Tactical Combat Casualty Care

Journal Article Abstracts

Committee on Tactical Combat Casualty Care

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Adams P, Warren K, Guyette F, et al: Implementation of a prehospital air medical thawed plasma program: is it even feasible? J Trauma Acute Care Surg 2019;87:1077-1081

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Abstracts

J Trauma Acute Care Surg. 2019 Nov;87(5):1077-1081

Implementation of a prehospital air medical thawed plasma program: Is it even feasible?

Adams P, Warren K, Guyette F, Yazer M, Brown J, Daily B, Miller R, Harbrecht B, Claridge J, Phelan HA, Witham WR, Putnam AT, Zuckerbraun BS, Neal M, Sperry J; PAMPer study group.

BACKGROUND: The Prehospital Air Medical Plasma (PAMPer) trial demonstrated a 30-day survival benefit among hypotensive trauma patients treated with prehospital plasma during air medical transport. We characterized resources, costs and feasibility of air medical prehospital plasma program implementation.

METHODS: We performed a secondary analysis using data derived from the recent PAMPer trial. Intervention patients received thawed plasma (5-day shelf life). Unused plasma units were recycled back to blood bank affiliates, when possible. Distribution method and capability of recycling varied across sites. We determined the status of plasma units deployed, utilized, wasted, and returned. We inventoried thawed plasma use and annualized costs for distribution and recovery.

RESULTS: The PAMPer trial screened 7,275 patients and 5,103 plasma units were deployed across 22 air medical bases during a 42-month period. Only 368 (7.2%) units of this total thawed plasma pool were provided to plasma randomized PAMPer patients. Of the total plasma pool, 3,716 (72.8%) units of plasma were returned to the blood bank with the potential for transfusion prior to expiration and 1,019 (20.0%) thawed plasma units were deemed wasted for this analysis. The estimated average annual cost of implementation of a thawed plasma program per air medical base at an average courier distance would be between US $24,343 and US $30,077, depending on the ability to recycle plasma and distance of courier delivery required.

CONCLUSION: A prehospital plasma program utilizing thawed plasma is resource intensive. Plasma waste can be minimized depending on trauma center and blood bank specific logistics. Implementation of a thawed plasma program can occur with financial cost. Products with a longer shelf life, such as liquid plasma or freeze-dried plasma, may provide a more cost-effective prehospital product relative to thawed plasma.

LEVEL OF EVIDENCE: Therapeutic, level III.

J Surg Res. 2019 Oct 7;246:190-199

Safety of Pressurized Intraosseous Blood Infusion Strategies in a Swine Model of Hemorrhagic Shock.

Auten J, McEvoy C, Roszko P, Polk T, Kachur R, Kemp J, Natarajan R, Zarow G

BACKGROUND: Current guidelines support intraosseous access for trauma resuscitation when intravenous access is not readily available. However, safety of intraosseous blood transfusions with varying degrees of infusion pressure has not been previously characterized.

MATERIALS AND METHODS: Adult female Yorkshire swine (Sus scrofa; n = 36; mean (M): 80 kg, 95% CI: 78-82 kg) were cannulated and then bled approximately 30% total blood volume. Swine were randomly assigned to proximal humerus intraosseous blood infusion with either Rapid Infuser, or Pressure Bag, or Push-Pull methods (n = 12 each). Flow rates, infusion pressures, vitals, biochemical variables, and pulmonary and renal tissue pathology were contrasted between groups.

RESULTS: Flow rates were greater for the Push-Pull strategy than Pressure Bag (96.5 mL/min versus 72.6 mL/min, P = 0.02) or Rapid Infuser (96.5 mL/min versus 60 mL/min, P = 0.002) strategies. The pressures generated during the Push-Pull transfusion (3058 mmHg) were greater than the other strategies (≤360 mmHg). After the observation period, plasma-free hemoglobin levels were higher in the Push-Pull strategy than in the Rapid Infuser (40 mg/dL versus 12 mg/dL, P = 0.02) or Pressure Bag (40 mg/dL versus 12 mg/dL, P = 0.01). Groups did not significantly differ in vitals, biochemical variables, or tissue pathology.

CONCLUSIONS: Push-Pull conferred the highest flow rates, but with higher infusion pressures and evidence of intravascular hemolysis. Rapid Infuser and Pressure Bag infusions had no increase from baseline in plasma-free hemoglobin. Pressure Bag infusion was noted to confer an advantage in flow rates over Rapid Infuser. Intraosseous blood transfusion with pressure bags can safely bridge toward central access in the early phases of trauma resuscitation.

Am J Surg. 2019 Dec;218(6):1138-1142

Prehospital needle thoracostomy: What are the indications and is a post-trauma center arrival chest tube required?

Axtman B, Stewart K, Robbins J, Garwe T, Sarwar Z, Gonzalez R, Zander T, Balla F, Albrecht R

OBJECTIVE: This study examined the indications for prehospital needle thoracostomy (pNT), the need for tube thoracostomy (TT) following pNT, and the outcomes of patients who underwent pNT.

METHODS: This study is a retrospective chart review of patients who underwent pNT prior to trauma center arrival. Patients were identified from the trauma registry and a quality improvement (QI) database from 9/2014-9/2018.

RESULTS: 59 patients underwent 63 pNTs during the time period. The indication for pNT was "hypotension" in only 5 patients (7.9%). A CT chest was obtained on 51 NT attempts with the catheter in place. In 48 (94.1%) NT attempts, the catheter was not in the pleural space. 44 (69.4%) TTs were placed on admission date.

CONCLUSION: In patients undergoing pNT, hypotension was rarely the indication. Additionally, CT identified the catheter within the pleural space in only 3 (5.8%) NT attempts. TT placement was performed in 79.3% of NT attempts.

Acad Emerg Med. 2019 Oct;26(10):1181-1182

Tranexamic Acid for Upper Gastrointestinal Bleeding.

Beyda R, Johari D

QUOTE:

"Despite TXA's lack of demonstrated benefit compared to standard treatments with respect to the endpoints of mortality or rebleeding, given the relative safety, lack of significant adverse events, and low cost of the medication, it may be reasonable to consider TXA in severe upper gastrointestinal bleeding as an adjunct to standard therapy or if standard therapy fails."

Eur J Trauma Emerg Surg. 2019 Oct 1;Epub ahead of print

Resuscitative endovascular balloon occlusion of the aorta (REBOA) in a swine model of hemorrhagic shock and blunt thoracic injury.

Beyer C, Hoareau G, Kashtan H, Wishy A, Caples C, Spruce M, Grayson J, Neff L, Williams T, Johnson M

PURPOSE: While resuscitative endovascular balloon occlusion of the aorta (REBOA) is contraindicated in patients with aortic injuries, this technique may benefit poly-trauma patients with less extreme thoracic injuries. The purpose of this study was to characterize the effects of thoracic injury on hemodynamics during REBOA and the changes in pulmonary contusion over time in a swine model.

METHODS: Twelve swine were anesthetized, instrumented, and randomized to receive either a thoracic injury with 5 impacts to the chest or no injury. All animals underwent controlled hemorrhage of 25% blood volume followed by 45 min of Zone 1 REBOA. Animals were then resuscitated with shed blood, observed during a critical care period, and euthanized after 6 h of total experimental time.

RESULTS: There were no differences between the groups at baseline. The only difference after 6 h was a lower hemoglobin in the thoracic trauma group (8.4 ± 0.8 versus 9.4 ± 0.6 g/dL, P = 0.04). The average proximal mean arterial pressures were significantly lower in the thoracic trauma group during aortic occlusion [103 (98-108) versus 117 (115-124) mmHg, P = 0.04]. There were no differences between the pulmonary contusion before REBOA and at the end of the experiment in size (402 ± 263 versus 356 ± 291 mL, P = 0.782) or density (- 406 ± 127 versus - 299 ± 175 HFU, P = 0.256).

CONCLUSIONS: Thoracic trauma blunted the proximal arterial pressure augmentation during REBOA but had minimal impacts on resuscitative outcomes. This initial study indicates that REBOA does not seem to exacerbate pulmonary contusion in swine, but blunt thoracic injuries may attenuate the expected rises in proximal blood pressure during REBOA.

J Trauma Acute Care Surg. 2019 Sep;87(3):590-598

Resuscitative endovascular balloon occlusion of the aorta induced myocardial injury is mitigated by endovascular variable aortic control.

Beyer C, Hoareau G, Tibbits E, Davidson A, DeSoucy E, Simon M, Grayson J, Neff L, Williams TK, Johnson MA.

BACKGROUND: The cardiac effects of resuscitative endovascular balloon occlusion of the aorta (REBOA) are largely unknown. We hypothesized that increased afterload from REBOA would lead to cardiac injury, and that partial flow using endovascular variable aortic control (EVAC) would mitigate this injury.

METHODS: Eighteen anesthetized swine underwent controlled 25% blood volume hemorrhage. Animals were randomized to either Zone 1 REBOA, Zone 1 EVAC, or no intervention (control) for 45 minutes. Animals were then resuscitated with shed blood, observed during critical care, and euthanized after a 6-hour total experimental time. Left ventricular function was measured with a pressure-volume catheter, and blood samples were drawn at routine intervals.

RESULTS: The average cardiac output during the intervention period was higher in the REBOA group (9.3 [8.6-15.4] L/min) compared with the EVAC group (7.2 [5.8-8.0] L/min, $p = 0.01$) and the control group (6.8 [5.8-7.7] L/min, $p < 0.01$). At the end of the intervention, the preload recruitable stroke work was significantly higher in both the REBOA and EVAC groups compared with the control group (111.2 [102.5-148.6] and 116.7 [116.6-141.4] vs. 67.1 [62.7-87.9], $p = 0.02$ and $p < 0.01$, respectively). The higher preload recruitable stroke work was maintained throughout the experiment in the EVAC group, but not in the REBOA group. Serum troponin concentrations after 6 hours were higher in the REBOA group compared with both the EVAC and control groups (6.26 ± 5.35 ng/mL vs 0.92 ± 0.61 ng/mL and 0.65 ± 0.38 ng/mL, $p = 0.05$ and $p = 0.03$, respectively). Cardiac intramural hemorrhage was higher in the REBOA group compared with the control group (1.67 ± 0.46 vs. 0.17 ± 0.18, $p = 0.03$), but not between the EVAC and control groups
.
CONCLUSION: In a swine model of hemorrhagic shock, complete aortic occlusion resulted in cardiac injury, although there was no direct decrease in cardiac function. EVAC mitigated the cardiac injury and improved cardiac performance during resuscitation and critical care.

J Trauma Acute Care Surg. 2019 Oct;87(4):849-855

Transition from abdominal aortic and junctional tourniquet to zone 3 resuscitative endovascular balloon occlusion of the aorta is feasible with hemodynamic support after porcine class IV hemorrhage.

Brännström A, Dahlquist A, Gustavsson J, Arborelius UP, Günther M.

BACKGROUND: Traumatic hemorrhage remains a major cause of death in rural civilian and combat environments. Potential interventions to control hemorrhage from the pelvis and lower junctional regions include the abdominal aortic and junctional tourniquet (AAJT) and resuscitative endovascular balloon occlusion of the aorta (REBOA). The AAJT requires low technical skills and may thus be used by nonmedical professionals, but is associated with time-dependent ischemic complications. In combination with delayed patient evacuation, it may therefore be deleterious. Transition to zone 3 REBOA in higher levels of care may be a possibility to maintain hemostasis, mitigate adverse effects and enable surgery in patients resuscitated with the AAJT. It is possible that a transition between the interventions could lead to hemodynamic penalties. Therefore, we investigated the feasibility of replacing the AAJT with zone 3 REBOA in a porcine model of uncontrolled femoral hemorrhage.

METHODS: Domestic pigs (n = 12) averaging 57 kg were exposed to a class IV uncontrolled hemorrhage from the common femoral artery. The animals were randomized to 60-minute AAJT (n = 6) or 30-minute AAJT with transition to 30-minute zone 3 REBOA. Hemodynamic and metabolic parameters and ultrasonographic measurements of the common femoral artery were collected.

RESULTS: Transition from AAJT to zone 3 REBOA caused a significant decrease in mean arterial pressure (25 mm Hg). Hemostasis was maintained. The common femoral artery diameter decreased by 1.8 mm (38%) after hemorrhage and further 0.7 mm (23%) after aortic occlusion.

CONCLUSION: Transition from AAJT to zone 3 REBOA after a class IV bleeding is feasible with hemodynamic support. Vascular access to the femoral artery for REBOA insertion poses a technical challenge after hemorrhage and AAJT application.

LEVEL OF EVIDENCE: Laboratory animal study, level IV.

AANA J. 2019 Feb;87(1):65-70.

Management of Gravity Intravenous Infusions in an Austere Environment Using the DripAssist Infusion Rate Monitor.

Buonora M

ABSTRACT: The US Army's 541st Forward Surgical Team (FST) deployed in support of Operation Inherent Resolve- Syria in 2017. Throughout the deployment the 541st FST provided surgical and anesthesia services to US, coalition, and partner forces in numerous austere environments. Following an enemy attack, the FST received multiple casualties and provided a total of 7 critical medication infusions to 3 patients without the aid of electronic-controlled intravenous (IV) infusion pumps or syringes for 10 hours while the wounded soldiers waited for evacuation to a higher level of care. The team administered propofol, norepinephrine, tranexamic acid, and ketamine by individual gravity infusions relying solely on counting drops. An infusion rate monitor (DripAssist, Shift Labs Inc) was used to assist in initial IV rate setup and maintenance. The medics and nurses of the 541st FST found that the infusion rate monitor improved the speed of setting the IV infusion rate, drop counting accuracy, and the team's ability to monitor the continuous delivery of gravity IV infusions.

J Spec Oper Med. 2019 Fall;19(3):76-81.

Operational Advantages of Enteral Resuscitation Following Burn Injury in Resource-Poor Environments: Palatability of Commercially Available Solutions.

Burmeister D, Little J, Gomez B, Gurney J, Chao T, Cancio L, Kramer G, Dubick M

BACKGROUND: In recent combat operations, 5% to 15% of casualties sustained thermal injuries, which require resource-intensive therapies. During prolonged field care or when caring for patients in a multidomain battlefield, delayed transport will complicate the challenges that already exist in the burn population. A lack of resources and/or vascular access in the future operating environment may benefit from alternative resuscitation strategies. The objectives of the current report are 1) to briefly review actual and potential advantages/caveats of resuscitation with enteral fluids and 2) to present new data on palatability of oral rehydration solutions.

METHODS: A review of the literature and published guidelines are reported. In addition, enlisted US military active duty Servicemembers (N = 40) were asked to taste/rank five different oral rehydration solutions on several parameters.

RESULTS AND CONCLUSIONS: There are several operational advantages of using enteral fluids including ease of administration, no specialized equipment needed, and the use of lightweight sachets that are easily reconstituted/ administered. Limited clinical data along with slightly more extensive preclinical studies have prompted published guidelines for austere conditions to indicate consideration of enteral resuscitation for burns. Gatorade® and Drip-Drop® were the overall preferred rehydration solutions based on palatability, with the latter potentially more appropriate for resuscitation. Taken together, enteral resuscitation may confer several advantages over intravenous fluids for burn resuscitation under resource-poor scenarios. Future research needs to identify what solutions and volumes are optimal for use in thermally injured casualties.

J Trauma Acute Care Surg. 2019 Oct;87(4):954-960

Progress on combat damage control resuscitation/surgery and its application in the Chinese People's Liberation Army.

Chen S, Yang J, Zhang L, Yang L, Qin H, Liu D, Ye Z, Du W, Zhong X, Zong Z.

ABSTRACT: Damage control resuscitation (DCR) and damage control surgery (DCS) has now been developed as a well-established standard of care for severely injured civilian patients worldwide. On the other hand, the application of combat DCR/DCS has saved the lives of thousands of severely injured casualties in several wars during the last two decades. This article describes the great progress on DCR/DCS in the last two decades and its application in the Chinese People's Liberation Army (PLA). The main development of the advanced theories of combat DCR/DCS including the global integration of DCR/DCS, application of remote battlefield DCR, balanced hemostatic resuscitation in combat hospitals and enhancement of en route DCR. There are two key factors that determine the feasibility of combat DCR: one is the availability of resources and supplies to implement the advanced theories of combat DCR/DCS, the other is the availability of qualified personnel who master the skills needed for the implementation of DCR/DCS. In the PLA, the advanced theories of combat DCR/DCS have now been widely accepted, and some of related advanced products, such as fresh-frozen plasma, packed red blood cells, and platelets, have been available in Level III medical facilities. In conclusion, great progress in combat DCR/DCS has been achieved in recent years, and the Chinese PLA is keeping good pace with this development, although there is still room for improvement.

Ann Surg. 2019 Oct 22;Epub ahead of print

A Decade of Damage Control Resuscitation: New Transfusion Practice, New Survivors, New Directions.

Cole E, Weaver A, Gall L, West A, Nevin D, Tallach R, O'Neill B, Lahiri S, Allard S, Tai N, Davenport R, Green L, Brohi K

OBJECTIVE: The aim of this study was to identify the effects of recent innovations in trauma major hemorrhage management on outcome and transfusion practice, and to determine the contemporary timings and patterns of death.

BACKGROUND: The last 10 years have seen a research-led change in hemorrhage management to damage control resuscitation (DCR), focused on the prevention and treatment of trauma-induced coagulopathy.

METHODS: A 10-year retrospective analysis of prospectively collected data of trauma patients who activated the Major Trauma Centre's major hemorrhage protocol (MHP) and received at least 1 unit of red blood cell transfusions (RBC).

RESULTS: A total of 1169 trauma patients activated the MHP and received at least 1 unit of RBC, with similar injury and admission physiology characteristics over the decade. Overall mortality declined from 45% in 2008 to 27% in 2017, whereas median RBC transfusion rates dropped from 12 to 4 units (massive transfusion rates from 68% to 24%). The proportion of deaths within 24 hours halved (33%-16%), principally with a fall in mortality between 3 and 24 hours (30%-6%). Survivors are now more likely to be discharged to their own home (57%-73%). Exsanguination is still the principal cause of early deaths, and the mortality associated with massive transfusion remains high (48%). Late deaths are now split between those due to traumatic brain injury (52%) and multiple organ dysfunction (45%).

CONCLUSIONS: There have been remarkable reductions in mortality after major trauma hemorrhage in recent years. Mortality rates continue to be high and there remain important opportunities for further improvements in these patients.

Eur J Trauma Emerg Surg. 2019 Aug 20; Epub ahead of print

The safety and efficacy of improvised tourniquets in life-threatening hemorrhage: a systematic review.

Cornelissen M, Brandwijk A, Schoonmade L, Giannakopoulos G, van Oostendorp S, Geeraedts L

OBJECTIVE: The increased incidence of mass casualty incident (MCI) with penetrating injuries in the civilian setting creates a call for implementing devices, such as a tourniquet (TQ), in civilian first aid. Bystanders could act as immediate responders after an MCI in order to prevent a victim from exsanguination using direct pressure or commercial tourniquets (C-TQ). Reports have shown that immediate access to C-TQs was not available and bystanders used objects available at the trauma scene to make an improvised tourniquet (I-TQ). The aim of this systematic review of literature was to summarize the existing literature on designs, efficacy and safety of I-TQs.

METHODS: A systematic review of the literature was performed. Bibliographic databases PubMed, EMBASE.com and Cochrane Library were searched. All types of original studies about I-TQ's were included. Review studies, exempts from textbooks or studies with TQs applied during elective surgeries were excluded.

RESULTS: Twenty studies were included. In both simulated experiments and real-life situations, I-TQs outperformed commercial TQs (C-TQ) regarding success rate. Of the I-TQs, the band and windlass design performed most consistently. Although lacking any statistical analysis, there was no reported difference in adverse events between I-TQs and C-TQs.

CONCLUSION: The use of- and training in I-TQ by civilian immediate responders is not recommended because of limited efficacy and safety concerns; direct pressure is a viable alternative. However, I-TQs may save lives when applied correctly with proper objects; therefore, future studies regarding the best design and training in application of effective and safe I-TQs should be encouraged.

J Trauma Nurs. 2019 May/Jun;26(3):128-133

A Retrospective Study of Transfusion Requirements in Trauma Patients receiving Tranexamic Acid.

Cornelius B, Moody K, Hopper K, Kilgore P, Cvek U, Trutschl M, Cornelius A

ABSTRACT: The Military Application of Tranexamic Acid in Trauma Emergency Resuscitation Study (MATTERs) and Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage-2 (CRASH-2) studies demonstrate that tranexamic acid (TXA) reduces mortality in patients with traumatic hemorrhage. However, their results, conducted in foreign countries and U.S. military soldiers, provoke concerns over generalizability to civilian trauma patients in the United States. We report the evaluation of patient outcomes and transfusion requirements following treatment with TXA by a civilian air medical program. We conducted a retrospective chart review of trauma patients transported by air service to a Level 1 trauma center. For the purposes of intervention evaluation, patients meeting this criterion for the 2 years (2012-2014) prior to therapy implementation were compared with patients treated during the 2-year study period (2014-2016). Goals were to evaluate morbidity, mortality, transfusion requirements, and length of stay. During the review, 52 control (non-TXA) and 43 study (TXA) patients were identified as meeting inclusion criteria. Patients in the control group were found to be less acute, which correlated with shorter hospitals stays. There was reduced mortality for patients receiving TXA in spite of their increased acuity and decreased likelihood of survival. Trauma patients from this cohort study receiving TXA demonstrate decreased mortality in spite of increased acuity. This increased acuity is associated with increased transfusion requirements. Future research should evaluate patient selection with concern for fibrinolysis and provider bias. Randomized controlled trial is needed to evaluate the role of TXA administration in the United States.

