Tactical Combat Casualty Care

Journal Article Abstracts

Committee on Tactical Combat Casualty Care
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Abstracts

J Shoulder Elbow Surg. 2016 Apr 19. [Epub ahead of print]

Tranexamic acid decreases blood loss in total shoulder arthroplasty and reverse total shoulder arthroplasty.

Abildgaard JT, McLemore R, Hattrup SJ

BACKGROUND: Efficacy of tranexamic acid (TXA) remains unproven in the setting of shoulder arthroplasty. The purpose of this study was to determine the effects of TXA on perioperative blood loss and drain output in patients undergoing primary total shoulder arthroplasty (TSA) and reverse total shoulder arthroplasty (RTSA).

METHODS: We conducted a retrospective comparison of 77 TSAs and 94 RTSAs performed in 168 patients. TXA was administered intravenously in 35 TSA and 42 RTSA patients. Changes in hemoglobin (Hgb), hematocrit (Hct), drain output, and total blood loss were reviewed with univariate analysis and additional multivariate regression examining the cofactors of age, body mass index, American Society of Anesthesiologists status, and gender of each patient.

RESULTS: Use of TXA in TSA led to a significant decrease in total blood loss (679 mL vs. 910 mL; $P < .001$), change in Hgb (1.8 mg/dL vs. 2.6 mg/dL; $P < .001$), and drop in Hct (5.2 vs. 7.0; $P < .001$). Similarly, RTSA also had significantly less total blood loss with the use of TXA (791 mL vs. 959 mL; $P < .001$), change in Hgb (2.3 mg/dL vs. 2.9 mg/dL; $P < .001$), and change in Hct (6.4 vs. 8.3; $P < .001$). TXA also significantly decreased drain output in both TSA (99 mL vs. 235 mL; $P < .001$) and RTSA (180 mL vs. 370 mL; $P < .001$).

CONCLUSIONS: Use of TXA perioperatively among patients undergoing primary shoulder arthroplasty can decrease perioperative blood loss, change in Hgb and Hct, and postoperative drain output.

Ann Vasc Surg. 2016 May;33:258-62.

Lead, Follow, or Get out of the Way-How Bold Young Surgeons Brought Vascular Surgery into Clinical Practice from the Korean War Battlefield.

Baker MS

Abstract: The maturation of vascular surgery into widespread clinical practice was accelerated by events that took place in Korea during the conflict of 1950-1953. Early research and anecdotal clinical trials were just then resulting in publication of cases of the successful vascular repairs and replacements. Noncrushing vascular clamps were being developed and limited manufacture begun. The stage was set for a major advance in the treatment of arterial injury, just as war commenced in Korea, which provided a clinical laboratory. When the war on the Korean Peninsula erupted in June 1950, the policy of the Army Medical department was to ligate all arterial injuries unless a simple transverse or end-to-end anastomosis could be performed, and repair was "contrary to policy and orders." Despite pressure and threats of "courts martial for vascular repairs" from the senior military medicine leaders-clinical experiments in arterial repair were carried out at Mobile Army Surgical Hospital facilities at battlefield locations across Korea. The young surgeons, mostly draftees and reservists, resisted rigid doctrine and orders to desist, and in the face of threatened punishment, were committed to do the right thing, and ultimately went on to change military medicine and vascular surgery. The "on-the-job" training in vascular surgery that was carried out in Korea by military surgeons who demonstrated substantially higher limb salvage rates energized the field from the battlefield laboratory. Many wounded soldiers had limbs saved by the new techniques in vascular repair pioneered by surgeons in the Korean War, and countless thousands who entered civilian hospitals for emergency vascular surgery in subsequent years also ultimately benefited from their work.

Clin Infect Dis. 2016 Apr 5. pii: ciw209. [Epub ahead of print]

Association Between Initial Route of Fluoroquinolone Administration and Outcomes in Patients Hospitalized for Community-acquired Pneumonia.

Belforti RK, Lagu T, Haessler S, Lindenauer PK, Pekow PS, Priya A, Zilberberg MD, Skiest D, Higgins TL, Stefan MS, Rothberg MB.

BACKGROUND: Fluoroquinolones have equivalent oral and intravenous bioavailability, but hospitalized patients with community-acquired pneumonia (CAP) generally are treated intravenously. Our objectives were to compare outcomes of hospitalized CAP patients initially receiving intravenous vs oral respiratory fluoroquinolones.

METHODS: This was a retrospective cohort study utilizing data from 340 hospitals involving CAP patients admitted to a non-intensive care unit (ICU) setting from 2007 to 2010, who received intravenous or oral levofloxacin or moxifloxacin. The primary outcome was in-hospital mortality. Secondary outcomes included clinical deterioration (transfer to ICU, initiation of vasopressors, or invasive mechanical ventilation [IMV] initiated after the second hospital day), antibiotic escalation, length of stay (LOS), and cost.

RESULTS: Of 36 405 patients who met inclusion criteria, 34 200 (94%) initially received intravenous treatment and 2205 (6%) received oral treatment. Patients who received oral fluoroquinolones had lower unadjusted mortality (1.4% vs 2.5%; P = .002), and shorter mean LOS (5.0 vs 5.3; P < .001). Multivariable models using stabilized inverse propensity treatment weighting revealed lower rates of antibiotic escalation for oral vs intravenous therapy (odds ratio [OR], 0.84; 95% confidence interval [CI], .74-.96) but no differences in hospital mortality (OR, 0.82; 95% CI, .58-1.15), LOS (difference in days 0.03; 95% CI, -.09-.15), cost (difference in $-7.7; 95% CI, -197.4-182.0), late ICU admission (OR, 1.04; 95% CI, .80-1.36), late IMV (OR, 1.17; 95% CI, .87-1.56), or late vasopressor use (OR, 0.94; 95% CI, .68-1.30).

CONCLUSIONS: Among hospitalized patients who received fluoroquinolones for CAP, there was no association between initial route of administration and outcomes. More patients may be treated orally without worsening outcomes.

CJEM. 2016 Mar;18(2):112-20.

Hypertonic saline in severe traumatic brain injury: a systematic review and meta-analysis of randomized controlled trials.

Berger-Pelleiter E, Émond M, Lauzier F, Shields JF, Turgeon AF.

OBJECTIVES: Hypertonic saline solutions are increasingly used to treat increased intracranial pressure following severe traumatic brain injury. However, whether hypertonic saline provides superior management of intracranial pressure and improves outcome is unclear. We thus conducted a systematic review to evaluate the effect of hypertonic saline in patients with severe traumatic brain injury.

METHODS: Two researchers independently selected randomized controlled trials studying hypertonic saline in severe traumatic brain injury and collected data using a standardized abstraction form. No language restriction was applied. We searched MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, Scopus, Web of Science, and BIOSIS databases. We searched grey literature via OpenGrey and National Technical Information Service databases. We searched the references of included studies and relevant reviews for additional studies.

RESULTS: Eleven studies (1,820 patients) were included. Hypertonic saline did not decrease mortality (risk ratio 0.96, 95% confidence interval [CI] 0.83 to 1.11, I2=0%) or improve intracranial pressure control (weighted mean difference -1.25 mm Hg, 95% CI -4.18 to 1.68, I2=78%) as compared to any other solutions. Only one study reported monitoring for adverse events with hypertonic saline, finding no significant differences between comparison groups.

CONCLUSIONS: We observed no mortality benefit or effect on the control of intracranial pressure with the use of hypertonic saline when compared to other solutions. Based on the current level of evidence pertaining to mortality or control of intracranial pressure, hypertonic saline could thus not be recommended as a first-line agent for managing patients with severe traumatic brain injury.

Int J Surg. 2016 Apr 20. pii: S1743-9191(16)30024-3.

Damage control resuscitation.

Briggs A, Askari R

Summary and Future Directions

The principles of damage control resuscitation include hemorrhage control, careful use of crystalloid intravenous fluids, and early delivery of high ratios of platelets and plasma to red blood cells. These have become more widely applied in trauma patients as both military and civilian experience continues to support this approach, and studies now are looking to expand DCR to the prehospital arena. Continued research is required to establish the ideal approach to blood product transfusion, to investigate the use of additional hemostatic agents, and to continue to optimize prehospital care of trauma patients.

Quote

“The existing guidelines suggest that trauma patients who are alert and have a palpable radial pulse do not require prehospital fluid administration. Fluids should be given to patients with falling blood pressures to maintain mentation and regain a strong pulse. Goal blood pressures should be higher in patients with traumatic brain injury, however, in order to maintain cerebral perfusion with goal mean pressure greater than 60mmgHg. When these guidelines and the existing literature are taken together, they suggest that judicious use of pre-hospital crystalloids may be indicated in some trauma populations, as long as volumes are monitored carefully. The data do demonstrate that high volume crystalloid resuscitation is likely detrimental and may increase morbidity in trauma patients.”

J Trauma Acute Care Surg. 2016 Apr 26.

Prehospital Lactate Improves Accuracy of Prehospital Criteria for Designating Trauma Activation Level.

Brown JB, Lerner EB, Sperry JL, Billiar TR, Peitzman AB, Guyette FX.

BACKGROUND: Trauma activation level is determined by prehospital criteria. The American College of Surgeons (ACS) recommends trauma activation criteria; however, their accuracy may be limited. Prehospital lactate has shown promise in predicting trauma center resource requirements. Our objective was to investigate the added value of incorporating prehospital lactate in an algorithm to designate
trauma activation level.

METHODS: Air medical trauma patients undergoing prehospital lactate measurement were included. Algorithms using ACS activation criteria (ACS) and ACS activation criteria plus prehospital lactate (ACS+LAC) to designate trauma activation level were compared. Test characteristics and net reclassification improvement (NRI), which evaluates reclassification of patients among risk categories with additional predictive variables, were calculated. Algorithms were compared to predict trauma center need (TCN) defined as >1unit of blood in the ED; spinal cord injury; advanced airway; thoracotomy or pericardiocentesis; ICP monitoring; emergent operative or interventional radiology procedure; or death.

RESULTS: There were 6,347 patients included. Twenty-eight percent had TCN. The ACS+LAC algorithm upgraded 256 patients and downgraded 548 patients compared to the ACS algorithm. The ACS+LAC algorithm versus ACS algorithm had a NRI of 0.058 (95%CI 0.044, 0.071; p<0.01), with an event NRI of -0.5% and non-event NRI of 6.2%. When weighted to favor changes in under-triage, the ACS+LAC still had a favorable overall reclassification (wNRI 0.041; 95%CI 0.028, 0.054; p=0.01). The ACS+LAC algorithm increased PPV, NPV, and accuracy. Over-triage was reduced 7.2%, while under-triage only increased 0.7%. The area under the curve (AUC) was significantly higher for the ACS+LAC algorithm (0.79 vs. 0.76, p<0.01).

CONCLUSIONS: The ACS+LAC algorithm reclassified patients to more appropriate levels of trauma activation when compared to the ACS algorithm. This overall benefit is achieved by significant reduction in over-triage relative to very small increase in under-triage. In the context of trauma team activation, this trade-off may be acceptable, especially in the current healthcare environment.

LEVEL OF EVIDENCE: Diagnostic study, Level IV.

J Trauma Acute Care Surg. 2016 Apr;80(4):586-96.

The impact of short prehospital times on trauma center performance benchmarking: an ecologic study.

Byrne JP, Mann NC, Hoeft CJ, Buick J, Karanicolas P, Rizoli S, Hunt JP, Nathens AB.

BACKGROUND: Emergency medical service (EMS) prehospital times vary between regions, yet the impact of local prehospital times on trauma center (TC) performance is unknown. To inform external benchmarking efforts, we explored the impact of EMS prehospital times on the risk-adjusted rate of emergency department (ED) death and overall hospital mortality at urban TCs across the United States.

METHODS: We used a novel ecologic study design, linking EMS data from the National EMS Information System to TCs participating in the American College of Surgeons' Trauma Quality Improvement Program (TQIP) by destination zip code. This approach provided EMS times for populations of injured patients transported to TQIP centers. We defined the exposure of interest as the 90th percentile total prehospital time (PHT) for each TC. TCs were then stratified by PHT quartile. Analyses were limited to adult patients with severe blunt or penetrating trauma, transported directly by land to urban TQIP centers. Random-intercept multilevel modeling was used to evaluate the risk-adjusted relationship between PHT quartile and the outcomes of ED death and overall hospital mortality.

RESULTS: During the study period, 119,740 patients met inclusion criteria at 113 TCs. ED death occurred in 1% of patients, and overall mortality was 7.2%. Across all centers, the median PHT was 61 minutes (interquartile range, 53-71 minutes). After risk adjustment, TCs in regions with the shortest quartile of PHTs (<53 minutes) had significantly greater odds of ED death compared with those with the longest PHTs (odds ratio, 2.00; 95% confidence interval, 1.43-2.78). However, there was no association between PHT and overall TC mortality.

CONCLUSION: At urban TCs, local EMS prehospital times are a significant predictor of ED death. However, no relationship exists between prehospital time and overall TC risk-adjusted mortality. Therefore, there is no evidence for the inclusion of EMS prehospital time in external benchmarking analyses.

J Trauma Acute Care Surg. 2016 Apr;80(4):665-9.

Building community resilience to dynamic mass casualty incidents: A multiagency white paper in support of the first care provider.

Callaway D, Bobko J, Smith ER, Shapiro G, McKay S, Anderson K, Sarani B.

CONCLUSION
Professional first responders in the United States are highly trained and are the cornerstone of high-threat disaster response; however, there exists a very real operational gap between existing doctrine, public expectations, and operational capabilities. The FCP decreases the time between point of injury and potentially lifesaving medical intervention. FCPs should be trained in the tenets of the TECC guidelines similar to their first response agencies. National planning is required to develop a means to promulgate this training and ensure ongoing competency for the population at large.

Quote:
“Appropriately analyzed and translated, the military combat experience offers important lessons that can inform the development of civilian response strategies and tactics to address these complexities. The best example of the transition from the military environment to the civilian arena is the evolution of military TCCC to civilian TECC. The Committee on TCCC was the first to emphasize the critical relationship between the tactical environment and appropriate medical interventions. Combined with the tenets of TCCC, the Ranger First Response program is a key reason that the rate of potentially preventable deaths was only 3% from 2001 to 2010. This program integrates trauma care as a fundamental skill for each Ranger.”

Ann Emerg Med. 2016 May;67(5):565-72.

Efficacy of an Acute Pain Titration Protocol Driven by Patient Response to a Simple Query: Do You Want More Pain Medication?

Chang AK, Bijur PE, Holden L, Gallagher EJ.

STUDY OBJECTIVE: We assess the efficacy of a simple pain titration protocol of 1-mg increments of intravenous hydromorphone, given at fixed intervals, driven solely by patient response to a yes/no question.

METHODS: This was a prospective interventional cohort study of nonelderly adults with acute severe pain defined as requiring intravenous opioids in the judgment of the attending emergency physician. All patients received 1 mg intravenous hydromorphone and 30 minutes later were asked, "Do you want more pain medication?" Patients responding yes received an additional 1 mg of intravenous hydromorphone and were asked the same question 30 minutes after receiving it. Those responding no did not receive additional opioid and were asked the question again 30 minutes later. Each patient was queried 4 times. The primary endpoint was the proportion of patients achieving satisfactory pain control, defined as declining additional pain medication on 1 or more occasions.

RESULTS: Of 215 patients enrolled, there were 8 protocol violations, leaving 207 patients with analyzable data; 205 of 207 patients (99%; 95% confidence interval 97% to 100%) achieved satisfactory analgesia at 1 or more points during the study. Nine patients desaturated below 95% on room air, 2 had respiratory rates less than 10 breaths/min, and 2 had pulse rates less than 50 beats/min. No adverse events were associated with amount of hydromorphone received.

CONCLUSION: A pain protocol, based on titration of 1 mg intravenous hydromorphone, driven solely by patient response to a simple standardized question repeated at intervals, resulted in achievement of satisfactory analgesia on at least 1 occasion in 99% of patients.

J Spec Oper Med. 2016 Spring;16(1):36-42.

Testing of Junctional Tourniquets by Medics of the Israeli Defense Force in Control of Simulated Groin Hemorrhage.

Chen J, Benov A, Nadler R, Landau G, Sorkin A, Aden JK 3rd, Kragh JF Jr, Glassberg E.

BACKGROUND: Junctional hemorrhage is a common cause of battlefield death but little is known about testing of junctional tourniquet models by medics. The purpose of the testing described herein is to assess military experience in junctional tourniquet use in simulated prehospital care.

METHODS: Fourteen medics were to use the following four junctional tourniquets: Combat Ready Clamp (CRoC), Abdominal Aortic Junctional Tourniquet (AAJT), Junctional Emergency Treatment Tool (JETT), and SAM Junctional Tourniquet (SJT). The five assessment categories were safety, effectiveness, time to effectiveness, and two categories of user preference: (1) by all models assessed, and (2) by only the model most preferred. Users ranked preference by answering, "If you had to go to war today and you could only choose one, which tourniquet would you choose to bring?"

RESULTS: All tourniquet uses were safe. By the time the first five testers were done, all three AAJT models had been broken. CRoC and AAJT had the highest percentage effectiveness as their difference was not statistically significant. SJT and JETT had fastest mean times to effectiveness as their difference was not significant. For preference, using each user's ranking of all models assessed, SJT and AAJT were most preferred as their difference was not significant. For each user's most preferred model, SJT, AAJT, and JETT were most preferred as their difference was not significant.

CONCLUSION: In the five assessment categories, multiple tourniquet models performed similarly well; SJT and AAJT performed best in four categories, JETT was best in three, and CRoC was best in two. Differences between the top-ranked models in each category were not statistically significant.

Emerg Med J. 2016 Apr 5. pii: emermed-2015-205458.

Tranexamic acid: there's new life in the old drug.

Coats TJ.

Quote:
“There is certainly an enthusiasm for TXA at present—a straw poll in the 2015 RCEM Conference showed that about 30% of UK hospitals had TXA included as a routine part of their massive transfusion protocols—therefore, recommending its use in all patients with massive haemorrhage, irrespective of the cause of the bleeding. This indication has never been the subject of a clinical trial, and is in fact very different from those that have been tested. The trials in both surgery and trauma have administered TXA at a much earlier stage, well before the massive transfusion criteria are fulfilled. In coagulopathic massive haemorrhage, a drug that prevents clot breakdown is unlikely to have much effect if the patient is no longer forming clot.

Linking TXA to a massive haemorrhage protocol creates the wrong mindset in clinicians—if you are not giving TXA until the patient fulfils the criteria for massive haemorrhage, you will be giving it too late. Universal use of TXA in massive haemorrhage also makes research impossible, as there is no longer equipoise.”

Clin Toxicol (Phila). 2016 Apr 22:1-7. [Epub ahead of print]

A prospective study of ketamine versus haloperidol for severe prehospital agitation.

Cole JB, Moore JC, Nystrom PC, Orozco BS, Stellpflug SJ, Kornas RL, Fryza BJ, Steinberg LW, O'Brien-Lambert A, Bache-Wiig, Engebretsen KM, Ho JD.

CONTEXT: Ketamine is an emerging drug for the treatment of acute undifferentiated agitation in the prehospital environment, however no prospective comparative studies have evaluated its effectiveness or safety in this clinical setting.

