Tactical Combat Casualty Care

Journal Article Abstracts

Committee on Tactical Combat Casualty Care
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J Bone Joint Surg Am. 2013 Nov 20;95(22):2001-7. doi: 10.2106/JBJS.L.01182.

Efficacy and safety of fibrin glue and tranexamic acid to prevent postoperative blood loss in total knee arthroplasty: a randomized controlled clinical trial.

Aguilera X, Martinez-Zapata MJ, Bosch A, Urrútia G, González JC, Jordan M, Gich I, Maymó RM, Martínez N, Monllau JC, Celaya F, Fernández JA.

BACKGROUND: Postoperative blood loss in patients after total knee arthroplasty may cause local and systemic complications and influence clinical outcome. The aim of this study was to assess whether fibrin glue or tranexamic acid reduced blood loss compared with routine hemostasis in patients undergoing total knee arthroplasty.

METHODS: A randomized, single-center, parallel, open clinical trial was performed in adult patients undergoing primary total knee arthroplasty. Patients were divided into four groups. Group 1 received fibrin glue manufactured by the Blood and Tissue Bank of Catalonia, Group 2 received Tissucol (fibrinogen and thrombin), Group 3 received intravenous tranexamic acid, and Group 4 (control) had no treatment other than routine hemostasis. The primary outcome was total blood loss collected in drains after surgery. Secondary outcomes were the calculated hidden blood loss, transfusion rate, preoperative and postoperative hemoglobin, number of blood units transfused, adverse events, and mortality.

RESULTS: One hundred and seventy-two patients were included. The mean total blood loss (and standard deviation) collected in drains was 553.9 ± 321.5 mL for Group 1, 567.8 ± 299.3 mL for Group 2, 244.1 ± 223.4 mL for Group 3, and 563.5 ± 269.7 mL for Group 4. In comparison with the control group, Group 3 had significantly lower total blood loss ($p < 0.001$), but it was not significantly lower in Groups 1 and 2. The overall rate of patients who had a blood transfusion was 21.1% (thirty-five of 166 patients analyzed per protocol). Two patients required transfusion in Group 3 compared with twelve patients in Group 4 ($p = 0.015$). No significant difference was observed between the two fibrin glue groups and the control group with regard to the need for transfusion. There was no difference between groups with regard to the percentage of adverse events.

CONCLUSIONS: Neither type of fibrin glue was more effective than routine hemostasis in reducing postoperative bleeding and transfusion requirements, and we no longer use them. However, this trial supports findings from previous studies showing that intravenous tranexamic acid can decrease postoperative blood loss.

Acta Anaesthesiol Scand. 2014 Feb;58(2):251-3. doi: 10.1111/aas.12238. Epub 2013 Dec 11.

A prehospital use of ITClamp for haemostatic control and fixation of a chest tube.

Barnung S, Steinmetz J.

Abstract: We here present three cases in which a new device, the ITClamp Hemorrhage Control System (Innovative Trauma Care, Inc., Edmonton, Canada), was used for bleeding control and for securing a chest tube.

J Trauma Acute Care Surg. 2013 Oct;75(4):747-8. doi: 10.1097/TA.0b013e31829cbf48.

Experimental evaluation of the Combat Ready Clamp.

Cotte J, Cungi PJ, Montcriol A.

Quotes: “Our team conducted an experimental study on 30 healthy subjects. Its main objective was to evaluate the ability of the CROC to stop Doppler flow distal to the clamp……The CROC was applied over the right femoral pulse at the inguinal region by a trained physician…..Blood flow was successfully interrupted in 29 subjects (96.7%).”

Ann Emerg Med. 2013 Oct;62(4):380-387.e1. doi: 0.1016/j.annemergmed.2013.04.018. Epub 2013 May 24.

Impact of temperature exposure on stability of drugs in a real-world out-of-hospital setting.

De Winter S(1), Vanbrabant P, Vi NT, Deng X, Spriet I, Van Schepdael A, Gillet JB.

STUDY OBJECTIVE: The aim of this study is to determine the content of 5 important emergency medical services (EMS) drugs after being stored at the recommended refrigerated temperature, room temperature, or in an emergency physician transport vehicle operating under real-world working conditions.

METHODS: Adrenaline hydrochloride, cisatracurium besylate, lorazepam, methylergonovine maleate, and succinylcholine chloride were stored for 1 year under the 3 conditions. For each storage condition, samples of the drugs were taken after 1, 2, 3, and 4 weeks and after 2, 4, 6, 8, 10, and 12 months. For adrenaline hydrochloride, however, the samples were taken after 1, 2, 4, 6, 8, 10, and 12 months. The samples were analyzed with a validated high-performance liquid chromatography assay. A drug was considered stable if its content was above 90%.

RESULTS: Adrenaline hydrochloride and methylergonovine maleate remained stable for 1 year at room temperature and in the emergency physician transport vehicle. At room temperature and in the emergency physician transport vehicle, lorazepam became unstable within 4 weeks. Succinylcholine chloride was stable for 2 months at room temperature and for 1 month in the emergency physician transport vehicle. Cisatracurium besylate became unstable within 4 months at room temperature. However, it remained stable for 4 months in the emergency physician transport vehicle.

CONCLUSION: When stored at room temperature or in the emergency physician transport vehicle, lorazepam became unstable within weeks, whereas succinylcholine chloride and cisatracurium besylate became unstable within months. Adrenaline hydrochloride and methylergonovine maleate remained stable for several months, even under room temperature and emergency physician transport vehicle conditions. Thus, real-world EMS working conditions pose challenges for maintaining optimal efficacy of these important EMS drugs.

J Emerg Med. 2013 Apr;44(4):829-38. doi: 10.1016/j.jemermed.2012.11.025. Epub 2013 Jan 30.

Massive transfusion in traumatic shock.

Elmer J, Wilcox SR, Raja AS.

BACKGROUND: Hemorrhage after trauma is a common cause of death in the United States and globally. The primary goals when managing traumatic shock are the restoration of oxygen delivery to end organs, maintenance of circulatory volume, and prevention of ongoing bleeding through source control and correction of coagulopathy. Achieving these goals may require massive transfusion of blood products. Although use of blood products may be lifesaving, dose-related adverse effects are well described.

DISCUSSION: Complications of massive transfusion include interdependent derangements such as coagulopathy, hypothermia, acidosis, and electrolyte abnormalities, as well as infectious and immunomodulatory phenomena. This article explores the pathogenesis, implications, prevention, and treatment of these complications through the use of massive transfusion protocols. Particular attention is given to the optimal ratio of blood products transfused in large volume resuscitation and prevention of secondary coagulopathy.

CONCLUSIONS: Observational data indicate that the development and use of a massive transfusion protocol may reduce the morbidity and mortality associated with large-volume resuscitation of patients with hemorrhagic shock. Such protocols should include a pre-defined ratio of packed red blood cells, fresh frozen plasma, and platelets transfused; most commonly, the ratio used is 1:1:1. Additionally, such protocols should monitor for and correct hypothermia, hypofibrinogenemia, and electrolyte disturbances such as hypocalcemia and hyperkalemia.

