS

I. Converting from warfarin to enoxaparin

a. Start enoxaparin when INR is equal to or below the lower end of the therapeutic range for the patient's indication.

II. Converting from enoxaparin to warfarin

a. Start warfarin therapy while continuing enoxaparin therapy. Once INR reaches the therapeutic range for the patient, discontinue enoxaparin.

III. Converting from another anticoagulant other than warfarin to enoxaparin

Alternate Anticoagulant	Time after last dose of alternate anticoagulant before start of enoxaparin
Unfractionated heparin or parenteral direct thrombin inhibitor IV continuous infusion	Start enoxaparin immediately upon discontinuation of continuous infusion
Subcutaneous fondaparinux; oral dabigatran or rivaroxaban	Start enoxaparin 0 – 2 hours before the next dose of alternate anticoagulant was to be administered

Enoxaparin Use in Adult Patients (cont'd)

IV. Converting from enoxaparin to another anticoagulant other than warfarin

Alternate Anticoagulant	Time after last dose of enoxaparin before start of alternate anticoagulant
Unfractionated heparin IV continuous infusion	Start infusion at the time the next dose of enoxaparin would have been given and consider use of a bolus dose
Parenteral direct thrombin inhibitor IV continuous infusion	Start infusion at the time the next dose of enoxaparin would have been given
Subcutaneous fondaparinux; oral dabigatran or rivaroxaban	Give first dose of alternate anticoagulant at the time the next dose of enoxaparin would have been given

References:

1. American College Chest Physicians. Chest 2008 Guidelines for Antithrombotic and Thrombolytic Therapy. CHEST. 2008;133 (6):67S-70S.
2. Laposata et al. College of American Pathologists Conference XXXI on Laboratory Monitoring of Anticoagulant Therapy: The Clinical Use and Laboratory Monitoring of Low-Molecular-Weight Heparin, Danaproid, Hirudin and Related Compounds, and Argatroban. Arch Pathol Lab Med. 1998;122:799-807.
3. Duhl AJ et al. Antithrombotic Therapy and Pregnancy: Consensus Report and Recommendations for Prevention and Treatment of Venous Thromboembolism and Adverse Pregnancy Outcomes. Am J Obstet Gynecol. 2007;197:457.e1-e21.

Authors: Anticoagulation Subcommittee

Approved: Anticoagulation Subcommittee, October 2010, September 2011, March 2012, October 2012
Pharmacy and Therapeutics Committee, November 2011

Warfarin Guidelines for Initiation in Adults:

University of Michigan Health System
Anticoagulation Program
Guideline for Initiating Oral Warfarin in Adult Inpatients

Purpose: The purpose of this guideline is to provide dosing assistance for initiating warfarin therapy in patients that have not previously been on warfarin.

Loading doses of warfarin (e.g., 10 mg on days 1 and 2) are no longer recommended.
Several controlled studies have shown that starting patients on 5 mg of warfarin daily achieves a therapeutic anticoagulant effect as rapidly as 10 mg loading regimens while causing fewer supratherapeutic INRs. The following algorithm by Crowther and colleagues should guide the dosing of warfarin during the first several days of therapy.

Nomogram for Starting Patients on Warfarin*

	INR	Dosage
DAY 1	A baseline INR must be obtained prior to starting warfarin	5 mg**
DAY 2	<1.5 1.5 - 1.9 2.0 - 2.5 > 2.5	5 mg 2.5 mg 1 - 2 mg 0 mg
DAY 3	<1.5 1.5 - 1.9 2.0 - 3.0 > 3.0	5 - 10 mg 2.5 - 5 mg 0 - 2.5 mg 0 mg
DAY 4	< 1.5 1.5 - 1.9 2.0 - 3.0 > 3.0	10 mg 5 -7.5 mg 0 - 5 mg 0
DAY 5	< 1.5 1.5 - 1.9 2.0 - 3.0 > 3.0	10 mg 7.5 - 10 mg 0 - 5 mg 0
DAY 6	< 1.5 1.5 - 1.9 2.0 - 3.0 > 3.0	7.5 - 12.5 mg 5 - 10 mg 0 - 7.5 mg 0

*This algorithm can be used in patients currently receiving unfractionated heparin or low molecular weight heparin (LMWH).

**In select patients (e.g., very large or frail patients, those on medications known to interact with warfarin, elderly, and those with heart failure or liver failure), a Day 1 warfarin dose different from 5mg may be appropriate.

Due to the uncertain clinical benefit and cost of the pharmacogenetic tests, their routine use is not recommended to guide warfarin dose initiation or adjustment.

Warfarin INR Goal and Durations of Therapy:

University of Michigan Health System
Anticoagulation Program
Guideline for Warfarin INR Goals and Duration of Therapy

Indication	INR	Suggested Duration
Acute myocardial infarction with or at risk for intracardiac thrombus[1]	2.0 – 3.0	3 months
Triple antithrombotic therapy after AMI, consider†	2.0 – 2.5	3 months
Atrial fibrillation or flutter[2]	2.0 – 3.0	Indefinite
Antiphospholipid antibody syndrome[3]	2.0 – 3.0	Indefinite
Treatment of deep venous thrombosis (DVT) or pulmonary embolism (PE)[4]	2.0 – 3.0	3 months
If provoked by a transient risk factor		At least 3 months, then re-evaluate according to patient-specific criteria* Indefinite
If unprovoked:		
First unprovoked VTE		At least 3 months
Second unprovoked VTE		Indefinite
With high bleed risk		
With active cancer		
Pulmonary Hypertension[5]	1.5 – 2.5	Indefinite
Mechanical valve in the aortic position[6]**	2.0 - 3.0	Indefinite
Caged ball or Caged Disk	2.5 - 3.5	Indefinite
Mechanical valve in the mitral position[7]**	2.5 – 3.5	Indefinite
Mechanical valves in both aortic and mitral position[6]**	2.5 – 3.5	Indefinite
Bioprosthetic valve in mitral position[6]	2.0 – 3.0	3 months then continue aspirin 50-100 mg/d
Prophylaxis of VTE post-total hip or knee replacement surgery	2.0 – 3.0	1 month

†Consider reduced INR goal if triple therapy (warfarin plus dual antiplatelet therapy) deemed necessary
*Criteria for evaluation of treatment duration include individual patient's anatomical clot location, bleeding risk, and patient preference.
**Add low-dose aspirin (50-100mg/d)

-PLEASE SEE "EXTENDED REFERENCES" FOR CITATIONS-

Dabigatran Use Guidelines:

https://pharmwebsp.med.umich.edu/GuideLines/Anticoagulation/DabigatranGuidelines.pdf

University of Michigan Health System
Anticoagulation Program
Guideline for Use of Oral Direct Thrombin Inhibitor Dabigatran Etexilate in Adult Inpatients

I. **Purpose:** The purpose of this guideline is to provide recommendations for treatment with dabigatran etexilate in adult inpatients (18 years of age or older) regardless of location.

II. **Criteria for Use:**

a. Inclusion:

i. Reduction of stroke and systemic embolism in non-valvular atrial fibrillation

ii. Utilization peri-procedurally for direct current cardioversion (DCC) and/or radiofrequency ablation (RFA) as recommended by electrophysiology

iii. Treatment for venous thromboembolism after receiving at least 5 days of initial parenteral anticoagulant treatment

b. Exclusion:

i. Creatinine clearance based upon indication (see section IV. Dosing below)

ii. Prosthetic mechanical heart valve

iii. Active bleeding

iv. Pregnancy

v. Hemodynamically unstable pulmonary embolism

vi. Venous thromboembolism prophylaxis

vii. Concurrent epidural use

viii. Pediatrics (< 18 years of age) due to the lack of data to guide safe use

Dabigatran Use Guidelines (cont'd)

III. Drug Interactions:

Interacting Agent(s)	Possible Effect	Management
P-gp inducers (e.g., rifampin)	Reduces exposure to dabigatran	Avoid concomitant administration
P-gp inhibitors dronedarone and systemic ketoconazole in patients with moderate renal impairment (CrCl 30-50 mL/min)	Increases exposure to dabigatran	See table below for dosing recommendations or if it is recommended to avoid
P-gp inhibitors in patients with severe renal impairment (CrCl 15-30 mL/min)	Increases exposure to dabigatran	Avoid concomitant administration
Verapamil	If verapamil is present in the gut when dabigatran is ingested, dabigatran exposure is increased (AUC increased by a factor of 2.4). If verapamil is given 2 hours after dabigatran the increase in AUC is negligible.	Separate verapamil and dabigatran administration by 2 hours

IV. Dosing:

a. Dosing differs based upon indication for use and renal function, expressed as mL/min as calculated via the Cockroft-Gault equation.

b. All doses are administered orally.

c. If a dose is missed and the next dose is due within 6 hours, skip the missed dose and resume previous dosing schedule.

Indication	Dosage	
VTE treatment	CrCl 30ml/min or above	150mg every 12 hours
	CrCl less than 30ml/min without P-gp inhibitor	Avoid
	CrCl less than 50ml/min with concomitant P-gp inhibitor	Avoid
Reduction of stroke and systemic embolism in non-valvular AF	CrCl greater than 30ml/min	150mg every 12 hours
	CrCl 15-30ml/min	75mg every 12 hours
	CrCl less than 15ml/min	Contraindicated
	CrCl 30-50ml/min with concomitant dronedarone or ketoconazole	75mg every 12 hours
	CrCl less than 30ml/min with concomitant P-gp inhibitor	Avoid

Dabigatran Use Guidelines (cont'd)

V. Administration:

a. Routine administration times will default to 06:00 and 18:00 to minimize medication interactions.

b. Dabigatran should not be open, chewed, or crushed prior to administration and should not be administered via any feeding tubes. The oral bioavailability increases by 75% when the pellets are taken without the capsule shell when compared to the intact capsule formulation.

VI. Monitoring:

a. Baseline monitoring

i. aPTT, INR/PT, platelet count, and hemoglobin/hematocrit and serum creatinine

b. On-going monitoring

i. Patients in an intensive care unit will have serum creatinine monitored at least every 3 days. All other patients will have serum creatinine monitored at least once per week. Hemoglobin/hematocrit will be monitored at least weekly while hospitalized.

ii. **On-going monitoring of anticoagulant assays is not routinely recommended.** If the clinician feels monitoring is necessary (e.g. concern for overdose) consider use of anti-IIa inhibitor assay calibrated for dabigatran (DABIG).

- A correlation of anti-IIa activity and therapeutic benefit has not been demonstrated. If this test result is greater than 0.04 ug/mL, then the patient has some anticoagulant effect from dabigatran. Normal individuals have no dabigatran activity

VII. Conversion to and from other agents:

a. ***Black Box Warning:*** **Discontinuing dabigatran in patients being treated for atrial fibrillation places patients at an increased risk of thrombotic events. An increased rate of stroke was observed following discontinuation of dabigatran in clinical trials in patients with nonvalvular atrial fibrillation. If anticoagulation with dabigatran must be discontinued for a reason other than pathological bleeding, coverage with another anticoagulant should be strongly considered.**

b. Converting from warfarin to dabigatran

i. Discontinue warfarin and begin dabigatran when the INR is below 2.0

c. Converting from dabigatran to warfarin

i. When converting from dabigatran to warfarin the INR is unlikely to be useful until at least two days after discontinuation of dabigatran.

CrCl (mL/min)	**Warfarin treatment prior to dabigatran discontinuation**
Greater than 50	Start warfarin 3 days before discontinuing dabigatran
31 to 50	Start warfarin 2 days before discontinuing dabigatran
15 to 30	Start warfarin 1 day before discontinuing dabigatran

Dabigatran Use Guidelines (cont'd)

d. Converting from another anticoagulant other than warfarin to dabigatran

Alternate Anticoagulant	Time after last dose of alternate anticoagulant before start of dabigatran
Unfractionated heparin or parenteral direct thrombin inhibitor intravenous continuous infusion	Start dabigatran immediately upon discontinuation of continuous infusion
Subcutaneous LMWH or fondaparinux; oral apixaban or rivaroxaban	Start dabigatran 0 – 2 hours before the next dose of alternate anticoagulant was to be administered

e. Converting from dabigatran to another anticoagulant other than warfarin

CrCl (mL/min)	Time after last dose of dabigatran before start of parenteral anticoagulant
Greater than or equal to 30	12 hours
Less than 30	24 hours

VIII. Periprocedural Management

a. Pre-operative/Pre-procedural management

i. Low thrombotic risk★ patients

Dabigatran pre-procedural management in Low thrombotic risk★ patients		
	Time after last dose of dabigatran before procedure	
CrCl (mL/min)	*Standard risk of bleeding*[1]	*High risk of bleeding*[3, †]
Greater than or equal to 50	2 days	4 days
Less than 50	4 days	5 days

ii. Intermediate -high thrombotic risk# patients

Dabigatran pre-procedural management in Intermediate-high thrombotic risk# patients		
	Time after last dose of dabigatran before procedure	
CrCl (mL/min)	*Standard risk of bleeding*[1]	*High risk of bleeding*[3, †]
Greater than or equal to 50	1 day	2 days
Less than 50	2 days	3 days

★#Patient criteria as outlined in UMHS Perioperative and Periprocedural Warfarin Guidelines for Adult and Pediatric Patients

† Types of surgery associated with a high risk of bleeding (or in major surgery where complete hemostasis may be required) may include but are not limited to cardiac surgery, neurosurgery, or others determined by the proceduralist or surgeon. Other procedures such as spinal anesthesia may also require complete hemostatic function. Other important determinants of bleeding risk may include advancing age, co-morbidities (e.g. renal or liver disease) and concomitant use of antiplatelet therapy.

iii. Bridging with a parenteral anticoagulant prior to a procedure/operation is not necessary. However, physicians may choose to use a parenteral anticoagulant instead of dabigatran prior to surgery.

Dabigatran Use Guidelines (cont'd)

b. Post-operative/Post-procedural management

i. Resuming treatment dose dabigatran: Subject to surgeon approval. Minimum 24 hours after procedure.

c. Dabigatran and Central Neuraxial Blockade

i. **Use of dabigatran during the use of central neuraxial blockade is contraindicated.**

ii. Dabigatran should be discontinued 48 hours before epidural catheter placement.