OBJECTIVE: We hypothesized 5 mg/kg of intramuscular ketamine would be superior to 10 mg of intramuscular haloperidol for severe prehospital agitation, with time to adequate sedation as the primary outcome measure.

METHODS: This was a prospective open label study of all patients in an urban EMS system requiring chemical sedation for severe acute undifferentiated agitation that were subsequently transported to the EMS system's primary Emergency Department. All paramedics were trained in the Altered Mental Status Scale and prospectively recorded agitation scores on all patients. Two 6-month periods where either ketamine or haloperidol was the first-line therapy for severe agitation were prospectively compared primarily for time to adequate sedation. Secondary outcomes included laboratory data and adverse medication events.

RESULTS: 146 subjects were enrolled; 64 received ketamine, 82 received haloperidol. Median time to adequate sedation for the ketamine group was 5 minutes (range 0.4-23) vs. 17 minutes (range 2-84) in the haloperidol group (difference 12 minutes, 95% CI 9-15). Complications occurred in 49% (27/55) of patients receiving ketamine vs. 5% (4/82) in the haloperidol group. Complications specific to the ketamine group included hypersalivation (21/56, 38%), emergence reaction (5/52, 10%), vomiting (5/57, 9%), and laryngospasm (3/55, 5%). Intubation was also significantly higher in the ketamine group; 39% of patients receiving ketamine were intubated vs. 4% of patients receiving haloperidol.

CONCLUSIONS: Ketamine is superior to haloperidol in terms of time to adequate sedation for severe prehospital acute undifferentiated agitation, but is associated with more complications and a higher intubation rate.

J Trauma Acute Care Surg. 2016 May;80(5):717-25.

Current management of hemorrhage from severe pelvic fractures: Results of an American Association for the Surgery of Trauma multi-institutional trial.

Costantini TW, Coimbra R, Holcomb JB, Podbielski JM, Catalano R, Blackburn A, Scalea TM, Stein DM, Williams L, Conflitti J, Keeney S, Suleiman G, Zhou T, Sperry J, Skiada D, Inaba K, Williams BH, Minei JP, Privette A, Mackersie RC, Robinson BR, Moore FO; AAST Pelvic Fracture Study Group.

BACKGROUND: There is no consensus as to the optimal treatment paradigm for patients presenting with hemorrhage from severe pelvic fracture. This study was established to determine the methods of hemorrhage control currently being used in clinical practice.

METHODS: This prospective, observational multi-center study enrolled patients with pelvic fracture from blunt trauma. Demographic data, admission vital signs, presence of shock on admission (systolic blood pressure < 90 mm Hg or heart rate > 120 beats per minute or base deficit < -5), method of hemorrhage control, transfusion requirements, and outcome were collected.

RESULTS: A total of 1,339 patients with pelvic fracture were enrolled from 11 Level I trauma centers. Fifty-seven percent of the patients were male, with a mean ± SD age of 47.1 ± 21.6 years, and Injury Severity Score (ISS) of 19.2 ± 12.7. In-hospital mortality was 9.0 %. Angioembolization and external fixator placement were the most common method of hemorrhage control used. A total of 128 patients (9.6%) underwent diagnostic angiography with contrast extravasation noted in 63 patients. Therapeutic angioembolization was performed on 79 patients (5.9%). There were 178 patients (13.3%) with pelvic fracture admitted in shock with a mean ± SD ISS of 28.2 ± 14.1. In the shock group, 44 patients (24.7%) underwent angiography to diagnose a pelvic source of bleeding with contrast extravasation found in 27 patients. Thirty patients (16.9%) were treated with therapeutic angioembolization. Resuscitative endovascular balloon occlusion of the aorta was performed on five patients in shock and used by only one of the participating centers. Mortality was 32.0% for patients with pelvic fracture admitted in shock.

CONCLUSION: Patients with pelvic fracture admitted in shock have high mortality. Several methods were used for hemorrhage control with significant variation across institutions. The use of resuscitative endovascular balloon occlusion of the aorta may prove to be an important adjunct in the treatment of patients with severe pelvic fracture in shock; however, it is in the early stages of evaluation and not currently used widely across trauma centers.

J Trauma Acute Care Surg. 2016 Apr;80(4):610-6.

Rapid assessment of shock in a nonhuman primate model of uncontrolled hemorrhage: Association of traditional and nontraditional vital signs to mortality risk.

Crossland RF, Mitchell A, Macko AR, Aden JK, Campbell JE, Sheppard FR.

BACKGROUND: Heart rate (HR), systolic blood pressure (SBP) and mean arterial pressure (MAP) are traditionally used to guide patient triage and resuscitation; however, they correlate poorly to shock severity. Therefore, improved acute diagnostic capabilities are needed. Here, we correlated acute alterations in tissue oxygen saturation (StO2) and end-tidal carbon dioxide (ETCO2) to mortality in a rhesus macaque model of uncontrolled hemorrhage.

METHODS: Uncontrolled hemorrhage was induced in anesthetized rhesus macaques by a laparoscopic 60% left-lobe hepatectomy (T = 0 minute). StO2, ETCO2, HR, as well as invasive SBP and MAP were continuously monitored through T = 480 minutes. At T = 120 minutes, bleeding was surgically controlled, and blood loss was quantified. Data analyses compared nonsurvivors (expired before T = 480 minutes, n = 5) with survivors (survived to T = 480 minutes, n = 11) using repeated-measures analysis of variance with Bonferroni correction. All $p < 0.05$ was considered statistically significant. Results were reported as mean ± SEM.

RESULTS: Baseline values were equivalent between groups for each parameter. In nonsurvivors versus survivors at T = 5 minutes, StO2 (55% ± 10% vs. 78% ± 3%, p = 0.02) and ETCO2 (15 ± 2 vs. 25 ± 2 mm Hg, p = 0.0005) were lower, while MAP (18 ± 1 vs. 23 ± 2 mm Hg, p = 0.2), SBP (26 ± 2 vs. 34 ± 3 mm Hg, p = 0.4), and HR (104 ± 13 vs. 105 ± 6 beats/min, p = 0.3) were similar. Association of values over T = 5-30 minutes to mortality demonstrated StO2 and ETCO2 equivalency with a significant group effect ($p \leq 0.009$ for each parameter; R = 0.92 and R = 0.90, respectively). MAP and SBP associated with mortality later into the shock period ($p < 0.04$ for each parameter; R = 0.91 and R = 0.89, respectively), while HR yielded the lowest association (p = 0.8, R = 0.83).

CONCLUSION: Acute alterations in StO2 and ETCO2 strongly associated with mortality and preceded those of traditional vital signs. The continuous, noninvasive aspects of Food and Drug Administration-approved StO2 and ETCO2 monitoring devices provide logistical benefits over other methodologies and thus warrant further investigation.

Prehosp Emerg Care. 2016 Mar 17:1-6. [Epub ahead of print]

Computer Modelling Using Prehospital Vitals Predicts Transfusion and Mortality.

Dezman ZD, Hu E, Hu PF, Yang S, Stansbury LG, Cooke R, Fang R, Miller C, Mackenzie CF.

OBJECTIVE: Test computer-assisted modeling techniques using prehospital vital signs of injured patients to predict emergency transfusion requirements, number of intensive care days, and mortality, compared to vital signs alone.

METHODS: This single-center retrospective analysis of 17,988 trauma patients used vital signs data collected between 2006 and 2012 to predict which patients would receive transfusion, require 3 or more days of intensive care, or die. Standard transmitted prehospital vital signs (heart rate, blood pressure, shock index, and respiratory rate) were used to create a regression model (PH-VS) that was internally validated and evaluated using area under the receiver operating curve (AUROC). Transfusion records were matched with blood bank records. Documentation of death and duration of intensive care were obtained from the trauma registry.

RESULTS: During the course of their hospital stay, 720 of the 17,988 patients in the study population died (4%), 2,266 (12.6%) required at least a 3-day stay in the intensive care unit (ICU), 1,171 (6.5%) required transfusions, and 210 (1.2%) received massive transfusions. The PH-VS model significantly outperformed any individual vital sign across all outcomes (average AUROC = 0.82), The PH-VS model correctly predicted that 512 of 777 (65.9%) and 580 of 931 (62.3%) patients in the study population would receive transfusions within the first 2 and 6 hours of admission, respectively.

CONCLUSIONS: The predictive ability of individual vital signs to predict outcomes is significantly enhanced with the model. This could support prehospital triage by enhancing decision makers' ability to match critically injured patients with appropriate resources with minimal delays.

HDIAC 2016;3:30-34

Sprayable foam limiting blood loss on the battlefield.

Dowling M

Quotes:

"Non-compressible injuries are difficult for field medics to control, and therefore, the majority of deaths occur before transporting the patient to a hospital..... Scientists created an artificial clotting process that mimics natural clotting principles. The research resulted in the development of a hemostatic bandage that will stop the flow of blood. This development, if implemented in both military and civilian trauma centers will increase survivability..... The foam is created by loading an aqueous solution of hmC and propellant into an aluminum canister..... The structure of hmC is shown in the inset.....The molecules are schematically represented by a blue (hydrophilic) backbone and purple hydrophobes attached to the backbone. "

"Hm-Chitosan is used commercially as a compressible hemostatic agent, but aerosolized hemostatic foam has not been utilized. The hm-chitosan- modified aerosol produces a foam dispensed from a standard, lightweight, pressurized aluminum canister, making it a practical tool for field medics. The compact canister does not require refrigeration and does not expire."

Scand J Trauma Resusc Emerg Med. 2016 Apr 6;24:42. doi: 10.1186/s13049-016-0233-4.

Prehospital volume resuscitation - Did evidence defeat the crystalloid dogma? An analysis of the TraumaRegister DGU® 2002-2012.

Driessen A, Fröhlich M, Schäfer N, Mutschler M, Defosse JM, Brockamp T, Bouillon B, Stürmer EK, Lefering R, Maegele M; TraumaRegister DGU.

BACKGROUND: Various studies have shown the deleterious effect of high volume resuscitation following severe trauma promoting coagulopathy by haemodilution, acidosis and hypothermia. As the optimal resuscitation strategy during prehospital trauma care is still discussed, we raised the question if the amount and kind of fluids administered changed over the recent years. Further, if less volume was administered, fewer patients should have arrived in coagulopathic depletion in the Emergency Department resulting in less blood product transfusions.

METHODS: A data analysis of the 100 489 patients entered into the TraumaRegister DGU® (TR-DGU) between 2002 and 2012 was performed of which a total of 23512 patients (23.3%) matched the inclusion criteria. Volume and type of fluids administered as well as outcome parameter were analysed.

RESULTS: Between 2002 and 2012, the amount of volume administered during prehospital trauma care decreased from 1790 ml in 2002 to 1039 ml in 2012. At the same time higher haemoglobin mean values, higher Quick's mean values and reduced mean aPTT can be observed. Simultaneously, more patients received catecholamines (2002: 9.2 to 2012: 13.0%). Interestingly, the amount of volume administered decreased steadily regardless of the presence of shock. Fewer patients were in the need of blood products and the number of massive transfusions (≥10 pRBC) more than halved.

DISCUSSION: The changes in volume therapy might have reduced haemodilution potentially resulting in an increase of the Hb value. During the period observed transfusion strategies have become more restrictiveand ratio based; the percentage of patients receiving MT halved as blood products may imply negative secondary effects. Furthermore, preventing administration of high blood product ratios result in less impairment of coagulation factors and inhibitors and an therefore improved coagulation.

CONCLUSION: The volume administered in severely injured patients decreased considerably during the last decade, possibly supporting beneficial effects such as minimizing the risk of coagulopathy and avoiding potential harmful effects caused by blood product transfusions. Despite outstanding questions in trauma resuscitation, principle evidence merges quickly into clinical practice and algorithms.

J Trauma Acute Care Surg. 2016 Apr 5. [Epub ahead of print]

The AAST Prospective Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery (AORTA) Registry: Data on contemporary utilization and outcomes of aortic occlusion and resuscitative balloon occlusion of the aorta (REBOA).

DuBose JJ, Scalea TM, Brenner M, Skiada D, Inaba K, Cannon J, Moore L, Holcomb J, Turay D, Arbabi CN, Kirkpatrick A, Xiao J, Skarupa D, Poulin N; AAST AORTA Study Group.

INTRODUCTION: Aortic occlusion (AO) for resuscitation in traumatic shock remains controversial. Resuscitative Endovascular Balloon Occlusion of the aorta (REBOA) offers an emerging alternative.

METHODS: The AAST Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery (AORTA) registry prospectively identified trauma patients requiring AO from 8 ACS level I centers. Presentation, intervention and outcome variables were collected and analyzed to compare REBOA and open AO.

RESULTS: From Nov 2013-Feb2015, 114 AO patients were captured (46 REBOA; 68 Open); 80.7% male; 62.3% blunt injured. AO occurred in the Emergency Department (ED) (73.7%) or Operating Room (OR) (26.3%). Hemodynamic improvement after AO was observed in 62.3% [REBOA 29/67.4%; Open 42/61.8%); 36.0% achieving stability (SBP consistently > 90 mm Hg, > 5 minutes) [REBOA 22/46; 47.8%; Open 19/68; 27.9%, p =0.014]. REBOA access was femoral cut-down (50%); US guided (10.9%) and percutaneous without imaging (28.3%). Deployment was achieved in zones I (78.6%), II (2.4%) and III (19.0%). A second AO attempt was required in 9.6% [REBOA 2/46, 4.3%; Open 9/68, 13.2%]. REBOA complications were uncommon (pseudoaneursym 2.1%; embolism 4.3%, 0% limb ischemia). There was no difference in time to successful AO between REBOA and open procedures [REBOA 6.6 ± 5.6 mins; Open 7.2 ± 15.1, p = 0.842]. Overall survival was 21.1% (24/114), with no significant difference between REBOA and open AO with regards to mortality [REBOA 28.2% (13/46); Open 16.1% (11/68); p = 0.120].

CONCLUSION: REBOA has emerged as a viable alternative to open AO in centers that have developed this capability. Further maturation of the AAST AORTA database is required to better elucidate optimal indications and outcomes.

LEVEL OF EVIDENCE: Therapeutic / Care management, level IV.

JEMS 2016;41:35-37

Preparing EMS Agencies and Civilians to Respond to Active Shooter Events.

Eastman A, Chase J, Stark B

Quotes

"Recent events leave no doubt as to the importance of active shooter incident preparedness for first responders and their communities; but what are the essential elements of comprehensive preparedness?

The American College of Surgeons (ACS) gathered world-renowned subject matter experts from law enforcement, Fire/EMS/ rescue and medicine for the purpose of producing guidelines to increase the survivability of mass casualties in active shooter incidents in April 2013 in Hartford, Conn. The resulting guidelines, commonly referred to as the Hartford Consensus, recommended a "seamless, integrated response" from all incident stakeholders including: "Immediate responders," or those present at the time of the incident; "professional first responders," such as Fire/EMS/law enforcement; and "trauma professionals," such as emergency physicians, trauma surgeons, nurses and other in-hospital providers.2
The Hartford Consensus group also created the THREAT acronym that describes the action items, in chronological order, that must be addressed to increase the likelihood of survivability during an active shooter incident:

Threat suppression;
Hemorrhage control;
Rapid Extrication to safety;
Assessment by medical providers; and
Transport to definitive care.

Other Hartford Consensus suggestions included the integration of hemorrhage control with law enforcement response; approaching casualty care as a team effort conducted by law enforcement, Fire/rescue and EMS responders, and a response to active shooter incidents that requires a continuum of care across all public safety personnel."

"Fourteen years of conflict in Afghanistan and Iraq have completely transformed battlefield trauma care in the U.S. military. The Committee on Tactical Combat Casualty Care (CoTCCC), in partnership with the National Association of EMTs (NAEMT), provides an excellent evidence-based source of medical information for EMS providers with its Tactical Combat Casualty Care (TCCC) course. Although developed by the military, the curriculum serves as the source for which other courses, such as Tactical Emergency Casualty Care (TECC), rely on heavily."

J Trauma Acute Care Surg. 2016 Apr 8. [Epub ahead of print]

Prehospital traumatic cardiac arrest: management and outcomes from the Resuscitation Outcomes Consortium Epistry-Trauma and PROPHET registries.

Evans CC, Petersen A, Meier EN, Buick JE, Schreiber M, Kannas D, Austin MA; Resuscitation Outcomes Consortium Investigators.

BACKGROUND: Traumatic arrests have historically had poor survival rates. Identifying salvageable patients and ideal management is challenging. We aimed to: 1) Describe the management and outcomes of prehospital traumatic arrests; 2) Determine regional variation in survival; and 3) Identify Advanced Life Support (ALS) procedures associated with survival.

METHODS: This was a secondary analysis of cases from the Resuscitation Outcomes Consortium Epistry-Trauma and Prospective Observational Prehospital and Hospital Registry for Trauma registries. Patients were included if they suffered a blunt or penetrating injury and received CPR. Logistic regression analyses were used to determine the association between ALS procedures and survival.

RESULTS: We included 2300 patients who were predominately young (Epistry mean: 39 years, SD: 20 years; PROPHET mean: 40 years, SD: 19 years), males (79%), injured by blunt trauma (Epistry: 68%, PROPHET: 67%), and treated by ALS paramedics (Epistry: 93%, PROPHET: 98%). A total of 145 patients (6.3%) survived to hospital discharge. More patients with blunt (Epistry 8.3%, PROPHET: 6.5%) vs. penetrating injuries (Epistry 4.6%, PROPHET: 2.7%) survived. Most survivors (81%) had vitals on EMS arrival. Rates of survival varied significantly between the 12 study sites (p=0.048) in the Epistry but not PROPHET (p=0.14) registries.PROPHET patients who received a supraglottic airway insertion or intubation experienced decreased odds of survival (Adjusted ORs: 0.27, 95% CI: 0.08-0.93, and 0.37, 95% CI: 0.17-0.78, respectively) compared to those receiving bag-mask ventilation. No other procedures were associated with survival.

CONCLUSIONS: Survival from traumatic arrest may be higher than expected, particularly in blunt trauma and patients with vitals on EMS arrival. Although limited by confounding and statistical power, no ALS procedures were associated with an increased odds of survival.

LEVEL OF EVIDENCE: Level IV, prognostic study.

J Arthroplasty. 2016 Mar 19. pii: S0883-5403(16)00288-6.

A Randomized Controlled Trial of Oral and Intravenous Tranexamic Acid in Total Knee Arthroplasty: The Same Efficacy at Lower Cost?

Fillingham YA, Kayupov E, Plummer DR, Moric M, Gerlinger TL, Della Valle CJ

BACKGROUND: Tranexamic acid (TXA) is a synthetic antifibrinolytic agent successfully used intravenously (IV) to reduce blood loss after total knee arthroplasty (TKA). An oral formulation of the medication is available, at a fraction of the cost of the IV preparation. The purpose of this randomized controlled trial is to determine if oral TXA is equivalent to IV TXA in reducing blood loss in TKA.

