Tactical Combat Casualty Care

Journal Article Abstracts

Committee on Tactical Combat Casualty Care

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Abstracts

J Trauma Acute Care Surg. 2016 Nov;81 (5 Suppl 2 Proceedings of the 2015 Military Health System Research Symposium):S87-S94.

Analysis of injury patterns and roles of care in US and Israel militaries during recent conflicts: Two are better than one.

Antebi B, Benov A, Mann-Salinas EA, Le TD, Cancio LC, Wenke JC, Paran H, Yitzhak A, Tarif B, Gross KR, Dagan D, Glassberg E.

BACKGROUND: As new conflicts emerge and enemies evolve, military medical organizations worldwide must adopt the "lessons learned." In this study, we describe roles of care (ROCs) deployed and injuries sustained by both US and Israeli militaries during recent conflicts. The purpose of this collaborative work is facilitate exchange of medical data among allied forces in order to advance military medicine and facilitate strategic readiness for future military engagements that may involve less predictable situations of evacuation and care, such as prolonged field care.

METHODS: This retrospective study was conducted for the periods of 2003 to 2014 from data retrieved from the Department of Defense Trauma Registry and the Israel Defense Force (IDF) Trauma Registry. Comparative analyses included ROC capabilities, casualties who died of wounds, as well as mechanism of injury, anatomical wound distribution, and Injury Severity Score of US and IDF casualties during recent conflicts.

RESULTS: Although concept of ROCs was similar among militaries, the IDF supports increased capabilities at point of injury and Role 1 including the presence of physicians, but with limited deployment of other ROCs; conversely, the US maintains fewer capabilities at Role 1 but utilized the entire spectrum of care, including extensive deployment of Roles 2/2+, during recent conflicts. Casualties from US forces (n = 19,005) and IDF (n = 2,637) exhibited significant differences in patterns of injury with higher proportions of casualties who died of wounds in the US forces (4%) compared with the IDF (0.6%).

CONCLUSIONS: As these data suggest, deployed ROCs and injury patterns of US and Israeli militaries were both conflict and system specific. We envision that identification of discordant factors and common medical strategies of the two militaries will enable strategic readiness for future conflicts as well as foster further collaboration among allied forces with the overarching universal goal of eliminating preventable death on the battlefield.

Injury. 2016 Oct;47(10):2097-2104.

Adherence evaluation of vented chest seals in a swine skin model.

Arnaud F, Maudlin-Jeronimo E, Higgins A, Kheirabadi B, McCarron R,Kennedy D, Housler G.

OBJECTIVES: Perforation of the chest (open pneumothorax) with and without lung injury can cause air accumulation in the chest, positive intrapleural pressure and lead to tension pneumothorax if untreated. The performance of chest seals to prevent tension physiology depends partially on their ability to adhere to the skin and seal the chest wound. Novel non-occlusive vented chest seals were assessed for their adhesiveness on skin of live swine under normal and extreme environmental conditions to simulate austere battlefield conditions.

METHODS: Chest seals were applied on the back of the swine on skin that was soiled by various environmental contaminants to represent battlefield situations. A peeling (horizontal rim peeling) and detachment and breaching (vertical pulling) techniques were used to quantify the adhesive performance of vented chest seals. Among eight initially selected vented seals, five (Bolin, Russell, Fast Breathe, Hyfin and SAM) were further down-selected based on their superior adherence scores at ambient temperatures. The adherence of these seals was then assessed after approximately 17h storage at extreme cold (-19.5°C) and hot (71.5°C) temperatures.

RESULTS: Adherence scores for peeling (above 90%) and detachment scores (less than 25%) were comparable for four vented chest seals when tested at ambient temperature, except for the Bolin seal which had higher breaching. Under extreme storage temperatures, adherence peeling scores were comparable to those at ambient temperatures for four chest seals. Scores were significantly lower for the Bolin seal at extreme temperatures. This seal also had the highest detachment and breaching scores. In contrast, the Russell, Fast breathe, Hyfin and SAM seals showed similar ability to stay air tight without breaching after hot storage.

CONCLUSION: No significant difference was found in skin adherence of the five vented chest seals at ambient temperature and the four seals (Russell, Fast breathe, Hyfin and SAM) maintained superior adherence even after exposure to extreme temperatures compared to the Bolin. To select the most effective product from the 5 selected vented chest seals, further functional evaluation of the valve of these chest seals on a chest wound with the potential for tension in the pneumothorax or hemopneumothorax is warranted.

J Emerg Med. 2016 Dec;51(6):680-683.

Point-Of-Care Ultrasound Diagnosis of Intravascular Air after Lower Extremity Intraosseous Access.

Azan B, Teran F, Nelson BP, Andrus P.

BACKGROUND: Vascular air embolism is a rare but potentially deadly phenomenon. Early diagnosis allows providers to initiate measures aimed at preventing further air entry, preventing the migration of air to the lungs, and mitigating the hemodynamic effects of pulmonary air embolism.

CASE REPORT: An emergency physician used point-of-care ultrasound to identify intravascular air before embolization to the pulmonary vasculature. WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?: Bedside ultrasound can be used as a tool for early diagnosis of intravascular air. Emergency physicians should be aware of the typical sonographic manifestations of intravascular air and the initial steps in treating vascular air embolism.

Am J Emerg Med. 2016 Aug 27. [Epub ahead of print]

Does practice make perfect? Prospectively comparing effects of 2 amounts of practice on tourniquet use performance.

Baruch EN, Benov A, Shina A, Berg AL, Shlaifer A Glassberg E, Aden JK 3rd, Bader T, Kragh JF Jr, Yitzhak A.

INTRODUCTION: Although a lifesaving skill, currently, there is no consensus for the required amount of practice in tourniquet use. We compared the effect of 2 amounts of practice on performance of tourniquet use by nonmedical personnel.

METHODS: Israeli military recruits without previous medical training underwent their standard tactical first aid course, and their initial performance in use of the Combat Application Tourniquet (CAT; Composite Resources, Rock Hill, SC) was assessed. The educational intervention was to allocate the participants into a monthly tourniquet practice program: either a single-application practice (SAP) group or a triple-application practice (TAP) group. Each group practiced according to its program. After 3 months, the participants' tourniquet use performance was reassessed. Assessments were conducted using the HapMed Leg Tourniquet Trainer (CHI Systems, Fort Washington, PA), a mannequin which measures time and pressure.

RESULTS: A total of 151 participants dropped out, leaving 87 in the TAP group and 69 in the SAP group. On initial assessment, the TAP group and the SAP group performed similarly. Both groups improved their performance from the initial to the final assessment. The TAP group improved more than the SAP group in mean application time (faster by 18 vs 8 seconds, respectively; P = .023) and in reducing the proportion of participants who were unable to apply any pressure to the mannequin (less by 18% vs 8%, respectively; P = .009).

CONCLUSION: Three applications per monthly practice session were superior to one. This is the first prospective validation of a tourniquet practice program based on objective measurements.

J Orthop Trauma. 2016 Oct;30 Suppl 3:S2-S6.

Resuscitation and Treatment of Shock.

Beltran MJ, Becker TE, Hurley RK, Gurney JM, Hayda RA.

ABSTRACT:
Hemorrhage continues to be the most common cause of death among service members wounded in combat. Injuries that were previously nonsurvivable in previous wars are now routinely seen by combat surgeons in forward surgical units, the result of improvements in body armor, the universal use of field tourniquets to control extremity hemorrhage at the point of injury, and rapid air evacuation strategies. Combat orthopaedic surgeons remain a vital aspect of the forward surgical unit, tasked with assisting general surgical colleagues in the resuscitation of patients in hemorrhagic shock while also addressing traumatic amputations, open and closed long bone fractures, and mechanically unstable pelvic trauma. Future military and civilian trauma research endeavors will seek to identify how the advances made in the past 15 years will translate toward the emerging battlefield of the future, one where forward surgical units must be lighter, smaller, and more mobile to address the changing scope of military combat operations.

JAMA. 2016 Sep 6;316(9):927-8.

A National Trauma Care System to Achieve Zero Preventable Deaths After Injury: Recommendations From a National Academies of Sciences, Engineering, and Medicine Report.

Berwick DM, Downey AS, Cornett EA.

QUOTES:

"During those recent wars, the percentage of wounded service members who died of their injuries reached the lowest point in recorded wartime history - 9.3%in Afghanistan and Iraq compared with 23% during the Vietnam War. (2) Effective bleeding-control measures, Improved resuscitation techniques,and aggressive neurocritical care interventions are among many advances that saved lives on the battlefield that otherwise would have been lost. For example, an estimated 1000 to 2000 lives were saved by widespread use of tourniquets. (3)"

"**Leadership and a Culture of Learning**
A learning health system must be stewarded by leadership committed to nurturing a culture of continuous learning and improvement. Diffusion of responsibility in both military and civilian trauma care has permitted unwarranted variation in practice and suboptimal patient outcomes. Nearly 1000 service members died of potentially survivable injuries in Afghanistan and Iraq, (4) and 20 to 30 times that number of US trauma deaths each year may be preventable. (9) Given these challenges and the high stakes for the nation in the face of foreign and domestic threats, the White House should lead the integration of military and civilian trauma care to establish a national trauma care system. Such a system should unite military and civilian trauma care leaders around a common, core aim established at the highest level in the nation; namely, to achieve zero preventable deaths after injury and minimize trauma-related disability. The White House should direct both the US Department of Health and Human Services and the US Department of Defense to organize to pursue that aim."

J Trauma Acute Care Surg. 2016 Nov;81(5):849-854.

Open chest cardiac massage offers no benefit over closed chest compressions in patients with traumatic cardiac arrest.

Bradley MJ, Bonds BW, Chang L, Yang S, Hu P, Li HC, Brenner ML, Scalea TM, Stein DM.

BACKGROUND: Open chest cardiac massage (OCCM) is a commonly performed procedure after traumatic cardiac arrest (TCA). OCCM has been reported to be superior to closed chest compressions (CCC) in animal models and in non-TCA. The purpose of this study is to prospectively compare OCCM versus CCC in TCA using end-tidal carbon dioxide (ETCO2), the criterion standard for determining the effectiveness of chest compressions and detection of return of spontaneous circulation (ROSC), as the surrogate for cardiac output and marker for adequacy of resuscitation.

METHODS: This prospective observational study enrolled patients over a 9-month period directly presenting to a level 1 trauma center after TCA. Continuous high-resolution ETCO2 measurements were collected every 6 seconds for periods of CCC and OCCM, respectively. Patients receiving CCC only were compared with patients receiving CCC followed by OCCM. Student's t tests were used to compare ETCO2 within and between groups.

RESULTS: Thirty-three patients were enrolled (16 OCCM, 17 CCC-only). Mean time of CCC before OCCM was 66 seconds. Within the OCCM group, final, peak, mean, and median ETCO2 levels significantly increased when comparing the initial CCC period to the OCCM interval. Using a time-matched comparison, significant increases were observed in the final and peak but not mean and median values when comparing the first minute of CCC to the remaining time in the CCC-only group. However, whenperiods of OCCM were compared with equivalent periods of CCC-only, there were no differences in the initial, final, peak, mean, or median ETCO2 values.Correspondingly, no difference in rates of ROSC was observed between groups (OCCM 23.5% vs. CCC 38.9%; p = 0.53).

CONCLUSION: Although we could not control for confounders, we found no significant improvement in ETCO2 or ROSC with OCCM. With newer endovascular techniques for aortic occlusion, thoracotomy solely for performing OCCM provides no benefit over CCC.

LEVEL OF EVIDENCE: Therapeutic study, level III.

Shock. 2016 Sep;46(3 Suppl 1):55-60.

Noninvasive Continuous Hemoglobin Monitoring in Combat Casualties: A Pilot Study.

Bridges E, Hatzfeld JJ.

OBJECTIVE: To describe the accuracy and precision of noninvasive hemoglobin measurement (SpHb) compared with laboratory or point-of-care Hb, and SpHb ability to trend in seriously injured casualties.

METHODS: Observational study in a convenience sample of combat casualties undergoing resuscitation at two US military trauma hospitals in Afghanistan. SpHb was obtained using the Masimo Rainbow SET (Probe Rev E/Radical-7 Pulse CO-Oximeter v 7.6.2.1). Clinically indicated Hb was analyzed with a Coulter or iStat and compared with simultaneous SpHb values.

RESULTS: Twenty-three patients were studied (ISS 20±9.8; age 29±9 years; male 97%; 100% intubated). Primary injury cause: improvised explosive device (67%) or gunshot (17%). There were 49 SpHb-Hb pairs (median 2 per subject). Bias: 0.3±1.6g/dL (95% LOA -2.4, 3.4g/dL). The SpHb-Hb difference < ± 1g/dL in 37% of pairs. Eighty-six percent of pairs changed in a similar direction. Using an absolute change in Hb of >1g/dL, a concurrent absolute change in SpHb of >1g/dL had a sensitivity: 61%, specificity 85%, positive predictive value: 80%, and a negative predictive value: 69%. The SpHb signal was present in 4643 of 6137 min monitored (76%).

CONCLUSIONS: This was the first study to describe continuous SpHb in seriously injured combat casualties. Using a threshold of 1g/dL previously specified in the literature, continuous SpHb is not precise enough to serve as sole transfusion trigger in trauma patients. Further research is needed to determine if it is useful for trending Hb changes or as an early indicator of deterioration in combat casualties.

Mil Med. 2016 Oct;181(10):1176-1181.

Forty Years on From an Event That Changed the Management of Trauma Around the World: What Actually Happened That Night Forty Years Ago?

Bridgewater FH.

ABSTRACT:
The management of trauma has evolved significantly over the last 40 years. Seminal to this process was the development in Nebraska of a concept of trauma management that was promulgated as Advanced Trauma Life Support (ATLS). It has achieved global support and is considered by many to be the acme in trauma management. Every participant in an ATLS course remembers that an aviation accident in rural Nebraska was responsible for the nascence of the program but very few know the details of the crash. February 17, 2016, was the 40th anniversary of the accident. This article extracts the details of the flight, the crash, the search, the extrication, the reception at the nearby rural hospital, and the injuries from both the official report and the published, personal records of survivors of the crash. The effect of ATLS can be debated elsewhere and its future questioned. However, the article concludes by highlighting the fortitude and resilience of the human spirit that were demonstrated that night under incredible circumstances.

J Trauma Acute Care Surg. 2016 Sep;81(3):445-52.

Prehospital lactate improves accuracy of prehospital criteria for designating trauma activation level.

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

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

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

RESULTS: There were 6,347 patients included. Twenty-eight percent had trauma center need. The ACS+LAC algorithm upgraded 256 patients and downgraded 548 patients compared to the ACS algorithm. The ACS+LAC algorithm versus ACSalgorithm had an NRI of 0.058 (95% confidence interval [CI], 0.044-0.071; $p < 0.01$), with an event NRI of -0.5% and nonevent NRI of 6.2%. When weighted to favor changes in undertriage, the ACS+LAC still had a favorable overall reclassification (weighted NRI, 0.041; 95% CI, 0.028-0.054; $p = 0.01$). The ACS+LAC algorithm increased positive predictive value, negative predictive value, and accuracy. Over-triage was reduced 7.2%, while undertriage only increased 0.7%. The area under the curve was significantly higher for the ACS+LAC algorithm (0.79 vs. 0.76; $p < 0.01$).

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

LEVEL OF EVIDENCE: Therapeutic/care management study, level III; prognostic/epidemiologic study, level III.

Mil Med. 2016 Oct;181(10):1195-1199.

A Double-Blinded, Randomized, Placebo-Controlled Sub-Dissociative Dose Ketamine Pilot Study in the Treatment of Acute Depression and Suicidality in a Military Emergency Department Setting.

Burger J, Capobianco M, Lovern R, Boche B, Ross E, Darracq MA, McLay R.

BACKGROUND: Rates of completed suicide in the military have increased. Options are limited for acute relief of depression and suicidal ideation. Traditional treatments' effects take weeks to months. A novel, rapid, therapeutic target has emerged with the N-methyl-D-aspartate antagonist ketamine. Previous studies suggest that a single dose of intravenous (IV) ketamine rapidly alleviates depression and suicidality.

METHODS: In this proof of concept study, an active duty convenience sample population presenting to the emergency department (ED) meeting criteria for inpatient psychiatric admission as a result of depression and suicidal thinking were randomized to receive either a subdissociative dose (0.2 mg/kg) of IV ketamine or equivalent volume of normal saline (placebo). Subjects were evaluated for symptoms throughout a 4-hour ED course, at hospital discharge, and 2 weeks postdischarge.

RESULTS: Methodological problems limited analyzable data to 10 subjects. Two of three who received ketamine experienced dramatic decreases in suicidality and hopelessness within 40 minutes. No such improvements were seen in any of seven controls over the 4-hour observation in the ED. At discharge from the hospital, there was no clinically significant difference. No subjects described adverse symptoms.

CONCLUSION: Despite methodology difficulties noted in this pilot study, there was statistical improvement in intervention group versus controls.

Surgery. 2016 Oct 13. pii: S0039-6060(16)30443-3.

Early plasma transfusion is associated with improved survival after isolated traumatic brain injury in patients with multifocal intracranial hemorrhage.

Chang R, Folkerson LE, Sloan D, Tomasek JS, Kitagawa RS, Choi HA, Wade CE, Holcomb JB.

BACKGROUND: Plasma-based resuscitation improves outcomes in trauma patients with hemorrhagic shock, while large-animal and limited clinical data suggest that it also improves outcomes and is neuroprotective in the setting of combined hemorrhage and traumatic brain injury. However, the choice of initial resuscitation fluid, including the role of plasma, is unclear for patients after isolated traumatic brain injury.

METHODS: We reviewed adult trauma patients admitted from January 2011 to July 2015 with isolated traumatic brain injury. "Early plasma" was defined as transfusion of plasma within 4 hours. Purposeful multiple logistic regression modeling was performed to analyze the relationship of early plasma and inhospital survival. After testing for interaction, subgroup analysis was performed based on the pattern of brain injury on initial head computed tomography: epidural hematoma, intraparenchymal contusion, subarachnoid hemorrhage, subdural hematoma, or multifocal intracranial hemorrhage.

RESULTS: Of the 633 isolated traumatic brain injury patients included, 178 (28%) who received early plasma were injured more severely coagulopathic, hypoperfused, and hypotensive on admission. Survival was similar in the early plasma versus no early plasma groups (78% vs 84%, P = .08). After adjustment for covariates, early plasma was not associated with improved survival (odds ratio 1.18, 95% confidence interval 0.71-1.96). On subgroup analysis, multifocal intracranial hemorrhage was the largest subgroup with 242 patients. Of these, 61 (25%) received plasma within 4 hours. Within-group logistic regression analysis with adjustment for covariates found that early plasma was associated with improved survival (odds ratio 3.34, 95% confidence interval 1.20-9.35).

CONCLUSION: Although early plasma transfusion was not associated with improved in-hospital survival for all isolated traumatic brain injury patients, early plasma was associated with increased in-hospital survival in those with multifocal intracranial hemorrhage.

Br J Anaesth. 2016 Sep;117 Suppl 2:ii85-ii94. doi: 10.1093/bja/aew270.

Management of bleeding in vascular surgery.

Chee YE, Liu SE, Irwin MG.

ABSTRACT:
Management of acute coagulopathy and blood loss during major vascular procedures poses a significant haemostatic challenge to anaesthetists. The acute coagulopathy is multifactorial in origin with tissue injury and hypotension as the precipitating factors, followed by dilution, hypothermia, acidemia, hyperfibrinolysis and systemic inflammatory response, all acting as a self-perpetuating spiral of events. The problem is confounded by the high prevalence of antithrombotic agent use in these patients and intraoperative heparin administration. Trials specifically examining bleeding management in vascular surgery are lacking, and much of the literature and guidelines are derived from studies on patients with trauma. In general, it is recommended to adopt permissive hypotension with a restrictive fluid strategy, using a combination of crystalloid and colloid solutions up to one litre during the initial resuscitation, after which blood products should be administered. A restrictive transfusion trigger for red cells remains the mainstay of treatment except for the high-risk patients, where the trigger should be individualized. Transfusion of blood components should be initiated by clinical evidence of coagulopathy such as diffuse microvascular bleeding, and then guided by either laboratory or point-of-care coagulation testing. Prophylactic antifibrinolytic use is recommended for all surgery where excessive bleeding is anticipated. Fibrinogen and prothrombin complex concentrates administration are recommended during massive transfusion, whereas rFVIIa should be reserved until all means have failed. While debates over the ideal resuscitative strategy continue, the approach to vascular haemostasis should be scientific, rational, and structured. As far as possible, therapy should be monitored and goal directed.