For patients with CrCl less than 50 mL/min discontinuing dabigatran 3-5 days before epidural catheter placement may be warranted.

iii. Dabigatran may be restarted 2 hours after epidural catheter removal.

d. Peri-procedural during DCC or RFA

i. Refer to electrophysiology guidelines

(See Antithrombotic/Antiplatelet Agents & Central Neuraxial Blockade Guidelines for Adult and Pediatric Patients)

IX. Management of dabigatran associated bleeding complications

a. There is no antidote to dabigatran

Clinical Setting	Action/Recommendation
Mild bleeding	Delay next dose or discontinue dabigatran treatment if clinically appropriate
Moderate-severe bleeding	
Ingestion less than 2 hours ago	Activated charcoal Consider blood product transfusion Consider hemodialysis‡
Ingestion greater than 2 hours ago	Consider blood product transfusion Consider hemodialysis‡
Life-threatening bleeding	
Ingestion less than 2 hours ago	Activated charcoal Blood product transfusion Consider hemodialysis‡ Consider Factor VIIa*
Ingestion greater than 2 hours ago	Blood product transfusion Consider hemodialysis‡ Consider Factor VIIa*

*UMHS Factor VIIa (Novoseven) Guidelines: Adult Patients

‡ Consult inpatient nephrology service

-PLEASE SEE "EXTENDED REFERENCES" FOR CITATIONS-

Rivaroxaban Use Guidelines:

https://pharmwebsp.med.umich.edu/GuideLines/Anticoagulation/RivaroxabanGuideline.pdf

University of Michigan Health System
Anticoagulation Program
Guideline for Use of the Oral Direct Factor Xa Inhibitor Rivaroxaban in Adult Inpatients

I. **Purpose:** The purpose of this guideline is to provide recommendations for the use of rivaroxaban in adult inpatients (18 years of age or older) regardless of location.

II. **Criteria for Use:**

a. Inclusion:

i. Venous thromboembolism (VTE) prophylaxis in patients undergoing knee or hip replacement surgery

ii. VTE treatment (pulmonary embolism and/or deep vein thrombosis)

iii. Reduction of stroke and systemic embolism in non-valvular atrial fibrillation (AF)

b. Exclusion:

i. Creatinine clearance (CrCl), differing based upon indication (see Section III. Dosing)

1. VTE prophylaxis and treatment – less than 30 mL/min
2. AF – less than 15ml/min

ii. Moderate (Child-Pugh B) or severe (Child-Pugh C) hepatic impairment or with hepatic disease associated with coagulopathy

iii. Prosthetic mechanical heart valve

iv. Pediatrics (less than 18 years of age) due to the lack of data to guide safe use

v. Active bleeding

vi. Pregnancy or nursing

vii. Use of an epidural catheter

Rivaroxaban Use Guidelines (cont'd)

III. Drug Interactions:

Interacting Agent(s)	Possible Effect	Management
Ketoconazole, itraconazole, lopinavir/ritonavir, indinavir/ritonavir, and conivaptan	P-gp and *strong* CYP3A4 inhibitors increase rivaroxaban concentrations and may increase risk of bleeding	Avoid concomitant administration
Carbamazepine, phenytoin, phenobarbital, rifampin, rifampicin, and St. John's wort	P-gp and CYP3A4 inducers due to decrease rivaroxaban concentrations and may reduce efficacy	
Other anticoagulants	Concomitant use with rivaroxaban increase bleeding risk	
Erythromycin, clarithromycin, diltiazem, verapamil, quinidine, ranolazine, dronedarone, amiodarone, and felodipine	Combined P-gp and *weak or moderate* CYP3A4 inhibitors increase rivaroxaban concentrations and may increase risk of bleeding	Use only if benefit outweighs the risk
Aspirin and/or clopidogrel	Concomitant use with rivaroxaban increase bleeding risk	Monitor for clinical sign/symptoms of bleeding

IV. Dosing:

a. Dosing differs based upon indication for use and renal function, expressed as ml/min as calculated via the Cockroft-Gault equation.

b. All doses are administered orally.

Indication	Dosage	
VTE prophylaxis in hip replacement*	CrCl 30ml/min or above	10mg every 24 hours; continue for 35 days
	CrCl less than 30ml/min	Contraindicated
VTE prophylaxis in knee replacement*	CrCl 30ml/min or above	10mg every 24 hours; continue for 12 days
	CrCl less than 30ml/min	Contraindicated
VTE treatment	CrCl 30ml/min or above	15mg every 12 hours x 21 days; 20mg every 24 hours thereafter
	CrCl less than 30ml/min	Contraindicated
Reduction of stroke and systemic embolism in non-valvular AF	CrCl greater than50ml/min	20mg every 24 hours
	CrCl 15-50ml/min	15mg every 24 hours
	CrCl less than 15ml/min	Contraindicated

*Initial dose should be given 6-10 hours after surgery once hemostasis is established

Rivaroxaban Use Guidelines (cont'd)

V. Administration:

a. Rivaroxaban can be crushed and administered in a feeding tube, but gastric placement is required to assure adequate drug absorption

b. In patients receiving rivaroxaban for reduction of stroke and systemic embolism in AF, routine administration time will default to 17:00 with the evening meal. This is in order to ensure complete absorption of the drug for this indication only.

V. Administration:

a. Rivaroxaban can be crushed and administered in a feeding tube, but gastric placement is required to assure adequate drug absorption

b. In patients receiving rivaroxaban for reduction of stroke and systemic embolism in AF, routine administration time will default to 17:00 with the evening meal. This is in order to ensure complete absorption of the drug for this indication only.

c. In patients receiving rivaroxaban for VTE treatment, routine administration time will default to 06:00 and 18:00 for twice daily dosing and 17:00 for once daily dosing so doses will be given with meals.

d. In patients receiving rivaroxaban for VTE prophylaxis, the drug will be administered q24h with no default time, in order to allow for first doses to be timed according to surgical time and achievement of hemostasis. There is no concern for absorption with the 10mg dose used for this indication thus it may be given at any time of the day without regard for food.

VI. Inpatient Monitoring:

a. Baseline monitoring

i. aPTT, INR/PT, platelet count, and hemoglobin/hematocrit and serum creatinine

b. On-going monitoring

i. Patients in an intensive care unit will have serum creatinine monitored at least every 3 days. All other patients will have serum creatinine monitored at least once per week. Hemoglobin/hematocrit will be monitored at least weekly while hospitalized.

ii. On-going monitoring of anticoagulant assays is not routinely recommended.

Rivaroxaban Use Guidelines (cont'd)

VII. Conversion to and from other agents:

a. ***Black Box Warning:*** **Discontinuing rivaroxaban in patients being treated for atrial fibrillation places patients at an increased risk of thrombotic events. An increased rate of stroke was observed following discontinuation of rivaroxaban in clinical trials in patients with nonvalvular atrial fibrillation. If anticoagulation with rivaroxaban must be discontinued for a reason other than pathological bleeding, coverage with another anticoagulant should be strongly considered.**

b. There is a lack of data regarding these conversion strategies but they represent reasonable strategies when conversion is necessary.

c. Converting from warfarin to rivaroxaban

i. Discontinue warfarin and begin rivaroxaban when the INR is equal to or below 2.0.

d. Converting from rivaroxaban to warfarin

i. When converting from rivaroxaban to warfarin the INR is unlikely to be useful for several days.

ii. Discontinue rivaroxaban and begin warfarin bridged with a concomitant parenteral anticoagulant when the next dose of rivaroxaban would have been due if continuous therapeutic anticoagulation is required.

e. Converting from another anticoagulant other than warfarin to rivaroxaban

Alternate Anticoagulant	Time after last dose of alternate anticoagulant before start of rivaroxaban
Unfractionated heparin or parenteral direct thrombin inhibitor intravenous continuous infusion	Start rivaroxaban immediately upon discontinuation of continuous infusion
Subcutaneous LMWH or fondaparinux; oral apixaban or dabigatran	Start rivaroxaban 0 – 2 hours before the next dose of alternate anticoagulant was to be administered

f. Converting from rivaroxaban to another anticoagulant other than warfarin

i. Discontinue rivaroxaban and begin the alternate anticoagulant at the time the next dose of rivaroxaban would have been given

Rivaroxaban Use Guidelines (cont'd)

VIII. Periprocedural/Perioperative Management:

a. For patients receiving rivaroxaban for **VTE prophylaxis** (10mg), rivaroxaban should be stopped at least 24 hours before the procedure.

b. For patients receiving **treatment doses** (15-20mg) of rivaroxaban:

i. Low thrombotic risk★ patients

Rivaroxaban pre-procedural management in Low thrombotic risk★ patients		
	Time after last dose of rivaroxaban before procedure	
CrCl (mL/min)	***Standard risk of bleeding***	***High risk of bleeding***†
Greater than or equal to 50	2 days	4 days
Less than 50	4 days	5 days

ii. Intermediate -high thrombotic risk# patients

Rivaroxaban pre-procedural management in Intermediate-high thrombotic risk# patients		
	Time after last dose of rivaroxaban before procedure	
CrCl (mL/min)	***Standard risk of bleeding***	***High risk of bleeding***†
Greater than or equal to 50	1 day	2 days
Less than 50	2 days	3 days

★#Patient criteria as outlined in UMHS Perioperative and Periprocedural Warfarin Guidelines for Adult and Pediatric Patients

† Types of surgery associated with a high risk of bleeding (or in major surgery where complete hemostasis may be required) may include but are not limited to cardiac surgery, neurosurgery, or others determined by the proceduralist or surgeon. Other procedures such as spinal anesthesia may also require complete hemostatic function. Other important determinants of bleeding risk may include advancing age, co-morbidities (e.g. renal or liver disease) and concomitant use of antiplatelet therapy.

c. Bridging with a parenteral anticoagulant prior to a procedure/operation is not necessary. However, physicians may choose to use a parenteral anticoagulant instead of rivaroxaban prior to surgery.

d. Post-operative/Post-procedural management

i. Resuming treatment dose rivaroxaban is subject to surgeon or interventionalist approval based upon achievement of adequate hemostasis.

ii. Prophylactic rivaroxaban after hip/knee replacement should be initiated 6 to 10 hours after surgery once hemostasis is achieved.

e. Central Neuraxial Blockade

i. **Use of rivaroxaban during the use of central neuraxial blockade is contraindicated.**

ii. Rivaroxaban should be discontinued at least 24 hours before epidural catheter placement.

iii. Rivaroxaban may be restarted 6 hours after epidural catheter removal

(See Antithrombotic/Antiplatelet Agents & Central Neuraxial Blockade Guidelines for Adult and Pediatric Patients)

IX. Management of rivaroxaban associated bleeding complications

a. There is no antidote available in the United States for rivaroxaban

Clinical Setting	Action/Recommendation
Mild bleeding	Delay next dose or discontinue rivaroxaban treatment if clinically appropriate
Moderate-severe bleeding	
Ingestion less than 2 hours ago	Activated charcoal Consider blood product
Ingestion greater than 2	Consider blood product
Life-threatening bleeding	
Ingestion less than 2 hours ago	Activated charcoal Blood product transfusion Consider prothrombin complex concentrate**
Ingestion greater than 2 hours ago	Blood product transfusion Consider prothrombin complex concentrate**

** Guideline for Prothrombin Complex Concentrate Use for Reversal of Anticoagulation

Rivaroxaban Use and Guideline References:

1. Xarelto package insert. Titusville, NJ: Janssen Pharmaceuticals, Inc. 2012 November. http://www.xareltohcp.com/sites/default/files/pdf/xarelto_0.pdf#zoom=100 (accessed 2012 November 19).
2. Eriksson BI, Borris LC, Friedman RJ, et al. Rivaroxaban versus enoxaparin for thromboprophylaxis after hip arthroplasty. *N Engl J Med* 2008;356:2765-75.
3. Kakkar AK, Brenner B, Dahl OE, et al. Extended duration rivaroxaban versus short-term enoxaparin for the prevention of venous thromboembolism after total hip arthroplasty: a double-bline, randomized controlled trial. *Lancet* 2008;372:31-9.
4. Lassen MR, Ageno W, Borris LC, et al. Rivaroxaban versus enoxaparin for thromboprophylaxis after total knee arthroplasty. *N Engl J Med* 2008;358:2776-86.
5. Turpie AGG, Lassen MR, Davidson BL, et al. Rivaroxaban versus enoxaparin for thromboprophylaxis after total knee arthroplasty (RECORD4): a randomized trial. *Lancet* 2009;373:1673-80.
6. Patel MR, Mahaffey KW, Garg J, et al. Rivaroxaban versus warfarin in nonvalvular atrial fibrillation (ROCKET AF). *N Engl J Med* 2001;365:883-91.
7. The EINSTEIN Investigators. Oral rivaroxaban for symptomatic venous thromboembolism. *N Engl J Med* 2010; 363:2499-2510.
8. The EINSTEIN Investigators. Oral rivaroxaban for the treatment of symptomatic pulmonary embolism. *N Engl J Med* 2012; 366:1287-1297.

Authors: Anticoagulation Subcommittee
Approved: Anticoagulation Subcommittee (10/10/11); (01/09/12); (11/19/12)

Apixiban Use Guidelines:

https://pharmwebsp.med.umich.edu/GuideLines/Anticoagulation/ApixabanGuideline.pdf

University of Michigan Health System
Anticoagulation Program
Guideline for Use of the Oral Direct Factor Xa Inhibitor Apixaban in Adult Inpatients

I. **Purpose:** The purpose of this guideline is to provide recommendations for the use of apixaban in adult inpatients (18 years of age or older) regardless of location.