METHODS: In this double-blinded, placebo-controlled trial, patients undergoing primary TKA were randomized to receive 1.95g of TXA orally 2 hours preoperatively or 1g IV bolus before wound closure. The primary outcome was reduction of hemoglobin. Power analysis determined that 30 patients were required in each group. Equivalence analysis was performed with pooled and Satterthwaite t tests with a P-value of <.05 suggesting equivalence between treatments.

RESULTS: Thirty-four patients received oral TXA and 37 patients received IV TXA. There was no difference in the mean reduction of hemoglobin between oral and IV groups (3.45g/dL vs 3.31g/dL, respectively; P = .001, equivalence), and total blood loss was equivalent at 1281 mL vs 1231 mL, respectively (P = .02, equivalence). One patient in each group was transfused.

CONCLUSION: Oral TXA provides equivalent reductions in blood loss, at a cost of $14 compared with $47-$108 depending on the IV formulation selected. As approximately 700,000 primary TKA are performed in the United States annually, a switch to oral TXA could yield total cost savings of between $23 million and $67 million dollars per year for our health care system.

Prehosp Emerg Care. 2016 Mar 17:1-3. [Epub ahead of print]

Guidance Document for the Prehospital Use of Tranexamic Acid in Injured Patients.

Fischer PE, Bulger EM, Perina DG, Delbridge TR, Gestring ML, Fallat ME, Shatz DV, Doucet J, Levy M, Stuke L, Zietlow SP, Goodloe JM, VanderKolk WE, Fox AD, Sanddal ND.

Abstract: Tranexamic acid (TXA) is being administered already in many prehospital air and ground systems. Insufficient evidence exists to support or refute the prehospital administration of TXA, and results are pending from several prehospital studies currently in progress. We have created this document to aid agencies and systems in best practices for TXA administration based on currently available best evidence. This document has been endorsed by the American College of Surgeons-Committee on Trauma, the American College of Emergency Physicians, and the National Association of EMS Physicians.

J Spec Oper Med. 2016 Spring;16(1):29-35.

Preliminary Comparison of New and Established Tactical Tourniquets in a Manikin Hemorrhage Model.

Gibson R, Housler GJ, Rush SC, Aden JK 3rd, Kragh JF Jr, Dubick MA.

BACKGROUND: Emergency tourniquet use has been associated with hemorrhage control and improved survival during the wars since 2001. The purpose of the present study is to compare the differential performance of two new tactical tourniquets with the standard-issue tourniquet to provide preliminary evidence to guide decisions on device development.

METHODS: A laboratory experiment was designed to test the effectiveness of tourniquets on a manikin thigh. Three models of tourniquets were assessed. The Rapid Application Tourniquet System (RATS) and the Tactical Mechanical Tourniquet (TMT) were compared with the standard-issue Combat Application Tourniquet(®) (C-A-T). Two users conducted 30 tests each.

RESULTS: Percentages for effectiveness (hemorrhage control, yes/no) and distal pulse cessation did not differ significantly by model. When compared with the RATS, the C-A-T performed better ($\rho < .001$) for time to hemorrhage control and fluid loss. The C-A-T and TMT had comparable responses for most measures, but the C-A-T applied more pressure ($\rho = .04$) than did the TMT for hemorrhage control.

CONCLUSION: All three tactical tourniquets showed substantial capacity for hemorrhage control. However, the two new tourniquet models (RATS and TMT) did not offer any improvement over the C-A-T, which is currently issued to military services. Indeed, one of the new models, the RATS, was inferior to the C-A-T in terms of speed of application and simulated loss of blood. Opportunities were detected for refinements in design of the two new tourniquets that may offer future improvements in their performance.

JEMS 2016;4:30-35

Tranexamic acid's potentially bright future relies on collaborative data.

Goodloe J, Gerecht R

Quote:

The processes utilized both in metropolitan Cincinnati and metropolitan Oklahoma City and Tulsa, Okla., can serve as a useful map in going from TXA pondering to reliable, accurate and coordinated TXA administration.

Both systems use committed physician medical oversight capabilities, specifically the Academy of Medicine of Southwest Ohio Prehospital Protocol Committee and the Medical Control Board for the EMS System for Metropolitan Oklahoma City and Tulsa, respectively. These deliberative bodies foster healthy debate and dialogue when determining if procedures or medications are appropriate for the needs of patients served.

They also serve as conduits for critically important input from the medical community, and consulted with trauma centers, trauma surgeons, emergency physicians and surgical intensivists when these agencies were considering TXA. Through such collaboration, evidenced-based treatment protocols and educational resources were developed.
Both agencies' protocols allow and encourage paramedics to initiate TXA administration when indicated, regardless of how close they are to a trauma center. This acknowledges the critical role EMS plays in the continuum of care for the severely injured. Furthermore, it recognizes the complex patient care logistics and inherent task saturation that can occur in a busy trauma center, thus potentially delaying hospital-based administration of TXA.

Both protocols use CRASH-2 and MATTERs dosing in adult trauma patients. This is 1 g of TXA mixed in at least 100 mL normal saline or lactated Ringer's and given IV or intraosseously (IO) over 10 minutes.

Of note, neither protocol directs the EMS initiation of the second 1 g dose (this is an 8-hour continuous infusion). This is based partially on relatively short transport times, but primarily on pharmacokinetics. Clinical and research pharmacists at the University of Cincinnati College of Medicine highlight the fact TXA has a half-life of about two hours, maintaining antifibrinolytic action in some tissues for up to 17 hours and in the blood for approximately 7–8 hours.9 Thus, based on customary EMS patient course of care times, the continuous TXA infusion is deferred to the receiving trauma center. In some trauma center protocols, this can allow for laboratory testing to determine if additional TXA is needed after the prehospital bolus."

Disaster Med Public Health Prep. 2016 Apr;10(2):274-80. doi: 10.1017/dmp.2016.4. Epub 2016 Feb 1.

Analysis of Layperson Tourniquet Application Using a Novel Color-Coded Device.

Goolsby C(1), Chen E(2), Branting A(2), Weissbrod E(3), David J(2), Moore K(2), Olsen C(4).

OBJECTIVE: To determine whether a color-coded tourniquet designed for public use increases successful tourniquet application by laypeople.

METHODS: This was a randomized study conducted on April 25, 2015. The study occurred during the Maryland Day activity at the University of Maryland in College Park, Maryland. Investigators recruited participants with posters displayed at major crosswalks around a central testing area. A total of 157 volunteers aged 18 years or older and without prior military service or medical training were enrolled. A participant stood in front of a waist-down mannequin with an isolated leg injury while an investigator read aloud a mass causality scenario. The investigator then asked the participant to apply a tourniquet to the mannequin's leg. All participants received a 4-step illustrated just-in-time (JiT) instruction card designed to facilitate layperson tourniquet application. Test participants received a color-coded tourniquet designed for layperson use with instructions printed on the device. Control participants received a black Combat Application Tourniquet (C-A-T; Composite Resources, Rock Hill, SC). Participants were randomized in a 1:1 ratio in blocks of 50. The primary outcome was the proportion of successful tourniquet applications by those who received color-coded tourniquets compared to those who received black tourniquets. Secondary outcomes included validation of previous data analyzing layperson success with tourniquet application, time for successful placement, reasons for failed applications, and participant self-willingness and comfort using tourniquets. We also analyzed demographic data on the study population and inter-rater reliability regarding the assessment of successful tourniquet application.

RESULTS: Participants supplied with color-coded tourniquets successfully placed the device 51.38% of the time, compared to 44.71% of the time for controls using a black tourniquet (risk ratio: 1.15; 95% confidence interval: 0.83-1.59; P=0.404). Participants' self-reported willingness to use a tourniquet rose from 40.8% before the study to 80.3% after the study (P<0.05).

CONCLUSIONS: The color-coded device did not significantly increase laypeople's proportion of successful tourniquet applications when compared with a standard black device. However, this study reproduced pilot study data showing that laypeople can successfully apply tourniquets about half the time if provided JiT instructions. Age, sex, race, income, and highest level of education were not found to impact one's ability to properly apply a tourniquet. Laypeople's willingness to apply tourniquets doubled to 80% after brief exposure to the device. These results affirm the feasibility of engaging laypeople as immediate lifesavers of trauma victims and justify further efforts to boost rates of proper application. (Disaster Med Public Health Preparedness. 2016;10:274-280).

Crit Care Med. 2016 Apr 7. [Epub ahead of print]

A Serious Adult Intraosseous Catheter Complication and Review of the Literature.

Greenstein YY(1), Koenig SJ, Mayo PH, Narasimhan M.

OBJECTIVE: Current guidelines recommend the use of intraosseous access when IV access is not readily attainable. The pediatric literature reports an excellent safety profile, whereas only small prospective studies exist in the adult literature. We report a case of vasopressor extravasation and threatened limb perfusion related to intraosseous access use and our management of the complication. We further report our subsequent systematic review of intraosseous access in the adult population.

DATA SOURCES: Ovid Medline was searched from 1946 to January 2015.

STUDY SELECTION: Articles pertaining to intraosseous access in the adult population (age greater than or equal to 14 years) were selected. Search terms were "infusion, intraosseous" (all subfields included), and intraosseous access" as key words.

DATA EXTRACTION: One author conducted the initial literature review. All authors assessed the methodological quality of the studies and consensus was used to ensure studies met inclusion criteria.

DATA SYNTHESIS: The case of vasopressor extravasation was successfully treated with pharmacologic interventions, which reversed the effects of the extravasated vasopressors: intraosseous phentolamine, topical nitroglycerin ointment, and intraarterial verapamil and nitroglycerin. Our systematic review of the adult literature found 2,332 instances of intraosseous insertion. A total of 2,106 intraosseous insertion attempts were made into either the tibia or the humerus; 192 were unsuccessful, with an overall success rate of 91%. Five insertions were associated with serious complications. A total of 226 insertion attempts were made into the sternum; 54 were unsuccessful, with an overall success rate of 76%.

CONCLUSIONS: Intraosseous catheter insertion provides a means for rapid delivery of medications to the vascular compartment with a favorable safety profile. Our systematic literature review of adult intraosseous access demonstrates an excellent safety profile with serious complications occurring in 0.3% of attempts. We report an event of vasopressor extravasation that was potentially limb threatening. Therapy included local treatment and injection of intraarterial vasodilators. Intraosseous access complications should continue to be reported, so that the medical community will be better equipped to treat them as they arise.

J Spec Oper Med. 2016 Spring;16(1):58-61.

SOLCUS: Update On Point-of-Care Ultrasound In Special Operations Medicine.

Hampton KK, Vasios WN 3rd, Loos PE.

Abstract: Point-of-care ultrasonography has been recognized as a relevant and versatile tool in Special Operations Forces (SOF) medicine. The Special Operator Level Clinical Ultrasound (SOLCUS) program has been developed specifically for SOF Medics. A number of challenges, including skill sustainment, high-volume training, and quality assurance, have been identified. Potential solutions, including changes to content delivery methods and application of tele-ultrasound, are described in this article. Given the shift in operational context toward extended care in austere environments, a curriculum adjustment for the SOLCUS program is also proposed.

J Trauma Acute Care Surg. 2016 Jun;80(6):989-97.

The acute respiratory distress syndrome following isolated severe traumatic brain injury.

Hendrickson CM, Howard BM, Kornblith LZ, Conroy AS, Nelson MF, Zhuo H, Liu KD, Manley GT, Matthay MA, Calfee CS, Cohen MJ.

BACKGROUND: Acute respiratory distress syndrome (ARDS) is common after traumatic brain injury (TBI) and is associated with worse neurologic outcomes and longer hospitalization. However, the incidence and associated causes of ARDS in isolated TBI have not been well studied.

METHODS: We performed a subgroup analysis of 210 consecutive patients with isolated severe TBI enrolled in a prospective observational cohort at a Level 1 trauma center between 2005 and 2014. Subjects required endotracheal intubation and had isolated severe TBI defined by a head Abbreviated Injury Scale (AIS score of 3 or greater and AIS score lower than 3 in all other categories. ARDS within the first 8 days of admission was rigorously adjudicated using Berlin criteria. Regression analyses were used to test the association between predictors of interest and ARDS.

RESULTS: The incidence of ARDS in the first 8 days after severe isolated TBI was 30%. Patients who developed ARDS were administered more crystalloids (4.3 L vs. 3.5 L, $p = 0.005$) and blood products in the first 12 hours of admission. Patients with ARDS had significantly worse clinical outcomes measured at 28 days, including longer median intensive care unit and hospital stays (4 days vs. 13 days, $p < 0.001$, and 7.5 days vs. 14.5 days, $p < 0.001$, respectively). In unadjusted logistic regression analyses, the odds of developing ARDS were significantly associated with head AIS score (odds ratio [OR], 1.8; $p = 0.018$), male sex (OR, 2.9; $p = 0.012$), and early transfusion of platelets (OR, 2.8; $p = 0.003$). These associations were similar in a multivariate logistic regression model.

CONCLUSION: In the era of balanced hemostatic resuscitation practices, severity of head injury, male sex, early crystalloids, and early transfusion of platelets are associated with a higher risk of ARDS after severe isolated TBI. Early transfusion of platelets after severe TBI may be a modifiable risk factor for ARDS, and these findings invite further investigation into causal mechanisms driving this observed association.

LEVEL OF EVIDENCE: Prognostic/epidemiologic study, level III.

Prehosp Emerg Care. 2016 Apr 8:1-8. [Epub ahead of print]

Impact of System-Wide King LT Airway Implementation on Orotracheal Intubation.

Hilton MT, Wayne M, Martin-Gill C.

OBJECTIVES: Orotracheal intubation is a key component of prehospital airway management and success rates are dependent on procedural experience. Supraglottic airway devices are increasingly being used in the prehospital setting. As a result, paramedics may have fewer opportunities for performing intubation, limiting their proficiency in the procedure. We aimed to determine the trends in intubation versus supraglottic airway use over an 8 year period. We also aimed to determine the association between system-wide introduction of King LT guidelines and ETI success rates.

METHODS: We performed a retrospective observational study of 37 Emergency Medical Services (EMS) agencies in a 10 county region of Southwestern Pennsylvania. Cases between January 1, 2005 and December 31, 2012 were included if an advanced airway procedure was performed. We determined trends in advanced airway placement and compared the proportion of cases with first pass intubation success before and after the King LT was introduced and promoted by statewide protocol starting in 2007. Use of airway devices before and after King LT implementation were presented using descriptive statistics and compared using Pearson's Chi-square or Fishers Exact test as appropriate. We compared first pass success rate of orotracheal intubation between study periods using multivariable logistic regression, controlling for other factors that may impact success of orotracheal intubation (year, EMS agency, age category, traumatic injury, and cardiac arrest).

RESULTS: There were 712 cases of orotracheal intubation before and 2,835 cases after introduction of the King LT. The proportion of cases ultimately managed with orotracheal intubation before and after 2007 decreased from 72.3% (95% CI 68.9-75.6%) to 67.1% (95% CI 65.3-68.8%) (p = 0.007). In the multivariable analysis, success of orotracheal intubation was not associated with implementation of the King LT airway (OR 1.02, 95% CI 0.74-1.41).

CONCLUSION: Fewer patients with advanced airway management received orotracheal intubation since introduction of the King LT. In spite of this modest change in airway management, there has not been a change in orotracheal intubation success rate since introduction of this supraglottic device as a primary or rescue airway in this regional EMS setting.

SAGE Open Med. 2016 Mar 8;4:2050312116637024. doi: 10.1177/2050312116637024. eCollection 2016.

Perioperative blood loss in total hip and knee arthroplasty: Outcomes associated with intravenous tranexamic acid use in an academic medical center.

Hogan CA, Golightly LK, Phong S, Dayton MR, Lyda C, Barber GR.

OBJECTIVES: Clinical trials have reported decreased blood loss with the use of tranexamic acid during joint reconstruction. The purpose of this study was to assess the individual practice implications of tranexamic acid use in joint replacement surgery.

METHODS: Health records of adults undergoing total knee arthroplasty and total hip arthroplasty over a 12-month period were retrospectively reviewed. The treatment group comprised patients who received intravenous tranexamic acid perioperatively. The control group comprised patients who did not receive tranexamic acid.

RESULTS: Patients in the treatment group (n = 64) and the control group (n = 99) were well matched for demographics, orthopedic diagnosis, and comorbidities. In-hospital postsurgical mean decreases in hemoglobin concentrations were -4.05 g/dL and -4.94 g/dL in the treatment and control groups, respectively ($p < 0.001$). Postsurgical mean decreases in hematocrit levels were -11.2% and -14.2% in the treatment and control groups, respectively ($p < 0.001$). Three patients in the treatment group (5%) and 21 patients in the control group (21%) received red blood cell transfusions ($p = 0.006$). As compared to control, the relative risk of transfusion in the treatment group was 0.23 (95% confidence interval = 0.07-0.76) and the number needed to treat to avoid one transfusion was 7.0 (95% confidence interval = 3.8-14.4). No evidence of thromboembolism or other serious complications were observed in either group.

CONCLUSIONS: In patients undergoing joint replacement surgery, perioperative administration of tranexamic acid was associated with diminished blood loss and lesser resource utilization.

J Trauma Acute Care Surg. 2016 Apr;80(4):559-67.

Resuscitative endovascular balloon occlusion of the aorta might be dangerous in patients with severe torso trauma: A propensity score analysis.

Inoue J, Shiraishi A, Yoshiyuki A, Haruta K, Matsui H, Otomo Y.

BACKGROUND: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a key procedure in early trauma care that provides hemorrhage control in hemodynamically unstable torso trauma patients. However, the clinical efficacy of REBOA remains uncertain. The objective of this study was to estimate the efficacy of REBOA in surgically treated severe torso trauma patients.

METHODS: We obtained data from the nationwide trauma registry in Japan (the Japan Trauma Data Bank) for trauma subjects who had undergone emergency surgery or transcatheter embolization against torso trauma. A logistic regression analysis estimated a propensity score to predict REBOA use from available predictors of in-hospital mortality. We then used a propensity score matching analysis to compare in-hospital mortality and door-to-primary surgery time in subjects who underwent REBOA and those who did not. In addition, we used an instrumental variable method to adjust for unmeasured confounding variables as a sensitivity analysis.

RESULTS: Overall, 12,053 of the 183,457 trauma patients registered in the Japan Trauma Data Bank were eligible based on selection criteria. Propensity score matching selected 625 patients each for the with-REBOA and without-REBOA groups. The in-hospital mortality was significantly higher in subjects who underwent REBOA (61.8% vs. 45.3%; absolute difference, +16.5%; 95% confident interval, +10.9% to +22.0%). Door-to-primary surgery time was shorter in subjects who underwent REBOA than in those who did not (97 minutes vs. 110 minutes; absolute difference, -14 minutes; 95% confidence interval, -25 minutes to -3 minutes). The sensitivity analysis with the instrumental variable method did not alter the results and estimated nonsignificantly higher in-hospital mortality in REBOA subjects (+16.4%; 95% confidence interval, -0.6% to 33.3%).

CONCLUSION: This study showed an association between the use of REBOA and excess mortality in patients with hemodynamically unstable torso trauma that had a median door-to-primary surgery time of 97 minutes. Further observational studies with detailed REBOA data are necessary to assess whether selected trauma subgroups could benefit from REBOA.

LEVEL OF EVIDENCE: Therapeutic study, level III.

