# Tactical Combat Casualty Care

# Journal Article Abstracts


**Committee on Tactical Combat Casualty Care**

**May 2017**

# Abstracts

**BMC Med Educ. 2017 Mar 2;17(1):50. doi: 10.1186/s12909-017-0882-7.**

## Intraosseous access can be taught to medical students using the four-step approach.

**Afzali M, Kvisselgaard A, Lyngeraa T, Viggers S**

**BACKGROUND:** The intraosseous (IO) access is an alternative route for vascular access when peripheral intravascular catheterization cannot be obtained. In Denmark the IO access is reported as infrequently trained and used. The aim of this pilot study was to investigate if medical students can obtain competencies in IO access when taught by a modified Walker and Peyton's four-step approach.

**METHODS:** Nineteen students attended a human cadaver course in emergency procedures. A lecture was followed by a workshop. Fifteen students were presented with a case where IO access was indicated and their performance was evaluated by an objective structured clinical examination (OSCE) and rated using a weighted checklist. To evaluate the validity of the checklist, three raters rated performance and Cohen's kappa was performed to assess inter-rater reliability (IRR). To examine the strength of the overall IRR, Randolph's free-marginal multi rater kappa was used.

**RESULTS:** A maximum score of 15 points was obtained by nine (60%) of the participants and two participants (13%) scored 13 points with all three raters. Only one participant failed more than one item on the checklist. The expert rater rated lower with a mean score of 14.2 versus the non-expert raters with mean 14.6 and 14.3. The overall IRR calculated with Randolph's free-marginal multi rater kappa was 0.71.

**CONCLUSION:** The essentials of the IO access procedure can be taught to medical students using a modified version of the Walker and Peyton's four-step approach and the checklist used was found reliable.

**Neurosurg Clin N Am. 2017 Apr;28(2):267-278**

## Neurocritical Care of Acute Subdural Hemorrhage.

**Al-Mufti F, Mayer S**

**Abstract:**
Although urgent surgical hematoma evacuation is necessary for most patients with subdural hematoma (SDH), well-orchestrated, evidenced-based, multidisciplinary, postoperative critical care is essential to achieve the best possible outcome. Acute SDH complicates approximately 11% of mild to moderate traumatic brain injuries (TBIs) that require hospitalization, and approximately 20% of severe TBIs. Acute SDH usually is related to a clear traumatic event, but in some cases can occur spontaneously. Management of SDH in the setting of TBI typically conforms to the Advanced Trauma Life Support protocol with airway taking priority, and management breathing and circulation occurring in parallel rather than sequence.

**Emerg Med Int. 2017;2017:4235785. doi: 10.1155/2017/4235785.**

## Tranexamic Acid (TXA) in Trauma Patients: Barriers to Use among Trauma Surgeons and Emergency Physicians.

**Alburaih A**

**Objective:** Tranexamic Acid (TXA) is currently the only drug with prospective clinical evidence supporting its use in bleeding trauma patients. We sought to better understand the barriers preventing its use and elicit suggestions to further its use in trauma patients in the state of Maryland.

**Methods:** This is a cross-sectional study. Results. The overall response rate was 38%. Half of all participants reported being familiar with the CRASH-2 trial and MATTERs study. Half reported being aware of TXA as part of their institution's massive transfusion protocol. The majority of participants felt that TXA would have a significant positive impact on the survival of trauma patients. A majority also felt that the use of TXA would increase if its administration was the responsibility of both trauma surgeons and emergency physicians.

**Conclusion:** Only half of responders reported being aware of TXA as being part of their institution's massive transfusion protocol. Lack of awareness of the clinical data supporting its use is a major barrier. However, most trauma providers and emergency physicians do have a favorable view of TXA and support its incorporation into massive transfusion protocols. We believe that more studies of this kind on both state and national level are needed.

**J Trauma Acute Care Surg. 2017 May;82(5):910-914**

## Resuscitative endovascular balloon occlusion of the aorta or resuscitative thoracotomy with aortic clamping for noncompressible torso hemorrhage: A retrospective nationwide study.

**Aso S, Matsui H, Fushimi K, Yasunaga H.**

**BACKGROUND:** Resuscitative endovascular balloon occlusion of the aorta (REBOA) is an emerging treatment for noncompressible torso hemorrhage. It remains unclear if REBOA is superior to resuscitative thoracotomy with aortic cross-clamping (RT) in terms of improving outcomes. This study compared in-hospital outcomes between REBOA and RT in trauma patients with uncontrolled hemorrhagic shock, using data from a national inpatient database in Japan.

**METHODS:** Using the Diagnosis Procedure Combination database, we identified patients who received REBOA or RT within 1 day after admission from July 1, 2010, to March 31, 2014. We excluded those with penetrating thoracic injuries. Propensity score-adjusted analyses were performed to compare in-hospital mortality and other in-hospital outcomes.

**RESULTS:** Eligible patients (n = 259) were classified into the REBOA group (n = 191) or the RT group (n = 68). In the propensity score-adjusted Cox regression analysis, the two groups did not differ significantly with respect to in-hospital mortality (hazard ratio, 0.94; 95% confidence interval, 0.60-1.48). There were also no significant differences between the groups in ventilator-free days, intensive care unit-free days, total amount of fluid infusion within 1 day after admission, total amount of transfusion within 1 day after admission, or total hospitalization costs.

**CONCLUSION:** In this retrospective nationwide study, in-hospital outcomes were not significantly different between REBOA and RT in trauma patients with uncontrolled hemorrhagic shock.

**LEVEL OF EVIDENCE:** Therapeutic/care management, level III.

**J Emerg Med. 2017 Mar 1. pii: S0736-4679(17)30024-0. doi: 10.1016/j.jemermed.2017.01.020. [Epub ahead of print]**

# Review of Intranasally Administered Medications for Use in the Emergency Department.

**Bailey A, Baum R, Horn K, Lewis T, Morizio K, Schultz A, Weant K, Justice S**

**BACKGROUND:** Intranasal (IN) medication delivery is a viable alternative to other routes of administration, including intravenous (IV) and intramuscular (IM) administration. The IN route bypasses the risk of needle-stick injuries and alleviates the emotional trauma that may arise from the insertion of an IV catheter.

**OBJECTIVE:** This review aims to evaluate published literature on medications administered via the IN route that are applicable to practice in emergency medicine.