Shock. 2013 Dec;40(6):444-50. doi: 10.1097/SHK.0000000000000047.

Freeze-dried plasma at the point of injury: from concept to doctrine.

Glassberg E, Nadler R, Gendler S, Abramovich A, Spinella PC, Gerhardt RT, Holcomb JB, Kreiss Y.

Abstract: While early plasma transfusion for the treatment of patients with ongoing major hemorrhage is widely accepted as part of the standard of care in the hospital setting, logistic constraints have limited its use in the out-of-hospital setting. Freeze-dried plasma (FDP), which can be stored at ambient temperatures, enables early treatment in the out-of-hospital setting. Point-of-injury plasma transfusion entails several significant advantages over currently used resuscitation fluids, including the avoidance of dilutional coagulopathy, by minimizing the need for crystalloid infusion, beneficial effects on endothelial function, physiological pH level, and better maintenance of intravascular volume compared with crystalloid-based solutions. The Israel Defense Forces Medical Corps policy is that plasma is the resuscitation fluid of choice for selected, severely wounded patients and has thus included FDP as part of its armamentarium for use at the point of injury by advanced life savers, across the entire military. We describe the clinical rationale behind the use of FDP at the point-of-injury, the drafting of the administration protocol now being used by Israel Defense Forces advanced life support providers, the process of procurement and distribution, and preliminary data describing the first casualties treated with FDP at the point of injury. It is our hope that others will be able to learn from our experience, thus improving trauma casualty care around the world.

Ann Emerg Med. 2014 Feb;63(2):247-258.e18. doi: 10.1016/j.annemergmed.2013.10.015.

Clinical policy: procedural sedation and analgesia in the emergency department.

Godwin SA, Burton JH, Gerardo CJ, Hatten BW, Mace SE, Silvers SM, Fesmire FM; American College of Emergency Physicians.

Abstract: This clinical policy from the American College of Emergency Physicians is the revision of a 2005 clinical policy evaluating critical questions related to procedural sedation in the emergency department.1 A writing subcommittee reviewed the literature to derive evidence-based recommendations to help clinicians answer the following critical questions: (1) In patients undergoing procedural sedation and analgesia in the emergency department does preprocedural fasting demonstrate a reduction in the risk of emesis or aspiration? (2) In patients undergoing procedural sedation and analgesia in the emergency department, does the routine use of capnography reduce the incidence of adverse respiratory events? (3) In patients undergoing procedural sedation and analgesia in the emergency department, what is the minimum number of personnel necessary to manage complications? (4) In patients undergoing procedural sedation and analgesia in the emergency department, can ketamine, propofol, etomidate, dexmedetomidine, alfentanil and remifentanil be safely administered? A literature search was performed, the evidence was graded, and recommendations were given based on the strength of the available data in the medical literature.

Crit Care Med. 2013 Dec;41(12):2800-11. doi: 10.1097/CCM.0b013e31829a6ecb.

The use of higher platelet: RBC transfusion ratio in the acute phase of trauma resuscitation: a systematic review.

Hallet J, Lauzier F, Mailloux O, Trottier V, Archambault P, Zarychanski R, Turgeon AF.

OBJECTIVE: With the recognition of early coagulopathy, trauma resuscitation has shifted toward liberal platelet transfusions. The overall benefit of this strategy remains controversial. Our objective was to compare the effects of a liberal use of platelet (higher platelet:RBC ratios) with a conservative approach (lower ratios) in trauma resuscitation.

DATA SOURCES: We systematically searched Medline, Embase, Web of Science, Biosis, Cochrane Central, and Scopus.

STUDY SELECTION: Two independent reviewers selected randomized controlled trials and observational studies comparing two or more platelet:RBC ratios in trauma resuscitation. We excluded studies investigating the use of whole blood or hemostatic products.

DATA EXTRACTION: Two independent reviewers extracted data and assessed the risk of bias. Primary outcomes were early (in ICU or within 30 d) and late (in hospital or after 30 d) mortality. Secondary outcomes were multiple organ failure, lung injury, and sepsis.

DATA SYNTHESIS: From 6,123 citations, no randomized controlled trials were identified. We included seven observational studies (4,230 patients) addressing confounders through multivariable regression or propensity scores. Heterogeneity of studies precluded meta-analysis. Among the five studies including exclusively patients requiring massive transfusions, four observed a lower mortality with higher ratios. Two studies considering nonmassively bleeding patients observed no benefit of using higher ratios. Two studies evaluated the implementation of a massive transfusion protocol; only one study observed a decrease in mortality with higher ratios. Of the two studies at low risk of survival bias, one study observed a survival benefit. Three studies assessed secondary outcomes. One study observed an increase in multiple organ failure with higher ratios, whereas no study demonstrated an increased risk in lung injury or sepsis.

CONCLUSIONS: There is insufficient evidence to strongly support the use of a precise platelet: RBC ratio for trauma resuscitation, especially in nonmassively bleeding patients. Randomized controlled trials evaluating both the safety and efficacy of liberal platelet transfusions are warranted.

Mil Med. 2014 Jan;179(1):92-8. doi: 10.7205/MILMED-D-13-00005.

Plasma-to-red cell ratio and mechanism of injury in massively transfused combat casualties.

Hardin MO, Ritchie JD, Aden JK, Blackbourne LH, White CE.

STUDY DESIGN: A retrospective review of 930 combat casualties from March 2003 to September 2009 who received a massive transfusion. Mechanism was categorized as explosion (EXPL) (712), gunshot wound (GSW) (190), and blunt trauma (28). Cohorts were also categorized by fresh frozen plasma (FFP) to red blood cell (RBC) ratio: low, ≤1:1.5 and high, >1:1.5. Patient characteristics and in-hospital mortality rates were compared among groups. Propensity matching was used to control for confounding variables.

RESULTS: Cohorts were similar in demographics, admission vital signs, and laboratory values. Median injury severity score was higher in EXPL compared to GSW. High FFP:RBC ratio was associated with improved survival compared to low ratio in the EXPL group ($p < 0.01$). The GSW group had similar survival in the high and low FFP:RBC ratio groups ($p = 0.06$). After propensity matching, a high FFP:RBC ratio was associated with improved survival compared to low ratio in both the EXPL ($p < 0.01$) and GSW groups ($p = 0.05$).

CONCLUSIONS: High FFP:RBC ratios are associated with improved survival in combat casualties regardless of injury mechanism.

J Trauma Acute Care Surg. 2013 Nov;75(5):904-6. doi: 0.1097/TA.0b013e3182a85f71.

What is the evidence of utility for intraosseous blood transfusion in damage-control resuscitation?

Harris M, Balog R, Devries G.