Bull Am Coll Surg. 2016 Mar;101(3):17-24.

The Hartford Consensus IV: A Call for Increased National Resilience.

Jacobs LM; Joint Committee to Create a National Policy to Enhance Survivability from Intentional Mass Casualty and Active Shooter Events.

Collaborators: Jacobs LM Jr, Carmona R, Butler F, Warshaw AL, Hoyt DB, Knudson MM, Woodson J, Eastman A, Brinsfield K, Fabbri W, Burns K, Levy M, Holcomb J, Stewart R, Pons P, Lewis T, Mollers R, Marquis M, Fanning S, Langer G.

Abstract: National implementation of the Hartford Consensus is a meticulous and incremental process. It consists of many elements that require collaboration and strategic leadership to achieve an efficient, effective, knowledgeable, resilient, and prepared citizenry. We strongly believe the public can and should act as immediate responders to stop bleeding from all hazards, including active shooter and intentional mass casualty events. The ACS has a long history of setting standards and educating responders through its Committee on Trauma and its programs. The ACS is therefore well-positioned to use its national and international networks to implement bleeding control education to improve survival and enhance resilience.

J Clin Neurosci. 2016 May;27:68-73.

An equiosmolar study on early intracranial physiology and long term outcome in severe traumatic brain injury comparing mannitol and hypertonic saline.

Jagannatha AT, Sriganesh K, Devi BI, Rao GS.

Abstract: The impact of hypertonic saline (HTS) on long term control of intracranial hypertension (ICH) is yet to be established. The current prospective randomized controlled study was carried out in 38 patients with severe traumatic brain injury (TBI). Over 450 episodes of refractory ICH were treated with equiosmolar boluses of 20% mannitol in 20 patients and 3.0% HTS in 18 subjects. Intracranial pressure (ICP) was monitored for 6days. ICP and cerebral perfusion pressure (CPP) were comparable between the groups. The mannitol group had a progressive increase in the ICP over the study period (p=0.01). A similar increase was not seen in the HTS group (p=0.1). The percentage time for which the ICP remained below a threshold of 20 mmHg on day6 was higher in the HTS group (63% versus 49%; p=0.3). The duration of inotrope requirement in the HTS group was less compared to the mannitol group (p=0.06). The slope of fall in ICP in response to a bolus dose at a given baseline value of ICP was higher with HTS compared to mannitol (p=0.0001). In-hospital mortality tended to be lower in the HTS group (3 versus 10; p=0.07) while mortality at 6 months was not different between the groups (6 versus 10; p=0.41). Dichotomized Glasgow Outcome Scale scores at 6months were comparable between the groups (p=0.21). To conclude, immediate physiological advantages seen with HTS over mannitol did not translate into long term benefit on ICP/CPP control or mortality of patients with TBI.

Arch Bone Jt Surg. 2016 Jan;4(1):65-9.

Which Route of Tranexamic Acid Administration is More Effective to Reduce Blood Loss Following Total Knee Arthroplasty?

Keyhani S, Esmailiejah AA, Abbasian MR, Safdari F.

BACKGROUND: The most appropriate route of tranexamic acid administration is controversial. In the current study, we compared the efficacy of intravenous (IV) and topical intra-articular tranexamic acid in reducing blood loss and transfusion rate in patients who underwent primary total knee arthroplasty.

METHODS: One hundred twenty 120 patients were scheduled to undergo primary total knee arthroplasty. Patients were randomly allocated to three equal groups: IV tranexamic acid (500 mg), topical tranexamic acid (3 g in 100 mL normal saline) and the control. In the topical group, half of the volume was used to irrigate the joint and the other half was injected intra-articularly. The volume of blood loss, hemoglobin (Hb) level at 24 hours postoperative, and rate of transfusion was compared between groups.

RESULTS: The blood loss and Hb level were significantly greater and lower in the control group, respectively (P=0.031). Also, the rate of transfusion was significantly greater in the control group (P=0.013). However, IV and topical groups did not differ significantly in terms of measured variables. No patient experienced a thromboembolic event in our study.

CONCLUSION: Tranexamic acid is a useful antifibrinolytic drug to reduce postoperative blood loss, Hb drop, and rate of blood transfusion in patients undergoing total knee arthroplasty. The route of tranexamic acid administration did not affect the efficacy and safety.

J Trauma Acute Care Surg. 2016 Apr 27. [Epub ahead of print]

Influences of Limited Resuscitation with Plasma or Plasma Protein Solutions on Hemostasis and Survival of Rabbits with Non-Compressible Hemorrhage.

Kheirabadi BS, Miranda N, Terrazas IB, Voelker AN, Grimm RC, Dubick MA.

BACKGROUND: Plasma infusion with or without RBC is the current military standard of care for prehospital resuscitation of combat casualties. We examined possible advantages of early and limited resuscitation with fresh plasma compared with a single plasma protein or crystalloid solutions in an uncontrolled hemorrhage model in rabbits.

METHODS: Anesthetized spontaneously breathing rabbits (3.3±0.1 kg) were instrumented and subjected to a splenic uncontrolled hemorrhage. Rabbits in shock were resuscitated at 15 min with Plasma-Lyte (PAL; 30 ml/kg), PAL+ fibrinogen (PAL+F; 30ml+100mg/kg), fresh rabbit plasma (PLS; 15ml/kg), or 25% albumin (ALB; 5 ml/kg) solution; all given in two bolus IV injections (15 min apart) to achieve a MAP of 65 mmHg, n=8-9/group. Animals were monitored for 2 hrs or until death and blood loss was measured. Blood samples and tissues were collected and analyzed.

RESULTS: There were no differences among groups in baseline measures and their initial bleeding volume at 15 min. At 60 min post-injury, MAP was higher with albumin than with crystalloids (PAL or PAL+F), but shock indices were not different despite the large differences in resuscitation volumes. Fibrinogen addition to PAL only increased clot strength. Plasma resuscitation increased survival rate (75%) without significant improvement in coagulation measures. Albumin administration replenished total plasma protein, and increased survival rate to 100% ($p<.05$ vs. crystalloids). No histological adverse events were identified in the vital organs.

CONCLUSION: Fibrinogen administration added to a compatible crystalloid did not improve hemostatic outcomes. Plasma resuscitation increased survival rate, however, its effects did not differ from those obtained with 25% albumin at 1/3 of the volume. The albumin advantage was consistent with our previous findings in which 5% albumin was used at a volume equal to plasma. The benefit of plasma for resuscitation may be mostly due to its albumin content rather than its coagulation proteins.

Emerg Med J. 2016 Apr 19. [Epub ahead of print]

Bystander cricothyrotomy with ballpoint pen: a fresh cadaveric feasibility study.

Kisser U, Braun C, Huber A, Stelter K.

OBJECTIVE: In motion pictures and anecdotal reports, ballpoint pens have been used for life-saving cricothyroidotomies. The objective of this study was to examine the widespread belief that ballpoint pens can perforate the skin and cricothyroid ligament and could be used as substitute tracheostomy sets in an emergency setting.

METHODS: Three different ballpoint pens were examined regarding their inner diameter, their demountability to form a cannula and their airflow properties. Ten medical laypersons were asked to try to puncture the trachea through the skin and the cricothyroid ligament in 10 fresh cadavers just using the ballpoint pens.

RESULTS: Two of three pens had inner diameters of >3 mm and were both suitable as cannulas in a tracheotomy. All participants could perforate the skin with both ballpoint pens. However, almost no one could penetrate through the cricothyroid ligament or the ventral wall of the trachea, except for one participant. He performed the tracheostomy after three attempts in >5 min with a lot of patience and force.

CONCLUSIONS: A cricothyroidotomy just with a ballpoint pen is virtually impossible. First, the airflow resistance in commercially available ballpoint pens is too high to produce effective ventilation. Second, the cricothyroid ligament is too strong to be penetrated by ballpoint pens.

BMJ Open. 2016 Mar 30;6(3):e009913.

Effects of prehospital hypothermia on transfusion requirements and outcomes: a retrospective observatory trial.

Klauke N, Gräff I, Fleischer A, Boehm O, Guttenthaler V, Baumgarten G, Meybohm P, Wittmann M.

OBJECTIVES: Prehospital hypothermia is defined as a core temperature <36.0°C and has been shown to be an independent risk factor for early death in patients with trauma. In a retrospective study, a possible correlation between the body temperature at the time of admission to the emergency room and subsequent in-hospital transfusion requirements and the in-hospital mortality rate was explored.

SETTING: This is a retrospective single-centre study at a primary care hospital in Germany.

PARTICIPANTS: 15 895 patients were included in this study. Patients were classified by admission temperature and transfusion rate. Excluded were ambulant patients and patients with missing data.

PRIMARY AND SECONDARY OUTCOME MEASURES: The primary outcome values were length of stay (LOS) in days, in-hospital mortality, the transferred amount of packed red blood cells (PRBCs), and admission to an intensive care unit. Secondary influencing variables were the patient's age and the Glasgow Coma Scale.

RESULTS: In 22.85% of the patients, hypothermia was documented. Hypothermic patients died earlier in the course of their hospital stay than non-hypothermic patients ($p<0.001$). The administration of 1-3 PRBC increased the LOS significantly ($p<0.001$) and transfused patients had an increased risk of death ($p<0.001$). Prehospital hypothermia could be an independent risk factor for mortality (adjusted OR 8.521; $p=0.001$) and increases the relative risk for transfusion by factor 2.0 (OR 2.007; $p=0.002$).

CONCLUSIONS: Low body temperature at hospital admission is associated with a higher risk of transfusion and death. Hence, a greater awareness of prehospital temperature management should be established.

J Spec Oper Med. 2016 Spring;16(1):14-7.

Short Report Comparing Generation 6 Versus Prototype Generation 7 Combat Application Tourniquet® in a Manikin Hemorrhage Model.

Kragh JF Jr, Moore VK 3rd, Aden JK 3rd, Parsons DL, Dubick MA.

BACKGROUND: The Combat Application Tourniquet® (C-A-T) is the standard-issue military tourniquet used in first aid in 2015, and the current model is called Generation 6. Soldiers in the field, however, have been asking for design changes in a possible Generation 7 to improve ease of use. This study compared the differential performance in use of the C-A-T in two designs: Generation 6 (C-A-T 6) versus a prototype Generation 7 (C-A-T 7).

METHODS: A laboratory experiment was designed to test the performance of two tourniquet designs in hemorrhage control, ease of use, and user preference. Ten users of the two C-A-T models placed them on a manikin thigh to stop simulated bleeding. Users included trauma researchers and instructors of US Army student medics. Ten users conducted 20 tests (10 each of both designs).

RESULTS: Most results were not statistically significant in their difference by C-A-T design. The mean difference in blood loss was statistically significant ($\rho = .03$) in that the C-A-T 7 performed better than the C-A-T 6, but only in the mixed statistical model analysis of variance, which accounted for user effects. The difference in ease-of-use score was statistically significant ($\rho = .002$); the C-A-T 7 was easier. All users preferred the C-A-T 7.

CONCLUSION: In each measure, the C-A-T Generation 7 prototype performed similar or better than Generation 6, was easier to use, and was preferred.

J Orthop Trauma. 2015 Jan;29(1):1-6. doi: 10.1097/BOT.0000000000000262.

Type III open tibia fractures: immediate antibiotic prophylaxis minimizes infection.

Lack WD, Karunakar MA, Angerame MR, Seymour RB, Sims S, Kellam JF, Bosse MJ.

OBJECTIVE: To examine the association between antibiotic timing and deep infection of type III open tibia fractures.

DESIGN: Retrospective prognostic study.

SETTING: Level 1 Trauma Center.

PATIENTS: The study population included 137 patients after exclusions for missing data (13), nonreconstructible limbs (9), and/or absence of 90-day outcome data (3).

INTERVENTION: An observational study of antibiotic timing.

MAIN OUTCOME MEASUREMENT: Deep infection within 90 days.

RESULTS: Age, smoking, diabetes, injury severity score, type IIIA versus 3B/C injury, and time to surgical debridement were not associated with infection on univariate analysis. Greater than 5 days to wound coverage ($P < 0.001$) and greater than 66 minutes to antibiotics ($P < 0.01$) were univariate predictors of infection. Multivariate analysis found wound coverage beyond 5 days [odds ratio, 7.39; 95% confidence interval (CI), 2.33-23.45; $P < 0.001$] and antibiotics beyond 66 minutes (odds ratio, 3.78; 95% CI, 1.16-12.31; $P = 0.03$) independently predicted infection. Immediate antibiotics and early coverage limited the infection rate (1 of 36, 2.8%) relative to delay in either factor (6 of 59, 10.2%) or delay in both factors (17 of 42, 40.5%).

CONCLUSIONS: Time from injury to antibiotics and to wound coverage independently predict infection of type III open tibia fractures. Both should be achieved as early as possible, with coverage being dependent on the condition of the wound. Given the relatively short therapeutic window for antibiotic prophylaxis (within an hour of injury), prehospital antibiotics may substantially improve outcomes for severe open fractures.

LEVEL OF EVIDENCE: Prognostic Level II. See Instructions for Authors for a complete description of levels of evidence.

Int J Mol Sci. 2016 Apr 12;17(4).

Comparison of Topical Hemostatic Agents in a Swine Model of Extremity Arterial Hemorrhage: BloodSTOP iX Battle Matrix vs. QuikClot Combat Gauze.

Li H, Wang L, Alwaal A, Lee YC, Reed-Maldonado A, Spangler TA, Banie L, O'Hara RB, Lin G.

Abstract: BloodSTOP iX Battle Matrix (BM) and QuikClot Combat Gauze (CG) have both been used to treat traumatic bleeding. The purpose of this study was to examine the efficacy and initial safety of both products in a swine extremity arterial hemorrhage model, which mimics combat injury. Swine (37.13 ± 0.56 kg, NBM = 11, NCG = 9) were anesthetized and splenectomized. We then isolated the femoral arteries and performed a 6 mm arteriotomy. After 45 s of free bleeding, either BM or CG was applied. Fluid resuscitation was provided to maintain a mean arteria pressure of 65 mmHg. Animals were observed for three hours or until death. Fluoroscopic angiography and wound stability challenge tests were performed on survivors. Tissue samples were collected for histologic examination. Stable hemostasis was achieved in 11/11 BM and 5/9 CG subjects, with recovery of mean arterial pressure and animal survival for three hours ($p < 0.05$, Odds Ratio (OR) = 18.82 (0.85-415.3)). Time to stable hemostasis was shorter for the BM-treated group (4.8 ± 2.5 min vs. 58 ± 20.1 min; Median = 2, Interquartile Range (IQR) = 0 min vs. Median = 60, IQR = 120 min; $p < 0.05$) and experienced longer total stable hemostasis (175.2 ± 2.5 min vs. 92.4 ± 29.9 min; Median = 178, IQR = 0 min vs. Median = 120, IQR = 178 min; $p < 0.05$). Post-treatment blood loss was lower with BM (9.5 ± 2.4 mL/kg, Median = 10.52, IQR = 13.63 mL/kg) compared to CG (29.9 ± 9.9 mL/kg, Median = 29.38, IQR = 62.44 mL/kg) ($p = 0.2875$). Standard BM products weighed less compared to CG (6.9 ± 0.03 g vs. 20.2 ± 0.4 g) ($p < 0.05$) and absorbed less blood (3.4 ± 0.8 g vs. 41.9 ± 12.3 g) ($p < 0.05$). Fluoroscopic angiography showed recanalization in 5/11 (BM) and 0/5 (CG) surviving animals ($p = 0.07$, OR = 9.3 (0.41-208.8)). The wound stability challenge test resulted in wound re-bleeding in 1/11 (BM) and 5/5 (CG) surviving animals ($p < 0.05$, OR = 0.013 (0.00045-0.375)). Histologic evidence indicated no wound site, distal limb or major organ damage in either group. BM is more effective and portable in treating arterial hemorrhage compared to CG. There was no histologic evidence of further damage in either group.

Seizure. 2016 Mar;36:70-3. doi: 10.1016/j.seizure.2016.02.011. Epub 2016 Feb 26.

Tranexamic acid-associated seizures: A meta-analysis.

Lin Z, Xiaoyi Z.

PURPOSE: To investigate the incidence rate of tranexamic acid (TXA)-associated seizures.

METHODS: Two electronic databases (Medline and Embase) were searched. We looked for additional studies in the references of all identified publications. The cutoff day was 2015 Dec 06. Two authors independently reviewed the titles and abstracts of the publications identified firstly. Odds ratio (OR) and 95% confidence interval (CI) were used to compare discontinuous variables.

RESULTS: Ten studies enrolling 26,079 patients with TXA exposure and 7395 patients with non-TXA exposure were included. The cumulative incidence rate of TXA-associated seizures is 2.7%. The odds ratio of seizure is 5.39 (95%CI: 3.29-8.85; I(2)=0%; P<0.001) in patients with TXA exposure vs patients with non-TXA exposure. The incidence rate of TXA-associated seizures increased when the dose levels increased.

CONCLUSION: The risk of seizure increased in patients with TXA exposure and the incidence rate of TXA-associated seizures increased when the dose levels increased.

Emerg Phys Monthly 2016;Epub ahead of print

Battle Tested: Ketamine Proves its Worth on the Front Lines.

Mabry R, Schauer S, Fisher A

Quote:

"Ketamine as an analgesic agent has proven its worth when used in combination with other drugs or when used as a solo agent. In combination with opioid medications, the addition of ketamine has an opioid-sparing effect, making it a useful agent in the hospital and prehospital settings [4-8]. A recent randomized controlled trial demonstrated a more rapid onset of analgesic effects from ketamine compared to morphine [9]. Ketamine has become a recommended analgesic agent in the combat environment in Afghanistan due to its safety profile, favorable hemodynamic characteristics in severely injured combat casualties, rapid onset and ease of use.

Current Tactical Combat Casualty Care guidelines allow for its use even in the setting of eye trauma and head injuries in which the person is conscious enough to demonstrate the need for analgesia. A recent study evaluating the use of analgesic agents at the point-of-injury found no adverse events from the use of ketamine – even under the harshest conditions with minimal to no monitoring [10]. It is a recommended agent by the Wilderness Medical Society for use in remote environments [11]. Even in the hands of non-physician practitioners it appears safe [12]. Risks associated with ketamine use in the setting of head or eye trauma appear to be supported by nothing more than medical folklore [13,14]. The Regional Emergency Medical Services Council of New York City has recently begun to adopt more widespread use of this agent. Based on the military's experience, ketamine's use as an analgesic agent in the civilian environment warrants further consideration."

Transfusion. 2016 Apr;56 Suppl 2:S157-65. doi: 10.1111/trf.13526.

Coagulation factor concentrate-based therapy for remote damage control resuscitation (RDCR): a reasonable alternative?

Maegele M.