**DISCUSSION:** The nasal mucosa is highly vascularized, and the olfactory tissues provide a direct conduit to the central nervous system, bypass first-pass metabolism, and lead to an onset of action similar to IV drug administration. This route of administration has also been shown to decrease delays in drug administration, which can have a profound impact in a variety of emergent scenarios, such as seizures, acutely agitated or combative patients, and trauma management. IN administration of midazolam, lorazepam, flumazenil, dexmedetomidine, ketamine, fentanyl, hydromorphone, butorphanol, naloxone, insulin, and haloperidol has been shown to be a safe, effective alternative to IM or IV administration. As the use of IN medications becomes a more common route of administration in the emergency department setting, and in prehospital and outpatient settings, it is increasingly important for providers to become more familiar with the nuances of this novel route of medication delivery.

**CONCLUSIONS:** IN administration of the reviewed medications has been shown to be a safe and effective alternative to IM or IV administration. Use of IN is becoming more commonplace in the emergency department setting and in prehospital settings.

**J Trauma Acute Care Surg. 2017 May;82(5):952-955.**

## Clinical features of 27 shark attack cases on La Réunion Island.

**Ballas R, Saetta G, Peuchot C, Elkienbaum P, Poinsot E.**

**BACKGROUND:** Between January 2000 and September 2016, there have been 27 documented shark attacks on La Réunion Island. The insular nature of La Réunion has allowed us to perform an extensive survey of these attacks. The objective was to describe the clinical features of these shark attacks, as only case reports have been published up to now.

**METHODS:** This was a retrospective observational study of the 27 cases of nonprovoked shark attacks that have occurred between January 2000 and September 2016. Post-mmortem predation, provoked attacks, and isolated attack on devices were excluded. All bone and vascular injuries were documented in the 21 remaining cases. Prehospital tourniquet use was specifically recorded.

**RESULTS:** Among the 21 victims, eight died (38%) despite rapid use of resuscitation techniques in five cases when it was feasible; these techniques were not needed in the survivors. Thirteen patients were immediately treated in the operating room. Amputation or disarticulation occurred 13 times in 10 victims, five of whom died. Twelve injuries to major vascular structures were found in 11 victims, six of which died. A prehospital tourniquet was applied in four of the five surviving victims who had injuries to major vascular structures (including one victim with major humeral and femoral artery damage) and in one victim who died (the very proximal wound was not controlled).

**CONCLUSION:** Our study found that quickly applying a tourniquet to the injured limb(s) contributes to the victim's survival. Disarticulation is a particular feature of shark attacks. The number and severity of shark attacks at La Réunion Island are worse than in the rest of the world.

**LEVEL OF EVIDENCE:** Epidemiological, level V.

**J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S96-S102.**

# Deployed skills training for whole blood collection by a special operations expeditionary surgical team.

**Benavides L, Smith I, Benavides J, Bowley D, Doughty H, Lundy J**

**BACKGROUND:** Noncompressible hemorrhage is the leading cause of potentially preventable battlefield death. Combining casualty retrieval from the battlefield and damage control resuscitation (DCR) within the "golden hour" increases survival. However, transfusion requirements may exceed the current blood component stocks held by forward surgical teams. Warm fresh whole blood (WFWB) is an alternative. We report WFWB transfusion training developed by and delivered to a US Golden Hour Offset Surgical Treatment Team and the resulting improvement in confidence with WFWB transfusion.

**METHODS:** A bespoke instructional package was derived from existing operational clinical guidelines. All Golden Hour Offset Surgical Treatment Team personnel completed initial training, reinforced through ongoing casualty simulations. A record of blood types and donor eligibility was established to facilitate rapid identification of potential WFWB donors. Self-reported confidence in seven aspects of the WFWB transfusion process was assessed before and after training using a five-point Likert scale. Personnel were analyzed by groups consisting of those whose operational role includes WFWB transfusion ("transfusers"), clinical personnel without such responsibilities ("nontransfusers") and nonclinical personnel (other). Comparisons within and between groups were made using appropriate nonparametric tests.

**RESULTS:** Data were collected from 39 (89%) of 44 training participants: 24 (62%) transfusers, 12 (31%) nontransfusing clinicians, and 3 (8%) other personnel. Transfusers and nontransfusers reported increased comfort with all practical elements of WFWB transfusion. The confidence of other personnel also increased, but (likely due to small numbers) was not statistically significant.

**CONCLUSION:** WFWB transfusion is an integral part of modern deployed military remote DCR. Our in-theater training program rapidly and reproducibly enhanced the comfort in WFWB transfusion in providers from a range of backgrounds and skill-mixes. This model has the potential to improve both safety and effectiveness of WFWB remote DCR in the far-forward deployed setting.

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

**Wilderness Environ Med. 2017 Jun;28(2S):S39-S49.**

## Bleeding Control Using Hemostatic Dressings: Lessons Learned.

**Bennett B**

**Abstract:**
Based on lessons learned, many military battlefield trauma advances ultimately transition to enhance civilian trauma care. However, even with major strides to enhance battlefield hemorrhage control, it is unclear how effectively these techniques and products are being translated to civilian trauma. The purpose of this brief review is to present the evidence of current hemostatic product effectiveness, determine the evidence for transitioning of this technology to prehospital civilian application, and provide recommendations about potential use in the wilderness/austere setting. It is concluded that there is adequate evidence of hemorrhage control effectiveness in both military and civilian preclinical studies and clinical case series. The Committee on Tactical Combat Casualty Care recommends implementing approved hemostatic dressings as one part of a comprehensive hemorrhage control training and clinical management program. These recommendations for hemostatic dressings use by public safety and laypersons should be applied in acute transport urban settings or during prolonged care in austere environments.

**Wilderness Environ Med. 2017 Jun;28(2S):S3-S4.**

## Tactical Combat Casualty Care: Transitioning Battlefield Lessons Learned to Other Austere Environments.

**Bennett B, Butler F, Wedmore I**

**Quote:**

"The Wilderness Medical Society hosted a 2-day preconference (July 30 and 31, 2016), titled "Tactical Combat Casualty Care: Transitioning Battlefield Lessons Learned to Other Austere Environments," in conjunction with the Seventh World Congress of Mountain & Wilderness Medicine in Telluride, CO. The audience included an array of civilian and military medical providers: trauma team members, physicians, physician assistants, nurses, paramedics, emergency medical technicians (EMTs), wilderness medicine first responders, EMS rotary evacuation teams, search and rescue personnel, wilderness and EMS medical directors, special weapons and tactic medics/physicians, and conventional and special operation forces military medical department personnel.

