goal of this study was to determine which initial hemorrhage control intervention is most effective with respect to bleeding control and decreased mortality in patients with severe pelvic fractures.

This was a multi-institutional retrospective database review in which 12 trauma centers participated. Patients included in the study had a diagnosis of pelvic fracture and were 18 years or older. They also had to have a systolic blood pressure of 90 mmHg or less, a heart rate greater than 120 beats per minute at admission, or a base deficit >5. Patients were excluded if they were pregnant, had an isolated hip fracture, or had a penetrating mechanism of injury. Adjuncts for hemorrhage control included pelvic binder, external fixator, pre-peritoneal packing (PPP), and resuscitative balloon occlusion of the aorta (REBOA). The primary outcome was the frequency of each type of adjunctive hemorrhage intervention used, the time until definitive bleeding control was established (either in the operating room or by interventional radiology for angioembolism) and the mortality within each group. The secondary outcome was the prevalence of transfusion requirements within 24 hours of admission as it relates to the associated adjunct hemorrhage intervention used. A subgroup analysis of patients based on injury severity scores (ISS) was performed, with patients grouped into lower severity (ISS < 25) or higher severity (ISS ≥ 25) injuries. Multivariable regression was also performed to identify independent predictors of mortality.

This study included 279 patients from twelve trauma centers, admitted between January 2011 and December 2016. The majority of patients were male (62%), white (55%), with a median age of 40, and an median ISS of 38. The overall mortality was 32% and 96% of those deaths occurred in patients with an injury severity score of over 25. The most common hemorrhage control adjunct used was pelvic binder (50%) followed by no adjunct (35%). The least common adjunct used was REBOA (2.5%). Use of pelvic binding and/or external fixator resulted in the lowest mortality rate. Patients who received both REBOA and PPP required the largest blood transfusions. REBOA alone or with adjuncts and PPP alone resulted in shorter time to definitive bleeding control. The highest incidence of death was seen in the REBOA and pre-peritoneal packing groups. Regression indicated that the following variables were predictive of death: age (OR 1.031; 95% CI 1.006-1.056), initial GCS of 3-8 (OR 2.899; 95% CI 1.200-7.005), and number of transfused PRBC units in the first 24 hours (OR 1.035; 95% CI 1.007-1.060).

The authors note that the variation in management of patients with pelvic fractures complicated by hemorrhagic highlights the lack of consensus on the best modality to treat and the need for a standardized approach. Pelvic binders play an important role in preserving volume in venous bleeding and should be first line. If hemorrhage is not controlled with a pelvic binder, the source is likely arterial and thus the authors suggest that REBOA should be the next preservation adjunct. The authors also mention that REBOA is underutilized and understudied and thus further studies are indicated to validate REBOA as a second line adjunct.

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Comments: This study suggests that pelvic binding plays an important role in initial hemorrhage control for pelvic fractures. This is an easily performed adjunct for emergency physicians regardless of location or resources. REBOA is suggested as the next step in bleeding control in patients who do not respond adequately to pelvic binders, however the available data for REBOA is conflicting and this is often not available in outlying hospitals. Further analysis and validation of REBOA in decreasing mortality in patients with pelvic fractures complicated by hemorrhagic shock is warranted.

☐ TRANEXAMIC ACID ADMINISTRATION FOLLOWING HEAD TRAUMA IN A COMBAT SETTING: DOES TRANEXAMIC ACID RESULT IN IMPROVED NEUROLOGIC OUTCOMES?

Morte D, Lammers D, Bingham J, et al. *Journal of Trauma and Acute Care Surgery.* 2019;87:125-129

Research shows that administration of tranexamic acid (TXA) in severely injured trauma patients can decrease mortality as well as the amount of blood products required. Morbidity and mortality is high for patients with traumatic brain injuries (TBIs). The theory is that progressive of intracranial bleeding, cerebral edema and cerebral ischemia may contribute to the poor outcomes for TBI patients. There have been studies looking at the progression of intracranial bleeding in patients with TBIs after receiving TXA, however these studies have not thoroughly evaluated the effect on clinical outcomes. The goal of this study was to compare neurological outcomes in adult trauma patients who received TXA versus those who did not receive TXA.

This study retrospectively reviewed the Joint Theater Trauma Registry of all adult patients treated after trauma at forward role 2 and higher medical treatment facilities in Iraq and Afghanistan from 2008 to 2015. Patients with a recorded Head Abbreviated Injury Scale (AIS) were included; patients without a Head AIS documented and patients without head injuries were excluded. Patients were given TXA if clinically indicated based on Combat Casualty Care Data guidelines with standardized dosing of 1 gram intravenously in the first 3 hours after injury followed by additional 1 gram dose infused over the next 8 hours. The indications for giving TXA included patients requiring resuscitation with blood products after combat-related hemorrhage or patients likely to require massive transfusion protocol (greater than 10 units of blood products over 24 hours). Propensity score matching was used to create two groups, the TXA group and the no-TXA group, with no statistically significant differences in age, sex, mechanism of injury, Injury Severity Score (ISS), anatomic AIS, vital signs, initial Glasgow Coma Scale (GCS), laboratory values, early transfusion requirements, total transfusion requirements, neurosurgical interventions, and emergent operations. Primary outcomes included severity of TBI at discharge (based on GCS; mild: 14-15, moderate: 9-13, severe 3-8), GCS score at discharge compared to initial presentation, and in-hospital mortality. Secondary outcomes looked at the incidence of respiratory failure and the rate of thromboembolic events.