Injury. 2016 Jul 21. pii: S0020-1383(16)30329-1.

Intra-abdominal packing with laparotomy pads and QuikClot™ during damage control laparotomy: A safety analysis.

Choron RL, Hazelton JP, Hunter K, Capano-Wehrle L, Gaughan J, Chovanes J, Seamon MJ.

BACKGROUND: Intra-abdominal packing with laparotomy pads (LP) is a common and rapid method for hemorrhage control in critically injured patients. Combat Gauze™ and Trauma Pads™ ([QC] Z-Medica QuikClot(®)) are kaolin impregnated hemostatic agents, that in addition to LP, may improve hemorrhage control. While QC packing has been effective in a swine liver injury model, QC remains unstudied for human intra-abdominal use. We hypothesized QC packing during damage control laparotomy (DCL) better controls hemorrhage than standard packing and is safe for intracorporeal use.

METHODS: A retrospective review (2011-2014) at a Level-I Trauma Center reviewed all patients who underwent DCL with intentionally retained packing. Clinical characteristics, intraoperative and postoperative parameters, and outcomes were compared with respect to packing (LP vs. LP+QC). All complications occurring within the patients' hospital stays were reviewed. A $p \leq 0.05$ was considered significant.

RESULTS: 68 patients underwent DCL with packing; (LP n=40; LP+QC n=28). No difference in age, BMI, injury mechanism, ISS, or GCS was detected (Table 1, all $p>0.05$). LP+QC patients had a lower systolic blood pressure upon ED presentation and greater blood loss during index laparotomy than LP patients. LP+QC patients received more packed red blood cell and fresh frozen plasma resuscitation during index laparotomy (both $p<0.05$). Despite greater physiologic derangement in the LP+QC group, there was no difference in total blood products required after index laparotomy until abdominal closure (LP vs LP+QC; $p>0.05$). After a median of 2days until abdominal closure in both groups, no difference in complications rates attributable to intra-abdominal packing (LP vs LP+QC) was detected.

CONCLUSION: While the addition of QC to LP packing did not confer additional benefit to standard packing, there was no additional morbidity identified with its use. The surgeons at our institution now select augmented packing with QC for sicker patients, as we believe this may have additional advantage over standard LP packing. A randomized controlled trial is warranted to further evaluate the intra-abdominal use of advanced hemostatic agents, like QC, for both hemostasis and associated morbidity.

Br J Anaesth. 2016 Aug;117(2):236-42.

Surgicric 2: A comparative bench study with two established emergency cricothyroidotomy techniques in a porcine model.

Chrisman L, King W, Wimble K, Cartwright S, Mohammed KB, Patel B.

BACKGROUND: 'Can't Intubate, Can't Oxygenate' is a rare but life threatening event. Anaesthetists must be trained and have appropriate equipment available for this. The ideal equipment is a topic of ongoing debate. To date cricothyroidotomy training for anaesthetists has concentrated on cannula techniques. However cases reported to the NAP4 audit illustrated that they were associated with a high failure rate. A recent editorial by Kristensen and colleagues suggested all anaesthetists must master a surgical technique. The surgical technique for cricothyroidotomy has been endorsed as the primary technique by the recent Difficult Airway Society 2015 guidelines.

METHODS: We conducted a bench study comparing the updated Surgicric 2 device with a scalpel-bougie-tube surgical technique, and the Melker seldinger technique, using a porcine model. Twenty six senior anaesthetists (ST5+) participated. The primary outcome was insertion time. Secondary outcomes included success rate, ease of use, device preference and tracheal trauma.

RESULTS: There was a significant difference ($P<0.001$) in the overall comparisons of the insertion times. The surgical technique had the fastest median time of 62 s. The surgical and Surgicric techniques were significantly faster to perform than the Melker (both $P<0.001$). The surgical technique had a success rate of 85% at first attempt, and 100% within two attempts, whereas the others had failed attempts. The surgical technique was ranked first by 50% participants and had the lowest grade of posterior tracheal wall trauma, significantly less than the Surgicric 2 ($P=0.002$).

CONCLUSIONS: This study supports training in and the use of surgical cricothyroidotomy by anaesthetists.

J Spec Oper Med. 2016 Fall;16(3):30-35.

Fraction of Inspired Oxygen Delivered by Elisée™ 350 Turbine Transport Ventilator With a Portable Oxygen Concentrator in an Austere Environment.

d'Aranda E, Bordes J, Bourgeois B, Clay J, Esnault P, Cungi PJ, Goutorbe P, Kaiser E, Meaudre E.

BACKGROUND: Management of critically ill patients in austere environments is a logistic challenge. Availability of oxygen cylinders for the mechanically ventilated patient may be difficult in such a context. One solution is to use a ventilator able to function with an oxygen concentrator (OC).

METHODS: We tested two Elisée™ 350 ventilators paired with SeQual Integra 10-OM oxygen concentrators (OC) (Chart Industries, http://www .chartindustries.com) and evaluated the delivered fraction of inspired oxygen (Fio2). Ventilators were connected to a test lung and Fio2 was measured and indicated by the ventilator. Continuous oxygen was generated by the OC from 0.5L/min to 10L/min, and administered by the specific inlet port of the ventilator. Several combinations of ventilator settings were evaluated to determine the factors affecting the delivered Fio2.

RESULTS: The Elisée 350 turbine ventilator is able to deliver a high Fio2 when functioning with an OC. However, modifications of the ventilator settings such as an increase in minute ventilation, inspiratory-to-expiratory ratio, and positive end-expiratory pressure affect delivered Fio2 despite steady-state oxygen flow from the concentrator.

CONCLUSION: OCs provide an alternative to oxygen cylinders for delivering high Fio2 with a turbine ventilator. Nevertheless, Fio2 must be monitored continuously, since it decreases when minute ventilation is increased.

Semin Immunol. 2016 Oct 18. [Epub ahead of print]

Platelets and infection.

Deppermann C, Kubes P.

ABSTRACT:
The primary function of platelets is to patrol the vasculature and seal vessel breaches to limit blood loss. However, it is becoming increasingly clear that they also contribute to pathophysiological conditions like thrombosis, atherosclerosis, stroke and infection. Severe sepsis is a devastating disease that claims hundreds of thousands of lives every year in North America and is a major burden to the public health system. Platelet surface receptors like GPIb, αIIbβ3, TLR2 and TLR4 are involved in direct platelet-bacteria interactions. Plasma proteins like fibrinogen and vWF enable indirect interactions. Furthermore, platelet granules contain a plethora of proteins that modulate the immune response as well as microbicidal agents which can directly lyse bacteria. Bacterial toxins are potent platelet activators and can cause intravascular platelet aggregation. Platelets contribute to the antibacterial response of the host involving Kupffer cells, neutrophils and the complement system. In this review we summarize the current knowledge about platelet-bacteria interactions and highlight recent advances in the field.

J Emerg Med. 2016 Dec;51(6):e133-e135

Tracheal Malplacement of the King LT Airway May Be an Important Cause of Prehospital Device Failure.

Driver BE, Plummer D, Heegaard W, Reardon RF.

BACKGROUND: The King LT airway (King Systems, Noblesville, IN) is a popular extraglottic device that is widely used in the prehospital setting. We report a case of tracheal malplacement of the King airway with a severe kink in the distal tube.

CASE REPORT: A 51-year-old unhelmeted motorcyclist collided with a freeway median and was obtunded when paramedics arrived. After bag mask ventilation, a King airway was placed uneventfully and the patient was transported to the emergency department. Because of the concern for an unstable cervical spine injury, a lateral cervical spine radiograph was obtained on arrival. No cervical injury was seen, but the King airway was noted to be malplaced; the King airway passed through the laryngeal inlet and became lodged on the anterior trachea, creating an acute kink between the two balloons. After reviewing the radiograph, ventilations were reassessed and remained adequate. Both balloons were deflated, and the King airway was removed; the patient was orotracheally intubated without complication. WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?: The King airway is a valuable prehospital airway that can be placed quickly and blindly with high success rates by inexperienced providers; the King airway, however, is not without complication. Ventilation was not impaired in this patient, but tracheal malplacement may be an important cause of prehospital device failure. If a first placement attempt of a King airway device fails, it is reasonable to reattempt King airway placement with a new, unkinked device before abandoning King airway placement.

J Trauma Acute Care Surg. 2016 Sep;81(3):409-19

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

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

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

METHODS: The American Association for the Surgery of Trauma Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery registry prospectively identified trauma patients requiring AO from eight ACS Level 1 centers. Presentation, intervention, and outcome variables were collected and analyzed to compare REBOA and open AO.

RESULTS: From November 2013 to February 2015, 114 AO patients were captured (REBOA, 46; open AO, 68); 80.7% were male, and 62.3% were blunt injured. Aortic occlusion occurred in the emergency department (73.7%) or the operating room (26.3%). Hemodynamic improvement after AO was observed in 62.3% [REBOA, 67.4%; open OA, 61.8%); 36.0% achieving stability (systolic blood pressure consistently >90 mm Hg, >5 minutes); REBOA, 22 of 46 (47.8%); open OA, 19 of 68 (27.9%); p =0.014]. Resuscitative endovascular balloon occlusion of the aorta (REBOA) access was femoral cut-down (50%); US guided (10.9%) and percutaneous without imaging (28.3%). Deployment was achieved in Zones I (78.6%), II (2.4%), and III (19.0%). A second AO attempt was required in 9.6% [REBOA, 2 of 46 (4.3%); open OA, 9 of 68 (13.2%)]. Complications of REBOA were uncommon (pseudoaneurysm, 2.1%; embolism, 4.3%; limb ischemia, 0%). There was no difference in time to successful AO between REBOA and open procedures (REBOA, 6.6 ± 5.6 minutes; open OA, 7.2 ± 15.1; p = 0.842). Overall survival was 21.1% (24 of 114), with no significant difference between REBOA and open AO with regard to mortality [REBOA, 28.2% (13 of 46); open OA, 16.1% (11 of 68); p = 0.120].

CONCLUSION: Resuscitative endovascular balloon occlusion of the aorta has emerged as a viable alternative to open AO in centers that have developed this capability. Further maturation of the American Association for the Surgery of Trauma Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery database is required to better elucidate optimal indications and outcomes.

LEVEL OF EVIDENCE: Therapeutic/care management study, level IV.

J Trauma Acute Care Surg. 2016 Nov;81(5 Suppl 2 Proceedings of the 2015 Military Health System Research Symposium):S77-S80.

Improving national preparedness for intentional mass casualty events: A seamless system of evidence-based care.

Eastman AL, Fabbri W, Brinsfield K, Jacobs L.

QUOTE:

"**An Evidence-Based, Seamless, Systematic Response to Mass Trauma**

While well discussed in other areas of this supplement, one cannot help but marvel at the impressive, seamless system of care for mass trauma designed and implemented to support Operation Iraqi Freedom and Operation Enduring Freedom. In considering this exemplary system and its potential civilian applicability, one should not become bogged down in the individual components of that system but to consider instead the strategy used to understand its effectiveness. Starting with A wide base of point-of-wounding care, the overall casualty management plan progresses through a system of rapid evacuation to echelons of definitive care facilities and ultimately to a long-term post–acute recovery framework, all combined to far exceed any other care delivery system worldwide.

In crafting national policy for true preparedness and community resilience, it is critical to remember that this military's system was not based on anecdote or conjecture. Instead, a vast quantity of data was collected through the US Department of Defense Joint Theater Trauma System and the Committee on Tactical Combat Casualty Care. This allowed for both real-time and post hoc analysis, and hence, the interventions designed were data driven and evidence based.

If a single shortcoming can be identified with our present national readiness, it would be the lack of a comparable system in the civilian setting. Investigative, clinical, and medical examiner data following IMCEs are often segmented, compartmentalized, or simply unobtainable. This is a result of the distribution of ownership of the various phases of the civilian care system, the elusive goal of collecting medical information in a uniform, searchable format, and legislation intended to preserve individual medical confidentiality that impedes data collection by its design or by misinterpretation. As a consequence, conjecture, bias, and anecdote inform the civilian section of our national response rather than scientific evidence."

Can J Surg. 2016 Oct 1;59(6):11215. [Epub ahead of print]

Use of intraosseous devices in trauma: a survey of trauma practitioners in Canada, Australia and New Zealand.

Engels PT, Erdogan M, Widder SL, Butler MB, Kureshi N, Martin K, Green RS.

BACKGROUND: Although used primarily in the pediatric population for decades, the use of intraosseous (IO) devices in the resuscitation of severely injured adult trauma patients has recently become more commonplace. The objective of this study was to determine the experience level, beliefs and attitudes of trauma practitioners in Canada, Australia and New Zealand regarding the use of IO devices in adult trauma patients.

METHODS: We administered a web-based survey to all members of 4 national trauma and emergency medicine organizations in Canada, Australia and New Zealand. Survey responses were analyzed using descriptive statistics, univariate comparisons and a proportional odds model.

RESULTS: Overall, 425 of 1771 members completed the survey, with 375 being trauma practitioners. IO devices were available to 97% (353 of 363), with EZ-IO being the most common. Nearly all physicians (98%, 357 of 366) had previous training with IO devices, and 85% (223 of 261) had previously used an IO device in adult trauma patients. Most respondents (79%, 285 of 361) were very comfortable placing an IO catheter in the proximal tibia. Most physicians would always or often use an IO catheter in a patient without intravenous access undergoing CPR for traumatic cardiac arrest (84%, 274 of 326) or in a hypotensive patient (without peripheral intravenous access) after 2 attempts or 90 s of trying to establish vascular access (81%, 264 of 326).

CONCLUSION: Intraosseous devices are readily available to trauma practitioners in Canada, Australia and New Zealand, and most physicians are trained in device placement. Most physicians surveyed felt comfortable using an IO device in resuscitation of adult trauma patients and would do so for indications broader than current guidelines.

Anaesth Crit Care Pain Med. 2016 Jul 30. [Epub ahead of print]

Triage in military settings.

Falzone E, Pasquier P, Hoffmann C, Barbier O, Boutonnet M, Salvadori A, Jarrassier A, Renner J, Malgras B, Mérat S.

ABSTRACT:
Triage, a medical term derived from the French word "trier", is the practical process of sorting casualties to rationally allocate limited resources. In combatsettings with limited medical resources and long transportation times, triage is challenging since the objectives are to avoid overcrowding medical treatment facilities while saving a maximum of soldiers and to get as many of them back into action as possible. The new face of modern warfare, asymmetric and non-conventional, has led to the integrative evolution of triage into the theatre of operations. This article defines different triage scores and algorithms currently implemented in military settings. The discrepancies associated with these military triage systems are highlighted. The assessment of combat casualty severity requires several scores and each nation adopts different systems for triage on the battlefield with the same aim of quickly identifying those combat casualties requiring lifesaving and damage control resuscitation procedures. Other areas of interest for triage in military settings are discussed, including predicting the need for massive transfusion, haemodynamic parameters and ultrasound exploration.

J Bone Joint Surg Am. 2016 Oct 5;98(19):e86.

Making Tranexamic Acid the Standard of Care in Hip and Knee Arthroplasty: Commentary on an article by Brian Hallstrom, MD, et al.: "The Michigan Experience with Safety and Effectiveness of Tranexamic Acid Use in Hip and Knee Arthroplasty".

Friedman RJ.

QUOTES:

“A theoretical drawback of the use of antifibrinolytics in total joint arthroplasty (TJA), and tranexamic acid (TXA) specifically, has been the concern regarding an increase in venous thromboembolism (VTE). This has probably been the single-most important factor affecting the slow uptake and usage of this drug, despite the large amount of published literature demonstrating efficacy and safety going back to the late 1990s. (1,2)”

“A common misconception regarding usage is that surgeons cannot use the drug off-label for fear of medicolegal repercussions. Although it is true that the only indication for TXA that has been approved by the U.S. Food and Drug Administration (FDA) is for limiting blood loss during tooth extraction in patients with hemophilia, the concern is no longer justified, as there are sufficient published data, both in cardiovascular and orthopaedic surgery, substantiating TXA use on the basis of its benefits to the patient and the health-care system.”

“The large database study by Hallstromet al., which involved almost 35,000 patients, may finally put these concerns to rest and allow for antifibrinolytics to become the standard of care in TJA. Once again, no increase in the risk of VTE or in cardiovascular events was demonstrated, while the benefits remained substantial. The authors demonstrated that previously published clinical trial results are applicable to a broader, unselected real-world population.”

BMJ. 2016 Jun 22;353:i3051.

Assessment and initial management of major trauma: summary of NICE guidance.

Glen J, Constanti M, Brohi K; Guideline Development Group.

Quotes:

"Dressings, tourniquets and pelvic binders

• Use simple dressings with direct pressure to control external haemorrhage.
• In patients with major limb trauma use a tourniquet if direct pressure has failed to control life threatening haemorrhage.

[Based on the experience and opinion of the GDG]

• In the pre-hospital setting, if active bleeding is suspected from a pelvic fracture after blunt high-energy trauma:
  – apply a purpose-made pelvic binder or
  – consider an improvised pelvic binder, but only if a purpose-made binder does not fit.

[Based on very low quality observational cohort studies and the experience and opinion of the GDG]"

"Haemostatic agents

Haemostatic agents may have a role to reduce or control bleeding. Tranexamic acid works by directly inhibiting clot breakdown, and its delayed use may be beneficial if there is evidence of hyperfibrinolysis (abnormally rapid clot breakdown), supported by blood tests such as D dimer and fibrinogen products.

• Use intravenous tranexamic acid as soon as possible in patients with major trauma and active or suspected active bleeding.
• Do not use intravenous tranexamic acid more than 3 hours after injury in patients with major trauma unless there is evidence of hyperfibrinolysis.

[Based on high to low quality evidence from randomised controlled trials and economic evidence with potentially serious limitations and direct to partial applicability]"

"Volume resuscitation

These guidelines suggest high volume blood product resuscitation, avoiding the use of crystalloids and colloids in hospital. A restricted, or permissive approach to volume resuscitation involves accepting a lower blood pressure during active bleeding to reduce bleeding; and restricting fluid administration to avoid diluting the blood's clotting ability.

• For patients with active bleeding, use a restrictive approach to volume resuscitation until definitive early control of bleeding has been achieved.
• In hospital settings move rapidly to haemorrhage control, titrating volume resuscitation to maintain central circulation (central pulse or mean arterial pressure of 50 mm Hg) until control is achieved.

For patients who have haemorrhagic shock and a traumatic brain injury:

– If haemorrhagic shock is the dominant condition, continue restrictive volume resuscitation.

– If traumatic brain injury is the dominant condition, use a less restrictive volume resuscitation approach to maintain cerebral perfusion.

[Based on low quality randomised controlled trials, and the experience and opinion of the GDG]

• In hospital settings do not use crystalloids for patients with active bleeding.

See NICE guideline *Intravenous fluid therapy in adults in hospital* (www.nice.org.uk/guidance/CG174) and the section on fluid resuscitation in the NICE guideline *Intravenous fluid therapy in children and young people in hospital (*www.nice.org.uk/guidance/ng29) for advice on tetrastarches.

• For adults (≥16 years old) use a ratio of 1 unit of plasma to 1 unit of red blood cells to replace fluid volume.
• For children (<16 years old) use a ratio of 1 part plasma to 1 part red blood cells and base the volume on the child's weight.

[Based on high quality randomised controlled trials and low quality observational cohort studies] **"**

Injury. 2016 Aug 17. pii: S0020-1383(16)30407-7. [Epub ahead of print]

Patients with multiple traumatic amputations: An analysis of operation enduring freedom joint theatre trauma registry data.

Godfrey BW, Martin A, Chestovich PJ, Lee GH, Ingalls NK, Saldanha V.