The preconference objectives were to 1) explain the historical overview of Tactical Combat Casualty Care (TCCC); 2) describe how the first set of TCCC Guidelines (1996) transitioned into a standing TCCC Committee that was tasked with maintaining, developing, and updating the guidelines with evidence-based research; 3) discuss the evolution of the TCCC Guidelines from 1997 to present; 3) describe the key topic updates to the TCCC Guidelines; 4) explain the ongoing TCCC process improvements and measures of effectiveness; 5) describe the key lessons learned with TCCC Guidelines and how they have transitioned into some key civilian programs; and 6) emphasize how the TCCC Guidelines can be applied in any austere environment. Faculty included military and civilian subject matter experts, clinicians, researchers, and trauma advisers to the CoTCCC, the group responsible for developing and advancing TCCC medical practice guidelines as published in the Prehospital Trauma Life Support manual."

**J Trauma Acute Care Surg. 2017 Apr 5. doi: 10.1097/TA.0000000000001481. [Epub ahead of print]**

# Battlefield pain management: A view of 17 years in Israel Defense Forces.

**Benov A, Salas M, Nakar H, Antebi B, Tarif B, Yitzhak A, Glassberg E.**

**INTRODUCTION:** Pain control in trauma is an integral part of treatment in combat casualty care (CCC). More soldiers injured on the battlefield will need analgesics for pain than those who will need life-saving interventions (LSI). It has been shown that early treatment of pain improves outcomes after traumatic injury, while inadequate treatment leads to higher rates of PTSD. The purpose of this article is to report the Israel Defense Forces Medical Corps (IDF-MC) experience with point of injury (POI) use of analgesia.

**METHODS:** All cases documented in the IDF Trauma Registry (ITR) between January 1997 and December 2014 were examined. All cases of POI pain medications were extracted. Data collection included mechanism of injury, wound distribution, pain medication administered, mortality, and provider type.

**RESULTS:** Of 8,576 patients, 1,056 (12.3%) patients who had at least one documented pain management treatment were included in this study. Demographics of the study population included 94.2% male and 5.8% female with a median age of 21 years. Injury mechanisms included 40.3% blast injuries (n=426) and 29% gunshot injuries (306). Of 1,513 injured body regions reported, 52% (787) were extremity wounds (upper and lower), 23% (353) were truncal wounds, and 17.7% (268) were head and neck injuries. A total of 1,469 episodes of analgesic treatment were reported. The most common types of analgesics were morphine (74.7%, 1097 episodes), ketamine (9.6%, 141 episodes) and fentanyl (13.6%, 200 episodes). Of the patients, 39% (413) received more than one type of analgesic. In 90.5% of cases, analgesia was administered by a physician or a paramedic. Over the span of the study period (1997-2014), types of analgesics given by providers at POI had changed, as fentanyl was introduced to providers. A total of 801 LSIs were performed on 379 patients (35.9%) receiving analgesia and no adverse events were found in any of the casualties.

**CONCLUSION:** Most casualties at POI did not receive any analgesics while on the battlefield. The most common analgesics administered at POI were opioids and the most common route of administration was intravenously (IV). This study provides evidence that over time analgesic administration has gained acceptance and has been more common place on the battlefield. Increasingly, more casualties are receiving pain management treatment early in CCC along with LSIs. We hope that this shift will impact CCC by reducing PTSD and overall morbidity resulting from inadequate management of acute pain.

**J Trauma Acute Care Surg. 2017 Apr 5. doi: 10.1097/TA.0000000000001474. [Epub ahead of print]**

# The effect of blood transfusion on compensatory reserve: A prospective clinical trial.

**Benov A, Yaslowitz O, Hakim T, Amir-Keret R, Nadler R, Brand A, Glassberg E, Yitzhak A, Convertino V, Paran H.**

**BACKGROUND:** Bleeding activates the body's compensatory mechanisms, causing changes in vital signs to appear late in the course of progressive blood loss. These vital signs are maintained even when up to 30% to 40% of blood volume is lost. Laboratory tests such as hemoglobin, hematocrit, lactate, and base deficit levels do not change during acute phase of bleeding. The compensatory reserve measurement (CRM) represents a new paradigm that measures the total of all physiological compensatory mechanisms, using noninvasive photoplethysmography to read changes in arterial waveforms. This study compared CRM to traditional vital signs and laboratory tests in actively bleeding patients.

**METHODS:** Study patients had gastrointestinal bleeding and required red blood cell (RBC) transfusion (n=31). Control group patients had similar demographic and medical backgrounds. They were undergoing minor surgical procedures and not expected to receive RBC transfusion. Vital signs, mean arterial pressure, pulse pressure, hemoglobin and hematocrit levels, and CRM were recorded before and after RBC transfusion or the appropriate time interval for the control group. Receiver operator characteristic (ROC) curves were plotted and areas under the curves (AUCs) were compared.

**RESULTS:** CRM increased 10.5% after RBC transfusion, from 0.77 to 0.85 ($p<0.005$). Hemoglobin level increased 22.4% after RBC transfusion from 7.3 to 8.7 ($p<0.005$). Systolic and diastolic blood pressure, mean arterial pressure, pulse pressure and heart rate did change significantly. The AUC for CRM as a single measurement for predicting hemorrhage at admission was 0.79, systolic blood pressure was 0.62, for heart rate was 0.60 and pulse pressure was 0.36.

**CONCLUSIONS:** This study demonstrated that CRM is more sensitive to changes in blood volume than traditional vital signs are and could be used to monitor and assess resuscitation of actively bleeding patients.

**LEVEL OF EVIDENCE:** II INDICATE STUDY TYPE: Care Management.

**Wilderness Environ Med. 2017 Apr 19. pii: S1080-6032(17)30060-1. doi: 10.1016/j.wem.2017.01.030. [Epub ahead of print]**

# Belts Evaluated as Limb Tourniquets: BELT Study Comparing Trouser Supporters Used as Medical Devices in a Manikin Model of Wound Bleeding.