Abstract: The concept of remote damage control resuscitation (RDCR) is still in its infancy and there is significant work to be done to improve outcomes for patients with life-threatening bleeding secondary to injury. The prehospital phase of resuscitation is critical and if shock and coagulopathy can be rapidly minimized before hospital admission this will very likely reduce morbidity and mortality. The optimum transfusion strategy for these patients is still highly debated and the potential implications of the recently published pragmatic, randomize, optimal platelet, and plasma ratios trial (PROPPR) for RDCR have been reviewed. Identifying the appropriate transfusion strategy is mandatory before adopting prehospital hemostatic resuscitation strategies. An alternative approach is based on the early administration of coagulation factor concentrates combined with the antifibrinolytic tranexamic acid (TXA). The three major components to this approach in the context of RDCR target the following steps to achieve hemostasis: 1) stop (hyper)fibrinolysis; 2) support clot formation; and 3) increase thrombin generation. Strong evidence exists for the use of TXA. The data from the prospective fibrinogen in trauma induced coagulopathy (FIinTIC) study will inform on the prehospital use of fibrinogen in bleeding trauma patients. Deficits in thrombin generation may be addressed by the administration of prothrombin complex concentrates. Handheld point-of-care devices may be able to support and guide the prehospital and remote use of intravenous hemostatic agents including coagulation factor concentrates along with clinical presentation, assessment, and the extent of bleeding. Combinations may even be more effective for bleeding control. More studies are urgently needed.

J Vasc Surg. 2016 Jun;63(6):1588-94. doi: 10.1016/j.jvs.2015.12.045.

A decade of pelvic vascular injuries during the Global War on Terror.

McDonald VS, Quail J, Tingzon M, Ayers JD, Casey KM.

BACKGROUND: Pelvic vascular injuries (PVIs) rarely occur in isolation and are often associated with significant morbidity. The purpose of this study was to examine the incidence, trends, and early outcomes of PVIs sustained in combat.

METHODS: The Department of Defense Trauma Registry was queried to identify all patients treated with PVIs during the first 10 years of Operation Enduring Freedom. Patient demographics, mechanism of injury, type of vascular injury, in-theater complications, and early clinical outcomes were examined.

RESULTS: From 2003 to 2012, 143 patients (99% male) sustained a PVI in Afghanistan. During this period, there was a persistent increase in the percentage of patient visits (0.4% in 2003 to 2.0% in 2012). The mean Injury Severity Score (ISS) was 24. Sixty-six percent of patient injuries were secondary to explosions. Improvised explosive devices (IEDs) encountered by dismounted personnel accounted for 47% of all injuries and were associated with a significantly higher ISS (28) compared with all other mechanisms of injury ($P < .01$). There were 85 (43%) arterial and 112 (57%) venous PVIs. The most frequent arterial injury was the common iliac artery. Injury to the femoral vein was associated with a higher median transfusion requirement. One patient died in combat theater. Injuries from IEDs had higher rates of coagulopathy, acidosis, and hypothermia compared with other mechanisms of injury ($P = .03$). Forty-two patients (29%) sustained early infectious complications. Injuries from explosions were also associated with a significantly higher rate of infectious complications compared with other mechanisms of injury ($P < .01$).

CONCLUSIONS: PVIs have occurred with increasing frequency during Operation Enduring Freedom. Despite a persistently low mortality, complication and infection rates remain high, particularly when injuries are secondary to explosions. IEDs are associated with higher ISS and complication rates. Future studies must continue to focus on the prevention and treatment of PVIs sustained in combat, particularly those caused by explosions.

Head Neck. 2016 Jul;38(7):1129-31.

Cricothyroidotomy - The emergency surgical airway.

Melchiors J, Todsen T, Konge L, Charabi B, von Buchwald C.

Quotes:

"The Rapid Four-Step Technique (RFST) is a very fast emergency cricothyroidotomy procedure that involves minimal demand for surgical aptitude, as no dissection is required. (2) A scalpel is introduced via a horizontal stab incision directly through the cricothyroid membrane into the trachea and an endotracheal tube is introduced into the trachea, aided by a hook. As the name indicates, the technique involves 4 steps, as shown in Figure 1. The RFST is easy to master, has a low risk of complications, and can be performed in less than 45 seconds. (3,4) Therefore, we have chosen the RFST as our standard emergency cricothyroidotomy procedure. As the use of instructional videos has a proven effect on acquiring skills,5 we have created a novel video that demonstrates the procedure."

"When comparing different emergency cricothyroidotomy procedures, evidence is based on trials in simulated conditions. The results of these trials differ markedly from the clinical experience, with considerably more favorable outcomes regarding both success rate and time spent from "knife to airway." (1,8) The lack of bleeding, abnormal anatomy, and circumstantial stress are the factors most likely to affect the outcome. Therefore, there is no solid experimental evidence to suggest that any one of the surgical techniques is superior to the others in terms of success rates or time. (9)"

"We believe the straightforwardness of the RFST is key to its clinical applicability. Moreover, a technique that utilizes standard surgical instruments accessible on a surgical ward is favorable to one that uses special equipment, such as a kit or bougie."

J Trauma Acute Care Surg. 2016 Mar 25. [Epub ahead of print]

Blood transfusion: In the air tonight?

Miller BT, Du L, Krzyzaniak MJ, Gunter OL, Nunez TC.

BACKGROUND: The use of prehospital blood transfusion (PBT) in air medical transport has become more widespread. However, the effect of PBT remains unknown. The aim of this study was to examine the impact of PBT on 24-hour and overall in-hospital mortality.

METHODS: This is a retrospective cohort study of all trauma patients carried by air medical transport from the scene to a Level One Trauma Center from 2007 to 2013. We excluded patients who died on the helipad or in the emergency department. Primary outcomes measured were 24-hour and overall in-hospital mortality. Multivariable logistic regressions using all available patient data or the propensity score (for receiving PBT) matched patient data were performed to study the effect of PBT on these outcomes.

RESULTS: Of the 5581 patients included in the study, 231 (4%) received PBT. Multivariable regression analyses did not show evidence of PBT effect on 24-hour in-hospital mortality (odds ratio [OR] 1.22; 95% confidence interval [CI] 0.61-2.44), nor on overall in-hospital mortality (OR 1.20; 95% CI 0.55-1.79). Additionally, using 1:1 propensity score matched data, the analysis did not show evidence of PBT effect on 24-hour in-hospital mortality (OR 1.04; 95% CI 0.54-1.98), nor on overall in-hospital mortality (OR 1.05; 95% CI 0.56-1.96). Factors associated with increased 24-hour mortality were advanced age, penetrating injury, increased blood transfusion requirement in the first 24 hours, and decreased Glasgow Coma Scale score ($p < 0.05$). These factors were also associated with overall mortality, in addition to increased Injury Severity Score ($p < 0.05$).

CONCLUSIONS: This is the largest study to date of trauma patients who received PBT and were transported from the scene by air medical transport. Our results show no effect of PBT on 24-hour and overall in-hospital mortality. Previous studies also suggest no benefit of PBT, which is counter-intuitive to damage control resuscitation. Prospective data on PBT is needed to assess risk, cost, and benefit.

STUDY TYPE: Therapeutic LEVEL OF EVIDENCE: III.

Am J Emerg Med. 2015 Mar;33(3):402-8. doi: 10.1016/j.ajem.2014.12.058. Epub 2015 Jan 7.

Low-dose ketamine vs morphine for acute pain in the ED: a randomized controlled trial.

Miller JP, Schauer SG, Ganem VJ, Bebarta VS.

OBJECTIVES: To compare the maximum change in numeric rating scale (NRS) pain scores, in patients receiving low-dose ketamine (LDK) or morphine (MOR) for acute pain in the emergency department.

METHODS: We performed an institutional review board-approved, randomized, prospective, double-blinded trial at a tertiary, level 1 trauma center. A convenience sample of patients aged 18 to 59 years with acute abdominal, flank, low back, or extremity pain were enrolled. Subjects were consented and randomized to intravenous LDK (0.3mg/kg) or intravenous MOR (0.1mg/kg). Our primary outcome was the maximum change in NRS scores. A sample size of 20 subjects per group was calculated based on an 80% power to detect a 2-point change in NRS scores between treatment groups with estimated SDs of 2 and an α of .05, using a repeated-measures linear model.

RESULTS: Forty-five subjects were enrolled (MOR 21, LDK 24). Demographic variables and baseline NRS scores (7.1 vs 7.1) were similar. Ketamine was not superior to MOR in the maximum change of NRS pain scores, MOR=5 (confidence interval, 6.6-3.5) and LDK=4.9 (confidence interval, 5.8-4). The time to achieve maximum reduction in NRS pain scores was at 5 minutes for LDK and 100 minutes for MOR. Vital signs, adverse events, provider, and nurse satisfaction scores were similar between groups.

CONCLUSION: Low-dose ketamine did not produce a greater reduction in NRS pain scores compared with MOR for acute pain in the emergency department. However, LDK induced a significant analgesic effect within 5 minutes and provided a moderate reduction in pain for 2 hours.

Transfusion. 2016 Apr;56 Suppl 2:S110-4. doi: 10.1111/trf.13486.

Rationale for the selective administration of tranexamic acid to inhibit fibrinolysis in the severely injured patient.

Moore EE, Moore HB, Gonzalez E, Sauaia A, Banerjee A, Silliman CC.

Abstract: Postinjury fibrinolysis can manifest as three distinguishable phenotypes: 1) hyperfibrinolysis, 2) physiologic, and 3) hypofibrinolysis (shutdown). Hyperfibrinolysis is associated with uncontrolled bleeding due to clot dissolution; whereas, fibrinolysis shutdown is associated with organ dysfunction due to microvascular occlusion. The incidence of fibrinolysis phenotypes at hospital arrival in severely injured patients is: 1) hyperfibrinolysis 18%, physiologic 18%, and shutdown 64%. The mechanisms responsible for dysregulated fibrinolysis following injury remain uncertain. Animal work suggests hypoperfusion promotes fibrinolysis, while tissue injury inhibits fibrinolysis. Clinical experience is consistent with these observations. The predominant mediator of postinjury hyperfibrinolysis appears to be tissue plasminogen activator (tPA) released from ischemic endothelium. The effects of tPA are accentuated by impaired hepatic clearance. Fibrinolysis shutdown, on the other hand, may occur from inhibition of circulating tPA, enhanced clot strength impairing the binding of tPA and plasminogen to fibrin, or the inhibition of plasmin. Plasminogen activator inhibitor -1 (PAI-1) binding of circulating tPA appears to be a major mechanism for postinjury shutdown. The sources of PAI-1 include endothelium, platelets, and organ parenchyma. The laboratory identification of fibrinolysis phenotype, at this moment, is best determined with viscoelastic hemostatic assays (TEG, ROTEM). While D-dimer and plasmin antiplasmin (PAP) levels corroborate fibrinolysis, they do not provide real-time assessment of the circulating blood capacity. Our clinical studies indicate that fibrinolysis is a very dynamic process and our experimental work suggests plasma first resuscitation reverses hyperfibrinolysis. Collectively, we believe recent clinical and experimental work suggest antifibrinolytic therapy should be employed selectively in the acutely injured patient, and optimally guided by TEG or ROTEM.

Wilderness Environ Med. 2016 Mar;27(1):125-30.

Portable Prehospital Methods to Treat Near-Hypothermic Shivering Cold Casualties.

Oliver SJ, Brierley JL, Raymond-Barker PC, Dolci A, Walsh NP.

OBJECTIVE: To compare the effectiveness of a single-layered polyethylene survival bag (P), a single-layered polyethylene survival bag with a hot drink (P+HD), a multi-layered metalized plastic sheeting survival bag (MPS: Blizzard Survival), and a multi-layered MPS survival bag with 4 large chemical heat pads (MPS+HP: Blizzard Heat) to treat cold casualties.

METHODS: Portable cold casualty treatment methods were compared by examining core and skin temperature, metabolic heat production, and thermal comfort during a 3-hour, 0°C cold air exposure in 7 shivering, near-hypothermic men (35.4°C). The hot drink (70°C, ~400ml, ~28kJ) was consumed at 0, 1, and 2 hours during the cold air exposure.

RESULTS: During the cold air exposure, core rewarming and thermal comfort were similar on all trials ($P = .45$ and $P = .36$, respectively). However, skin temperature was higher (10%-13%; $P < .001$; large effect sizes $d > 2.7$) and metabolic heat production lower (15%-39%; $P < .05$; large effect sizes $d > .9$) on MPS and MPS+HP than P and P+HD. The addition of heat pads further lowered metabolic heat production by 15% (MPS+HP vs MPS; $P = .05$; large effect size $d = .9$). The addition of the hot drink to polyethylene survival bag did not increase skin temperature or lower metabolic heat production.

CONCLUSIONS: Near-hypothermic cold casualties are rewarmed with less peripheral cold stress and shivering thermogenesis using a multi-layered MPS survival bag compared with a polyethylene survival bag. Prehospital rewarming is further aided by large chemical heat pads but not by hot drinks.

Med Oral Patol Oral Cir Bucal. 2016 Jan 1;21(1):e127-34.

Single dose of diclofenac or meloxicam for control of pain, facial swelling, and trismus in oral surgery.

Orozco-Solís M, García-Ávalos Y, Pichardo-Ramírez C, Tobías-Azúa F, Zapata-Morales JR, Aragon-Martínez OH, Isiordia-Espinoza MA.

BACKGROUND: Postoperative pain associated with removal of mandibular third molars has been documented from moderate to severe during the first 24 hours after surgery, with pain peaking between 6 and 8 hours when a conventional local anesthetic is used. Dental pain is largely inflammatory, and evidence-based medicine has shown that nonsteroidal anti-inflammatory drugs are the best analgesics for dental pain. The aim of this study was to compare the analgesic, anti-inflammatory and anti-trismus effect of a single dose of diclofenac and meloxicam after mandibular third molar extraction.

MATERIAL AND METHODS: A total of 36 patients were randomized into two treatment groups, each with 18 patients, using a series of random numbers: Group A, was administered 100 mg of diclofenac; and Group B, 15 mg of meloxicam. Drugs were administered orally 1 hour prior to surgery. We evaluated pain intensity, analgesic consumption, swelling, as well as trismus.

RESULTS: The results of this study showed that patients receiving 15 mg of meloxicam had less postoperative pain (P=0.04) and better aperture than those receiving 100 mg of diclofenac (P=0.03). The meloxicam group presented less swelling than diclofenac group; however, significant statistical differences were not observed.

CONCLUSIONS: Data of this double-blind, randomized, parallel-group clinical trial demonstrated that patients receiving 15 mg of preoperative meloxicam had a better postoperative analgesia and anti-trismus effect compared with who were given 100 mg of diclofenac after third molar extractions.

Clin Pharmacokinet. 2016 Mar 30. [Epub ahead of print]

Ketamine: A Review of Clinical Pharmacokinetics and Pharmacodynamics in Anesthesia and Pain Therapy.

Peltoniemi MA, Hagelberg NM, Olkkola KT, Saari TI.

Abstract: Ketamine is a phencyclidine derivative, which functions primarily as an antagonist of the N-methyl-D-aspartate receptor. It has no affinity for gamma-aminobutyric acid receptors in the central nervous system. Ketamine shows a chiral structure consisting of two optical isomers. It undergoes oxidative metabolism, mainly to norketamine by cytochrome P450 (CYP) 3A and CYP2B6 enzymes. The use of S-ketamine is increasing worldwide, since the S(+)-enantiomer has been postulated to be a four times more potent anesthetic and analgesic than the R(-)-enantiomer and approximately two times more effective than the racemic mixture of ketamine. Because of extensive first-pass metabolism, oral bioavailability is poor and ketamine is vulnerable to pharmacokinetic drug interactions. Sublingual and nasal formulations of ketamine are being developed, and especially nasal administration produces rapid maximum plasma ketamine concentrations with relatively high bioavailability. Ketamine produces hemodynamically stable anesthesia via central sympathetic stimulation without affecting respiratory function. Animal studies have shown that ketamine has neuroprotective properties, and there is no evidence of elevated intracranial pressure after ketamine dosing in humans. Low-dose perioperative ketamine may reduce opioid consumption and chronic postsurgical pain after specific surgical procedures. However, long-term analgesic effects of ketamine in chronic pain patients have not been demonstrated. Besides analgesic properties, ketamine has rapid-acting antidepressant effects, which may be useful in treating therapy-resistant depressive patients. Well-known psychotomimetic and cognitive adverse effects restrict the clinical usefulness of ketamine, even though fewer psychomimetic adverse effects have been reported with S-ketamine in comparison with the racemate. Safety issues in long-term use are yet to be resolved.

Strategies Trauma Limb Reconstr. 2016 Apr;11(1):13-8.

Factors influencing infection in 10 years of battlefield open tibia fractures.

Penn-Barwell JG, Bennett PM, Mortiboy DE, Fries CA, Groom AF, Sargeant ID.

Abstract: The aim of this study was to characterise severe open tibial shaft fractures sustained by the UK military personnel over 10 years of combat in Iraq and Afghanistan. The UK military Joint Theatre Trauma Registry was searched for all such injuries, and clinical records were reviewed for all patients. One hundred Gustilo-Anderson III tibia fractures in 89 patients were identified in the 10 year study period; the majority sustained injuries through explosive weapons (63, 68 %) with the remainder being injured from gunshot wounds. Three fractures were not followed up for 12 months and were therefore excluded. Twenty-two (23 %) of the remaining 97 tibial fractures were complicated by infection, with S. aureus being the causative agent in 13/22 infected fractures (59 %). Neither injury severity, mechanism, the use of an external fixator, the need for vascularized tissue transfer nor smoking status was associated with subsequent infection. Bone loss was significantly associated with subsequent infection ($p < 0.0001$, Fisher's exact test). This study presents 10 years of open tibial fractures sustained in Iraq and Afghanistan. Most infection in combat open tibia fractures is caused by familiar organisms, i.e. S. aureus. While the overall severity of a casualty's injuries was not associated with infection, the degree of bone loss from the fracture was.

Crit Care. 2016 Apr 20;20(1):107.

A recommended early goal-directed management guideline for the prevention of hypothermia-related transfusion, morbidity, and mortality in severely injured trauma patients.

Perlman R, Callum J, Laflamme C, Tien H, Nascimento B, Beckett A, Alam A.

Abstract: Hypothermia is present in up to two-thirds of patients with severe injury, although it is often disregarded during the initial resuscitation. Studies have revealed that hypothermia is associated with mortality in a large percentage of trauma cases when the patient's temperature is below 32 °C. Risk factors include the severity of injury, wet clothing, low transport unit temperature, use of anesthesia, and prolonged surgery. Fortunately, associated coagulation disorders have been shown to completely resolve with aggressive warming. Selected passive and active warming techniques can be applied in damage control resuscitation. While treatment guidelines exist for acidosis and bleeding, there is no evidence-based approach to managing hypothermia in trauma patients. We synthesized a goal-directed algorithm for warming the severely injured patient that can be directly incorporated into current Advanced Trauma Life Support guidelines. This involves the early use of warming blankets and removal of wet clothing in the prehospital phase followed by aggressive rewarming on arrival at the hospital if the patient's injuries require damage control therapy. Future research in hypothermia management should concentrate on applying this treatment algorithm and should evaluate its influence on patient outcomes. This treatment strategy may help to reduce blood loss and improve morbidity and mortality in this population of patients.

Resuscitation. 2016 May;102:70-4.

Evaluation of six different airway devices regarding regurgitation and pulmonary aspiration during cardio-pulmonary resuscitation (CPR) - A human cadaver pilot study.

Piegeler T, Roessler B, Goliasch G, Fischer H, Schlaepfer M, Lang S, Ruetzler K.