INTRODUCTION: Improvised Explosive Devices (IED) are the primary wounding mechanism for casualties in Operation Enduring Freedom. Patients can sustain devastating traumatic amputations, which are unlike injuries seen in the civilian trauma sector. This is a database analysis of the largest patient registry of multiple traumatic amputations.

METHODS: The Joint Theater Trauma Registry was queried for patients with a traumatic amputation from 2009 to 2012. Data obtained included the Injury Severity Score (ISS), Glasgow Coma Score (GCS), blood products, transfer from theatre, and complications including DVT, PE, infection (Acinetobacter and fungal), acute renal failure, and rhabdomyolysis. Comparisons were made between number of major amputations (1-4) and specific outcomes using $\chi(2)$ and Pearson's rank test, and multivariable logistic regression was performed for 30-day survival. Significance was considered with $p<0.05$.

RESULTS: We identified 720 military personnel with at least one traumatic amputation: 494 single, 191 double, 32 triple, and 3 quad amputees. Average age was 24.3 years (18-46), median ISS 24 (9-66), and GCS 15 (3-15). Tranexamic acid (TXA) was administered in 164 patients (23%) and tourniquets were used in 575 (80%). Both TXA and tourniquet use increased with increasing number of amputations ($p<0.001$). Average transfusion requirements (in units) were packed red blood cells (PRBC) 18.6 (0-142), fresh frozen plasma (FFP) 17.3 (0-128), platelets 3.6 (0-26), and cryoprecipitate 5.6 (0-130). Transfusion of all blood products increased with the number of amputations ($p<0.001$). All complications tested increased with the number of amputations except Acinetobacter infection, coagulopathy, and compartment syndrome. Transfer to higher acuity facilities was achieved in 676 patients (94%).

CONCLUSION: Traumatic amputations from blast injuries require significant blood product transfusion, which increases with the number of amputations. Most complications also increase with the number of amputations. Despite high injury severity, 94% of traumatic amputation patients who are alive upon admission to a role II/III facility will survive to transfer to facilities with higher acuity care.

J Spec Oper Med. 2016 Fall;16(3):53-56.

TCCC Standardization: The Time Is Now.

Goforth C, Antico D.

Quotes:

TCCC is now widely accepted by the US Armed Forces, federal agencies such as Department of Homeland Security, and civilian prehospital care organizations. Active shooter events, such as the Navy Yard in Washington, DC, and the Columbine High School in Colorado, have driven civilian first responders and tactical law enforcement departments toward the TCCC construct. For instance, the Hartford Consensus,[14,19] published in 2013, is a list of recommendations directly related to TCCC. Namely, that hemorrhage control should be a core function of law enforcement and the response to active shooter incidents requires a unified medical response involving all first responders and tactical personnel involved to minimize the loss of life.[16,20] Collectively, the work of the American College of Emergency Physicians, the American College of Surgeons Committee on Trauma, the Federal Bureau of Investigation,[19] and foreign armed forces[21] makes it clear that the TCCC concept is quickly becoming the new accepted standard for all prehospital environments.

These different organizations, however, are currently free to interpret and/or incorporate TCCC guidelines as they see fit for their particular organization or needs. The guidelines published by the CoTCCC are not uniformly applied across a disparate landscape of military, federal, and prehospital organizations. Thus, the interpretation of TCCC guiding principles varies widely from agency to agency. Naturally, this leads to an inconsistency from one agency's TCCC provider to the next. In turn, this lack of consistency is a threat to Service and agency interoperability at the trauma/prehospital level, which is a DoD priority.[22–24]

Using the model of the Military Training Network's agreement with the AHA as a baseline program, we propose that the solution to this lack of standardization is already in place. The civilian sector, namely the National Association of Emergency Medical Technicians (NAEMT), has already incorporated the DoD's TCCC course as part of the US prehospital trauma life support (PHTLS) program.[29] Therefore, the framework for standardization across Services and civilian agencies already exists. The struggle to bring consistency, quality, and competence to the delivery of prehospital Combat casualty care over the past 14 years of conflict has been a major factor in the US Military achieving the highest historical wounded survival rate during OEF and OIF. Despite paradigm-changing advances, adverse casualty care events directly attributed to inconsistent TCCC training still persists, as most recently highlighted by Col Kirby Gross, JTS Director.[24] Therefore, we conclude that a clear opportunity exists for CoTCCC and other governmental and civilian agencies (e.g., NAEMT and the PHTLS Executive Council) that have already adopted the TCCC construct to establish a strategic partnership with the central vision and overarching goals of developing national TCCC certifications applicable to all civilian services (fire, law enforcement, rescue), governmental agencies, and US Armed Services.

J Bone Joint Surg Am. 2016 Oct 5;98(19):1646-1655.

The Michigan Experience with Safety and Effectiveness of Tranexamic Acid Use in Hip and Knee Arthroplasty.

Hallstrom B, Singal B, Cowen ME, Roberts KC, Hughes RE.

BACKGROUND: The efficacy of tranexamic acid (TXA) in reducing blood loss and transfusion requirements in total hip and knee arthroplasty has been well established in small controlled clinical trials and meta-analyses. The purpose of the current study was to determine the risks and benefits of TXA use in routine orthopaedic surgical practice on the basis of data from a large, statewide arthroplasty registry.

METHODS: From April 18, 2013, to September 30, 2014, there were 23,236 primary total knee arthroplasty cases and 11,489 primary total hip arthroplasty cases completed and registered in the Michigan Arthroplasty Registry Collaborative Quality Initiative (MARCQI). We evaluated the association between TXA use and hemoglobin drop, transfusion, length of stay (LOS), venous thromboembolism (VTE), readmission, and cardiovascular events by fitting mixed-effects generalized linear and mixed-effects Cox models. We used inverse probability of treatment weighting to enhance causal inference.

RESULTS: For total hip arthroplasty, TXA use was associated with a smaller drop in hemoglobin (mean difference = -0.65 g/dL; 95% confidence interval [CI] = -0.60 to -0.71 g/dL), decreased odds of blood transfusion (odds ratio [OR] = 0.72; 95% CI = 0.60 to 0.86), and decreased readmissions (OR = 0.77; 95% CI = 0.64 to 0.93) compared with no TXA use. There was no effect on VTE (hazard ratio [HR] = 0.91; 95% CI = 0.62 to 1.33), LOS (incident rate ratio [IRR] = 1.00; 95% CI = 0.97 to 1.03), or cardiovascular events (OR = 0.85; 95% CI = 0.47 to 1.52). For total knee arthroplasty, TXA was associated with a smaller drop in hemoglobin (mean difference = -0.68 g/dL; 95% CI = -0.64 to -0.71 g/dL) and one-fourth the odds of blood transfusion (OR = 0.26; 95% CI = 0.21 to 0.31). There was an association with decreased risk of VTE within 90 days after surgery (HR = 0.56; 95% CI = 0.42 to 0.73), slightly decreased LOS (IRR = 0.93; 95% CI = 0.92 to 0.95), and no association with readmissions (OR = 0.90; 95% CI = 0.79 to 1.04) or cardiovascular events (OR = 1.12; 95% CI = 0.74 to 1.71).

CONCLUSIONS: In routine orthopaedic surgery practice, TXA use was associated with decreased blood loss and transfusion risk for both total knee and total hip arthroplasty, without evidence of increased risk of complications. TXA use was also associated with reduced risk of readmission among total hip arthroplasty patients and reduced risk of VTE among total knee arthroplasty patients, and did not have an adverse effect on cardiovascular complications in either group.

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

N Engl J Med. 2016 Oct 24. [Epub ahead of print]

Effect of Short-Term vs. Long-Term Blood Storage on Mortality after Transfusion.

Heddle NM, Cook RJ, Arnold DM, Liu Y, Barty R, Crowther MA, Devereaux PJ, Hirsh J, Warkentin TE, Webert KE, Roxby D, Sobieraj-Teague M, Kurz A, Sessler DI, Figueroa P, Ellis M, Eikelboom JW.

Background Randomized, controlled trials have suggested that the transfusion of blood after prolonged storage does not increase the risk of adverse outcomes among patients, although most of these trials were restricted to high-risk populations and were not powered to detect small but clinically important differences in mortality. We sought to find out whether the duration of blood storage would have an effect on mortality after transfusion in a general population of hospitalized patients. Methods In this pragmatic, randomized, controlled trial conducted at six hospitals in four countries, we randomly assigned patients who required a red-cell transfusion to receive blood that had been stored for the shortest duration (short-term storage group) or the longest duration (long-term storage group) in a 1:2 ratio. Only patients with type A or O blood were included in the primary analysis, since pilot data suggested that our goal of achieving a difference in the mean duration of blood storage of at least 10 days would not be possible with other blood types. Written informed consent was waived because all the patients received treatment consistent with the current standard of care. The primary outcome was in-hospital mortality, which was estimated by means of a logistic-regression model after adjustment for study center and patient blood type.

Results From April 2012 through October 2015, a total of 31,497 patients underwent randomization. Of these patients, 6761 who did not meet all the enrollment criteria were excluded after randomization. The primary analysis included 20,858 patients with type A or O blood. Of these patients, 6936 were assigned to the short-term storage group and 13,922 to the long-term storage group. The mean storage duration was 13.0 days in the short-term storage group and 23.6 days in the long-term storage group. There were 634 deaths (9.1%) in the short-term storage group and 1213 (8.7%) in the long-term storage group (odds ratio, 1.05; 95% confidence interval [CI], 0.95 to 1.16; P=0.34). When the analysis was expanded to include the 24,736 patients with any blood type, the results were similar, with rates of death of 9.1% and 8.8%, respectively (odds ratio, 1.04; 95% CI, 0.95 to 1.14; P=0.38). Additional results were consistent in three prespecified high-risk subgroups (patients undergoing cardiovascular surgery, those admitted to intensive care, and those with cancer).

Conclusions Among patients in a general hospital population, there was no significant difference in the rate of death among those who underwent transfusion with the freshest available blood and those who underwent transfusion according to the standard practice of transfusing the oldest available blood. (Funded by the Canadian Institutes of Health Research and others; INFORM Current Controlled trials number, ISRCTN08118744 .).

J Trauma Acute Care Surg. 2016 Oct;81(4):765-74.

Presumptive antibiotic therapy for civilian trauma injuries.

Hopkins TL, Daley MJ, Rose DT, Jaso TC, Brown CV.

QUOTE:

CONCLUSIONS
"Presumptive treatment in trauma injuries represents a unique role for antibiotic therapy, owing to the occurrence of bacterial contamination prior to the administration of antibiotics. The emergent nature of trauma injuries leads to many challenges with regard to antimicrobial therapy, particularly involving dosing and timing of antibiotics and the limited data indicating optimal duration for presumptive treatment. While evidence from randomized controlled trials is sparse for most types of trauma injury, there is a clear role to presumptive antibiotics in this setting. Balancing the benefits associated with presumptive antibiotic therapy with the risks associated with unnecessary antibiotic use is a challenge best met by limiting the antibiotic use to the minimum duration supported by evidence from well-designed studies."

Mil Med. 2016 Aug;181(8):e945-7. doi: 10.7205/MILMED-D-15-00046.

Consider Autotransfusion in the Field.

Hulsebos H, Bernard J.

ABSTRACT:
Massive hemothorax is a life-threatening condition that can present as hemorrhagic shock, cardiogenic shock, or elements of both. It is described by the American College of Surgeons, in the 9th Edition of Advanced Trauma Life Support, as a rapid accumulation of more than 1,500 mL of blood or one-third or more of the patient's blood volume. The use of autotransfusion systems has been implemented for the treatment of hemothorax in hospital settings. The implementation of autotransfusion has been documented in situations where an extended period can elapse before definitive treatment can occur. This article is the first described case where an autotransfusion system has been implemented in a prehospital setting, at a Role 1 medical facility, for massive hemothorax in Afghanistan.

J Urol. 2016 Aug 6. [Epub ahead of print]

Epidemiology of Genitourinary Injuries among Male U.S. Service Members Deployed to Iraq and Afghanistan: Early Findings from the Trauma Outcomes and Urogenital Health (TOUGH) Project.

Janak JC, Orman JA, Soderdahl DW, Hudak SJ.

PURPOSE: In this study we report the number, nature and severity of genitourinary injuries among male U.S. service members deployed to Operations Iraqi Freedom and Enduring Freedom.

MATERIALS AND METHODS: This retrospective cross-sectional study of the Department of Defense Trauma Registry used ICD-9-CM codes to identify service members with genitourinary injuries, and used Abbreviated Injury Scale codes to determine injury severity, genitourinary organs injured and comorbid injuries.

RESULTS: From October 2001 to August 2013, 1,367 male U.S. service members sustained 1 or more genitourinary injuries. The majority of injuries involved the external genitalia (1,000, 73.2%), including the scrotum (760, 55.6%), testes (451, 33.0%), penis (423, 31%) and/or urethra (125, 9.1%). Overall more than a third of service members with genitourinary injury sustained at least 1 severe genitourinary injury (502, 36.7%). Loss of 1 or both testes was documented in 147 men, including 129 (9.4%) unilateral orchiectomies and 17 (1.2%) bilateral orchiectomies. Common comorbid injuries included traumatic brain injury (549, 40.2%), pelvic fracture (341, 25.0%), colorectal injury (297, 21.7%) and lower extremity amputations (387, 28.7%).

CONCLUSIONS: An unprecedented number of U.S. service members sustained genitourinary injury while deployed to Operation Iraqi Freedom/Operation Enduring Freedom. Further study is needed to describe the long-term impact of genitourinary injury and determine the potential need for novel treatments to improve sexual, urinary and/or reproductive function among service members with severe genital injury.

J Trauma Acute Care Surg. 2016 Nov;81(5 Suppl 2 Proceedings of the 2015 Military Health System Research Symposium):S75-S76.

Origins and importance of the joint trauma system

Jenkins DH, Bailey JA

Quotes:

"Experience in Vietnam with rapid evacuation and early surgical care led to the development of trauma centers in the United States. Soon afterward in the 1970s, it was realized by the surgeons who came out of Vietnam that a system of care would need to be put in place to make sure that every injured person got the care that he/she needed in the place where it was available in the time needed to save his/her life. The military did not adopt such a system and therefore began the wars in Iraq and Afghanistan without an organized trauma system."

"The impact of the development of a DoDTS has been heralded as the seminal battlefield innovation in a decade of war as acknowledged by the Military Health System. This effort to identify all areas for opportunity to improve outcomes and to improve care communicated directly and frequently to those providing that care in the combat zone has led to the lowest death rate of injured troops in combat in human history. Lessons learned in combat from the use of tourniquets for badly injured extremities to stop the bleeding to what type of blood products and in what proportion to transfuse to injured troops have now been adopted from the military into the civilian community in a way not seen since Vietnam. There are many additional lessons to be learned and to be shared over the next decade as the DoDTS is further analyzed, and we understand all of the outcomes of the injured troops over time. Those issues would include things such as posttraumatic stress disorder and mild traumatic brain injury (concussion) that will affect injured troops likely for the rest of their lives.(4)"

Wilderness Environ Med. 2016 Dec;27(4):500-503.

Improvised Cricothyrotomy on a Mountain Using Hiking Gear.

Johnson CA, Goodwine DS, Passier I.

CASE REPORT:
We present a case of a 57-year-old man who fell while climbing a mountain in California and sustained severe facial trauma. Three firefighters and 2 emergency physicians witnessed the fall and resuscitated the patient. The patient ultimately required a surgical cricothyrotomy performed with a pocket knife and Platypus hydration pack. The physicians made a makeshift positive pressure airway device using the Platypus hydration pack. We believe this is the first case report describing an improvised cricothyrotomy performed in the wilderness using only hiking gear. This report also discusses indications for cricothyrotomy, the challenges of resuscitation in a low-resource environment, and special considerations in a high-altitude setting.

HPB (Oxford). 2016 Dec;18(12):991-999.

Major liver resection, systemic fibrinolytic activity, and the impact of tranexamic acid.

Karanicolas PJ, Lin Y, Tarshis J, Law CH, Coburn NG, Hallet J, Nascimento B, Pawliszyn J, McCluskey SA.

BACKGROUND: Hyperfibrinolysis may occur due to systemic inflammation or hepatic injury that occurs during liver resection. Tranexamic acid (TXA) is an antifibrinolytic agent that decreases bleeding in various settings, but has not been well studied in patients undergoing liver resection.

METHODS: In this prospective, phase II trial, 18 patients undergoing major liver resection were sequentially assigned to one of three cohorts: (i) Control (no TXA); (ii) TXA Dose I - 1 g bolus followed by 1 g infusion over 8 h; (iii) TXA Dose II - 1 g bolus followed by 10 mg/kg/hr until the end of surgery. Serial blood samples were collected for thromboelastography (TEG), coagulation components and TXA concentration.

RESULTS: No abnormalities in hemostatic function were identified on TEG. PAP complex levels increased to peak at 1106 μg/L (normal 0-512 μg/L) following parenchymal transection, then decreased to baseline by the morning following surgery. TXA reached stable, therapeutic concentrations early in both dosing regimens. There were no differences between patients based on TXA.

CONCLUSIONS: There is no thromboelastographic evidence of hyperfibrinolysis in patients undergoing major liver resection. TXA does not influence the change in systemic fibrinolysis; it may reduce bleeding through a different mechanism of action. Registered with ClinicalTrials.gov: NCT01651182.

J Trauma Acute Care Surg. 2016 Jul;81(1):42-9.

Influences of limited resuscitation with plasma or plasma protein solutions on hemostasis and survival of rabbits with noncompressible hemorrhage.

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

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

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

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

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

Am J Emerg Med. 2016 Oct 5.

The impact of preinjury antithrombotic medication on hemostatic interventions in trauma patients: an observational study in Japan.

Kudo D, Kushimoto S, Shiraishi A, Ogura H, Hagiwara A, Saitoh D; J-OCTET Investigators.

PURPOSE: The purpose of this study was to determine whether preinjury medication with antithrombotic agents was related to an increase in hemostatic interventions in patients with severe trauma without traumatic brain injury.

METHODS: Consecutive trauma patients who were admitted to the emergency departments of the study hospitals with an injury severity score ≥16 were enrolled in this retrospective, observational, multicenter study of coagulation in the acute phase of severe trauma. Patients without a traumatic brain injury with an abbreviated injury scale ≥3 were evaluated. Patients were divided into those with and those without preinjury medication with antithrombotic agents. The impact of preinjury antithrombotic medication on the composite primary outcome, defined as administration of fresh frozen plasma ≥10 U and/or hemostatic treatment (surgery and/or interventional radiology) within 24 hours, was analyzed.

RESULTS: The preinjury medication group consisted of 20 (6.4%) of the total 312 patients. Preinjury medication was one of the independent risk factors for the composite outcome (odds ratio, 3.16; 95% confidence interval, 1.08-9.10; $P < .05$) adjusting for age, sex, and injury severity score on multivariate analysis. Preinjury antithrombotic therapy was also associated with hemostatic treatments within 24 hours (odds ratio, 3.40; 95% confidence interval, 1.16-9.85; $P = .026$). Survival time was not different between the 2 groups on Cox regression analysis.

CONCLUSIONS: Preinjury antithrombotic medication in severe trauma patients without traumatic brain injury may be associated with a higher risk of hemostatic interventions.

Scand J Trauma Resusc Emerg Med. 2016 Oct 10;24(1):122.

The pre-hospital administration of tranexamic acid to patients with multiple injuries and its effects on rotational thrombelastometry: a prospective observational study in pre-hospital emergency medicine.

Kunze-Szikszay N, Krack LA, Wildenauer P, Wand S, Heyne T, Walliser K, Spering C, Bauer M, Quintel M, Roessler M.

BACKGROUND: Hyperfibrinolysis (HF) is a major contributor to coagulopathy and mortality in trauma patients. This study investigated (i) the rate of HF during the pre-hospital management of patients with multiple injuries and (ii) the effects of pre-hospital tranexamic acid (TxA) administration on the coagulation system.

METHODS: From 27 trauma patients with pre-hospital an estimated injury severity score (ISS) ≥16 points blood was obtained at the scene and on admission to the emergency department (ED). All patients received 1 g of TxA after the first blood sample was taken. Rotational thrombelastometry (ROTEM) was performed for both blood samples, and the results were compared. HF was defined as a maximum lysis (ML) >15 % in EXTEM.