**Bequette B, Kragh J, Aden J, Dubick M**

**OBJECTIVE:** The purpose of the present study is to compare several models of commercially designed belts as used as a tourniquet.

**METHODS:** In the Belts Evaluated as Limb Tourniquets (BELT) study, an experiment was designed to test the effectiveness of pants belts as nonimprovised medical devices to control hemorrhage in a manikin. Models of belts included Tourni-belt, Tourniquet Belt, ParaBelt, and Battle Buddy. Data collected included effectiveness, time to stop bleeding, total time of application, pressure, blood loss, and composite results (score count of good results; composite outcome good if every component was good).

**RESULTS:** Differences in effectiveness percentages among models were not statistically significant. The difference in mean between users was statistically significant for stop time, total time, pressure, blood loss, composite score, and composite outcome. Mean time to stop bleeding differed for only 1 pair of models after the Tukey-Kramer adjustment; ParaBelt was faster than Tourniquet Belt. Mean total time of application differed between ParaBelt-Tourniquet Belt and Tourni-belt-Tourniquet Belt; the former model in both pairs was faster. No significant difference in mean blood loss measured by model was found. For composite outcome score, no pairwise difference between models was significant. For composite outcome (good-bad), ParaBelt had good results in 75% of tests; the other 3 models had significantly worse results.

**CONCLUSIONS:** In a preliminary laboratory analysis of belt tourniquet models using a manikin, performance differed by model. ParaBelt performed better than other models for the composite outcome.

**JAMA. 2017 Feb 21;317(7):738-747. doi: 10.1001/jama.2016.21037.**

# Effect of Fibrinogen Concentrate on Intraoperative Blood Loss Among Patients With Intraoperative Bleeding During High-Risk Cardiac Surgery: A Randomized Clinical Trial.

**Bilecen S, de Groot J, Kalkman C, Spanjersberg A, Brandon Bravo Bruinsma G, Moons K, Nierich A**

**Importance:** Fibrinogen concentrate might partly restore coagulation defects and reduce intraoperative bleeding.

**Objective:** To determine whether fibrinogen concentrate infusion dosed to achieve a plasma fibrinogen level of 2.5 g/L in high-risk cardiac surgery patients with intraoperative bleeding reduces intraoperative blood loss.

**Design, Setting, and Participants:** A randomized, placebo-controlled, double-blind clinical trial conducted in Isala Zwolle, the Netherlands (February 2011-January 2015), involving patients undergoing elective, high-risk cardiac surgery (ie, combined coronary artery bypass graft [CABG] surgery and valve repair or replacement surgery, the replacement of multiple valves, aortic root reconstruction, or reconstruction of the ascending aorta or aortic arch) with intraoperative bleeding (blood volume between 60 and 250 mL suctioned from the thoracic cavity in a period of 5 minutes) were randomized to receive either fibrinogen concentrate or placebo.

**Interventions:** Intravenous, single-dose administration of fibrinogen concentrate (n = 60) or placebo (n = 60), targeted to achieve a postinfusion plasma fibrinogen level of 2.5 g/L.

**Main Outcomes and Measures:** The primary outcome was blood loss in milliliters between intervention (ie, after removal of cardiopulmonary bypass) and closure of chest. Safety variables (within 30 days) included: in-hospital mortality, myocardial infarction, cerebrovascular accident or transient ischemic attack, renal insufficiency or failure, venous thromboembolism, pulmonary embolism, and operative complications.

**Results:** Among 120 patients (mean age; 71 [SD, 10] years, 37 women [31%]) included in the study, combined CABG and valve repair or replacement surgery comprised 72% of procedures and had a mean (SD) cardiopulmonary bypass time of 200 minutes (83) minutes. For the primary outcome, median blood loss in the fibrinogen group was 50 mL (interquartile range [IQR], 29-100 mL) compared with 70 mL (IQR, 33-145 mL) in the control group (P = .19), the absolute difference 20 mL (95% CI, -13 to 35 mL). There were 6 cases of stroke or transient ischemic attack (4 in the fibrinogen group); 4 myocardial infarctions (3 in the fibrinogen group); 2 deaths (both in the fibrinogen group); 5 cases with renal insufficiency or failure (3 in the fibrinogen group); and 9 cases with reoperative thoracotomy (4 in the fibrinogen group).

**Conclusions and Relevance:** Among patients with intraoperative bleeding during high-risk cardiac surgery, administration of fibrinogen concentrate, compared with placebo, resulted in no significant difference in the amount of intraoperative blood loss.

**BMJ Open. 2017 Mar 29;7(3):e014472.**

## Transfusion of red blood cells in patients with traumatic brain injuries admitted to Canadian trauma health centres: a multicentre cohort study.

**Boutin A, Moore L, Lauzier F, Chassé M, English S, Zarychanski R, McIntyre L, Griesdale D, Fergusson D, Turgeon A**

**BACKGROUND:** Optimisation of healthcare practices in patients sustaining a traumatic brain injury is of major concern given the high incidence of death and long-term disabilities. Considering the brain's susceptibility to ischaemia, strategies to optimise oxygenation to brain are needed. While red blood cell (RBC) transfusion is one such strategy, specific RBC strategies are debated. We aimed to evaluate RBC transfusion frequency, determinants of transfusions and associated clinical outcomes.

**METHODS:** We conducted a retrospective multicentre cohort study using data from the National Trauma Registry of Canada. Patients admitted with moderate or severe traumatic brain injury to participating hospitals between April 2005 and March 2013 were eligible. Patient information on blood products, comorbidities, interventions and complications from the Discharge Abstract Database were linked to the National Trauma Registry data. Relative weights analyses evaluated the contribution of each determinant. We conducted multivariate robust Poisson regression to evaluate the association between potential determinants, mortality, complications, hospital-to-home discharge and RBC transfusion. We also used proportional hazard models to evaluate length of stay for time to discharge from ICU and hospital.

**RESULTS:** Among the 7062 patients with traumatic brain injury, 1991 patients received at least one RBC transfusion during their hospital stay. Female sex,anaemia, coagulopathy, sepsis, bleeding, hypovolemic shock, other comorbid illnesses, serious extracerebral trauma injuries were all significantly associated with RBC transfusion. Serious extracerebral injuries altogether explained 61% of the observed variation in RBC transfusion. Mortality (risk ratio (RR) 1.23 (95% CI 1.13 to 1.33)), trauma complications (RR 1.38 (95% CI 1.32 to 1.44)) and discharge elsewhere than home (RR 1.88 (95% CI 1.75 to 2.04)) were increased in patients who received RBC transfusion. Discharge from ICU and hospital were also delayed in transfused patients.