CONCLUSION: DCR is the new paradigm for trauma resuscitation in both military and civilian populations. As of 2013, the key national organizations that set trauma resuscitation and vascular access guidelines recommend the use of IO access for transfusing blood when IV access cannot be established. Extrapolation from animal studies and undue generalization from human case reports at the extremes of age seem to form the basis for the recommendations. Two of the major manufacturers of IO technology also recommend the use of IO access for blood transfusion. In one case, the company's chief scientific officer, acknowledging the total lack of available scientific evidence, stated that IO use for blood transfusion is ''better than nothing in most cases'' (Philbeck T, personal communication, 2012). We disagree with this comment and go further to say that it actually could be far worse than nothing. Based on the Darcy's Law and the resulting low flow rates of blood transfused into the IO space, nothing of substance can be achieved by transfusing blood via the IO route in DCR. Analysis of flow dynamics in the appropriate theoretical model of porous media reveals that flow rates through IO access can be markedly limited by the viscosity of the blood products and the permeability of cancellous bone in the IO space. Permeability creates an even greater obstacle to flow in the military aged population. These limits push the pressure needed to attain flow rates adequate for DCR above the pressure levels tolerated by the infusion system and risk causing hemolysis. Consequently, it would make much more sense to take notice of the 2006 and 2010 recommendations of the INS and have all medical personnel trained in the use of light or sound technologies to facilitate successful peripheral IV access and to avoid the IO route entirely when blood transfusion is required. Based on clinical observation, the lack of clinical evidence in the medical literature, and the factors discussed herein, we postulate that maximum flow rates attainable for transfusion of blood products used in DCR via the IO route are simply inadequate for successful resuscitation. Until studies in a representative population show the clinical success of the IO technique in DCR, current recommendations for the use of IO access for blood transfusion by ATLS and the INS should be modified to better reflect this scientific uncertainty.

J Burn Care Res. 2013 Sep-Oct;34(5):498-506. doi: 10.1097/BCR.0b013e3182a231fb.

Admission temperature and survival in patients admitted to burn centers.

Hostler D, Weaver MD, Ziembicki JA, Kowger HL, McEntire SJ, Rittenberger JC, Callaway CW, Patterson PD, Corcos AC.

Abstract: It is commonly believed that hypothermia occurring during burn resuscitation is associated with poor outcome, but there is little direct supporting evidence. The authors conducted an analysis of a statewide trauma registry to determine whether hypothermia (T ≤36.5°C) was associated with mortality when controlling for clinical confounders. They included all patients treated at an accredited burn center from 2000 to 2011 where the trauma registrar recorded the primary injury type as a burn. They excluded records with missing data and nonphysiologic temperature (<26°C or >42°C). The primary exposure of interest was hypothermia. The authors constructed a hierarchical, multivariable logistic regression model to examine the effect of hypothermia on survival, controlling for potentially confounding variables. Predictors of mortality are presented as odds ratio (95% confidence interval). Primary burn injury was coded 17,098 times during the study period. Of these, 3809 were not treated at a burn center and 1192 were excluded for missing data. Admission hypothermia was independently associated with mortality (1.91 [1.58-2.29]) when adjusting for age, sex, total second- and third-degree burn surface area (TBSA), comorbid conditions, injury severity score, direct transport vs referral, method of temperature measurement, year, and the hospital providing care. Increasing age, female sex, TBSA >40%, presence of multiple comorbid conditions, and increasing injury severity score were associated with mortality. Other variables in the model were not independently associated with outcome. There was a weak correlation between TBSA and admission temperature (r = .18). Hypothermia at hospital admission is independently associated with mortality in burn patients when controlling for clinical confounders. Future studies should address potential causes underlying this observation.

Hip Int 2013; epub ahead of print; DOI: 10.5301/hipint.5000090

Single tranexamic acid dose to reduce perioperative morbidity in primary total hip replacement: a randomised clinical trial

Hervé Hourlier1, Peter Fennema2

Introduction: Although prophylactic tranexamic acid (TXA) is a safe, low-cost option to reduce bleeding in patients undergoing total hip replacement (THR), its optimal dose and duration is unknown. We compared the safety and effectiveness of TXA given as either a single injection or continuous infusion in THR patients, hypothesizing that a second TXA dose would not offer any clinical advantages over the single injection.

Materials and methods: One hundred and sixty-four patients undergoing unilateral THR were randomised. Exclusion criteria were history of thromboembolic events (TE), epilepsy, thrombophilia, and severe chronic renal failure. Patients received either a single dose of 30 mg/kg TXA on induction of surgery (one shot [OS] group), or a loading dose of 10 mg/kg TXA followed two hours later by a continuous infusion of 2 mg/kg per hour for 20 hours (one day [OD] group). The primary outcome was blood loss (BL) calculated from haematocrit levels. Secondary outcomes were mortality and TE events within 90 days postoperatively.

Results: All patients completed treatment, with none lost to follow-up. Mean BL was 1107 ± 508 ml in Group OS and 1047 ± 442 ml in Group OD ($p = 0.43$). No patients were transfused prior to Day 10 postoperatively. At final follow-up, no patients had died, and there were no occurrences of major TE.

Conclusion: The 30 mg/kg TXA single shot was as safe as continuous infusion. As it is also less cumbersome, we recommend it as part of routine care in THR patients.

Keywords: Tranexamic acid, Total hip replacement, Blood transfusion, Randomised controlled trial

J Surg Res. 2014 Jan;186(1):318-27. doi: 10.1016/j.jss.2013.08.020. Epub 2013 Sep 13.

The use of tranexamic acid to reduce blood loss and transfusion in major orthopedic surgery: a meta-analysis.

Huang F, Wu D, Ma G, Yin Z, Wang Q.

BACKGROUND: Conflicting reports have been published regarding the effect of tranexamic acid (TXA) on reducing blood loss and transfusion in patients undergoing orthopedic surgery. We performed a meta-analysis to evaluate the effectiveness and safety of TXA treatment in reducing blood loss and transfusion in major orthopedic surgery.

MATERIALS AND METHODS: MEDLINE, PubMed, EMBASE, and Cochrane databases were searched for relevant studies. Only randomized controlled trials were eligible for this study. The weighted mean difference in blood loss, number of transfusions per patient, and the summary risk ratio of transfusion and deep vein thrombosis (DVT) were calculated in the TXA-treated group and the control group.

RESULTS: A total of 46 randomized controlled trials involving 2925 patients were included. The use of TXA reduced total blood loss by a mean of 408.33 mL (95% confidence interval [CI], -505.69 to -310.77), intraoperative blood loss by a mean of 125.65 mL (95% CI, -182.58 to -68.72), postoperative blood loss by a mean of 214.58 mL (95% CI, -274.63 to -154.52), the number of blood transfusions per patient by 0.78 U (95% CI, -0.19 to -0.37), and the volumes of blood transfusions per patient by 205.33 mL (95% CI, -301.37 to -109.28). TXA led to a significant reduction in transfusion requirements (relative risk, 0.51; 95% CI, 0.46-0.56), and no increase in the risk of DVT (relative risk, 1.11; 95% CI, 0.69-1.79).

CONCLUSIONS: TXA significantly reduced blood loss and blood transfusion requirements in patients undergoing orthopedic surgery, and did not appear to increase the risk of DVT.

Am J Nurs. 2013 Nov;113(11):34-9; quiz 40. doi: 10.1097/01.NAJ.0000437110.65929.70.

Intraosseous vascular access for alert patients.

Hunsaker S, Hillis D.