Lancet. 2019 Nov 9;394(10210):1713-1723

Effects of tranexamic acid on death, disability, vascular occlusive events and other morbidities in patients with acute traumatic brain injury (CRASH-3): a randomised, placebo-controlled trial.

CRASH-3 trial collaborators.

BACKGROUND: Tranexamic acid reduces surgical bleeding and decreases mortality in patients with traumatic extracranial bleeding. Intracranial bleeding is common after traumatic brain injury (TBI) and can cause brain herniation and death. We aimed to assess the effects of tranexamic acid in patients with TBI.

METHODS: This randomised, placebo-controlled trial was done in 175 hospitals in 29 countries. Adults with TBI who were within 3 h of injury, had a Glasgow Coma Scale (GCS) score of 12 or lower or any intracranial bleeding on CT scan, and no major extracranial bleeding were eligible. The time window for eligibility was originally 8 h but in 2016 the protocol was changed to limit recruitment to patients within 3 h of injury. This change was made blind to the trial data, in response to external evidence suggesting that delayed treatment is unlikely to be effective. We randomly assigned (1:1) patients to receive tranexamic acid (loading dose 1 g over 10 min then infusion of 1 g over 8 h) or matching placebo. Patients were assigned by selecting a numbered treatment pack from a box containing eight packs that were identical apart from the pack number. Patients, caregivers, and those assessing outcomes were masked to allocation. The primary outcome was head injury-related death in hospital within 28 days of injury in patients treated within 3 h of injury. We prespecified a sensitivity analysis that excluded patients with a GCS score of 3 and those with bilateral unreactive pupils at baseline. All analyses were done by intention to treat. This trial was registered with ISRCTN (ISRCTN15088122), ClinicalTrials.gov (NCT01402882), EudraCT (2011-003669-14), and the Pan African Clinical Trial Registry (PACTR20121000441277).

RESULTS: Between July 20, 2012, and Jan 31, 2019, we randomly allocated 12 737 patients with TBI to receive tranexamic acid (6406 [50·3%] or placebo [6331 [49·7%], of whom 9202 (72·2%) patients were treated within 3 h of injury. Among patients treated within 3 h of injury, the risk of head injury-related death was 18·5% in the tranexamic acid group versus 19·8% in the placebo group (855 vs 892 events; risk ratio [RR] 0·94 [95% CI 0·86-1·02]). In the prespecified sensitivity analysis that excluded patients with a GCS score of 3 or bilateral unreactive pupils at baseline, the risk of head injury-related death was 12·5% in the tranexamic acid group versus 14·0% in the placebo group (485 vs 525 events; RR 0·89 [95% CI 0·80-1·00]). The risk of head injury-related death reduced with tranexamic acid in patients with mild-to-moderate head injury (RR 0·78 [95% CI 0·64-0·95]) but not in patients with severe head injury (0·99 [95% CI 0·91-1·07]; p value for heterogeneity 0·030). Early treatment was more effective than was later treatment in patients with mild and moderate head injury (p=0·005) but time to treatment had no obvious effect in patients with severe head injury (p=0·73). The risk of vascular occlusive events was similar in the tranexamic acid and placebo groups (RR 0·98 (0·74-1·28). The risk of seizures was also similar between groups (1·09 [95% CI 0·90-1·33]).

INTERPRETATION: Our results show that tranexamic acid is safe in patients with TBI and that treatment within 3 h of injury reduces head injury-related death. Patients should be treated as soon as possible after injury.

J Trauma Acute Care Surg. 2019 Nov;87(5):1096-1103

Missing expectations: Windlass tourniquet use without formal training yields poor results.

Dennis A, Bajani F, Schlanser V, Tatebe L, Impens A, Ivkovic K, Li A, Pickett T, Butler C, Kaminsky M, Messer T, Starr F, Mis J, Bokhari F.

BACKGROUND: Despite significant attempts to educate civilians in hemorrhage control, the majority remain untrained. We sought to determine if laypersons can successfully apply one of three commercially available tourniquets; including those endorsed by the United States Military and the American College of Surgeons.

METHODS: Preclinical graduate health science students were randomly assigned commercially available windless tourniquet: SAM XT, Combat Application Tourniquet (CAT), or Special Operation Forces Tactical Tourniquet (SOFT-T). Each was given up to 1 minute to read package instructions and asked to apply it to the HapMed Leg Tourniquet Trainer. Estimated blood loss was measured until successful hemostatic pressure was achieved or simulated death occurred from exsanguination. Simulation survival, time to read instructions and stop bleeding, tourniquet pressure, and blood loss were analyzed.

RESULTS: Of the 150 students recruited, 55, 46, and 49 were randomized to the SAM XT, CAT, SOFT-T, respectively. Mean overall simulation survival was less than 66% (65%, 72%, 61%; p = 0.55). Of survivors, all three tourniquets performed similarly in median pressure applied (319, 315, and 329 mm Hg; p = 0.54) and median time to stop bleeding (91, 70, 77 seconds; p = 0.28). There was a statistical difference in median blood loss volume favoring SOFT-T (SAM XT, 686 mL; CAT, 624 mL; SOFT-T, 433 mL; p = 0.03). All 16 participants with previous experience were able to successfully place the tourniquet compared with 81 (62%) of 131 first-time users (p = 0.008).

CONCLUSION: No one should die of extremity hemorrhage, and civilians are our first line of defense. We demonstrate that when an untrained layperson is handed a commonly accepted tourniquet, failure is unacceptably high. Current devices are not intuitive and require training beyond the enclosed instructions. Plans to further evaluate this cohort after formal "Stop the Bleed" training are underway.

Laryngoscope. 2019 Sep 30;Epub ahead of print

Live porcine model for surgical training in tracheostomy and open-airway surgery.

Deonarain A, Harrison R, Gordon K, Wolter N, Looi T, Estrada M, Propst E

OBJECTIVES/HYPOTHESIS: To evaluate the validity of a live porcine model for surgical training in tracheostomy and open-airway surgery.

STUDY DESIGN: Prospective observational study.

METHODS: Eleven expert otolaryngologists-head and neck surgeons rated a live porcine model's realism/anatomical accuracy (face validity) and perceived effectiveness as a training tool (content validity) for tracheostomy and laryngotracheoplasty using anterior costal cartilage and thyroid ala cartilage grafts using a 53-item post-trial questionnaire with a five-point Likert scale.

RESULTS: Experts rated the face validity of the live porcine model a median (interquartile range [IQR]) of 4/5 (4-5) and the content validity a median (IQR) of 5/5 (4-5) for each surgical procedure. Overall, 91% strongly agreed or agreed that the simulator would increase trainee competency for tracheostomy and laryngotracheoplasty using costal cartilage graft, and 82% strongly agreed or agreed that it would increase trainee competency for laryngotracheoplasty using thyroid ala cartilage graft.

CONCLUSIONS: The live porcine model has high face and content validity as a training tool for tracheostomy and laryngotracheoplasty using costal cartilage and thyroid ala cartilage grafts. This training model can help surgical trainees practice these complex, low-frequency procedures.

LEVEL OF EVIDENCE: NA Laryngoscope, 2019.

Am J Surg. 2019 Dec;218(6):1110-1113

Does tranexamic acid really work in an urban US level I trauma center? A single level 1 trauma center's experience.

Dixon A, Emigh B, Spitz K, Teixeira P, Coopwood B, Trust M, Daley M, Ali S, Brown C, Aydelotte J

BACKGROUND: The use of Tranexamic Acid (TXA) in trauma patients remains controversial. The CRASH II trial, while randomized and prospective, did not include patients suffering from major bleeding. We wanted to examine our population of patients who underwent a massive transfusion protocol (MTP) (greater than 10 Units of packed red blood cells in the first 24 h of admission) to see if those who were undergoing massive transfusion and received TXA had any benefit in mortality. Our hypothesis was that massively transfused patients who received TXA and those that did not had no difference in mortality.

METHODS: We performed a single institution retrospective review of our Trauma Registry for all patients who received a massive transfusion between 2010 and 2017. Patients were separated into two cohorts, those who received TXA within the first 24 h of admission and those who did not. The primary outcome of the study was mortality. Secondary outcomes included total blood products transfused, Deep Venous Thrombosis (DVT), Pulmonary Embolus (PE), Myocardial Infarction (MI), and cardiac arrest.

RESULTS: 283 patients received MTP between 2010 and 2017. 179 (63%) did not receive TXA and 104 (37%) were treated with TXA. The groups were then propensity matched and yielded 62 patients in each group (124 total) (ISS 36 ± 12 no TXA vs. 37 ± 13 TXA; p = 0.59). There was no significant difference observed in mortality (50% no TXA vs. 39% TXA; p = 0.21), total PRBC's transfused (20 ± 11 no TXA vs. 23 ± 18 TXA; p = 0.45), DVT (8% no TXA vs. 6% TXA; p = 0.99), PE (2% no TXA vs. 3% TXA; p = 0.99), MI (3% no TXA vs. 0% TXA; p = 0.50), or cardiac arrest (26% no TXA vs. 18% TXA; p = 0.28).

CONCLUSION: There does not appear to be any benefit to TXA administration in Trauma Patients in our institution. This is a single-center retrospective review. More data from other similar centers in the region or the United States is warranted.

J Spec Oper Med. 2019 Fall;19(3):24-25.

Risk Associated With Autologous Fresh Whole Blood Training.

Donham B, Barbee GA, Deaton TG, Kerr W, Wier RP, Fisher AD.

ABSTRACT: Fresh whole blood (FWB) is increasingly being recognized as the ideal resuscitative fluid for hemorrhagic shock. Because of this, military units are working to establish the capability to give FWB from a walking blood bank donor in environments that are unsupported by conventional blood bank services. Therefore, many military units are performing autologous blood transfusion training. In this training, a volunteer has a unit of blood collected and then transfused back into the same donor. The authors report their experience performing an estimated 3408 autologous transfusions in training and report no instances of hemolytic transfusion reactions or other major complications. With appropriate control measures in place, autologous FWB training is low-risk training.

J Spec Oper Med. Winter 2017;17(4):68-71.

Experience With Prehospital Damage Control Capability in Modern Conflict: Results From Surgical Resuscitation Team Use.

DuBose J, Martens D, Frament C, Haque I, Telian S, Benson P

BACKGROUND: Early resuscitation and damage control surgery (DCS) are critical components of modern combat casualty care. Early and effective DCS capabilities can be delivered in a variety of settings through the use of a mobile surgical resuscitation team (SRT).

METHODS: Twelve years of after-action reports from SRTs were reviewed. Demographics, interventions, and outcomes were analyzed.

RESULTS: Data from 190 casualties (185 human, five canine) were reviewed. Among human casualties, 12 had no signs of life at intercept and did not survive. Of the remaining 173 human casualties, 96.0% were male and 90.8% sustained penetrating injuries. Interventions by the SRT included intravascular access (50.9%) and advanced airway establishment (29.5%). Resuscitation included whole blood (3.5%), packed red blood cells (20.8%), and thawed plasma (11.0%). Surgery was provided for 63 of the 173 human casualties (36.4%), including damage control laparotomy (23.8%) and arterial injury shunting or repair (19.0%). SRTs were effectively used to augment an existing medical treatment facility (70.5%), to facilitate casualty transport (13.3%), as an independent surgical entity at a forward ground structure (9.2%), and in mobile response directly to the point of injury (6.9%). Overall survival was 97.1%.

CONCLUSION: An SRT provides a unique DCS capability that can be successfully used in a variety of flexible roles.

Eur J Obstet Gynecol Reprod Biol. 2019 Sep;240:151-155

Uterine packing with chitosan-covered gauze compared to balloon tamponade for managing postpartum hemorrhage.

Dueckelmann A, Hinkson L, Nonnenmacher A, Siedentopf J, Schoenborn I, Weizsaecker K, Kaufner L, Henrich W, Braun T

BACKGROUND: Postpartum hemorrhage (PPH) is a major cause of maternal death worldwide. Management of PPH includes the administration of uterotonics, and intrauterine packing techniques.

OBJECTIVE: In this study the effectiveness and safety of chitosan covered gauze versus a balloon tamponade for managing severe PPH should be assessed.

STUDY DESIGN: This retrospective cohort study was conducted at the Department of Obstetrics, Charité, university hospital Berlin, between October 2016 and June 2018. Women with PPH were treated according to management guidelines. When bleeding persisted, we applied additional uterine packing with either chitosan covered gauze or a balloon tamponade. The primary outcome was uterine bleeding termination without additional surgical interventions. Secondary outcomes included the amount of blood loss, the amount of blood transfusions and maternal complications.

RESULTS: Among the 78 patients included in this study, 47 (60.3%) received chitosan covered gauze tamponade and 31 (39.7%) received a balloon tamponade. The major reason for PPH was atonic bleeding, no statistically significant group differences were observed. With respect to the outcomes monitored, the groups were not significantly different in postpartum vital signs, hemoglobin levels, blood loss, admission to intensive care unit, or inflammation parameters. However, three patients in balloon tamponade group required a hysterectomy. No hysterectomy was required in gauze group.

CONCLUSION: Chitosan covered gauze is an excellent option for treating PPH, it appeared to be at least equivalent to the balloon tamponade, in our experience particularly suitable for atony or placenta bed bleeding after spontaneous delivery or during cesarean sections, in cases of lower uterine segment atony, placenta previa bed bleeding, and/or coagulopathy.

Anesth Analg. 2019 Nov;129(5):e146-e149

Anesthetic Management of Patients After Traumatic Injury With Resuscitative Endovascular Balloon Occlusion of the Aorta.

Engdahl A, Parrino C, Wasicek P, Galvagno S, Brenner M, Anders M, Conti B, Rock P, McCunn M

ABSTRACT: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a temporizing maneuver for noncompressible torso hemorrhage. To our knowledge, this single-center brief report provides the most extensive anesthetic data published to date on patients who received REBOA. As anticipated, patients were critically ill, exhibiting lactic acidosis, hypotension, hyperglycemia, hypothermia, and coagulopathy. All patients received blood products during their index operations and received less inhaled anesthetic gas than normally required for healthy patients of the same age. This study serves as an important starting point for clinician education and research into anesthetic management of patients undergoing REBOA.

Mil Med. 2019 Jul 1;184(7-8):e236-e246

Reconstructing the Face of War.

Farber S, Latham K, Kantar R, Perkins J, Rodriguez E

INTRODUCTION: Ongoing combat operations in Iraq, Afghanistan, and other theaters have led to an increase in high energy craniomaxillofacial (CMF) wounds. These challenging injuries are typically associated with complex tissue deficiencies, evolving areas of necrosis, and bony comminution with bone and ballistic fragment sequestrum. Restoring form and function in these combat-sustained CMF injuries is challenging, and frequently requires local and distant tissue transfers. War injuries are different than the isolated trauma seen in the civilian sector. Donor sites are limited on patients with blast injuries and they may have preferences or functional reasons for the decisions to choose flaps from the available donor sites.

METHODS: A case series of patients who sustained severe combat-related CMF injury and were treated at Walter Reed National Military Medical Center (WRNMMC) is presented. Our study was exempt from Institutional Review Board review, and appropriate written consent was obtained from all patients included in the study for the use of representative clinical images.

RESULTS: Four patients treated by the CMF team at Walter Reed National Military Medical Center are presented. In this study, we highlight their surgical management by the CMF team at WRNMMC, detail their postoperative course, and illustrate the outcomes achieved using representative patient clinical images. We also supplement this case series demonstrating military approaches to complex CMF injuries with CMF reconstructive algorithms utilized by the senior author (EDR) in the management of civilian complex avulsive injuries of the upper, mid, and lower face are thoroughly reviewed.

CONCLUSION: While the epidemiology and characteristics of military CMF injuries have been well described, their management remains poorly defined and creates an opportunity for reconstructive principles proven in the civilian sector to be applied in the care of severely wounded service members. The War on Terror marks the first time that microsurgery has been used extensively to reconstruct combat sustained wounds of the CMF region. Our manuscript reviews various options to reconstruct these devastating CMF injuries and emphasizes the need for steady communication between the civilian and military surgical communities to establish the best care for these complex patients.

J Emerg Med. 2019 Nov;57(5):646-652

An Analysis of Adherence to Tactical Combat Casualty Care Guidelines for the Administration of Tranexamic Acid.

Fisher A, Carius B, April M, Naylor J, Maddry J, Schauer S

BACKGROUND: Hemorrhage is the leading cause of potentially survivable deaths in combat. Previous research demonstrated that tranexamic acid (TXA) administration decreased mortality among casualties. For casualties expected to receive a transfusion, the Committee on Tactical Combat Casualty Care (TCCC) recommends TXA. Despite this, the use and adherence of TXA in the military prehospital combat setting, in accordance with TCCC guidelines, is low.

OBJECTIVES: We sought to analyze TXA administration and use among combat casualties reasonably expected to require blood transfusion, casualties with tourniquet placement, amputations, and gunshot wounds.

METHODS: Based on TCCC guidelines, we measured proportions of patients receiving prehospital TXA: casualties undergoing tourniquet placement, casualties sustaining amputation proximal to the phalanges, patients sustaining gunshot wounds, and patients receiving ≥10 units of blood products within 24 h of injury. Univariable and multivariable analyses were also completed.

RESULTS: Within our dataset, 255 subjects received TXA. Four thousand seventy-one subjects had a tourniquet placed, of whom 135 (3.3%) received prehospital TXA; 1899 subjects had an amputation proximal to the digit with 106 (5.6%) receiving prehospital TXA; and 6660 subjects had a gunshot wound with 88 (1.3%) receiving prehospital TXA. Of 4246 subjects who received ≥10 units of blood products within the first 24 h, 177 (4.2%) received prehospital TXA.

CONCLUSIONS: We identified low TXA administration despite TCCC recommendations. Future studies should seek to both identify reasons for limited TXA administration and methods to increase future utilization.

J Trauma Acute Care Surg. 2019 Nov;87(5):1015-1025

Titrate to equilibrate and not exsanguinate! Characterization and validation of a novel partial resuscitative endovascular balloon occlusion of the aorta catheter in normal and hemorrhagic shock conditions.

Forte D, Do W, Weiss J, Sheldon R, Kuckelman J, Eckert M, Martin M

BACKGROUND: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a significant advancement in the control of noncompressible truncal hemorrhage. However, its ischemic burden and reperfusion injury following balloon deflation limits its utilization. Partial restoration of aortic flow during REBOA has the potential to balance hemorrhage control and ischemia. This study validates the mechanics, physiology, and optimal partial flow rates using a prototype partial REBOA (pREBOA) device.

METHODS: Twenty-five swine underwent placement of aortic flow probes and zone 1 pREBOA. Experiment 1 (N = 5) animals were not injured and assessed the tested the catheters ability to titrate and control flow. Experiment 2 (N = 10) added 20% hemorrhage and either solid organ, or abdominal vascular injury to compare flow rate and rebleeding from injuries. Experiment 3 (N = 10) swine were similarly prepared, hemorrhaged, and underwent pREBOA at set partial flow rates for 2 hours followed by complete deflation for 30 minutes.

RESULTS: Balloon volume at minimum flow (mean, 0.09 L/min) was 3.5 mL to 6.0 mL. Half maximal flow was achieved with 56.5% of maximum balloon inflation. Partial REBOA allowed very fine titration of flow rates. Rebleeding occurred at 0.45 L/min to 0.83 L/min. Distal flow of 0.7 L/min had 50% survival, 0.5 had 100% survival, and 0.3 L had 50% survival with mean end lactates of 9.6, 12.6, and 13.3, respectively. There was a trend toward hyperkalemia and hypocalcemia in nonsurvivors.

CONCLUSION: The pREBOA device demonstrated a high level of titratability for restoration of aortic flow. An optimal partial flow of 0.5 L/min was effective at hemorrhage control while limiting the burden of ischemic injury, and extending the tolerable duration of zone 1 occlusion. Aggressive calcium supplementation prior to and during partial occlusion and reperfusion may be warranted to prevent hyperkalemic arrest.

Sci Rep. 2019 Sep 24;9(1):13755

Prehospital lactate improves prediction of the need for immediate interventions for hemorrhage after trauma.

