

Nonoperative management of complex splenic injuries

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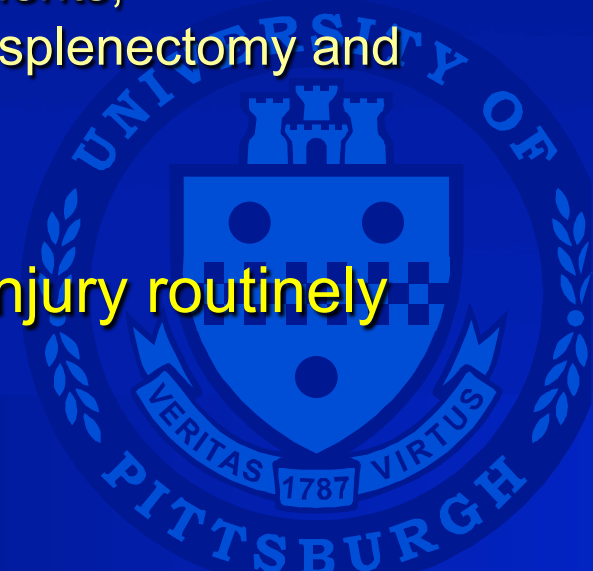
Key principles with splenic injury

- Hemodynamically unstable patients require immediate laparotomy. Generally, splenectomy is the best treatment.
- Nonoperative management is an option in the hemodynamically stable patient ONLY.
- Splenorrhaphy is an option in the stable pt with low ISS
- **No patient should die as a consequence of nonoperative management of a splenic injury**



Change in the approach to splenic injury: previous dogma

- the spleen has no purpose
 - Cellular and humoral immunity, IgM production
 - Opsonization of bacteria, tuftsin production, immune response to bloodborne antigens, hematopoiesis
- splenectomy has no consequences
 - Morris and Bullock, 1919; King and Shumacker, 1951
 - Singer, 1973, reviewed 2795 asplenic patients; incidence of OPSI related to indication for splenectomy and age at splenectomy
- the spleen cannot heal
- nonoperative management of splenic injury routinely results in bleeding at some point

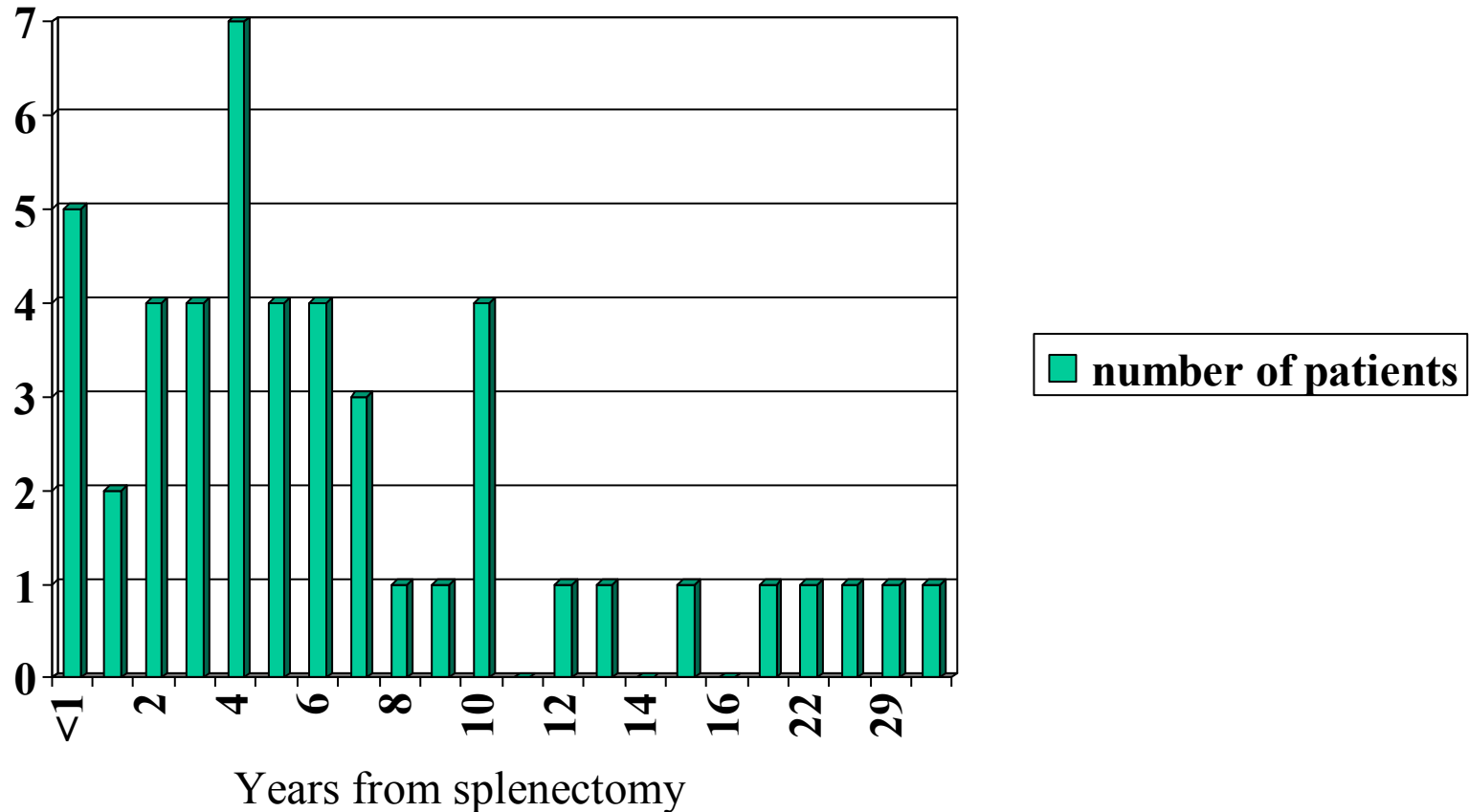


Immunologic consequences of splenectomy: OPSI

- Lifelong risk for Overwhelming Postsplenectomy infection (OPSI)
 - Caused by pneumococcus, meningococcus, *Haemophilus influenzae*, meningococcus and gram negative bacteria
 - Initial Symptoms: fever, chills, muscle aches, headache, vomiting, diarrhea, and abdominal pain
 - Progressive symptoms: bacteremic septic shock, extremity gangrene, convulsions, and coma
 - **Mortality rate of 50-80%**
 - ♦ **from onset of initial symptoms, 68% of those deaths occur within 24 hours and 80% occur within 48 hours**
 - Prevention: routine vaccinations and prophylactic antibiotics



Interval from splenectomy for trauma to infectious episode in 47 adults



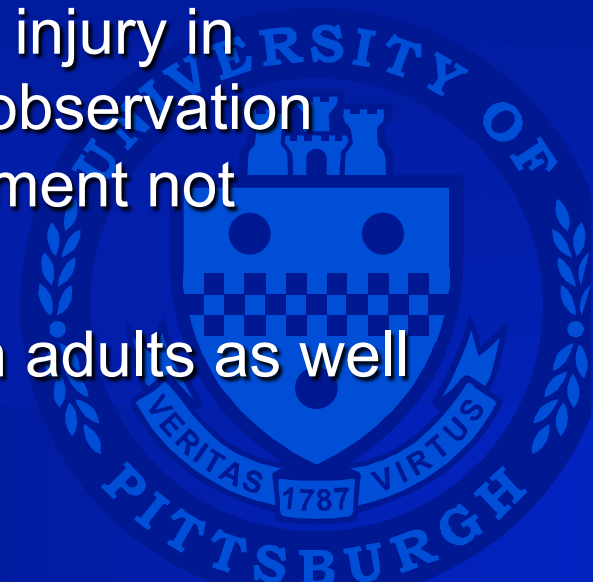
How can we preserve the spleen?