Abstract: Nurses are often faced with the challenge of starting an IV line in a patient who is dehydrated, has suffered trauma, or is in shock. Even the efforts of the most skilled clinician may fail, while valuable time is lost. Intraosseous access is a rapid, safe, and effective route for delivering fluids and medications, and is recommended by numerous professional and specialty organizations for both pediatric and adult patients. Yet many clinicians remain unaware of the procedure. This article outlines the procedure and devices used, describes support for use in the literature, and discusses various considerations and nursing implications.

J Trauma Acute Care Surg. 2013 Dec;75(6):968-74; discussion 974-5. doi: 10.1097/TA.0b013e31829a021a.

Differential effects of fresh frozen plasma and normal saline on secondary brain damage in a large animal model of polytrauma, hemorrhage and traumatic brain injury.

Hwabejire JO, Imam AM, Jin G, Liu B, Li Y, Sillesen M, Jepsen CH, Lu J, deMoya MA, Alam HB.

BACKGROUND: We have previously shown that the extent of traumatic brain injury (TBI) in large animal models can be reduced with early infusion of fresh frozen plasma (FFP), but the precise mechanisms remain unclear. In this study, we investigated whether resuscitation with FFP or normal saline differed in their effects on cerebral metabolism and excitotoxic secondary brain injury in a model of polytrauma, TBI, and hemorrhagic shock.

METHODS: Yorkshire swine (n = 10) underwent Grade III liver injury, rib fracture, standardized TBI, and volume-controlled hemorrhage, (40% ± 5%) and were randomly resuscitated with either FFP or normal saline. Hemodynamic parameters and brain oxygenation were continuously monitored, while microdialysis was used to measure the brain concentrations of pyruvate, lactate, glutamate, and glycerol at baseline; 1 hour and 2 hours after shock; immediate postresuscitation (PR); as well as 2, 4, and 6 hours PR. Cells from the injured hemisphere were separated into mitochondrial and cytosolic fractions and analyzed for activity of the pyruvate dehydrogenase complex (PDH).

RESULTS: There were no baseline differences in cerebral perfusion pressure, brain oxygenation, as well as concentrations of pyruvate, lactate, glutamate, and glycerol between the groups. At 2 hours and 4 hours PR, the FFP group had significantly higher cerebral perfusion pressures (52 [5] mm Hg vs. 43 [2] mm Hg, $p = 0.016$; and 50 [7] mm Hg vs. 37 [1] mm Hg, $p = 0.008$, respectively). There was a sustained and significant ($p < 0.05$) drop in the glutamate and glycerol levels in the FFP group, implying a decrease in excitotoxicity and brain damage, respectively. Mitochondrial PDH activity was significantly higher (2,666.2 [638.2] adjusted volume INT × mm vs. 1,293.4 [88.8] adjusted volume INT × mm, $p = 0.008$), and cytosolic PDH activity was correspondingly lower (671.4 [209.2] adjusted volume INT × mm vs. 3070.7 [484.3] adjusted volume INT × mm, $p < 0.001$) in the FFP group, suggesting an attenuation of mitochondrial dysfunction and permeability.

CONCLUSION: In this model of TBI, polytrauma, and hemorrhage, FFP resuscitation confers neuroprotection by improving cerebral perfusion, diminishing glutamate-mediated excitotoxic secondary brain injury and reducing mitochondrial dysfunction.

J Trauma Acute Care Surg. 2013 Dec;75(6):976-83. doi: 10.1097/TA.0b013e31829e2186.

Early treatment with lyophilized plasma protects the brain in a large animal model of combined traumatic brain injury and hemorrhagic shock.

Imam AM, Jin G, Sillesen M, Duggan M, Jepsen CH, Hwabejire JO, Lu J, Liu B, DeMoya MA, Velmahos GC, Alam HB.

BACKGROUND: Combination of traumatic brain injury (TBI) and hemorrhagic shock (HS) can result in significant morbidity and mortality. We have previously shown that early administration of fresh frozen plasma (FFP) in a large animal model of TBI and HS reduces the size of the brain lesion as well as the associated edema. However, FFP is a perishable product that is not well suited for use in the austere prehospital settings. In this study, we tested whether a shelf-stable, low-volume, lyophilized plasma (LSP) product was as effective as FFP.

METHODS: Yorkshire swine (42-50 kg) were instrumented to measure hemodynamic parameters, intracranial pressure, and brain tissue oxygenation. A prototype, computerized, cortical impact device was used to create TBI through a 20-mm craniotomy: 15-mm cylindrical tip impactor at 4 m/s velocity, 100-millisecond dwell time, and 12-mm penetration depth. Volume-controlled hemorrhage was induced (40-45% total blood volume) concurrent with the TBI. After 2 hours of shock, animals were treated with (1) normal saline (NS, n = 5), (2) FFP (n = 5), and (3) LSP (n = 5). The volume of FFP and LSP matched the shed blood volume, whereas NS was 3 times the volume. Six hours after resuscitation, brains were sectioned and stained with TTC (2, 3, 5-Triphenyltetrazolium chloride), and lesion size (mm) and swelling (percent change in volume compared with the contralateral, uninjured side) were measured.

RESULTS: This protocol resulted in a highly reproducible brain injury, with clinically relevant changes in blood pressure, cardiac output, tissue hypoperfusion, intracranial pressure, and brain tissue oxygenation. Compared with NS, treatment with LSP significantly ($p < 0.05$) decreased brain lesion size and swelling (51% and 54%, respectively).

CONCLUSION: In a clinically realistic combined TBI + HS model, early administration of plasma products decreases brain lesion size and edema. LSP is as effective as FFP, while offering many logistic advantages.

Shock. 2014 Jan 14. [Epub ahead of print]

THOR Position Paper on Remote Damage Control Resuscitation: Definitions, Current Practice and Knowledge Gaps.

Jenkins DH, Rappold JF, Badloe JF, Berséus O, Blackbourne L, Brohi KH, Butler FK, Cap AP, Cohen MJ, Davenport R, Depasquale M, Doughty H, Glassberg E, Hervig T, Hooper TJ, Kozar R, Maegele M, Moore EE, Murdock A, Ness PM, Pati S, Rasmussen T, Sailliol A, Schreiber MA, Sunde GA, van de Watering LM, Ward KR, Weiskopf RB, White NJ, Strandenes G, Spinella PC.

Conclusion: The concept of Remote Damage Control Resuscitation is in its infancy and there is a significant amount of work that needs to be done to improve outcomes for patients with life-threatening bleeding secondary to injury. The pre-hospital phase of their resuscitation is critical and if shock and coagulopathy can be rapidly identified and corrected prior to hospital admission this will likely reduce morbidity and mortality. The THOR Network is committed to improving outcomes for patients with traumatic injury through education, training and research. This position statement begins to standardize the terms used, provides an acceptable range of therapeutic options, and identifies the major knowledge gaps in the field.

J Trauma Nurs. 2014 Jan-Feb;21(1):22-9. doi: 10.1097/JTN.0000000000000025.

Increased mortality in adult patients with trauma transfused with blood components compared with whole blood.

Jones A, Frazier SK.