RESULTS: The median (min-max) ISS was 17 points (4-50 points). Four patients (15 %) had HF diagnosed via ROTEM at the scene, and 2 patients (7.5 %) had HF diagnosed via ROTEM on admission to the ED. The median ML before TxA administration was 11 % (3-99 %) vs. 10 % after TxA administration (4-18 %; $p > 0.05$). TxA was administered 37 min (10-85 min) before ED arrival. The ROTEM results before and after TxA administration did not significantly differ. No adverse drug reactions were observed after TxA administration.

DISCUSSION: HF can be present in severely injured patients during pre-hospital care. Antifibrinolytic therapy administered at the scene is a significant time saver. Even in milder trauma fibrinogen can be decreased to critically low levels. Early administration of TxA cannot reverse or entirely stop this decrease.

CONCLUSIONS: The pre-hospital use of TxA should be considered for severely injured patients to prevent the worsening of trauma-induced coagulopathy and unnecessarily high fibrinogen consumption.

TRIAL REGISTRATION: ClinicalTrials.gov ID NCT01938768 (Registered 5 September 2013).

Prehosp Emerg Care. 2016 Sep-Oct;20(5):648-56.

Subcutaneous Fentanyl Administration: A Novel Approach for Pain Management in a Rural and Suburban Prehospital Setting.

Lebon J, Fournier F, Bégin F, Hebert D, Fleet R, Foldes-Busque G, Tanguay A.

OBJECTIVE: To determine the feasibility, safety, and effectiveness of the subcutaneous route of fentanyl administration by Basic Life Support-Emergency Medical Technicians (BLS-EMT) in a rural and suburban region, with the support of an online pain management medical control center.

METHODS: Retrospective study of patients who received subcutaneous fentanyl and were transported by BLS-EMT to the emergency department (ED) of an academic hospital between July 1, 2013 and January 1, 2014, inclusively. Fentanyl orders were obtained from emergency physicians via an online medical control (OLMC) center. Effectiveness was defined by changes in pain scores 15 minutes, 30 minutes, and 45+ minutes after initial fentanyl administration. Safety was evaluated by measuring vital signs, Ramsay sedation scores, and adverse events subsequent to fentanyl administration. Feasibility was defined as successful fentanyl administration by BLS-EMT. SPSS-20 was used for descriptive statistics, and independent t-tests and Mann-Whitney U tests were used to determine inter- and intra-group differences based on transport time.

RESULTS: Two hundred and eighty-eight patients (288; 14 to 93 years old) with pain scores ≥7 were eligible for the study. Of the 284 (98.6%) who successfully received subcutaneous fentanyl, 35 had missing records or data, and 249 (86.5%) were included in analyses. Average pain score pre-fentanyl was 8.9 ± 1.1. Patients <70 years old received a higher dose of fentanyl than those ≥70 years old (1.4 ± 0.3 vs, 0.8 ± 0.2 mcg/kg, $p < 0.05$). Pain scores decreased significantly post-fentanyl administration and the proportion of patients achieving pain relief increased significantly ($p < 0.05$) over the course of transport to ED (15 minutes, 30 minutes, 45+ minutes). Only 1.6% of patients experienced adverse events, including hypotension (n = 2; 0.8%), nausea (n = 1; 0.4%), and Ramsay level >3 (n = 1; 0.4%).

CONCLUSION: Prehospital subcutaneous fentanyl administration by BLS-EMT with the support of an OLMC center is a safe and feasible approach to pain relief in prehospital settings, and is not associated with major adverse events. Effectiveness, subsequent to subcutaneous fentanyl administration is characterized by a decrease in pain over the course of transport to ED. Further studies are needed to compare the effectiveness of SC administration by EMS with other routes of administration and other analgesics.

J Trauma Acute Care Surg. 2016 Sep;81(3):441-4.

A multi-institutional study of hemostatic gauze and tourniquets in rural civilian trauma.

Leonard J, Zietlow J, Morris D, Berns K, Eyer S, Martinson K, Jenkins D, Zietlow S.

BACKGROUND: Life-threatening hemorrhage is a leading cause of preventable mortality in trauma patients. Since publication of the Hartford Consensus statement, there has been intense interest in civilian use of commercial hemostatic gauze and tourniquets. Although the military has studied their use on soldiers with wartime injuries, there are limited data on patient outcomes following civilian prehospital use and no data on the use in rural trauma.

METHODS: We performed a multi-institutional retrospective analysis of clinical outcomes following prehospital use of QuikClot combat gauze (QC) and combat application tourniquets (CATs) from 2009 to 2014. The primary outcome measured was effectiveness. Secondary outcomes included morbidity, mortality, patients' demographics, injury characteristics, and hospital outcomes.

RESULTS: Between 2009 and 2014, 95 patients were managed by prehospital personnel with QC and/or CAT. Forty received QC, 61 received CAT, and 6 received both products. The median age was 40 years (6-91 years), 29% were female, and the median injury severity score was 7 (1-25). QuikClot combat gauze was 89% effective. Minimal morbidity was associated with QC use. Combat application tourniquet was 98% effective. Median tourniquet time was 21 minutes (6-142 minutes), the median injury severity score was 9 (1-50), and mortality was 9.8%. Morbidities observed with tourniquet use included amputation, fasciotomy, rhabdomyolysis, and acute kidney injury. Risk of amputation was associated with higher injury severity ($p = 0.04$) but not with elderly age, obesity, or the presence of medical comorbidities. No amputations resulted solely from the use of tourniquets.

CONCLUSIONS: QuikClot combat gauze and CAT are safe and effective adjuncts for hemorrhage control in the rural civilian trauma across a wide range of injury patterns. In a rural civilian population including women, children, and elderly patients with medical comorbidities, these devices are associated with minimal morbidity beyond that of the original injury.

LEVEL OF EVIDENCE: Therapeutic study, level V.

Eur Spine J. 2016 Sep 26. [Epub ahead of print]

Efficacy of antifibrinolytic agents on surgical bleeding and transfusion requirements in spine surgery: a meta-analysis.

Li G, Sun TW, Luo G, Zhang C

PURPOSE: Spine surgery is usually associated with large amount of blood loss and blood transfusion. Excessive blood loss may cause hypotension, inadequate oxygenation of organs, necessitate allogeneic blood transfusion, and spinal epidural hematoma formation. Aprotinin, TXA, and EACA are antifibrinolytics currently offered as prophylactic agents to reduce surgery-associated blood loss. The purpose of this study was to assess the efficacy of using antifibrinolytic agents in reducing blood loss and blood transfusions in spine surgery.

METHODS: PubMed, Embase, and Cochrane-controlled trials register were used to identify RCTs published before April 2015 that examined the effectiveness of intravenous aprotinin, tranexamic acid (TXA), and epsilon-aminocaproic acid (EACA) on reduction of blood loss and blood transfusions, compared with placebo in spine surgery. Randomized controlled trials reported the primary outcome that included total blood loss, intra-operative blood loss, post-operative blood loss, blood transfusion requirements, blood transfusion rate, and incidence of deep vein thrombosis. Meta-analysis was performed using the Stata12.0. Weighted mean difference with 95 % confidence intervals was used to summarize the findings across the trials for continuous outcomes. Dichotomous data were expressed as risk ratios with 95 % confidence intervals. A $P < 0.05$ was considered statistically significant.

RESULTS: 17 studies involving 1191 patients were identified. Among them, 13 RCTs with 943 patients were included for the evaluation of total blood loss. Compared with the control group, the antifibrinolytic agents reduced total blood loss (SMD = -0.62; 95 % CI -0.75, -0.48; P = 0.000), The aprotinin group (SMD = -0.80; 95 % CI -1.22, -0.37; P = 0.938), The TXA group (SMD = -0.75; 95 % CI -0.93, -0.57; P = 0.000), and the EACA group (SMD = -0.28; 95 % CI -0.54, -0.01; P = 0.185). Thirteen RCTs with eight hundred and ninety four patients were included for the evaluation of intra-operative blood loss. Compared with the control group, the antifibrinolytic agents reduced intra-operative blood loss (SMD = -0.41; 95 % CI -0.55, -0.28; P = 0.010), The aprotinin group (SMD = -0.62; 95 % CI -0.93, -0.30; P = 0.862), The TXA group (SMD = -0.47; 95 % CI -0.64, -0.29; P = 0.005), and the EACA group (SMD = -0.16; 95 % CI -0.42, -0.11; P = 0.897). Eight RCTs with six hundred and seven patients were included for the evaluation of post-operative blood loss. Compared with the control group, the antifibrinolytic agents reduced post-operative blood loss (SMD = -0.68; 95 % CI -0.85, -0.51; P = 0.000), the aprotinin group (SMD = -0.48; 95 % CI -0.85, -0.12; P = 0.036), the TXA group (SMD = -0.80; 95 % CI -1.01, -0.59; P = 0.000), and the EACA group (SMD = -0.32; 95 % CI -0.68, -0.04; P = 0.009). Ten RCTs with seven hundred and twenty twopatients were included for the evaluation of blood transfusion. Compared with the control group, the antifibrinolytic agents reduced blood transfusion (SMD = -0.68; 95 % CI -0.85, -0.51; P = 0.000), the aprotinin group (SMD = -0.80; 95 % CI -1.22, -0.37; P = 0.938), the TXA group (SMD = -0.38; 95 % CI -0.58, -0.18; P = 0.000), and the EACA group (SMD = -0.28; 95 % CI -0.54, -0.01; P = 0.185). Twelve RCTs with eight

hundred and fifteenpatients were included for the evaluation of blood transfusion rate. The transfusion rate was 35.6 % in the patients with antifibrinolytic agents and 55.2 % in the patients with placebo (RR = 0.75; 95 % CI 0.63, 0.89; P = 0.939). All studies were included for the evaluation of safety, with a total of eight thromboembolic events reported overall (two in the experimental group and six in the control group).

CONCLUSIONS: The antifibrinolytic agents were able to reduce perioperative blood loss and transfusion requirements in spine surgery. TXA appeared more effective than aprotinin and EACA in reducing total blood loss, intra-operative blood loss, and blood transfusion according to the results of this analysis. The three groups in reducing the post-operative blood loss are significantly better than control groups. There was no evidence that the use of antifibrinolytic agents was a risk factor for thromboembolism in spine surgery. Further multicenter, large-sample, double-blind RCTs are required to confirm the efficacy and safety of the three antifibrinolytic agents in spine surgery.

Singapore Med J. 2016 Aug;57(8):432-7.

Comparison of the clinical performance of i-gel, LMA Supreme and LMA ProSeal in elective surgery.

Liew GH, Yu ED, Shah SS, Kothandan H.

INTRODUCTION: The LMA Supreme™, i-gel® and LMA ProSeal™ are second-generation supraglottic airway devices. We tested the hypothesis that these devices differ in performance when used for spontaneous ventilation during anaesthesia.

METHODS: 150 patients who underwent general anaesthesia for elective surgery were randomly allocated into three groups. Data was collected on oropharyngeal leak pressures, ease and duration of device insertion, ease of gastric tube insertion, and airway safety.

RESULTS: Leak pressure, our primary outcome measure, was found to be higher for the i-gel than the Supreme and ProSeal (mean ± standard error of the mean: 27.31 ± 0.92 cmH2O, 23.60 ± 0.70 cmH2O and 24.44 ± 0.70 cmH2O, respectively; p = 0.003). Devices were inserted on the first attempt for 90%, 82% and 72% of patients in the i-gel, Supreme and ProSeal groups, respectively (p = 0.105); mean device placement times were 23.58 seconds, 25.10 seconds and 26.34 seconds, respectively (p = 0.477). Gastric tubes were inserted on the first attempt in 100% of patients in the Supreme group, and 94% of patients in the i-gel and ProSeal groups (p = 0.100). There was blood staining on removal in 9 (18%) patients in each of the Supreme and ProSeal groups, with none in the i-gel group (p = 0.007). The incidence of postoperative sore throat, dysphagia and hoarseness was lowest for the i-gel.

CONCLUSION: The three devices were comparable in terms of ease and duration of placement, but the i-gel had higher initial oropharyngeal leak pressure and lower airway morbidity compared with the ProSeal and Supreme.

J Trauma Acute Care Surg. 2016 Sep;81(3):453-7.

Emergent non-image-guided resuscitative endovascular balloon occlusion of the aorta (REBOA) catheter placement: A cadaver-based study.

Linnebur M, Inaba K, Haltmeier T, Rasmussen TE, Smith J, Mendelsberg R, Grabo D, Demetriades D.

BACKGROUND: Emergent resuscitative endovascular balloon occlusion of the aorta (REBOA) insertion for critically injured patients in hemorrhagic shock is performed blindly with fluoroscopic imaging confirmation. The aim of this study was to determine a reliable method for initial REBOA catheter insertion with balloon deployment between the left subclavian artery takeoff and the celiac trunk (CT).

METHODS: Human cadaver study. External surface (sternal notch, mid-sternum, xiphoid) and intravascular (left subclavian artery [LSA], and CT) landmarks were measured from standardized left and right common femoral artery puncture sites. The landing zone (LZ, distance between LSA and CT) and margins of safety (distance from distal balloon edge to LSA and proximal balloon edge to CT) were calculated using intravascular landmarks. The probability of balloon deployment in the LZ using external landmarks was compared in univariate analysis using the Fisher exact test.

RESULTS: Ten cadavers were analyzed (seven males; mean body mass index, 19.4 kg/m). Mean (SD) intravascular distances from femoral puncture sites to the LSA and CT were 54.8 (1.9) cm and 32.9 (1.9) cm. The mean (SD) LZ was 21.8 (3.8) cm. Mean (SD) surface distances from femoral puncture sites to the xiphoid, mid-sternum, and sternal notch were 31.8 (3.9) cm, 41.8 (3.3) cm, and 51.8 (3.2) cm. Inserting the catheter to a distance approximated by surface distance from the femoral puncture site to mid-sternum resulted in a 100% likelihood balloon deployment in the LZ for both sides. This was superior to the xiphoid and sternal notch (left site, $p = 0.005$; right site, $p = 0.036$; mean of both sites, $p = 0.083$). Using the mid-sternum landmark, the mean (SD) margins of safety to the LSA and CT were 10.7 (4.3) cm and 3.1 (3.4) cm.

CONCLUSION: When using the use of the mid-sternum landmark for REBOA balloon placement, the likelihood of balloon deployment in the LZ was 100% with an acceptable margin of safety.

J Trauma Acute Care Surg. 2016 Nov;81(5 Suppl 2 Proceedings of the 2015 Military Health System Research Symposium):S111-S115.

Machine learning and new vital signs monitoring in civilian en route care: A systematic review of the literature and future implications for the military.

Liu NT, Salinas J.

BACKGROUND: Although air transport medical services are today an integral part of trauma systems in most developed countries, to date, there are no reviews on recent innovations in civilian en route care. The purpose of this systematic review was to identify potential machine learning and new vital signs monitoring technologies in civilian en route care that could help close civilian and military capability gaps in monitoring and the early detection and treatment of various trauma injuries.

METHODS: MEDLINE, the Cochrane Database of Systematic Reviews, and citation review of relevant primary and review articles were searched for studies involving civilian en route care, air medical transport, and technologies from January 2005 to November 2015. Data were abstracted on study design, population, year, sponsors, innovation category, details of technologies, and outcomes.

RESULTS: Thirteen observational studies involving civilian medical transport met inclusion criteria. Studies either focused on machine learning and software algorithms (n = 5), new vital signs monitoring (n = 6), or both (n = 2). Innovations involved continuous digital acquisition of physiologic data and parameter extraction. Importantly, all studies (n = 13) demonstrated improved outcomes where applicable and potential use during civilian and military en route care. However, almost all studies required further validation in prospective and/or randomized controlled trials.

CONCLUSION: Potential machine learning technologies and monitoring of novel vital signs such as heart rate variability and complexity in civilian en route care could help enhance en route care for our nation's war fighters. In a complex global environment, they could potentially fill capability gaps such as monitoring and the early detection and treatment of various trauma injuries. However, the impact of these innovations and technologies will require further validation before widespread acceptance and prehospital use.

LEVEL OF EVIDENCE: Systematic review, level V.

J Trauma Acute Care Surg. 2016 Nov;81(5 Suppl 2 Proceedings of the 2015 Military Health System Research Symposium):S104-S110.

Combat MEDEVAC: A comparison of care by provider type for en route trauma care in theater and 30-day patient outcomes.

Maddry JK, Mora AG, Savell S, Reeves LK, Perez CA, Bebarta VS.

BACKGROUND: Medical evacuation (MEDEVAC) is the movement and en route care of injured and medically compromised patients by medical care providers via helicopter. Military MEDEVAC platforms provide lifesaving interventions that improve survival in combat. There is limited evidence to support decision making related to en route care and allocation of resources. The association between provider type and en route care is not well understood. Our objective was to describe MEDEVAC providers and identify associations between provider type, procedures performed, and outcomes.

METHODS: We conducted an institutional review board-approved, retrospective record review of patients traumatically injured in combat, evacuated by MEDEVAC from the point of injury, between 2011 and 2014. Data abstracted included injury description, provider type, procedures performed, medications administered, survival, and 30-day outcomes. Subjects were grouped according to provider type: medics, paramedics, and ADVs (advanced-level providers to include nurses, physician assistants, and physicians). Groups were compared. Analyses were performed using χ tests for categorical variables and analysis of variance tests (Kruskal-Wallis tests) for continuous variables; $p < 0.05$ was considered significant.

RESULTS: The MEDEVAC records were reviewed, and data were abstracted from 1,237 subjects. The providers were composed of medics, 76%; paramedics, 21%; and ADVs, 4%. Patient and injury demographics were similar among groups. The ADVs were most likely to perform intubation, chest needle decompressions ($p < 0.0001$), and hypothermia prevention ($p = 0.01$). Paramedics were most likely to administer blood en route ($p < 0.0001$). All other procedures were similar between groups. Paramedics were most likely to administer ketamine ($p < 0.0001$), any analgesic ($p < 0.0001$), or any medication en route ($p < 0.0001$). Incidence rates of en route events (pain, hypoxia, abnormal hemodynamics, vital signs) were similar between provider types. In-theater and 30-day survival rates were similar between provider types.

CONCLUSION: Providers with higher-level training were more likely to perform more advanced procedures during en route care. Our study found no significant association between provider type and in-theater or 30-day mortality rates. Upon subgroup analysis, no difference was found in patients with an injury severity score greater than 16. More evidence is needed to determine the appropriate level of MEDEVAC personnel training and skill maintenance necessary to minimize combat mortality.

LEVEL OF EVIDENCE: Therapeutic study, level III.

BMJ. 2016 Sep 28;354:i4814. doi: 10.1136/bmj.i4814.

Does tranexamic acid improve outcomes in traumatic brain injury?

Mahmood A, Roberts I, Shakur H, Harris T, Belli A.

Quote:

"A substudy conducted within the CRASH-3 trial will use computed tomography scans to examine the effect of tranexamic acid on intracranial bleeding and thrombosis. These scans can detect traumatic haemorrhage (high attenuation) in the acute stage of traumatic brain injury. Ischaemic lesions (low attenuation) are visible on a computed tomography scan done several hours after injury. This substudy will provide information on the effect of tranexamic acid on intracranial haemorrhage and ischaemia and whether this varies by time to treatment.

Further research
Randomised trials looking at the effect of tranexamic acid in patients with isolated traumatic brain injury are currently ongoing. These trials will address the uncertainty of whether tranexamic acid improves outcomes in patients with traumatic brain injury. At this stage we do not make recommendations for further research in this area.

What should we do in light of the uncertainty?
The authors recommend that patients with isolated traumatic brain injury should not receive tranexamic acid outside the context of a randomised trial, and clinicians should consider enrolling their patients in one of the relevant trials wherever possible."

J Spec Oper Med. 2016 Fall;16(3):93-96.

A Case of Prehospital Traumatic Arrest in a US Special Operations Soldier: Care From Point of Injury to Full Recovery.

McKenzie MR, Parrish EW, Miles EA, Spradling JC, Littlejohn LF, Quinlan MD, Barbee GA, King DR.