BACKGROUND: Chest compressions and ventilation are lifesaving tasks during cardio-pulmonary resuscitation (CPR). Besides oxygenation, endotracheal intubation (ETI) during CPR is performed to avoid aspiration of gastric contents. If intubation is difficult or impossible, supraglottic airway devices are utilized. We tested six different airway devices regarding their potential to protect against regurgitation and aspiration during CPR in a randomized experimental human cadaver study.

METHODS: Five-hundred ml of 0.01% methylene-blue-solution were instilled into the stomach of 30 adult human cadavers via an oro-gastric tube. The cadavers were then randomly assigned to one of six groups, resulting in 5 cadavers in each group. Airway management was performed with either bag-valve ventilation, Laryngeal Tube, EasyTube, Laryngeal Mask (Classic), I-Gel, or ETI. Thereafter 5min of CPR were performed according to the 2010 Guidelines of the European Resuscitation Council. Pulmonary aspiration was defined as the presence of methylene-blue-solution below the vocal cords or the ETI cuff as assessed by fiber-optic bronchoscopy.

RESULTS: Thirty cadavers were included (14 females, 16 males). Aspiration was detected in three out of five cadavers receiving bag-valve ventilation and in two out of five intubated with LMA or I-Gel. In cadavers intubated with the LT, aspiration occurred in one out of five cases. No aspiration could be detected in cadavers intubated with ETI and EasyTube.

CONCLUSION: This study provides experimental evidence that, during CPR, ETI offers superior protection against regurgitation and pulmonary aspiration of gastric contents than supraglottic airway devices or bag-valve ventilation.

J Trauma Acute Care Surg. 2016 Apr 5. [Epub ahead of print]

Shorter Times to Packed Red Blood Cell Transfusion are Associated with Decreased Risk of Death in Traumatically Injured Patients.

Powell EK, Hinckley WR, Gottula A, Hart KW, Lindsell CJ, McMullan JT.

BACKGROUND: Hemorrhage is a leading cause of death in traumatically injured patients. Currently, the importance of earlier administration of packed red blood cells (pRBC) to improve outcomes is limited. We evaluated the association of earlier pRBC administration and mortality when compared with later transfusion initiation.

METHODS: This single center retrospective, cohort study of trauma patients transported by a single helicopter service from the scene of injury to an urban, academic trauma center included patients receiving at least one unit of pRBCs within 24 hours of hospital arrival. The final cohort included patients transported to the trauma center between March 11, 2010 and October 30, 2013. The helicopter service carries two units of pRBCs for protocol-driven prehospital transfusion. Logistic regression was used to model odds of death, and 95% confidence intervals were calculated.

RESULTS: The 94 patients meeting inclusion criteria had a mean age of 43 years (SD 19), 87/94 (93%) were Caucasian, 66/94 (70%) were male, and 88/94 (94%) sustained blunt force injuries. Median Injury Severity Score was 29 (range 2-75), and 31/94 (33%) died within 30 days. Most patients [82/94 (87%)] received their first pRBC transfusion during transport or within one hour of ED arrival. For the 82 patients receiving a first pRBC transfusion within one hour of ED arrival, each 10 minute increase in time to transfusion increased the odds of death [OR 1.27 (95% CI 1.01 - 1.62, p=0.044)], controlling for TRISS. At 30 days, 29/82 (35%) patients who received a pRBC transfusion within one hour of ED arrival and 2/12 (16%) patients who received delayed transfusion were deceased (difference 19%, 95% CI -5% to 42%).

CONCLUSION: In this study, delays in time to pRBC administration of as short as ten minutes were associated with increased odds of death for patients receiving ultra-early pRBC transfusion. Expedient prehospital and ED transfusion capabilities may improve outcomes after trauma.

LEVEL OF EVIDENCE: This was a level III therapeutic/care management study.

Injury. 2016 Mar;47(3):717-20.

Comparison of skin pressure measurements with the use of pelvic circumferential compression devices on pelvic ring injuries.

Prasarn ML, Horodyski M, Schneider PS, Pernik MN, Gary JL, Rechtine GR.

OBJECTIVES: Pelvic circumferential compression devices are commonly used in the acute treatment of pelvic fractures for reduction of pelvic volume and initial stabilisation of the pelvic ring. There have been reports of catastrophic soft-tissue breakdown with their use. The aim of the current investigation was to determine whether various pelvic circumferential compression devices exert different amounts of pressure on the skin when applied with the force necessary to reduce the injury. The study hypothesis was that the device with the greatest surface area would have the lowest pressures on the soft-tissue.

METHODS: Rotationally unstable pelvic injuries (OTA type 61-B) were surgically created in five fresh, whole human cadavers. The amount of displacement at the pubic symphysis was measured using a Fastrak, three-dimensional, electromagnetic motion analysis device (Polhemus Inc., Colchester, VT). The T-POD, Pelvic Binder, Sam Sling, and circumferential sheet were applied in random order for testing. The devices were applied with enough force to obtain a reduction of less than 10mm of diastasis at the pubic symphysis. Pressure measurements, force required, and contact surface area were recorded with a Tekscan pressure mapping system.

RESULTS: The mean skin pressures observed ranged from 23 to 31kPa (173 to 233mm of Hg). The highest pressures were observed with the Sam Sling, but no statistically significant skin pressure differences were observed with any of the four devices ($p>0.05$). The Sam Sling also had the least mean contact area (590cm(2)). In greater than 70% of the trials, including all four devices tested, skin pressures exceeded what has been shown to be pressure high enough to cause skin breakdown (9.3kPa or 70mm of Hg).

CONCLUSIONS: Application of commercially available pelvic binders as well as circumferential sheeting commonly results in mean skin pressures that are considered to be above the threshold for skin breakdown. We therefore recommend that these devices only be used acutely, and definitive fixation or external fixation should be performed early as patient physiology allows. There may be some advantage of use of a simple sheet given its low cost, versatility, and ability to alter contact surface area.

Transfusion. 2016 Mar;56 Suppl 1:S16-23.

Comprehensive US government program for dried plasma development.

Pusateri AE, Given MB, Macdonald VW, Homer MJ.

Abstract: Transfusion of plasma early after severe injury has been associated with improved survival. There are significant logistic factors that limit the ability to deliver plasma where needed in austere environments, such as the battlefield or during a significant civilian emergency. While some countries have access to more logistically supportable dried plasma, there is no such product approved for use in the United States. There is a clear need for a Food and Drug Administration (FDA) -approved dried plasma for military and emergency-preparedness uses, as well as for civilian use in remote or austere settings. The Department of Defense (DoD) and Biomedical Advanced Research and Development Authority are sponsoring development of three dried plasma products, incorporating different technologic approaches and business models. At the same time, the DoD is sponsoring prospective, randomized clinical studies on the prehospital use of plasma. These efforts are part of a coordinated program to provide a dried plasma for military and civilian applications and to produce additional information on plasma use so that, by the time we have an FDA-approved dried plasma, we will better understand how to use it.

Transfusion. 2016 Apr;56 Suppl 2:S128-39. doi: 10.1111/trf.13580.

Dried plasma: state of the science and recent developments.

Pusateri AE, Given MB, Schreiber MA, Spinella PC, Pati S, Kozar RA, Khan A, Dacorta JA, Kupferer KR, Prat N, Pidcoke HF, Macdonald VW, Malloy WW, Sailliol A, Cap AP.

Abstract: The early transfusion of plasma is important to ensure optimal survival of patients with traumatic hemorrhage. In military and remote or austere civilian settings, it may be impossible to move patients to hospital facilities within the first few hours of injury. A dried plasma product with reduced logistical requirements is needed to enable plasma transfusion where medically needed, instead of only where freezers and other equipment are available. First developed in the 1930s, pooled lyophilized plasma was widely used by British and American forces in WWII and the Korean War. Historical dried plasma products solved the logistical problem but were abandoned because of disease transmission. Modern methods to improve blood safety have made it possible to produce safe and effective dried plasma. Dried plasma products are available in France, Germany, South Africa, and a limited number of other countries. However, no product is available in the US. Promising products are in development that employ different methods of drying, pathogen reduction, pooling, packaging, and other approaches. Although challenges exist, the in vitro and in vivo data suggest that these products have great potential to be safe and effective. The history, state of the science, and recent developments in dried plasma are reviewed.

JAMA Ophthalmol. 2016 Apr 1;134(4):415-21.

Association Between Oral Fluoroquinolone Use and Retinal Detachment.

Raguideau F, Lemaitre M, Dray-Spira R, Zureik M.

IMPORTANCE: Several studies have focused on the current use of oral fluoroquinolones and the risk for retinal detachment (RD), but the existence of this association is under debate. Given the widespread fluoroquinolone use, investigation of this association is essential.

OBJECTIVE: To assess the association between oral fluoroquinolone use and the risk for RD, including the rhegmatogenous and exudative types.

DESIGN, SETTING, AND PARTICIPANTS: This case-crossover study included 27,540 adults with RD from French health care databases from July 1, 2010, through December 31, 2013. Patients with a history of RD or retinal break, endophthalmitis, intravitreal injection, choroidal retinal vitreal biopsy, and human immunodeficiency virus infection or those hospitalized within 6 months of RD were excluded. The risk period of primary interest was current use, defined as exposure to fluoroquinolones within 10 days immediately before RD surgery, according to previous findings. Oral fluoroquinolone use was assumed to start on the day the prescription was dispensed.

MAIN OUTCOMES AND MEASURES: Exposure to fluoroquinolones during the risk period (1-10 days) compared with the control period (61-180 days). The association was also assessed regarding use in the recent (11-30 days) and past (31-60 days) intermediate risk period, type of fluoroquinolone, and type of RD.

RESULTS: Of the 27,540 eligible patients (57% men; mean [SD] age, 61.5 [13.6] years), 663 patients with RD were exposed to fluoroquinolones during the observation period, corresponding to 80 cases exposed during the 10-day risk period (≤10 days before RD) and 583 cases exposed during the control period (61-180 days). We found a significant increased risk for RD during the 10-day period after the dispensing of oral fluoroquinolones, with an adjusted odds ratio of 1.46 (95% CI, 1.15-1.87). The risk was significantly increased for rhegmatogenous and exudative RD, with adjusted odds ratios of 1.41 (95% CI, 1.04-1.92) and 2.57 (95% CI, 1.46-4.53), respectively. Recent and past use of fluoroquinolones were not associated with a higher risk for RD, with adjusted odds ratios of 0.94 (95% CI, 0.78-1.14) and 1.06 (95% CI, 0.91-1.24), respectively.

CONCLUSIONS AND RELEVANCE: Current oral fluoroquinolone use was associated with an increased risk for RD, including the rhegmatogenous and exudative types. These findings, along with the available literature, suggest an association between fluoroquinolone use and the risk for RD. The nature of this association should be further investigated in future studies.

J Trauma Acute Care Surg. 2016 May;80(5):787-91.

The state of the union: Nationwide absence of uniform guidelines for the prehospital use of tourniquets to control extremity exsanguination.

Ramly E, Runyan G, King DR.

BACKGROUND: After the Sandy Hook shootings and the resulting Hartford Consensus, as well as the recent Boston Marathon bombing, the need for a uniform, detailed, and aggressive prehospital extremity exsanguination control protocol became clear. We hypothesized that most states within the United States lack a detailed uniform protocol.

METHODS: We performed a systematic nationwide assessment of emergency medical services (EMS) prehospital extremity exsanguination control protocols. An online search (updated February 7, 2015) identified state-, region-, or county-specific EMS protocols in all 50 states. If unavailable online, protocols were retrieved directly by contacting each state's Department of Public Health (or other appropriate agency). Two investigators independently screened each extremity exsanguination control protocol. Protocols were first grouped into three categories: I, tourniquet not mentioned; II, tourniquet mentioned, without specific guidance; III, tourniquet mentioned, with specific guidance related to type, indications, application technique, and safety concerns. Each protocol was then scored on a five-point scale for comparison.

RESULTS: Forty-two states (84%) had statewide and 14 (28%) had at least one county-specific protocol. Seven states (16%) had no statewide protocol but at least one county-specific protocol (range, 1-10). Mississippi had neither statewide nor county-specific protocols. Of statewide protocols, 4 (9.5%) were in Category I, 23 (54.8%) in Category II, and 15 (35.7%) in Category III. The mean score for statewide tourniquets was 2.4/5 (SD, 1.25; range, 0-5). Thirteen (31%) statewide protocols referred to "commercial" or "approved" tourniquets; only three (7%) recommended a particular commercial device. The mean score for the county-specific protocols of states with no statewide protocol was 3.10 (SD,
1.56; range, 0-5)

CONCLUSIONS: Throughout the United States, there is considerable variability in EMS protocols addressing the management of extremity exsanguination and an alarming absence of specific guidance for tourniquet use. Most states do not have a uniform, detailed, and aggressive prehospital extremity exsanguination control protocol.

LEVEL OF EVIDENCE: Epidemiologic and prognostic study, level III.

Transfusion. 2016 Apr;56 Suppl 2:S203-7.

Surgical adjuncts to noncompressible torso hemorrhage as tools for patient blood management.

Rappold JF, Bochicchio GV.

Abstract: Despite the tremendous advances and successes in the care of combat casualties over the past 15 years of war, noncompressible torso hemorrhage (NCTH) remains the most likely source of potentially preventable death (approx. 25%) on the battlefield. This is also likely true for civilian victims of blunt and penetrating trauma. Various devices and therapeutic interventions have been, and are being, developed in an attempt to reduce morbidity and mortality for patients with NCTH. Examples include the use of prehospital blood and blood products, tranexamic acid, specially designed tourniquets for junctional hemorrhage control, retrograde endovascular balloon occlusion of the aorta, intracavity foam, expandable hemostatic sponges, and intravascular nanoparticles to suspended animation. Although each of these modalities offer the potential to staunch uncontrolled hemorrhage until an injured patient is able to reach definitive surgical care, further research and advances must be made to further reduce trauma morbidity and mortality and to identify those technologies and modalities that are best suited to rapid movement to the front lines of combat casualty care as well as to emergency medical personnel dealing with civilian trauma victims. The surgical adjuncts for NCTH discussed may all be considered as potential tools for patient blood management programs. If effective they offer the possibility of reduce hemorrhage and blood product exposure and improved patient outcomes.

Air Med J. 2016 Mar-Apr;35(2):84-5.

High-Dose Ketamine Sedation of an Agitated Patient During Air Medical Transport.

Reicher D.

Abstract: We report a case in which a high-dose ketamine infusion was used to sedate an agitated patient for air medical transport, avoiding the risks of general anesthesia and causing no exacerbation of psychiatric symptoms.

Quotes:

"Shortly afterward, the increased agitation recurred. Boluses of ketamine were given, and the rate of ketamine infusion was increased over the next 30 minutes until the patient was calm and presented no further risk to himself. The rate of ketamine infusion at which this occurred was 250 mg/h or 3.85 mg/kg/h (patient weight was 65 kg). Occasionally, an additional ketamine bolus of 20 mg was required."

"At this dose of ketamine infusion, he remained hemodynamically stable with a heart rate averaging 90 beats/min and systolic blood pressure of 140 mm Hg. Respirations were regular and averaged 18 breaths/min, with oxygen saturations greater than 95%. He appeared to be in a state of full dissociative anesthesia, with eyes opening to voice, inability to obey commands, and occasionally speaking incoherently (Richmond Agitation-Sedation Scale: _3)."

"In summary, this case contributes to the experiential evidence that high-dose ketamine has been safely used for sedation of an agitated patient with a known psychiatric disorder during air medical transport without causing exacerbation of symptoms."

J Trauma Acute Care Surg 2016 May;80(5):799-804. doi: 10.1097/TA.0000000000001003.

Feasibility of a perfused and ventilated cadaveric model for assessment of lifesaving traumatic hemorrhage and airway management skills.

Reihsen TE, Alberti L, Speich J, Poniatowski LH, Hart D, Sweet RM.

BACKGROUND:
Training health care providers to manage common life-threatening traumatic injuries is an important endeavor. A fresh perfused cadaveric model with high anatomic and tissue fidelity was developed to assess performance of hemorrhage and airway management skills during a simulated polytrauma scenario.

METHODS:
Fresh human cadavers were obtained within 96 hours of death. Hemorrhage from a right traumatic amputation and left inguinal wound was simulated using cannulation of the right popliteal and left femoral artery, respectively. The thoracic aorta (thoracotomy method) or external iliac arteries (Pfannenstiel method) were used for catheter access points. Lung ventilation to simulate chest rise and fall was achieved using bilateral chest tubes connected to a bag valve mask. Participants underwent a simulated nighttime field care scenario in which they attempted tourniquet placement, direct wound pressure and packing, and endotracheal intubation.

RESULTS:
Twenty-four donors were obtained (58-95 years old; mean, 77). There were 305 total scenarios completed using 23 cadavers (mean, approximately 13 scenarios per cadaver). The cost for acquisition and preparation of donors can be estimated at $3,611 to $9,399.

CONCLUSION:
This model successfully allowed for the demonstration of hemorrhage and airway management skills with high anatomic and tissue fidelity. For the assessment of critical lifesaving skills that are nondestructive in nature, the use of a fresh perfused cadaveric model is feasible and suitable for evaluation of these procedures.

J Neurotrauma. 2016 Jun 1;33(11):1054-9

The Impact of Pre-Hospital Administration of Lactated Ringer's Solution versus Normal Saline in Patients with Traumatic Brain Injury.

Rowell SE, Fair KA, Barbosa RR, Watters JM, Bulger EM, Holcomb JB, Cohen MJ, Rahbar MH, Fox EE, Schreiber MA.

Abstract: Lactated Ringer's (LR) and normal saline (NS) are both used for resuscitation of injured patients. NS has been associated with increased resuscitation volume, blood loss, acidosis, and coagulopathy compared with LR. We sought to determine if pre-hospital LR is associated with improved outcome compared with NS in patients with and without traumatic brain injury (TBI). We included patients receiving pre-hospital LR or NS from the PRospective Observational Multicenter Major Trauma Transfusion (PROMMTT) study. Patients with TBI (Abbreviated Injury Scale [AIS] head ≥3) and without TBI (AIS head ≤2) were compared. Cox proportional hazards models including Injury Severity Score (ISS), AIS head, AIS extremity, age, fluids, intubation status, and hospital site were generated for prediction of mortality. Linear regression models were generated for prediction of red blood cell (RBC) and crystalloid requirement, and admission biochemical/physiological parameters. Seven hundred ninety-one patients received either LR (n = 117) or NS (n = 674). Median ISS, AIS head, AIS extremity, and pre-hospital fluid volume were higher in TBI and non-TBI patients receiving LR compared with NS ($p < 0.01$). In patients with TBI (n = 308), LR was associated with higher adjusted mortality compared with NS (hazard rate [HR] = 1.78, confidence interval [CI] 1.04-3.04, $p = 0.035$). In patients without TBI (n = 483), no difference in mortality was demonstrated (HR = 1.49, CI 0.757-2.95, $p = 0.247$). Fluid type had no effect on admission biochemical or physiological parameters, 6-hour RBC, or crystalloid requirement in either group. LR was associated with increased mortality compared with NS in patients with TBI. These results underscore the need for a prospective randomized trial comparing pre-hospital LR with NS in patients with TBI.