- Nonoperative management (observation)
- Splenorrhaphy



Evolution of management of blunt splenic injury

- Routine nonoperative management- very high mortality
- 1920s--Routine splenectomy for all splenic injuries: stops the bleeding, low mortality
- **1980s**—splenic preservation by splenorrhaphy
 - Splenorrhaphy vs splenectomy
- **1990s**—routine observation of splenic injury in children with good results. Criteria for observation and outcome of nonoperative management not defined in adults
- **2000s**— Observation of splenic injury in adults as well



A four-year experience with splenectomy versus splenorrhaphy.

(Feliciano et al Ann Surg 201: 569, 1985)

- 326 pts, 51% penetrating
- 60% grade 3,4 5
- 55% splenectomy, 45% splenorrhaphy
- Splenorrhaphy: grades 1,2 (88%), grade 3(61%), grades 4,5 (8%)
- Multiple injuries → splenectomy
- Mortality for splenectomy 13 x higher than splenorrhaphy

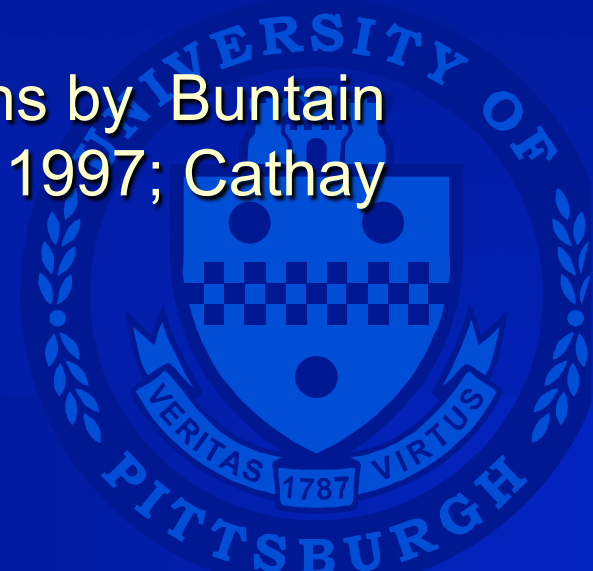


organ injury scaling for the spleen

AAST grade*	Type	Description of injury
I	Hematoma	Subcapsular, < 10% of surface area
	Laceration	Capsular tear, < 1 cm of parenchymal depth
II	Hematoma	Subcapsular, 10%–50% of surface area Intraparenchymal hematoma, < 5 cm in diameter
	Laceration	1–3 cm in parenchymal depth not involving a parenchymal vessel
III	Hematoma	Subcapsular, > 50% of surface area or expanding; ruptured subcapsular or parenchymal hematoma Intraparenchymal hematoma, > 5 cm in diameter
	Laceration	> 3 cm parenchymal depth or involving trabecular vessels
IV	Laceration	Laceration of segmental or hilar vessels producing major devascularization (> 25% of spleen)
V	Laceration	Completely shattered spleen Vascular hilar injury that devascularized the spleen

EAST practice guidelines (published 2003)

- Nonoperative management of blunt injury to the spleen and liver
 - class II data support nonoperative management of injuries to the liver or spleen
 - severity of grade of injury to the liver or the spleen is not a contraindication to nonoperative management
 - ♦ this is contrary to observations by Buntain 1988; Resciniti 1988; Powell 1997; Cathay 1998; Bee, 2001



Blunt splenic injury in adults: EAST multi-institutional study I

(Peitzman et al, J Trauma, 2000)

- Hypotheses:
 - degree of patient injury based on ISS and hemodynamics will correlate with frequency of operation
 - AAST Grade of splenic injury will predict frequency of operation
 - quantity of hemoperitoneum will correlate with frequency of laparotomy



Materials and methods

- twenty seven trauma centers, 1488 patients with blunt splenic injury
- retrospective data, 1997 patients only
- **adult** defined as > 15 years old
- **nonoperative failure** defined as any patient who was admitted to the ICU or floor with planned nonoperative management who later underwent laparotomy for any injury



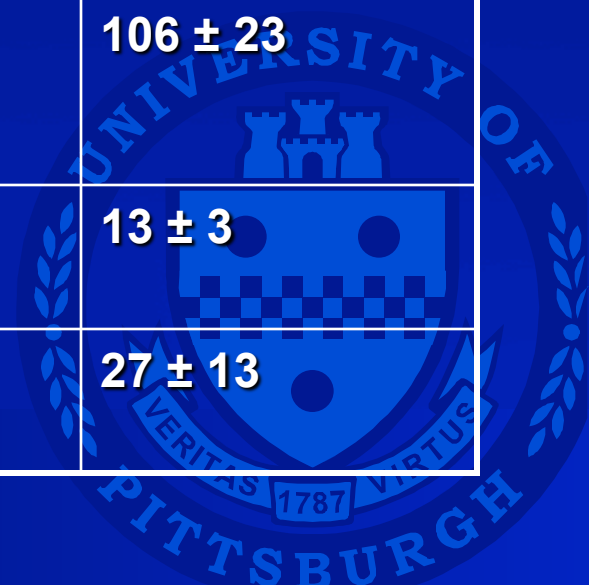
RESULTS

- 38.5% of patients went directly from the ED to OR (may have had CT en route)
- 61.5% of patients admitted with planned nonoperative management; of this group
 - 10.8% failed nonoperative management and underwent laparotomy