Case Report:
During an assault on an extremely remote target, a US Special Operations Soldier sustained multiple gunshot and fragmentation wounds to the thorax, resulting in a traumatic arrest and subsequent survival. His care, including Care Under Fire, Tactical Field Care, Tactical Evacuation Care, and Role III, IV, and V care, is presented. The case is used to illustrate the complex dynamics of Special Operations care on the modern battlefield and the exceptional outcomes possible when evidence-based medicine is taken to the warfighter with effective, far-forward, expeditionary medical-force projection.

J Spec Oper Med. 2016 Fall;16(3):41-46.

Evaluation of Two Junctional Tourniquets Used on the Battlefield: Combat Ready Clamp® versus SAM® Junctional Tourniquet.

Meusnier JG, Dewar C, Mavrovi E, Caremil F, Wey PF, Martinez JY.

BACKGROUND: Junctional hemorrhages (i.e., between the trunk and limbs) are too proximal for a tourniquet and difficult to compress. These hemorrhages are responsible for 20% of preventable deaths by bleeding on the battlefield. The majority of these involve the groin area. Devices allowing a proximal compression for arterial axes have been recently developed.

OBJECTIVE: The purpose of this study was to compare the use of two junctional-tourniquet models, the Combat Ready Clamp (CRoC®) and the SAM® Junctional Tourniquet (SJT), in simulated out-of-hospital trauma care when tourniquets were ineffective to stop the arterial flow.

METHODS: During our clinical study, 84 healthy volunteers wearing battle dress performed a physical exercise to come approximate the operational context. The volunteers were randomly divided into two groups according to the device (the CRoC or SJT) used as supplement to a tourniquet self-applied to the root of the thigh. The primary study end point was the complete interruption of popliteal arterial flow, measured with Doppler auscultation. Time to effectiveness and subjective questionnaire data to evaluate the devices' application were also collected.

RESULTS: Junctional device effectiveness was almost 90% for both the CRoC and the SJT, and did not differ between them, either used with a tourniquet ($\rho = .36$) or alone ($\rho = .71$). The time to effectiveness of the SJT was significantly shorter than that of the CRoC ($\rho = .029$).

CONCLUSION: The SJT and the CRoC were equally effective. The SJT was faster to apply and preferred by the users. Our study provides objective evidence to the French Tactical Casualty Care Committee for improving junctional hemorrhage treatment.

J Clin Anesth. 2016 Sep;33:298-305.

Laryngeal mask airway ProSeal provides higher oropharyngeal leak pressure than i-gel in adult patients under general anesthesia: a meta-analysis.

Maitra S, Baidya DK, Arora MK, Bhattacharjee S, Khanna P.

STUDY OBJECTIVE: i-gel is a single-use supraglottic airway device that has a gastric drain tube similar to laryngeal mask airway (LMA) ProSeal. Randomized trials, when compared i-gel with LMA ProSeal, reported a differing results. Primary objective of this study is to compare LMA ProSeal and i-gel in terms of oropharyngeal leak pressure.

DESIGN: Meta-analysis of randomized controlled trials where i-gel has been compared to LMA ProSeal in adult airway management during general anesthesia.

SETTING: Teaching institutions.

MEASUREMENTS: PubMed, PubMed Central, and Cochrane databases were searched with search words "i-gel," "i-gel laryngeal mask airway," "i-gel ProSeal," and "i-gel LMA ProSeal" to find out the randomized controlled trials that compared i-gel with LMA ProSeal in terms of safety and efficacy. A total of 10 prospective randomized trials have been included in this meta analysis.

MAIN RESULTS: LMA ProSeal provides higher oropharyngeal leak pressure than i-gel (mean difference, 3.37 cm H2O; 95% confidence interval, 1.80-4.95 cm H2O; P< .0001). Time to insert the device, first insertion success rate, and ease of gastric tube insertion are similar with both the devices, but i-gel may be easier to insert. Although the reported complications are not frequent and not very serious, a significantly higher blood staining on the mask has been noted with LMA ProSeal (odds ratio, 0.27; 95% confidence interval, 0.13-0.56; P= .0004).

CONCLUSION: LMA ProSeal may still remain the supraglottic device of choice over i-gel in adult patients during general anesthesia as it provided better seal against leak pressure with comparable device insertion characteristics.

J Med Case Rep. 2016 Oct 19;10(1):294.

Acute transfusion-related abdominal injury in trauma patients: a case report.

Michel P, Wähnert D, Freistühler M, Laukoetter MG, Rehberg S, Raschke MJ, Garcia P.

BACKGROUND: Secondary abdominal compartment syndrome is well known as a life-threatening complication in critically ill patients in an intensive care unit. Massive crystalloid fluid resuscitation has been identified as the most important risk factor. The time interval from hospital admittance to the development of manifest abdominal compartment syndrome is usually greater than 24 hours. In the absence of any direct abdominal trauma, we observed a rapidly evolving secondary abdominal compartment syndrome shortly after hospital admittance associated with massive transfusion of blood products and only moderate crystalloid resuscitation.

CASE PRESENTATION: We report the case of an acute secondary abdominal compartment syndrome developing within 3 to 4 hours in a 74-year-old polytraumatized white woman. Although multiple fractures of her extremities and a B-type pelvic ring fracture were diagnosed by a full body computed tomography scan, no intra-abdominal injury could be detected. Hemorrhagic shock with a drop in her hemoglobin level to 5.7 g/dl was treated by massive transfusion of blood products and high doses of catecholamines. Shortly afterwards, her pulmonary gas exchange progressively deteriorated and mechanical ventilation became almost impossible with peak airway pressures of up to 60 cmH2O. Her abdomen appeared rigid and tense accompanied by a progressive hemodynamic decompensation necessitating mechanic cardiopulmonary resuscitation. Although preoperative computed tomography scans showed no signs of intra-abdominal fluid, a decompressive laparotomy under cardiopulmonary resuscitation conditions was performed and 2 liters of ascites-like fluid disgorged. Her hemodynamics and pulmonary ventilation improved immediately.

CONCLUSIONS: This case report describes for the first time acute secondary abdominal compartment syndrome in a trauma patient, evolving in a very short time period. We hypothesize that the massive transfusion of blood products along with high doses of catecholamines triggered the acute development of abdominal compartment syndrome. Trauma teams need to consider a rapidly developing secondary abdominal compartment syndrome to be a potential cause of hemodynamic decompensation not only in the later phase of treatment but also in the emergency phase of treatment.

J Trauma Acute Care Surg. 2016 Oct;81(4):685-91.

Effect of time to operation on mortality for hypotensive patients with gunshot wounds to the torso: The golden 10 minutes.

Meizoso JP, Ray JJ, Karcutskie CA 4th, Allen CJ, Zakrison TL, Pust GD, Koru-Sengul T, Ginzburg E, Pizano LR, Schulman CI, Livingstone AS, Proctor KG, Namias N.

INTRODUCTION: Timely hemorrhage control is paramount in trauma; however, a critical time interval from emergency department arrival to operation for hypotensive gunshot wound (GSW) victims is not established. We hypothesize that delaying surgery for more than 10 minutes from arrival increases all-cause mortality in hypotensive patients with GSW.

METHODS: Data of adults (n = 309) with hypotension and GSW to the torso requiring immediate operation from January 2004 to September 2013 were retrospectively reviewed. Patients with resuscitative thoracotomies, traumatic brain injury, transfer from outside institutions, and operations occurring more than 1 hour after arrival were excluded. Survival analysis using multivariate Cox regression models was used for comparison. Hazard ratios (HRs) and 95% confidence intervals (CIs) are reported. Statistical significance was considered at $p \leq 0.05$.

RESULTS: The study population was aged 32 ± 12 years, 92% were male, Injury Severity Score was 24 ± 15, systolic blood pressure was 81 ± 29 mm Hg, Glasgow Coma Scale score was 13 ± 4. Overall mortality was 27%. Mean time to operation was 19 ± 13 minutes. After controlling for organ injury, patients who arrived to the operating room after 10 minutes had a higher likelihood of mortality compared with those who arrived in 10 minutes or less (HR, 1.89; 95% CI, 1.10-3.26; p = 0.02); this was also true in the severely hypotensive patients with systolic blood pressure of 70 mm Hg or less (HR, 2.67; 95% CI, 0.97-7.34; p = 0.05). The time associated with a 50% cumulative mortality was 16 minutes.

CONCLUSIONS: Delay to the operating room of more than 10 minutes increases the risk of mortality by almost threefold in hypotensive patients with GSW. Protocols should be designed to shorten time in the emergency department. Further prospective observational studies are required to validate these findings.

LEVEL OF EVIDENCE: Therapeutic study, level IV.

Perioper Med (Lond). 2016 Aug 17;5:20.

Coagulation during elective neurosurgery with hydroxyethyl starch fluid therapy: an observational study with thromboelastometry, fibrinogen and factor XIII.

Nilsson CU, Strandberg K, Engström M, Reinstrup P.

BACKGROUND: Several studies have described hypercoagulability in neurosurgery with craniotomy for brain tumor resection. In this study, hydroxyethyl starch (HES) 130/0.42 was used for hemodynamic stabilization and initial blood loss replacement. HES can induce coagulopathy with thromboelastographic signs of decreased clot strength. The aim of this study was to prospectively describe perioperative changes in coagulation during elective craniotomy for brain tumor resection with the present fluid regimen.

METHODS: Forty patients were included. Perioperative whole-blood samples were collected for EXTEM and FIBTEM assays on rotational thromboelastometry (ROTEM) and plasma fibrinogen analysis immediately before surgery, after 1 L of HES infusion, at the end of surgery and in the morning after surgery. Factor (F)XIII activity, thrombin-antithrombin complex (TAT) and plasmin-α2-antiplasmin complex (PAP) were analysed in the 25 patients receiving ≥1 L of HES.

RESULTS: Most patients (37 of 40) received HES infusion (0.5-2 L) during surgery. Preoperative ROTEM clot formation/structure, plasma fibrinogen and FXIII levels were generally within normal range but approached a hypocoagulant state during and at end of surgery. ROTEM variables and fibrinogen levels, but not FXIII, returned to baseline levels in the morning after surgery. Low perioperative fibrinogen levels were common. TAT levels were increased during and after surgery. PAP levels mostly remained within the reference ranges, not indicating excessive fibrinolysis. There were no differences in ROTEM results and fibrinogen levels in patients receiving <1 L HES and ≥1 L HES.

CONCLUSIONS: Only the increased TAT levels indicated an intra- and postoperative activation of coagulation. On the contrary, all other variables deteriorated towards hypocoagulation but were mainly normalized in the morning after surgery. Although this might be an effect of colloid-induced coagulopathy, we found no dose-dependent effect of HES. The unactivated fibrinolysis indicates that prophylactic use of tranexamic acid does not seem warranted under normal circumstances in elective neurosurgery. Individualized fluid therapy and coagulation factor substitution is of interest for future studies.

Mil Med. 2016 Sep;181(9):1069-74.

Dismounted Blast Injuries in Patients Treated at a Role 3 Military Hospital in Afghanistan: Patterns of Injury and Mortality.

Oh JS, Tubb CC, Poepping TP, Ryan P, Clasper JC, Katschke AR, Tuman C, Murray MJ.

BACKGROUND: The purposes of this study are to define the pattern of injuries sustained by dismounted troops exposed to improvised explosive devices blasts treated at a Role 3 combat support hospital and to assess injury patterns and mortality associated with the mechanism. Our hypothesis was that mortality is associated with pelvic fracture, massive transfusion, high Injury Severity Score (ISS), multiple limb amputations, and transfer from a Role 2 facility.

STUDY DESIGN: Retrospective study of 457 patients. Analysis performed on trauma registry data and systematic review of radiographs.

RESULTS: 99.9% were men with a median age of 23 years and median ISS 10. 141 patients (30.9%) required massive blood transfusion. Limb amputations were frequently observed injuries, 109 of 172 amputees (63.4%) had a double amputation. 34 subjects (7.4%) had pelvic fractures; majority of pelvic fractures (88%) were unstable (Tile B or C). Risk factors associated with the overall mortality rate of 1.8% were an ISS greater than 15 (odds ratio: 11.5; 95% confidence interval: 1.38, 533; $p = 0.009$), need for massive transfusion ($p < 0.0001$), and the presence of a pelvic fracture (odds ratio: 7.63; 95% confidence interval: 1.13, 41.3; $p = 0.018$).

CONCLUSIONS: Dismounted improvised explosive devices blast injuries result in devastating multiple limb amputations and unstable pelvic fractures, which are associated with mortality after initial trauma resuscitation at a Role 3 hospital.

Pol J Vet Sci. 2016;19(2):337-43.

Safety of the long-term application of QuikClot Combat Gauze, ChitoGauze PRO and Celox Gauze in a femoral artery injury model in swine - a preliminary study.

Otrocka-Domagała I, Jastrzębski P, Adamiak Z, Paździor-Czapula K, Gesek M, Mikiewicz M, Rotkiewicz T.

ABSTRACT:
The purpose of this study was to examine the safety of the long-term application of QuikClot Combat Gauze, ChitoGauze PRO and Celox Gauze using a swine model. The study was conducted on nine pigs weighing approximately 30 kg, which were randomly divided into three groups. Under deep anesthesia, the pigs underwent complete transverse cutting of the femoral artery in the groin region. Hemostatic dressings were left in the wound for 24 hours. The animals were euthanized 24 hours after dressing application. In each group, macroscopic and microscopic severe changes and shock symptoms were observed in the lungs, liver, kidneys and heart. Fibrino-gaseous embolic material was found in the pulmonary artery of each group and in the lung vessels of the animals from the ChitoGauze PRO and Celox Gauze groups. In conclusion, the long-term application of the evaluated hemostatic dressings has the risk of coagulopathy and reaching the progressive stage of shock. The residues from the hemostatic dressings can ingress into the systemic circulation, thereby increasing the risk of embolus formation. Because of these harmful effects, the evaluated hemostatic dressings are not appropriate for long-term use. Future studies are needed on the consequences of the long-term application of these hemostatic agents.

Injury. 2016 Nov 3. [Epub ahead of print]

Trends in 1029 trauma deaths at a level 1 trauma center: Impact of a bleeding control bundle of care.

Oyeniyi BT, Fox EE, Scerbo M, Tomasek JS, Wade CE, Holcomb JB.

BACKGROUND: Over the last decade the age of trauma patients and injury mortality has increased. At the same time, many centers have implemented multiple interventions focused on improved hemorrhage control, effectively resulting in a bleeding control bundle of care. The objective of our study was to analyze the temporal distribution of trauma-related deaths, the factors that characterize that distribution and how those factors have changed over time at our urban level 1 trauma center.

METHODS: Records at an urban Level 1 trauma center were reviewed. Two time periods (2005-2006 and 2012-2013) were included in the analysis. Mortality rates were directly adjusted for age, gender and mechanism of injury. The Mann-Whitney and chi square tests were used to compare variables between periods, with significance set at 0.05.

RESULTS: 7080 patients (498 deaths) were examined in 2005-2006, while 8767 patients (531 deaths) were reviewed in 2012-2013. The median age increased 6 years, with a similar increase in those who died. In patients that died, no differences by gender, race or ethnicity were observed. Fall-related deaths are now the leading cause of death. Traumatic brain injury (TBI) and hemorrhage accounted for >91% of all deaths. TBI (61%) and multiple organ failure or sepsis (6.2%) deaths were unchanged, while deaths associated with hemorrhage decreased from 36% to 25% ($p<0.01$). Across time periods, 26% of all deaths occurred within one hour of hospital arrival, while 59% occurred within 24h. Unadjusted mortality dropped from 7.0% to 6.1 ($p=0.01$) and in-hospital mortality dropped from 6.0% to 5.0% ($p<0.01$). Adjusted mortality dropped 24% from 7.6% (95% CI: 6.9-8.2) to 5.8% (95% CI: 5.3-6.3) and in-hospital mortality decreased 30% from 6.6% (95% CI: 6.0-7.2) to 4.7 (95% CI: 4.2-5.1).

CONCLUSIONS: Over the same time frame of this study, increases in trauma death across the globe have been reported. This single-site study demonstrated a significant reduction in mortality, attributable to decreased hemorrhagic death. It is possible that efforts focused on hemorrhage control interventions (a bleeding control bundle) resulted in this reduction. These changing factors provide guidance on future prevention and intervention efforts.

Am J Emerg Med. 2016 Aug 20. [Epub ahead of print]

Determination of the chest wall thicknesses and needle thoracostomy success rates at second and fifth intercostal spaces: a cadaver-based study.

Ozen C, Akoglu H, Ozdemirel RO, Omeroglu E, Ozpolat CU, Onur O, Buyuk Y, Denizbasi A.

INTRODUCTION: The purposes of this study were to measure the chest wall thicknesses (CWTs) at second intercostal space (ICS) mid-clavicular line (MCL) and fifth ICS MAL directly, and compare the actual success rates of needle thoracostomies (NTs) by inserting a 5-cm-long syringe needle. Predictive values of weight, body mass index (BMI) and CWT were also analyzed.

MATERIALS AND METHODS: This study included 199 measurements of 50 adult fresh cadavers from both hemithoraces. Five-centimeter-long syringe needles were inserted and secured. Penetration into the pleural cavity was assessed, and CWTs at 4 locations were measured. Achieved power of this study for the primary aim of CWT comparison from 2(nd) and 5(th) ICSs was .94.

RESULTS: Overall mean CWTs at 2(nd) ICS MCL and 5(th) ICS MAL were measured as 2.46 ± 0.78 and 2.89 ± 1.09, respectively, and 5(th) ICS MAL was found to be statistically thicker (P = .002). The success rate of NT at 2(nd) ICS MCL was 87% (95% CI, 80-94), and that at 5(th) ICS MAL was 78% (95% CI, 70-86; P = .3570). Only 6 (17.1%) of 35 failed NTs had a CWT greater than 5-cm. Needle thoracostomy has failed in 29 (14.9%) of 194 locations, despite a CWT less than 5-cm. Below a weight of 72 kg, BMI of 23 kg/m(2), or CWT of 2.4 cm, all NTs were successful.

DISCUSSION AND CONCLUSIONS: In this report, we present the largest cadaver-based cohort to date to the best of our knowledge, and we observed a statistically nonsignificant 9% more NT success rate at 2(nd) ICS at a power of 88%, a statistically significant more success rate in males at 5(th) ICS was (47.7%). We also observed thinner CWTs and higher success rates than previous imaging-based studies. A BMI of 23 kg/m(2) or less and weight of 72 kg or less seem to accurately rule-out NT failure in cadavers, and they seem to be better predictors at the bedside.

Scand J Trauma Resusc Emerg Med. 2016 Sep 15;24(1):111

Accidental hypothermia-an update: The content of this review is endorsed by the International Commission for Mountain Emergency Medicine (ICAR MEDCOM).

Paal P, Gordon L, Strapazzon G, Brodmann Maeder M, Putzer G, Walpoth B, Wanscher M, Brown D, Holzer M, Broessner G, Brugger H.

BACKGROUND: This paper provides an up-to-date review of the management and outcome of accidental hypothermia patients with and without cardiac arrest.

METHODS: The authors reviewed the relevant literature in their specialist field. Summaries were merged, discussed and approved to produce this narrative review.

RESULTS: The hospital use of minimally-invasive rewarming for non-arrested, otherwise healthy, patients with primary hypothermia and stable vital signs has the potential to substantially decrease morbidity and mortality for these patients. Extracorporeal life support (ECLS) has revolutionised the management of hypothermic cardiac arrest, with survival rates approaching 100 % in some cases. Hypothermic patients with risk factors for imminent cardiac arrest (temperature <28 °C, ventricular arrhythmia, systolic blood pressure <90 mmHg), and those who have already arrested, should be transferred directly to an ECLS-centre. Cardiac arrest patients should receive continuous cardiopulmonary resuscitation (CPR) during transfer. If prolonged transport is required or terrain is difficult, mechanical CPR can be helpful. Delayed or intermittent CPR may be appropriate in hypothermic arrest when continuous CPR is impossible. Modern post-resuscitation care should be implemented following hypothermic arrest. Structured protocols should be in place to optimise pre-hospital triage, transport and treatment as well as in-hospital management, including detailed criteria and protocols for the use of ECLS and post-resuscitation care.