J Trauma Acute Care Surg. 2016 Mar;80(3):372-80.

Extending the golden hour: Partial resuscitative endovascular balloon occlusion of the aorta in a highly lethal swine liver injury model.

Russo RM, Williams TK, Grayson JK, Lamb CM, Cannon JW, Clement NF, Galante JM, Neff LP.

BACKGROUND: Combat-injured patients may require rapid and sustained support during transport; however, the prolonged aortic occlusion produced by conventional resuscitative endovascular balloon occlusion of the aorta (REBOA) may lead to substantial morbidity. Partial REBOA (P-REBOA) may permit longer periods of occlusion by allowing some degree of distal perfusion. However, the ability of this procedure to limit exsanguination is unclear. We evaluated the impact of P-REBOA on immediate survival and ongoing hemorrhage in a highly lethal swine liver injury model.

METHODS: Fifteen Yorkshire-cross swine were anesthetized, instrumented, splenectomized, and subjected to rapid 10% total blood loss followed by 30% liver amputation. Coagulopathy was created through colloid hemodilution. Randomized swine received no intervention (control), P-REBOA, or complete REBOA (C-REBOA). Central mean arterial pressure (cMAP), carotid blood flow, and blood loss were recorded. Balloons remained inflated in the P-REBOA and C-REBOA groups for 90 minutes followed by graded deflation. The study ended at 180 minutes from onset of hemorrhage or death of the animal. Survival analysis was performed, and data were analyzed using repeated-measures analysis of variance with post hoc pairwise comparisons.

RESULTS: Mean survival times in the control, P-REBOA, and C-REBOA groups were, 25 ± 21, 86 ± 40, and 163 ± 20 minutes, respectively ($p < 0.001$). Blood loss was greater in the P-REBOA group than the C-REBOA or control groups, but this difference was not significant (4,722 ± 224, 3,834 ± 319, 3,818 ± 37 mL, respectively, $p = 0.10$). P-REBOA resulted in maintenance of near-baseline carotid blood flow and cMAP, while C-REBOA generated extreme cMAP and prolonged supraphysiologic carotid blood flow. Both experimental groups experienced profound decreases in cMAP following balloon deflation.

CONCLUSION: In the setting of severe ongoing hemorrhage, P-REBOA increased survival time beyond the golden hour while maintaining cMAP and carotid flow at physiologic levels.

Prehosp Emerg Care. 2016 May 31:1-11. [Epub ahead of print]

Safety and Appropriateness of Tourniquets in 105 Civilians.

Scerbo MH, Mumm JP, Gates K, Love JD, Wade CE, Holcomb JB, Cotton BA.

BACKGROUND: The United States military considers tourniquets to be effective for controlling bleeding from major limb trauma. The purpose of this study was to assess whether tourniquets are safely applied to the appropriate civilian patient with major limb trauma of any etiology.

METHODS: Following IRB approval, patients arriving to a level-1 trauma center between October 2008 and May 2013 with a prehospital (PH) or emergency department (ED) tourniquet were reviewed. Cases were assigned the following designations: absolute indication (operation within 2 hours for limb injury, vascular injury requiring repair/ligation, or traumatic amputation); relative indication (major musculoskeletal/soft-tissue injury requiring operation 2-8 hours after arrival, documented large blood loss); and non-indicated. Patients with absolute or relative indications for tourniquet placement were defined as indicated, while the remaining were designated as non-indicated. Complications potentially associated with tourniquets, including amputation, acute renal failure, compartment syndrome, nerve palsies, and venous thromboembolic events, were adjudicated by orthopedic, hand or trauma surgical staff. Univariate analysis was performed to compare patients with indicated versus non-indicated tourniquet placement.

RESULTS: A total of 105 patients received a tourniquet for injuries sustained via sharp objects, i.e., glass or knives (32%), motor vehicle collisions (30%), or other mechanisms (38%). A total of 94 patients (90%) had indicated tourniquet placement; 41 (44%) of which had a vascular injury. Demographics, mechanism, transport, and vitals were similar between patients that had indicated or non-indicated tourniquet placement. 48% of the indicated tourniquets placed PH were removed in the ED, compared to 100% of the non-indicated tourniquets ($p < 0.01$). The amputation rate was 32% among patients with indicated tourniquet placement (vs. 0%; $p = 0.03$). Acute renal failure (3.2 vs. 0%, $p = 0.72$), compartment syndrome (2.1 vs. 0%, $p = 0.80$), nerve palsies (5.3 vs. 0%; $p = 0.57$), and venous thromboembolic events (9.1 vs. 8.5%; $p = 0.65$) and were similar in patients that had indicated compared to non-indicated tourniquet placement. After adjudication, no complication was a result of tourniquet use.

CONCLUSION: The current study suggests that PH and ED tourniquets are used safely and appropriately in civilians with major limb trauma that occur via blunt and penetrating mechanisms.

J Trauma Acute Care Surg. 2016 Mar 18. [Epub ahead of print]

Brain hypoxia is exacerbated in hypobaria during aeromedical evacuation in swine with TBI.

Scultetus AH, Haque A, Chun SJ, Hazzard B, Mahon RT, Harssema MJ, Auker CR, Moon-Massat P, Malone DL, McCarron RM.

BACKGROUND: There is inadequate information on the physiological effects of aeromedical evacuation on wounded warfighters with traumatic brain injury (TBI). At altitudes of 8,000 ft., the inspired oxygen is lower than standard sea level values. In troops suffering TBI, this reduced oxygen may worsen or cause secondary brain injury. We tested the hypothesis that the effects of prolonged aeromedical evacuation on critical neurophysiological parameters (i.e., brain oxygenation [PbtO2]) of swine with a fluid percussion injury (FPI) -TBI would be detrimental compared to ground (normobaric) transport.

METHODS: Yorkshire swine underwent FPI-TBI with pre-transport stabilization before being randomized to a 4 h aeromedical transport at simulated flight altitude of 8,000 ft. (HYPO, N = 8) or normobaric ground transport (NORMO, N = 8). Physiological measurements (i.e., PbtO2, cerebral perfusion pressure [CPP], intracranial pressure [ICP], regional cerebral blood flow [rCBF], mean arterial blood pressure [MAP], and oxygen transport variables) were analyzed.

RESULTS: Survival was equivalent between groups. Measurements were similar in both groups at all phases up to and including onset of flight. During the flight, PbtO2, CPP and MAP were significantly lower in HYPO vs. NORMO groups, respectively. At the end of flight, rCBF was lower in HYPO vs. NORMO groups. Other parameters such as ICP, cardiac output and mean pulmonary artery pressure were not significantly different between the two groups.

CONCLUSION: A 4 h aeromedical evacuation at simulated flight altitude of 8,000 ft. caused a notable reduction in neurophysiological parameters compared to normobaric conditions in this TBI swine model. Results suggest hypobaric conditions exacerbate cerebral hypoxia and may worsen TBI in casualties already in critical condition.

Evidence Level II, Animal Research.

World J Emerg Med. 2016;7(1):19-24. doi: 10.5847/wjem.j.1920-8642.2016.01.003.

Intranasal ketamine for the treatment of patients with acute pain in the emergency department.

Shrestha R, Pant S, Shrestha A, Batajoo KH, Thapa R, Vaidya S.

BACKGROUND: Pain in the emergency department (ED) is common but undertreated. The objective of this study was to examine the efficacy and safety of intranasal (IN) ketamine used as an analgesic for patients with acute injury with moderate to severe pain.

METHODS: This study was a cross sectional, observational study of patients more than 8 years old experiencing moderate to severe pain [visual analog score (VAS) >50 mm]. The initial dose of IN ketamine was 0.7 mg/kg with an additional dose of 0.3 mg/kg if VAS was more than 50 mm after 15 minutes. Pain scores and vital signs were recorded at 0, 15, 30 and 60 minutes. Side-effects, sedation level and patient's satisfaction were also recorded. The primary outcome was the number of patients achieving ≥ 20 mm reductions in VAS at 15 minutes. Other secondary outcome measures were median reduction in VAS at 15, 30 and 60 minutes, changes of vital signs, adverse events, satisfaction of patients, and need for additional ketamine.

RESULTS: Thirty-four patients with a median age of 29.5 years (IQR 17.5-38) were enrolled, and they had an initial median VAS of 80 mm (IQR 67-90). The VAS decreased more than 20 mm at 15 minutes in 27 (80%) patients. The reduction of VAS from baseline to 40 mm (IQR 20-40), 20 mm (IQR 14-20) and 20 mm (IQR 10-20)respectively at 15, 30 and 60 minutes ($P<0.001$). No critical changes of vital signs were noted and adverse effects were mild and transient.

CONCLUSION: This study showed that IN ketamine is an analgesic choice for patients with acute injury in moderate to severe pain in an overcrowded and resource limited ED.

J Spec Oper Med. 2016 Spring;16(1):19-28.

Management of External Hemorrhage in Tactical Combat Casualty Care: The Adjunctive Use of XStat™ Compressed Hemostatic Sponges: TCCC Guidelines Change 15-03.

Sims K, Montgomery HR, Dituro P, Kheirabadi BS, Butler FK.

Abstract: Exsanguination from wounds in the so-called junctional regions of the body (i.e., the neck, the axilla, and the groin) was responsible for 19% of the combat fatalities who died from potentially survivable wounds sustained in Afghanistan or Iraq during 2001 to 2011. The development of improved techniques and technology to manage junctional hemorrhage has been identified in the past as a high-priority item by the Committee on Tactical Combat Casualty Care (CoTCCC) and the Army Surgeon General's Dismounted Complex Blast Injury (DCBI) Task Force. Additionally, prehospital care providers have had limited options with which to manage hemorrhage resulting from deep, narrow-track, penetrating trauma. XStat™ is a new product recently approved by the US Food and Drug Administration as a hemostatic adjunct to aid in the control of bleeding from junctional wounds in the groin or axilla. XStat has now been recommended by the CoTCCC as another tool for the combat medical provider to use in the management of junctional hemorrhage. The evidence that supports adding XStat to the TCCC Guidelines for the treatment of external hemorrhage is summarized in this paper.

Quotes:

"XStat has been designed and tested specifically in a highly lethal junctional bleeding model for penetrating injury that includes bleeding from both the subclavian artery and vein at the depth of a wound with a 4.5cm tract. The key properties that differentiate this hemostatic adjunct from other devices are as follows: (1) it is designed such that the wound would be, in effect, packed from the inside of the wound out, whereas hemostatic dressings are packed from the outside in; (2) the application time has been shown to be shorter than Combat Gauze; and (3) XStat does not require a 3-minute period of external manual pressure on the wound after application."

"Based on the demonstrated ability of XStat to control severe bleeding from vascular injury sites located at the internal aspect of narrow-tract junctional wounds, this product offers an external hemorrhage control capability that may be more efficacious than Combat Gauze for these types of wounds. The Mueller and the Cestero studies have shown that XStat achieved 100% survival in subclavian vascular injuries, a wounding pattern that has been observed to be highly lethal in trauma patients. Furthermore, XStat may be a very valuable adjunct in treating axillary wounds, which is a junctional site that is relatively difficult to treat with the three current TCCC-approved junctional tourniquets."

Transfusion. 2016 Apr;56 Suppl 2:S190-202. doi: 10.1111/trf.13491.

Whole blood for hemostatic resuscitation of major bleeding.

Spinella PC, Pidcoke HF, Strandenes G, Hervig T, Fisher A, Jenkins D, Yazer M, Stubbs J, Murdock A, Sailliol A, Ness PM, Cap AP.

Abstract: Recent combat experience reignited interest in transfusing whole blood (WB) for patients with life-threatening bleeding. US Army data indicate that WB transfusion is associated with improved or comparable survival compared to resuscitation with blood components. These data complement randomized controlled trials that indicate that platelet (PLT)-containing blood products stored at 4°C have superior hemostatic function, based on reduced bleeding and improved functional measures of hemostasis, compared to PLT-containing blood products at 22°C. WB is rarely available in civilian hospitals and as a result is rarely transfused for patients with hemorrhagic shock. Recent developments suggest that impediments to WB availability can be overcome, specifically the misconceptions that WB must be ABO specific, that WB cannot be leukoreduced and maintain PLTs, and finally that cold storage causes loss of PLT function. Data indicate that the use of low anti-A and anti-B titer group O WB is safe as a universal donor, WB can be leukoreduced with PLT-sparing filters, and WB stored at 4°C retains PLT function during 15 days of storage. The understanding that these perceived barriers are not insurmountable will improve the availability of WB and facilitate its use. In addition, there are logistic and economic advantages of WB-based resuscitation compared to component therapy for hemorrhagic shock. The use of low-titer group O WB stored for up to 15 days at 4°C merits further study to compare its efficacy and safety with current resuscitation approaches for all patients with life-threatening bleeding.

J Spec Oper Med. 2016 Spring;16(1):122-4.

Closing The Gap: Improving Trauma Care On The Ukrainian Battlefield.

Stacey SK, Jones PH.

Abstract: Since early 2014, Ukraine has been involved in a violent social and political revolution that has taken more than 7,000 lives. Many of these deaths were due to limited field medical care and prolonged evacuation times because the Ukrainian military has been slow to adopt standard combat medical processes. We deployed with the US Army's 173rd Airborne Brigade to train soldiers in the National Guard of Ukraine (NGU) on combat first aid. We discovered that a major deficiency limiting the quality of trauma care and evacuation is an endemic lack of prior coordination and planning. The responsibility for this coordination falls on military leaders; therefore, we delivered medical operations training to officers of the NGU unit and observed great improvement in medical care sustainment. We recommend systematic leader education in best medical practices be institutionalized at all levels of the Ukrainian Army to foster sustained improvement and refinement of trauma care.

Quote:

"Their outlook on the current status of trauma care was illustrated in a conversation we had with a veteran Ukrainian sergeant. He had been to the conflict zone and had both heard and seen firsthand how his comrades would languish for hours without definitive care. During a field training exercise on tourniquet application for hemorrhage control under enemy fire, he asked intently how long the tourniquet could remain applied before the limb could no longer be salvaged (Figure 1). We discussed that there is a wide range of time in which limbs have remained viable, but that permanent injury from tourniquet application will seldom occur if they meet the evacuation target of 60 minutes to higher level of care. Considering the stories he had heard and his own experience with the wounded and dying, he responded with understandable disbelief that such rapid evacuation could be routinely possible. We stressed the necessity of preparation, emphasizing that failure to consider medical actions until after an injury is sustained endangers lives. At that point, he led the group of trainees in expressing that prior planning simply is not done."

Curr Opin Anaesthesiol. 2016 Apr;29(2):250-5.

Trauma-associated bleeding: management of massive transfusion.

Stephens CT, Gumbert S, Holcomb JB.

PURPOSE OF REVIEW: Early treatment goals in the bleeding trauma patient have changed based on recent research findings. Trauma patients requiring a massive transfusion protocol have shown a decreased mortality based on a more aggressive and balanced approach to blood product resuscitation. This chapter will review the recent advances in managing the bleeding trauma patient.

RECENT FINDINGS: Recent data have suggested a combined approach of early ratio-based blood product use, bedside viscoelastic hemostatic assays, hemostatic resuscitation, and finally goal-directed therapy to complete resuscitation.

SUMMARY: There is now evidence to support the early use of a 1:1:1 blood product transfusion protocol to restore lost circulating volume, improve oxygen carrying capacity, replace diluted platelets, and replenish clotting factors in massively bleeding trauma patients. Further study is needed to determine whether prehospital initiation of blood products and pharmacological adjuncts will improve outcomes.

CONCLUSION: Based on the data presented above the National Institute for Health & Care Excellence policy and Trauma Quality Improvement Program guidelines support balanced ratio driven transfusion approaches in patients with massive blood loss. Balanced blood product resuscitation protocols and goal-directed therapy are emerging as the mainstays of treatment strategies in the massively bleeding trauma patient population. In addition, hypotensive and hemostatic resuscitation approaches are also equally important to the overall success in resuscitation of acutely injured patients. Recent literature now supports the early use of a 1 : 1 : 1 blood product transfusion protocol to restore lost circulating volume, improve oxygen carrying capacity, replace diluted platelets, and replenish clotting factors. Further studies are needed to determine whether prehospital initiation of blood products and point of care testing will improve outcomes of trauma resuscitation.

Prehosp Emerg Care. 2016 Mar 1:1-5. [Epub ahead of print]

Development of a Pre-hospital Tranexamic Acid Administration Protocol.

Strosberg DS, Nguyen MC, Mostafavifar L, Mell H, Evans DC.

OBJECTIVE: Early administration of tranexamic acid (TXA) has been shown to reduce all-cause mortality and death secondary to trauma. Our objective was to develop a collaborative pre-hospital TXA administration protocol between a ground EMS and academic medical center.

METHODS: Physicians, pharmacists, and EMS and fire department personnel developed a prehospital TXA administration protocol between a local fire and EMS center with a Midwest tertiary care health system based on results from the CRASH-2 Trial. The protocol was initiated March 27, 2013 and the first dose of TXA was administered in September 2013.

RESULTS: Since September 2013, nineteen trauma patients received TXA. Survival rate was 89% (17/19); 2 patients expired immediately following arrival to the trauma bay. Seven patients did not receive the in-hospital maintenance dose due to the following: 3/7 (43%) due to miscommunication of pre-TXA administration; 2/7 (29%) did not meet inclusion criteria for TXA protocol; 1/7 (14%) due to protocol noncompliance; 1/7 (14%) due to a chaotic situation with an unstable patient.

CONCLUSIONS: Prehospital TXA protocol based on the CRASH-2 trial is safe and feasible. The first dose of TXA administered under this protocol marks the first ground EMS administration in the USA. Conceivably, this will pose as a model to other trauma centers that receive patients from outlying areas without immediate access to care. Large multi-institutional analyses need to be performed to evaluate survival benefits of prehospital TXA administration protocol.

Transfusion. 2016 Apr;56 Suppl 2:S173-81. doi: 10.1111/trf.13501.

The state of the science of whole blood: lessons learned at Mayo Clinic.

Stubbs JR, Zielinski MD, Jenkins D.

Abstract: AABB Standards specify that ABO group-specific whole blood is the only acceptable choice for whole blood transfusions. Although universal donor group O stored whole blood (SWB) was used extensively by the military during the wars of the mid-twentieth century, its use has fallen out of favor and has never been used to great extent in the civilian trauma population. Interest in the use of whole blood has been renewed, particularly in light of its potential value in far-forward military and other austere environments. Evidence of preserved platelet function in SWB has heightened enthusiasm for a "one stop shop" resuscitation product providing volume, oxygen carrying capacity, and hemostatic effects. Experience with universal donor group O SWB is required to ascertain whether its use will be an advance in trauma care. Described here is the process of establishing a universal donor group O SWB at a civilian trauma center in the United States.

Quote:

"In early 1965, during the Vietnam War, a decision was made to only ship universal donor, low-titer, group O whole blood to the war zone. However, as blood requirements increased, the policy was changed to allow for the shipment of nongroup O whole blood to Vietnam. The initial shipment of group A whole blood was delivered to Vietnam in December 1965 and additional whole blood units with random blood group distributions were delivered starting in January 1966. Exclusive use of low-titer, group O whole blood continued to be the practice utilized by forward medical personnel and forward surgical hospitals where pretransfusion testing and compatibility testing could not be performed.