II. **Criteria for Use:**

a. Indications:

i. Reduction of stroke and systemic embolism in non-valvular atrial fibrillation (AF)

ii. Venous thromboembolism (VTE) prophylaxis in patients undergoing knee or hip replacement surgery

iii. VTE treatment

b. Contraindications:

i. Creatinine clearance (CrCl) less than 15ml/min or on dialysis

ii. Severe (Child-Pugh C) hepatic impairment

iii. Prosthetic mechanical heart valve

iv. Pulmonary embolism (PE) complicated by hemodynamic instability or requiring thrombolysis

v. Use of strong dual inducers of P-gp and cytochrome P (CYP) 3A4 (see section III for agents)

vi. Use of strong dual inhibitors of P-gp and CYP3A4, dependent upon dose and indication (see sections III and IV)

vii. Pediatrics (less than 18 years of age) due to the lack of data to guide safe use

viii. Active bleeding

ix. Pregnancy or nursing

x. Use of an epidural catheter

Apixiban Use Guidelines (cont'd)

III. Drug Interactions:

Interacting Agent(s)	Possible Effect	Management
Ketoconazole, itraconazole, ritonavir, and clarithromycin	Strong dual inhibitors of P-gp and CYP3A4 inhibitors increase apixaban concentrations and may increase risk of bleeding	Decrease doses > 2.5 mg q12h by 50%; if already taking 2.5 mg q12h, avoid coadministration
Carbamazepine, phenytoin, phenobarbital, rifampin, and St. John's wort	Strong inducers P-gp and CYP3A4 inducers decrease apixaban concentrations and may reduce efficacy	Avoid coadministration
Anticoagulants, antiplatelets, fibrinolytics, chronic NSAIDs	Concomitant use with apixaban increases bleeding risk	Monitor for clinical sign/symptoms of bleeding

IV. Dosing:

a. Dosing differs based upon indication for use.
b. All doses are administered orally every 12 hours.
c. Avoid with strong dual P-gp/CYP3A4 inducers (see III above for agents).

Indication	Dosage	
VTE prophylaxis in hip or knee replacement*	Without concomitant P-gp/CYP3A4 inhibitor	Hip: 2.5 mg every 12 hours; continue for 35 days Knee: 2.5 mg every 12 hours; continue for 12 days
	With concomitant P-gp/CYP3A4 inhibitor	Avoid
VTE treatment	Without concomitant P-gp/CYP3A4 inhibitor	10 mg every 12 hours x 7 days; 5 mg every 12 hours thereafter
	With concomitant P-gp/CYP3A4 inhibitor	5 mg every 12 hours x 7 days; 2.5 mg every 12 hours thereafter
Reduction of stroke and systemic embolism in non-valvular AF	Without concomitant P-gp/CYP3A4 inhibitor	5 mg every 12 hours
	Any **two** dose reduction criteria† without concomitant P-gp/CYP3A4 inhibitor	2.5 mg every 12 hours
	Any **two** dose reduction criteria† with concomitant P-gp/CYP3A4 inhibitor	Avoid

Note: strong dual inhibitors of P-gp/CYP3A4 include ketoconazole, itraconazole, ritonavir and clarithromycin as noted in section III.

*Initial dose should be given 12-24 hours after surgery once hemostasis has been established.

† Dose reduction criteria include: 1) Age greater than or equal to 80 years; 2) Body weight less than or equal to 60 kg; and, 3) SCr greater than or equal to 1.5 mg/dL.

Apixiban Use Guidelines (cont'd)

V. Administration:

a. If a dose of apixaban is missed and the next dose is due within 6 hours, skip the missed dose and resume the previous dosing schedule. The dose should not be doubled to make up for a missed dose.

b. Apixaban can be crushed and administered through a feeding tube.

VI. Inpatient Monitoring:

a. Baseline monitoring

i. aPTT, INR/PT, platelet count, hemoglobin/hematocrit, and serum creatinine

b. On-going monitoring

i. Patients in an intensive care unit will have serum creatinine monitored at least every 3 days. All other patients will have serum creatinine monitored at least once per week. Hemoglobin/hematocrit will be monitored at least weekly while hospitalized.

ii. On-going monitoring of anticoagulant assays is not routinely recommended.

VII. Conversion to and from other agents:

a. ***Black Box Warning:*** **Discontinuing apixaban places patients at an increased risk of thrombotic events. An increased rate of stroke was observed following discontinuation of apixaban in clinical trials in patients with nonvalvular atrial fibrillation. If anticoagulation with apixaban must be discontinued for a reason other than pathological bleeding, coverage with another anticoagulant should be strongly considered.**

b. There is a lack of data regarding these conversion strategies but they represent reasonable strategies when conversion is necessary.

c. Converting from warfarin to apixaban

i. Discontinue warfarin and begin apixaban when the INR is below 2.0.

d. Converting from apixaban to warfarin

i. Apixaban affects INR. INR measurements during coadministration with warfarin may not be useful for determining appropriate dose of warfarin.

ii. If continuous anticoagulation is necessary, discontinue apixaban and begin warfarin with a concomitant parenteral anticoagulant when the next dose of apixaban would have been due, discontinuing the parenteral anticoagulant when INR reaches goal range.

e. Converting from another anticoagulant other than warfarin to apixaban

Apixiban Use Guidelines (cont'd)

Alternate Anticoagulant	Time after last dose of alternate anticoagulant before start of apixaban
Unfractionated heparin or parenteral direct thrombin inhibitor intravenous continuous infusion	Start apixaban immediately upon discontinuation of continuous infusion
Subcutaneous LMWH or fondaparinux; oral dabigatran, rivaroxaban	Start apixaban 0-2 hours before the next dose of alternate anticoagulant was to be administered

f. Converting from apixaban to another anticoagulant other than warfarin

i. Discontinue apixaban and begin the alternate anticoagulant at the time the next dose of apixaban would have been given

VIII. Periprocedural/Perioperative Management:

a. Pre-operative/Pre-procedural management

i. Low thrombotic risk★ patients

Apixaban pre-procedural management in Low thrombotic risk★ patients		
CrCl (mL/min)	Time after last dose of apixaban before procedure	
	Standard risk of bleeding	*High risk of bleeding*†
Greater than or equal to 50	2 days	4 days
Less than 50	4 days	5 days

ii. Intermediate -high thrombotic risk# patients

Apixaban pre-procedural management in Intermediate-high thrombotic risk# patients		
CrCl (mL/min)	Time after last dose of apixaban before procedure	
	Standard risk of bleeding	*High risk of bleeding*†
Greater than or equal to 50	1 day	2 days
Less than 50	2 days	3 days

★#Patient criteria as outlined in UMHS Perioperative and Periprocedural Warfarin Guidelines for Adult and Pediatric Patients

† Types of surgery associated with a high risk of bleeding (or in major surgery where complete hemostasis may be required) may include but are not limited to cardiac surgery, neurosurgery, or others determined by the proceduralist or surgeon. Other procedures such as spinal anesthesia may also require complete hemostatic function. Other important determinants of bleeding risk may include advancing age, co-morbidities (e.g. renal or liver disease) and concomitant use of antiplatelet therapy.

b. Bridging with a parenteral anticoagulant prior to a procedure/operation is not necessary. However, prescribers may choose to use a parenteral anticoagulant instead of apixaban prior to surgery.

c. Post-operative/Post-procedural management

i. Resuming treatment dose apixaban is subject to surgeon or proceduralist approval based upon achievement of adequate hemostasis.

d. Central Neuraxial Blockade

i. Use of apixaban during the use of central neuraxial blockade is contraindicated.

ii. Apixaban should be discontinued at least 24 hours before epidural catheter placement.

iii. Apixaban may be restarted 6 hours after epidural catheter removal

(See Antithrombotic/Antiplatelet Agents & Central Neuraxial Blockade Guidelines for Adult and Pediatric Patients)

Apixiban Use Guidelines (cont'd)

IX. Management of apixaban associated bleeding complications

a. There is no antidote available in the United States for apixaban

Clinical Setting	Action/Recommendation
Mild bleeding	Delay next dose or discontinue apixaban treatment if clinically appropriate
Moderate-severe bleeding	
Ingestion less than 6 hours ago	Activated charcoal Consider blood product transfusion
Ingestion greater than 6 hours ago	Consider blood product transfusion
Life-threatening bleeding	
Ingestion less than 6 hours ago	Activated charcoal Blood product transfusion Consider prothrombin complex concentrate**
Ingestion greater than 6 hours ago	Blood product transfusion Consider prothrombin complex concentrate**

** Guideline for Prothrombin Complex Concentrate Use for Reversal of Anticoagulation

Apixaban Use and Guideline References:

1. Eliquis® package insert. Princeton, NJ: Bristol-Myers Squibb Company. 2014 August. http://packageinserts.bms.com/pi/pi_eliquis.pdf (accessed 2014 October 23).
2. The AVERROES Investigators. Apixaban in patients with atrial fibrillation. N Engl J Med 2011 Mar 3;364(9):806-17.
3. The ARISTOTLE Investigators. Apixaban versus warfarin in patients with atrial fibrillation. *N Engl J Med* 2011 Sep 15;365(11):981-92.
4. The AMPLIFY Investigators. Oral apixaban for the treatment of acute venous thromboembolism. *N Engl J Med* 2013;369:799-808.
5. Lassen MR et al. Apixaban or enoxaparin for thromboprophylaxis after knee replacement. *N Engl J Med* 2009;361:594-604.
6. The ADVANCE-2 Investigators. Apixaban versus enoxaparin for thromboprophylaxis after knee replacement (ADVANCE-2): A randomized double-blind trial. *Lancet* 2010;375:807-15.
7. The ADVANCE-3 Investigators. Apixaban versus enoxaparin for thromboprophylaxis after hip replacement. *N Engl J Med* 2010;363:2487-98.

Other Medication Use Guidelines

Neostigmine for Colonic Pseudo-Obstruction:

https://pharmwebsp.med.umich.edu/GuideLines/Gastroenterology/NeostigmineGuidelines.pdf

University of Michigan Health System
Clinical Guideline for use of IV neostigmine for colonic pseudo-obstruction in adults

Purpose:
The purpose of this guideline is to describe the process and restrictions for the safe administration of IV neostigmine in the management of colonic pseudo-obstruction.

I. Indications

A. Acute colonic pseudo-obstruction or colonic ileus with absence of mechanical obstruction and failure to improve with conservative management

B. **Patient must be located in a monitored bed** (See monitoring section for details)

II. Dosing and Administration

A. Continuous infusion

a. Neostigmine infusion 5 mg in 50 ml 0.9% NaCl

b. Start at 0.4 mg/hour. If no response after 8 hours and CrCl ≥ 30 ml/min, may increase to 0.8 mg/hour. (Dose increase not recommended for CrCl < 30 ml/min due to accumulation in renal dysfunction.)

c. Continue until patient passes stool

d. Maximum recommended duration of infusion 24 hours for CrCl ≥ 30 ml/min, 12 hours for CrCl < 30 ml/min

III. Contraindications

A. Known or suspected intestinal ischemia

B. Risk of intestinal ischemia due to high dose vasopressors

C. Documented or suspected intestinal perforation

D. Baseline HR < 60 bpm or SBP < 90 mmHg

E. AV conduction disturbances

F. Active bronchospasm

Neostigmine for CPO (cont'd)

IV. Precautions

A. Adverse effects

a. Bradycardia

b. Hypotension

c. Abdominal pain

d. Increased sputum and saliva production

B. Order atropine 1 mg IV PRN symptomatic bradycardia

C. If symptomatic hypotension and bradycardia not responsive to atropine, epinephrine and other emergency drugs are available in code carts on each unit

V. Monitoring

A. Continuous infusion

a. ECG monitoring is required from the start of the infusion until 4 hours after infusion stopped.

b. Vital signs (Blood pressure, heart rate, respiratory rate and SPO2)

- Immediately before infusion initiation
- q1 hour x 2 after initiation or with a dosage increase
- Then q4 hours
- Finally, 4 hours after the infusion is discontinued

c. Patient is to be placed on bed rest with bedside commode privileges

d. Contact MD when patient passes stool for reassessment of need to continue infusion

References:

1. Ponec RJ, Saunders MD, Kimmey MB. Neostigmine for the treatment of acute colonic pseudo-obstruction. NEJM. 1999;341:137-141.
2. Van der Spoel JI, Oudemans-van Staaten HM, Stoutenbeck CP, Bosman RJ, Zandstra DF. Neostigmine resolves critical illness-related colonic ileus in intensive care patients with multiple organ failure – a prospective, double-blind, placebo-controlled trial. Intensive Care Med. 2001;27: 822-827.

Approval:

Critical Care Steering Committee: 4/7/2011
Medication Safety Committee: 4/24/2011
Pharmacy & Therapeutic Committee: 5/17/2011

Clostridium Difficile Guidelines:

GUIDELINES FOR TREATMENT OF *CLOSTRIDIUM DIFFICILE* COLITIS IN ADULTS

***Clostridium difficile* Assay Results**			
Antigen Result[1]	**EIA Toxin Result[2]**	**PCR Result[3]**	**Interpretation**
Negative	Negative	Not necessary	No *C. difficile* present.
Positive	Positive	Not necessary	Toxigenic *C. difficile* present.
Positive	Negative	Positive	Toxigenic C. *difficile* present.
		Negative	Non-toxigenic *C. difficile* present. **Treatment not required.**
Negative	Positive	Positive	Toxigenic *C. difficile* present.
		Negative	No *C. difficile* present.