**CONCLUSIONS:** RBC transfusion is common in patients with traumatic brain injury and associated with unfavourable outcomes. Trauma severity is an important determinant of RBC transfusion. Prospective studies are needed to further evaluate optimal transfusion strategies in traumatic brain injury.

**Am J Emerg Med. 2017 Feb;35(2):227-233.**

## Comparison of tranexamic acid plasma concentrations when administered via intraosseous and intravenous routes.

**Boysen S, Pang J, Mikler J, Knight C, Semple H, Caulkett N**

**INTRODUCTION:** There is a lack of information regarding intraosseous (IO) administration of tranexamic acid (TXA). Our hypothesis was that a single bolus IO injection of TXA will have a similar pharmacokinetic profile to TXA administered at the same dose IV.

**METHODS:** Sixteen male Landrace cross swine (mean body weight 27.6±2.6kg) were divided into an IV group (n=8) and an IO group (n=8). Each animal received 30mg/kg TXA via an IV or IO catheter, respectively. Jugular blood samples were collected for pharmacokinetic analysis over a 3h period. The maximum TXA plasma concentration (Cmax) and corresponding time as well as distribution half-life, elimination half-life, area under the curve, plasma clearance and volume of distribution were calculated. One- and two-way analysis of variance for repeated measures (time, group) with Tukey's and Bonferonni post hoc tests were used to compare TXA plasma concentrations within and between groups, respectively.

**RESULTS:** Plasma concentrations of TXA were significantly higher ($p<0.0001$) in the IV group during the TXA infusion. Cmax occurred at 4min after initiation of the bolus in the IV group (9.36±3.20ng/μl) and at 5min after initiation of the bolus in the IO group (4.46±0.49ng/μl). Plasma concentrations were very similar from the completion of injection onwards. There were no significant differences between the two administration routes for any other pharmacokinetic variables measured.

**CONCLUSION:** The results of this study support pharmacokinetic bioequivalence of IO and IV administration of TXA.

**Emerg Med Clin North Am. 2017 May;35(2):391-407.**

**Tactical Combat Casualty Care and Wilderness Medicine: Advancing Trauma Care in Austere Environments.**

**Butler F, Bennett B, Wedmore C**

**ABSTRACT:**
Tactical Combat Casualty Care (TCCC) is a set of evidence-based, best-practice prehospital trauma care guidelines customized for use on the battlefield. Military units that have trained all of their unit members in TCCC have now documented the lowest incidence of preventable deaths in the history of modern warfare and TCCC is now the standard for battlefield trauma care in the US Military. TCCC and wilderness medicine share the goal of optimizing care for patients with trauma in austere environments that impose significant challenges in both equipment and evacuation capability. This article reviews the current battlefield trauma care recommendations in TCCC and discusses their applicability to the wilderness setting.

**J Trauma Acute Care Surg. 2017 Jun;82 (6S Suppl 1):S16-S25.**

# Leadership lessons learned in Tactical Combat Casualty Care.

**Butler F**

**Abstract**
The US Military has achieved remarkable success in improving survival for our nation's combat wounded throughout the 14 years of conflict in Iraq and Afghanistan. For the prehospital phase of care, where most combat fatalities occur, these advances have been embodied in Tactical Combat Casualty Care (TCCC.) TCCC is a set of evidence-based, best-practice, prehospital trauma care guidelines that are customized for use on the battlefield. The TCCC Guidelines have been updated on an ongoing basis over the last 15 years through the work of the Committee on TCCC and the TCCC Working Group. The process of developing improvements in battlefield trauma care and advocating for them to be implemented throughout the US Military was lengthy, challenging, and evolutionary. This paper describes the major leadership lessons learned in the TCCC effort during the 20 years from its inception to the present.

**Wilderness Environ Med. 2017 Jun;28(2S):S12-S17.**

# Tactical Combat Casualty Care: Beginnings.

**Butler F**

**ABSTRACT:**
Tactical Combat Casualty Care (TCCC) is a set of evidence-based, best-practice prehospital trauma care guidelines customized for use on the battlefield. The origins of TCCC were nontraditional. The TCCC program began as a Naval Special Warfare biomedical research effort launched after the realization that extremity hemorrhage, a leading cause of preventable death on the battlefield, was not being treated with a readily available and highly effective intervention: the tourniquet. This insight prompted a systematic reevaluation of all aspects of battlefield trauma care that was conducted from 1993 to 1996 as a joint effort by special operations medical personnel and the Uniformed Services University of the Health Sciences. The product of that 3-year research project was TCCC, the first-ever set of battlefield trauma care guidelines designed to combine good medicine with good small-unit tactics.

**Mil Med. 2017 Mar;182(3):e1563-e1568.**

## Two Decades of Saving Lives on the Battlefield: Tactical Combat Casualty Care Turns 20.

**Butler F**

**BACKGROUND:** Twenty years ago, the original Tactical Combat Casualty Care (TCCC) article was published in this journal. Since TCCC is essentially a set of best-practice prehospital trauma care guidelines customized for use on the battlefield, the presence of a journal with a specific focus on military medicine was a profound benefit to the initial presentation of TCCC to the U.S. Military.

**METHODS:** In the two ensuing decades, which included the longest continuous period of armed conflict in our nation's history, TCCC steadily evolved as the prehospital trauma care evidence base was augmented and as feedback from user medics, corpsmen, and pararescuemen was obtained.

**FINDINGS:** TCCC has taken a leadership role in advocating for battlefield trauma care advances such as the aggressive use of tourniquets and hemostatic dressings to control life-threatening external hemorrhage; improved fluid resuscitation techniques for casualties in hemorrhagic shock; increased emphasis on airway positioning and surgical airways to manage the traumatized airway; faster, safer, and more effective battlefield analgesia; the increased use of intraosseous vascular access when needed; battlefield antibiotics; and combining good medicine with good small-unit tactics. With the continuing assistance of Military Medicine, these advances and the evidence base that supports them have been presented to TCCC stakeholders.