Between September 1967 and February 1969, 230,323 whole blood units (all ABO groups included) were transfused in Vietnam. During this time period, 24 hemolytic transfusion reactions were documented. Only one of these transfusion reactions, however, was caused by ABO isoagglutinins in a transfused group O whole blood unit. This reaction occurred in a far-forward setting when a high-titer unit (IgM and IgG titers of 256 and 32,768, respectively) was transfused as universal blood by mistake. This patient experienced oliguria and hemolysis for 2 days and then recovered. The experience in Vietnam served to reinforce the concept that the transfusion of universal donor low-titer group O whole blood was a safe practice."

Intern Emerg Med. 2016 Mar 28. [Epub ahead of print]

Cadaver-based training is superior to simulation training for cricothyrotomy and tube thoracostomy.

Takayesu JK, Peak D, Stearns D.

Abstract: Emergency medicine (EM) training mandates that residents be able to competently perform low-frequency critical procedures upon graduation. Simulation is the main method of training in addition to clinical patient care. Access to cadaver-based training is limited due to cost and availability. The relative fidelity and perceived value of cadaver-based simulation training is unknown. This pilot study sought to describe the relative value of cadaver training compared to simulation for cricothyrotomy and tube thoracostomy. To perform a pilot study to assess whether there is a significant difference in fidelity and educational experience of cadaver-based training compared to simulation training. To understand how important this difference is in training residents in low-frequency procedures. Twenty-two senior EM residents (PGY3 and 4) who had completed standard simulation training on cricothyrotomy and tube thoracostomy participated in a formalin-fixed cadaver training program. Participants were surveyed on the relative fidelity of the training using a 100 point visual analogue scale (VAS) with 100 defined as equal to performing the procedure on a real patient. Respondents were also asked to estimate how much the cadaveric training improved the comfort level with performing the procedures on a scale between 0 and 100 %. Open-response feedback was also collected. The response rate was 100 % (22/22). The average fidelity of the cadaver versus simulation training was 79.9 ± 7.0 vs. 34.7 ± 13.4 for cricothyrotomy ($p < 0.0001$) and 86 ± 8.6 vs. 38.4 ± 19.3 for tube thoracostomy ($p < 0.0001$). Improvement in comfort levels performing procedures after the cadaveric training was rated as 78.5 ± 13.3 for tube thoracostomy and 78.7 ± 14.3 for cricothyrotomy. All respondents felt this difference in fidelity to be important for procedural training with 21/22 respondents specifically citing the importance of superior landmark and tissue fidelity compared to simulation training. Cadaver-based training provides superior landmark and tissue fidelity compared to simulation training and may be a valuable addition to EM residency training for certain low-frequency procedures.

S Afr J Surg. 2015 Oct 8;53(1):13-8.

Time since injury is the major factor in preventing tranexamic acid use in the trauma setting: An observational cohort study from a major trauma centre in a middle-income country.

Thurston B, Chowdhury S, Edu S, Nicol AJ, Navsaria PH.

BACKGROUND: Haemorrhage is responsible for about a third of in-hospital trauma deaths. The CRASH-2 trial demonstrated that early administration of tranexamic acid, ideally within 3 hours, can reduce mortality from trauma-associated bleeding by up to 32%.

OBJECTIVE: To explore whether, in our trauma network in a middle-income country, patients arrived at hospital soon enough after injury for tranexamic acid administration to be effective and safe.

METHODS: A prospective cohort study of 50 consecutive patients admitted to our trauma unit was undertaken. Inclusion criteria were as for the CRASH-2 study: systolic blood pressure <90 mmHg and/or heart rate >110 beats per minute, with injuries suggestive of a risk of haemorrhage. Patients with isolated head injuries were excluded. The mechanisms of injury, time since injury and any reasons for delay were recorded.

RESULTS: Thirteen (26%) patients presented early enough for tranexamic acid administration. Of these, only three patients presented within the 1st hour. Eleven patients had a documented time of injury > 3 hours prior to presentation. We were unsure of the time of injury for 26 patients, although for most of these it was likely to be >3 hours before presentation.

CONCLUSIONS: The majority (74%) of bleeding trauma patients did not present within the timeframe allowed for safe administration of tranexamic therapy. Of those who did, most would have benefited from even earlier commencement of therapy. This raises the possibility that tranexamic acid may be more effective on a population basis if incorporated into prehospital rather than in-hospital protocols; future studies should explore the benefits and risks of this approach.

QUOTE:

"Tranexamic acid is a cheap, effective and easily stored drug that has been shown to have a survival benefit when given to bleeding trauma patients. In lower-and middle-income countries where access to blood products is limited, tranexamic acid could have a considerable effect on reducing mortality from trauma. However, there is evidence that it needs to be used as soon as possible after injury – most benefit is seen in the 1st hour after injury; after 3 hours, administering tranexamic acid increases mortality."

Anesth Essays Res. 2016 Jan-Apr;10(1):33-7.

Six percent hetastarch versus lactated Ringer's solution for preloading before spinal anesthesia for cesarean section.

Upadya M, Bhat S, Paul S.

BACKGROUND: Regional anesthesia has been the choice of preference for elective cesarean sections. This study was designed to determine whether preoperative administration of 6% hetastarch decreases the incidence of hypotension.

MATERIALS AND METHODS: This study was conducted on 50 nonlaboring American Society of Anesthesiologists class I and II women undergoing elective cesarean section. Patients were randomly divided into two groups and were preloaded either with 1000 ml Ringer's lactate (RL) or 500 ml of 6% hetastarch 30 min prior to the surgery. Spinal anesthesia was performed with patients in the left lateral position and 2 cc (10 mg) of 0.5% of bupivacaine injected into subarachnoid space. Hemodynamic variables (heart rate, noninvasive blood pressure, and SpO2) were recorded from prior to preloading until the recovery from the subarachnoid blockade.

RESULTS: Our study showed the incidence of hypotension to be 28% in the hetastarch group and 80% in the RL group. Rescue ephedrine requirements for the treatment of hypotension were significantly less in patients who were preloaded with 6% hetastarch prior to cesarean section. The neonatal outcome, as determined by Apgar scores was good and similar in both groups.

CONCLUSION: Hence, we conclude that 6% hydroxyl ethyl starch is more effective than lactated Ringers solution and that its routine use for preloading prior to spinal anesthesia should be considered.

Prehosp Emerg Care. 2016 Apr 26:1-7. [Epub ahead of print]

Laryngeal Tube Practice in a Metropolitan Ambulance Service: A Five-year Retrospective Observational Study (2009-2013).

van Tulder R, Schriefl C, Roth D, Stratil P, Thalhammer M, Wieczorek H, Lausch F, Zajicek A, Haidvogel J, Sebald D, Schreiber W, Sterz F, Laggner A.

BACKGROUND: The endotracheal tube (ETT) is considered the gold standard in emergency airway management, although supraglottic airway devices, especially the laryngeal tube (LT), have recently gained in importance. Although regarded as an emergency device in case of failure of endotracheal intubation in most systems, we investigated the dynamics of the use of the LT in a metropolitan ambulance service without any regulations on the choice of airway device.

METHODS: A retrospective, observational study on all patients from the Municipal Ambulance Service, Vienna in need of advanced airway management over a 5-year period. Differences between years were compared; influencing factors for the use of the LT were analyzed using multivariable logistic regression.

RESULTS: In total 5,175 patients (mean age 62 ± 20 years, 36.6% female) underwent advanced airway management. Of these, 15.6% received the LT. LT use increased from 20 out of 1,001 (2.0%) in 2009 to 292 of 1,085 (26.9%) in 2013 ($p < 0.001$). The increase between each consecutive year was also significant. Paramedics more frequently inserted the LT than physicians (RR 1.80 (95%CI 1.48-2.16); $p <0.001$). Female patients received a LT less frequently (RR 0.84 (95%CI 0.72-0.97), $p = 0.013$). There was no difference regarding airway device due to underlying causes requiring airway management and no relationship to the NACA-score.

CONCLUSION: In a European EMS system of physician and paramedic response, the proportion of airway managed by LT over ETT rose considerably over five years. Although the ET is still the gold standard, the LT is gaining in importance for EMS physicians and paramedics.

Braz J Anesthesiol. 2016 May-Jun;66(3):254-8.

Use of tranexamic acid in primary total knee replacement: effects on perioperative blood loss.

Volquind D, Zardo RA, Winkler BC, Londero BB, Zanelatto N, Leichtweis GP.

BACKGROUND AND OBJECTIVES: The use of tranexamic acid in primary total knee replacement surgeries has been the subject of constant study. The strategies to reduce bleeding are aimed at reducing the need for blood transfusion due to the risks involved. In this study we evaluated the use of tranexamic acid in reducing bleeding, need for blood transfusion, and prevalence of postoperative deep vein thrombosis in primary total knee replacement.

METHOD: 62 patients undergoing primary total knee replacement were enrolled in the study, from June 2012 to May 2013, and randomized to receive a single dose of 2.5g of intravenous tranexamic acid (Group TA) or saline (Group GP), 5 min before opening the pneumatic tourniquet, respectively. Hemoglobin, hematocrit, and blood loss were recorded 24h after surgery. Deep vein thrombosis was investigated during patient's hospitalization and 15 and 30 days after surgery in review visits.

RESULTS: There was no demographic difference between groups. Group TA had 13.89% decreased hematocrit (p=0.925) compared to placebo. Group TA had a decrease of 12.28% (p=0.898) in hemoglobin compared to Group GP. Group TA had a mean decrease of 187.35mL in blood loss (25.32%) compared to group GP (p=0.027). The number of blood transfusions was higher in Group GP (p=0.078). Thromboembolic events were not seen in this study.

CONCLUSION: Tranexamic acid reduced postoperative bleeding without promoting thromboembolic events.

Thromb Res. 2016 May;141:119-23. doi: 10.1016/j.thromres.2016.02.027. Epub 2016 Mar 4.

Single-dose tranexamic acid for reducing bleeding and transfusions in total hip arthroplasty: A double-blind, randomized controlled trial of different doses.

Wang C, Kang P, Ma J, Yue C, Xie J, Pei F.

BACKGROUND: Tranexamic acid can be effective at decreasing blood loss and transfusion requirements associated with total hip arthroplasty (THA), but few studies have compared the efficacy of different intravenous dosing regimes. This double-blind, randomized controlled trial compared the ability of two doses of intravenous TXA (IV-TXA, 10 or 15mg/kg) to reduce bleeding and transfusions associated with THA.

MATERIALS AND METHODS: A total of 124 patients scheduled for THA were consecutively randomized 1:1:1 into three parallel arms: control (placebo), 10mg/kg IV-TXA and 15mg/kg IV-TXA.

RESULTS: The proportion of patients who experienced bleeding and required transfusions was significantly lower in the 15mg/kg IV-TXA group (1 of 42, 2.4%) than in the 10mg/kg IV-TXA group (8 of 39, 20.5%; P=0.012) and in the control group (10 of 38, 26.3%; P=0.002). In fact, this proportion was similar between the 10mg/kg IV-TXA and control groups (P=0.547). Ultrasound examination on postoperative day 3 revealed only one case of asymptomatic deep vein thrombosis (in the femoral vein) in the 10mg/kg IV-TXA group, which was managed by administering low-molecular-weight heparin. No cases of deep-vein thrombosis were observed in the other two groups. No cases of symptomatic pulmonary embolism were observed.

CONCLUSION: IV-TXA at 10 mg/kg significantly reduced blood loss and mitigated the decrease in hemoglobin and hematocrit after THA, but it did not significantly reduce the need for transfusions. In contrast, a dose of 15 mg/kg reduced both bleeding and transfusion requirements. Our results argue for a dose of 15 mg/kg when using single-dose IV-TXA.

LEVEL OF EVIDENCE: Therapeutic Level I.

Global Spine J. 2016 May;6(3):284-95.

Systemic and Topical Use of Tranexamic Acid in Spinal Surgery: A Systematic Review.

Winter SF, Santaguida C, Wong J, Fehlings MG.

Study Design: Combination of narrative and systematic literature reviews.

Objectives: Massive perioperative blood loss in complex spinal surgery often requires blood transfusions and can negatively affect patient outcome. Systemic use of the antifibrinolytic agent tranexamic acid (TXA) has become widely used in the management of surgical bleeding. We review the clinical evidence for the use of intravenous TXA as a hemostatic agent in spinal surgery and discuss the emerging role for its complementary use as a topical agent to reduce perioperative blood loss from the surgical site. Through a systematic review of published and ongoing investigations on topical TXA for spinal surgery, we wish to make spine practitioners aware of this option and to suggest opportunities for further investigation in the field.

Methods: A narrative review of systemic TXA in spinal surgery and topical TXA in surgery was conducted. Furthermore, a systematic search (using PRISMA guidelines) of PubMed (MEDLINE), EMBASE, and Cochrane CENTRAL databases as well as World Health Organization International Clinical Trials Registry Platform, ClinicalTrials.gov (National Institutes of Health), and International Standard Randomized Controlled Trial Number registries was conducted to identify both published literature and ongoing clinical trials on topical TXA in spinal surgery.

Results: Of 1,631 preliminary search results, 2 published studies were included in the systematic review. Out of 285 ongoing clinical trials matching the search criteria, a total of 4 relevant studies were included and reviewed.

Conclusion: Intravenous TXA is established as an efficacious hemostatic agent in spinal surgery. Use of topical TXA in surgery suggests similar hemostatic efficacy and potentially improved safety as compared with intravenous TXA. For spinal surgery, the literature on topical TXA is sparse but promising, warranting further clinical investigation and consideration as a clinical option in cases with significant anticipated surgical site blood loss.

Transfusion. 2016 Apr;56 Suppl 2:S217-23. doi: 10.1111/trf.13489.

NATO Blood Panel perspectives on changes to military prehospital resuscitation policies: current and future practice.

Woolley T, Badloe J, Bohonek M, Taylor AL, Erik Heier H, Doughty H.

Abstract: The North Atlantic Treaty Organization (NATO) Blood Panel exists to promote interoperability of transfusion practice between NATO partners. However, it has served as an important forum for the development of prehospital transfusion and transfusion in the austere environment. There are synergies with the trauma hemostasis and oxygen research community especially in the areas of innovation and research. Four presentations are summarized together with a review of some scientific principles. The past decade has already seen significant changes in early transfusion support. Sometimes practice has preceded the evidence and has stretched regulatory and logistic constraints. Ethical and philosophical issues are also important and require us to question "should we" and not just "could we." The challenge for the combined communities is to continue to optimize transfusion support underpinned by evidence-based excellence.

Transfusion. 2016 Apr;56 Suppl 2:S149-56. doi: 10.1111/trf.13502.

The pragmatic randomized optimal platelet and plasma ratios trial: what does it mean for remote damage control resuscitation?

Yonge JD, Schreiber MA.

BACKGROUND: Implications from the pragmatic, randomize, optimal platelet and plasma ratios (PROPPR) trial are critical for remote damage control resuscitation (DCR). Utilizing DCR principals in remote settings can combat early mortality from hemorrhage. Identifying the appropriate transfusion strategy is mandatory prior to adopting prehospital hemostatic resuscitation strategies.

STUDY DESIGN AND METHODS: The PROPPR study was examined in relation to the following questions: 1) Why is it important to have blood products in the prehospital setting?; 2) Which products should be investigated for prehospital hemostatic resuscitation?; 3) What is the appropriate ratio of blood product transfusion?; and 4) What are the appropriate indications for hemostatic resuscitation?

RESULTS: PROPPR demonstrates that early and balanced blood product transfusion ratios reduced mortality in all patients at 3 hours and death from exsanguination at 24 hours ($p = 0.03$). The median time to death from exsanguination was 2.3 hours, highlighting the need for point-of-injury DCR capabilities. A 1:1:1 transfusion ratio of plasma:platelets:packed red blood cells increased the percentage of patients achieving anatomic hemostasis ($p = 0.006$). PROPPR used the assessment of blood consumption score to identify patients likely to require ongoing hemostatic resuscitation. The critical administration threshold predicted patient mortality and identified patients likely to require ongoing hemostatic resuscitation.

CONCLUSION: A balanced resuscitation strategy demonstrates an early survival benefit, decreased death from exsanguination at 24 hours and a greater likelihood of achieving hemostasis in critically injured patients receiving a 1:1:1 ratio of plasma:platelets:PRBCs. This finding highlights the need to import DCR principals to remote locations.

Chin J Traumatol. 2015;18(4):194-200.

The past and present of blast injury research in China.

Zhao Y, Zhou YG.

Abstract: With the increasing incidence of blast injury, the research on its mechanisms and protective measures draws more and more attention. Blast injury has many characteristics different from general war injuries or trauma. For example, soldiers often have various degrees of visceral injury without significant surface damage, combined injuries and arterial air embolism. Researchers in China began to investigate blast injury later than the United States and Sweden, but the development is so fast that lots of achievements have been gained, including the development of biological shock tube, the mechanisms and characteristics of blast injury in various organs, as well as protective measures under special environments. This article reviews the past and current situation of blast injury research in China.

J Neurol Sci. 2016 May 15;364:12-8.

Analysis of the association of fluid balance and short-term outcome in traumatic brain injury.

Zhao Z, Wang D, Jia Y, Tian Y, Wang Y, Wei Y, Zhang J, Jiang R.

INTRODUCTION: A balance of fluid intake and output (fluid balance) influences outcomes of critical illness, but the level of such influence remains poorly understood for traumatic brain injury (TBI) and was quantitatively examined in this study.

METHODS: We conducted a retrospective cohort study of 351 moderate and severe TBI patients to associate the degree of fluid balance with clinical outcomes of TBI. Fluid balance and intracranial pressure (ICP) were continuously recorded for 7days on patients admitted to neurocritical care unit (NCCU). The short-term outcome was dichotomized into improvement and deterioration groups based on changes in Glasgow Coma Scale (GCS) measured between admission and 30days after admission. Fluid balance was calculated as: Fluid intake (mL) - fluid outputs (mL)/day×5 and used to group patients in tertiles to study its effect on TBI outcome.

RESULTS: Patients at the low (<637mL) and upper (>3673mL) tertiles of fluid balance were associated with poor outcomes. Those in the upper tertile also had a higher incidence of acute kidney injury (AKI) and refractory intracranial hypertension (RIH). There was a negative correlation between the cumulative fluid balance and the short-term outcome for patients in the low tertile and a positive correlation between the cumulative fluid balance and the short-term outcome in the upper fluid balance group. Levels of fluid balance were also associated with serum creatinine (Cr, r=0.451, P<0.0001) and days in NCCU (r=0.188, P=0.001). More patients in the upper tertile had ICP higher than 20mmHg (P=0.009). A fluid balance in the upper tertile is an independent predictor of poor 30-day clinical outcomes after the adjustment for confounding variables in a multivariable logistic regression model.

CONCLUSION: We found that fluid balance in low and upper tertiles were associated with poor short-term outcomes and ICP variations. Fluid balance in the upper tertile may be an independent predictor for poor 30-day outcome, primarily due to high AKI and RIH.