Abstract: Hemorrhage is a preventable cause of death among patients with trauma, and management often includes transfusion, either whole blood or a combination of blood components (packed red blood cells, platelets, fresh frozen plasma). We used the 2009 National Trauma Data Bank data set to evaluate the relationship between transfusion type and mortality in adult patients with major trauma (n = 1745). Logistic regression analysis identified 3 independent predictors of mortality: Injury Severity Score, emergency medical system transfer time, and type of blood transfusion, whole blood or components. Transfusion of whole blood was associated with reduced mortality; thus, it may provide superior survival outcomes in this population.

J Trauma Acute Care Surg. 2014 Feb;76(2):457-61. doi: 10.1097/TA.0b013e3182a9ea44.

The conjoint effect of reduced crystalloid administration and decreased damage-control laparotomy use in the development of abdominal compartment syndrome.

Joseph B, Zangbar B, Pandit V, Vercruysse G, Aziz H, Kulvatunyou N, Wynne J, O'Keeffe T, Tang A, Friese RS, Rhee P.

BACKGROUND: Anticipation of abdominal compartment syndrome (ACS) is a factor for performing damage-control laparotomy (DCL). Recent years have seen changes in resuscitation patterns and a decline in the use of DCL. We hypothesized that reductions in both crystalloid resuscitation and the use of DCL is associated with a reduced rate of ACS in trauma patients.

METHODS: We reviewed the records of all patients who underwent trauma laparotomies at our Level 1 trauma center over a 6-year period (2006-2011). We defined DCL as a trauma laparotomy in which the fascia was not closed at the initial operation. We defined ACS by elevated intravesical pressures and end-organ dysfunction. Our primary outcome measure was a development of ACS.

RESULTS: A total of 799 patients were included. We noted a significant decrease in the DCL rate (39% in 2006 vs. 8% in 2011, $p < 0.001$), the crystalloid volume per patient (mean [SD], 12.8 [7.8] L in 2006 vs. 6.6 [4.2] L in 2011; $p < 0.001$), rate of ACS (7.4% in 2006 vs. 0% in 2011, $p < 0.001$), and mortality rate (22.8% in 2006 vs. 10.6% in 2011, $p < 0.001$). However, we noted no significant changes in the mean Injury Severity Score (ISS) ($p = 0.09$), in the mean abdominal Abbreviated Injury Scale (AIS) score ($p = 0.17$), and in the mean blood product volume per patient ($p = 0.67$). On multivariate regression analysis, crystalloid resuscitation ($p = 0.01$) was the only significant factor associated with the development of ACS.

CONCLUSION: Minimizing the use of crystalloids and DCL was associated with better outcomes and virtual elimination of ACS in trauma patients. With the adaption of new resuscitation strategies, goals for a trauma laparotomy should be definitive surgical care with abdominal closure. ACS is a rare complication in the era of damage-control resuscitation and may have been iatrogenic.

LEVEL OF EVIDENCE: Epidemiologic/therapeutic study, level IV.

Crit Care Med. 2014 Jan;42(1):169-78. doi: 10.1097/CCM.0b013e31829a721f.

Advanced airway management simulation training in medical education: a systematic review and meta-analysis.

Kennedy CC, Cannon EK, Warner DO, Cook DA.

OBJECTIVE: To perform a systematic review and meta-analysis of the literature on teaching airway management using technology-enhanced simulation.

DATA SOURCES: We searched MEDLINE, EMBASE, CINAHL, PsycINFO, ERIC, Web of Science, and Scopus for eligible articles through May 11, 2011.

STUDY SELECTION: Observational or controlled trials instructing medical professionals in direct or fiberoptic intubation, surgical airway, and/or supraglottic airway using technology-enhanced simulation were included. Two reviewers determined eligibility.

DATA EXTRACTION: Study quality, instructional design, and outcome data were abstracted independently and in duplicate.

DATA SYNTHESIS: Of 10,904 articles screened, 76 studies were included (n = 5,226 participants). We used random effects meta-analysis to pool results. In comparison with no intervention, simulation training was associated with improved outcomes for knowledge (standardized mean difference, 0.77 [95% CI, 0.19-1.35]; n = 7 studies) and skill (1.01 [0.68-1.34]; n = 28) but not for behavior (0.52 [-0.30 to 1.34]; n = 4) or patient outcomes (-0.12 [-0.41 to 0.16]; n = 4). In comparison with nonsimulation interventions, simulation training was associated with increased learner satisfaction (0.54 [0.37-0.71]; n = 2), improved skills (0.64 [0.12-1.16]; n = 5), and patient outcomes (0.86 [0.12-1.59]; n = 3) but not knowledge (0.29 [-0.28 to 0.86]; n = 4). We found few comparative effectiveness studies exploring how to optimize the use of simulation-based training, and these revealed inconsistent results. For example, animal models were found superior to manikins in one study (p = 0.004) using outcome of task speed but inferior in another study in terms of skill ratings (p = 0.02). Five studies comparing simulators of high versus low technical sophistication found no significant difference in skill outcomes (p > 0.31). Limitations of this review include heterogeneity (I2 > 50% for most analysis) and variation in quality among primary studies.

CONCLUSIONS: Simulation-based airway management curriculum is superior to no intervention and nonsimulation intervention for important education outcomes. Further research is required to fine-tune optimal curricular design.

Support Care Cancer. 2014 Feb 8. [Epub ahead of print]

The use of Instanyl® in the treatment of breakthrough pain in cancer patients: a 3-month observational, prospective, cohort study.

Kongsgaard UE, Eeg M, Greisen H.

PURPOSE: Instanyl® (intranasal fentanyl spray) is a novel treatment for breakthrough pain (BTP) in cancer patients. It has shown a rapid onset of pain relief in clinical trials. This study examines the use of Instanyl® in real-life settings.

METHODS: A 3-month observational, prospective, cohort study of cancer patients with BTP receiving Instanyl® (50, 100, or 200 µg) under routine clinical practice. Data were collected at three time points corresponding with routine clinic visits - baseline, Week 4, and Week 13. Primary outcomes: success of titration and maintenance dose after titration. Secondary outcomes: change in maintenance dose of Instanyl® and level of background pain medication; Brief Pain Inventory-Short Form (BPI-SF) and Patient Treatment Satisfaction Scale (PTSS) scores; adverse drug reactions (ADRs).

RESULTS: Titration with Instanyl® was successful in 84.5 % of 309 patients; most patients were titrated at the lowest dose (50 µg). The majority showed no change in maintenance dose, with little change in the level of background pain medication. BPI-SF and PTSS scores significantly improved from baseline to Week 4. The main reason for terminating Instanyl® was death, as expected due to the underlying disease; incidence of ADRs was low and no fatal ADRs were reported.

CONCLUSIONS: In a real-life group of cancer patients with disease progression, Instanyl® was titrated successfully at doses <200 µg in the majority of patients, requiring only one dose, with no further change in maintenance dose. Pain severity, impact of pain on daily life, and treatment satisfaction significantly improved with Instanyl® treatment. No unexpected ADRs occurred.

J Spec Op Med 2013 Winter;13(4):85-93.

Management of Junctional Hemorrhage in Tactical Combat Casualty Care: TCCC Guidelines Proposed Change 13 - 03.