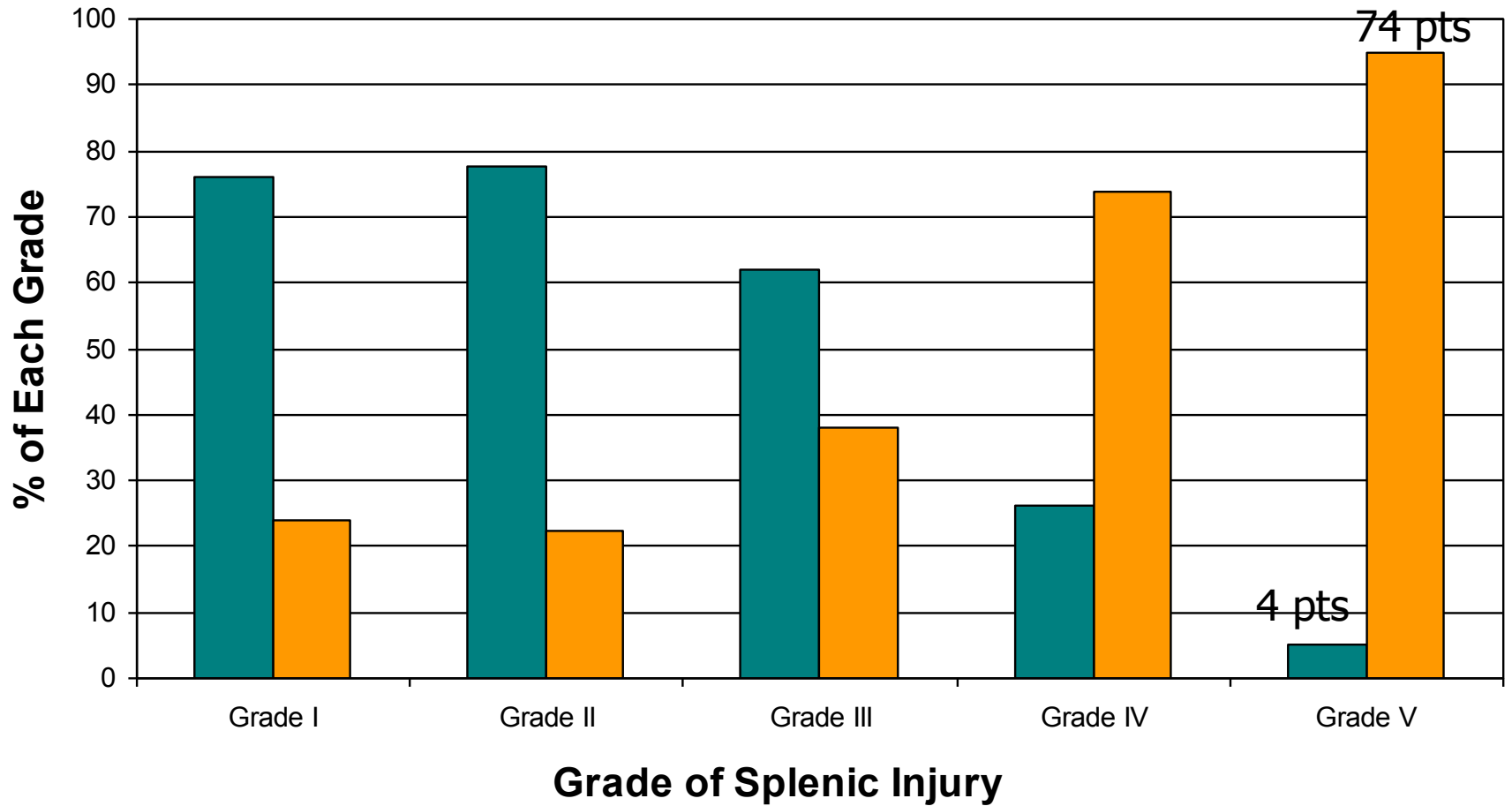


EAST multicenter adult spleen study I

	Group I (direct to OR)	Group II (observation)	Group III (failed observation)
Age (years)	36 ± 19	34 ± 17	41 ± 20
Highest ED heartrate *	120 ± 26	107 ± 22	109 ± 23
Lowest ED systolic BP (mmHg) *	90 ± 30	112 ± 23	106 ± 23
GCS*	11 ± 5	13 ± 4	13 ± 3
ISS*	32 ± 13	20 ± 11	27 ± 13



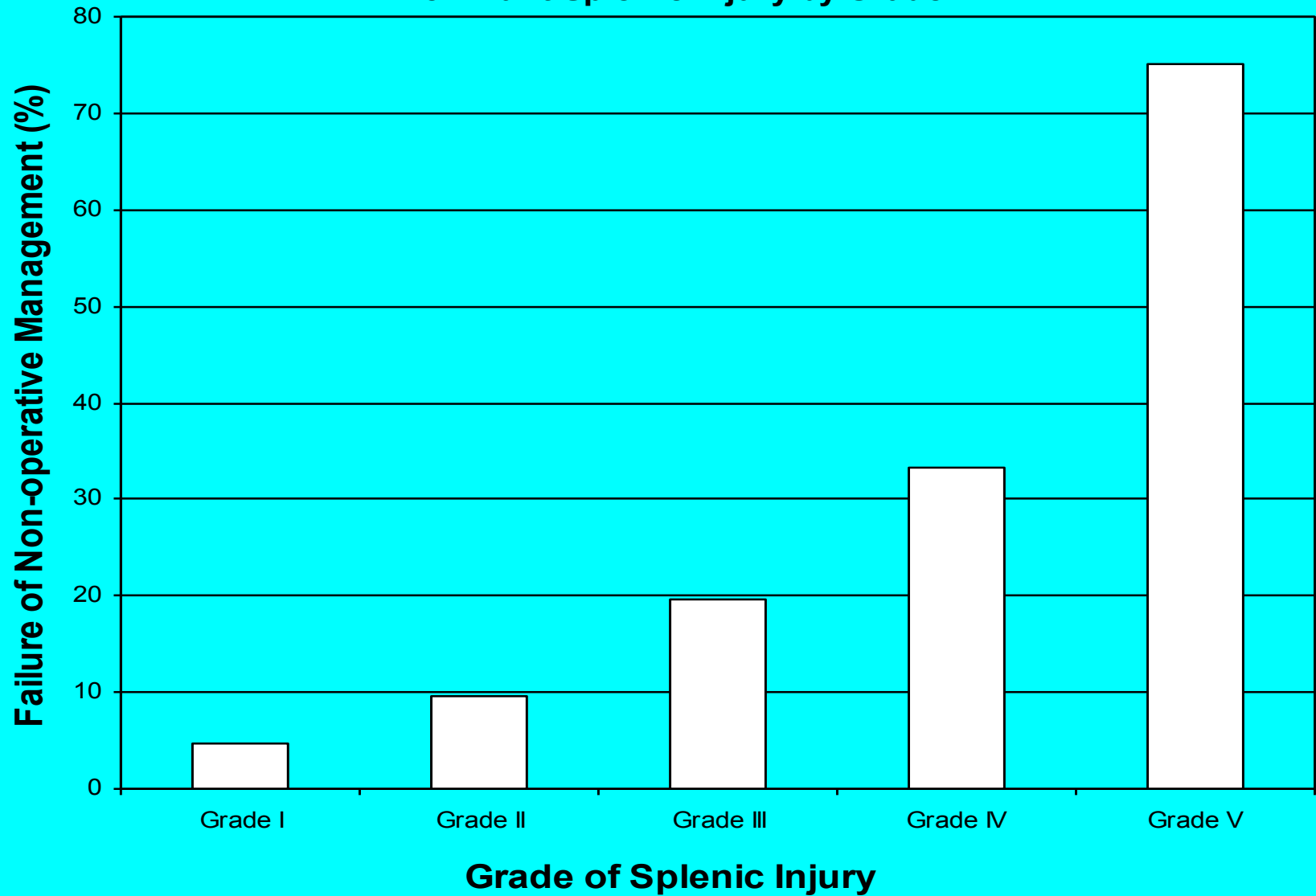
Initial Management of Blunt Splenic Injury by Grade