1. The negative predictive value of this test for ruling-out C. *difficile*-associated diarrhea approaches 99%
2. C. *difficile* toxin assay is not a test of cure, and may be positive for up to 30 days after treatment. Re-testing is not recommended
3. PCR testing is automatically performed if the antigen and EIA toxin results are discordant

Treatment of *Clostridium difficile* colitis			
For all patients: - Discontinue/change antibiotics if possible. - Avoid PPI/H2 blockers without an appropriate indication. - Implement infection control measures: http://www.med.umich.edu/i/policies/ice/ICM_dx/pdf/cdif.pdf			
Clinical Setting	**Initial Episode[1]**	**First Recurrence[1,2]**	**Second Recurrence[1,5,6]**
Mild - Moderate Disease (WBC ≤ 15,000 and SrCr < 1.5 times premorbid level)	Metronidazole 500mg PO tid x 10-14 days	Metronidazole 500mg PO tid x 10-14 days	Vancomycin 125 mg PO qid x 10-14 days then taper[7] over 4-6 weeks. Infectious Diseases consultation Consider referral to ID clinic for fecal microbiota transplantation evaluation[6b]
Severe Disease (Age ≥ 65, WBC>15,000, absolute neutrophil count ≤ 500, Albumin ≤ 2.5, SrCr ≥ 1.5 times premorbid level, SOT/BMT < 100 days, chronic GVHD (BMT), treatment of rejection in preceding 2 months (SOT))	Vancomycin 125mg PO qid x 10-14 days Consider Infectious Diseases consultation	Vancomycin 125mg PO qid x 10-14 days Consider Infectious Diseases consultation	Vancomycin 125mg PO qid x 10-14 days then taper[7] over 4-6 weeks. Infectious Diseases consultation Consider referral to ID clinic for fecal microbiota transplantation evaluation[6b]
Severe Disease with Complications (Hypotension or shock, ileus, megacolon, peritonitis, bowel perforation)	Metronidazole 500mg IV[3,4] every 8 hours plus vancomycin 500mg PO qid If ileus, vancomycin by enema every 8 hrs[4] Surgical consultation for possible colectomy Infectious Diseases consultation	Repeat primary therapy Surgical consultation Infectious Diseases consultation	Repeat primary therapy then taper[7] vancomycin over 4-6 weeks. Surgical consultation Infectious Diseases consultation Consider referral to ID clinic for fecal microbiota transplantation evaluation[6b]

Clostridium Difficile Guidelines (cont'd)

1. Failure is defined as no improvement or worsening symptoms after 48-96 hours of primary therapy. If no resolution after 14 days of treatment, look for alternative explanations diagnoses, continue C. *difficile* treatment doses until resolution, and consider infectious diseases consultation.
2. *C.difficile* colitis recurrence is defined as relapse within 4 weeks of finishing primary therapy.
3. Parenteral administration of metronidazole has poor intraluminal penetration. Parenteral vancomycin has no significant luminal accumulation and should not be used for C. difficile treatment.
4. Intracolonic vancomycin 500 mg in 1,000 mL of normal saline every 8 hours given as retention enema using the following procedure: 18-inch Foley catheter with a 30-ml balloon inserted into rectum, balloon inflated, vancomycin instilled, catheter clamped for 60 minutes, deflate and remove.
5. Avoid multiple or prolonged courses of metronidazole in recurrent disease due to the risk for cumulative neurotoxicity.
6. Alternative and/or adjunctive agents:
    a. Rifaximin, nitazoxanide, fidaxomicin (requires ID approval) and IVIG (requires approval) may be effective in specific patient populations. Consider infectious diseases consultation for appropriate alternative agents in a given patient.
    b. Fecal microbiota transplantation (FMT) is a highly effective option for patients with multiply-recurrent disease (van Nood NEJM 2013). Stool transplantation is performed at UM on an outpatient basis. Interested providers should refer patients to the ID clinic, with stool transplant/fecal microbiota transplant indicated in the referral.
    c. The role of probiotics in prevention and treatment of C. difficile colitis is unclear. Avoid the use of probiotics in immunocompromised patients (transplant recipients, unintact gut mucosa, neutropenic patients, HIV/AIDS patients, etc) and patients with severe C. *difficile* colitis.
    d. Cholestyramine binds PO vancomycin and may decrease its efficacy. Avoid concomitant use.
7. Patients on tapered doses of PO vancomycin should continue to be monitored for signs and symptoms of C. *difficile* disease. Tapers should begin after the treatment course is completed. Example of PO vancomycin taper:

125mg PO BID x 7 days, then 125mg PO daily x 7 days, then 125mg PO every other day x 7 days, and 125mg PO every 2-3 days x 2-8 weeks

Last Updated: July 2014; Approved by: UMHS P & T Committee 3/18/2014

-PLEASE SEE "EXTENDED REFERENCES" FOR CITATIONS-

THAM (tromethamine, tris-hydroxymethyl aminomethane)

THAM is a biologically inert amino alcohol of low toxicity which buffers carbon dioxide and acids in vitro and invivo. At 37^{o} C, the pK of THAM is 7.8, making it a more effective buffer than bicarbonate in the physiological range of blood pH. THAM is a proton acceptor, generating bicarbonate and decreasing the partial pressure of carbon dioxide in arterial blood. It rapidly distributes through the extracellular space and slowly penetrates the intracellular space, except for erythrocytes and hepatocytes, and it is excreted by the kidney in its protonated form at a rate that slightly exceeds creatinine clearance. Unlike bicarbonate, which requires an open system for carbon dioxide elimination in order to exert its buffering effect, THAM is effective in a closed or semiclosed system and maintains its buffering power in the presence of hypothermia.

The use of THAM is well documented in treating acidosis following cardiac bypass. Its use in ARDS is lightly reported, but it is useful in treating acidosis that accompanies permissive hypercapnia. THAM administration may permit correction of severe acidosis temporarily until vital homeostasis returns to normal. THAM administration should follow established guidelines, along with concurrent monitoring of acid-base status, ventilation and plasma electrolytes and glucose.

Indications

- Treatment of metabolic acidosis refractory to bicarbonate therapy
- To facilitate permissive hypercapnia in patients with severe ARDS during acute ventilator management

Patient Eligibility

- Patients must be in an ICU or PACU and administration of therapy must be per protocol, unless cleared by an ICU attending

Monitoring

- Q 1h ABG, potassium and glucose till stable then q 4h
- Q 6h basic
- Q 6h osmolarity with osmole gap for 24h and as indicated

Dosing

THAM acetate 0.3 mol/L (pH8.6) is well tolerated and is the only formulation available in the US. In large doses, THAM may induce respiratory depression requiring ventilatory assistance, hypokalemia secondary to pH changes and hypoglycaemia requiring glucose administration. It is supplied in 500 ml bottles.

1) Initial loading dose THAM acetate
0.3 mol/L (in ml) = lean body-weight (kg) x base deficit (mmol/L)
25-50% of the calculated dose is given IV over 5-10 minutes and the balance administered over 1 hour
--One bottle (500 ml) for a 70kg person with base deficit -8.0, half the dose over 5-10 minutes, remainder of the hour
2) Rate of administration should not exceed 15 ml/kg in 1 hour, not to exceed 50 ml/kg/day
--70 kg person, max rate short term 1000 ml/hr, max daily dose 3500 ml = 150 ml/hr
3) THAM is excreted renally at similar rates as creatinine.
IR (ml/hr) = 0.2 x CLCR(ml/min) x PTHAM (mmol/L)
(If ClCr is 30 ml/min, the maximum THAM infusion rate should be 35 ml/h to keep plasma THAM less than 6mmol/l)

Endpoints

Goal pH 7.25 – 7.30; Orders must be rewritten daily

Medication-Related Hospital-Wide Guidelines
Procedural Sedation (Moderate Sedation) Policy/Guidelines

http://www.med.umich.edu/i/policies/umh/62-11-001.html

Medication-Related Hospital-Wide Guidelines

https://pharmwebsp.med.umich.edu/SitePages/Medication%20Use%20GuideLines.aspx

HEALTH SYSTEM
UNIVERSITY OF MICHIGAN

Immunization Record for Adults with a Splenectomy or Splenic Embolization

People without a functional spleen need to be vaccinated against pneumococcus, *haemophilus influenzae* type B, and meningococcus, to reduce the risk of life-threatening infections.

You have received immunizations listed at the end of this document. Please keep a copy with your personal medical records and also provide a copy to your primary care provider if they are not a University of Michigan physician.

In order to provide the best protection, it's important that you receive your future vaccines on schedule.

Pneumococcal Vaccines:

Patients without a spleen **need two types of pneumococcal vaccine:**

- Prevnar 13® (generic name: pneumococcal conjugate or PCV13)
- Pneumovax 23® (generic name: pneumococcal polysaccharide or PPSV23)

There are different recommendations for people under or over 65 years of age.

If you are **under age 65:**

- You need one dose of Prevnar 13 if no history of a previous dose
- You need one dose of Pneumovax 23 if you have a history of one or less doses and there has been at least 5 years since any prior dose of Pneumovax 23
- If needed, Prevnar 13®should be given first, follow by Pneumovax 23® at least 8 weeks later.
- If you never received Prevnar 13® but you received Pneumovax 23®, you will need a Prevnar 13® dose 12 months after receiving the Pneumovax 23®.

If you are **65 years of age or older:**

- You need one dose of Prevnar 13 if no history of a previous dose
- If you have not had one dose of Pneumovax 23 at or after the age of 65, you will need one dose. There must be 5 years between this dose and any dose received prior to age 65.
- If needed, Prevnar 13®should be given first, follow by Pneumovax 23® at least 8 weeks later.

- If you never received Prevnar 13® but you received Pneumovax 23®, you will need a Prevnar 13® dose 12 months after receiving the Pneumovax 23®.

You may receive **up to three doses** of Pneumovax 23® in your lifetime: up to two doses under age 65 and one dose at age 65 or older. The doses must be given at least five years apart.

Meningococcal Vaccines:

Patients without a spleen **need two types of meningococcal vaccine:**

- **Menactra**® (Generic name: meningococcal conjugate or MCV4) which protects against meningococcal strains A, C, Y and W
- **Bexsero®** (Generic name: Meningococcal Group B Vaccine or MenB-4c) which protects against meningococcal B strain

Menactra® - If no history of two previous doses, people without a spleen need an initial series of two doses of Menactra® given 8-12 weeks apart **and revaccination with Menactra® every 5 years thereafter**.

Bexsero® - People without a spleen need a series of two doses of Bexsero® given at least 4 weeks apart. If you have already had a complete series of meningococcal B vaccine you will not need to repeat this series.

Haemophilus influenzae b Vaccine (Hib)

People without a spleen need one dose of PedvaxHib® if no history of a previous dose.

Seasonal Influenza Vaccine

Annual flu vaccine is recommended for **every** patient without a spleen.

Additional vaccines

Your doctor may recommend additional vaccines as necessary.

Please note that the Centers for Disease Control (CDC) guidelines are subject to change. To find the most up-to-date version of the immunizations guidelines visit http://www.cdc.gov/vaccines/

Immunization Schedule for patients with an UNPLANNED splenectomy or splenic embolization:

Initial Start Date: **Date** _____	4 weeks from **Initial Start Date** **Due:** _____	8 weeks from **Initial Start Date** **Due:** _____	12 weeks from **Initial Start Date** **Due:** _____	5 years + 12 weeks **from Initial Start Date** **Due:** _____
• **Prevnar 13®** if no known history of a previous dose • **PedvaxHib®** if no known history of a previous dose of Hib • **Bexsero®** If no complete series of meningococcal B • **Influenza vaccine** (during flu season)	• **Bexsero® -** at least 4 weeks from first dose • **Menactra®-** at least 4 weeks after Prevnar 13® if no history of two previous doses	**Pneumovax 23® - Less than age 65: You will need one dose of Pneumovax 23 if you have had one or fewer doses** Age 65 and older: You will need one dose if you have not had one dose after age 65. Note: There must be at least 5 years between any Pneumovax 23 doses	• **Menactra®-** at least 8 weeks after first dose of Menactra, if you have not yet had a total of 2 or more doses	• **Menactra®** one dose every 5 years thereafter • **Pneumovax 23®** to equal two doses below the age of 65 plus one dose after age 65

Immunization Schedule for patients with a PLANNED splenectomy or splenic embolization:

- Ideally these vaccines are started at least two weeks before surgery.

Initial Start Date: **Date** _____	4 weeks from **Initial Start Date** **Due:** _____	8 weeks from **Initial Start Date** **Due:** _____	5 years + 8 weeks **from Initial Start Date** **Due:** _____
• **Prevnar 13®** if no known history of a previous dose • **Menactra®** if no history of two previous doses • **PedvaxHib®** if no known history of a previous dose of Hib • **Bexsero®** If no complete series of meningococcal B • **Influenza vaccine** (during flu season)	• **Bexsero®** - at least 4 weeks from first dose	• **Menactra®** - at least 8 weeks from first dose **Pneumovax 23® - Less than age 65: You will need one dose of Pneumovax 23 if you have had one or fewer doses** Age 65 and older: You will need one dose if you have not had one dose after age 65. • Note: There must be at least 5 years between any Pneumovax 23 doses	• **Menactra®** one dose every 5 years thereafter **Pneumovax 23®** to equal two doses below the age of 65 plus one dose after age 65

Additional Medication Information

1. **ED Section**
   - ED Propofol Use **[pg. 36]**
   - ED Med Pack **[pg. 36]**
   - Tranexamic Acid **[pg. 38]**
   - **0**Kcentra: 4-Factor PCC **[pg. 45]**
   - CroFab (Snakebite) **[pg. 46]**

2. **Trauma Section:**
   - Solumedrol in spinal cord injury **[pg. 61]**
   - Antihypertensive medications for Blunt Thoracic Aortic Injury **[pg. 72]**
   - Antibiotics for open fractures **[pg. 87]**

3. **ICU section:**
   - Prokinetics **[pg. 117]**
     - Erythromycin
     - Metoclopramide (Reglan)
   - Heparin-Induced Thrombocytopenia (HIT) treatment **[pg. 140]**
   - Hemopure **[pg. 146]**
   - Vasopressors **[pg. 150]**
   - Drugs commonly given by IV infusion in critical care **[pg. 101]**

4. **Burn Section:**
   - Oxandrolone Use in Adult Burns **[pg. 157]**
   - HAM **[pg. 181]**
   - Wound Care Products **[pg. 183]**
     - Silvadene (SSD) (Silver Sulfadiazine Cream)
     - Bacitracin (Bacitracin zinc or triple antibiotic ointment)
     - Xeroform Gauze (Bismuth & petroleum gauze)
     - Collagenase (Papain Urea Ointment)
     - Sulfamylon (Mafenide Acetate Cream)
     - Acticoat (Silver impregnated gauze)
     - Mepilex (Silver Impregnated foam)
     - Silverlon (Silver impregnated fabric)

5. **Scores/Scales Section:**
   - ACLS Algorithms/Drugs **[pg. 228]**

Extended References

Warfarin Anticoagulation and Reversal References

1. Baggs JH, Patanwala AE, Williams EM, Erstad BL. Dosing of 3-factor prothrombin complex concentrate for international normalized ratio reversal. Ann Pharmacother 2012;46:51-6.
2. Baker RI, Coughlin PB, Gallus AS, et al. Warfarin reversal: consensus guidelines, on behalf of the Australasian Society of Thrombosis and Haemostasis. Med J Aust. 2004;181(9):492-497.
3. Cartmill M, Dolan G, Byrne JL, Vyrne PO. Prothrombin complex concentrate for oral anticoagulant reversal in neurosurgical emergencies. Br J Neurosurg 200;14:458-61
4. Demeyere R, Gillardin S, Arnout J, et al. Comparison of fresh frozen plasma and prothrombin complex concentrate for reversal of oral anticoagulants in patients undergoing cardiopulmonary bypass surgery: a randomized study. Vox Sang 2010;99:251-60.
5. Desmettre T, Dubart AE, Capellier G, et al. Emergency reversal of anticoagulation: the real use of prothrombin complex concentrates. A prospective multicenter two year French study from 2006 to 2008. Thromb Res 2012;130(3):e178-83.
6. Deveras RE, Kessler GM. Reversal of warfarin-induced excessive anticoagulation with recombinant human factor VIIa concentrate. Ann Intern Med 2002;137:884-888.
7. Fredriksson K, Norrving B, Stromblad LG. Emergency reversal of anticoagulation after intracerebral hemorrhage. Stroke 1992;23:972-7.
8. Holland L, Warkentin TE, Refaai M, et al. Suboptimal effect of a three-factor prothrombin complex concentrate (Profilnine-SD) in correcting supratherapeutic international normalized ratio due to warfarin overdose. Transfusion 2009;49:1171-1177.
9. Lessinger CA, Blatt PM, Hoots WK, Ewenstein B. Role of prothrombin complex concentrates in reversing warfarin anticoagulation: a review of the literature. Am J Hematol 2008;83:137-143.
10. Majeed A, Eelde A, Agren A et al. Thromboembolic safety and efficacy of prothrombin complex concentrates in the emergency reversal of warfarin coagulopathy. Thromb Res 2012;129:146-151.
11. Morgenstern LB, Hemphill JC III, Anderson C, et al. Guidelines for the management of spontaneous intracerebral hemorrhage: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2010;41(9):2108-2129.
12. Pabinger I, Brenner B, Kalina U, et al. Prothrombin complex concentrate (Beriplex P/N) for emergency anticoagulation reversal: a prospective multinational clinical trial. J Thromb Haemost 2008;6:622-31.