Fukuma H, Nakada T, Shimada T, Shimazui T, Aizimu T, Nakao S, Watanabe H, Mizushima Y, Matsuoka T

ABSTRACT: The blood lactate level is used to guide the management of trauma patients with circulatory disturbance. We hypothesized that blood lactate levels at the scene (Lac scene) could improve the prediction for immediate interventions for hemorrhage. We prospectively measured blood lactate levels and assessed retrospectively in 435 trauma patients both at the scene and on arrival at the emergency room (ER) of a level I trauma center. Primary outcome was immediate intervention for hemorrhage defined as surgical/radiological intervention and/or blood transfusion within 24 h. Physiological variables plus Lac scene significantly increased the predictive value for immediate intervention (area under the curve [AUC] 0.882, 95% confidence interval [CI] 0.839-0.925) compared to that using physiological variables only (AUC 0.837, 95% CI 0.787-0.887, P = 0.0073), replicated in the validation cohort (n = 85). There was no significant improvement in predicting value of physiological variables plus Lac scene for massive transfusion compared to physiological variables (AUC 0.903 vs 0.895, P = 0.32). The increased blood lactate level per minute from scene to ER was associated with increased probability for immediate intervention (P < 0.0001). Both adding Lac scene to physiological variables and the temporal elevation of blood lactate levels from scene to ER could improve the prediction of the immediate intervention.

Global Spine J. 2019 Aug;9(5):545-558

Epidemiology of War-Related Spinal Cord Injury Among Combatants: A Systematic Review.

Furlan J, Gulasingam S, Craven B

Study Design: Systematic review.

Objectives: War-related spinal cord injuries (SCIs) are commonly more severe and complex than traumatic SCIs among civilians. This systematic review, for the first time, synthesized and critically appraised the literature on the epidemiology of war-related SCIs. This review aimed to identify distinct features from the civilian SCIs that can have an impact on the management of military and civilian SCIs.

Methods: Medline, EMBASE, and PsycINFO databases were searched for articles on epidemiology of war-related SCI among combatants, published from 1946 to December 20, 2017. This review included only original publications on epidemiological aspects of SCIs that occur during an act of war. The STROBE statement was used to examine the quality of the publications.

Results: The literature search identified 1594 publications, of which 25 articles fulfilled the inclusion and exclusion criteria. The studies were classified into the following topics: 17 articles reported demographics, level and severity of SCI, mechanism of injury and/or associated bodily injuries; 5 articles reported the incidence of war-related SCI; and 6 articles reported the frequency of SCI among other war-related bodily injuries. Overall, military personnel with war-related SCI were typically young, white men, with predominantly thoracic or lumbar level, complete (American Spinal Injury Association [ASIA] Impairment Scale A) SCI due to gunshot or explosion and often associated with other bodily injuries. Marines appear to be at a greater risk of war-related SCI than the military personal in the Army, Navy, and Air Force.

Conclusions: The war-related SCIs among soldiers are distinct from the traumatic SCI in the general population. The majority of the current literature is based on the American experiences in most recent wars.

Air Med J. 2019 Sep - Oct;38(5):366-373

Prehospital Airway Management in Severe Traumatic Brain Injury.

Gamberini L, Baldazzi M, Coniglio C, Gordini G, Bardi T

OBJECTIVE: Traumatic brain injury (TBI) is a leading cause of death and disability among trauma patients. The final outcome of TBI results from a complex interaction between primary and secondary mechanisms of injury that begin immediately after the traumatic event. The aim of this review was to evaluate the latest evidence regarding the impact of prehospital airway management and the outcome after traumatic brain injury.

METHODS: PubMed, Embase, and Cochrane searches were conducted using the MeSH database. Airway management, traumatic brain injury, pneumonia, and the subheadings of these Medical Subject Headings were combined.

RESULTS: The review is structured into 4 major topics: airway management devices, prehospital pharmacologic management, mortality and neurologic outcomes, and early respiratory infections. The available literature shows a shift toward a more comprehensive view of prehospital airway management, taking into account not only the location where airway management is attempted but also the drugs administered, the airway management devices used, and the skills of the main professional figures attending the scene.

CONCLUSIONS: Literature about this topic is still inconclusive; however, new evidence taking into consideration more complex aspects of airway management rather than orotracheal intubation per se shows improved outcomes with aggressive prehospital airway management.

Wilderness Environ Med. 2019 Sep 28;Epub ahead of print

Risk of Burns During Active External Rewarming for Accidental Hypothermia.

Giesbrecht G, Walpoth B

ABSTRACT: This article describes 3 incidents in which therapeutic or experimental warming of cold individuals caused first- to third-degree burns to the skin. Mechanisms for these injuries are considered. We conclude that active external rewarming of the trunk of a cold patient in the field can be administered safely and burn risk reduced if 1) manufacturer instructions are followed; 2) insulation is placed between the skin the and heat source; and 3) caregivers make regular efforts to observe heated skin for possible pending burn injury. Direct inspection is mandatory for the skin of areas that are on top of a heat source when the patient is lying on the heat source.

Emerg Med J. 2019 Oct;36(10):608-612

Pulmonary embolism following complex trauma: UK MTC observational study.

Glover T, Sumpter J, Ercole A, Newcombe V, Lavinio A, Carrothers A, Menon D, O'Leary R

OBJECTIVES: To describe the incidence of pulmonary embolism (PE) in a critically ill UK major trauma centre (MTC) patient cohort.

METHODS: A retrospective, multidataset descriptive study of all trauma patients requiring admission to level 2 or 3 care in the East of England MTC from 1 November 2014 to 1 May 2017. Data describing demographics, the nature and extent of injuries, process of care, timing of PE prophylaxis, tranexamic acid (TXA) administration and CT scanner type were extracted from the Trauma Audit and Research Network database and hospital electronic records. PE presentation was categorised as immediate (diagnosed on initial trauma scan), early (within 72 hours of admission but not present initially) and late (diagnosed after 72 hours).

RESULTS: Of the 2746 trauma patients, 1039 were identified as being admitted to level 2 or 3 care. Forty-eight patients (4.6%) were diagnosed with PE during admission with 14 immediate PEs (1.3%). Of 32.1% patients given TXA, 6.3% developed PE compared with 3.8% without TXA (p=0.08).

CONCLUSION: This is the largest study of the incidence of PE in UK MTC patients and describes the greatest number of immediate PEs in a civilian complex trauma population to date. Immediate PEs are a rare phenomenon whose clinical importance remains unclear. Tranexamic acid was not significantly associated with an increase in PE in this population following its introduction into the UK trauma care system.

Br J Anaesth. 2019 Nov;123(5):696-703

Performance of emergency surgical front of neck airway access by head and neck surgeons, general surgeons, or anaesthetists: an in situ simulation study.

Groom P, Schofield L, Hettiarachchi N, Pickard S, Brown J, Sandars J, Morton B

BACKGROUND: The 'cannot intubate cannot oxygenate' (CICO) emergency requires urgent front of neck airway (FONA) access to prevent death. In cases reported to the 4th National Audit Project, the most successful FONA was a surgical technique, almost all of which were performed by surgeons. Subsequently, UK guidelines adopted surgical cricothyroidotomy as the preferred emergency surgical FONA technique. Despite regular skills-based training, anaesthetists may still be unwilling to perform an emergency surgical FONA. Consultant anaesthetists, head and neck surgeons, and general surgeons were compared in a high-fidelity simulated emergency. We hypothesised that head and neck surgeons would successfully execute emergency surgical FONA faster than anaesthetists and general surgeons.

METHODS: We recruited 15 consultants from each specialty (total of 45) at a single tertiary care hospital in the UK. All agreed to participate in an in situ high-fidelity simulation of an 'anaesthetic emergency'. Participants were not told in advance that this would be a CICO scenario.

RESULTS: There were no significant differences in total time to successful ventilation between anaesthetists, head and neck surgeons and general surgeons (median 86 vs 98 vs 126 s, respectively, P=0.078). Anaesthetists completed the emergency surgical FONA procedure significantly faster than general surgeons (median 50 vs 86 s, P=0.018). Despite this strong performance, qualitative data suggested some anaesthetists still believed 'surgeons' best placed to perform emergency surgical FONA in a genuine CICO situation.

CONCLUSION: Anaesthetists regularly trained in emergency surgical FONA function at levels comparable with head and neck surgeons and should feel empowered to lead this procedure in the event of a CICO emergency.

J Trauma Acute Care Surg. 2019 Aug 5;Epub ahead of print

A Novel Protocol to Maintain Continuous Access to Thawed Plasma at a Rural Trauma Center.

Hannigan C, Ologun G, Trecartin A, Colom L, Bloomdahl R, Seyer A, LaRock L, Tubby B, Cagir B, Granet J, Behm R.

BACKGROUND: Early administration of plasma improves mortality in massively transfused patients, but the thawing process causes delay. Small rural centers have been reluctant to maintain thawed plasma due to waste concerns. Our 254-bed rural level II trauma center initiated a protocol allowing continuous access to thawed plasma and we hypothesized its implementation would not increase waste or cost.

METHODS: Two units of thawed plasma are continuously maintained in the trauma bay blood refrigerator. After 3 days these units are replaced with freshly thawed plasma and returned to the blood bank for utilization prior to their 5-day expiration date. The blood bank monitors and rotates the plasma. Only trauma surgeons can use the plasma stored in the trauma bay. Wasted units and cost were measured over a 12-month period and compared to the previous 2 years.

RESULTS: The blood bank thawed 1127 units of plasma during the study period assigning 274 to the trauma bay. When compared to previous years, we found a significant increase in waste ($p<0.001$) and cost ($p=0.020$) after implementing our protocol. It cost approximately $125/month extra to maintain continuous access to thawed plasma during the study period.A protocol to maintain thawed plasma in the trauma bay at a rural level II trauma center resulted in a miniscule increase in waste and cost when considering the scope of maintaining a trauma center. We feel this cost is also minimal when compared to the value of having immediate access to thawed plasma. Constant availability of thawed plasma can be offered at smaller rural centers without a meaningful impact on cost.Level III; Economic & Value-based Evaluations.

Ann Intensive Care. 2019 Sep 5;9(1):99

Serum sodium and intracranial pressure changes after desmopressin therapy in severe traumatic brain injury patients: a multi-centre cohort study.

Harrois A, Anstey J, Taccone F, Udy A, Citerio G, Duranteau J, Ichai C, Badenes R, Prowle J, Ercole A, Oddo M, Schneider A, van der Jagt M, Wolf S, Helbok R, Nelson D, Skrifvars M, Cooper D, Bellomo R; TBI Collaborative

BACKGROUND: In traumatic brain injury (TBI) patients desmopressin administration may induce rapid decreases in serum sodium and increase intracranial pressure (ICP).

AIM: In an international multi-centre study, we aimed to report changes in serum sodium and ICP after desmopressin administration in TBI patients.

METHODS: We obtained data from 14 neurotrauma ICUs in Europe, Australia and UK for severe TBI patients (GCS ≤ 8) requiring ICP monitoring. We identified patients who received any desmopressin and recorded daily dose, 6-hourly serum sodium, and 6-hourly ICP.

RESULTS: We studied 262 severe TBI patients. Of these, 39 patients (14.9%) received desmopressin. Median length of treatment with desmopressin was 1 [1-3] day and daily intravenous dose varied between centres from 0.125 to 10 mcg. The median hourly rate of decrease in serum sodium was low (- 0.1 [- 0.2 to 0.0] mmol/L/h) with a median period of decrease of 36 h. The proportion of 6-h periods in which the rate of natremia correction exceeded 0.5 mmol/L/h or 1 mmol/L/h was low, at 8% and 3%, respectively, and ICPs remained stable. After adjusting for IMPACT score and injury severity score, desmopressin administration was independently associated with increased 60-day mortality [HR of 1.83 (1.05-3.24) ($p = 0.03$)].

CONCLUSIONS: In severe TBI, desmopressin administration, potentially representing instances of diabetes insipidus is common and is independently associated with increased mortality. Desmopressin doses vary markedly among ICUs; however, the associated decrease in natremia rarely exceeds recommended rates and median ICP values remain unchanged. These findings support the notion that desmopressin therapy is safe.

Shock. 2019 Oct;52:4-6

Hemoglobin-based Oxygen Carriers (HBOC)-What the Next Generation Holds: When Red Blood Cells are not an Option.

Hill-Pryor C, Pusateri A, Weiskopf R

QUOTE:

"Consequently, other patient populations may need to be studied, with the population of patients who refuse transfusion being a leading candidate. Options include a defined protocol for use in this population, with comparison to historical controls; or comparison to some combination of historical controls with contemporaneous data from patients who refuse both transfusion and HBOC; or a randomized trial. The first two have obvious issues of scientific validity. The latter is complicated, owing to many thinking a randomized trial is both without equipoise and unethical given their clinical experience of use, and knowledge of the published data cited above.

Despite the hurdles for development, most at the symposium were quite positive overall, with many expressing a renewed optimism that HBOC development will proceed to the point of regulatory approval for use when red cell transfusion is not an option. Development has suffered owing to several factors, including funding difficulties; the latter may require resources in supplement to industry. Based on the published literature and information presented at this symposium, there is strong reason to support the continued development of HBOCs for this indication ‘‘when red cell transfusion is not an option,’’ where it appears that HBOCs would have an appropriate risk to benefit profile. A summary of the entire Interagency Oxygen Carrier State of the Science Meeting can be found at:
https://ccc. amedd.army.mil/Portfolios/Pages/Oxygen-Carrier-Meeting-2017.aspx"

Injury. 2019 Nov;50(11):1908-1914

Renal effects of three endoaortic occlusion strategies in a swine model of hemorrhagic shock.

Hoareau G, Tibbits E, Simon M, Davidson A, DeSoucy E, Faulconer E, Grayson J, Stewart I, Neff L, Williams T, Johnson M

INTRODUCTION: Trauma patients are predisposed to kidney injury. We hypothesized that in shock, zone 3 REBOA would increase renal blood flow (RBF) compared to control and that a period of zone 3 occlusion following zone 1 occlusion would improve renal function compared to zone 1 occlusion alone.

MATERIALS AND METHODS: Twenty-four anesthetized swine underwent hemorrhagic shock, 45 min of zone 1 REBOA (Z1, supraceliac), zone 3 REBOA (Z3, infrarenal), or no intervention (control) followed by resuscitation with shed blood and 5 h of critical care. In a fourth group (Z1Z3), animals underwent 55 min of zone 3 REBOA following zone 1 occlusion. Physiologic parameters were recorded, blood and urine were collected at specified intervals.

RESULTS: During critical care, there were no differences in RBF between the Z1 and Z3 groups. The average RBF during critical care in Z1Z3 was significantly lower than in Z3 alone (98.2 ± 23.9 and 191.9 ± 23.7 mL/min; p = 0.046) and not different than Z1. There was no difference in urinary neutrophil gelatinase-associated lipocalin-to-urinary creatinine ratio between Z1 and Z1Z3. Animals in the Z1Z3 group had a significant increase in the ratio at the end of the experiment compared to baseline [median (IQR)] [9.2 (8.2-13.2) versus 264.5 (73.6-1174.6)]. Following Z1 balloon deflation, RBF required 45 min to return to baseline.

CONCLUSION: Neither zone 3 REBOA alone nor zone 3 REBOA following zone 1 REBOA improved renal blood flow or function. Following zone 1 occlusion, RBF is restored to baseline levels after approximately 45 min.

Medicine (Baltimore). 2019 Oct;98(40):e17133

Early preoperative versus postoperative administration of meloxicam in pain control, patient global status improvement, knee function recovery of arthroscopic knee surgery.

Hou J, Li W, Chen Y, Yang L, Li L, Zhao L

BACKGROUND: This study aimed to investigate the efficacy and safety between early preoperative administration and postoperative administration of oral meloxicam in patients underwent arthroscopic knee surgery (AKS).

METHODS: Totally 296 patients with the intention to undergo AKS were recruited and randomly allocated as 1:1 ratio into early preoperative analgesia (EPA) group and postoperative analgesia (POA) group. Pain visual analog scale (VAS) score and severity (at rest and at flexion), patient global assessment (PGA) score, the consumption of rescue analgesia (pethidine), and adverse events were evaluated during the perioperation. And knee range of motion (ROM), International Knee Documentation Committee (IKDC) score, and Lysholm score were assessed at baseline and at 3 months after AKS.

RESULTS: Both pain VAS score and severity (at rest and at flexion) were decreased at 4, 8, and 12 hours, but similar at -24, -2, 24, 36, and 48 hours after AKS in EPA group compared with POA group. Besides, PGA score was lower at 4, 8, 12, and 24 hours, but similar at -24, -2, 36, and 48 hours after AKS in EPA group compared with POA group. As to the consumption of pethidine in perioperative period, it was decreased in EPA group compared with POA group. No difference was observed in knee ROM, IKDC score, Lysholm score, and adverse effects between EPA group and POA group.

CONCLUSION: Early preoperative administration of meloxicam was a superior approach in pain control compared with postoperative administration in treating patients underwent AKS.

BMC Emerg Med. 2019 Oct 18;19(1):56

Introduction of a standardised protocol, including systematic use of tranexamicbacid, for management of severe adult trauma patients in a low-resource setting:bthe MSF experience from Port-au-Prince, Haiti.

Jachetti A, Massénat R, Edema N, Woolley S, Benedetti G, Van Den Bergh R, Trelles M

BACKGROUND: Bleeding is an important cause of death in trauma victims. In 2010, the CRASH-2 study, a multicentre randomized control trial on the effect of tranexamic acid (TXA) administration to trauma patients with suspected significant bleeding, reported a decreased mortality in randomized patients compared to placebo. Currently, no evidence on the use of TXA in humanitarian, low-resource settings is available. We aimed to measure the hospital outcomes of adult patients with severe traumatic bleeding in the Médecins Sans Frontières Tabarre Trauma Centre in Port-au-Prince, Haiti, before and after the implementation of a Massive Haemorrhage protocol including systematic early administration of TXA.

METHODS: Patients admitted over comparable periods of four months (December2015-March2016 and December2016 - March2017) before and after the implementation of the Massive Haemorrhage protocol were investigated. Included patients had blunt or penetrating trauma, a South Africa Triage Score ≥ 7, were aged 18-65 years and were admitted within 3 h from the traumatic event. Measured outcomes were hospital mortality and early mortality rates, in-hospital time to discharge and time to discharge from intensive care unit.

RESULTS: One-hundred and sixteen patients met inclusion criteria. Patients treated after the introduction of the Massive Haemorrhage protocol had about 70% less chance of death during hospitalization compared to the group "before" (adjusted odds ratio 0.3, 95%confidence interval 0.1-0.8). They also had a significantly shorter hospital length of stay ($p = 0.02$).

CONCLUSIONS: Implementing a Massive Haemorrhage protocol including early administration of TXA was associated with the reduced mortality and hospital stay of severe adult blunt and penetrating trauma patients in a context with poor resources and limited availability of blood products.

Am J Emerg Med. 2019 Jul 15;Epub ahead of print

The utility of iPhone oximetry apps: A comparison with standard pulse oximetry measurement in the emergency department.

Jordan T, Meyers C, Schrading W, Donnelly J

OBJECTIVES: To determine if a correlation exists between 3 iphone pulse ox applications' measurements and the standard pulse oximetry (SpO2) and whether these applications can accurately determine hypoxia.

METHODS: Three applications reportedly measuring SpO2 were downloaded onto an iPhone 5s. Two of these applications used the onboard light and camera lens "Pulse Oximeter" (Pox) and "Heart Rate and Pulse Oximeter" (Ox) and one used an external device that plugged into the iphone (iOx). Patients in the ED were enrolled with chief complaints of cardiac/pulmonary origin or a SpO2 ≤ 94%. All measurements were compared to controls. Concordance correlation coefficients, sensitivity, and specificity were calculated.

RESULTS: A total of 191 patients were enrolled. The concordance correlation of iOx with control was 0.55 (CI 0.46, 0.63), POx was 0.01 (CI -0.09, 0.11), and Ox was 0.07 (CI -0.02, 0.15). 68/191 patients (35%) were found to have hypoxemia. Sensitivities for detecting hypoxia were 69%, 0%, and 7% for iOx, POx, and Ox, respectively. Specificities were 89%, 100%, and 89%. Even iOx (the most accurate) 21 (11%) were incorrectly classified nonhypoxic, and 22 (12%) were incorrectly classified hypoxic.

CONCLUSIONS: While iOx has modest concordance with control, Ox and POx showed almost none. The iOx device was best in correctly identifying hypoxia patients, but almost 1/4 of patients were incorrectly classified. The three apps provided inaccurate SpO2 measurements and had limited to no ability to accurately detect hypoxia. These apps should not be relied upon to provide accurate SpO2 measurements in emergent, even austere conditions.

Ophthalmic Plast Reconstr Surg. 2019 Sep 25;Epub ahead of print

Orbital Fractures and Associated Ocular Injuries in Operation Iraqi Freedom and Operation Enduring Freedom Referred to a Tertiary Care Military Hospital and the Effect on Final Visual Acuity.

Justin G, Turnage W, Brooks DI, Davies B, Ryan D, Eiseman A, Weichel E, Colyer M

PURPOSE: To update the incidence of orbital fractures in U.S. Soldiers admitted to the former Walter Reed Army Medical Center from 2001 to 2011 after sustaining combat injuries in Operation Iraqi Freedom and Operation Enduring Freedom.

METHODS: Data were collected in the Walter Reed Ocular Trauma Database. Inclusion criteria were any U.S. Soldier or Department of Defense civilian with an orbital fracture injured in Operation Iraqi Freedom/Operation Enduring Freedom. Primary outcome measures were final visual acuity and the effect of orbital fracture, number of fractures, and anatomic location of fracture on final visual acuity.