Overall when comparing patients who received TXA to those who did not receive TXA, the TXA group had higher rates of higher ISS (29.1 vs. 10.1, p = <0.001), higher head AIS >3 (32.8% vs. 13.7%, p = <0.001), higher transfusion requirements (39.5 units vs. 1.2 units, p = <0.001), higher rate of emergent operations (47.1% vs. 42.5%, p = <0.001) and neurosurgical interventions (12.6% vs. 3.7%, p = <0.001), lower initial GCS, and were more likely to have penetrating injuries (93.6 vs. 33.7, p = <0.001). After propensity score matching, however, there were no statistically significant differences between the groups for the above variables. There was an independent association with improved neurological outcomes in patients who received TXA. All of the TXA patients (n=46) were discharged with a GCS of 14-15, compared to only 87% (n=40) in the no-TXA group (*p*=0.01). There was no significant difference in intubation at discharge or thromboembolic events between the groups, however the TXA group had significantly improved mortality (0% vs. 10.1%, p = 0.028).

The authors of this study concluded that, as previously demonstrated, TXA is associated with improved mortality in severely injured trauma patients. Their findings also supported improved neurological outcomes in patients who are traumatically injured with associated head injuries. The authors acknowledged the limitations of this study given its small cohort size, inherent bias associated with retrospective studies, and the risk of selection bias secondary to omission of incomplete records. They discussed that given that the majority of the patients in the study were active-duty soldiers, it is difficult to translate the results into civilian trauma populations which include older patients with more co-morbidities. Although the results are limited, this study encourages further research with larger prospective trials.

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Comment: This study is a great step into understanding TXA's effect on neurological outcomes in adult patients with TBI. Although this study is limited by several factors as detailed above, TXA definitely appears promising in reducing additional injury for TBI patients. We are hopeful for results of ongoing prospective trials that will add the stronger evidence needed in order for emergency physicians to be routinely using this in practice for head injury.

☐ THE POCUS PULSE CHECK: A RANDOMIZED CONTROLLED CROSSOVER STUDY COMPARING PULSE DETECTION BY PALPATION VERSUS BY POINT-OF-CARE ULTRASOUND.

Badra K, Coutin A, Simard R, et al. *Resuscitation* 2019;139:17-23

Point-of-care ultrasound (POCUS) has become an important adjunct available for cardiopulmonary resuscitation (CPR) in cardiac arrest. CPR depends on high-quality chest compressions with few interruptions, however detection of a pulse has been repeatedly shown to be unreliable and often leads to prolonged pauses in compressions. Ultrasound (US) provides a possible alternative method for pulse checks that could be more reliable than standard methods. The overall objective of this study was to determine whether healthcare providers could perform US pulse checks as quickly as manual pulse checks in cardiac arrest.

The primary outcome of this randomized crossover non-inferiority trial was the amount of time required to perform a pulse check with POCUS as compared to a manual pulse check. Secondary outcomes included number of attempts at pulse check, number of participants who took more than 5 and 10 seconds to complete a pulse check, and confidence levels of the participants. Participants included healthcare professionals 18 years old and older who provided informed consent and were enrolled in an advanced life support (ALS) course. Exclusion criteria included age under 18 and participant not providing informed consent. Participants performed pulse checks on volunteers provided by an ALS course who had their age, sex, weight, height, body mass index, heart rate, blood pressure, neck circumference, and neck length recorded. Study participants included attending physicians, medical students, nurses, and paramedics. Initial confidence levels of participants with pulse detection by US and palpation were recorded as measured by a 100mm visual analogue scale (VAS). Characteristics such as recent BLS or ACLS certification were also recorded. Participants then underwent training to learn to identify the carotid pulse with US using B-mode. Three hours after the US training, each participant performed a pulse check on two separate live models. Each participant was randomized to use palpation or US first and to the model used for testing. A countdown was performed, and participants attempted to identify a carotid pulse using the method to which they had been randomized. Detection of a pulse was confirmed by the investigator palpating a radial pulse while the participant counted in time with the heartbeat. The time it took each participant to detect a pulse was measured by two independent viewers blinded to the group of each participant. Investigators consulted with multiple experts in resuscitation to determine a non-inferiority margin of two seconds.

Investigators enrolled 115 participants, but four were excluded due to incorrect US setup or models prompting participants. Average time to identification of a carotid pulse was 4.22 s (standard deviation (SD) 3.26 s) with US and 4.71 s (SD 6.45 s) manually with a mean difference of -0.49 s (90% CI: -1.77 to 0.39). Manual pulse check had a larger variability in time to identification of a pulse compared to US (*p* <0.001). Success on the first pulse check attempt was significantly higher in the US group (99.1% vs 85.6%, p=0.0001). There was no significant difference in the number of participants who took greater than 5 seconds and greater than 10 seconds to identify a pulse between groups. However, there were four outliers that took greater than 20 seconds to identify a pulse, all using manual palpation. Recent BLS or ACLS certification had no significant effect on pulse check times for participants. Prior experience with US did lead to quicker pulse identification with a mean of 3.13 s for those with prior US experience and 5.00 s for those without (*p*=0.003). Staff physicians and residents had faster pulse check times of 3.29 s, with paramedics and medical students (4.04 s), and nurses (5.12 s) having significantly slower times (p=0.02). Prior to the US training course, participants had higher confidence