13. Patanwala A, Acquisto N, Erstad B. Prothrombin Complex Concentrates for Critical Bleeding. Annals of Pharmacotherapy. 2011;45:990-9.
14. Switzer JA, Rocker J, Mohorn P et al. Clinical experience with three-factor prothrombin complex concentrate to reverse warfarin anticoagulation in intracranial hemorrhage. Stroke 2012;43:2500-2502.
15. Tran H, Collecutt M, Whitehead S, Salem HH. Prothrombin complex concentrates used alone in urgent reversal of warfarin anticoagulation. Intern Med J 2011;41(4):337-43.
16. Voils SA and Baird B. Systematic review: 3-factor versus 4-factor prothrombin complex concentrate for warfarin reversal: does it matter? Thromb Res 2012;130:833-840.

Dabigatran Anticoagulation and Reversal References

1. Eerenberg E., Kamphulsen P, Sijpkens M, et al. Reversal of Rivaroxaban and Dabigatran by Prothrombin Complex Concentrate. Circulation. 2011;124:1573-1579
2. Lambourne MD, Eltringham-Smith LJ, Gataiance DM et al. Prothrombin complex concentrates reduce blood loss in murine coagulopathy induced by warfarin, but not in that induced by dabigatran etexilate. J Thromb Haemost 2012;10:1830-40
3. Levi M, Eerenberg E, Kamphuisen PW. Bleeding risk and reversal strategies for old and new anticoagulants and antiplatelets. J Thromb Haemost 2010;9:1705-12
4. Marlu R, Hodaj E, Paris A, et al. Effect of non-specific reversal agents on anticoagulant activity of dabigatran and rivaroxaban. Thromb Haemost 2012;108:217-224
5. MIyares MA, Davis K. Newer oral anticoagulants: a review of laboratory monitoring options and reversal agents in the hemorrhagic patient. Am J Health-Syst Pharm. 2012;69:1473-84
6. Pradaxa (dabigatran etexelate) package insert and patient information, Boehringer Ingelheim Pharmaceuticals, Inc. Ridgefield, CT. December 2012.
7. Siegal DM, Cuker A. Reversal of novel oral anticoagulants in patients with major bleeding. J Thromb Thrombolysis 2013 Feb 7 [Epub ahead of print].
8. Van Ryn J, Stangier J, Haertter S, et al. Dabigatran etexilate – a novel, reversible, oral direct thrombin inhibitor: interpretation of coagulation assays and reversal of anticoagulant activity. Thromb Haemost 2010;103:1116-1127
9. Wolzt M, Leve M, Sarich T. Effect of recombinant factor VIIa on melagatran-induced inhibition of thrombin generation and platelet activation in healthy volunteers. Thromb Haemost 2004;91:1090-6.
10. Zhou W, Schwarting S, Illanes S, et al. Hemostatic Therapy in Experimental Intracerebral Hemorrhage Associated With the Direct Thrombin Inhibitor Dabigatran. Stroke 2011, 42:3594-3599.

Rivaroxaban Anticoagulation and Reversal References

1. Eerenberg E., Kamphulsen P, Sijpkens M, et al. Reversal of Rivaroxaban and Dabigatran by Prothrombin Complex Concentrate. Circulation. 2011;124:1573-1579

2. Food and Drug Administration. Advisory committee briefing book: rivaroxaban. www.fda.gov/downloads/AdvisoryCommittees/CommitteesMeetingMaterials/Drugs/CardiovascularandRenalDrugsAdvisoryCommittee/UCM138385.pdf (accessed 2013 Aug 6).

3. Godier A, Miclot A, Le Bonniec B, et al. Evaluation of prothrombin complex concentrate and recombinant activated factor VII to reverse rivaroxaban in a rabbit model. Anesthesiology 2012;116:94-102

4. Kubitza D, Beck M, Mueck W, et al. Effects of renal impairment on the pharmacokinetics, pharmacodynamics, and safety of rivaroxaban, an oral, direct Factor Xa inhibitor. Br J Clin Pharm 2010;70(5):703-712.

5. Kubitza D, Roth A, Becka M et al. Effect of hepatic impairment on the pharmacokinetics and pharmacodynamics of a single dose of rivaroxaban – an oral direct Factor Xa inhibitor. Br J Clin Pharmcol 2013 Jan 8 [Epub ahead of print]

6. Levi M, Eerenberg E, Kamphuisen PW. Bleeding risk and reversal strategies for old and new anticoagulants and antiplatelets. J Thromb Haemost 2010;9:1705-12

7. Marlu R, Hodaj E, Paris A, et al. Effect of non-specific reversal agents on anticoagulant activity of dabigatran and rivaroxaban. Thromb Haemost 2012;108:217-224

8. MIyares MA, Davis K. Newer oral anticoagulants: a review of laboratory monitoring options and reversal agents in the hemorrhagic patient. Am J Health-Syst Pharm. 2012;69:1473-84

9. Siegal DM, Cuker A. Reversal of novel oral anticoagulants in patients with major bleeding. J Thromb Thrombolysis 2013 Feb 7 [Epub ahead of print].

10. Xarelto (rivaroxaban) package insert and patient information, Janssen Pharmceuticals, Inc. Titusville, NJ, November 2012.

11. Zhou W, Zorn M, Nawroth P, et al. Hemostatic Therapy in Experimental Intracerebral Hemorrhage Associated With Rivaroxaban. Stroke 2013 Jan 22 [Epub ahead of print].

Apixaban Anticoagulation and Reversal References

1. Apixaban (Eliquis) package insert and patient information, Bristol-Meyers Squibb. Princeton, NJ, December 2012.
2. Graff J, Harder S. “Anticoagulant therapy with the oral direct factor Xa inhibitors rivaroxaban, apixaban and edoxaban and the thrombin inhibitor dabigatran etexilate in patients with hepatic impairment. Clin Pharmcokinet 2013 Apr;52(4):243-54
3. MIyares MA, Davis K. Newer oral anticoagulants: a review of laboratory monitoring options and reversal agents in the hemorrhagic patient. Am J Health-Syst Pharm. 2012;69:1473-84
4. Poulsen BK, Grove EL, and Husted SE. New oral anticoagulants. A review of the literature with particular emphasis on patients with impaired renal function. Drugs 2012;72(13):1739-1753
5. Siegal DM, Cuker A. Reversal of novel oral anticoagulants in patients with major bleeding. J Thromb Thrombolysis 2013 Feb 7 [Epub ahead of print].
6. Zhang D, Frost CE, He K, et al. Investigating the enteroenteric recirculation of apixaban, a factor Xa inhibitor: administration of activated charcoal to bile duct-cannulated rats and dogs receiving an intravenous dose and use of drug transporter knockout rats. Drug Metab Dispos. 2013 Apr;41(4):906-15

Fondaparinux Anticoagulation and Reversal References

1. Arixtra (Fondaparinux sodium) package insert. GlaxoSmithKline
2. Bijsterveld NR, Moons AH, Boekholdt SM, et al. Ability of recombinant factor VIIa to reverse the anticoagulant effect of the pentasaccharides fondaparinux in healthy volunteers. Circulation 2002; 106:2550-4.
3. Bijsterveld NR, Vink R, van Aken BE, et al. Recombinant factor VIIa reverses the anticoagulant effect of the long-acting pentasaccharide idraparinux in healthy volunteers. Br J Haematol 2004; 124:653-8.
4. Luporsi P, Chopard R, Janin S. Use of recombinant factor VII in 8 patients with ongoing life-threatening bleeding treated with fondaparinux. Acute Cardiac Care. June 2011;13(1-2):93-98.
5. Samama M, Guinet C. Laboratory assessment of new anticoagulants. Clin Chem Lab Med. 2011;49(5):761-772

Heparin/LMWH/Parenteral DTI Anticoagulation and Reversal References

1. Angiomax [package insert]. Parsippany, NJ: The Medicines Company; 201
2. Argatroban [package insert]. Research Triangle Park, NC: GlaxoSmithKline; 2012.
3. Bjornaas MA, Jacobsen EM, and Jacobsen D. Nonfatal self-poisoning with LMW heparin and the use of antidote. Thromb Res 2010; 126(5):e403-e405.
4. Heparin sodium injection [package insert]. Schaumburg, IL: Fresenius Kabi USA, LLC; 2013.
5. Levi M. Emergency Reversal of Antithrombotic Treatment. Intern Emerg Med (2009) 4:137–145.
6. Lovenox [package insert]. Bridgewater, NJ: Sanofi-Aventis; 2009.
7. Parenteral Anticoagulants. Chest 2008 Guidelines for Antithrombotic and Thrombolytic Therapy. CHEST 2008;133;141S-159S.
8. Protamine Sulfate [package insert]. Schaumburg, IL: AAP Pharmaceuticals, LLC; 2008.

PCC References

1. Kcentra (prothrombin complex concentrate [Human]) package insert. Available at: http://labeling.cslbehring.com/PI/US/Kcentra/EN/Kcentra-Prescribing-Information.pdf Accessed July 11, 2013.
2. Profilnine SD® (Factor IX Complex). Los Angeles, CA: Grifols Biologicals Inc.; 2011.
3. Feiba NF® (Factor IX Complex). Deerfield, IL: Baxter Healthcare Corporation.; 2011.
4. Levi M, Moore KT, Castillejos CF, et al. Comparison of three-factor and four-factor prothrombin complex concentrates regarding reversal of the anticoagulant effects of rivaroxaban in healthy volunteers. J Thromb Haemost 2014;12(9):1428-36.
5. Eerenberg ES, Kamphuisen PW, Sijpkens MK, et al. Reversal of rivaroxaban and dabigatran by prothrombin complex concentrate. Circulation 2011;124:1573-79.
6. Marlu R, Hodaj E, Paris A, et al. Effect of non-specific reversal agents on anticoagulant activity of dabigatran and rivaroxaban. J Thromb Haemost 2012;108:217-224.
7. Babilonia K and Trujillo T. The role of prothrombin complex concentrates in reversal of target specific anticoagulants. Thromb J. 2014;12:8. doi: 10.1186/1477-9560-12-8. eCollection 2014.

Authors: Anticoagulation Subcommittee
Approved: Anticoagulation Subcommittee (1/7/13, 3/14/13, 5/6/13, 8/5/13, 11/10/14) P&T Committee (2/19/13, 8/20/13, 12/16/14)

Factor VIIA References

1. Product Information: NovoSeven®, Recombinant factor VII. NovoNordisk Pharmaceuticals, Inc., Princeton, NJ 2004.
2. Mayo A, et al. Recombinant activated factor VII (NovoSeven®): addition to replacement therapy in acute, uncontrolled and life-threatening bleeding. Vox Sanguinis 2004;87:34-40.
3. UHC. Evidence and Consensus-based recommendations for the use of recombinant activated factor VII (rVIIa) therapy. Washington DC, 2004.
4. Dutton RP, et al. Factor VIIa for correction of traumatic coagulopathy. J Tauma 2004;57:709-19.
5. Mayer SA, et al. Recombinant activated factor VII for acute intracerebral hemorrhage. N Engl J Med 2005;352:777-85.
6. Park P, et al. Recombinant activated factor VII for rapid correction of coagulopathy in nonhemophilic neurosurgical patients. Neurosurg 2003;53:34-9.
7. Kaw LL, et al. The use of recombinant factor VIIa for severe intractable bleeding during spine surgery. Spine 2004;29:1384-88.
8. Price G, Skowronski G. Use of recombinant factor VIIa to treat life-threatening non-surgical bleeding in a post-partum patient. Br J Anaesth 2004;93:298-300.
9. Weilbach C, et al. Excessive blood loss after abdominal hysterectomy – use of recombinant factor VIIa.
10. Anasthesiol Intensivmed Notfallmed Schmerzther 2004;39:672-5.
11. Bouwmeester FW, et al. Successful treatment of life-threatening postpartum hemorrhage with recombinant activated factor VII. Obstet Gynecol 2003;101:1174-6.
12. Caldwell SH, Chang C, Macik BG. Recombinant activated factor (rFVIIa) as a hemostatic agent in liver disease: a break from convention in need of controlled trials. Hepatology 2004;39: 542-98.