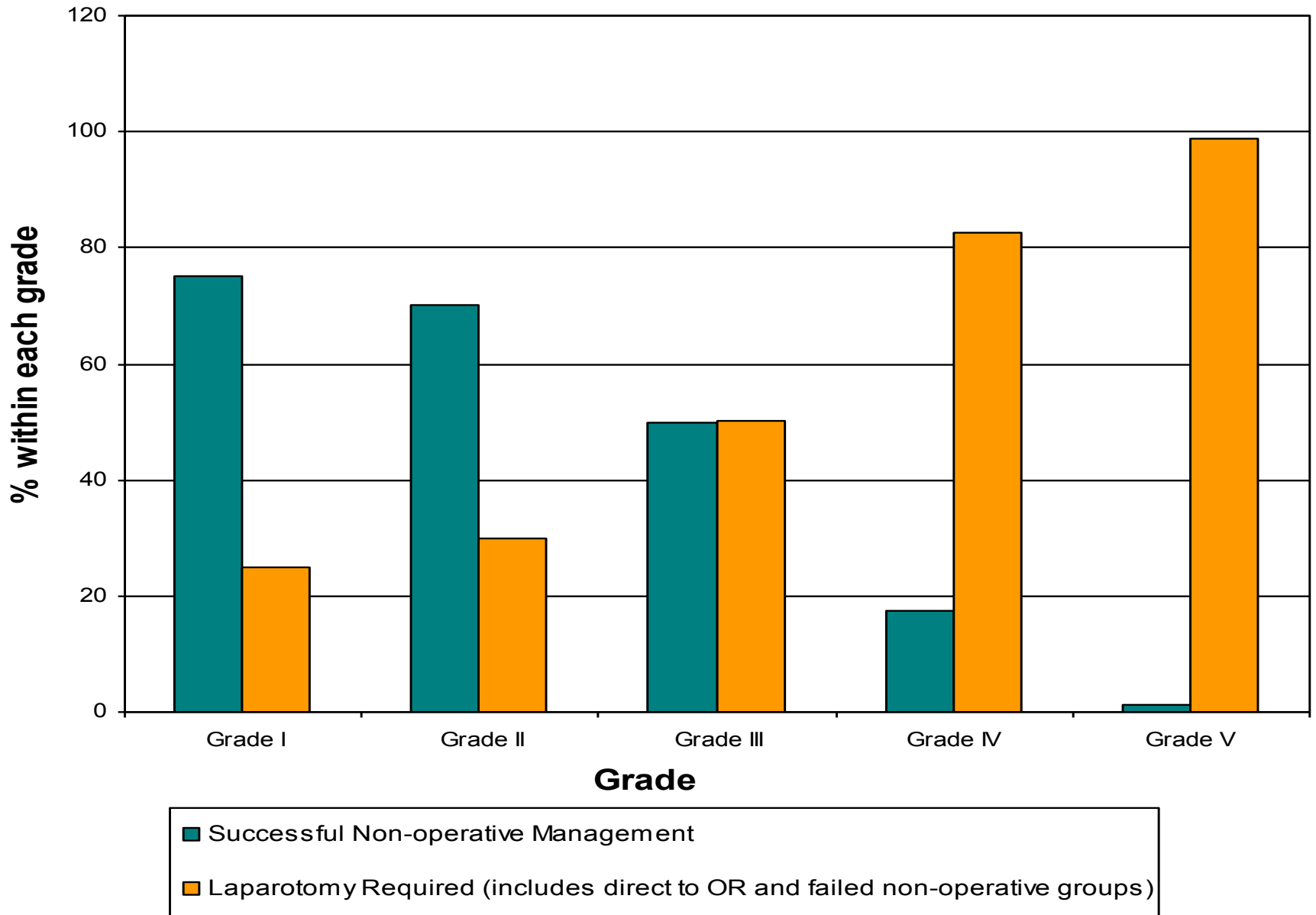
■ Planned Non-operative Management

■ Direct to OR

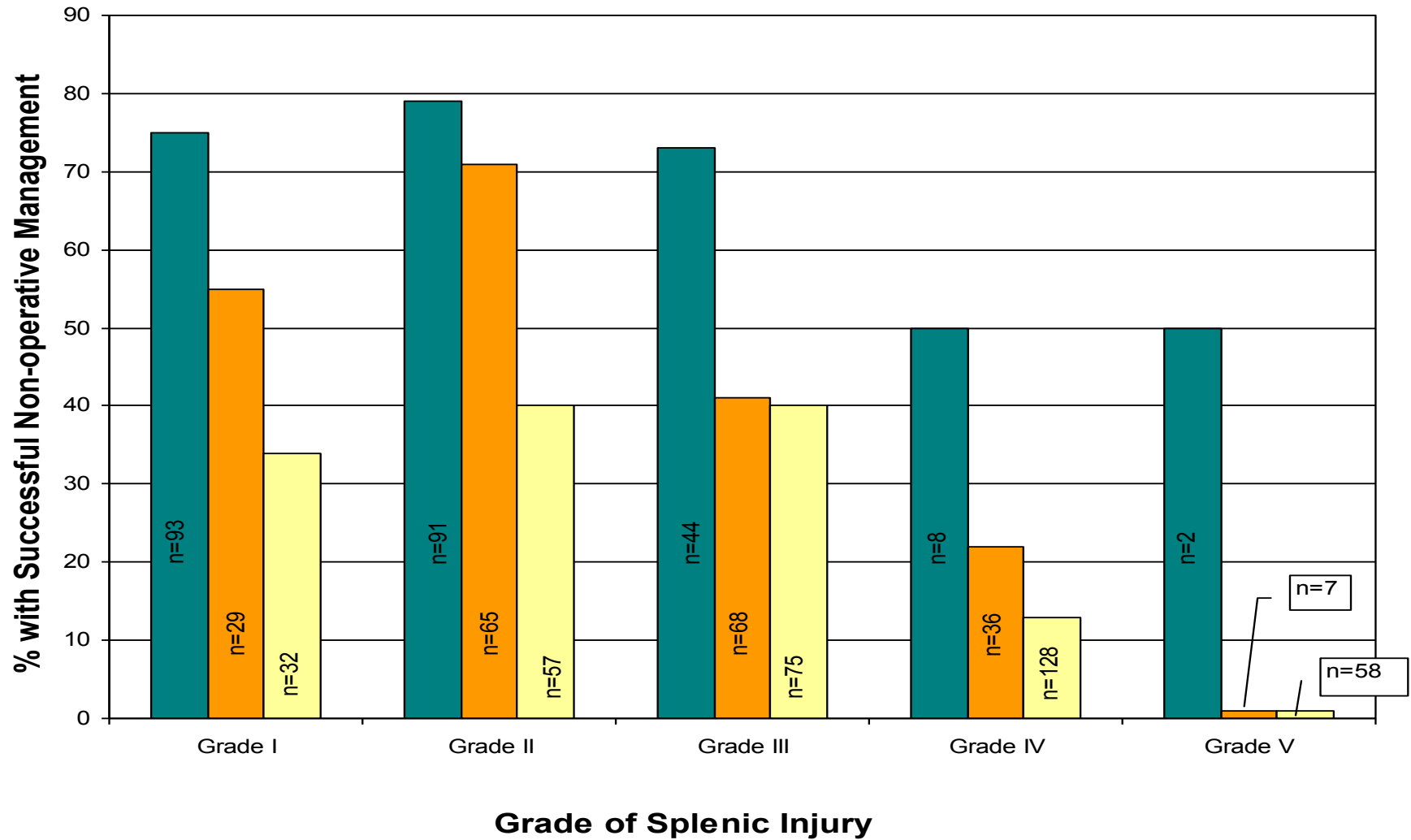
**Failure Rate of Non-operative Management
of Blunt Splenic Injury by Grade**



Ultimate Management of Splenic Injury by Grade



Ultimate management of splenic injury based on grade of injury and amount of hemoperitoneum