RESULTS: Eight-hundred ninety eye injuries occurred in 652 patients evacuated to Walter Reed Army Medical Center between 2001 and 2011. Orbital fractures occurred in 304 eyes (34.2%). A single wall was fractured in 140 eyes (46.05%), 2 in 99 (32.6%) eyes, 3 in 31 (10.2%), 4 in 28 (9.2%), and unknown in 6 (1.9%) eyes. Roof fractures were found in 74 (24.34%), medial wall in 135 (44.41%), lateral wall in 109 (35.9%), and floor fractures in 217 (71.4%). Final visual acuity was analyzed and 140 (46.05%) eyes had greater than 20/40 vision, 17 (5.59%) were 20/50 to 20/200, 26 (8.5%) were count fingers to light perception, and 95 (31.3%) were no light perception. In logistic regression analysis, roof ($p = 0.001$), medial ($p = 0.009$), and lateral fractures ($p = 0.016$) were significantly associated with final visual acuity less than 20/200, while floor fractures were not ($p = 0.874$). Orbital fracture and all fracture subtypes were significantly associated with traumatic brain injury, retrobulbar hematoma, optic nerve injury, but not for vitreous hemorrhage, commotio, hyphema, and choroidal rupture. Fracture repair was noted in 45 (14.8%).

CONCLUSIONS: Orbital fractures occurred in a third of Operation Iraqi Freedom/Operation Enduring Freedom eyes of ocular trauma patients referred to one tertiary care military hospital. This resulted in approximately 40% of these eyes remaining legally blind after injury.

J Int Med Res. 2019 Aug;47(8):3559-3568

Effect of hypothermia on haemostasis and bleeding risk: a narrative review.

Kander T, Schött U

QUOTE:

"It must be remembered that clinically important haemostasis occurs in vivo and not in a tube, and that variables such as the number of bleeding events and bleeding volume are more robust measures of bleeding risk than the results of analyses. In this narrative review, we highlight trauma, surgery, and mild induced hypothermia as three clinically important situations in which the effects of hypothermia on haemostasis are important. In observational studies of trauma, hypothermia (body temperature <35_C) has demonstrated an association with mortality and morbidity, perhaps owing to its effect on haemostatic functions. Randomised trials have shown that hypothermia causes increased bleeding during surgery. Although causality between hypothermia and bleeding risk has not been well established, there is a clear association between hypothermia and negative outcomes in connection with trauma, surgery, and accidental hypothermia; thus, it is crucial to rewarm patients in these clinical situations without delay. Mild induced hypothermia to _33_C for 24 hours does not seem to be associated with either decreased total haemostasis or increased bleeding risk."

J Trauma Acute Care Surg. 2019 Nov;87(5):1026-1034

Effect of partial and complete aortic balloon occlusion on survival and shock in a swine model of uncontrolled splenic hemorrhage with delayed resuscitation.

Kauvar D, Schechtman D, Thomas S, Prince M, De Guzman R, Polykratis I, Kheirabadi B, Dubick M

BACKGROUND: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is accepted as a resuscitation adjunct and bridge to definitive hemostasis. The ischemic burden of REBOA may be mitigated by a partial REBOA (P-REBOA) strategy permitting longer occlusion times and military use for combat trauma. We evaluated REBOA and P-REBOA in a swine multiple trauma model with uncontrolled solid organ hemorrhage and delayed resuscitation and surgical hemostasis.

METHODS: Anesthetized swine (51.9 ± 2.2 kg) had 20 mL/kg hemorrhage and closed femur fracture. Splenic transection was performed and free bleeding permitted for 10 minutes. Controls (n = 5) were hemorrhaged but had no REBOA, REBOA (n = 8) had 60 minutes complete zone 1 occlusion, P-REBOA (n = 8) had 15 minutes complete occlusion and 45 minutes 50% occlusion. Splenectomy was performed and plasma (15 mL/kg) resuscitation initiated 5 minutes prior to deflation. Resuscitation goal was 80 mm Hg systolic with epinephrine as needed. Animals were monitored for 6 hours.

RESULTS: An initial study with 120-minute occlusion had universal fatality in three REBOA (upon deflation) and three P-REBOA animals (after 60 minutes inflation). With 60-minute occlusion, mortality was 100%, 62.5%, and 12.5% in the control, REBOA, and P-REBOA groups, respectively ($p < 0.05$). Survival time was shorter in controls (120 ± 89 minutes) than REBOA and P-REBOA groups (241 ± 139, 336 ± 69 minutes). Complete REBOA hemorrhaged less during inflation (1.1 ± 0.5 mL/kg) than Control (5.6 ± 1.5) and P-REBOA (4.3 ± 1.4), which were similar. Lactate was higher in the REBOA group compared with the P-REBOA group after balloon deflation, remaining elevated. Potassium increased in REBOA after deflation but returned to similar levels as P-REBOA by 120 minutes.

CONCLUSION: In a military relevant model of severe uncontrolled solid organ hemorrhage 1-hour P-REBOA improved survival and mitigated hemodynamic and metabolic shock. Two hours of partial aortic occlusion was not survivable using this protocol due to ongoing hemorrhage during inflation. There is potential role for P-REBOA as part of an integrated minimally invasive field-expedient hemorrhage control and resuscitation strategy.

J Trauma Acute Care Surg. 2019 Sep;87(3):740-741

Safe duration of Abdominal Aortic and Junctional Tourniquet application.

Kheirabadi B, Dubick M

QUOTE:

"We recently completed a 2-week survival study evaluating long-term consequences of the application of the AAJT for 1 hour, 1.5 hour, or 2 hour in a junctional uncontrolled hemorrhage model in swine.2 We found that ischemic reperfusion injuries associated with 1-hour AAJT application were reversible and swine were able to regain full hind leg function within 1 week, with insignificant or undetectable damages in their skeletal muscle, intestinal, and neural tissues. These findings are in agreement with the Brännström et al.(1) report. However, longer application of the AAJT (1.5 and 2 hours) caused not only ischemic necrosis of skeletal muscle and large intestine tissues but also neural damages that led to paraplegia, urinary retention, and loss of bowel function in some (1.5 hours) or all (2 hours) surviving swine. These animals had to be euthanized early (within 2–3 days after operation) because of their inability to move and feed and drink normally in their cage. Significant necrosis was also found in the descending colon and rectum of these animals after necropsy. Based on the results of this study and recognizing the anatomical differences between swine and human, we concluded that abdominal application of AAJT should not exceed 1 hour."

Ann Vasc Surg. 2019 Oct 30;Epub ahead of print

Compartment Syndrome of the Leg after Intraosseous (IO) Needle Insertion.

Kibrik P, Alsheekh A, Rajaee S, Marks N, Hingorani A, Ascher E

ABSTRACT: Intraosseous (IO) needles are used in patients who are critically ill when it is not possible to obtain venous access. While IO allows for immediate access, IO infusions are associated with complications including fractures, infections, and compartment syndrome. We present a case of an 87-year-old man who developed lower extremity compartment syndrome after receiving an IO needle insertion and had to be treated surgically with fasciotomy to correct the problem.

J Spec Oper Med. 2019 Fall;19(3):110-115.

United States Military Parachute Injuries. Part 1: Early Airborne History and Secular Trends in Injury Incidence.

Knapik J

ABSTRACT: This article traces the early history of military airborne operations and examines studies that have provided overall incidences of parachute-related injuries over time. The first US combat parachute assault was proposed during World War I, but the war ended before the operation could be conducted. Experimental jumps were conducted near San Antonio, Texas, in 1928 and 1929, but it was not until 1939, spurred by the developments in Germany, that the US Army Chief of Infantry proposed the development of an "air infantry." An Airborne Test Platoon was instituted with 48 men at Fort Benning, Georgia, and mass training of paratroopers began in 1940. The US entered World War II in December 1941 with the attack on Pearl Harbor and declaration of war by Germany. In January 1942, US War Department directed that four parachute regiments be formed. The 509th Parachute Infantry Battalion made the first US Army combat jumps into Morocco and Algeria in November 1942. At the US Army Airborne School in the 1940-1941 period, the parachute-related injury incidence was 27 injuries/1000 jumps; by 1993 it was 10 injuries/1000 jumps and in 2005-2006, 6 injuries/1000 jumps. Analysis of time-loss injuries in operational units showed a decline in injuries from 6 injuries/1000 jumps to 3 injuries/1000 jumps to 1 injury/1000 jumps in the periods 1946-1949, 1956-1962, and 1962-1963, respectively. When all injuries (not just time-loss) experienced in operational units are considered, the overall injury incidence was about 8 injuries/1000 jumps in the 1993- 2013 period. In jump operations involving a larger number of risk factors (e.g., high winds, combat loads, rough drop zones) injury incidences was considerably higher. The few studies that have reported on parachute-related injuries in combat operations suggest injury incidence ranged from 19 to 401 injuries/ 1000 jumps, likely because of the number of known injury risk factors present during these jumps. Despite the limitations of this analysis stemming from different injury definitions and variable risk factors, the data strongly suggest that military parachute injuries have sharply declined over time. Part 2 of this series will discuss techniques and equipment that have likely improved the safety of parachute operations.

J Trauma Acute Care Surg. 2019 Oct;87(4):978-989

Influence of prehospital physician presence on survival after severe trauma: Systematic review and meta-analysis.

Knapp J, Häske D, Böttiger B, Limacher A, Stalder O, Schmid A, Schulz S, Bernhard M.

BACKGROUND: As trauma is one of the leading causes of death worldwide, there is great potential for reducing mortality in trauma patients. However, there is continuing controversy over the benefit of deploying emergency medical systems (EMS) physicians in the prehospital setting. The objective of this systematic review and meta-analysis is to assess how out-of-hospital hospital management of severely injured patients by EMS teams with and without physicians affects mortality.

METHODS: PubMed and Google Scholar were searched for relevant articles, and the search was supplemented by a hand search. Injury severity in the group of patients treated by an EMS team including a physician had to be comparable to the group treated without a physician. Primary outcome parameter was mortality. Helicopter transport as a confounder was accounted for by subgroup analyses including only the studies with comparable modes of transport. Quality of all included studies was assessed according to the Cochrane handbook.

RESULTS: There were 2,249 publications found, 71 full-text articles assessed, and 22 studies included. Nine of these studies were matched or adjusted for injury severity. The odds ratio (OR) of mortality was significantly lower in the EMS physician-treated group of patients: 0.81; 95% confidence interval (CI): 0.71-0.92. When analysis was limited to the studies that were adjusted or matched for injury severity, the OR was 0.86 (95% CI, 0.73-1.01). Analyzing only studies published after 2005 yielded an OR for mortality of 0.75 (95% CI, 0.64-0.88) in the overall analysis and 0.81 (95% CI, 0.67-0.97) in the analysis of adjusted or matched studies. The OR was 0.80 (95% CI, 0.65-1.00) in the subgroup of studies with comparable modes of transport and 0.74 (95% CI, 0.53-1.03) in the more recent studies.

CONCLUSION: Prehospital management of severely injured patients by EMS teams including a physician seems to be associated with lower mortality. After excluding the confounder of helicopter transport we have shown a nonsignificant trend toward lower mortality.

LEVEL OF EVIDENCE: Systematic review and meta-analysis, level III.

J Spec Oper Med. 2019 Fall;19(3):45-50.

Deliberate Practice in Combat Application Tourniquet Placement by Loop Passage.

Kragh JF Jr, Aden JK 3rd, Dubick MA.

BACKGROUND: We sought opportunities to develop learning practices of individual first aid providers. In this study, we simulated deliberate practice in placing limb tourniquets.

METHODS: This study comprised tourniquet uses by two experienced persons. Their practice sessions focused on developing a motor skill with periodic coaching. The Combat Application Tourniquet is 1.5-inches wide and was used in a technique of loop passage around the end of the limb to place it 2-3 inches above the wound. The simulated limb was a Z-Medica Hemorrhage Control Trainer. Both users applied the tourniquet six times over 5 days to accrue 30 uses individually (N = 60 tourniquet applications for the study).

RESULTS: When represented as summary parameters, differences were small. For example, average ease of use was the same for both users, but such parameters only took a snapshot of performance, yielding a general assessment. However, for a learning curve by use number, a surrogate of experience accrual, application time revealed spiral learning. The amount that users compressed a limb averaged -15% compared with its unsqueezed state. Placement accuracy was classified relative to gap widths between the tourniquet and the wound, and of 60 performances, 55 were satisfactory and five were unsatisfactory (i.e., placement was <2 inches from the wound). When a tourniquet only overlaid the 2-inch edge of the placement zone (i.e., tourniquet was 2-3.5 inches away from the wound), no error was made, but errors were made in crossing that 2-inch edge. These gauging errors led us to create a template for learners to see and to demonstrate what the meaning of 2-3 inches is.

CONCLUSION: Each metric had value in assessing first aid, but turning attention to gauging wound-tourniquet gaps revealed placement errors. Analysis of such errors uncovered what 2-3 inches meant in operation. Spiral learning may inform the development of best readiness practices such as coaching deliberate-practice sessions.

Crit Care Med. 2019 Oct;47(10):1362-1370

Comparing the McGrath Mac Video Laryngoscope and Direct Laryngoscopy for Prehospital Emergency Intubation in Air Rescue Patients: A Multicenter, Randomized, Controlled Trial.

Kreutziger J, Hornung S, Harrer C, Urschl W, Doppler R, Voelckel W, Trimmel H

OBJECTIVES: Tracheal intubation in prehospital emergency care is challenging. The McGrath Mac Video Laryngoscope (Medtronic, Minneapolis, MN) has been proven to be a reliable alternative for in-hospital airway management. This trial compared the McGrath Mac Video Laryngoscope and direct laryngoscopy for the prehospital setting.

DESIGN: Multicenter, prospective, randomized, controlled equivalence trial.

SETTING: Oesterreichischer Automobil- und Touring Club (OEAMTC) Helicopter Emergency Medical Service in Austria, 18-month study period.

PATIENTS: Five-hundred fourteen adult emergency patients (≥ 18 yr old).

INTERVENTIONS: Helicopter Emergency Medical Service physicians followed the institutional algorithm, comprising a maximum of two tracheal intubation attempts with each device, followed by supraglottic, then surgical airway access in case of tracheal intubation failure. No restrictions were given for tracheal intubation indication.

MEASUREMENTS MAIN RESULTS: The Primary outcome was the rate of successful tracheal intubation; equivalence range was ± 6.5% of success rates. Secondary outcomes were the number of attempts to successful tracheal intubation, time to glottis passage and first end-tidal CO2 measurement, degree of glottis visualization, and number of problems. The success rate for the two devices was equivalent: direct laryngoscopy 98.5% (254/258), McGrath Mac Video Laryngoscope 98.1% (251/256) (difference, 0.4%; 99% CI, -2.58 to 3.39). There was no statistically significant difference with regard to tracheal intubation times, number of attempts or difficulty. The view to the glottis was significantly better, but the number of technical problems was increased with the McGrath Mac Video Laryngoscope. After a failed first tracheal intubation attempt, immediate switching of the device was significantly more successful than after the second attempt (90.5% vs 57.1%; p = 0.0003), regardless of the method.

CONCLUSIONS: Both devices are equivalently well suited for use in prehospital emergency tracheal intubation of adult patients. Switching the device following a failed first tracheal intubation attempt was more successful than a second attempt with the same device.

Can J Anaesth. 2019 Sep 23;Epub ahead of print

Managing and securing the bleeding upper airway: a narrative review.

Kristensen M, McGuire B

ABSTRACT: Failure to manage bleeding in the airway is an important cause of airway-related death. The purpose of this narrative review is to identify techniques and strategies that can be employed when severe bleeding in the upper airway may render traditional airway management (e.g., facemask ventilation, intubation via direct/video laryngoscopy, flexible bronchoscopy) impossible because of impeded vision. An extensive literature search was conducted of bibliographic databases, guidelines, and textbooks using search terms related to airway management and bleeding. We identified techniques that establish a definitive airway, even in cases of impeded visibility resulting from severe bleeding in the airway. These include flexible video-/optical- scope-guided intubation via a supraglottic airway device; cricothyroidotomy or tracheotomy; and retrograde-, blind nasal-, oral-digital-, light-, and ultrasound-guided intubation. We provide a structured approach to managing bleeding in the airway that accounts for the source of bleeding and the estimated risk of failure to intubate using direct laryngoscopy or to achieve a front-of-neck access for surgical airway rescue. In situations where these techniques are predicted to be successful, the recommended approach is to identify the cricothyroid membrane (in preparation for rescue cricothyroidotomy), followed by rapid sequence induction. In situations where traditional management of the airway is likely to fail, we recommend an awake approach with one of the aforementioned techniques.

J Trauma Acute Care Surg. 2019 Nov;87(5):1181-1188

Ketamine infusion for pain control in elderly patients with multiple rib fractures: Results of a randomized controlled trial.

Kugler N, Carver T, Juul J, Peppard W, Boyle K, Drescher K, Szabo A, Rein L, Somberg L, Paul J

BACKGROUND: Rib fractures are associated with increased mortality, particularly in the elderly. While opiate-based pain regimens remain the cornerstone of rib fracture management, issues related to opioids have driven research into alternative analgesics. Adjunctive ketamine use in lieu of opioids continues to increase but little evidence exists to support its efficacy or safety within the elderly trauma population.

METHODS: A prospective, randomized, double-blind placebo-controlled trial of elderly patients (age, ≥65 years) with three or more rib fractures admitted to a Level I trauma center was conducted. Exclusion criteria included Glasgow Coma Scale score less than 14, and chronic opiate use. Groups were randomized to either low-dose ketamine (LDK) at 2 μg·kg·min or an equivalent rate of 0.9% normal saline. The primary outcome was reduction in numeric pain scores (NPS). Secondary outcomes included oral morphine equivalent (OME) utilization, epidural rates, pulmonary complications, and adverse events.

RESULTS: Thirty (50.8%) of 59 were randomized to the experimental arm. Groups were similar in makeup. Low-dose ketamine failed to reduce 24-hour NPS or OME totals. Subgroup analysis of 24 patients with Injury Severity Score greater than 15 demonstrated that LDK was associated with a reduction in OME utilization the first 24-hours (25.6 mg vs. 42.6 mg, p = 0.04) but at no other time points. No difference in other secondary outcomes or adverse events was noted.

CONCLUSION: Low-dose ketamine failed to affect NPS or OME within the overall cohort, but a decrease in OME was observed in those with an Injury Severity Score greater than 15. Additional studies are necessary to confirm whether LDK benefits severely injured elderly patients.

LEVEL OF EVIDENCE: Therapeutic, level I.

Medicine (Baltimore). 2019 Oct;98(42):e17713

Incidence and outcomes of cricothyrotomy in the "cannot intubate, cannot oxygenate" situation.

Kwon Y, Lee C, Park S, Ha S, Sim Y, Baek M

ABSTRACT: Few data are available regarding factors that impact cricothyrotomy use and outcome in general hospital setting. The aim of the present study was to determine the incidence and outcomes of the patients underwent cricothyrotomy in a "cannot intubate, cannot oxygenate" (CICO) situation at university hospitals in Korea.This was a retrospective review of the electronic medical records of consecutive patients who underwent cricothyrotomy during a CICO situation between March, 2007, and October, 2018, at 2 university hospitals in Korea. Data regarding patient characteristics and outcomes were analyzed using descriptive statistics. During the study period, a total of 10,187 tracheal intubations were attempted and 23 patients received cricothyrotomy. Hospital-wide incidence of cricothyrotomy was 2.3 per 1000 tracheal intubations (0.23%). The majority of cricothyrotomy procedures (22 cases, 95.7%) were performed in the emergency department (ED); 1 cricothyrotomy was attempted in the endoscopy room. In the ED, 5663 intubations were attempted and the incidence of cricothyrotomy was 3.9 per 1000 tracheal intubations (0.39%). Survival rate at hospital discharge was 47.8% (11 of 23 cases). Except for cardiac arrest at admission, survival rate was 62.5% (10 of 16 cases). Successful cricothyrotomy was performed in 17 patients (73.9%) and 9 patients (52.9%) were survived. Among 6 patients of failed cricothyrotomy (26.1%), 2 patients (33.3%) were survived. After failure of cricothyrotomy, various methods of securing airway were established: 3 tracheal intubations, 1 nasotracheal intubation, and 1 tracheostomy.The success rate of cricothyrotomy and survival rate in the CICO situation were not high. After failure of cricothyrotomy, various methods of securing airway were performed.

Anesth Analg. 2019 Dec;129(6):1574-1584

Tranexamic Acid for Acute Hemorrhage: A Narrative Review of Landmark Studies and a Critical Reappraisal of Its Use Over the Last Decade.

Lier H, Maegele M, Shander A

ABSTRACT: The publication of the Clinical Randomization of an Antifibrinolytic in Significant Hemorrhage-2 (CRASH-2) study and its intense dissemination prompted a renaissance for the use of the antifibrinolytic agent tranexamic acid (TXA) in acute trauma hemorrhage. Subsequent studies led to its widespread use as a therapeutic as well as prophylactic agent across different clinical scenarios involving bleeding, such as trauma, postpartum, and orthopedic surgery. However, results from the existing studies are confounded by methodological and statistical ambiguities and are open to varied interpretations. Substantial knowledge gaps remain on dosing, pharmacokinetics, mechanism of action, and clinical applications for TXA. The risk for potential thromboembolic complications with the use of TXA must be balanced against its clinical benefits. The present article aims to provide a critical reappraisal of TXA use over the last decade and a "thought exercise" in the potential downsides of TXA. A more selective and individualized use of TXA, guided by extended and functional coagulation assays, is advocated in the context of the evolving concept of precision medicine.