Warfarin Use and INR Goals References

1. O'Gara, P. 2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction: A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation* 2013;127:e362-e425.
2. You, J. Antithrombotic Therapy for Atrial Fibrillation. Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *CHEST*. 2012;141:e531S-e575S.
3. Holbrook, A. Evidence-Based Management of Anticoagulant Therapy. Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *CHEST* 2012;141:e152S-e184S.
4. Kearon, C. Antithrombotic Therapy for VTE Disease. Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *CHEST* 2012;141:e419S-e496S.
5. Badesh, D. Medical Therapy For Pulmonary Arterial Hypertension: ACCP Evidence-Based Clinical Practice Guidelines. *CHEST* 2004;126:35S-62S.
6. Whitlock, R. Antithrombotic and Thrombolytic Therapy for Valvular Disease, 9th ed. American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *CHEST* 2012;141:e576S-e600S.

Authors: Anticoagulation Subcommittee
Approved: Anticoagulation Subcommittee (2/2/2014)
P&T Committee (7/15/2014)

Dabigatran Use and Guideline References

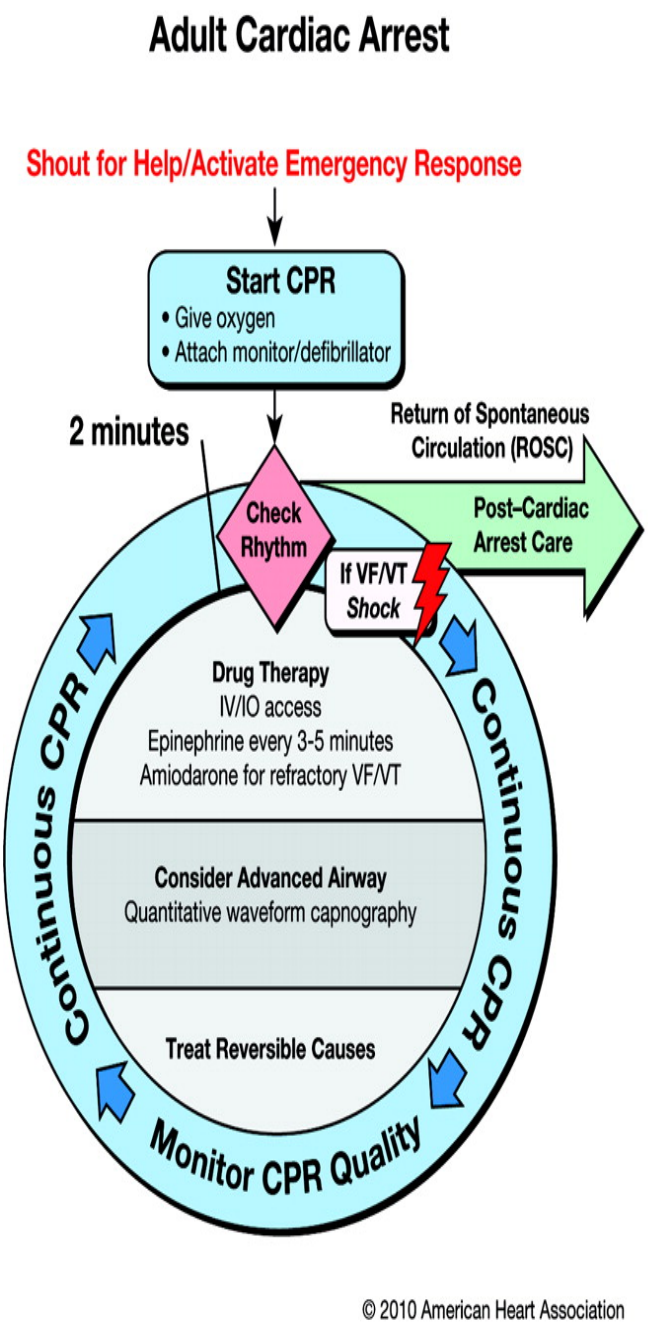
1. Pradaxa [package insert]. Ridgefield, CT: Boehringer Ingelheim Pharmaceuticals, Inc.; 2014 November.
2. Dabigatran versus warfarin in the treatment of acute venous thromboembolism.N Engl J Med 2009;361:2342-52 (http://bidocs.boehringer-ingelheim.com/BIWebAccess/ViewServlet.ser?docBase=renetnt&folderPath=/Prescribing%20Information/PIs/Pradaxa/Pradaxa.pdf)
3. Dabigatran extexilate – a novel reversible, oral direct thrombin inhibitor: Interpretation of coagulation assays and reversal of anticoagulant activity. Thromb Haemost 2010; 103:1116 -1127
4. van Ryn J, Sieger P, Kink-Eiband M, et al. Adsorption of dabigatran etexilate in water or dabigatran in pooled human plasma by activated charcoal in vitro [Abstract no. 1065]. In: *51st ASH Annual Meeting and Exposition* [website]. New Orleans (LA): American Society of Hematology; 2009. Available at: http://ash.confex.com/ash/2009/webprogram/Paper21383.html (Accessed 2010 Dec 10)

Authors: Anticoagulation Subcommittee
Approved: Anticoagulation Subcommittee (01/10/2011)

Clostidrium Dificile References

1. Clinical Practice Guidelines for Clostridium difficile Infection in Adults: 2010 Update by the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA). Available at: http://www.idsociety.org/uploadedFiles/IDSA/Guidelines-Patient_Care/PDF_Library/cdiff2010a.pdf
2. A Comparison of Vancomycin and Metronidazole for the Treatment of Clostridium difficile–Associated Diarrhea, Stratified by Disease Severity. Available at: http://cid.oxfordjournals.org/content/45/3/302.full.pdf+html
3. European Society of Clinical Microbiology and Infectious Diseases: update of the treatment guidance document for Clostridium difficile infection. Available at: http://onlinelibrary.wiley.com/doi/10.1111/1469-0691.12418/pdf

Adult Cardiac Arrest



CPR Quality
- Push hard (≥2 inches [5 cm]) and fast (≥100/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
- If no advanced airway, 30:2 compression-ventilation ratio
- Quantitative waveform capnography
  - If P_{ETCO_2} <10 mm Hg, attempt to improve CPR quality
- Intra-arterial pressure
  - If relaxation phase (diastolic) pressure <20 mm Hg, attempt to improve CPR quality

Return of Spontaneous Circulation (ROSC)
- Pulse and blood pressure
- Abrupt sustained increase in P_{ETCO_2} (typically ≥40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

Shock Energy
- **Biphasic:** Manufacturer recommendation (120-200 J); if unknown, use maximum available. Second and subsequent doses should be equivalent, and higher doses may be considered.
- **Monophasic:** 360 J

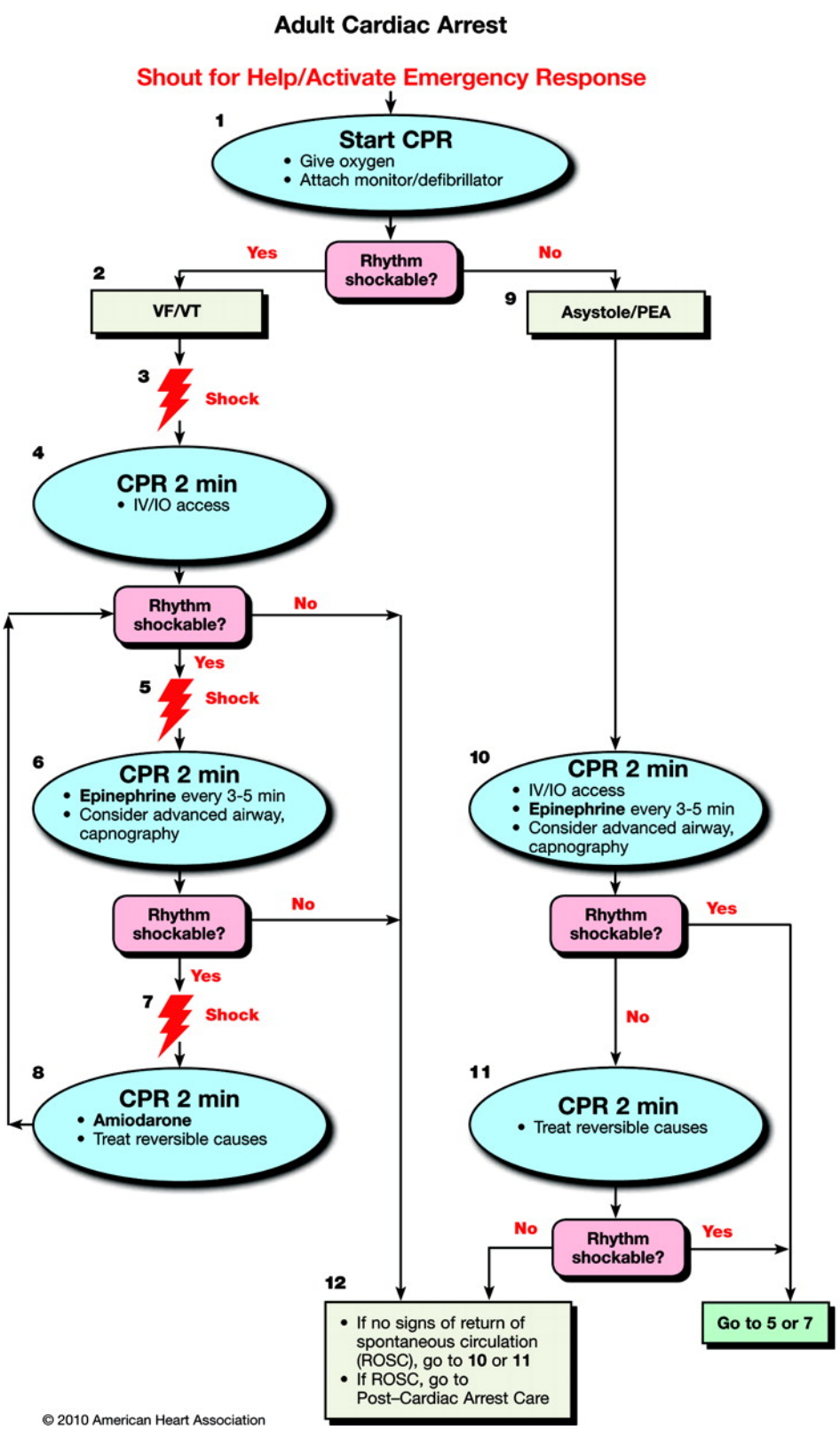
Drug Therapy
- **Epinephrine IV/IO Dose:** 1 mg every 3-5 minutes
- **Vasopressin IV/IO Dose:** 40 units can replace first or second dose of epinephrine
- **Amiodarone IV/IO Dose:** First dose: 300 mg bolus. Second dose: 150 mg.

Advanced Airway
- Supraglottic advanced airway or endotracheal intubation
- Waveform capnography to confirm and monitor ET tube placement
- 8-10 breaths per minute with continuous chest compressions

Reversible Causes

– Hypovolemia	– Tension pneumothorax
– Hypoxia	– Tamponade, cardiac
– Hydrogen ion (acidosis)	– Toxins
– Hypo-/hyperkalemia	– Thrombosis, pulmonary
– Hypothermia	– Thrombosis, coronary