CONCLUSIONS: Based on new evidence, additional clinical experience and clearer management guidelines and documentation, the treatment of accidental hypothermia has been refined. ECLS has substantially improved survival and is the treatment of choice in the patient with unstable circulation or cardiac arrest.

Clin Ophthalmol. 2016 Aug 1;10:1461-6.

Risk factors for poor outcomes in patients with open-globe injuries.

Page RD, Gupta SK, Jenkins TL, Karcioglu ZA.

PURPOSE: The aim of this study was to identify the risk factors that are predictive of poor outcomes in penetrating globe trauma.

PATIENTS AND METHODS: This retrospective case series evaluated 103 eyes that had been surgically treated for an open-globe injury from 2007 to 2010 at the eye clinic of the University of Virginia. A total of 64 eyes with complete medical records and at least 6 months of follow-up were included in the study. Four risk factors (preoperative best-corrected visual acuity [pre-op BCVA], ocular trauma score [OTS], zone of injury [ZOI], and time lapse [TL] between injury and primary repair) and three outcomes (final BCVA, monthly rate of additional surgeries [MRAS], and enucleation) were identified for analysis.

RESULTS: Pre-op BCVA was positively associated with MRAS, final BCVA, and enucleation. Calculated OTS was negatively associated with the outcome variables. No association was found between TL and ZOI with the outcome variables. Further, age and predictor variable-adjusted analyses showed pre-op BCVA to be independently positively associated with MRAS ($P=0.008$) and with final BCVA ($P<0.001$), while the calculated OTS was independently negatively associated with final BCVA ($P<0.001$), but not uniquely associated with MRAS ($P=0.530$).

CONCLUSION: Pre-op BCVA and OTS are best correlated with prognosis in open-globe injuries. However, no conventional features reliably predict the outcome of traumatized eyes.

J Trauma Acute Care Surg. 2016 Nov;81(5 Suppl 2 Proceedings of the 2015 Military Health System Research Symposium):S150-S156.

Incidence, risk factors, and mortality associated with acute respiratory distress syndrome in combat casualty care.

Park PK, Cannon JW, Ye W, Blackbourne LH, Holcomb JB, Beninati W, Napolitano LM.

BACKGROUND: The overall incidence and mortality of acute respiratory distress syndrome (ARDS) in civilian trauma settings have decreased over the past four decades; however, the epidemiology and impact of ARDS on modern combat casualty care are unknown. We sought to determine the incidence, risk factors, resource utilization, and mortality associated with ARDS in current combat casualty care.

METHODS: This was a retrospective review of mechanically ventilated US combat casualties within the Department of Defense Trauma Registry (formerly the Joint Theater Trauma Registry) during Operation Iraqi Freedom/Enduring Freedom (October 2001 to August 2008) for ARDS development, resource utilization, and mortality.

RESULTS: Of 18,329 US Department of Defense Trauma Registry encounters, 4,679 (25.5%) required mechanical ventilation; ARDS was identified in 156 encounters (3.3%). On multivariate logistic regression, ARDS was independently associated with female sex (odds ratio [OR], 2.62; 95% confidence interval [CI], 1.21-5.71; p = 0.02), higher military-specific Injury Severity Score (Mil ISS) (OR, 4.18; 95% CI, 2.61-6.71; p < 0.001 for Mil ISS ≥25 vs. <15), hypotension (admission systolic blood pressure <90 vs. ≥90 mm Hg; OR, 1.76; 95% CI, 1.07-2.88; p = 0.03), and tachycardia (admission heart rate ≥90 vs. <90 beats per minute; OR, 1.53; 95% CI, 1.06-2.22; p = 0.02). Explosion injury was not associated with increased risk of ARDS. Critical care resource utilization was significantly higher in ARDS patients as was all-cause hospital mortality (ARDS vs. no ARDS, 12.8% vs. 5.9%; p = 0.002). After adjustment for age, sex, injury severity, injury mechanism, Mil ISS, hypotension, tachycardia, and admission Glasgow Coma Scale score, ARDS remained an independent risk factor for death (OR, 1.99; 95% CI, 1.12-3.52; p = 0.02).

CONCLUSIONS: In this large cohort of modern combat casualties, ARDS risk factors included female sex, higher injury severity, hypotension, and tachycardia, but not explosion injury. Patients with ARDS also required more medical resources and were at greater risk of death compared with patients without ARDS. Thus, ARDS remains a significant complication in current combat casualty care.

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

Medicine (Baltimore). 2016 Aug;95(33):e4598.

Comparison between supraglottic airway devices and endotracheal tubes in patients undergoing laparoscopic surgery: A systematic review and meta-analysis.

Park SK, Ko G, Choi GJ, Ahn EJ, Kang H.

BACKGROUND: Comparisons between the efficacies of supraglottic airway devices (SGAs) and endotracheal tubes (ETTs) in patients undergoing laparoscopic surgeries have yielded conflicting results. Therefore, in this meta-analysis, we compared the clinical performance and incidence of complications between SGAs and ETT intubation in laparoscopic surgery.

METHODS: A comprehensive search was conducted using MEDLINE, EMBASE, the Cochrane Central Register of Controlled Trials, and Google Scholar to identify randomized controlled trials that compared SGAs with ETTs in laparoscopic surgery.

RESULTS: In total, 1433 patients from 17 studies were included in the final analysis. SGAs and ETTs showed no difference in insertion success rate on the first attempt (relative risk [RR] 1.01, 95% confidence interval [CI] 0.99-1.03), insertion time (standardized mean difference 1.57, 95% CI -3.74 to 0.61), and oropharyngeal leak pressure (OLP) (mean difference -2.54, 95% CI -7.59 to 2.50). The incidence of desaturation (RR 3.65, 95% CI 1.39-9.62), gastric insufflations (RR 0.90, 95% CI 0.48-1.71), regurgitation (RR 0.98, 95% CI 0.02-49.13), and aspiration (RR 0.99, 95% CI 0.01-78.4) also showed no intergroup differences. However, the incidence of laryngospasm (RR 3.12, 95% CI 1.29-7.52), cough at removal (RR 6.68, 95% CI 4.70-9.48), dysphagia (RR 1.47, 95% CI 1.12-1.95) or dysphonia (RR 4.41, 95% CI 1.25-15.55), sore throat (RR 1.60, 95% CI 1.33-1.93), and hoarseness (RR 1.53, 95% CI 1.29-1.81) was higher in the ETT group than in the SGA group.

CONCLUSIONS: The incidence of laryngospasm, cough at removal, dysphagia or dysphonia, sore throat, and hoarseness were higher in the ETT group than in the SGA group. However, the groups showed no differences in the rate of insertion success on the first attempt, insertion time, OLP, and other complications. Therefore, SGAs might be clinically more useful as effective airways in laparoscopic surgery.

Crit Care Clin. 2016 Oct;32(4):561-5.

Burn Resuscitation in the Austere Environment.

Peck M, Jeng J, Moghazy A.

ABSTRACT:
Intravenous (IV) cannulation and sterile IV salt solutions may not be options in resource-limited settings (RLSs). This article presents recipes for fluid resuscitation in the aftermath of burns occurring in RLSs. Burns of 20% total body surface area (TBSA) can be resuscitated, and burns up to 40% TBSA can most likely be resuscitated, using oral resuscitation solutions (ORSs) with salt supplementation. Without IV therapy, fluid resuscitation for larger burns may only be possible with ORSs. Published global experience is limited, and the magnitude of burn injuries that successfully respond to World Health Organization ORSs is not well-described.

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

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

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

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

Aerosp Med Hum Perform. 2016 Aug;87(8):728-34.

Army Air Ambulance Blood Product Program in the Combat Zone and Challenges to Best Practices.

Powell-Dunford N, Quesada JF, Gross KR, Shackelford SA.

BACKGROUND: Identify challenges and best practices in the development of an austere air ambulance transfusion program.

METHODS: A search of PubMed using combinations of the key terms 'prehospital,' 'blood product,' 'red blood cells,' 'damage control resuscitation,' 'transfusion,' 'air ambulance,' 'medical evacuation,' and 'medevac' yielded 196 articles for further analysis, with 14 articles suitable for addressing the background of prehospital transfusion within a helicopter. Retrospective analysis of unclassified briefs, after action reports, and procedures was also undertaken along with interview of subject matter experts. The initial series of 15 transfusions were discussed telephonically among flight crew, trauma surgeons, and lab specialists. Review of Joint Theater System data was readily available for 84 U.S. Army air ambulance transfusions between May-December 2012, with December marking the redeployment of the 25(th) Combat Aviation Brigade.

RESULTS: Standardized implementation enabled safe blood product administration for 84 causalities from May-December 2012 without blood product shortage, expiration, or transfusion reaction. Challenges included developing transfusion competency, achieving high quality blood support, countering the potential for anti-U.S. sentiment, and diversity in coalition transfusion practices.

DISCUSSION: Blood product administration aboard the air ambulance is logistically complex, requiring blood bank integration. Repetitive training enabled emergency medical technicians (EMTs) with basic medical training to safely perform transfusion in accordance with clinical operating guidelines. In the austere environment, logistic factors are significant challenges and political sensitivities are important considerations. Best practices may facilitate new en route transfusion programs.

N Engl J Med. 2016 Oct 27;375(17):1612-1615

Wartime Lessons - Shaping a National Trauma Action Plan.

Rasmussen TE, Kellermann AL.

Quote:

"The wars in Iraq and Afghanistan presented U.S. military medicine with its toughest challenge since the Vietnam War. In the wars' early phases, the military had no overarching system to collect actionable data on the causes and timing of death, much less to monitor care delivery and outcomes. As injuries and deaths mounted, it became clear that a better approach was needed. In 2004, the Army, Navy, and Air Force agreed to create the Joint Trauma System (JTS), an enterprise modeled on high-performing civilian trauma systems. The initial goals of the JTS included the creation of a trauma registry, modeled on the American College of Surgeons National Trauma Data Bank, to compile treatment and outcomes data, including information on the timing and causes of death and disability; the establishment of procedures to improve performance and the quality of care; and the formation and dissemination of clinical practice guidelines.

Data from the trauma registry illuminated the most pressing challenges, such as bleeding control, and identified aspects of care that were suboptimal or were associated with poor outcomes. The JTS also provided a mechanism for informing the military's trauma research program, evaluating new products and interventions, and integrating techniques developed in the civilian sector, such as damage-control surgery. Because it's not feasible to conduct randomized, controlled trials to assess new innovations or practice methods in a war zone, the JTS relied on retrospective and comparative effectiveness studies to shape clinical practice guidelines. In light of the weaknesses of available clinical evidence, the JTS used continuous performance improvement processes and what the academies' report calls "focused empiricism" to inform practice and evolve its standards of care.(1) Although this approach lacks the rigor of controlled trials, it uses "the best data available in combination with experience to develop clinical guidelines that, through an iterative process, continue to be refined until high quality data can be generated to further inform practice and standards of care.(1)"

J Trauma Acute Care Surg. 2016 Nov;81(5):813-815.

A national trauma care system: From call to action.

Rasmussen TE.

Quote:

"The Stated Aim
Interestingly, the phrase "preventable deaths after injury" is not uniformly accepted—some suggest that the term "potentially survivable deaths" is more accurate, whereas others consider the concept unrealistic or illogical. However, as a lesson from the wars and as outlined in the National Academies' report, the military showed that pursuing a multidisciplinary, datadriven approach to understanding the timing, location, and cause of death provided more comprehensive and actionable knowledge on the topic. (5) Promoting this model and establishing it as a lead ambition for the broader enterprise allowed the military to make demonstrable progress in saving lives. With the exception of the amount of federal funding supporting it, the stated aim of "zero preventable deaths" is similar to other national goals that have been set to spur progress in challenging conditions such as cancer (i.e., the "moonshot" to end cancer) and infectious disease (i.e., the "countdown to the cure" for HIV). (6)

By announcing this aim of zero preventable deaths from trauma and injury, the National Academies has also established a challenge to develop new collaborations among traditionally separate disciplines. For the veil to be lifted from the burden of preventable mortality from trauma in the US, medical examiners, directors of emergency medical systems, emergency medicine physicians, and trauma, critical care surgeons will need to partner in a more concerted manner. As the military learned, it was not until it integrated its Joint Trauma System, the Armed Forces Medical Examiner's office, and the Tactical Combat Casualty Care community that it was able to understand the whole burden of trauma and more accurately inform policy and investments in training, systems, and research. (7,8) Although the virtues of the phrase "potentially preventable death following injury" can be debated, in choosing it as the stated aim of its report, the National Academies has set an objective that is both proven and compelling for the country."

J Trauma Acute Care Surg. 2016 Nov;81(5 Suppl 2 Proceedings of the 2015 Military Health System Research Symposium):S72-S74.

Combat casualty care: Partnering for preparedness

Remick KN, Baer DG, Rasmussen TE

Quote:

"Unfortunately, our national and military leadership has the tendency to quickly forget the importance of advances made through a dedicated and focused investment in operationally relevant, gap-driven trauma research. In addition, the skills of combat casualty care experienced physicians, nurses, medics, and ancillary staff rapidly fade because of attrition to civilian life and because of a lack of dedicated sustainment of trauma skills as these military medical personnel return to a military facility practices not involving routine trauma care.

In an unsettling way, we are told that we have reached the conclusion of military conflicts in Iraq (2012) and in Afghanistan (2014), yet we remain involved with a significant number of US Military service members deployed in harm's way in both locations. In addition to Afghanistan and Iraq, we are also engaged globally with small military teams working in dispersed and remote locations such as in Africa and Asia without the benefit of a robust Joint Trauma System, which has given us the lowest case fatality rate in military history.

Equally concerning, we are experiencing an increase in the frequency and number of intentional mass casualty events from active shooter and intentional bombings on the home front. Almost daily, we see news reports of events involving multiple casualty scenarios right here on our home soil. We face an onslaught of intentional harm events with increasing complexity and are compelled to act with urgency to ensure that investment is commensurate to the importance of supporting ongoing military operations and civilian mass casualty preparedness. Increased funding for trauma research and partnership between military and civilian trauma communities are essential to meet this threat."

Eur J Trauma Emerg Surg. 2016 Oct 13. [Epub ahead of print]

Resuscitative endovascular balloon occlusion of the aorta: what is the optimum occlusion time in an ovine model of hemorrhagic shock?

Reva VA, Matsumura Y, Hörer T, Sveklov DA, Denisov AV, Telickiy SY, Seleznev AB, Bozhedomova ER, Matsumoto J, Samokhvalov IM, Morrison JJ.

PURPOSE: The aim of this study is to evaluate the early survival and organ damage following 30 and 60 min of thoracic resuscitative endovascular balloon occlusion of the aorta (REBOA) in an ovine model of severe hemorrhagic shock.

METHODS: Eighteen sheep were induced into shock by undergoing a 35 % controlled exsanguination over 30 min. Animals were randomized into three groups: 60-min REBOA 30 min after the bleeding (60-REBOA), 30-min REBOA 60 min after the bleeding (30-REBOA) and no-REBOA control (n-REBOA). Resuscitation with crystalloids and whole blood was initiated 20 and 80 min after the induction of shock. Animals were observed for 24 h with serial potassium and lactate measurements. Autopsy was performed to evaluate organ damage.

RESULTS: Two animals of the n-REBOA group died within 90 min of shock induction; no hemorrhagic deaths were observed in the REBOA groups. Twenty-four-hour survival for the 60-, 30-, and n-REBOA groups was 0/6, 5/6, and 4/6 (P = 0.002). In 60-REBOA, potassium and lactate were increased at 270-min time point: from 4.3 to 5.1 mEq/l and from 3.7 to 5.1 mmol/L, respectively. Both these values were significantly higher than in the n-REBOA group (P = 0.029 for potassium and P = 0.039 for lactate). Autopsy revealed acute tubular necrosis in all died REBOA group animals.

CONCLUSIONS: In this ovine model of severe hemorrhagic shock, REBOA can be used to prevent early death from hemorrhage; however, 60 min of occlusion results in significant metabolic derangement and organ damage that offsets this gain.

J Cardiothorac Vasc Anesth. 2016 Jul 21. [Epub ahead of print]

Con: Hetastarch Should be Avoided for Volume Expansion in Cardiac Surgery Patients.

Sacchet-Cardozo F, Stoicea N, Joseph N, Dewhirst E, Essandoh M.

CONCLUSIONS: This reviewofthecurrentliteratureindicatedthatHESuse during cardiac surgery was associated with an increased incidence of coagulopathy,increased bleeding and transfusion requirements, increased need for surgical re-intervention,and increased rates of AKI and RRT. Furthermore, longer MV duration and ICU stay, as well as higher hospital costs, have been noted. These numerous adverse effects, along with the active FDA warnings should induce strong caution against the tendency to consider the newer low-molecular-weight (130 kDa) and 0.4-to-0.42 substituted hetastarch solutions as being unequivocally safe and efficacious when compared to tetra- starch, other colloids,and crystalloids.More conclusive studies are needed, particularly in the subspecialty of cardiac surgery. With the newer HES formulations, the authors believe that HES presently should be avoided for routine volume expansion in cardiac surgery patients.

Transfus Med. 2016 Oct 12. [Epub ahead of print]

Measurement of haemolysis markers following transfusion of uncrossmatched, low-titer, group O+ whole blood in civilian trauma patients: initial experience at a level 1 trauma centre.

Seheult JN, Triulzi DJ, Alarcon LH, Sperry JL, Murdock A, Yazer MH.

BACKGROUND/OBJECTIVES: The safety of administering uncrossmatched, group O, cold-stored, whole blood (cWB) during civilian trauma resuscitation was evaluated.

METHODS/MATERIALS: Male trauma patients with haemorrhage-induced hypotension who received leuko-reduced uncrossmatched group O+, low titer (<50) anti-A and -B, platelet-replete cWB during initial resuscitation were included. The biochemical markers of haemolysis (lactate dehydrogenase, total bilirubin, haptoglobin, creatinine, serum potassium) were measured on the day of cWB receipt (day 0), and over the next 2 days, reports of transfusion reactions and total blood product administration in first 24 h of admission were recorded.

RESULTS: There were 27 non-group O and 17 group O cWB recipients. The median number of cWB units transfused was 1 [interquartile range (IQR): 1-2] in both groups. The median day 0 post-transfusion serum total bilirubin concentration, although still in the normal range, was higher in the non-group O versus group O recipients (1·4 versus 0·5 mg/dL, $P < 0·01$). There were no significant differences in any of the other biochemical parameters at any other time point. Non-group O recipients received a median of 3 times more red blood cell (RBC) units compared with group O recipients ($P = 0·01$ RBCs), likely explaining the bilirubin difference on day 0. The median volume of ABO-incompatible plasma transfused to non-group O recipients was 600 mL (IQR: 300-1140 mL). There were no reports of adverse events related to the cWB transfusion in either group.

CONCLUSIONS: Administration of ≤2 units of cWB in civilian trauma resuscitation was not associated with clinically significant changes in laboratory haemolysis markers. Efficacy will be determined when larger quantities are transfused.

J Trauma Acute Care Surg. 2016 Oct;81(4):780-94.

Bundles of care for resuscitation from hemorrhagic shock and severe brain injury in trauma patients - Translating knowledge into practice.

Shafi S, Collinsworth AW, Richter KM, Alam HB, Becker LB, Bullock MR, Ecklund JM, Gallagher J, Gandhi R, Haut ER, Hickman ZL, Hotz H, McCarthy J, Valadka AB, Weigelt J, Holcomb JB.