■ Small Hemoperitoneum ■ Moderate Hemoperitoneum ■ Large Hemoperitoneum

Blunt splenic injury in adults

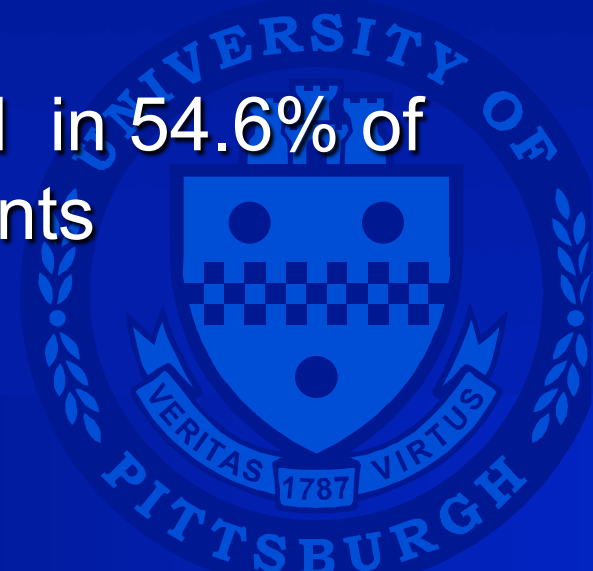
- Need for operation (immediate and ultimate) correlated with:
 - hemodynamic instability
 - Higher grade splenic injury
 - ISS > 15
 - quantity of hemoperitoneum
 - 61% of failures occurred within 24 hours
 - ◆ were these patients mistriaged?
 - ◆ what are the factors that predicted early failure?
 - ◆ Only 1/3 of trauma centers had protocols for management of blunt splenic injury



Nonoperative management of severe blunt splenic injury: Are we getting better?

(Watson GA, et al J Trauma, 2006)

- National Trauma Data Bank from 1997-2003
- 22,887 adults with blunt splenic injury.
- 3085 grade IV and V injuries
- Nonoperative management was attempted in 40.5% of grade IV and V injuries.
- Nonoperative management failed in 54.6% of the grade IV and V patients



Blunt splenic injuries: have we watched long enough?

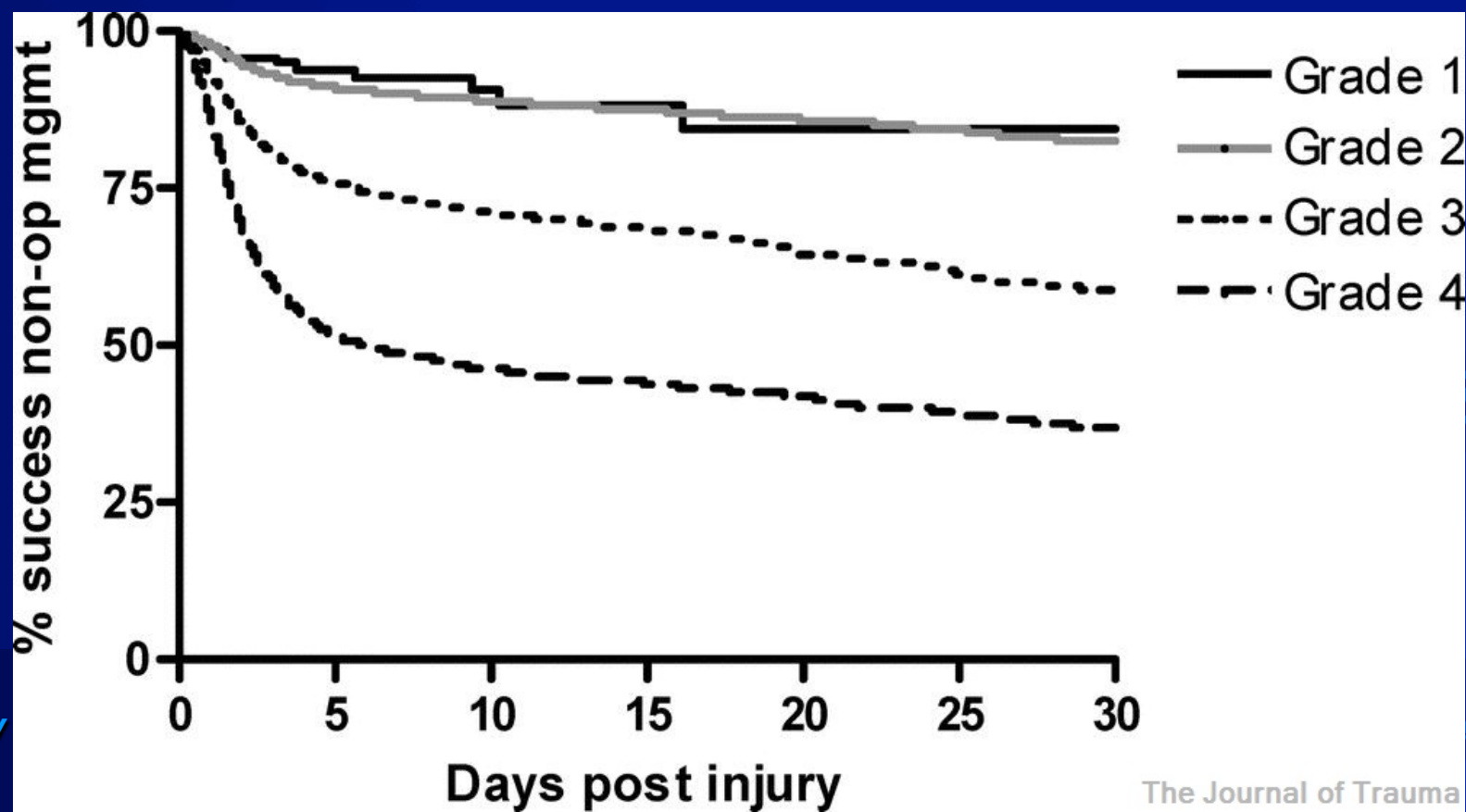
(Smith J, et al. J Trauma, 2008)

- National Trauma Data Bank from 1999-2004.
- 23,532 adults with blunt splenic injury.
- Conclusion... "We conclude that at least 80% of blunt splenic injury can be managed successfully nonoperatively, and that patients should be monitored from 3 to 5 days postinjury."



Smith et al.....

53 % of grade 4 and 5 injuries failed observation. Grade of splenic injury and ISS correlated with failure of observation of blunt splenic injury.



Meta-analysis of factors predicting failure of nonoperative management of blunt splenic injury in adults (Olthof et al)

- 335 papers were reviewed
- Strong evidence for failure of nonoperative management:
 - ISS > 25
 - Splenic injury grade 3,4,5
 - Age > 40 years



The background of the slide features a large, semi-transparent watermark of the University of Pittsburgh seal. The seal is circular, with the words "UNIVERSITY" at the top and "PITTSBURGH" at the bottom. In the center is a shield with a checkered pattern, flanked by the words "VERITAS" and "VIRTUS". Below the shield is the year "1787".