J Surg Res. 2019 Aug 16;245:367-372

Preinjury Statins Are Associated With Improved Survival in Patients With Traumatic Brain Injury.

Lokhandwala A, Hanna K, Gries L, Zeeshan M, Ditillo M, Tang A, Hamidi M, Joseph B

BACKGROUND: Statins have been shown to improve outcomes in traumatic brain injury (TBI) in animal models. The aim of our study was to determine the effect of preinjury statins on outcomes in TBI patients.

METHODS: We performed a 4-y (2014-2017) review of our TBI database and included all patients aged ≥18 y with severe isolated TBI. Patients were stratified into those who were on statins and those who were not and were matched (1:2 ratio) using propensity score matching. The primary outcome was in-hospital mortality. The secondary outcomes were skilled nursing facility disposition, Glasgow Outcome Scale-extended score, and hospital and intensive care unit length of stay (LOS).

RESULTS: We identified 1359 patients, of which 270 were matched (statin: 90, no-statin: 180). Mean age was 55 ± 8y, median Glasgow Coma Scale was 10 (8-12), and median head-abbreviated injury scale was 3 (3-5). Matched groups were similar in age, mechanism of injury, Glasgow Coma Scale, Injury Severity Score, neurosurgical intervention, type and size of intracranial hemorrhage, and preinjury anticoagulant or antiplatelet use. The overall in-hospital mortality rate was 18%. Patients who received statins had lower rates of in-hospital mortality (11% versus 21%, P = 0.01), skilled nursing facility disposition (19% versus 28%; P = 0.04), and a higher median Glasgow Outcome Scale-extended (11 [9-13] versus 9 [8-10]; P = 0.04). No differences were found between the two groups in terms of hospital LOS (6 [4-9] versus 5 [3-8]; P = 0.34) and intensive care unit LOS (3 [3-6] versus 4 [3-5]; P = 0.09).

CONCLUSIONS: Preinjury statin use in isolated traumatic brain injury patients is associated with improved outcomes. This finding warrants further investigations to evaluate the potential beneficial role of statins as a therapeutic drug in a TBI.

LEVEL OF EVIDENCE: Level III Therapeutic.

J Trauma Acute Care Surg. 2019 Nov;87(5):1220-1227

Evaluation and management of abdominal gunshot wounds: A Western Trauma Association critical decisions algorithm.

Martin M, Brown C, Shatz D, Alam H, Brasel K, Hauser C, de Moya M, Moore E, Vercruysse G, Inaba K

Figure:

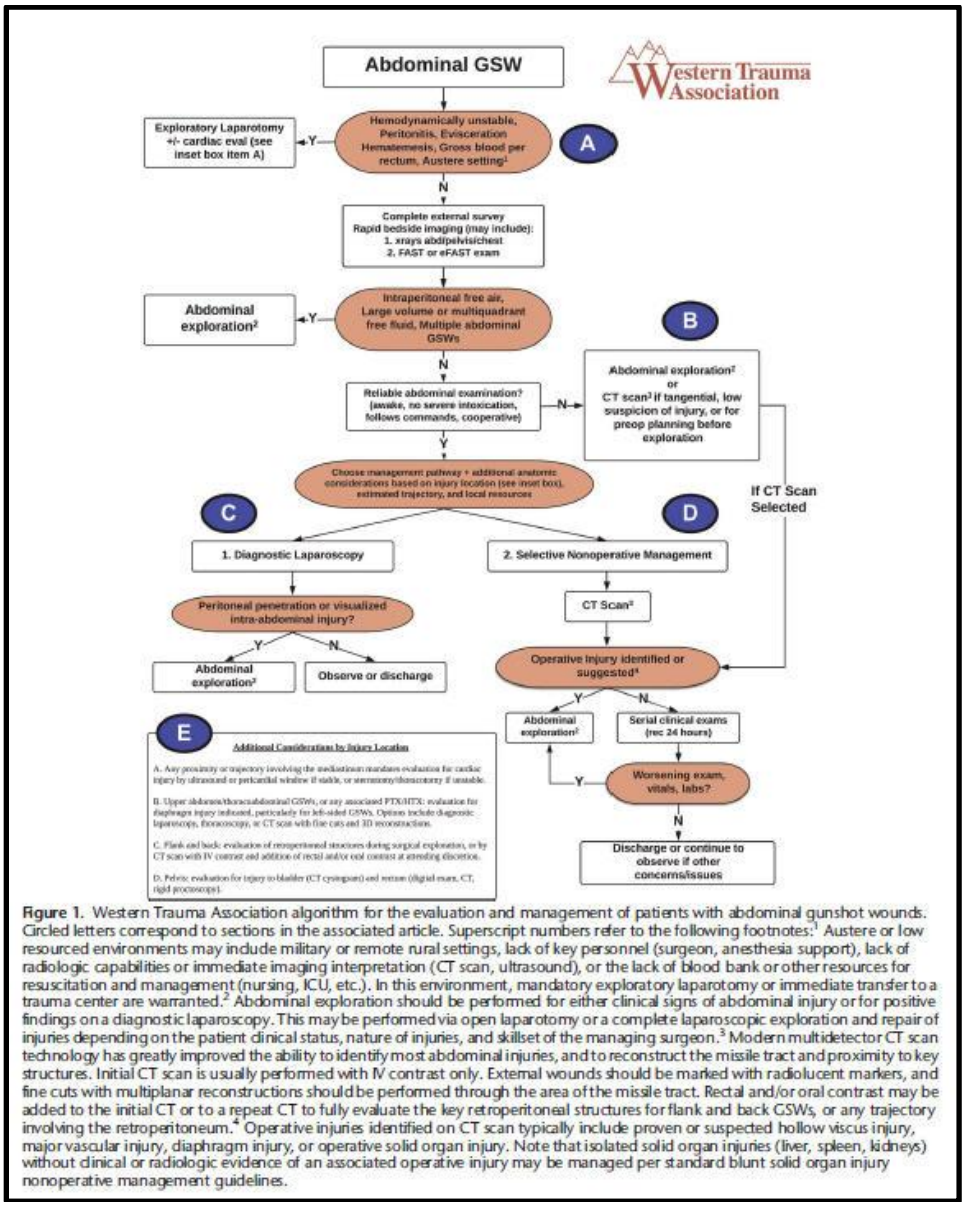

Figure 1. Western Trauma Association algorithm for the evaluation and management of patients with abdominal gunshot wounds. Circled letters correspond to sections in the associated article. Superscript numbers refer to the following footnotes:[1] Austere or low resourced environments may include military or remote rural settings, lack of key personnel (surgeon, anesthesia support), lack of radiologic capabilities or immediate imaging interpretation (CT scan, ultrasound), or the lack of blood bank or other resources for resuscitation and management (nursing, ICU, etc.). In this environment, mandatory exploratory laparotomy or immediate transfer to a trauma center are warranted.[2] Abdominal exploration should be performed for either clinical signs of abdominal injury or for positive findings on a diagnostic laparoscopy. This may be performed via open laparotomy or a complete laparoscopic exploration and repair of injuries depending on the patient clinical status, nature of injuries, and skillset of the managing surgeon.[3] Modern multidetector CT scan technology has greatly improved the ability to identify most abdominal injuries, and to reconstruct the missile tract and proximity to key structures. Initial CT scan is usually performed with IV contrast only. External wounds should be marked with radiolucent markers, and fine cuts with multiplanar reconstructions should be performed through the area of the missile tract. Rectal and/or oral contrast may be added to the initial CT or to a repeat CT to fully evaluate the key retroperitoneal structures for flank and back GSWs, or any trajectory involving the retroperitoneum.[4] Operative injuries identified on CT scan typically include proven or suspected hollow viscus injury, major vascular injury, diaphragm injury, or operative solid organ injury. Note that isolated solid organ injuries (liver, spleen, kidneys) without clinical or radiologic evidence of an associated operative injury may be managed per standard blunt solid organ injury nonoperative management guidelines.

Scand J Trauma Resusc Emerg Med. 2019 Aug 19;27(1):77

New clinical guidelines on the spinal stabilisation of adult trauma patients - consensus and evidence based.

Maschmann C, Jeppesen E, Rubin M, Barfod C

ABSTRACT: Traumatic spinal cord injury is a relatively rare injury in Denmark but may result in serious neurological consequences. For decades, prehospital spinal stabilisation with a rigid cervical collar and a hard backboard has been considered to be the most appropriate procedure to prevent secondary spinal cord injuries during patient transportation. However, the procedure has been questioned in recent years, due to the lack of high-quality studies supporting its efficacy. A national interdisciplinary task force was therefore established to provide updated clinical guidelines on prehospital procedures for spinal stabilisation of adult trauma patients in Denmark. The guidelines are based on a systematic review of the literature and grading of the evidence, in addition to a standardised consensus process.This process yielded five main recommendations: A strong recommendation against spinal stabilisation of patients with isolated penetrating trauma; a weak recommendation against the prehospital use of a rigid cervical collar and a hard backboard for ABCDE-stable patients; and a weak recommendation for the use of a vacuum mattress for patient transportation. Finally, our group recommends the use of our clinical algorithm to ensure good clinical practice.

JAMA Surg. 2019 Jul 24;Epub ahead of print

Effectiveness of the American College of Surgeons Bleeding Control Basic Training Among Laypeople Applying Different Tourniquet Types: A Randomized Clinical Trial.

McCarty J, Hashmi Z, Herrera-Escobar J, de Jager E, Chaudhary M, Lipsitz S, Jarman M, Caterson E, Goralnick E

Importance: More than 500 000 laypeople in the United States have been trained in hemorrhage control, including tourniquet application, under the Stop the Bleed campaign. However, it is unclear whether after hemorrhage control training participants become proficient in a specific type of tourniquet or can also use other tourniquets effectively.

Objective: To assess whether participants completing the American College of Surgeons Bleeding Control Basic (B-Con) training with Combat Application Tourniquets (CATs) can effectively apply bleeding control principles using other tourniquet types (commercial and improvised).

Design, Setting, and Participants: This nonblinded, crossover, sequential randomized clinical trial with internal control assessed a volunteer sample of laypeople who attended a B-Con course at Gillette Stadium and the Longwood Medical Area in Boston, Massachusetts, for correct application of each of 5 different tourniquet types immediately after B-Con training from April 4, 2018, to October 9, 2018. The order of application varied for each participant using randomly generated permutated blocks.

Interventions: Full B-Con course, including cognitive and skill sessions, that taught bleeding care, wound pressure and packing, and CAT application.

Main Outcomes and Measures: Correct tourniquet application (applied pressure of ≥250 mm Hg with a 2-minute time cap) in a simulated scenario for 3 commercial tourniquets (Special Operation Forces Tactical Tourniquet, Stretch-Wrap-and-Tuck Tourniquet, and Rapid Application Tourniquet System) and improvised tourniquet compared with correct CAT application as an internal control using 4 pairwise Bonferroni-corrected comparisons with the McNemar test.

Results: A total of 102 participants (50 [49.0%] male; median [interquartile range] age, 37.5 [27.0-53.0] years) were included in the study. Participants correctly applied the CAT at a significantly higher rate (92.2%) than all other commercial tourniquet types (Special Operation Forces Tactical Tourniquet, 68.6%; Stretch-Wrap-and-Tuck Tourniquet, 11.8%; Rapid Application Tourniquet System, 11.8%) and the improvised tourniquet (32.4%) ($P < .001$ for each pairwise comparison). When comparing tourniquets applied correctly, all tourniquet types had higher estimated blood loss, had longer application time, and applied less pressure than the CAT.

Conclusions and Relevance: The B-Con principles for correct CAT application are not fully translatable to other commercial or improvised tourniquet types. This study demonstrates a disconnect between the B-Con course and tourniquet designs available for bystander first aid, potentially stemming from the lack of consensus guidelines. These results suggest that current B-Con trainees may not be prepared to care for bleeding patients as tourniquet design evolves.

Injury. 2019 Aug 10. pii: S0020-1383(19)30456-5

Haemodynamics as a determinant of need for pre-hospital application of a pelvic circumferential compression device in adult trauma patients.

McCreary D, Cheng C, Lin Z, Nehme Z, Fitzgerald M, Mitra B

INTRODUCTION: Pelvic ring fractures are common following high-energy blunt trauma and can lead to substantial haemorrhage, morbidity and mortality. Pelvic circumferential compression devices (PCCDs) improve position and stability of open-book type pelvic fracture, and can improve haemodynamics in patients with hypovolaemic shock. However, PCCDs may cause adverse outcomes including worsening of lateral compression fracture patterns and routine use is associated with high costs. Controversy regarding indication of PCCDs exists with some centres recommending PCCD in the setting of hypovolaemic shock compared to placement for any suspected pelvic injury.

OBJECTIVE: To assess the need for PCCD application based on pre-hospital vital signs and mechanism of injury.

METHODS: A retrospective cohort study was conducted in a single adult major trauma centre examining a 2-year period. Patients were sub-grouped based on initial pre-hospital and emergency department observations as haemodynamically normal (heart rate <100 bpm, systolic blood pressure ≥100 mmHg and Glasgow Coma Scale ≥13) or abnormal. Diagnostic accuracy of pre-hospital haemodynamics as a predictor of pelvic fracture requiring intervention within 24 h was assessed.

RESULTS: There were 376 patients with PCCD in-situ on hospital arrival. Pelvic fractures were diagnosed in 137 patients (36.4%). Of these, 39 (28.5%) were haemodynamically normal and 98 (71.5%) were haemodynamically abnormal. The most common mechanisms of injury were motor vehicle collision (57.7%) and motorcycle collision (13.8%). Of those with fractures, 40 patients (29.2%) required pelvic intervention within 24 h of admission; of these, 8 (20%) were haemodynamically normal and 32 (80%) were haemodynamically abnormal. As a test for pelvic fracture requiring intervention within 24 h, abnormal pre-hospital haemodynamics had a sensitivity of 0.80 (95% CI 0.64-0.91), specificity of 0.32 (95% CI 0.27-0.38) and negative predictive value (NPV) of 0.93 (95% CI 0.88-0.96). Combined with absence of a major mechanism of injury, normal haemodynamics had a sensitivity 1.00, specificity 0.51 (95% CI 0.36-0.66) and NPV of 1.00 for pelvic intervention within 24 h.

CONCLUSION: Normal haemodynamic status, combined with absence of major mechanism of injury can rule out requirement for urgent pelvic intervention. Ongoing surveillance is recommended to monitor for any adverse effects of this change in practice.

Ann Emerg Med. 2019 Nov;74(5):706-710

Point-of Care Ultrasonographically Guided Proximal External Aortic Compression in the Emergency Department.

Michel W, Lachance A, Turcotte A, Morris J

ABSTRACT: In cases of severe subdiaphragmatic vascular trauma, only in extremis interventions such as emergency thoracotomy with aortic cross clamping or resuscitative endovascular balloon occlusion of the aorta are available for temporization until definitive care. This case report proposes a noninvasive approach consisting of localizing the proximal aorta with ultrasonographic guidance and applying a compressive force to occlude the aorta and limit distal flow. Using point-of-care ultrasonography allows precise compression, continuous monitoring of its efficacy, and early detection of return of spontaneous circulation in arrest patients. We present the case of a patient who sustained a gunshot wound causing a left iliac artery injury and subsequent cardiac arrest while he was on route to the hospital. Point-of-care ultrasonographically guided proximal external aortic compression was attempted and return of spontaneous circulation was achieved and maintained, allowing transfer of the patient to the operating room. This single-case report suggests that point-of-care ultrasonographically guided proximal external aortic compression could be used as a bridge to definitive care or to more advanced techniques such as resuscitative endovascular balloon occlusion of the aorta and emergency department thoracotomy with aortic cross clamping.

J Spec Oper Med. 2019 Fall;19(3):64-70.

Airway Management for Army Reserve Combat Medics: An Interdisciplinary Workshop.

Miller BM, Kinder C, Smith-Steinert R.

BACKGROUND: An Army Reserve Combat Medic's training is focused on knowledge attainment, skill development, and building experience and training to prepare them to perform in austere conditions with limited resources like on the battlefield. Unfortunately, the exposure to skills they may be responsible for performing is limited. Research shows that greater than 90% of battlefield deaths occur in the prehospital setting, 24% of which are potentially survivable. Literature demonstrates that 91% of these deaths are related to hemorrhage; the remaining are related to other causes, including airway compromise. The skill and decision-making of this population are prime targets to optimize outcomes in the battlefield setting.

METHODS: Army Reserve combat medics were selected to voluntarily participate in an educational intervention provided by anesthesia providers focusing on airway management. Participants completed a preintervention assessment to evaluate baseline knowledge levels as well as comfort with airway skills. Medics then participated in a simulated difficult airway scenario. Next, airway management was reviewed, and navigation of the difficult airway algorithm was discussed. The presentation was followed by simulations at four hands-on stations, which focused on fundamental airway concepts such as bag-mask ventilation and placement of oral airways, tracheal intubation, placement of supraglottic airways, and cricothyrotomy. Pre/post knowledge assessments and performance evaluation tools were used to measure the effectiveness of the intervention.

RESULTS: Statistically significant results were found in self-reported confidence levels with airway skills ($z = -2.803$, $p = .005$), algorithm progression ($z = -2.807$, $p = .005$), and predicting difficulty with airway interventions based on the patient's features ($z = -2.809$, $p = .005$). Establishment of ventilation was completed faster after the intervention. More coherent and effective airway management was noted, new knowledge was gained, and implications from psychological research applied.

CONCLUSION: Supplementing the training of Army Reserve Combat Medics with the utilization of anesthesia providers is an effective platform. This exercise imparted confidence in this population of military providers. This is critical for decision-making capabilities, performance, and the prevention of potentially survivable mortality on the battlefield.

J Spec Oper Med. 2019 Fall;19(3):71-75.

A Comparison of the Laryngeal Handshake Method Versus the Traditional Index Finger Palpation Method in Identifying the Cricothyroid Membrane, When Performed by Combat Medic Trainees.

Moore A, Aden JK 3rd, Curtis R, Umar M.

BACKGROUND: The laryngeal handshake method (LHM) may be a reliable standardized method to quickly and accurately identify the cricothyroid membrane (CTM) when performing an emergency surgical airway (ESA). However, there is currently minimal available literature evaluating the method. Furthermore, no previous CTM localization studies have focused on success rates of military prehospital providers. This study was conducted with the goal of answering the question: Which method is superior, the LHM or the traditional method (TM), for identifying anatomical landmarks in a timely manner when performed by US Army combat medic trainees?

METHODS: This prospective randomized crossover study was conducted at Ft Sam Houston, TX, in September 2018. Two Army medic trainees with similar body habitus volunteered as subjects, and the upper and lower borders and midline of their CTMs were identified by ultrasound (US). The participants were also recruited from the medic trainee population. After receiving initial training on the LHM and refresher training on the TM, participants were asked to localize the CTMs of each subject with one method per subject. Success was defined as a marking within the borders and 5mm of midline within 2 minutes.

RESULTS: Thirty-two combat medic trainees participated; 78% (n = 25) successfully localized the CTM using the TM versus 41% (n = 13) using the LHM (p = .002).

CONCLUSION: Findings of this study support that at present the TM is a superior method for successful localization of the CTM when performed by Army combat medic trainees.

Acta Neurochir (Wien). 2019 Sep;161(9):1943-1953

A retrospective study of the effect of fibrinogen levels during fresh frozen plasma transfusion in patients with traumatic brain injury.

Nakae R, Yokobori S, Takayama Y, Kanaya T, Fujiki Y, Igarashi Y, Suzuki G, Naoe Y, Fuse A, Yokota H

BACKGROUND: The association between traumatic brain injury (TBI) and coagulopathy is well established. While coagulopathy prophylaxis in TBI involves replenishing coagulation factors with fresh frozen plasma (FFP), its effectiveness is controversial. We investigated the relationship between plasma fibrinogen concentration 3 h after initiating FFP transfusion and outcomes and evaluated the correlation with D-dimer levels at admission.

METHODS: We retrospectively examined data from 380 patients with severe isolated TBI with blood samples collected a maximum of 1 h following injury. Plasma fibrinogen and D-dimer concentrations were obtained at admission, and plasma fibrinogen concentration was again assessed 3-4 h following injury. The patients were divided into two groups based on whether or not they received FFP transfusion. Patients were also divided into subgroups according their fibrinogen level: ≥ 150 mg/dL (high-fibrinogen subgroup) or < 150 mg/dL (low-fibrinogen subgroup) 3 h after injury. Demographic, clinical, radiological and laboratory data were compared between these subgroups.