Kotwal RS, Butler FK, Gross KR, Kheirabadi BS, Baer DG, Dubick MA, Rasmussen TE, Weber MA, Bailey JA

Abstract: The vast majority of combat casualties who die from their injuries do so prior to reaching a medical treatment facility. Although most of these deaths result from nonsurvivable injuries, efforts to mitigate combat deaths can still be directed toward primary prevention through modification of techniques, tactics, and procedures and secondary prevention through improvement and use of personal protective equipment. For deaths that result from potentially survivable injuries, mitigation efforts should be directed toward primary and secondary prevention as well as tertiary prevention through medical care with an emphasis toward prehospital care as dictated by the fact that the preponderance of casualties die in the prehospital environment. Since the majority of casualties with potentially survivable injuries died from hemorrhage, priority must be placed on interventions, procedures, and training that mitigate death from truncal, junctional, and extremity exsanguination. In response to this need, multiple novel and effective junctional tourniquets have recently been developed.

J Trauma Acute Care Surg. 2013 Dec;75(6):947-53. doi: 10.1097/TA.0b013e3182a9676c.

The International Normalized Ratio overestimates coagulopathy in stable trauma and surgical patients.

McCully SP, Fabricant LJ, Kunio NR, Groat TL, Watson KM, Differding JA, Deloughery TG, Schreiber MA.

BACKGROUND: The international normalized ratio (INR) was developed to assess adequacy of Coumadin dosing. Its use has been generalized to guide fresh frozen plasma (FFP) therapy in stable patients. Thrombelastography (TEG) is a whole-blood assay measuring the viscoelastic properties of the clot in near real time. This study hypothesized that INR does not reflect coagulopathy and should not be used to guide FFP therapy in stable trauma and surgical patients.

METHODS: Prospective observational data were collected from stable trauma and surgical patients (n = 106) who received FFP transfusions. Pretransfusion and posttransfusion blood samples were obtained to assess complete blood count, standard coagulation parameters (INR, partial thromboplastin time, fibrinogen and D-dimer), soluble clotting factors (II, V, VII, VIII, IX, X, XI, XII, proteins C and S) and TEG. Data were analyzed using a Mann-Whitney U-test. Significance was defined as $p < 0.05$.

RESULTS: A total of 262 U of FFP were transfused, with 78% of 106 patients receiving two or more units. Despite a reduction in INR, median TEG values remained within normal limits, while clotting factor levels retained adequate function to produce normal clotting before and following FFP transfusion.

CONCLUSION: The use of FFP in this population did not affect coagulation status in a clinically relevant manner based on TEG values and coagulation factor function. INR is not a predictor of coagulopathy and should not be used to guide coagulation factor replacement in stable trauma and surgical patients.

LEVEL OF EVIDENCE: Diagnostic study, level III.

Br J Anaesth. 2013 Dec;111 Suppl 1:i71-82. doi: 10.1093/bja/aet376.

Update on massive transfusion.

Pham HP, Shaz BH.

Abstract: Massive haemorrhage requires massive transfusion (MT) to maintain adequate circulation and haemostasis. For optimal management of massively bleeding patients, regardless of aetiology (trauma, obstetrical, surgical), effective preparation and communication between transfusion and other laboratory services and clinical teams are essential. A well-defined MT protocol is a valuable tool to delineate how blood products are ordered, prepared, and delivered; determine laboratory algorithms to use as transfusion guidelines; and outline duties and facilitate communication between involved personnel. In MT patients, it is crucial to practice damage control resuscitation and to administer blood products early in the resuscitation. Trauma patients are often admitted with early trauma-induced coagulopathy (ETIC), which is associated with mortality; the aetiology of ETIC is likely multifactorial. Current data support that trauma patients treated with higher ratios of plasma and platelet to red blood cell transfusions have improved outcomes, but further clinical investigation is needed. Additionally, tranexamic acid has been shown to decrease the mortality in trauma patients requiring MT. Greater use of cryoprecipitate or fibrinogen concentrate might be beneficial in MT patients from obstetrical causes. The risks and benefits for other therapies (prothrombin complex concentrate, recombinant activated factor VII, or whole blood) are not clearly defined in MT patients. Throughout the resuscitation, the patient should be closely monitored and both metabolic and coagulation abnormalities corrected. Further studies are needed to clarify the optimal ratios of blood products, treatment based on underlying clinical disorder, use of alternative therapies, and integration of laboratory testing results in the management of massively bleeding patients.

J Emerg Med. 2014 Feb;46(2):304-7. doi: 10.1016/j.jemermed.2013.08.065. Epub 2013 Nov 1.

Emergent surgical airway: comparison of the three-step method and conventional cricothyroidotomy utilizing high-fidelity simulation.

Quick JA, Macintyre AD, Barnes SL.

BACKGROUND: Surgical airway creation has a high potential for disaster. Conventional methods can be cumbersome and require special instruments. A simple method utilizing three steps and readily available equipment exists, but has yet to be adequately tested.

OBJECTIVE: Our objective was to compare conventional cricothyroidotomy with the three-step method utilizing high-fidelity simulation.

METHODS: Utilizing a high-fidelity simulator, 12 experienced flight nurses and paramedics performed both methods after a didactic lecture, simulator briefing, and demonstration of each technique. Six participants performed the three-step method first, and the remaining 6 performed the conventional method first. Each participant was filmed and timed. We analyzed videos with respect to the number of hand repositions, number of airway instrumentations, and technical complications. Times to successful completion were measured from incision to balloon inflation.

RESULTS: The three-step method was completed faster (52.1 s vs. 87.3 s; $p = 0.007$) as compared with conventional surgical cricothyroidotomy. The two methods did not differ statistically regarding number of hand movements (3.75 vs. 5.25; $p = 0.12$) or instrumentations of the airway (1.08 vs. 1.33; $p = 0.07$). The three-step method resulted in 100% successful airway placement on the first attempt, compared with 75% of the conventional method ($p = 0.11$). Technical complications occurred more with the conventional method (33% vs. 0%; $p = 0.05$).

CONCLUSION: The three-step method, using an elastic bougie with an endotracheal tube, was shown to require fewer total hand movements, took less time to complete, resulted in more successful airway placement, and had fewer complications compared with traditional cricothyroidotomy.

Wilderness Environ Med. 2014 Jan 21. pii: S1080-6032(13)00267-6. doi: 10.1016/j.wem.2013.10.001. [Epub ahead of print]

Wilderness Medical Society Practice Guidelines for the Treatment of Acute Pain in Remote Environments.

Russell KW, Scaife CL, Weber DC, Windsor JS, Wheeler AR, Smith W, Wedmore I, McIntosh SE, Lieberman JR.

Abstract: The Wilderness Medical Society convened an expert panel to develop evidence-based guidelines for the management of pain in austere environments. Recommendations are graded based on the quality of supporting evidence as defined by criteria put forth by the American College of Chest Physicians.

Mil Med. 2014 Jan;179(1):42-8. doi: 10.7205/MILMED-D-13-00247.

Reliability and validity of a test designed to assess combat medics' readiness to perform life-saving procedures.

Schmitz CC, Chipman JG, Yoshida K, Vogel RI, Sainfort F, Beilman G, Clinton J, Cooper J, Reihsen T, Sweet RM.

