

Massive Transfusion Ratios

Cardenas, J. C., Zhang, X., Fox, E. E., Cotton, B. A., Hess, J. R., Schreiber, M. A., . . . Holcomb, J. B. (2018). Platelet transfusions improve hemostasis and survival in a substudy of the prospective, randomized PROPPR trial. *Blood Adv*, 2(14), 1696-1704. This PROPPR trial analysis compared massive transfusion patients who received platelets in the first cooler to those receiving first cooler without platelets. Early platelet administration is associated with improved hemostasis and reduced mortality in severely injured, bleeding patients.

Meyer, D. E., Vincent, L. E., Fox, E. E., O'Keeffe, T., Inaba, K., Bulger, E., . . . Cotton, B. A. (2017). Every minute counts: Time to delivery of initial massive transfusion (MT) cooler and its impact on mortality. *J Trauma Acute Care Surg*, 83(1), 19-24. This PROPPR trial analysis of massive transfusion patients studied the effect of time to cooler arrival on blood ratios and patient outcomes. Independent of product ratios, every minute from time of MT protocol activation to time of initial cooler arrival increases odds of mortality by 5%.

Chang, R., Folkerson, L. E., Sloan, D., Tomasek, J. S., Kitagawa, R. S., Choi, H. A., . . . Holcomb, J. B. (2017). Early plasma transfusion is associated with improved survival after isolated traumatic brain injury in patients with multifocal intracranial hemorrhage. *Surgery*, 161(2), 538-545. This single center retrospective analysis of 633 isolated TBI (head AIS>3) patients compared those receiving early plasma (<4 hrs of arrival) to no early plasma. Early plasma transfusion was associated with increased in-hospital survival in those with multifocal intracranial hemorrhage.

Bui, E., Inaba, K., Ebadat, A., Karamanos, E., Byerly, S., Okoye, O., . . . Demetriades, D. (2016). The impact of increased plasma ratios in massively transfused trauma patients: a prospective analysis. *European Journal of Trauma and Emergency Surgery*, 42(4), 519-525. This is a single center, prospective, observational study of trauma patients requiring massive transfusion (>10 PRBC in <24 hrs). Achieving a ratio of FFP:PRBC \geq 1:1.5 after the initial 24 h of resuscitation significantly improves survival in massively transfused trauma patients compared to patients that achieved a ratio <1:1.5.

Holcomb, J. B., Tilley, B. C., Baraniuk, S., Fox, E. E., Wade, C. E., Podbielski, J. M., . . . van Belle, G. (2015). Transfusion of plasma, platelets, and red blood cells in a 1:1:1 vs a 1:1:2 ratio and mortality in patients with severe trauma: The PROPPR randomized clinical trial. *JAMA*, 313(5), 471-482. PROPPR is the largest randomized study to date to enroll severely bleeding patients. This pragmatic, phase 3, multisite, randomized clinical trial of 680 severely injured patients (12 civilian trauma centers) compared ratios of 1:1:1 vs 1:1:2. No difference found in 24 hr or 30-day mortality. More patients in the 1:1:1 group achieved hemostasis and fewer experienced death due to exsanguination by 24 hours. Clinicians should consider using a 1:1:1 transfusion protocol, starting with the initial units transfused while patients are actively bleeding, and then transition to laboratory-guided treatment once hemorrhage is controlled.

Holcomb, J. B., del Junco, D. J., Fox, E. E., Wade, C. E., Cohen, M. J., Schreiber, M. A., . . . Rahbar, M. H. (2013). The prospective, observational, multicenter, major trauma transfusion (PROMMTT) study: comparative effectiveness of a time-varying treatment with competing risks. *JAMA Surg*, 148(2), 127-136. PROMMTT is a prospective, multicenter observational cohort study conducted at ten Level 1 trauma centers in the US (n=905) analyzing the effect of early plasma and or platelets on

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in-hospital mortality, and time varying plasma to RBC and platelet to RBC ratios. Early higher plasma and platelet ratios were associated with decreased mortality in patients transfused at least 3 units of blood products during the first 24 hours after admission