**DISCUSSION/IMPACT:** Now-20 years later-TCCC has been documented to produce unprecedented decreases in preventable combat death in military units that have trained all of their members in TCCC. As a result of this proven success, TCCC has become the standard for battlefield trauma care in the U.S. military and for the militaries of many of our allied nations. Committee on TCCC members and the Joint Trauma System also work closely with civilian trauma colleagues through initiatives such as the Hartford Consensus, the White House Stop the Bleed campaign, and the development of National Association of Emergency Medical Technicians TCCC-based courses to ensure that advances in prehospital trauma care pioneered by the military on the battlefield are translated into civilian practice on the streets of America. Active shooter incidents, terrorist bombings, and the day-to-day trauma that results from motor vehicle accidents and criminal violence create the potential for many additional lives to be saved in the civilian sector. Along with the other components of the Department of Defense's Joint Trauma System, the Committee on TCCC, and the TCCC Working Group have been recognized as a national resource and will continue to advocate for advances in best-practice battlefield trauma care as opportunities to improve are identified.

**J Spec Oper Med. Winter 2016;16(4):130-131.**

# Committee on Tactical Combat Casualty Care 7-8 September 2016: Meeting Highlights.

**Butler F, Giebner S**

**Quotes:**

**"**The Committee on Tactical Combat Casualty Care (TCCC) conducted a meeting on 7–8 September at the Atlanta Airport Westin, Atlanta, Georgia. The two major changes to the TCCC Guidelines discussed at the meeting were the use of pelvic binders and a compilation of needed tactical or editorial modifications to the guidelines. There were several presentations describing the extensive use of TCCC concepts in various Department of Homeland Security and Department of Justice agencies, and by law enforcement tactical emergency medical support units."

**TCCC Special Award: Dr John Kragh**

"Dr John Kragh of the US Army Institute of Surgical Research was honored with a TCCC Special Award for his landmark research on the use of tourniquets. His work has proven the lifesaving benefit and low risk of extremity tourniquets applied for short periods of time. As noted by Dr Butler, "Without Dr Kragh's work, we would still be debating about whether or not to use tourniquets, rather than how best to use them."

**Annual TCCC Award: Col Stacy Shackelford and COL (Ret) Rocky Farr**

"The annual TCCC Award for 2016 honoring the individual who has made the most notable contributions to the advancement and use of TCCC was awarded for the first time to two individuals who finished in a tie in the voting: COL (Ret) Rocky Farr and Col Stacy Shackelford."

**Wilderness Environ Med 2017 Jun;28(2S):S140-S145. doi: 10.1016/j.wem.2016.11.008. Epub 2017 Apr 6.**

# Translating Tactical Combat Casualty Care Lessons Learned to the High-Threat Civilian Setting: Tactical Emergency Casualty Care and the Hartford Consensus.

**Callaway DW[1].**

**ABSTRACT:**
Combat operations necessitate bold thought and afford the opportunity to rapidly evolve and improve trauma care. The development and maturation of Tactical Combat Casualty Care (TCCC) is an important example of a critical process improvement strategy that reduced mortality in high-threat combat-related trauma. The Committee for Tactical Emergency Casualty Care (C-TECC) adapted the lessons of TCCC to the civilian high-threat environment and provided important all-hazards response principles for austere, dynamic, and resource-limited environments. The Hartford Consensus mobilized the resources of the American College of Surgeons to drive public policy regarding a more singular focus: hemorrhage control. The combined efforts of C-TECC and Hartford Consensus have helped redefine the practice of trauma care in high-threat scenarios across the United States.

**J Trauma Acute Care Surg. 2017 Mar;82(3):605-617.**

## Damage control resuscitation in patients with severe traumatic hemorrhage: A practice management guideline from the Eastern Association for the Surgery of Trauma.

**Cannon J, Khan M, Raja A, Cohen M, Como J, Cotton B, Dubose J, Fox E, Inaba K, Rodriguez C, Holcomb J, Duchesne J**

**BACKGROUND:** The resuscitation of severely injured bleeding patients has evolved into a multi-modal strategy termed damage control resuscitation (DCR). This guideline evaluates several aspects of DCR including the role of massive transfusion (MT) protocols, the optimal target ratio of plasma (PLAS) and platelets (PLT) to red blood cells (RBC) during DCR, and the role of recombinant activated factor VII (rVIIa) and tranexamic acid (TXA).

**METHODS:** Using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology, a subcommittee of the Practice Management Guidelines (PMG) Section of EAST conducted a systematic review using MEDLINE and EMBASE. Articles in English from1985 through 2015 were considered in evaluating four PICO questions relevant to DCR.

**RESULT:** A total of 37 studies were identified for analysis, of which 31 met criteria for quantitative meta-analysis. In these studies, mortality decreased with use of an MT/DCR protocol vs. no protocol (OR 0.61, 95% CI 0.43-0.87, $p = 0.006$) and with a high ratio of PLAS:RBC and PLT:RBC (relatively more PLAS and PLT) vs. a low ratio (OR 0.60, 95% CI 0.46-0.77, $p < 0.0001$; OR 0.44, 95% CI 0.28-0.71, $p = 0.0003$). Mortality and blood product use were no different with either rVIIa vs. no rVIIa or with TXA vs. no TXA.

**CONCLUSION:** DCR can significantly improve outcomes in severely injured bleeding patients. After a review of the best available evidence, we recommend the use of a MT/DCR protocol in hospitals that manage such patients and recommend that the protocol target a high ratio of PLAS and PLT to RBC. This is best achieved by transfusing equal amounts of RBC, PLAS, and PLT during the early, empiric phase of resuscitation. We cannot recommend for or against the use of rVIIa based on the available evidence. Finally, we conditionally recommend the in-hospital use of TXA early in the management of severely injured bleeding patients.

**Mil Med. 2017 Mar;182(S1):47-52**

## Prehospital Blood Transfusion During Aeromedical Evacuation of Trauma Patients in Israel: The IDF CSAR Experience.

**Chen J, Benov A, Nadler R, Darlington D, Cap A, Lipsky A, Glassberg E**

**BACKGROUND:** Data regarding the effect of prehospital blood administration to trauma patients during short-to-moderate time evacuations is scarce. The Israel Air Force Airborne Combat Search and Rescue is the only organization that deals with aeromedical evacuation for both military and civilian casualties in Israel and the only one with the ability to give blood in the prehospital setting.