Quotes:

"Injuries are a leading cause of death, disability, years of productive lives lost, and health care costs in the United States.(1) Approximately 190,000 people die each year from injuries, and the total medical and work loss costs of injuries exceed $600 billion per year. The 2 leading causes of death after injury are hemorrhagic shock and traumatic brain injury (TBI), in both military and civilian settings, with mortality rates of 30% to 50%. (2,3) Injured patients treated at designated trauma centers are more likely to survive than those treated at hospitals that are not trauma centers (4); however, risk-adjusted mortality rates are nearly 50% higher at some trauma centers than at others.(5) Given that designated trauma centers have similar structures and resources, these variations in risk-adjusted patient outcomes are likely explained by variations in clinical practices.(6)

Although clinical practice guidelines for the management of hemorrhagic shock and TBI have been developed and disseminated by multiple organizations, adoption of evidence-based practices at trauma centers remains suboptimal.(7,8) In a study of 5 Level I trauma centers, compliance with 22 commonly recommended clinical practices for TBI, hemorrhagic shock, pelvic fractures, and long-bone extremity fractures ranged from 13% to 94%.(7) After adjustment for patient demographics and injury severity, each 10% increase in compliance with recommended care was associated with a 14% reduction in risk of death. These findings indicate a gap in knowledge translation.(8–10)

Bundles of care are tools that promote rapid adoption of proven therapies, enable benchmarking of performance, and improve patient outcomes.(11) A bundle is a vetted collection of 3 to 5 interventions or processes of care derived from evidence-based practice guidelines that, when used together, enhance the quality of care.(10,12) The concept of bundling care was first suggested by Berenholtz et al., who found that consistent use of evidence-based interventions could prevent mortality and morbidity in intensive care units (ICUs).(13) The objective of this study was to bridge the gap between knowledge and clinical practice by developing evidence-based bundles of care for early management of hemorrhagic shock and TBI.**"**

"In conclusion, we have developed 2 bundles of care for resuscitation from hemorrhagic shock and the early management of severe TBI. Adoption of these bundles has the potential to increase compliance with evidence-based practices. Evidence from adoption of other bundles suggests that adoption of these trauma bundles might improve patient outcomes. However, future clinical trials are needed to measure the impact of adopting these bundles."

Rev Esp Quimioter. 2016 Oct;29(5):259-64

The use of ertapenem for the treatment of community-acquired pneumonia in routine hospital practice: a matched cohort study.

Sousa D, Bravo-Ferrer JM, Seoane-Pillado T, Vázquez-Rodríguez P, Ramos-Merino L, Gutiérrez-Urbón JM, Pita S, Llinares P.

OBJECTIVE: The clinical response to ertapenem in community-acquired pneumonia (CAP) at the setting of routine hospital practice has been scarcely evaluated.

METHODS: We retrospectively compared CAP cases treated with ertapenem or with other standard antimicrobials (controls) at a tertiary 1,434-bed center from 2005 to 2014.

RESULTS: Out of 6,145 patients hospitalized with CAP, 64 (1%) ertapenem-treated and 128 controls were studied (PSI IV-V 72%, mean age 73 years.). A significant higher proportion of bedridden patients (41% vs. 21%), residence in nursing homes (19% vs. 7%), previous use of antibiotics (39% vs. 29%) and necrotizing (13% vs. 1%) or complicated (36% vs. 19%) pneumonia, was observed in the ertapenem vs. non-ertapenem patients. Initial treatment with ertapenem was independently associated with an earlier resolution of signs of infection. In patients aged 65 or older the independent risks factors for mortality were: PSI score (7.0, 95%CI 1.8-27.7), bedridden status (4.6, 95%CI 1.1-20.9) and Health Care Associated Pneumonia (HCAP) (4.6, 95%CI 1.3-16.5). First-line treatment with ertapenem was an independent protector factor in this subgroup of patients (0.1, 95%CI 0.1-0.7).

CONCLUSIONS: Ertapenem showed a superior clinical response in frail elderly patients with complicated community-acquired pneumonia, and it may be considered as a first-line therapeutic regimen in this setting.

Ann Emerg Med. 2016 Sep 27. [Epub ahead of print]

The Effect of Combined Out-of-Hospital Hypotension and Hypoxia on Mortality in Major Traumatic Brain Injury.

Spaite DW, Hu C, Bobrow BJ, Chikani V, Barnhart B, Gaither JB, Denninghoff KR, Adelson PD, Keim SM, Viscusi C, Mullins T, Sherrill D.

STUDY OBJECTIVE: Survival is significantly reduced by either hypotension or hypoxia during the out-of-hospital management of major traumatic brain injury. However, only a handful of small studies have investigated the influence of the combination of both hypotension and hypoxia occurring together. In patients with major traumatic brain injury, we evaluate the associations between mortality and out-of-hospital hypotension and hypoxia separately and in combination.

METHODS: All moderate or severe traumatic brain injury cases in the preimplementation cohort of the Excellence in Prehospital Injury Care study (a statewide, before/after, controlled study of the effect of implementing the out-of-hospital traumatic brain injury treatment guidelines) from January 1, 2007, to March 31, 2014, were evaluated (exclusions: <10 years, out-of-hospital oxygen saturation ≤10%, and out-of-hospital systolic blood pressure <40 or >200 mm Hg). The relationship between mortality and hypotension (systolic blood pressure <90 mm Hg) or hypoxia (saturation <90%) was assessed with multivariable logistic regression, controlling for Injury Severity Score, head region severity, injury type (blunt versus penetrating), age, sex, race, ethnicity, payer, interhospital transfer, and trauma center.

RESULTS: Among the 13,151 patients who met inclusion criteria (median age 45 years; 68.6% men), 11,545 (87.8%) had neither hypotension nor hypoxia, 604 (4.6%) had hypotension only, 790 (6.0%) had hypoxia only, and 212 (1.6%) had both hypotension and hypoxia. Mortality for the 4 study cohorts was 5.6%, 20.7%, 28.1%, and 43.9%, respectively. The crude and adjusted odds ratios for death within the cohorts, using the patients with neither hypotension nor hypoxia as the reference, were 4.4 and 2.5, 6.6 and 3.0, and 13.2 and 6.1, respectively. Evaluation for an interaction between hypotension and hypoxia revealed that the effects were additive on the log odds of death.

CONCLUSION: In this statewide analysis of major traumatic brain injury, combined out-of-hospital hypotension and hypoxia were associated with significantly increased mortality. This effect on survival persisted even after controlling for multiple potential confounders. In fact, the adjusted odds of death for patients with both hypotension and hypoxia were more than 2 times greater than for those with either hypotension or hypoxia alone. These findings seem supportive of the emphasis on aggressive prevention and treatment of hypotension and hypoxia reflected in the current emergency medical services traumatic brain injury treatment guidelines but clearly reveal the need for further study to determine their influence on outcome.

Curr Opin Hematol. 2016 Nov;23(6):536-542.

Whole blood: back to the future.

Spinella PC, Cap AP.

PURPOSE OF REVIEW: We present data comparing whole blood with blood components and summarize the data that support increased availability of whole blood for patients with life-threatening bleeding.

RECENT FINDINGS: Recent data indicate that whole-blood transfusion is associated with improved or comparable survival compared with resuscitation with blood components. These data complement randomized controlled trials indicating that platelet-containing blood products stored at 4°C have superior hemostatic function, compared with platelet-containing blood products at 22°C. Whole blood is rarely available in civilian hospitals and, thus, is rarely transfused into patients with hemorrhagic shock. Misconceptions that whole blood must be ABO specific, that whole blood cannot be leukoreduced and maintain platelets, and that cold storage causes loss of platelet function have limited its availability. Understanding that these barriers are not insurmountable will improve the availability of whole blood and facilitate its use. In addition, there are logistical advantages of whole-blood-based resuscitation, as compared with component therapy, for hemorrhagic shock.

SUMMARY: Low titer Group O whole blood stored for up to 21 days at 4°C merits further study to compare its efficacy and safety with current resuscitation approaches for patients with life-threatening bleeding.

Mil Med. 2016 Oct;181(10):1305-1307.

Compatibility of Hydroxyethyl Starch and Tranexamic Acid for Battlefield Co-Administration.

Studer NM, Yassin AH, Keen DE.

INTRODUCTION: The current Tactical Combat Casualty Care Guidelines recommend tranexamic acid (TXA) administration for casualties in whom massive blood transfusion is anticipated. However, despite Hextend being the recommended resuscitation fluid, the guidelines recommend against using TXA with Hextend. This appears to be due to a concern about pharmaceutical compatibility, despite the absence of a direct study of compatibility in the literature.

METHODS: Two solutions of Hextend and TXA were examined for compatibility. One solution simulated direct Y-site injection of TXA, and a second solution replicated a typical piggyback infusion. These solutions, along with two control solutions, were observed for the formation of precipitants immediately on mixing, at 1 hour, and at 4 hours by unaided visual inspection, as well as with the use of a basic digital turbidimeter.

RESULTS: No evidence of chemical or physical interaction was noted by visual inspection at any time in either solution. In addition, turbidimeter results did not demonstrate a difference of greater than 10% from the control solutions, falling below the cutoff set in other studies as an indicator for precipitant formation.

CONCLUSION: There was no evidence of incompatibility between the solutions of Hextend and TXA by either visual inspection or by digital turbidimeter.

Medicine (Baltimore). 2016 May;95(20):e3724.

A Randomized Cadaver Study Comparing First-Attempt Success Between Tibial and Humeral Intraosseous Insertions Using NIO Device by Paramedics: A Preliminary Investigation.

Szarpak L, Truszewski Z, Smereka J, Krajewski P, Fudalej M, Adamczyk P, Czyzewski L.

ABSTRACT:
Medical personnel may encounter difficulties in obtaining intravenous (IV) access during cardiac arrest. The 2015 American Heart Association guidelines and the 2015 European Resuscitation Council guidelines for cardiopulmonary resuscitation (CPR) suggest that rescuers establish intraosseous (IO) access if an IV line is not easily obtainable.The aim of the study was to compare the success rates of the IO proximal tibia and proximal humerus head access performed by paramedics using the New Intraosseous access device (NIO; Persys Medical, Houston, TX, USA) in an adult cadaver model during simulated CPR.In an interventional, randomized, crossover, single-center cadaver study, a semi-automatic spring-load driven NIO access device was investigated. In total, 84 paramedics with less than 5-year experience in Emergency Medical Service participated in the study. The trial was performed on 42 adult cadavers. In each cadaver, 2 IO accesses to the humerus head, and 2 IO accesses to the proximal tibia were obtained.The success rate of the first IO attempt was 89.3% (75/84) for tibial access, and 73.8% (62/84) for humeral access ($P=0.017$). The procedure times were significantly faster for tibial access [16.8 (interquartile range, IQR, 15.1-19.9]s] than humeral access [26.7 (IQR, 22.1-30.9)s] ($P<0.001$).Tibial IO access is easier and faster to put in place than humeral IO access. Humeral IO access can be an alternative method to tibial IO access.

Mil Med. 2016 Oct;181(10):1314-1323.

Spine Injuries Sustained by U.S. Military Personnel in Combat are Different From Non-Combat Spine Injuries.

Szuflita NS, Neal CJ, Rosner MK, Frankowski RF, Grossman RG.

ABSTRACT:
Spine injuries are more prevalent among Iraq and Afghanistan veterans than among veterans of previous conflicts. The purpose of this investigation was to characterize the context, mode, and clinical outcomes of spine injuries sustained by U.S. military personnel in theater. Injury and clinical data from patients who sustained a spine injury in Iraq or Afghanistan between 2003 and 2008 were extracted from the Joint Theater Trauma Registry. Fischer's exact test was used to compare demographic variables between battle and nonbattle spine injuries. Two-sided t tests and univariate analyses were performed to analyze the association between injury context, mechanism, and severity with clinical outcome. A total of 307 patients sustained spine injuries in theater during the study period, and 296 had adequate data for analysis. Most injuries occurred in battle (69.6%), and these injuries were more likely to have an Injury Severity Score considered severe (44.7% vs. 20.0%; $p < 0.001$) or critical (13.6% vs. 5.6%; $p = 0.0458$). Blast was the most common mechanism of injury (42.2%) and was more likely to be blunt (81.6%) than penetrating (18.4%; $p < 0.0001$). Battle-associated spine injuries were most commonly caused by blasts, were more severe, and more likely to involve multiple spinal levels.

Blood Coagul Fibrinolysis. 2016 Sep 2. [Epub ahead of print]

Temporal changes in clot lysis and clot stability following tranexamic acid in cardiac surgery.

Tang M, Wierup P, Rea CJ, Ingerslev J, Hjortdal VE, Srensen B.

ABSTRACT:
Cardiac surgery induces a multifactorial coagulopathy. Regular use of tranexamic acid (TXA) is becoming standard of care. Clinical challenges include selecting optimal dosing regimen and balancing the benefit versus risk of additional dosing with antifibrinolytics. The objective was to evaluate the effect of TXA by assessing kinetic properties of plasma clot formation, clot stability, and clot fibrinolysis. The study was a prospective case follow-up of 28 patients undergoing cardiac surgery (mean age 63.9 years, 29% women). Blood samples were analysed at seven time points during the first 48 h after surgery. All patients were treated with TXA, 2 g at start surgery, 1 g during extra corporeal circulation, and 1 g after reversal of heparin. An automated clot lysis assay using tissue factor and tissue plasminogen activator (tPA) was performed to evaluate clot formation, stability, and fibrinolysis. TXA protects against facilitated fibrinolysis and induces up to 13-fold increase in clot stability. All patients showed complete resistance to tPA-induced fibrinolysis during the first 6 h after cardiac surgery declining to 33% of patients at 48 h. Impaired renal function was associated with prolonged resistance to tPA-induced fibrinolysis. Despite inhibition of fibrinolysis with TXA, the overall clot stability declines and the kinetic properties of clot formation were impaired after cardiac surgery. TXA induces a multifold increase in clot resistance to fibrinolysis but does not affect clot formation or clot stability. Monitoring the level of resistance to fibrinolysis may prevent overdosing in particular in patients with impaired renal function.

World J Surg. 2016 Oct;40(10):2297-304.

Prehospital Blood Transfusions in Non-Trauma Patients.

Thiels CA, Aho JM, Fahy AS, Parker ME, Glasgow AE, Berns KS, Habermann EB, Zietlow SP, Zielinski MD.

INTRODUCTION: Despite advances in trauma care, hemorrhage continues to be the leading cause of preventable mortality in trauma. The evidence to support its use in non-trauma patients is limited. We aim to report our experience with prehospital blood product transfusion. We hypothesize that it is safe, appropriately utilized, and that our protocol, which was designed for trauma patients, is adaptable to fit the needs of non-trauma patients.

METHODS: Patients transfused with blood products, packed red blood cells (pRBCs) or plasma, in the prehospital environment between 2002 and 2014 were included. Trauma patients were compared to non-trauma patients using descriptive statistics.

RESULTS: A total of 857 patients (n = 549 trauma and n = 308 non-trauma) were transfused with pRBCs (76 %, n = 654, mean 1.6 ± 1.1 units en route), plasma (53 %, n = 455, mean 1.7 ± 0.7 unit), or both (29 %, n = 252) during ground (12 %) or air (84 %) critical care transport. Mean age was 60.8 ± 21.6 years with 60.1 % (n = 515) males. Subsequently, in-hospital blood transfusions were performed in 80 % of patients, operations in 44 %, and endoscopy in 31 %. Five percent (n = 41) of patients did not require any of these interventions. Thirty-day mortality rate was 18 %, and one patient (<0.01 %) had a transfusion reaction. The majority of patients were non-trauma (n = 549, 64 %). Of the non-trauma patients, 219 (40 %) were surgical, 193 (35 %) gastrointestinal bleeds, and 137 (25 %) medical.

CONCLUSION: Both non-trauma and trauma patients require blood products for life threatening hemorrhage and the majority required further interventions. Further research on the benefits of transfusion among non-trauma patients is warranted.

Mil Med. 2016 Oct;181(10):1258-1268.

Impact of Operational Theater on Combat and Noncombat Trauma-Related Infections.

Tribble DR, Li P, Warkentien TE, Lloyd BA, Schnaubelt ER, Ganesan A, Bradley W, Aggarwal D, Carson ML, Weintrob AC, Murray CK.

ABSTRACT:
The Trauma Infectious Disease Outcomes Study began in June 2009 as combat operations were decreasing in Iraq and increasing in Afghanistan. Our analysis examines the rate of infections of wounded U.S. military personnel from operational theaters in Iraq and Afghanistan admitted to Landstuhl Regional Medical Center between June 2009 and December 2013 and transferred to a participating U.S. hospital. Infection risk factors were examined in a multivariate logistic regression analysis (expressed as odds ratios [OR]; 95% confidence intervals [CI]). The study population includes 524 wounded military personnel from Iraq and 4,766 from Afghanistan. The proportion of patients with at least one infection was 28% and 34% from the Iraq and Afghanistan theaters, respectively. The incidence density rate was 2.0 (per 100 person-days) for Iraq and 2.7 infections for Afghanistan. Independent risk factors included large-volume blood product transfusions (OR: 10.68; CI: 6.73-16.95), high Injury Severity Score (OR: 2.48; CI: 1.81-3.41), and improvised explosive device injury mechanism (OR: 1.84; CI: 1.35-2.49). Operational theater (OR: 1.32; CI: 0.87-1.99) was not a risk factor. The difference in infection rates between operational theaters is primarily a result of increased injury severity in Afghanistan from a higher proportion of blast-related trauma during the study period.

J Arthroplasty. 2016 Nov;31(11):2465-2470.

Intravenous vs Topical Tranexamic Acid in Total Knee Arthroplasty without Tourniquet Application: A Randomized Controlled Study.

Tzatzairis TK, Drosos GI, Kotsios SE, Ververidis AN, Vogiatzaki TD, Kazakos KI.

BACKGROUND: Use of tranexamic acid (TXA) is effective and safe in reducing the blood loss in total knee arthroplasty (TKR) performed using a tourniquet, but, data in TKR performed without tourniquet are limited, and there is no study comparing the topical (T) with intravenous (IV) TXA administration. Our aim was to compare the topical (T) with intravenous (IV) TXA administration in TKR performed without tourniquet.

MATERIAL AND METHODS: A total of 120 patients undergoing unilateral TKR for knee osteoarthritis were included in a prospective randomized study. Operations were performed under spinal anesthesia, no tourniquet was used, and the postoperative regime was the same for all patients. Patients were divided into 3 groups; in group C (control), 40 patients received no TXA, in group IV, 40 patients received 1 g of TXA intravenously, and in group L, 1 g of TXA was applied locally to 40 patients. The primary outcome measures included the calculated blood loss, the transfusion rate, and quantity of allogeneic blood units, whereas secondary outcome measures were complications.

RESULTS: There was no statistically significant difference in patient's demographics and perioperative results. Calculated blood loss, allogeneic blood transfusion rate, and quantity in group C were significantly higher compared with those of TXA groups ($P < .001$). There was no significant difference in complications rate between the 3 groups.

CONCLUSIONS: According to the results of this study, IV or T administration of 1-g TXA significantly reduced the blood loss and the need for allogeneic blood transfusion in patients undergoing TKR without a tourniquet (with no significant difference between the 2 routes of administration).

Emerg Med Int. 2016;2016:5437490.

Trauma Simulation Training Increases Confidence Levels in Prehospital Personnel Performing Life-Saving Interventions in Trauma Patients.

Van Dillen CM, Tice MR, Patel AD, Meurer DA, Tyndall JA, Elie MC, Shuster JJ.

Introduction. Limited evidence is available on simulation training of prehospital care providers, specifically the use of tourniquets and needle decompression. This study focused on whether the confidence level of prehospital personnel performing these skills improved through simulation training.

Methods. Prehospital personnel from Alachua County Fire Rescue were enrolled in the study over a 2- to 3-week period based on their availability. Two scenarios were presented to them: a motorcycle crash resulting in a leg amputation requiring a tourniquet and an intoxicated patient with a stab wound, who experienced tension pneumothorax requiring needle decompression. Crews were asked to rate their confidence levels before and after exposure to the scenarios. Timing of the simulation interventions was compared with actual scene times to determine applicability of simulation in measuring the efficiency of prehospital personnel.

Results. Results were collected from 129 participants. Pre- and postexposure scores increased by a mean of 1.15 (SD 1.32; 95% CI, 0.88-1.42; $P < 0.001$). Comparison of actual scene times with simulated scene times yielded a 1.39-fold difference (95% CI, 1.25-1.55) for Scenario 1 and 1.59 times longer for Scenario 2 (95% CI, 1.43-1.77).

Conclusion. Simulation training improved prehospital care providers' confidence level in performing two life-saving procedures.