Failure of nonoperative management of blunt splenic injury in adults: variability in physician practice and impact on outcome

(Peitzman et al, JACS August, 2005)

Multi-institutional study of the Eastern Association for the
Surgery of Trauma III

Methods:

Failure of nonoperative management of blunt splenic injury

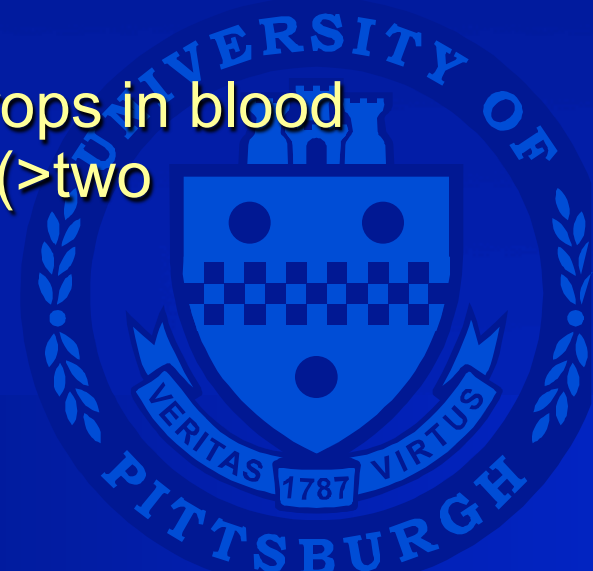
- 1488 adults (>15 years) with blunt splenic injury in 1997 from 27 trauma centers were studied
- 97 failed nonoperative management (ultimately underwent laparotomy)
- three trauma centers had no failures
- blinded charts were requested on the 97 patients who failed nonoperative management at 24 trauma centers



Methods:

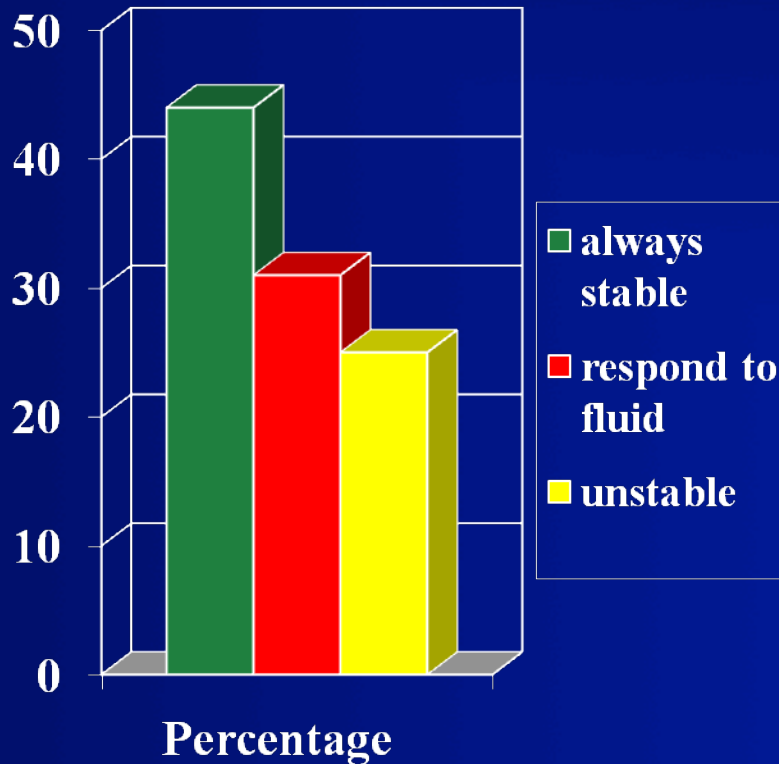
Failure of nonoperative management of blunt splenic injury

- Based on heart rate and blood pressure, hemodynamic stability was classified [unstable=systolic BP<90mmHg OR heart rate>112/min] :
 - **stable**: no hypotension or tachycardia
 - **responder**: transient hypotension or tachycardia that responded to fluid resuscitation (one or two episodes)
 - **unstable**: persistent or repeated drops in blood pressure or increases in heart rate (>two episodes)

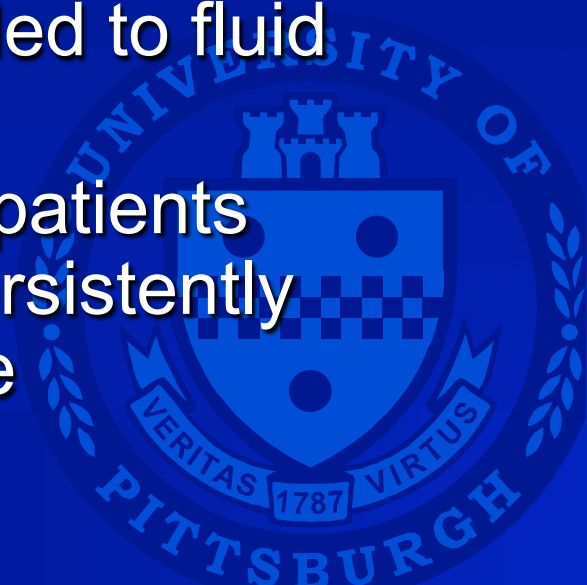


Hemodynamic stability:

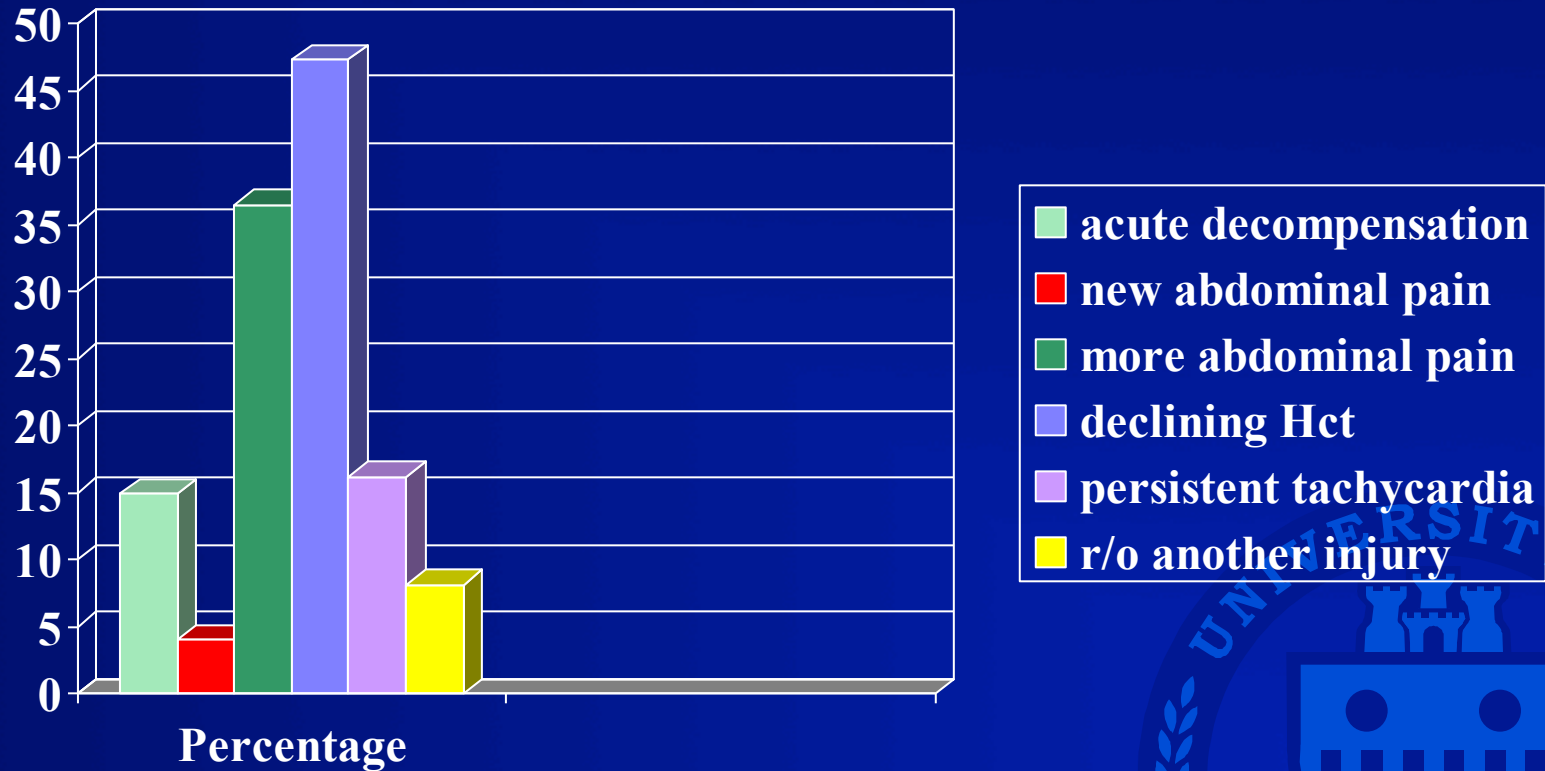
Failure of nonoperative management of blunt splenic injury