RESULTS: Glasgow Outcome Scale (GOS) scores at discharge and 3 months after injury were significantly lower in the FFP transfusion group than in the FFP non-transfusion group. Among patients who received FFP, GOS scores at discharge and 3 months after injury were significantly higher in the high-fibrinogen subgroup than in the low-fibrinogen subgroup. Elevated admission D-dimer predicted subsequent fibrinogen decrease.

CONCLUSIONS: In FFP transfusion, fibrinogen level ≥ 150 mg/dL 3 h after injury was associated with better outcomes in TBI patients. Assessing the admission D-dimer and tracking the fibrinogen are crucial for optimal coagulopathy prophylaxis in TBI patients.

Transfusion. 2019 Oct;59(10):3077-3083

Blood transfusion for deep space exploration.

Nowak E, Reyes D, Bryant B, Cap A, Kerstman E, Antonsen E

BACKGROUND: Astronauts on exploration missions may be at risk for traumatic injury and medical conditions that lead to life threatening hemorrhage. Resuscitation protocols are limited by the austere conditions of spaceflight. Solutions may be found in low-resource terrestrial settings. The existing literature on alternative blood product administration and walking blood banks was evaluated for applicability to spaceflight.

STUDY DESIGN AND METHODS: A literature review was done using PubMed and Google Scholar. References were crosschecked for additional publications not identified using the initial search terms. Twenty-seven articles were identified, including three controlled trials, six retrospective cohort analyses, 15 reviews, one case report, and two experimental studies.

RESULTS: Solutions to blood transfusion in austere settings include lyophilized blood products, hemoglobin-based oxygen carriers (HBOCs), and fresh whole blood. Many of these products are investigational. Protocols for walking blood banks include methods for screening and activating donors, transfusion, and monitoring for adverse reactions. Microgravity and mission limitations create additional challenges for transfusion, including baseline physiologic changes, difficulty reconstituting lyophilized products, risk of air emboli during transfusion, equipment constraints, and limited evacuation and surgical options.

CONCLUSION: Medical planning for space exploration should consider the possibility of acute blood loss. A model for "floating" blood banks based on terrestrial walking blood bank protocols from austere environments is presented, with suggestions for future development. Constraints on volume, mass, storage, and crew, present challenges to blood transfusion in space and must be weighed against the benefits of expanding medical capabilities.

J Spec Oper Med. 2019 Fall;19(3):31-44.

Management of Hemorrhage From Craniomaxillofacial Injuries and Penetrating Neck Injury in Tactical Combat Casualty Care: iTClamp Mechanical Wound Closure Device TCCC Guidelines Proposed Change 19-04 06 June 2019.

Onifer DJ, McKee JL, Faudree LK, Bennett BL, Miles EA, Jacobsen T, Morey JK, Butler FK Jr.

ABSTRACT: The 2012 study Death on the battlefield (2001-2011) by Eastridge et al.1 demonstrated that 7.5% of the prehospital deaths caused by potentially survivable injuries were due to external hemorrhage from the cervical region. The increasing use of Tactical Combat-Casualty Care (TCCC) and other medical interventions have dramatically reduced the overall rate of combat-related mortality in US forces; however, uncontrolled hemorrhage remains the number one cause of potentially survivable combat trauma. Additionally, the use of personal protective equipment and adaptations in the weapons used against US forces has caused changes in the wound distribution patterns seen in combat trauma. There has been a significant proportional increase in head and neck wounds, which may result in difficult to control hemorrhage. More than 50% of combat wounded personnel will receive a head or neck wound. The iTClamp (Innovative Trauma Care Inc., Edmonton, Alberta, Canada) is the first and only hemorrhage control device that uses the hydrostatic pressure of a hematoma to tamponade bleeding from an injured vessel within a wound. The iTClamp is US Food and Drug Administration (FDA) approved for use on multiple sites and works in all compressible areas, including on large and irregular lacerations. The iTClamp's unique design makes it ideal for controlling external hemorrhage in the head and neck region. The iTClamp has been demonstrated effective in over 245 field applications. The device is small and lightweight, easy to apply, can be used by any level of first responder with minimal training, and facilitates excellent skills retention. The iTClamp reapproximates wound edges with four pairs of opposing needles. This mechanism of action has demonstrated safe application for both the patient and the provider, causes minimal pain, and does not result in tissue necrosis, even if the device is left in place for extended periods. The Committee on TCCC recommends the use of the iTClamp as a primary treatment modality, along with a CoTCCC-recommended hemostatic dressing and direct manual pressure (DMP), for hemorrhage control in craniomaxillofacial injuries and penetrating neck injuries with external hemorrhage.

Anaesthesiol Intensive Ther. 2019;51(3):240-248

Pre-hospital environment bleeding: from history to future prospects.

Pereira B, Dorigatti A, Calderon L, Negrão M, Meirelles G, Duchesne J

ABSTRACT: While the blood was related to life since antiquity, scientific investigations on anatomy and physio-logy of the circulation system had to wait until the arrival of the 16th century. In trauma patients, hemorrhagic shock is the main risk factor for multiple organ dysfunction and consequent increased mortality. On the pre-hospital setting intravenous administration of crystalloid solution became the more common intervention during resuscitation of trauma patient due to many reasons although currently new discussions have blossomed on regards type of fluids and resuscitation. The object of this manuscript is to review the history of pre-hospital care bleeding management and to gather new perspectives for the future. Herein authors discuss several issues on bleeding control: 1. Current status and future possibilities on stop the bleeding in the the pre-hospital setting - movements after the Hartford Consensus, use of topic homeostatic agents, tourniquets, REBOA and other radical interventions; 2. Damage control resuscitation in the pre-hospital environment - is massive transfusion protocol feasible at this setting? Tranexemic acid should be done? Possibilities that may improve survival and coagulopathy understanding; 3. Critical decision and decision making on stop the bleed; 4. Proposed flowchart on bleeding control. The implementation of measures to stop acute bleeding in the pre-hospital setting is a well-known and well-founded measure. However, the provision of current evidence demonstrates that these measures go far beyond compression and elevation of the limb as was known in the past. The deep understanding of the mechanism of coagulopathy and the new adjuvant arsenal to control bleeding are essential for a better quality of pre-hospital medical care as well as lower mortality rates.

Curr Opin Crit Care. 2019 Dec;25(6):668-674

Coagulopathy in the surgical patient: trauma-induced and drug-induced coagulopathies.

Peralta R, Thani H, Rizoli S

PURPOSE OF REVIEW: Coagulopathy is the derangement of hemostasis that in surgical patients may result in excessive bleeding, clotting or no measurable effect. The purpose of this review is to provide an overview of the most current evidence and practical approach to trauma- and drug-induced coagulopathy in surgical patients.

RECENT FINDINGS: Early identification and timely correction of coagulopathy in surgical patients with significant bleeding is paramount to prevent death and other consequences of hemorrhage. Trauma-induced coagulopathy is managed by protocols recommending fibrinogen replacement, FFP, platelets, TXA and frequent lab monitorization including viscoelastic tests. For warfarin- or DOAC-induced coagulopathy, the management follows similar principles plus drug reversal. Warfarin is diagnosed by prolonged international normalized ratio and reversed by PCC or FFP. DOACs are inconsistently diagnosed by routine coagulation tests, and reversed by a combination of TXA, PCC and specific antidotes (if available).

SUMMARY: Despite different understandings of the pathophysiology, trauma- and drug-induced coagulopathies are managed following similar protocols. In most of cases of significant surgical bleeding, timely and protocolized approach to correct the coagulopathy is likely to improve patients' outcome.

Eur J Trauma Emerg Surg. 2019 Sep 5;Epub ahead of print

International perspective of tourniquet use in extremity vascular trauma: a commentary from the Sri Lankan civil war experience.

Ratnayake A, Bala M, Worlton T

QUOTE:

" However, when looking at longer evacuation times, there are recognized complications from prolonged use of tourniquets. In the 2014 update to the Tactical Combat Casualty Care (TCCC) guidelines the authors cited a patient with an avoidable amputation secondary to tourniquet application for 8 h which on eventual exploration showed no major vascular injury. They used this opportunity to address alternative means of hemorrhage control and reemphasize early tourniquet conversion to pressure or hemostatic dressing in the absence of shock, capable of close monitoring for re-bleed and not being applied for amputation [3].

This oft-overlooked update in TCCC was more applicable for the civil war in Sri Lanka. This conflict spanned from 1983 to 2009 and during this time liberal application of tourniquets was not common. In the author's experience, documented transfer time of casualties was an average of 335 min. In this unique setting, 80% (103/129) of documented extremity arterial injuries had preservation of the injured limb [6]."

J Trauma Acute Care Surg. 2019 Sep 12;Epub ahead of print

PREHOSPITAL PLASMA IN INJURED PATIENTS IS ASSOCIATED WITH SURVIVAL PRINCIPALLY IN BLUNT INJURY: RESULTS FROM TWO RANDOMIZED PREHOSPITAL PLASMA TRIALS.

Reitz K, Moore H, Guyette F, Sauaia A, Pusateri A, Moore E, Hassoune A, Chapman M, Daley B, Miller R, Harbrecht B, Claridge J, Phelan H, Brown J, Zuckerbraun B, Neal M, Yazer M, Sperry J

INTRODUCTION: Recent evidence demonstrated that prehospital plasma in patients at risk of hemorrhagic shock was safe for ground transport and resulted in a 28-day survival benefit for air medical transport patients. Whether any beneficial effect of prehospital plasma varies across injury mechanism remains unknown.

METHODS: We performed a secondary analysis using a harmonized dataset derived from two recent prehospital plasma randomized trials. Identical inclusion/exclusion criteria and primary/secondary outcomes were employed for the trials. Prehospital time, arrival shock parameters and 24-hour transfusion requirements were compared across plasma and control groups stratified by mechanism of injury. Stratified survival analysis and Cox hazard regression were performed to determine the independent survival benefits of plasma across blunt and penetrating injury.

RESULTS: Blunt patients had higher injury severity, were older and had a lower GCS. Arrival indices of shock and coagulation parameters were similar across blunt and penetrating injury. The percentage of patients with a prehospital time less than 20 mins was significantly higher for penetrating patients relative to blunt injured patients (28.0% vs 11.6%, $p<0.01$). Stratified Kaplan-Meier curves demonstrated a significant separation for blunt injured patients (n=465, p=0.01) with no separation demonstrated for penetrating injured patients (n=161, p=0.60) Stratified Cox hazard regression verified, after controlling for all important confounders, that prehospital plasma was associated with a 32% lower independent hazard for 28 day mortality in blunt injured patients (HR 0.68, 95% CI 0.47-0.96, p= 0.03) with no independent survival benefit found in penetrating patients (HR 1.16, 95%CI 0.4-3.1, p=0.78).

CONCLUSION: A survival benefit associated with prehospital plasma at 24 hours and 28 days exists primarily in blunt injured patients with no benefit shown in penetrating trauma patients. No detrimental effects attributable to plasma are demonstrated in penetrating injury. These results have important relevance to military and civilian trauma systems.Original ArticleSecondary Analysis LEVEL OF EVIDENCE: I.

Adv Anesth. 2019 Dec;37:87-110

Tranexamic Acid in the Perioperative Period: Yes, No, Maybe?

Richards J, Samet R, Koerner A, Grissom T

QUOTE:

"Key points

- Antifibrinolytics have a role in the management of acute bleeding states as part of a blood conservation strategy.
- Early tranexamic acid administration has been shown to decrease blood loss and death from hemorrhage for trauma and postpartum hemorrhage without an increase in thromboembolic events.
- Although using tranexamic acid during orthotopic liver transplantation results in lower blood loss, its use is guided by viscoelastic hemostatic assay monitoring rather than an empiric approach in most programs.
- Routine use of tranexamic acid is common in major orthopedic spine, joint replacement, and trauma surgery.
- Tranexamic acid or other antifibrinolytics for cardiac surgery results in less blood loss, fewer transfusions, and less need for reoperation, although the optimal dosing strategy has not been established."

Anesth Pain Med. 2019 Apr 28;9(2):e90858

Significance of Cardiac Troponin I Elevation in Traumatic Brain Injury Patients.

Rimaz S, Ashraf A, Marzban S, Haghighi M, Zia Ziabari S, Biazar G, Rimaz S, Omidi S

Background: Myocardial dysfunction is frequently described as an underlying cause of mortality in traumatic brain injury (TBI) known as brain-cardiac link. However the impact on prognosis of a disease remains uncertain.

Objectives: The current study aimed at investigating the correlation between TBI and cardiac troponin I (cTnI) rise and in-hospital mortality rate among patients with TBI.

Methods: In the current prospective study TBI patients with abbreviated injury scale score (AIS) > 3 and Glasgow coma scale (GCS) score ≤ 8 with cTnI measurement within the first 24 hours of admission were evaluated. Chi-square, Kruskal-Wallis, Mann-Whitney U and Logistic Regression tests were used for data analysis.

Results: A total of 166 eligible patients were studied .The mean age of the cases was 37.64 ± 17.21 years, largely under 65 (93.4%) and male (86.7%).The most common injuries were cerebral contusion (35.1%), while motor vehicle crash (MVC) was the most common cause of injuries (83.73%); 59 % of the patients showed detectable cTnI concentrations within 24 hours of admission; 65.7% of the patients expired; they showed higher levels of cTnI compared to survivors that showed lower levels, 0.148 ± 0.074 vs 0.057 ± 0.055, respectively ($P < 0.001$). Moreover, a significant association was observed between mortality rate and lower admission GCS 3.49 ± 1.08 vs 6.79 ± 1.66, respectively ($P < 0.001$).

Conclusions: Increased cTnI levels could be a predictor of mortality among patients with TBI. Its measurement and investigation for therapeutic strategies could lead to better management of these cases.

J Spec Oper Med. 2019 Fall;19(3):123-127.

Proficiency in Improvised Tourniquets for Extremities: A Review.

Rohrich C, Plackett T, Scholz B, Hetzler M

ABSTRACT: Tourniquets have become ubiquitous tools for controlling hemorrhage in the modern prehospital environment, and while commercial products are preferable, improvised tourniquets play an important role when commercial options are not available. A properly constructed improvised tourniquet can be highly effective provided the user adheres to certain principles. This review article identifies key skills in the construction and application of improvised tourniquets on an extremity. An improvised tourniquet design for an extremity should include three components: a strap, a rod, and a securing mechanism. The strap can be made from a variety of materials, but cravat- like fabric has been shown to work well. Optimal strap dimensions should be at least 2cm in width and a continuous segment long enough to extend around the extremity while still offering ends to accommodate and secure the rod. The rod should be constructed from a material that is hard, strong, and capable of withstanding the torque placed on it without bending or breaking. After torque is applied, the rod must be secured into position to maintain the constricting force and survive patient transport. Finally, the need for an improvised tourniquet is a contingency that all first responders should anticipate. Hands-on training should be conducted routinely in conjunction with other first responder tasks.

JAMA Network Open. 2019 Sep 4;2(9):e1912076

Association of Early, High Plasma-to-Red Blood Cell Transfusion Ratio With Mortality in Adults With Severe Bleeding After Trauma.

Roquet F, Neuschwander A, Hamada S, Favé G, Follin A, Marrache D, Cholley B, Pirracchio R); Traumabase Group.

Importance: Optimal transfusion management is crucial when treating patients with trauma. However, the association of an early, high transfusion ratio of fresh frozen plasma (FFP) to packed red blood cells (PRBC) with survival remains uncertain.

Objective: To study the association of an early, high FFP-to-PRBC ratio with all-cause 30-day mortality in patients with severe bleeding after trauma.

Design, Setting, and Participants: This cohort study analyzes the data included in a multicenter national French trauma registry, Traumabase, from January 2012 to July 2017. Traumabase is a prospective, active, multicenter adult trauma registry that includes all consecutive patients with trauma treated at 15 trauma centers in France. Overall, 897 patients with severe bleeding after trauma were identified using the following criteria: (1) received 4 or more units of PRBC during the first 6 hours or (2) died from hemorrhagic shock before receiving 4 units of PRBC.

Exposures: Eligible patients were divided into a high-ratio group, defined as an FFP-to-PRBC ratio more than 1:1.5, and a low-ratio group, defined as an FFP-to-PRBC ratio of 1:1.5 or less. The ratio was calculated using the cumulative units of FFP and PRBC received during the first 6 hours of management.

Main Outcomes and Measures: A Cox regression model was used to analyze 30-day survival with the transfusion ratio as a time-dependent variable to account for survivorship bias.

Results: Of the 12 217 patients included in the registry, 897 (7.3%) were analyzed (median [interquartile range] age, 38 (29-54) years; 639 [71.2%] men). The median (interquartile range) injury severity score was 34 (22-48), and the overall 30-day mortality rate was 33.6% (301 patients). A total of 506 patients (56.4%) underwent transfusion with a high ratio and 391 (43.6%) with a low ratio. A high transfusion ratio was associated with a significant reduction in 30-day mortality (hazard ratio, 0.74; 95% CI, 0.58-0.94; P = .01). When only analyzing patients who had complete data, a high transfusion ratio continued to be associated with a reduction in 30-day mortality (hazard ratio, 0.57; 95% CI, 0.33-0.97; P = .04).

Conclusions and Relevance: In this analysis of the Traumabase registry, an early FFP-to-PRBC ratio of more than 1:1.5 was associated with increased 30-day survival among patients with severe bleeding after trauma. This result supports the use of early, high FFP-to-PRBC transfusion ratios in patients with severe trauma.

J Spec Oper Med. Spring 2019;19(1):52-55.

The Prehospital Trauma Registry Experience With Intraosseous Access.

Schauer SG, Naylor JF, April MD, Fisher AD, Cunningham CW, Fernandez JRD, Shreve BP, Bebarta VS.

BACKGROUND: Peripheral intravenous (IV) cannulation is often difficult to obtain in a patient with hemorrhagic shock, delaying the appropriate resuscitation of critically ill patients. Intraosseous (IO) access is an alternative method. To date, few data exist on use of this procedure by ground forces in Afghanistan. Here, we compare patient characteristics and concomitant interventions among patients undergoing IO access versus those undergoing IV access only.

METHODS: We obtained data from the Prehospital Trauma Registry (PHTR). When possible, patients were linked to the Department of Defense Trauma Registry for outcome data. To develop the cohorts, we searched for all patients with documented IO or IV access placement. Those with both IO and IV access documented were placed in the IO group.

RESULTS: Of the 705 available patients in the PHTR, we identified 55 patients (7.8% of the population) in the IO group and 432 (61.3%) in the IV group. Among patients with documentation of access location, the most common location was the tibia (64.3%; n = 18). Compared with patients with IV access, those who underwent IO access had higher urgent evacuation rates (90.9% versus 72.4%; p = .01) and air evacuation rates (58.2% versus 14.8%; p < .01). The IO cohort had significantly higher rates of interventions for hypothermia, chest seals, chest tubes, needle decompressions, and tourniquets, but a significantly lower rate of analgesic administration (ρ ≤ .05).

CONCLUSION: Within the registry, IO placement was relatively low (<10%) and used in casualties who received several other life-saving interventions at a higher rate than casualties who had IV access. Incidentally, lower proportions of analgesia administration were detected in the IO group compared with the IV group, despite higher intervention rates.

J Spec Oper Med. 2019 Fall;19(3):86-89.

Survival of Casualties Undergoing Prehospital Supraglottic Airway Placement Versus Cricothyrotomy.

Schauer S, Naylor J, Chow A, Maddry J, Cunningham C, Blackburn M, Nawn C, April M

BACKGROUND: Airway compromise is the second leading cause of preventable death on the battlefield. Unlike a cricothyrotomy, supraglottic airway (SGA) placement does not require an incision and is less technically challenging. We compare survival of causalities undergoing cricothyrotomy versus SGA placement.

METHODS: We used a series of emergency department (ED) procedure codes to search within the Department of Defense Trauma Registry (DoDTR) from January 2007 to August 2016. This is a subanalysis of that dataset.

RESULTS: During the study period, 194 casualties had a documented cricothyrotomy and 22 had a documented SGA as the sole airway intervention. The two groups had similar proportions of explosive injuries (57.7% versus 63.6%, p = .328), similar composite injury severity scores (25 versus 27.5, p = .168), and similar AIS for the head, face, extremities, and external body regions. The cricothyrotomy group had lower AIS for the thorax (0 versus 3, p = .019) a trend toward lower AIS for the abdomen (0 versus 0, p = .077), more serious injuries to the head (67.5% versus 45.5%, p = .039), and similar rates of serious injuries to the face (4.6% versus 4.6%, p = .984). Glasgow Coma Scale (GCS) scores were similar upon arrival to the ED (3 versus 3, p = .467) as were the proportion of patients surviving to discharge (45.4% versus 40.9%, p = .691). On repeated multivariable analyses, the odds ratios (ORs) for survival were not significantly different between the two groups.

CONCLUSION: We found no difference in short-term outcomes between combat casualties who received an SGA vs cricothyrotomy. Military prehospital personnel rarely used either advanced airway intervention during the recent conflicts in Afghanistan and Iraq.

J Trauma Acute Care Surg. 2019 Oct;87(4):865-869

Undertriaged trauma patients: Who are we missing?

Schellenberg M, Benjamin E, Bardes J, Inaba K, Demetriades D.