Adult Cardiac Arrest



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- Push hard (≥2 inches [5 cm]) and fast (≥100/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
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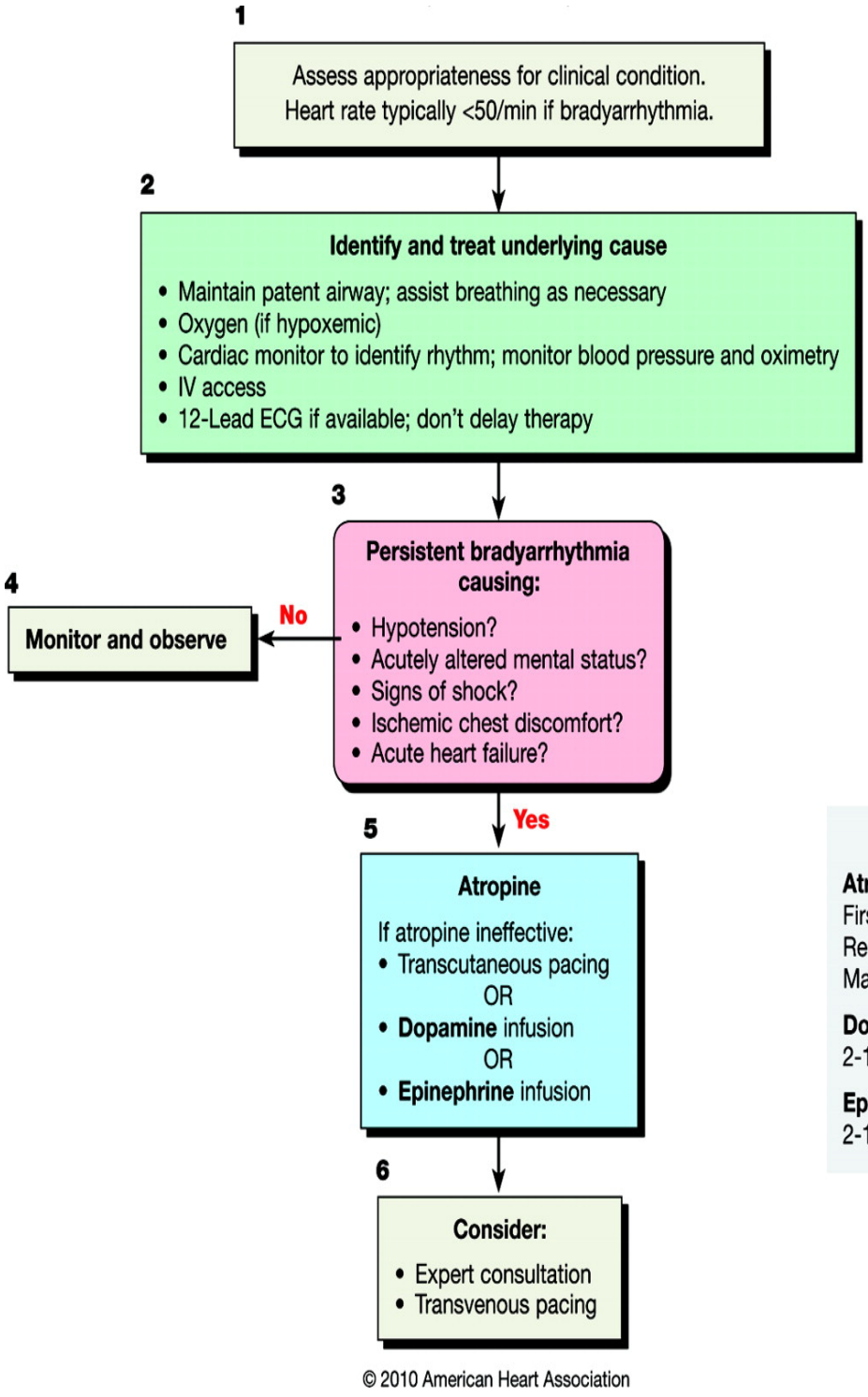
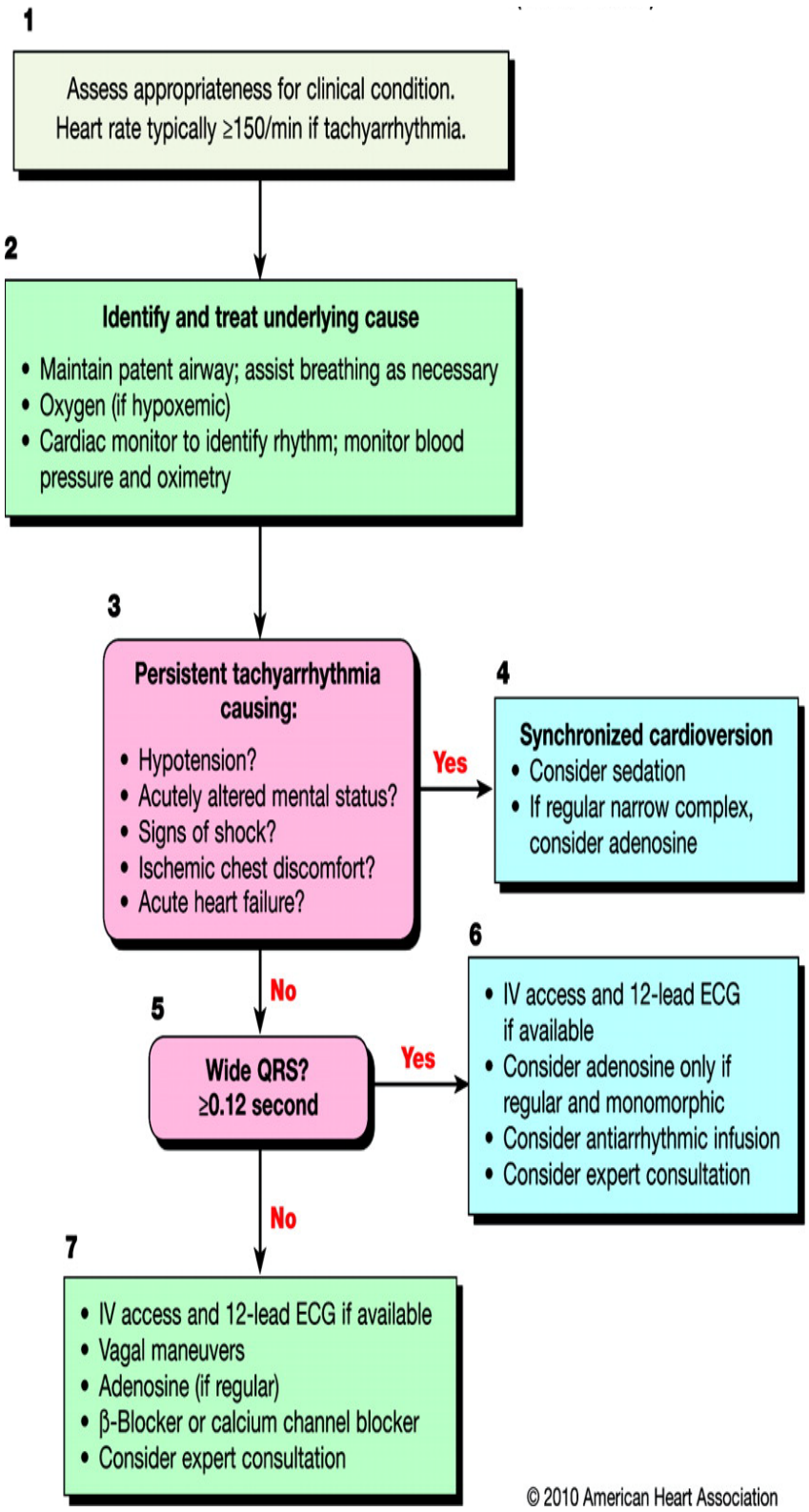
- Waveform capnography to confirm and monitor ET tube placement
- 8-10 breaths per minute with continuous chest compressions

Reversible Causes
- **H**ypovolemia
- **H**ypoxia
- **H**ydrogen ion (acidosis)
- **H**ypo-/hyperkalemia
- **H**ypothermia
- **T**ension pneumothorax
- **T**amponade, cardiac
- **T**oxins
- **T**hrombosis, pulmonary
- **T**hrombosis, coronary

Adult Bradycardia with Pulse



Adult Tachycardia with Pulse



Doses/Details

Synchronized Cardioversion
Initial recommended doses:
- Narrow regular: 50-100 J
- Narrow irregular: 120-200 J biphasic or 200 J monophasic
- Wide regular: 100 J
- Wide irregular: defibrillation dose (NOT synchronized)

Adenosine IV Dose:
First dose: 6 mg rapid IV push; follow with NS flush.
Second dose: 12 mg if required.

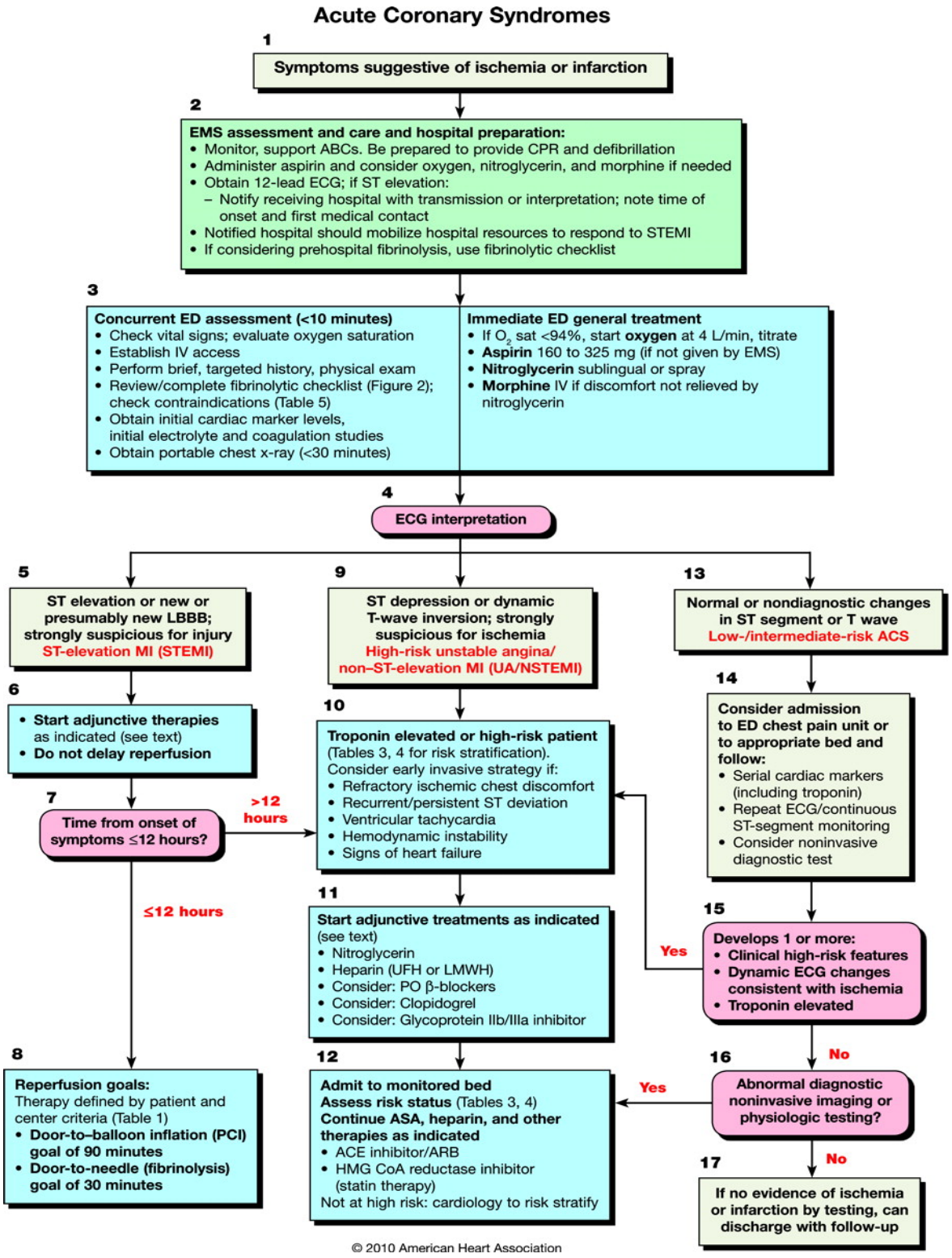
Antiarrhythmic Infusions for Stable Wide-QRS Tachycardia

Procainamide IV Dose:
20-50 mg/min until arrhythmia suppressed, hypotension ensues, QRS duration increases >50%, or maximum dose 17 mg/kg given. Maintenance infusion: 1-4 mg/min. Avoid if prolonged QT or CHF.

Amiodarone IV Dose:
First dose: 150 mg over 10 minutes. Repeat as needed if VT recurs. Follow by maintenance infusion of 1 mg/min for first 6 hours.

Sotalol IV Dose:
100 mg (1.5 mg/kg) over 5 minutes. Avoid if prolonged QT.

Acute Coronary Syndrome



Rancho Los Amigos Cognitive Scale

Level I: No response to pain, touch, sound, or sight.

Level II: Generalized reflex response to pain.

Level III: Localized response. Blinks to strong light, turns toward/away from sound, responds to physical discomfort, inconsistent response to commands.

Level IV: Confused – agitated. Alert, very active, aggressive or bizarre behaviors, performs motor activities, but behavior is non-purposeful, extremely short attention span.

Level V: Confused – non-agitated. Gross attention to environment, highly distractible, requires continual redirection, difficulty learning new tasks, agitated by too much stimulation. May engage in social conversation but with inappropriate verbalizations.

Level VI: Confused – appropriate. Inconsistent orientation to time and place, retentions span/recent memory impaired, begins to recall past, consistently follows simple directions, goal-directed behavior with assistance.

Level VIII: Purposeful- appropriate.

Trauma Scoring Systems

Multiple trauma scoring systems have been promulgated over the years. These scores were developed for trauma triage and others used to evaluate and predict outcomes: Revised Trauma Score (1989) uses the initial respiratory rate, systolic blood pressure and GCS of the patient. The score has good inter-rater reliability. The higher the score the higher the probability of survival. The scores range from 0-7.8.

Injury Severity Score (1974) is based on an abbreviated injury score (AIS). Each injury is assigned an AIS score, ranging from 1 (minor) to 6 (lethal). The highest AIS within each of six body regions- head/neck, face, thorax, abdominal/pelvic contents, extremities, external structures- are identified. The ISS = the sum of the square of the three highest of these scores. Scores range from 0-75; any AIS of 6 automatically results in ISS= 75. It does not consider age of physiologic status, and may misrepresent injury severity when injuries are confined to a single body region (e.g. in penetrating trauma). Below is an example of an ISS calculation:

ISS Body Region	Injury	AIS Code	Highest AIS	AIS2
Head Neck:	Cerebral contusion	140604.3	4	16
	ICA: complete	320212.4		
	transection	210600.1	1	
Face:	Ear laceration	450220.2	2	
Chest:	Rib fractures			
	Left side, ribs 3-4	543800.3	3	9
Abdominal:	Retroperitoneal	851800.3	3	9
	hematoma	910200.1	1	
Extremities:	Fractured femur			
External:	Overall abrasions			ISS=34

NISS (New Injury Severity Score) considers the three highest AIS scores, irrespective of body region. This improves its predictive power for penetrating injury.

The TRISS method is logistic regression equation based on the Revised Trauma Score, ISS and age. It allows for the difference between blunt and penetrating injury.

The ASCOT- a severity and characterization of trauma score- is very similar to the TRISS method in that is uses the components of the Revised Trauma Score but in a separated manner of Glasgow Coma Scale, systolic blood pressure and respiratory rate and also uses a different scoring system for injury to the different body regions, analogous to the ISS, and also includes age. Predicted outcome is also based on logistical regression analysis.