OBJECTIVES: Reducing preventable deaths because of uncontrolled hemorrhage, tension pneumothorax, and airway loss is a priority. As part of a research initiative comparing different training models, this study evaluated the reliability and validity of a test that assesses combat medic performance during a polytrauma scenario using live animal models.

METHODS: Nine procedural checklists and seven global rating scales were piloted with four cohorts of soldiers (n = 94) at two U.S. training sites. Cohorts represented "novice" to "proficient" trainees. Procedure scores and a mean global score were calculated per subject. The intraclass correlation was calculated per procedure, with 0.70 as the threshold for acceptability. An overall difference among cohorts was hypothesized: Cohort 4 (proficient) > Cohort 3 (competent) > Cohort 2 (beginners) > Cohort 1 (novice) trainees. Data were analyzed using Kruskal-Wallis and analysis of variance.

RESULTS: At Site A, intraclass correlation coefficients ranged from 74% to 93% for 6 of 9 procedures. Cohorts differed significantly on hemorrhage control, needle compression, cricothyrotomy, amputation management, chest tube insertion, and mean global scores. Cohort 4 outperformed the others, and Cohorts 2 and 3 outperformed Cohort 1.

CONCLUSION: The test differentiates novices from beginners, competent, and proficient trainees on difficult procedures and overall performance.

Mil Med. 2014 Feb;179(2):114-20. doi: 10.7205/MILMED-D-13-00311.

Effects of training and simulated combat stress on leg tourniquet application accuracy, time, and effectiveness.

Schreckengaust R, Littlejohn L, Zarow GJ.

Abstract: The lower extremity tourniquet failure rate remains significantly higher in combat than in preclinical testing, so we hypothesized that tourniquet placement accuracy, speed, and effectiveness would improve during training and decline during simulated combat. Navy Hospital Corpsman (N = 89), enrolled in a Tactical Combat Casualty Care training course in preparation for deployment, applied Combat Application Tourniquet (CAT) and the Special Operations Forces Tactical Tourniquet (SOFT-T) on day 1 and day 4 of classroom training, then under simulated combat, wherein participants ran an obstacle course to apply a tourniquet while wearing full body armor and avoiding simulated small arms fire (paint balls). Application time and pulse elimination effectiveness improved day 1 to day 4 ($p < 0.005$). Under simulated combat, application time slowed significantly ($p < 0.001$), whereas accuracy and effectiveness declined slightly. Pulse elimination was poor for CAT (25% failure) and SOFT-T (60% failure) even in classroom conditions following training. CAT was more quickly applied ($p < 0.005$) and more effective ($p < 0.002$) than SOFT-T. Training fostered fast and effective application of leg tourniquets while performance declined under simulated combat. The inherent efficacy of tourniquet products contributes to high failure rates under combat conditions, pointing to the need for superior tourniquets and for rigorous deployment preparation training in simulated combat scenarios.

J Trauma Acute Care Surg. 2014 Jan;76(1):160-6. doi: 10.1097/TA.0b013e3182a9680e.

Injury patterns of soldiers in the second Lebanon war.

Schwartz D, Glassberg E, Nadler R, Hirschhorn G, Marom OC, Aharonson-Daniel L.

BACKGROUND: In the second Lebanon war in 2006, the Israeli Defense Forces fought against well-prepared and well-equipped paramilitary forces. The conflict took place near the Israeli border and major Israeli medical centers. Good data records were maintained throughout the campaign, allowing accurate analysis of injury characteristics. This study is an in-depth analysis of injury mechanisms, severity, and anatomic locations.

METHODS: Data regarding all injured soldiers were collected from all care points up to the definitive care hospitals and were cross-referenced. In addition, trauma branch physicians and nurses interviewed medical teams to validate data accuracy. Injuries were analyzed using Injury Severity Score (ISS) (when precise anatomic data were available) and multiple injury patterns scoring for all.

RESULTS: A total of 833 soldiers sustained combat-related injury during the study period, including 119 fatalities (14.3%). Although most soldiers (361) sustained injury only to one Abbreviated Injury Scale (AIS) region, the average number of regions per soldier was 2.0 but was 1.5 for survivors versus 4.2 for fatalities.

CONCLUSION: Current war injury classifications have limitations that hinder valid comparisons between campaigns and settings. In addition, limitation on full autopsy in war fatalities further hinders data use. To partly compensate for those limitations, we have looked at the correlation between fatality rates and number of involved anatomic regions and found it to be strong. We have also found high fatality rates in some "combined" injuries such as head and chest injuries (71%) or in the abdomen and an extremity (75%). The use of multiinjury patterns analysis may help understand fatality rates and improve the utility of war injury analysis.

LEVEL OF EVIDENCE: Epidemiologic study, level III.

Anaesth Intensive Care. 2013 Sep;41(5):623-30.

Training for cricothyroidotomy.

Shetty K, Nayyar V, Stachowski E, Byth K.

Abstract: Cricothyroidotomy is infrequently performed in the intensive care unit but may be a lifesaving procedure. The aim of this study was to determine the number of attempts required by trainees to gain adequate skills for a successful cricothyroidotomy (defined as lung inflation <60 seconds). The effect of training on time to completion of cricothyroidotomy was also studied. After viewing a demonstration video on the procedure, each participant attempted cricothyroidotomy five times consecutively on a manikin with a pre-assembled Melker cricothyroidotomy kit. Time from 'skin' palpation to 'lung' inflation was recorded for 30 participants. Time to completion of cricothyroidotomy decreased over consecutive attempts within each participant ($F_{4df=39.6}$; $P < 0.001$) and between participant variability in times recorded at each attempt also decreased ($P=0.04$). Overall improvement in time to completion was seen even between the fourth and fifth attempts (mean difference -6.3 seconds; $P < 0.001$). All participants were successful by the fifth attempt, by which stage all but two had been successful on two consecutive attempts. Age, years of postgraduate practice and level of seniority appeared to be associated with earlier success. Consecutive attempts on a manikin led to an improvement in the time to completion of cricothyroidotomy and rate of a successful outcome (<60 seconds). We recommend that clinicians undergo at least five training attempts on a manikin to gain proficiency in cricothyroidotomy.

Wilderness Environ Med. 2014 Jan 10. pii: S1080-6032(13)00335-9. doi: 10.1016/j.wem.2013.10.007. [Epub ahead of print]

They Had Me in Stitches: A Grand Canyon River Guide's Case Report and a Review of Wilderness Wound Management Literature.

Spano SJ, Dimock B.

Abstract: We present a case of failed conservative management of a traumatic wound sustained in a wilderness setting. The patient was initially treated with a povidone-iodine scrub, suture closure, and expectant management by 2 physicians who were paying clients on a multiday river rafting expedition. Empiric antibiotic coverage and irrigation of the dehisced wound were initiated several days after initial treatment. The patient arranged his own evacuation 8 days after injury. Hospitalization, intravenous (IV) antibiotics, and surgical debridement with wound vacuum placement led to a full recovery. This case presents several common wound care pitfalls. The sequelae to these pitfalls are more dramatic in a wilderness setting and underscore the importance of early aggressive management and considering prompt evacuation when treating wounds sustained in the wilderness.