BACKGROUND: Trauma team activation (TTA) criteria, set by the American College of Surgeons Committee on Trauma, are used to identify patients prehospital who are at highest risk for severe injury and mobilize the optimal resources. Patients are undertriaged if they are severely injured (Injury Severity Score, ≥16) but do not meet TTA criteria. This study examined the epidemiology and injury patterns of undertriaged patients and potential clinical effects.

METHODS: All patients presenting to our Level I trauma center (June 1, 2017 to May 31, 2018) were screened for inclusion using modified TTA criteria (mTTA), that is, age over 70 years added to the standard American College of Surgeons Committee on Trauma TTA criteria. Demographics, injury/clinical data, and outcomes of undertriaged patients were analyzed. Undertriaged patients were further subcategorized as "high-risk" if they expired or required emergent intervention.

RESULTS: 233 undertriaged patients were identified from 1423 routine trauma consults (16%). Mean Injury Severity Score was 20 (range, 16-43). Most undertriage occurred following blunt trauma (n = 224, 96%), especially motor vehicle collisions (n = 66, 28%) and auto versus pedestrian collisions (n = 57, 24%). Thirty-two (14%) patients were identified as high-risk undertriaged patients: 16 (50%) required emergency surgery (mainly craniectomy; n = 10, 63%), 5 (16%) required angioembolization, and 14 patients (44%) died. In this high-risk group, the cause of death was almost exclusively traumatic brain injury (TBI) (n = 13, 93%). Of the patients who died of TBI, the majority had a depressed Glasgow Coma Scale score on presentation to the ED (<11) (n = 10, 77%) despite not meeting field criteria for TTA.

CONCLUSION: Using mTTA criteria, undertriage rates are relatively low, particularly after penetrating trauma. However, there is a high-risk population that is not captured, among whom mortality and need for emergent intervention are high. Most undertriage deaths are secondary to severe TBI. Despite not qualifying for highest-level activation, patients with head trauma and Glasgow Coma Scale score less than 11 on admission are at high-risk for adverse outcomes and additional resource mobilization should be considered.

LEVEL OF EVIDENCE: Care Management, level IV.

Eur J Trauma Emerg Surg. 2019 Oct 14;Epub ahead of print

Is there any benefit in the pre-hospital application of pelvic binders in patients with suspected pelvic injuries?

Schweigkofler U, Wohlrath B, Trentzsch H, Horas K, Hoffmann R, Wincheringer D

BACKGROUND: Massive hemorrhage is a common cause of death in patients sustaining instable pelvic ring fractures. Pelvic binders have been propagated for rapid, non-invasive pelvic ring stabilization and control of severe pelvic hemorrhage. There is a recommendation to applicate a pelvic binder due to the trauma mechanism alone. However, there is little evidence to support this advice. The aim of this study was to evaluate effects of an early pelvic binder application on transfusion requirements and hospital mortality.

METHODS: This was a subgroup analysis of a study investigating clinical examination for pelvic stability. We included 64 patients who showed radiologically proven pelvic ring fracture (Tile type B or C). Study data were complemented by retrospective chart review to assess transfusion requirements. We used descriptive statistical analysis.

RESULTS: 37 patients had a pelvic binder applied during prehospital treatment (pb), 27 received no binder (npb). Both showed no statistically significant difference in terms of injury severity or probability of survival. We found a trend towards higher ISS (29.7 vs. 24.4) and a lower probability of survival (RISC-II Prognosis 81% vs. 89%) in the pb group. Risk for massive transfusion according to TASH-Scores (10% vs. 6%), and average number of RPBC transfused (10.5 vs. 7.5) was higher in the pb group, without statistically significance. 20 patients (54%) in the pb group and 15 patients (55%) in the npb group showed a need of RPBC within the first 72 h. There was no significant difference in hospital mortality (20% vs. 13.3%).

CONCLUSION: We were unable to identify blood-saving effects with application of a pelvic binder to patients with instable pelvic ring fractures in terms of RPBC requirements. Nevertheless, some salutary effect of prehospital pb application may be assumed. Better studies are needed to elucidate the value of this intervention.

J Emerg Med. 2019 Oct;57(4):587-588

Ketamine: Safe Until It's Not - A Terrifying Trip to the K-Hole.

Simon E

QUOTES:

"In my short emergency medicine career, I've heard the praises of ketamine thousands of times over: ‘‘Ketamine is safe and effective.’’ ‘‘You can never give too much ketamine.’’ ‘‘You can theoretically get an emergence reaction, but I haven't seen it.’’ I will be the first to admit that I used ketamine for nearly every procedural sedation that I performed— until my little adventure to the K-hole."

"I scream in pain.My elbow is dislocated."

"Minutes later a nurse enters with ketorolac because ‘‘that's the doctor's policy.she starts with ketorolac.’’ I feel the waterworks coming as I bow my head and timidly beg for morphine. ‘‘Don't worry, your x-rays will be done soon.’’

‘‘Dr. Simon, we're going to reduce your elbow with ketamine now.We just need your consent.’’ ‘‘Do it already,’’ I angrily reply. My treating physician directs the nurse to draw up the ketamine. ‘‘Doctor, I can't do that, the policy here is that the physician draws and administers ketamine.’’ Immediately, my heart sinks.why doesn't this physician know that? ‘‘How much ketamine are you giving me?’’ I ask. ‘‘100 milligrams.’’ I lay my head back for the nurse to place an end-tidal nasal cannula. Seconds later, I glance down at an empty 10-mL syringe."

"I plummet to the depths of my consciousness. My mind bounces from a 1980s television screen, black and white with snow, to a kaleidoscope of colors. I feel myself slipping away. I can no longer remember my name. I search my memories for clues to my identity. I do not know where I am. I become oddly fixated on my breathing. I watch my chest rise and fall, but in my dissociated state I cannot understand what I am seeing. My body parts grow mouths that begin to hum, to sing."

"‘‘Okay, what time is it?’’ ‘‘Ma'am, it's 3 o'clock in the morning.’’ ‘‘That doesn't make sense. I was seen yesterday around 2 o'clock in the afternoon.’’ ‘‘In the nursing report they told me that you were mistakenly given 500 mg of intravenous ketamine. The ketamine was pushed, you stopped breathing. You were sedated for nearly 8 hours and had a severe emergence reaction. The medical director from the satellite emergency department will be in this morning to talk to you, but here's the package from the transferring facility, you should read it.’’ ‘‘Ketamine administered: patient apneic, SpO2 77% despite jaw thrust and sternal rub. Patient bagged until apnea resolved, SpO2 95%."

J Trauma Acute Care Surg. 2019 Oct;87(4):883-891

Ketamine/propofol admixture vs etomidate for intubation in the critically ill: KEEP PACE Randomized clinical trial.

Smischney N, Nicholson W, Brown D, Gallo De Moraes A, Hoskote S, Pickering B, Oeckler R, Iyer V, Gajic O, Schroeder D, Bauer P

BACKGROUND: Periintubation hypotension is associated with poor outcomes in the critically ill. We aimed to determine if an admixture of ketamine and propofol for emergent endotracheal intubation in critically ill patients was superior to etomidate. Primary endpoint was the change in mean arterial pressure from baseline to 5 minutes postdrug administration.

METHODS: Emergent-use, stratified (shock status and unit type), multiunit, randomized, parallel-group superiority clinical trial was conducted at a tertiary academic medical center. Adult medical/surgical and transplant/oncologic intensive care unit patients undergoing emergent intubation were assigned randomly to receive either ketamine/propofol admixture (0.5 mg/kg of ketamine and propofol each) or reduced dose etomidate (0.15 mg/kg) for emergent intubation.

RESULTS: One hundred sixty participants were randomized, and 152 (79 ketamine/propofol admixture, 73 etomidate) were included in the intention-to-treat analysis. There was no statistically significant difference in mean arterial pressure change from baseline to 5 minutes postdrug administration (treatment difference [ketamine/propofol admixture-etomidate]: -2.1 mm Hg; 95% confidence interval, -6.9 mm Hg to +2.7 mm Hg; p = 0.385). In addition, no statistically significant difference was demonstrated in the change of mean arterial pressure from baseline at 10 minutes and 15 minutes postdrug administration, no statistical difference in the use of new-onset vasoactive agents or difficulty of intubation between groups. More patients in the etomidate group required non-red blood cell transfusions (16 [22%] vs. 8 [10%], p = 0.046). For patients who had adrenal testing performed, more patients in the etomidate group developed immediate adrenal insufficiency (13 [81%] of 16 vs. 5 [38%] of 13, p = 0.027). Serious adverse events were rare, 2 (3%) (cardiac arrest, hypotension) in ketamine/propofol admixture and 4 (5%) (hypertension, hypotension) in etomidate (p = 0.430).

CONCLUSION: In a heterogeneous critically ill population, ketamine/propofol admixture was not superior to a reduced dose of etomidate at preserving per-intubation hemodynamics and appears to be a safe alternative induction agent in the critically ill.

LEVEL OF EVIDENCE: Therapeutic/Care Management, level II.

Future Microbiol. 2019 Oct 1;Epub ahead of print

Eravacycline: a new treatment option for complicated intra-abdominal infections in the age of multidrug resistance.

Solomkin J, Sway A, Lawrence K, Olesky M, Izmailyan S, Tsai L.

Aim: Recently approved for use in complicated intra-abdominal infection, eravacycline is a novel fluorocycline with broad spectrum of activity against resistant Gram-negative pathogens. This manuscript is a pooled analysis of two Phase III trials. Clinical efficacy: Clinical cure rates were 86.8% for eravacycline versus 87.6% for ertapenem, and 90.8% for eravacycline versus 91.2% for meropenem in the Intent to Treat (micro-ITT) populations, and 87.0% for eravacycline versus 88.8% ertapenem, and 92.4 versus 91.6% for meropenem in the Modified Intent to Treat (MITT) populations. Safety: Eravacycline is well tolerated, with lower rates of nausea, vomiting and diarrhea than other tetracyclines.

Conclusion: Eravacycline is an effective new option for use in complicated intra-abdominal infections, and in particular, for the treatment of extended-spectrum β-lactamase- and carbapenem-resistant Enterobacteriaceae-expressing organisms.

JAMA Surg. 2019 Jul 1;154(7):e191152

Association of Statewide Implementation of the Prehospital Traumatic Brain Injury Treatment Guidelines With Patient Survival Following Traumatic Brain Injury: The Excellence in Prehospital Injury Care (EPIC) Study.

Spaite D, Bobrow B, Keim S, Barnhart B, Chikani V, Gaither J, Sherrill D, Denninghoff K, Mullins T, Adelson P, Rice A, Viscusi C, Hu C

Importance: Traumatic brain injury (TBI) is a massive public health problem. While evidence-based guidelines directing the prehospital treatment of TBI have been promulgated, to our knowledge, no studies have assessed their association with survival.

Objective: To evaluate the association of implementing the nationally vetted, evidence-based, prehospital treatment guidelines with outcomes in moderate, severe, and critical TBI.

Design, Setting, and Participants: The Excellence in Prehospital Injury Care (EPIC) Study included more than 130 emergency medical services systems/agencies throughout Arizona. This was a statewide, multisystem, intention-to-treat study using a before/after controlled design with patients with moderate to critically severe TBI (US Centers for Disease Control and Prevention Barell Matrix-Type 1 and/or Abbreviated Injury Scale Head region severity ≥3) transported to trauma centers between January 1, 2007, and June 30, 2015. Data were analyzed between October 25, 2017, and February 22, 2019.

Interventions: Implementation of the prehospital TBI guidelines emphasizing avoidance/treatment of hypoxia, prevention/correction of hyperventilation, and avoidance/treatment of hypotension.

Main Outcomes and Measures: Primary: survival to hospital discharge; secondary: survival to hospital admission.

Results: Of the included patients, the median age was 45 years, 14 666 (67.1%) were men, 7181 (32.9%) were women; 16 408 (75.1%) were white, 1400 (6.4%) were Native American, 743 (3.4%) were Black, 237 (1.1%) were Asian, and 2791 (12.8%) were other race/ethnicity. Of the included patients, 21 852 met inclusion criteria for analysis (preimplementation phase [P1]: 15 228; postimplementation [P3]: 6624). The primary analysis (P3 vs P1) revealed an adjusted odds ratio (aOR) of 1.06 (95% CI, 0.93-1.21; P = .40) for survival to hospital discharge. The aOR was 1.70 (95% CI, 1.38-2.09; P < .001) for survival to hospital admission. Among the severe injury cohorts (but not moderate or critical), guideline implementation was significantly associated with survival to discharge (Regional Severity Score-Head 3-4: aOR, 2.03; 95% CI, 1.52-2.72; P < .001; Injury Severity Score 16-24: aOR, 1.61; 95% CI, 1.07-2.48; P = .02). This was also true for survival to discharge among the severe, intubated subgroups (Regional Severity Score-Head 3-4: aOR, 3.14; 95% CI, 1.65-5.98; P < .001; Injury Severity Score 16-24: aOR, 3.28; 95% CI, 1.19-11.34; P = .02).

Conclusions and Relevance: Statewide implementation of the prehospital TBI guidelines was not associated with significant improvement in overall survival to hospital discharge (across the entire, combined moderate to critical injury spectrum). However, adjusted survival doubled among patients with severe TBI and tripled in the severe, intubated cohort. Furthermore, guideline implementation was significantly associated with survival to hospital admission. These findings support the widespread implementation of the prehospital TBI treatment guidelines.

Shock. 2019 Aug 5;Epub ahead of print

Pharmacokinetics of Tranexamic Acid Given as an Intramuscular Injection Compared to Intravenous Infusion in a Swine Model of Ongoing Hemorrhage.

Spruce M, Beyer C, Caples C, DeSoucy E, Kashtan H, Hoareau G, Grayson J, Johnson M

INTRODUCTION: Tranexamic acid (TXA) improves survival in traumatic hemorrhage, but difficulty obtaining intravenous (IV) access may limit its use in austere environments, given its incompatibility with blood products. The bioavailability of intramuscular (IM) TXA in a shock state is unknown. We hypothesized that IM and IV administration have similar pharmacokinetics and ability to reverse in vitro hyperfibrinolysis in a swine controlled-hemorrhage model.

METHODS: Twelve Yorkshire cross swine were anesthetized, instrumented, and subjected to a 35% controlled hemorrhage, followed by resuscitation. During hemorrhage, they were randomized to receive a 1 g IV TXA infusion over 10 minutes, 1 g IM TXA in two 5 mL injections, or 10 mL normal saline IM injection as a placebo group to assess model adequacy. Serum TXA concentrations were determined using liquid chromatography-mass spectrometry, and plasma samples supplemented with tissue plasminogen activator (tPA) were analyzed by rotational thromboelastometry (ROTEM).

RESULTS: All animals achieved class III shock. There was no difference in the concentration-time areas under the curve (AUC) between TXA given by either route. The absolute bioavailability of IM TXA was 97%. IV TXA resulted in a higher peak serum concentration during the infusion, with no subsequent differences. Both IV and IM TXA administration caused complete reversal of in vitro tPA-induced hyperfibrinolysis.

CONCLUSION: The pharmacokinetics of IM TXA were similar to IV TXA during hemorrhagic shock in our swine model. IV administration resulted in a higher serum concentration only during the infusion, but all levels were able to successfully correct in vitro hyperfibrinolysis. There was no difference in total body exposure to equal doses of TXA between the two routes of administration. IM TXA may prove beneficial in scenarios where difficulty establishing dedicated IV access could otherwise limit or delay its use.

Blood Rev. 2019 Nov;38:100593

Review of current transfusion therapy and blood banking practices.

Storch E, Custer B, Jacobs M, Menitove J, Mintz P

ABSTRACT: Transfusion Medicine is a dynamically evolving field. Recent high-quality research has reshaped the paradigms guiding blood transfusion. As increasing evidence supports the benefit of limiting transfusion, guidelines have been developed and disseminated into clinical practice governing optimal transfusion of red cells, platelets, plasma and cryoprecipitate. Concepts ranging from transfusion thresholds to prophylactic use to maximal storage time are addressed in guidelines. Patient blood management programs have developed to implement principles of patient safety through limiting transfusion in clinical practice. Data from National Hemovigilance Surveys showing dramatic declines in blood utilization over the past decade demonstrate the practical uptake of current principles guiding patient safety. In parallel with decreasing use of traditional blood products, the development of new technologies for blood transfusion such as freeze drying and cold storage has accelerated. Approaches to policy decision making to augment blood safety have also changed. Drivers of these changes include a deeper understanding of emerging threats and adverse events based on hemovigilance, and an increasing healthcare system expectation to align blood safety decision making with approaches used in other healthcare disciplines.

Anaesth Crit Care Pain Med. 2019 Oct 12;Epub ahead of print

Terrorist threat: Creating a nationwide damage control training program for non-trauma care providers.

Swiech A, de Rocquigny G, Martinez T, Loarer G, Vico S, Planchon J, Le Goff A, Bertho K, Derkenne C, Travers S, Malgras B, Martinaud C, Carfantan C, Gaudry S, Boutonnet M, Pasquier P

INTRODUCTION: The current terrorist threat challenges nations to train numerous non-trauma care providers with different backgrounds in damage control (DC) strategies. The purpose of this work was to propose a specific DC training program.

METHODS: A Task Force of 16 civilian and military physicians met for a 24-hour session, to propose the construction of a DC training program for non-specialised caregivers.

RESULTS: Existing DC training programs are heterogeneous, mainly theoretical and almost only for physicians. A program entitled Damage Control for Terrorist Attack Victims (DC-TAV) was then proposed. Identified training targets were care providers from prehospital and hospital staffs, with no experience in trauma care. The training objectives were the improvement of individual and collective skills in managing terrorist attacks casualties. The tools selected for training concerned e-learning on a dedicated digital teaching platform (including a core section of four modules with types and mechanisms of injury, basic DC techniques, triage, organisation of emergency medical response and two complementary modules for doctors with DC resuscitation including remote transfusion and DC surgery), hands-on workshops with procedural simulation and full-scale simulation exercises, technical (tourniquets, haemostatic gauzes, needle thoracostomy, chest tube drainage, management of airway, coniotomy) and non-technical (leadership, communication, coordination and triage, decision-making, appropriate use of resources) skills. Finally, an evaluation of the DC-TAV program was planned.

CONCLUSIONS: The DC-TAV program is an ambitious, civilian-military, nationwide and long-term program, based on a harmonised standard of care and including multidimensional training. Further studies are required to assess its efficacy.

J Cardiothorac Vasc Anesth. 2019 Jul 4. pii: S1053-0770(19)30596-8

Current Evidence and Future Directions of Tranexamic Acid Use, Efficacy, and Dosing for Major Surgical Procedures.

Taam J, Yang Q, Pang K, Karanicolas P, Choi S, Wasowicz M, Jerath A

ABSTRACT: Tranexamic acid reduces blood loss and transfusion requirements with nosignificant thrombotic adverse effects. Postoperative seizures have been seen in cardiac surgical patients in association with patient (advanced age, underlying neurologic disease, chronic kidney disease); surgical (open cardiac procedures, long bypass times); and drug (high tranexamic acid dose) risk factors. Tranexamic acid dosing regimens should be decreased in patients with chronic kidney dysfunction secondary to reduced clearance and drug accumulation. Optimal dosing for cardiac surgical patients has been recommended. Additional research is required to determine dosing regimens in major noncardiac surgery and plasma concentration levels associated with inducing seizures.

J Clin Anesth. 2019 Oct 25:Epub ahead of print

Predictors of early pharyngolaryngeal complications with cuffed supraglottic airway devices: A prospective observational study.

Thiruvenkatarajan V, Sim J, Emmerson R, Tong D, Liu W, Van Wijk R, Currie J

QUOTES:

"The odds of experiencing a pharyngolaryngeal complication increased by approximately 50% [24/93 (26.0%) vs 10/57 (17.5%)] when the intracuff pressure exceeded 60 cmH20. Randomized trials assessing the pharyngolaryngeal complications encompassing similar composite endpoints have shown an event rate between 13 and 26% when the cuff pressure is<60 cmH20, and up to 49% when the cuff pressure exceeded 60 cmH20 [1,2]. Governing body recommendations have called for routine manometry as standard of care while using cuffed SADs [3]. Although there is greater recognition towards the benefits of routine manometry, it is not translated in day to day practice."

"Limiting the cuff pressures to<60 cmH20 was overlooked despite using SADs with an inbuilt pressure indicator. Although pharyngolaryngeal complications are usually self-limiting, they can add significantly to post anaesthetic morbidity. Ongoing education and regular quality assurance appraisals regarding cuff pressure management may mitigate the cuffed SADs related pharyngolaryngeal morbidity."

J Trauma Acute Care Surg. 2019 Oct 14;Epub ahead of print

A Comprehensive Review of Topical Hemostatic Agents: The Good, The Bad, and the Novel.

Tompeck A, Gajdhar A, Dowling M, Johnson S, Barie P, Winchell R, King D, Scalea T, Britt L, Narayan M

ABSTRACT: Exsanguination remains the leading cause of preventable death for trauma patients, many of whom die in the pre-hospital setting. Without expedient intervention, trauma-associated hemorrhage induces a host of systemic responses, including the acute coagulopathy of trauma. For this reason, healthcare providers and pre-hospital personnel face the challenge of rapid, effective hemorrhage control. The utilization of adjuncts to facilitate hemostasis was first recorded in 1886. Commercial products have since expanded to include topical hemostats, surgical sealants, and adhesives. The ideal product balances efficacy, safety, practicality, and cost-effectiveness. This review of hemostatic agents provides a guide for successful implementation and simultaneously highlights future opportunities.