**METHODS:** Data on packed red blood cells (PRBCs) administration in the evacuation missions from January 2003 to June 2010 were analyzed and actual transfusion practice was compared to clinical practice guidelines (CPGs).

**RESULTS:** Over the studied 101 months, a total of 1,721 patients were evacuated by Combat Search and Rescue. Of these, 87 (5.1%) trauma patients were transfused with PRBC. Demographics included 83% male and 17% female with a median age of 23 years. Main mechanisms of injury included gunshot wounds (36%), motor vehicle accidents (28%), and blast injuries (24%) with an average of 2.6 injured regions per casualty. The most commonly injured body regions included lower extremities (52%), chest (45%), and abdomen (38%). Overall, 10 (11%) casualties died. Lifesaving intervention included tourniquets (27%), endotracheal intubation (24%), tube thoracostomy (24%), and needle thoracostomy (21%) times. For 98% of the patients, clinical judgment led to administration of red blood cells before indicated by the CPG. The heart rate tended to decrease during the evacuation, whereas there was no clear trend in systolic or diastolic blood pressure or shock index.

**CONCLUSIONS:** In our aeromedical experience, transfusion of PRBCs for trauma patients was safe, feasible, and most likely beneficial. PRBCs were administered according to the flight surgeons' clinical judgment and not in complete adherence to CPGs in most cases. Data collected from this and similar studies worldwide have led to change in CPGs with the shift from hypertensive resuscitation to hypotensive-hemostatic Remote Damage Control Resuscitation.

**Scand J Trauma Resusc Emerg Med. 2017 Apr 20;25(1):42. doi: 10.1186/s13049-017-0384-y.**

## Lessons from a large trauma center: impact of blunt chest trauma in polytrauma patients-still a relevant problem?

**Chrysou K Halat G, Hoksch B, Schmid R, Kocher G**

**BACKGROUND:** Thoracic trauma is the third most common cause of death after abdominal injury and head trauma in polytrauma patients. The purpose of this study was to investigate epidemiological data, treatment and outcome of polytrauma patients with blunt chest trauma in order to help improve management, prevent complications and decrease polytrauma patients' mortality.

**METHODS:** In this retrospective study we included all polytrauma patients with blunt chest trauma admitted to our tertiary care center emergency department for a 2-year period, from June 2012 until May 2014. Data collection included details of treatment and outcome. Patients with chest trauma and Injury Severity Score (ISS) ≥18 and Abbreviated Injury Scale (AIS) >2 in more than one body region were included.

**RESULTS:** A total of 110 polytrauma patients with blunt chest injury were evaluated. 82 of them were males and median age was 48.5 years. Car accidents, falls from a height and motorbike accidents were the most common causes (>75%) for blunt chest trauma. Rib fractures, pneumothorax and pulmonary contusion were the most common chest injuries. Most patients (64.5%) sustained a serious chest injury (AIS thorax 3), 19.1% a severe chest injury (AIS thorax 4) and 15.5% a moderate chest injury (AIS thorax 2). 90% of patients with blunt chest trauma were treated conservatively. Chest tube insertion was indicated in 54.5% of patients. The need for chest tube was significantly higher among the AIS thorax 4 group in comparison to the AIS groups 3 and 2 ($p < 0.001$). Also, admission to the ICU was directly related to the severity of the AIS thorax ($p < 0.001$). The severity of chest trauma did not correlate with ICU length of stay, intubation days, complications or mortality.

**CONCLUSION:** Although 84.5% of patients suffered from serious or even severe chest injury, neither in the conservative nor in the surgically treated group a significant impact of injury severity on ICU stay, intubation days, complications or mortality was observed. AIS thorax was only related to the rate of chest tube insertions and ICU admission. Management with early chest tube insertion when necessary, pain control and chest physiotherapy resulted in good outcome in the majority of patients.

**Am J Emerg Med. 2017 Feb;35(2):222-226.**

## Intravenous vs. intraosseous access and return of spontaneous circulation during out of hospital cardiac arrest.

**Clemency B, Tanaka K, May P, Innes J, Zagroba S, Blaszak J, Hostler D, Cooney D, McGee K, Lindstrom H**

**INTRODUCTION:** Guidelines endorse intravenous (IV) and intraosseous (IO) medication administration for cardiac arrest treatment. Limited clinical evidence supports this recommendation. A multiagency, retrospective study was performed to determine the association between parenteral access type and return of spontaneous circulation (ROSC) in out of hospital cardiac arrest.

**METHODS:** This was a structured, retrospective chart review of emergency medical services (EMS) records from three agencies. Data was analyzed from adults who suffered OHCA and received epinephrine through EMS established IV or IO access during the 18-month study period. Per regional EMS protocols, choice of parenteral access type was at the provider's discretion. Non-inferiority analysis was performed comparing the association between first access type attempted and ROSC at time of emergency department arrival.

**RESULTS:** 1310 subjects met inclusion criteria and were included in the analysis. Providers first attempted parenteral access via IV route in 788 (60.15%) subjects. Providers first attempted parenteral access via IO route in 552 (39.85%) subjects. Rates of ROSC at time of ED arrival were 19.67% when IV access was attempted first and 19.92% when IO access was attempted first. An IO first approach was non-inferior to an IV first approach based on the primary end point ROSC at time of emergency department arrival (p=0.01).

**CONCLUSION:** An IO first approach was non-inferior to an IV first approach based on the end point ROSC at time of emergency department arrival.

**Am J Emerg Med. 2017 Feb;35(2):222-226.**

## Intravenous vs. intraosseous access and return of spontaneous circulation during out of hospital cardiac arrest.

**Clemency B, Tanaka K, May P, Innes J, Zagroba S, Blaszak J, Hostler D, Cooney D, McGee K, Lindstrom H**

**INTRODUCTION:** Guidelines endorse intravenous (IV) and intraosseous (IO) medication administration for cardiac arrest treatment. Limited clinical evidence supports this recommendation. A multiagency, retrospective study was performed to determine the association between parenteral access type and return of spontaneous circulation (ROSC) in out of hospital cardiac arrest.