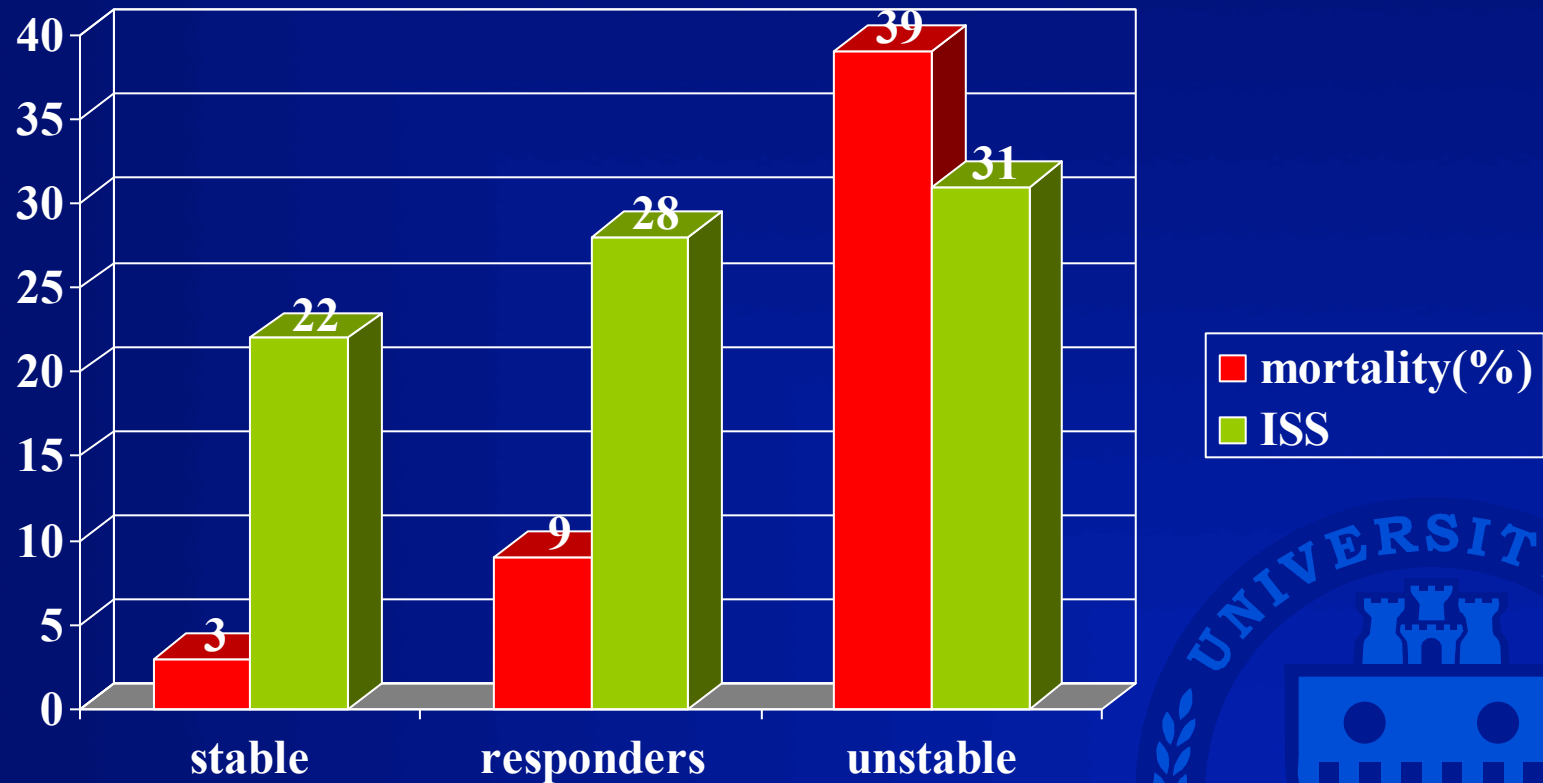
- 44% of patients were always stable
- 31% of patients were transiently hypotensive or tachycardic, but responded to fluid infusion
- 25% of patients were persistently unstable



Failure of nonoperative management of blunt splenic injury: Indication for laparotomy



Failure of nonoperative management of blunt splenic injury: Mortality and ISS



Mortality in adult patients who failed nonoperative management of blunt splenic injury

- ten patients died (12% mortality)
- 60% of the deaths were from delayed diagnosis and treatment of abdominal injuries
 - Three patients exsanguinated in the hospital, two of whom never underwent operation
 - Factors in these deaths:
 - ◆ unstable patients not undergoing laparotomy
 - ◆ misreading of CT scans
 - ◆ false negative abdominal ultrasound

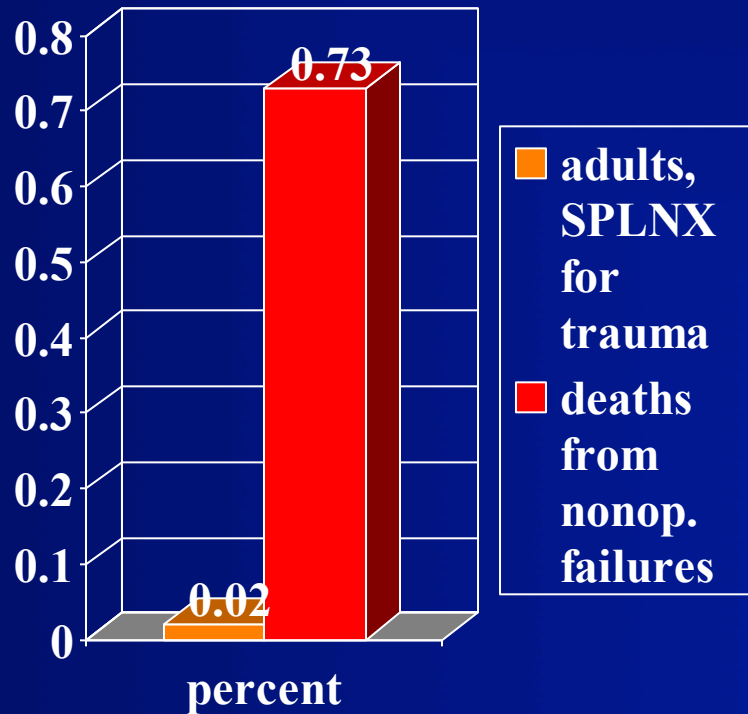


Violates a key principle

- No patient with a splenic injury should die from bleeding or missed injury



Risk of OPSI



- estimated risk of OPSI following splenectomy for trauma in adults (>15 years of age)
- mortality for deaths due to delayed management of abdominal injuries as a fraction of all patients initially observed (6/913)



Nonoperative management: where is the pendulum??