Ann Thorac Surg. 2019 Dec;108(6):e405-e407

Surgical Management of Iatrogenic Left Ventricle Perforation by Chest Tube Insertion.

Varghese S, Slottosch I, Saha S, Wacker M, Awad G, Wippermann J, Scherner M

ABSTRACT: Chest tube thoracostomy is a standard procedure in every intensive care unit. Although it is regarded as a safe procedure in experienced hands, rare complications do occur. This report describes iatrogenic perforation of the left ventricle after placement of an intercostal catheter and the successful surgical management of this injury. Various operative situations that may arise in relation to iatrogenic perforation of the left ventricle are also discussed, as well as steps to manage this potentially life-threatening complication.

J Trauma Acute Care Surg. 2019 Nov;87(5):1239-1243

Western Trauma Association critical decisions in trauma: Preferred triage and initial management of the burned patient.

Vercruysse G, Alam H, Martin M, Brasel K, Moore E, Brown C, Bettencourt A, Schulz J, Palmieri T, Haith L, Inaba K.

ABSTRACT: This is a recommended management algorithm from the Western Trauma Association addressing the management of victims of burn injury. Because there is a paucity of published prospective randomized clinical trials that have generated Class I data, these recommendations are based primarily on published retrospective studies, clinical guidelines, and the expert opinion of members of the Western Trauma Association in conjunction with partner members of the American Burn Association. The algorithm and accompanying comments represent one safe and sensible approach that can be followed at most trauma centers. We recognize that there may be patient or institutional factors that warrant deviation from the published algorithm. We would encourage institutions to use this document as a starting point toward a dialog with local burn centers to collaboratively create a patient-centered care experience for the victims of minor burn injuries arriving at local trauma centers.

Trauma Surg Acute Care Open. 2019 Jul 12;4(1):e000335

'Step Up' approach to the application of REBOA technology in a rural trauma system.

Vernamonti J, Holcomb J, Mick N, Falank C, Ontengco J, Rappold J, Sheppard F

ABSTRACT: Our group has developed a 'Step Up' approach to the application of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) in a rural trauma system. This incorporates viewing REBOA as a spectrum of technology. Examples of REBOA technology use to improve outcomes and provision of our system's clinical practice guideline for the Step-Up application of REBOA technology in the care of trauma patients are presented.

JAMA 2019 Jun 25;321(24):2389-2391. doi: 10.1001/jama.2019.5636.

The US Military Considers Whether Controversial Opioid Is Fit for Battlefield Duty.

Voelker R

QUOTES:

"Data the FDA reviewed didn't represent the big-picture view that Gottlieb promoted. Sufentanil tablets were approved based on research comparing them only with a placebo rather than other opioids used in combat, in hospital emergency rooms,or any other setting. The agency reviewed 3 phase 3 trials. Two were open-label trials that showed sufentanil tablets effectively relieved acute pain but didn't compare them with a placebo or other opioids. The only comparative trial involved 161 patients who underwent abdominoplasty, inguinal hernioplasty, or laparoscopic abdominalsurgery. Theresults showed that the tablets provided greater postoperative pain relief than placebo.

"It's good to know that sufentanil is better than placebo, but the question is, is it better than OTFC [oral transmucosal fentanyl citrate], which is what is currently recommended for battlefield use," said Frank Butler,MD, a retired US Navy captain and chairman of the DoD's Committee on Tactical Combat Casualty Care (TCCC), which produced and periodically updates evidence-based prehospital trauma care guidelines that are customized for the battlefield. Now the DoD is considering new research that might answer that question."

"Butler said the current thinking is that sufentanil might replace or supplement fentanyl lollipops. But "[t]here's really no data at this point guiding how to dose [sufentanil sublingual tablets] in terms of both frequency for pain relief and side effects relative relative to what we would get with OTFC," Schauer said. So he has proposed a dose-finding pilot study. The randomized trial would examine several dosing regimens of sufentanil tablets given to patients treated for acute pain in the emergency department at Brooke Army Medical Center (BAMC) at Fort Sam Houston. Schauer said participants would be of military age, roughly 18 to 50 years, who are otherwise in good health. Some of the injuries could include long bone or open fractures, gunshot wounds, and burns, all of which often occur in combat."

" In a 2014 report of which Butler was lead author, military medicine experts advised that development of sufentanil tablets and studies to compare the formulation with other pain relief options should continue. However, the report noted the many risks that opioids pose—sedation, confusion, respiratory depression, nausea, ileus, tolerance, opioid-induced hyperalgesia, and potential immunosuppression. It also included an observation from military leaders who oversee troops in Afghanistan and Iraq and those who develop best-practice trauma care guidelines: in combat, opioids were overused while ketamine was underused."

J Spec Oper Med. 2019 Fall;19(3):52-63.

Review: Getting Tourniquets Right = Getting Tourniquets Tight.

Wall P, Buising C, Sahr S

ABSTRACT: Tourniquet application to stop limb bleeding is conceptually simple, but optimal application technique matters, generally requires training, and is more likely with objective measures of correct application technique. Evidence of problems with application techniques, knowledge, and training can be ascertained from January 2007 to August 2018 PubMed peer-reviewed papers and in Stop The Bleed-related videos. Available data indicates optimal technique when not under fire involves application directly on skin. For nonelastic tourniquets, optimal application technique includes pulling the strap tangential to the limb at the redirect buckle (parallel to the limb-encircling strap entering the redirect buckle). Before engaging the mechanical advantage tightening system, the secured strap should exert at least 150mmHg inward, and skin indentation should be visible. For Combat Application Tourniquets, optimal technique includes the slot in the windlass rod parallel to the stabilization plate during the single 180° turn that should be sufficient for achieving arterial occlusion, which involves visible skin indentation and pressures of 250mmHg to 428mmHg on normotensive adult thighs. Appropriate pressures on manikins and isolated-limb simulations depend on how the under-tourniquet pressure response of each compares to the under-tourniquet pressure response of human limbs for matching tourniquet force applications. Lack of such data is one of several concerns with manikin and isolated-limb simulation use. Regardless of model or human limb use, pictures and videos purporting to show proper tourniquet application techniques should show optimal tourniquet application techniques and properly applied, arterially occlusive limb tourniquets. Ideally, objective measures of correct tourniquet application technique would be included.

Medicina (Kaunas). 2019 Sep 2;55

Geographical Variance in the Use of Tranexamic Acid for Major Trauma Patients.

Walsh K, O'Keeffe F, Mitra B

Background and Objectives: The CRASH-2 trial is the largest randomised control trial examining tranexamic acid (TXA) for injured patients. Since its publication, debate has arisen around whether results could be applied to mature trauma systems in developed nations, with global opinion divided. The aim of this study was to determine if, among trauma patients in or at significant risk of major haemorrhages, there is an association of geographic region with the proportion of patients that received tranexamic acid.

Materials and Methods: We conducted a systematic review of the literature. Potentially eligible papers were first screened via title and abstract screening. A full copy of the remaining papers was then obtained and screened for final inclusion. The Newcastle-Ottawa Scale for non-randomised control trials was used for quality assessment of the final studies included. A meta-analysis was conducted using a random-effects model, reporting variation in use sub-grouped by geographical location.

Results: There were 727 papers identified through database searching and 23 manuscripts met the criteria for final inclusion in this review. There was a statistically significant variation in the use of TXA for included patients. Europe and Oceania had higher usage rates of TXA compared to other continents. Use of TXA in Asia and Africa was significantly less than other continents and varied use was observed in North America. Conclusions: A large geographical variance in the use of TXA for trauma patients in or at significant risk of major haemorrhage currently exists. The populations in Asia and Africa, where the results of CRASH-2 could be most readily generalised to, reported low rates of use. The reason why remains unclear and further research is required to standardise the use of TXA for trauma resuscitation.

Sci Rep. 2019 Oct 10;9(1):14608

Evaluation of Chitosan-based Dressings in a Swine Model of Artery-Injury-Related Shock.

Wang Y, Liu C, Cherng J, Fan G, Wang Y, Chang S, Hong Z, Lin Y, Hsu S

ABSTRACT: Uncontrolled haemorrhage shock is the highest treatment priority for military trauma surgeons. Injuries to the torso area remain the greatest treatment challenge, since external dressings and compression cannot be used here. Bleeding control strategies may thus offer more effective haemostatic management in these cases. Chitosan, a linear polysaccharide derived from chitin, has been considered as an ideal material for bleeding arrest. This study evaluated the potential of chitosan-based dressings relative to commercial gauze to minimise femoral artery haemorrhage in a swine model. Stable haemostasis was achieved in animals treated with chitosan fibre (CF) or chitosan sponge (CS), resulting in stabilisation of mean arterial pressure and a substantially higher survival rate (100% vs. 0% for gauze). Pigs receiving treatment with CF or CS dressings achieved haemostasis within 3.25 ± 1.26 or 2.67 ± 0.58 min, respectively, significantly more rapidly than with commercial gauze (>100 min). Moreover, the survival of animals treated with chitosan-based dressings was dramatically prolonged (>180 min) relative to controls (60.92 ± 0.69 min). In summary, chitosan-based dressings may be suitable first-line treatments for uncontrolled haemorrhage on the battlefield, and require further investigation into their use as alternatives to traditional dressings in prehospital emergency care.

J Trauma Acute Care Surg. 2019 Aug 28;Epub ahead of print

SAFETY PROFILE AND IMPACT OF LOW-TITER GROUP O WHOLE BLOOD FOR EMERGENCY USE IN TRAUMA.

Williams J, Merutka N, Meyer D, Bai Y, Prater S, Cabrera R, Holcomb J, Wade C, Love J, Cotton B

PURPOSE: Following US military implementation of a cold-stored whole blood program, several US trauma centers have begun incorporating uncrossmatched, group O cold-stored whole blood into civilian trauma resuscitation. We set out to evaluate the safety profile, transfusion reactions events, and impact of low-titer group O whole blood (LTO-WB) at our center.

METHODS: In November 2017, we added LTO-WB to each of our helicopters and to our emergency department (ED) refrigerator, alongside that of existing RBCs and plasma. We collected information on all trauma patients receiving prehospital or ED transfusion of uncrossed, emergency release blood products between 11/17 and 06/18. Patients were divided into those receiving any LTO-WB and those receiving only RBC and or plasma (COMP). Serial hemolysis panels were obtained at 3-hrs, 24-hrs, and 48-hrs. All data was run using STATA 12.1. Statistical significance was set at $p<0.05$.

RESULTS: 198 patients received LTO-WB and 152 patients received COMP. There were no differences in age, sex, or mechanism. LTO-WB patients had higher chest AIS scores (median 3 vs. 2; p=0.027), as well as worse arrival base excess (median -7 vs. -5; p=0.014) and lactate (5.1 vs. 3.5; p<0.001). LTO-WB patients received less post-ED blood products than the COMP patients (median 0 vs. 3; p=0.001). There was no difference in survival (LTO-WB 73%, COMP 74%; p=0.805). There were only two suspected transfusion reactions, both in the COMP group (p=0.061). There was no difference in hemolysis panel values. Controlling for age, severity of injury and prehospital physiology, LTO-WB was associated with a 53% reduction in post-ED blood product transfusion (OR 0.47; 0.23-0.94; p=0.033) and two-fold increase in likelihood of survival (OR 2.19, 1.01-4.76, p=0.047).

CONCLUSIONS: LTO-WB has similar evidence of laboratory hemolysis, similar transfusion reaction rates, and is associated with a reduction in post-ED transfusions and increase likelihood of survival.Level of evidenceLevel II, Prospective comparator study without negative effect.

Am J Crit Care. 2019 Nov;28(6):415-423

Comparative Evaluation of Chest Tube Insertion Site Dressings: A Randomized Controlled Trial.

Wood M, Powers J, Rechter J

BACKGROUND: Little empirical evidence is available to guide decisions on what type of dressing to use and how often to change the dressing after placement of a thoracostomy tube.

OBJECTIVES: This prospective randomized controlled study was conducted to compare various dressing types and procedures after placement of thoracic and mediastinal chest tubes. Outcome measures included length of time between dressing changes, skin integrity, air leak presence, and patient-reported pain.

METHODS: The study involved a convenience sample of 127 patients with 236 chest tubes from 3 intensive care units at a midwestern regional medical center. The patients were randomized to 1 of 3 groups: (1) gauze and tape dressing changed once daily, (2) gauze and tape dressing changed every 3 days, and (3) silicone foam dressing changed every 3 days.

RESULTS: Patients with silicone foam dressings reported less pain at the insertion site than did patients with standard gauze and tape dressings, and patients with daily dressing changes reported significantly more pain with dressing removal than did patients with dressing changes every 3 days. The silicone foam dressing was associated with better skin integrity than the gauze and tape dressing. Dressing intactness, number of days with a chest tube inserted, and patient demographic characteristics did not differ significantly among the 3 groups.

CONCLUSIONS: Overall, the best type of dressing for promoting skin integrity and patient comfort was the silicone foam dressing. The results of this study may help identify best practices for dressing type and procedures among patients with chest tubes.

J Adv Med Educ Prof. 2019 Jul;7(3):144-148

Comparison of the Bleeding Cricothyrotomy Model to SimMan for Training Students and Residents Emergency Cricothyrotomy.

Wray A, Khan F, Ray J, Rowe R, Boysen-Osborn M, Wiechmann W, Toohey S

Introduction: A cricothyroidotomy is an emergency procedure that few emergency medicine residents see or perform during their training. Therefore, there is a need for low cost, high fidelity models for training. In this study, we explore a new training model for cricothyroidotomies (the bleeding CRIC [cost-effective realistic interactive cricothyroidotomy]) to determine if this new task-trainer is non-inferior compared to the current standard of training.

Methods: Authors conducted a randomized control non-inferiority study. There were seventeen residents and medical students enrolled by convenience sample to partake in the study. The participants were randomized by block randomization to be taught how to perform a cricothyroidotomy on either the new task trainer or the current standard task trainer and then were asked to perform the procedure on a pig trachea model. Primary outcome measures were scores on a previously validated objective assessment tool and secondary outcomes were comfort levels and realism scores based on pre and post survey results which were analyzed with ANOVA.

Results: There was found to be no statistically significant difference between the groups in assessment scores, time to completion, or comfort levels pre- and post-intervention. There was a statistically significant difference in that the participants gave higher realism scores in post-test analysis to the Bleeding CRIC compared to the SimMan. Both groups demonstrated that they had significantly improved comfort levels from baseline post-intervention.

Conclusion: Overall, the new task trainer was rated by learners to feel more realistic than the current standard. This study demonstrates non-inferiority of the new task trainer and further studies with larger sample sizes should be conducted to determine its true efficacy.

AANA J. 2017 Aug;85(4):256-260.

Comparison of Flow Dynamics of Peripherally and Centrally Inserted Intravenous Catheters Using a Rapid Infusion System (ThermaCor 1200).

Wrenn E, Wohlers R, Montgomery M, Cobb H, Condra J, Tharpe S, Patil N

ABSTRACT: The inability to rapidly administer warm intravenous fluids and blood products can potentially threaten a patient's safety and well-being in many clinical settings. Large-bore intravenous catheters and rapid infusion systems are often used in situations where rapid blood loss and massive blood transfusion may be expected. This study examined the maximum flow rate and infusion pressure of various peripherally and centrally inserted intravenous catheters using a rapid infusion system (ThermaCor 1200 Rapid Infusion System, Smisson-Cartledge Biomedical). Nine different peripheral and central catheters or lumens were studied using 500 mL of 0.9% sodium chloride and 250 mL of hetastarch. Ten trials were performed. The maximum flow rates and infusion pressures were noted. Data were analyzed using the analysis of variance and the Tukey Studentized Range test. Statistically significant greater flow rates were noted with both 0.9% sodium chloride and hetastarch in most of the peripherally inserted catheters compared with the centrally inserted catheters. These results suggest that use of this infusion system with peripherally inserted catheters may be more effective in achieving higher maximum flow rates than with centrally inserted catheters.

Am J Surg. 2019 Dec;218(6):1162-1168

Resuscitative endovascular balloon occlusion of the aorta (REBOA) is associated with improved survival in severely injured patients: A propensity score matching analysis.

Yamamoto R, Cestero R, Suzuki M, Funabiki T, Sasaki J

BACKGROUND: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a technique for temporary control of arterial hemorrhage. However, its effectiveness and clinical outcomes are unclear.

METHODS: Using a nationwide database (2004-2016) in Japan, trauma patients with survival data were identified. Patients were divided between REBOA and non-REBOA groups, and a propensity score was developed using multivariate logistic regression. Survival to discharge was compared between the groups after propensity score matching.

RESULTS: Among 82,371 patients included in this study, 385 were treated with REBOA. After propensity score matching, 117 pairs were selected. Survival to discharge was significantly higher among patients treated with REBOA than among those treated without REBOA (53 [45.3%] vs. 38 [32.5%]; odds ratio = 1.72; 95% CI = 1.01-2.93; p = 0.04).

CONCLUSIONS: REBOA use was associated with improved survival to discharge and should therefore be considered during the management of severely injured trauma patients.

Burns. 2019 Aug 1. pii: S0305-4179(19)30194-9

Early hypothermia as risk factor in severely burned patients: A retrospective outcome study.

Ziegler B, Kenngott T, Fischer S, Hundeshagen G, Hartmann B, Horter J, Münzberg M, Kneser U, Hirche C

INTRODUCTION: Burn trauma-related hypothermia is a frequent observation but risk factors and impact on patient related outcome are ambiguously reported. It is expected that hypothermia is associated with increased mortality and reduced overall outcome in severely burned patients, but available evidence is limited.

METHODS: This retrospective single-center-study reviewed preclinical service protocols and medical records of patients sustaining a burn with a total body surface area (TBSA) ≥15% from 2008 to 2012. General patient and burn specific characteristics, outcome parameters as well as body temperature at admission measured via urine catheter or nasal temperature probe were recorded and statistically analyzed comparing normothermic (≥36 °C), mild hypothermic (<36 °C) and severely hypothermic (<34.5 °C) patients. Chi-square test was performed to demonstrate impact of hypothermia on primary outcome parameters and to reveal risk factors for developing hypothermia. To assess independent influences on mortality, a multivariate logistic regression analysis was performed.

RESULTS: Out of 300 patients matching inclusion criteria, a sufficient record of temperature was found in 144 patients (48%). Out of 141 eligible patients with an average burn extent (SD) of 33.38% (24.5%) TBSA, 31.9% (n = 45) suffered from severe hypothermia (<34.5 °C) and 28.4% (n = 40) showed mild hypothermia. Total burn extent, presence of full thickness burns, presence of inhalation injury, preclinical mechanical ventilation and administration of sedative drugs were risk factors for developing hypothermia. Patients' age, total burn extent and presence of full thickness burns could be identified as independent factor for mortality. Although a trend towards an independent positive influence of normothermia at admission on mortality was seen, it was not statistically significant.

CONCLUSION: Incidental hypothermia of burned patients is associated with an increased mortality and needs to be addressed by emergency health care providers and immediately at the burn center. Especially patients with extensive burns, full-thickness burns, inhalation injury or patients undergoing preclinical intubation are at risk for hypothermia and benefit from any measures for temperature preserving.

Transfusion. 2019 Nov;59(11):3485-3490

Freeze-dried plasma stability under prehospital field conditions.

Zur M, Glassberg E, Gorenbein P, Epstein E, Eisenkraft A, Misgav M, Avramovich E

BACKGROUND: This study evaluated the effect of routine, uncontrolled, Israeli field storage conditions on the stability and efficacy of Lyo-Plas N freeze-dried plasma (FDP). We evaluated clotting factors V, VIII, and XI; proteins S and C; fibrinogen; partial thromboplastin time (PTT); antithrombin III (ATIII); von Willebrand factor (VWF); and international normalized ratio (INR) in FDP stored at 4°C, 25°C, and 40°C for 6 and 12 months, as well as FDP returned from field units after uncontrolled storage for 15 months (manufacturer's shelf life).

METHODS AND MATERIALS: After reconstitution, clotting factor levels were compared to those of freshly supplied FDP doses.

RESULTS: At 4°C for 12 months, factor V decreased slightly. At 25°C, average fibrinogen and factor V content were significantly lower at both periods, and INR was higher after 12 months. At 40°C, all samples were out of normal range in at least one clotting factor after 6 or 12 months. After field storage for 15 months, fibrinogen, factors V and XI, PTT, and protein S were significantly decreased, and INR increased. However, these levels were still within laboratory norms. Statistically significant difference in clotting factors compared to laboratory normal range was found in INR (higher) and factor V (lower).

CONCLUSIONS: Our data show minimal decreases in clotting factors in FDP after storage under field conditions, when compared to laboratory normal ranges. Along with the many advantages of FDP, this supports its use at the point of injury under battlefield conditions, despite uncontrolled storage environments. Under controlled storage conditions at 4°C, shelf life could possibly be extended, although further study is required.