Scand J Trauma Resusc Emerg Med. 2016 Sep 13;24(1):110.

Prehospital control of life-threatening truncal and junctional haemorrhage is the ultimate challenge in optimizing trauma care; a review of treatment options and their applicability in the civilian trauma setting.

van Oostendorp SE, Tan EC, Geeraedts LM Jr.

INTRODUCTION: Exsanguination following trauma is potentially preventable. Extremity tourniquets have been successfully implemented in military and civilian prehospital care. Prehospital control of bleeding from the torso and junctional area's remains challenging but offers a great potential to improve survival rates. This review aims to provide an overview of potential treatment options in both clinical as preclinical state of research on truncal and junctional bleeding. Since many options have been developed for application in the military primarily, translation to the civilian situation is discussed.

METHODS: Medline (via Pubmed) and Embase were searched to identify known and potential prehospital treatment options. Search terms were: haemorrhage/hemorrhage, exsanguination, junctional, truncal, intra-abdominal, intrathoracic, intervention, haemostasis/hemostasis, prehospital, en route, junctional tourniquet, REBOA, resuscitative thoracotomy, emergency horacotomy, pelvic binder, pelvic sheet, circumferential. Treatment options were listed per anatomical site: axilla, groin, thorax, abdomen and pelvis Also, the available evidence was graded in (pre) clinical stadia of research.

RESULTS: Identified treatment options were wound clamps, injectable haemostatic sponges, pelvic circumferential stabilizers, resuscitative thoracotomy, resuscitative endovascular balloon occlusion of the aorta (REBOA), intra-abdominal gas insufflation, intra-abdominal self-expanding foam, junctional and truncal tourniquets. A total of 70 papers on these aforementioned options was retrieved. No clinical reports on injectable haemostatic sponges, intra-abdominal insufflation or self-expanding foam injections and one type of junctional tourniquets were available.

CONCLUSION: Options to stop truncal and junctional traumatic haemorrhage in the prehospital arena are evolving and may offer a potentially great survival advantage. Because of differences in injury pattern, time to definitive care, different prehospital scenarios and level of proficiency of care providers; successful translation of various military applications to the civilian situation has to be awaited. Overall, the level of evidence on the retrieved adjuncts is extremely low.

J Trauma Acute Care Surg. 2016 Oct;81(4):775-9.

Critical care preparedness in law enforcement: Tales of two types of cities.

Walker P, Martin N, Allen S, Pascual J, Kaplan LJ.

Quotes:

“Given the frequency of violent crises that plague the United States, the need for the rapid delivery of on-scene life-threatening condition care has recently dramatically risen.(1–3) In general, the first emergency responder to these crises is a patrol police officer. Recognizing that civilians on the scene may also deliver emergency care, the Federal Emergency Management Agency has moved to help foster a culture of competency for emergency care regardless of the etiology—natural disaster, terror event, active shooter, and others.(4) Similarly, there has been a rise in Tactical Emergency Medical Services to address such circumstances as well.(5,6) In order to better respond to the acute injury needs of deployed officers, bystanders, victims, and suspects, many Special Weapons and Tactics (SWAT) teams incorporate specifically trained medics or physicians on their teams in both training and deployment modes.(7) Furthermore, earlier entry of appropriately trained medical care providers into areas of active threat is now supported in order to enhance survival.8 Such care often proceeds under the tenets of Tactical Combat Casualty Care that guides appropriate lifesaving interventions depending on the active threat status,(9) regardless of location.(10)”

“Despite the penetrance and well-known benefits of tourniquets, LEOs are rarely trained in their safe and effective application. Despite a national focus on violence in the United States, opportunities exist to improve compliance with recommendations made in the Hartford Consensus Conference. Law enforcement officer preparedness for immediate lifesaving critical care interventions needs improvement and offers opportunities for trauma surgeons, emergency medicine physicians, and intensivists to partner with PDs to augment training in deployable skills and reduce variations in care and care preparedness.”

J Trauma Acute Care Surg. 2016 Nov;81(5):931-935.

Police transport versus ground EMS: A trauma system-level evaluation of prehospital care policies and their effect on clinical outcomes.

Wandling MW, Nathens AB, Shapiro MB, Haut ER.

BACKGROUND: Rapid transport to definitive care ("scoop and run") versus field stabilization in trauma remains a topic of debate and has resulted in variability in prehospital policy. We aimed to identify trauma systems frequently using a true "scoop and run" police transport approach and to compare mortality rates between police and ground emergency medical services (EMS) transport.

METHODS: Using the National Trauma Databank (NTDB), we identified adult gunshot and stab wound patients presenting to Level 1 or 2 trauma centers from 2010 to 2012. Hospitals were grouped into their respective cities and regional trauma systems. Patients directly transported by police or ground EMS to trauma centers in the 100 most populous US trauma systems were included. Frequency of police transport was evaluated, identifying trauma systems with high utilization. Mortality rates and risk-adjusted odds ratio for mortality for police versus EMS transport were derived.

RESULTS: Of 88,564 total patients, 86,097 (97.2%) were transported by EMS and 2,467 (2.8%) by police. Unadjusted mortality was 17.7% for police transport and 11.6% for ground EMS. After risk adjustment, patients transported by police were no more likely to die than those transported by EMS (OR = 1.00, 95% CI: 0.69-1.45). Among all police transports, 87.8% occurred in three locations (Philadelphia, Sacramento, and Detroit). Within these trauma systems, unadjusted mortality was 19.9% for police transport and 13.5% for ground EMS. Risk-adjusted mortality was no different (OR = 1.01, 95% CI: 0.68-1.50).

CONCLUSIONS: Using trauma system-level analyses, patients with penetrating injuries in urban trauma systems were found to have similar mortality for police and EMS transport. The majority of prehospital police transport in penetrating trauma occurs in three trauma systems. These cities represent ideal sites for additional system-level evaluation of prehospital transport policies.

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

A A Case Rep. 2016 Nov 15;7(10):212-214.

Impaired Ventilation and Oxygenation after Emergency Cricothyrotomy: Recommendations for the Management of Suboptimal Invasive Airway Access.

Warner MA, Smith HM, Zielinski MD.

ABSTRACT:
Invasive airway access by emergent cricothyrotomy remains an essential treatment modality in "can't intubate/can't ventilate" scenarios. Although numerous commercial devices are available, limited comparative data exist with regard to the ventilation and oxygenation parameters of these devices. We report a case of severely compromised respiratory function while using the Quicktrach II, a commercially available emergency cricothyrotomy device. Because of oxygenation and ventilatory insufficiency, our patient required emergent removal of the device and surgical tracheostomy to improve respiratory function. When confronted with a difficult airway, anesthesiologists and surgeons should be aware of commonly encountered cricothyrotomy devices and their potential limitations.

Shock. 2016 Nov;46(5):468-479.

Plasma Transfusion: History, Current Realities, and Novel Improvements.

Watson JJ(1), Pati S, Schreiber MA.

ABSTRACT:
Traumatic hemorrhage is the leading cause of preventable death after trauma. Early transfusion of plasma and balanced transfusion have been shown to optimize survival, mitigate the acute coagulopathy of trauma, and restore the endothelial glycocalyx. There are a myriad of plasma formulations available worldwide, including fresh frozen plasma, thawed plasma, liquid plasma, plasma frozen within 24 h, and lyophilized plasma (LP). Significant equipoise exists in the literature regarding the optimal plasma formulation. LP is a freeze-dried formulation that was originally developed in the 1930s and used by the American and British military in World War II. It was subsequently discontinued due to risk of disease transmission from pooled donors. Recently, there has been a significant amount of research focusing on optimizing reconstitution of LP. Findings show that sterile water buffered with ascorbic acid results in decreased blood loss with suppression of systemic inflammation. We are now beginning to realize the creation of a plasma-derived formulation that rapidly produces the associated benefits without logistical or safety constraints. This review will highlight the history of plasma, detail the various types of plasma formulations currently available, their pathophysiological effects, impacts of storage on coagulation factors in vitro and in vivo, novel concepts, and future directions.

J Trauma Acute Care Surg. 2016 Nov;81(5):905-912.

Epidemiology of accidental hypothermia in polytrauma patients: An analysis of 15,230 patients of the TraumaRegister DGU.

Weuster M, Brück A, Lippross S, Menzdorf L, Fitschen-Oestern S, Behrendt P, Iden T, Höcker J, Lefering R, Seekamp A, Klüter T; TraumaRegister DGU.

BACKGROUND: Accidental hypothermia (AH) endangers the patient after polytrauma. Past studies have emphasized this entity as a major risk factor. The aim of this study was to describe the epidemiology of AH in major trauma considering the preclinical and clinical course. Predictors should be elucidated.

METHODS: This is a retrospective investigation from the TraumaRegister DGU. Patients were documented in the period between 2002 and 2012. The study compared multiple-injured patients with or without hypothermic temperatures. Different groups of body core temperature were analyzed. Preclinical and clinical parameters were documented.

RESULTS: Fifteen thousand two hundred thirty patients could be included. In 5,078 patients, temperature was below 36.0°C. Blunt trauma mechanisms surpassed penetrating injuries. The majority of patients sustained car accidents, accidents involving pedestrians, and falls from heights of greater than 3 m. Preclinical rescue procedures were extensively long in patients with low body temperature. Female gender, Glasgow Coma Scale score of 8 or less, night-time, winter, motorcycle/bicycle accidents, Injury Severity Score 9 or greater, shock on site and in the emergency room, preclinical volume therapy, and time until admission to emergency room are significant risk factors to develop AH of 33°C. Volume management ranged between 1,453 ± 1,051 mL (33°C) and 1,058 ± 768 mL (36°C). Treatment in emergency room was extensively long. In further clinical course, severe AH advanced the clinical development of sepsis and multiple organ failure. The overall mortality inclined with decreasing body temperatures.

CONCLUSIONS: Accidental hypothermia regularly occurred in polytrauma patients. Certain predictors exist, that is, female gender, which facilitate a body core temperature of 33°C. Preclinical and clinical courses match with other polytrauma studies. High incidence rates of sepsis, multiple organ failure, and mortality in hypothermic patients (33°C) demonstrate the severity of injury. Unfortunately, documentation of body core temperature remains challenging as the number of recorded hypothermic patients appears to be too small. We favor a strict focus on body core temperature on arrival in the emergency room.

LEVEL OF EVIDENCE: Prognostic and epidemiological study, level III.

Mil Med. 2016 Oct;181(10):1187-1194.

Historical Review: The U.S. Army Medical Belt for Front Line First Aid: A Well-Considered Design That Failed the Medical Department During the First World War.

Wever PC, Korst MB, Otte M.

ABSTRACT:
In December 1913, a board of medical officers was appointed to adapt new U.S. Army equipment to the needs of the Hospital Corps. One of the improvements concerned substitution of the satchel-like Hospital Corps pouch used to carry first aid equipment. A waist belt with 10 pockets, known as the medical belt, was devised, and supplied with a tourniquet, adhesive plaster, safety pins, iodine swabs, sublimated gauze, individual dressing packets, gauze bandages, aromatic spirit of ammonia, and common pins. In addition, an ax carrier accommodating a hand ax, a canteen hanger, and a pouch to carry diagnosis tags and instruments were attached to the medical belt. In 1916, the medical belt was incorporated in the field supply tables in the Manual for the Medical Department. The next year, on April 6, 1917, the U.S. Congress declared war on Germany in reaction to sinking of American ships by German submarines. Although the medical belt had given satisfaction in preliminary trials, it did not withstand the test of war. In practice, the medical belt proved a source of dissatisfaction both as to the methods of packing and its contents, which were considered useless in modern warfare. Subsequently, discontinuance of the medical belt was recommended.

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Spine Surgery and Blood Loss: Systematic Review of Clinical Evidence.

Willner D, Spennati V, Stohl S, Tosti G, Aloisio S, Bilotta F.

ABSTRACT:
Spine surgery has been growing rapidly as a neurosurgical operation, with an increase of 220% over a 15-year period. Intraoperative blood transfusion is a major outcome determinant of spine procedures. Various approaches, including pharmacologic and nonpharmacologic therapies, have been tested to decrease both intraoperative and postoperative blood loss. The aim of this systematic review is to report clinical evidence on the relationship between intraoperative blood loss (primary outcome) and on transfusion requirements and postoperative complications (secondary outcomes) in patients undergoing spine surgery. A literature search of PubMed database was performed using 5 key words: spine surgery and transfusion; spine surgery and blood loss; spine surgery and blood complications; spine surgery and deep vein thrombosis; and spine surgery and pulmonary embolism. Clinical reports (randomized controlled trials, prospective and retrospective studies, and case reports) were selected. A total of 473 articles were examined; 450 were excluded, and 24 were selected for this systematic review. Selected articles were categorized into 3 subchapters: (1) drugs active on coagulation (12 studies): tranexamic acid, aminocaproic acid, aprotinin, and recombinant activated factor VII; (2) drugs not active on coagulation (5 studies): ketorolac, epoetin alfa, magnesium sulfate, propofol/sevoflurane, and omega-3 and fish oil; (3) non-pharmacologic approaches (7 studies): surgical tips, patient positioning, and general or spinal anesthesia. Several studies have shown a significant reduction in intraoperative bleeding during spine surgery and in the requirement for blood transfusion.

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Blood products and procoagulants in traumatic bleeding: use and evidence.

Wong H, Curry N, Stanworth SJ.

PURPOSE OF REVIEW: Death from uncontrolled haemorrhage is one of the leading causes of trauma-related mortality and is potentially preventable. Advances in understanding the mechanisms of trauma-induced coagulopathy (TIC) have focused attention on the role of blood products and procoagulants in mitigating the sequelae of TIC and how these therapies can be improved.

RECENT FINDINGS: A host of preclinical and clinical studies have evaluated blood product availability and efficacy in trauma. Recently published randomized controlled trials have investigated the ratio of platelet:plasma:red cell transfusion and the role of early cryoprecipitate in trauma. Demand for readily available plasma has led to changes particularly in the use of thawed group A plasma. Furthermore, ex-vivo and early clinical work has demonstrated variations in the haemostatic activity of different plasma, platelet and whole blood products. A number of multicentre trials are in progress aiming to answer key questions regarding tranexamic acid, procoagulant factor and fibrinogen concentrates and their effect on trauma outcomes.

SUMMARY: There are promising results from ex-vivo studies in manufacturing and storage of blood products to optimize haemostatic activity and availability, particularly with alternative plasma and platelet products and whole blood. There is an urgent need for these products needs to be tested prospectively.

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Multiple Boluses of Intravenous Tranexamic Acid to Reduce Hidden Blood Loss After Primary Total Knee Arthroplasty Without Tourniquet: A Randomized Clinical Trial.

Xie J, Ma J, Yao H, Yue C, Pei F.

BACKGROUND: The optimal dosage and timing of tranexamic acid (TXA) in total knee arthroplasty (TKA) are undetermined. The purpose of this study was to explore the effect of multiple boluses of intravenous TXA on hidden blood loss (HBL), inflammatory response, and knee function after primary TKA without tourniquet.

METHODS: A total of 151 patients were randomly divided into 3 groups to receive single bolus of 20 mg/kg IV-TXA before skin incision (group A), or another bolus of 10 mg/kg IV-TXA 3 hours later (group B), or another 2 boluses of 10 mg/kg IV-TXA 3 hours and 6 hours later (group C). TKAs without tourniquet were operated by 1 single surgeon. The primary outcomes were HBL and maximum hemoglobin drop. Other outcome measurements such as total blood loss, transfusion rate, inflammation markers (C-reactive protein, interleukin 6), visual analog scale pain score, limb swelling ratio, Hospital for Surgery Score, range of motion, length of hospital stay (LOH), and deep venous thrombosis were also compared.

RESULTS: The mean HBL and maximum Hb drop in group C (467.6 ± 305.9 and 20.9 ± 9.3) was lower than those in group A (763.0 ± 373.3, $P < .001$; 28.7 ± 12.2, $P < .001$) and group B (637.5 ± 303.5, $P = .010$; 25.2 ± 8.4, $P = .036$). However, such differences were not detected between groups A and B ($P = .058$ and $P = .080$, respectively). The mean value of total blood loss in the groups A, B, and C were 967.2 ± 380.1, 803.7 ± 321.8, and 677.6 ± 326.0 mL, respectively, with a significant intergroup difference ($P < .001$). The mean serum level of C-reactive protein and interleukin 6 in group C were lower than those in group A and group B on postoperative days 1 and 2. The visual analog scale pain score and swelling ratio were also lower in group C than in the other 2 groups with statistical significance on POD 1-3. Moreover, the Hospital for Surgery Score, range of motion, and LOH were better in group C. No episodes of transfusion or deep venous thrombosis had occurred.

CONCLUSION: Multiple boluses of IV-TXA can effectively reduce HBL after primary TKA without tourniquet. What is the most important is that, by adding another bolus of IV-TXA, patients can gain a smaller decline of Hb, less postoperative inflammatory response, less pain, less knee swelling, better knee function, and shorter LOH.

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A case of cricothyroidotomy for facial trauma in a patient taking antiplatelet agents after a simple ground-level fall.

Yumoto T, Matsumura T, Tsukahara K, Sato K, Ugawa T, Ujike Y.

INTRODUCTION: Cricothyroidotomy is an emergency procedure that can be used to secure the airway in situations in which intubation and ventilation are not possible.

PRESENTATION OF CASE: We describe a case of 79-year-old male presenting with facial trauma combined with massive upper airway bleeding and swelling in which cricothyroidotomy was required to open the airway in an elderly male patient taking antiplatelet agents who suffered a simple ground-level fall.

DISCUSSION: Although emergency airway management is often required in patients with Le Fort fractures, mandibular condyle fractures exhibit a significant relationship with ground-level falls, which are not usually associated with emergency airway management. Prophylactic intubation should be considered prior to transfer or deterioration in a trauma patient with dual antiplatelet drugs and fractures of bilateral mandibular condyle.

CONCLUSION: Clinicians should be aware of the life-threatening injuries that can be caused by simple ground-level falls in patients taking antiplatelet agents.

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Infection After Orthopaedic Trauma: Prevention and Treatment.

Yun HC, Murray CK, Nelson KJ, Bosse MJ.

ABSTRACT:
Trauma to the extremities is disproportionately represented in casualties of recent conflicts, accounting for >50% of injuries sustained during operations in Iraq and Afghanistan. Infectious complications have been reported in >25% of those evacuated for trauma, and 50% of such patients were treated in the intensive care unit (ICU). Osteomyelitis has been reported in 9% (14% of intensive care unit patients), and deep-wound infection in 27% of type III open-tibia fractures. Infections complicating extremity trauma are frequently caused by multidrug-resistant bacteria and have been demonstrated to lead to failure of limb salvage, unplanned operative take-backs, late amputations, and decreased likelihood of returning to duty. Invasive fungal infections of extremities have also presented a unique challenge in combat-injured patients, particularly in those with blast injuries with massive transfusion requirements and high injury severity scores. Infection prevention should begin at the time of injury and, although context-specific depending on the level of care, includes appropriate irrigation, surgical debridement, wound care and coverage, fracture fixation, and antibiotic prophylaxis, in addition to basic infection prevention measures. Clinical practice guidelines to address infection prevention after combat trauma (including extremity infection) were developed in 2007 and revised in 2011, with endorsement from the Surgical Infection Society and the Infectious Disease Society of America. Nevertheless, significant challenges remain, including austere environments of care, multiple transitions of care, and lack of coordinated efforts in prevention. Treatment of established infections is optimally multidisciplinary, particularly when deep wounds, bone, and joints are involved. Surgical debridement of overtly infected or necrotic tissue is necessary, with particularly aggressive margins if invasive fungal infection is suspected. Infected nonunion frequently requires the use of prosthetic materials for fixation, potentiating biofilm formation, and complicating medical therapy. Antibiotic therapy should be targeted at results of deep wound and bone cultures. However, this is complicated by frequent contamination of wounds, requiring differentiation between potential pathogens in terms of their virulence and decreased culture recovery in patient who have frequently received previous antibiotics. Lessons learned in infection prevention and treatment of orthopaedic trauma from combat can serve to inform the care of patients injured in natural disasters and noncombat trauma.