- The nonoperative pendulum swung too far
- Nonoperative management does not mean neglect the patient.
- Understand injury patterns.
- Patients with splenic injury managed nonoperatively may die acutely as a consequence of the splenic injury or missed injuries.



Blunt injury to the spleen: angio/embolization????

Where is this literature??



Angio/embolization..

All studies are historical comparisons

- With the change in practice over this time period, to suggest that the increase in success of nonoperative management is due to angiography and embolization is not yet justified.



Western Trauma Association

(J Trauma, 2008)

- “There is considerable variability in the use of angiography across centers. Although more aggressive use of angiography is associated with the highest rates of nonoperative management (80%) and the lowest rates of failure (2–5%), there is ongoing debate over the optimal use of this intervention because it is labor intensive and several reports document a surprisingly high rate of complications.”



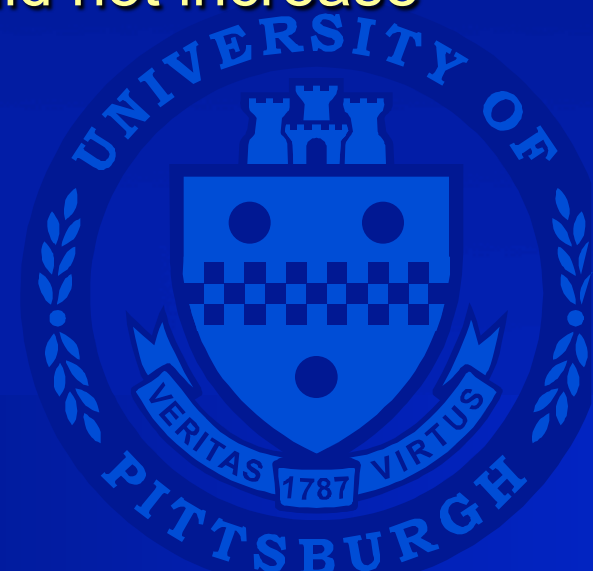
Nonoperative management of adult splenic injury with and without splenic artery embolotherapy: a meta-analysis

(Requarth et al, J Trauma, 2011)

- 33 articles from 1994-2009, 10,157 patients
- 31% of patients went to the OR
- 69% of patients managed nonoperatively
- Grade 4 and 5 injuries in only 12 %
- 80% grade 5 injuries direct to the OR
- 44% of grade 4 injuries direct to the OR



- Compared failure rate of observation only versus angioembolization
 - Failure rate of *observation only* increased with splenic injury grade
 - Failure rate of *angio/embolization* did not increase significantly with splenic grade



Observation only VS Angioembolization: failure rate

Splenic Injury Grade	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Observation only	4 %	9 %	20 %	44 %	83 %
Angio/ embolization	17 %	4 %	18 %	17 %	25 %

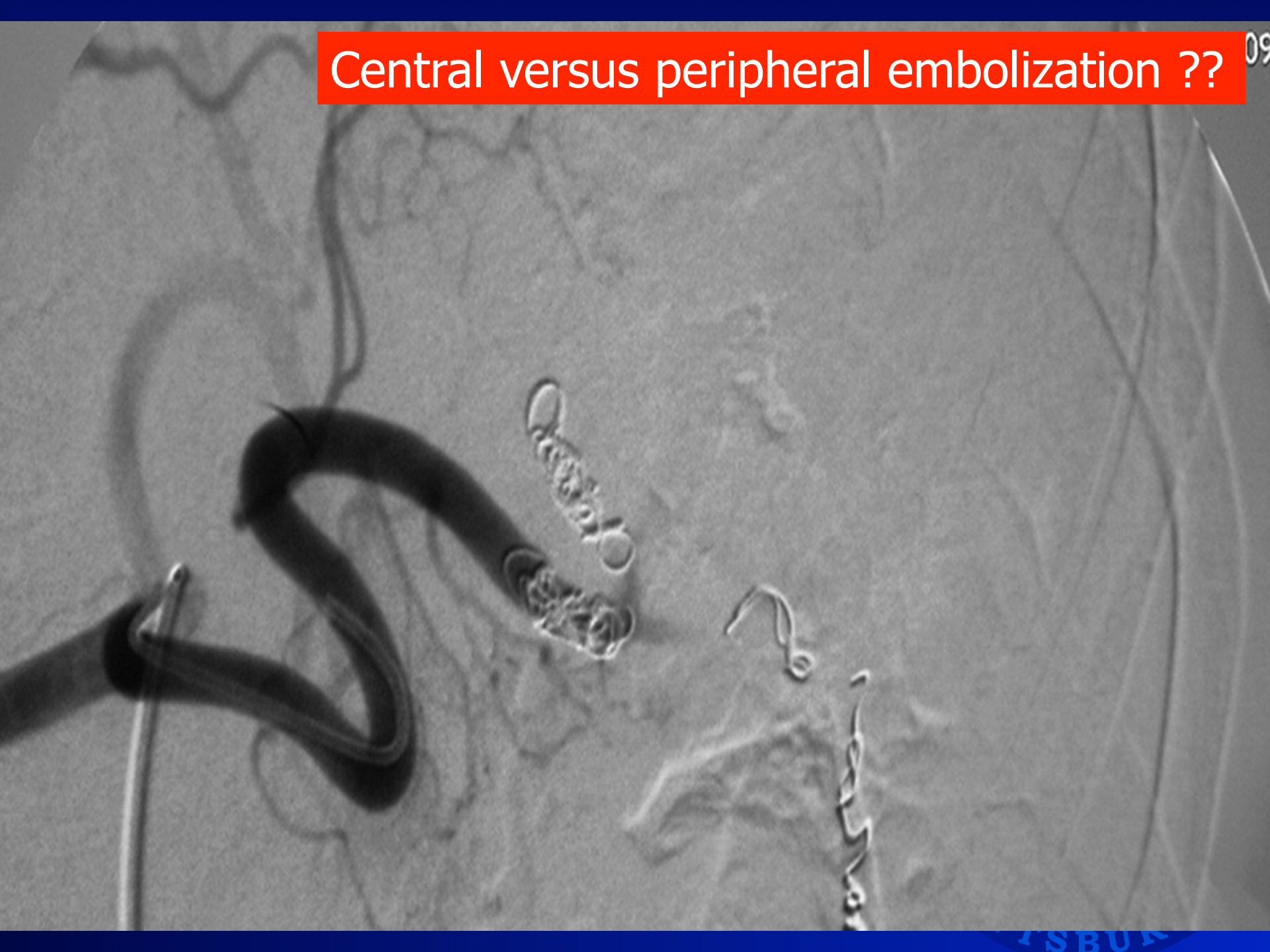


What is the current role of angio/embolization for adult blunt splenic injury?

- In a STABLE patient
- Active extravasation/contrast blush on CT
- Splenic artery pseudoaneurysm
- Hemodynamically normal patient with grade 4 or 5 splenic injury



Central versus peripheral embolization ??



Thank you