J Trauma Acute Care Surg. 2013 Nov;75(5):882-7. doi: 10.1097/TA.0b013e3182a9005f.

External fixation for acute pelvic ring injuries: decision making and technical options.

Stahel PF, Mauffrey C, Smith WR, McKean J, Hao J, Burlew CC, Moore EE.

TAKE-HOME MESSAGE: Pelvic ring disruptions are potentially life-threatening injuries due to the risk of acute exsanguinating hemorrhage. The immediate management of unstable pelvic ring injuries consists of application of a pelvic binder or sheet to decrease the intrapelvic bleeding space. Decision-making strategies for ‘‘damage control’’ external fixation of pelvic ring injuries are guided by the underlying mechanism of injury reflected in the fracture classification by Young and Burgess. APC and LC injuries are best managed by anterior resuscitation frames, using either iliac crest or supraacetabular routes. Either modality has specific risks and limitations. While the iliac crest route is technically less demanding and faster for acute application, the pin pullout resistance is lower and associated with a higher risk of failure of reduction and fixation. In contrast, supraacetabular frames require diligent pin placement under fluoroscopic guidance. These frames have the benefit of a high resistance to failure due to the solid surgical corridor of the supraacetabular route. Vertically unstable pelvic ring disruptions are best stabilized by a posterior C-clamp. The surgeon must be aware of specific contraindications and a risk for severe technical complications using the C-clamp, which requires a high level of expertise for safe application.

Mil Med. 2013;178(11):1218-21. doi: 10.7205/MILMED-D-13-00141.

Self-rated readiness for performance of needle decompression in combat lifesaver training.

Studer NM, Horn GT, Armstrong JH.

BACKGROUND: The Combat Lifesaver course taught to nonmedical personnel includes instruction on performing needle thoracostomy to decompress tension pneumothorax, the second leading cause of preventable combat death. Although the Tactical Combat Casualty Care curriculum is pushed to the lowest level of battlefield first responders, the instruction of this advanced procedure is routinely limited to a verbal block of instruction with a standardized presentation.

OBJECTIVE: The purpose of this study was to assess the confidence of nonmedical personnel in their preparation to perform a needle thoracostomy before Combat Lifesaver training, after verbal instruction on the procedure, manikin training, and practice on a human cadaver.

METHODS: Confidence was assessed by Likert scale surveys, as well as free response remarks collected before and after training.

RESULTS: Self-rated preparedness scores improved significantly with each level of training. Maximal improvements followed cadaver training, from a mean score of 2.31/5 before instruction to 4.75/5 following cadaver training (matched pairs t test: $p < 0.005$).

CONCLUSIONS: Cadaver training provided the largest single educational confidence boost for needle decompression skills, and is an effective method of enhancing confidence in needle decompression.

Curr Opin Anaesthesiol. 2014 Feb 1. [Epub ahead of print]

Applying 'Patient Blood Management' in the trauma center.

Theusinger OM, Stein P, Spahn DR.

PURPOSE OF REVIEW: The purpose of this review is to highlight the use of tranexamic acid, point-of-care testing, algorithm-based treatment of trauma-associated coagulopathy with factor concentrates to reduce blood loss and transfusion requirements in order to improve outcome. In addition, the management of patients on new oral anticoagulants, drugs with renewed interest and the tolerance of relatively low hemoglobin levels in the context of trauma will be discussed.

RECENT FINDINGS: Early administration of tranexamic acid reduces mortality without increasing the risk of thromboembolic events. Point-of-care testing is increasingly recommended. Goal-directed individualized coagulation algorithms with the use of factor concentrates allow reducing the amount of allogeneic blood products to be administered. Treatment of trauma patients with one of the new oral anticoagulants is challenging. Furthermore, new mechanisms have been discovered such as deep neuromuscular blockade to better tolerate acute anemia.

SUMMARY: Applying Patient Blood Management concept to the trauma patient is possible and efficacious. Antihyperfibrinolytics such as tranexamic acid, point-of-care testing and coagulation algorithms with the use of factor concentrates allow a reduction of the number of transfusions, the costs and will likely ameliorate outcome of major trauma patients.

Mil Med. 2013 Sep;178(9):981-5. doi: 10.7205/MILMED-D-13-00074.

Using augmented reality as a clinical support tool to assist combat medics in the treatment of tension pneumothoraces.

Wilson KL, Doswell JT, Fashola OS, Debeatham W, Darko N, Walker TM, Danner OK, Matthews LR, Weaver WL.

Abstract: This study was to extrapolate potential roles of augmented reality goggles as a clinical support tool assisting in the reduction of preventable causes of death on the battlefield. Our pilot study was designed to improve medic performance in accurately placing a large bore catheter to release tension pneumothorax (prehospital setting) while using augmented reality goggles. Thirty-four preclinical medical students recruited from Morehouse School of Medicine performed needle decompressions on human cadaver models after hearing a brief training lecture on tension pneumothorax management. Clinical vignettes identifying cadavers as having life-threatening tension pneumothoraces as a consequence of improvised explosive device attacks were used. Study group (n = 13) performed needle decompression using augmented reality goggles whereas the control group (n = 21) relied solely on memory from the lecture. The two groups were compared according to their ability to accurately complete the steps required to decompress a tension pneumothorax. The medical students using augmented reality goggle support were able to treat the tension pneumothorax on the human cadaver models more accurately than the students relying on their memory ($p < 0.008$). Although the augmented reality group required more time to complete the needle decompression intervention ($p = 0.0684$), this did not reach statistical significance.

J Spec Oper Med. 2013 Fall;13(3):92-7.

Operator Training and TEMS Support: A Survey of Unit Leaders in Northern and Central California.

Young JB, Galante JM, Sena MJ.

Background: Members of Special Weapons and Tactics (SWAT) teams routinely work in high-risk tactical situations. Awareness of the benefit of Tactical Emergency Medical Support (TEMS) is increasing but not uniformly emphasized.

Objectives: To characterize the current regional state of tactical medicine and identify potential barriers to more widespread implementation. Methods: A multiple-choice survey was administered to SWAT team leaders of 22 regional agencies in northern and central California. Questions focused on individual officer self-aid and buddy care training, the use and content of individual first aid kits (IFAKs), and the operational inclusion of a dedicated TEMS provider. Results: Respondents included city police (54%), local county sheriff (36%), state law enforcement (5%), and federal law enforcement (5%). Results showed that 100% of respondents thought it was very important for SWAT officers to understand the basics of self-aid and buddy care and to carry an IFAK, while only 71% of respondents indicated that team members actually carried an IFAK. In addition, 67% indicated that tourniquets were part of the IFAK, and 91% of surveyed team leaders thought it was very important for teams to have a trained medic available onsite at callouts or high-risk warrant searches. Also, 59% of teams used an organic TEMS element.

Conclusion: The majority of SWAT team leaders recognize the benefit of basic Operator medical training and the importance of a TEMS program. Despite near 100% endorsement by unit-level leadership, a significant proportion of teams are lacking one of the key components including Operator IFAKs and/or tourniquets. Tactical team leaders, administrators, and providers should continue to promote adequate Operator training and equipment as well as formal TEMS support.