The APACHE II (Acute Physiology and Chronic Health Evaluation) - is a predictor of mortality derived from a logistic equation utilized both acute and chronic conditions. The acute physiology score includes 12 data points: temperature, mean arterial blood pressure, heart rate, respiratory rate, paO2, pH, sodium, potassium, creatinine, hematocrit, white count and Glasgow Coma Score (the acute score ranges from 0-72). The chronic score accounts for respiratory failure (asthma, COPD, aspiration), heart failure (valvular dx, CHF, CAD), liver failure, immunosuppression, age and operative status (elective, emergent, non-operative)

For further details: www.trauma.org/scores/index.html
For APACHEII calculation: http://www.sfar.org/scores2/apache22.html

Trauma Scoring Systems (cont'd)

	1 (Minor)	2 (Moderate)	3 (Serious)	4 (Severe)	5 (Critical)	6 (Unsurvivable)
Head/Neck	Superficial Scalp lac	LOC: GCS 15	Cspine fx Lac with blood loss>20% CHI-GCS 9-14 ICA: Intimal flap	DAI with GCS <8 ICA: intimal flap with neurologic deficit	Cord contusions with paraplegia/quadriplegia or neurogenic shock Brain stem- DAI Penetrating injury	Decapitation
Face	Cornea abrasion Mandible fx-subcondylar	Deep tongue lac Zygoma fx T-spine fx	Maxilla fx- Lefort III	Lefort III w/ 20% blood loss		
Chest	Chest Wall contusion	Rib fxs Brachial plexus injury	>3 rib fx or hemo/pneumothorax Bronchus perforation Pulmonary contusion	Diaphragm rupture w/ herniation Myocardial contusion with shock	Aorta transection Tension Pneumothorax	Aortic transection-ruptured
Abdomen	Abdominal wall contusion	Spleen-subcapsular hematoma<50%	Iliac artery lac Bladder perforation Colon perforation	Liver- deep lac Parenchymal disruption< 75% of hepatic lobe	Kidney-hilum Avulsion Liver>75% destruction of lobe	Hepatic avulsion
Extremities Pelvis	Skin/SQ/Muscle Laceration	Brachial a-lac Radius fx-closed Scapula fx Degloving injury Brachial plexus injury	Humerus fx Femoral a.-lac Crushed/mangled extremity	Pelvis fx- substantial deformation and displacement	Pelvic fx w/ shock	
External	Burn <10% TBSA	High Voltage electrical injury with muscle necrosis	Burn 20-29%-TBSA Inhalation injury	Burns 30-40% TBSA	Burn 40-89% TBSA	Burn- > 90% TBSA

Glasgow Coma Scale & TBI

Mild TBI: GCS 13-15
Moderate TBI: GCS 9-12
Severe TBI: GCS 3-8

Category		Best Response
Eye Opening		
Spontaneous		4
To Speech		3
To Pain		2
None		1
Verbal	(Modified for Infants)	
Oriented	*Babbles*	5
Confused	*Irritable*	4
Inappropriate Words	*Cries to Pain*	3
Moans	*Moans*	2
None	*None*	1
Motor		
Follows Commands		6
Localizes to Pain		5
Withdraws to Pain		4
Abnormal Flexion		3
Abnormal Extension		2
None		1
GCS		
Best Possible Score		15
Worst Possible Score		3
Tracheally intubated: verbal score is designated with a “T”		
Best Possible Score While Intubated		10T
Worst Possible Score While Intubated		3T

Mangled Extremity Severity Score (MESS)

Type	Characteristics	Injury	Points
1	Low energy	stab wound, simple closed fx, small-caliber GSW	1
2	Medium energy	Open/multilevel fx, dislocation, moderate crush	2
3	High energy	shotgun, high-velocity GSW	3
4	Massive crush	Logging, railroad, oil rig accidents	4
Shock Group			
1	Normotensive	BP stable	0
2	Transiently hypotensive	BP unstable in field but responsive to fliud	1
3	Prolonged hypotension	SBP <90mmHg in field and responsive to IV fluids in OR	2
Ischemia Group			
1	None	Pulsatile, no signs of ischemia	1
2	Mild	Diminished pulses without signs of ischemia	2
3	Moderate	No dopplerable pulse, sluggish cap refill, paresthesia, diminished motor activity	3
4	Advanced	Pulseless, cool, paralyzed, numb without cap refill	4
Age Group			
1	<30y/o		0
2	>30 <50		1

MESS score: six or less consistent with a salvageable limb. Seven or greater amputation generally the eventual result.

From Helfet DL, Clin Orthop 1990 256:80

The Multiple Organ Dysfunction Score (MODS)

Organ System	Score points				
	0	1	2	3	4
Respiratory (PaO_2/FiO_2)	> 300	226-300	151-225	76-150	≤ 75
Renal (Serum Creatinine) (µmol/l)	≤ 100	101-200	201-350	351-500	> 500
Hepatic (Serum Bilirubin) (µmol/l)	≤ 20	21-60	61-120	121-240	> 240
Cardiovascular (PAR) (HRxCVP/MAD)	≤ 10.0	10.1-15.0	15.1-20.0	20.1-30.0	> 30
Hematologic (Platelet count) (ml x 10^3)	> 120	81-120	51-80	21-50	≤ 20
Neurologic (Glasgow Coma Scale)	15	13-14	10-12	7-9	≤ 6

The pressure adjusted heart rate (PAR) is calculated as the product of heart rate (HR) multiplied by the ratio of the central venous pressure (CVP) to the mean arterial pressure (MAD).The Glasgow Coma Scale is preferably calculated by the patients nurse, and is scored conservatively (for a patient receiving sedation or muscle relaxants, normal function is assumed, unless there is evidence of intrinsically altered mentation).
(From: Marshall JC, Cook DJ, Christou NV, Bernard GR, Sprung CL, Sibbald WJ. Multiple organ dysfunction score: a reliable descriptor of a complex clinical outcome. Crit Care Med 1995;23(10):1638-52)

Table 1. Physiologic (*Revised Trauma Score*, RTS) And Anatomic (*Injury Severity Score*, ISS) Trauma Scoring Systems.

Revised Trauma Score

Glasgow Coma Scale (GCS)	Systolic Blood Pressure (SBP)	Respiratory Rate (RR)	Coded Value
13-15	> 89	10-29	**4**
9-12	76-89	> 29	**3**
6-8	50-75	6-9	**2**
4-5	1-49	1-5	**1**
3	0	0	**0**

Revised Trauma Score (RTS) for field use = Summed points for each of the 3 systems (GCS, SBP, RR) added, with resultant range 0-12; useful for triage purposes
Calculated Revised Trauma Score (RTSc) for improved outcome prediction (by weighting head injury) = 0.9368 GCS + 0.7326 SBP + 0.2908 RR

Injury Severity Score

Body Region	Type of Injury	AIS*	Square of the Top 3 AIS Scores*
Head/Neck	Brain contusion	3	9
Face	None	0	
Chest	Hemothorax	3	16
	Pericardial injury	4	
Abdomen	Minor splenic contusion	2	25
	Complex hepatic rupture	5	
Extremeties	Femur fracture	3	
External	None	0	
		Injury Severity Score:	**50**

*AIS indicates Abbreviated Injury Scale score.
#If an injury is assigned AIS 6 (unsurvivable injury), the ISS is automatically assigned to 75.

Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) Score. A LRINEC Score of ≥6 was found to have a positive predictive value of 92% and a negative predictive value of 96%.Wong CH, Khin LW, Heng KS, Tan KC, Low CO. The LRINEC (Laboratory Risk Indicator for Necrotizing Fasciitis) score: a tool for distinguishing necrotizing fasciitis from other soft tissue infections. Crit Care Med. 2004; 32(7):1535-1541.

Table 2

The Laboratory Risk Indicator for Necrotizing Fasciitis Scoring System[16]

Variable	Value	Score
White blood cell count, per mm^3	<15	0
	15-25	1
	>25	2
Hemoglobin, g/dL	>13.5	0
	11-13.5	1
	<11	2
C-reactive protein, mg/L	<150	0
	⩾150	4
Sodium, mmol/L	⩾135	0
	<135	2
Creatinine, μmol/L	⩽141	0
	>141	2
Glucose, mmol/L	⩽10	0
	>10	1

FLACC Score

Categories	Scoring		
Face	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
Legs	Normal position or relaxed	Uneasy, restless, tense	Kicking, or legs drawn up
Activity	Lying quietly, normal position moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
Cry	No cry, (awake or asleep)	Moans or whimpers; occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching hugging or being talked to, distractable	Difficulty to console or comfort

The Ramsay Sedation Scale

Score	Description
1	Patient is anxious and agitated or restless, or both
2	Patient is co-operative, oriented, and tranquil
3	Patient responds to commands only
4	Patient exhibits brisk response to light glabellar tap or loud auditory stimulus
5	Patient exhibits a sluggish response to light glabellar tap or loud auditory stimulus
6	Patient exhibits no response

Ramsay MA, Savege TM, Simpson BR, Goodwin R. Controlled sedation with alphaxolone-alphadalone. BMJ. 1974;2:656-659.

Caprini Score

Choose All That Apply

Each Risk Factor Represents 1 Point

- ❑ Age 41-60 years
- ❑ Minor surgery planned
- ❑ History of prior major surgery (< 1 month)
- ❑ Varicose veins
- ❑ History of inflammatory bowel disease
- ❑ Swollen legs (current)
- ❑ Obesity (BMI > 25)
- ❑ Acute myocardial infarction
- ❑ Congestive heart failure (< 1 month)
- ❑ Sepsis (< 1 month)
- ❑ Serious lung disease incl. pneumonia (< 1 month)
- ❑ Abnormal pulmonary function (COPD)
- ❑ Medical patient currently at bed rest
- ❑ Other risk factors_____

Each Risk Factor Represents 2 Points

- ❑ Age 60-74 years
- ❑ Arthroscopic surgery
- ❑ Malignancy (present or previous)
- ❑ Major surgery (> 45 minutes)
- ❑ Laparoscopic surgery (> 45 minutes)
- ❑ Patient confined to bed (> 72 hours)
- ❑ Immobilizing plaster cast (< 1 month)
- ❑ Central venous access

Each Risk Factor Represents 3 Points

- ❑ Age over 75 years
- ❑ History of DVT/PE
- ❑ **Family history of thrombosis***
- ❑ Positive Factor V Leiden
- ❑ Positive Prothrombin 20210A
- ❑ Elevated serum homocysteine
- ❑ Positive lupus anticoagulant
- ❑ Elevated anticardiolipin antibodies
- ❑ Heparin-induced thrombocytopenia (HIT)
- ❑ Other congenital or acquired thrombophilia

If yes:

Type_____

***most frequently missed risk factor**

Each Risk Factor Represents 5 Points

- ❑ Elective major lower extremity arthroplasty
- ❑ Hip, pelvis or leg fracture (< 1 month)
- ❑ Stroke (< 1 month)
- ❑ Multiple trauma (< 1 month)
- ❑ Acute spinal cord injury (paralysis)(< 1 month)

For Women Only (Each Represents 1 Point)

- ❑ Oral contraceptives or hormone replacement therapy
- ❑ Pregnancy or postpartum (<1 month)
- ❑ History of unexplained stillborn infant, recurrent spontaneous abortion (≥ 3), premature birth with toxemia or growth-restricted infant

Total Risk Factor Score ☐

http://www.covidien.com/imageServer.aspx/doc245285.pdf?contentID=31695&contenttype=application/pdf

CAM-ICU Worksheet

Feature 1: Acute Onset or Fluctuating Course Positive if you answer 'yes' to either 1A or 1B.	**Positive**	**Negative**
1A: Is the pt different than his/her baseline mental status? Or **1B:** Has the patient had any fluctuation in mental status in the past 24 hours as evidenced by fluctuation on a sedation scale (e.g. RASS), GCS, or previous delirium assessment?	**Yes**	**No**
Feature 2: Inattention Positive if either score for 2A or 2B is less than 8. Attempt the ASE letters first. If pt is able to perform this test and the score is clear, record this score and move to Feature 3. If pt is unable to perform this test or the score is unclear, then perform the ASE Pictures. If you perform both tests, use the ASE Pictures' results to score the Feature.	**Positive**	**Negative**
2A: ASE Letters: record score (enter NT for not tested) Directions: Say to the patient, *"I am going to read you a series of 10 letters. Whenever you hear the letter 'A,' indicate by squeezing my hand."* Read letters from the following letter list in a normal tone. **S A V E A H A A R T** Scoring: Errors are counted when patient fails to squeeze on the letter "A" and when the patient squeezes on any letter other than "A."	**Score (out of 10):**	
2B: ASE Pictures: record score (enter NT for not tested) Directions are included on the picture packets.	**Score (out of 10):**	
Feature 3:Disorganized Thinking Positive if the combined score is less than 4	**Positive**	**Negative**
3A: Yes/No Questions (Use either Set A or Set B, alternate on consecutive days necessary)**:** **Set A** 1. Will a stone float on water? 2. Are there fish in the sea? 3. Does one pound weigh more than pounds? 4. Can you use a hammer to pound a nail? **Set B** 1. Will a leaf float on water? 2. Are there elephants in the sea? 3. Do two pounds weigh two more than one pound? 4. Can you use a hammer to cut wood? **Score ___**(Patient earns 1 point for each correct answer out of 4) **3B:Command** Say to patient: "Hold up this many fingers" (Examiner holds two fingers in front of patient) "Now do the same thing with the other hand" (Not repeating the number of fingers). *If pt is unable to move both arms, for the second part of the command ask patient "Add one more finger) **Score**___(Patient earns 1 point if able to successfully complete the entire command)	**Combined Score (3A+3B): ___(out of 5)**	
Feature 4: Altered Level of Consciousness Positive if the Actual RASS score is anything other than "0" (zero)	**Positive**	**Negative**
Overall CAM-ICU (Features 1 and 2 and either Feature 3 or 4):	**Positive**	**Negative**

The Richmond Agitation and Sedation Scale: The RASS*

Score	Description
+4	Combative - Overtly combative, violent, immediate danger to staff
+3	Very agitated - Pulls or removes tube(s) or catheter(s); aggressive
+2	Agitated - Frequent non-purposeful movement, fights ventilator
+1	Restless - Anxious but movements not aggressive vigorous
0	Alert and calm
-1	Drowsy - Not fully alert, but has sustained awakening (eye-opening/eye contact) to *voice* **(>10 seconds)**
-2	Light sedation - Briefly awakens with eye contact to *voice* **(<10 seconds)**
-3	Moderate sedation - Movement or eye opening to *voice* **(but no eye contact)**
-4	Deep sedation No response to voice, but movement or eye opening to *physical* stimulation
-5	Unarousable - No response to *voice or physical* stimulation

Procedure for RASS Assessment

1. Observe patient

a. Patient is alert, restless, or agitated. **(score 0 to +4)**

2. If not alert, state patient's name and *say* to open eyes and look at speaker.

a. Patient awakens with sustained eye opening and eye contact. **(score –1)**

b. Patient awakens with eye opening and eye contact, but not sustained. **(score –2)**

c. Patient has any movement in response to voice but no eye contact. **(score –3)**

3. When no response to verbal stimulation, physically stimulate patient by shaking shoulder and/or rubbing sternum.

a. Patient has any movement to physical stimulation. **(score –4)**

b. Patient has no response to any stimulation. **(score –5)**

If RASS is -4 or -5, then **Stop** and **Reassess** patient at later time

If RASS is above - 4 (-3 through +4) then **Proceed to Step 2**

*Sessler, et al. AJRCCM 2002; 166:1338-1344.
Ely, et al. JAMA 2003; 289:2983-2991.