**METHODS:** This was a structured, retrospective chart review of emergency medical services (EMS) records from three agencies. Data was analyzed from adults who suffered OHCA and received epinephrine through EMS established IV or IO access during the 18-month study period. Per regional EMS protocols, choice of parenteral access type was at the provider's discretion. Non-inferiority analysis was performed comparing the association between first access type attempted and ROSC at time of emergency department arrival.

**RESULTS:** 1310 subjects met inclusion criteria and were included in the analysis. Providers first attempted parenteral access via IV route in 788 (60.15%) subjects. Providers first attempted parenteral access via IO route in 552 (39.85%) subjects. Rates of ROSC at time of ED arrival were 19.67% when IV access was attempted first and 19.92% when IO access was attempted first. An IO first approach was non-inferior to an IV first approach based on the primary end point ROSC at time of emergency department arrival (p=0.01).

**CONCLUSION:** An IO first approach was non-inferior to an IV first approach based on the end point ROSC at time of emergency department arrival.

**Prehosp Emerg Care. 2017 May-Jun;21(3):408-410.**

## It's Time for EMS to Administer Ketamine Analgesia.

**Cousins R, Anderson D, Dehnisch F, Brown A, McKay S, Glassman ES**

**Quote:**

"While ketamine is indeed an ideal analgesic under virtually all conditions, in order to provide optimal patient care it should not be the sole medication available. Field providers should have the option to use an opioid such as fentanyl in lieu of ketamine for a severely hypertensive patient or one with a known psychosis history. It would also be wise to have a benzodiazepine available to treat emergence reactions if one occurs.

At the moment, ketamine is only United States Food and Drug Administration (FDA)-approved for use in general anesthesia and procedural sedation. NAEMSP takes the official position, however, that medical directors may authorize any legal medication for off-label use. Such treatment protocols are widely accepted in EMS and include nasal naloxone administration, administration of sublingual nitroglycerin to patients with early myocardial infarctions, and administration of glucagon to counteract beta blocker overdoses."

**J Trauma Acute Care Surg. 2017 Jun;82(6):1138-1146.**

# Whole blood transfusion closest to the point-of-injury during French remote military operations.

**Daniel Y, Sailliol A, Pouget T, Peyrefitte S, Ausset S, Martinaud C.**

**ABSTRACT:**
To improve the survival of combat casualties, interest in the earliest resort to whole blood (WB) transfusion on the battlefield has been emphasized. Providing volume, coagulation factors, plasma, and oxygenation capacity, WB appears actually as an ideal product severe trauma management. Whole blood can be collected in advance and stored for subsequent use, or can be drawn directly on the battlefield, once a soldier is wounded, from an uninjured companion and immediately transfused. Such concepts require a great control of risks at each step, especially regarding ABO mismatches, and transfusion-transmitted diseases. We present here the "warm and fresh" WB field transfusion program implemented among the French armed forces. We focus on the followed strategies to make it applicable on the battlefield, even during special operations and remote settings, and safe for recipients as well as for donors.

**J Intensive Care Med. 2016 Nov 28. pii: 0885066616680594. [Epub ahead of print]**

## Emergency Surgical Airways Following Activation of a Difficult Airway Management Team in Hospitalized Critically Ill Patients: A Case Series.

**Darby J, Halenda G, Chou C, Quinlan J, Alarcon L, Simmons R**

**INTRODUCTION:** An emergency surgical airway (ESA) is widely recommended for securing the airway in critically ill patients who cannot be intubated or ventilated. Little is known of the frequency, clinical circumstances, management methods, and outcomes of hospitalized critically ill patients in whom ESA is performed outside the emergency department or operating room environments.

**METHODS:** We retrospectively reviewed all adult patients undergoing ESA in our intensive care units (ICUs) and other hospital units from 2008 to 2012 following activation of our difficult airway management team (DAMT).

**RESULTS:** Of 207 DAMT activations for native airway events, 22 (10.6%) events culminated in an ESA, with 59% of these events occurring in ICUs with the remainder outside the ICU in the context of rapid response team activations. Of patients undergoing ESA, 77% were male, 63% were obese, and 41% had a history of a difficult airway (DA). Failed planned or unplanned extubations preceded 61% of all ESA events in the ICUs, while bleeding from the upper or lower respiratory tract led to ESA in 44% of events occurring outside the ICU. Emergency surgical airway was the primary method of airway control in 3 (14%) patients, with the remainder of ESAs performed following failed attempts to intubate. Complications occurred in 68% of all ESAs and included bleeding (50%), multiple cannulation attempts (36%), and cardiopulmonary arrest (27%). Overall hospital mortality for patients undergoing ESA was 59%, with 38% of deaths occurring at the time of the airway event.

**CONCLUSION:** An ESA is required in approximately 10% of DA events in critically ill patients and is associated with high morbidity and mortality. Efforts directed at early identification of patients with a difficult or challenging airway combined with a multidisciplinary team approach to management may reduce the overall frequency of ESA and associated complications.

**J Trauma Acute Care Surg. 2017 May;82(5):956-962.**

## Prehospital hypertonic fluid resuscitation for trauma patients: A systematic review and meta-analysis.

**de Crescenzo C, Gorouhi F, Salcedo ES, Galante JM.**

**BACKGROUND**: Prehospital assessment of a patient's circulation status and appropriate resuscitation with intravenous fluids plays a critical role in patients with obvious hemorrhage or systolic blood pressure below 90 mm Hg.

**OBJECTIVES:** We assessed the efficacy and safety of prehospital administration of crystalloids or colloids to improve the survival rate of trauma patients with acceptable safety profile.

**DATA SOURCES:** We searched SCOPUS, Embase, TRIP database, Cochrane Central Register of Controlled Trials, Ovid MEDLINE, and PubMed as per search protocol from January 1, 1900 to February 12, 2015.

**STUDY ELIGIBILITY CRITERIA:** All randomized controlled trials were considered.

**PARTICIPANTS AND INTERVENTIONS:** All patients had penetrating or blunt trauma, excluding traumatic brain or thermal injuries. At least one of the comparators should be a crystalloid or colloid.

**STUDY APPRAISAL AND SYNTHESIS METHODS:** Detailed search strategy was developed and utilized. Duplicates were removed from the search results. We, the co-first authors (C.d.C. and F.G.), independently reviewed the article titles and abstracts to assess eligibility. Eligible articles were downloaded for full text review to determine inclusion in the review and analysis. We (C.d.C. and F.G.) performed a methodological quality assessment of each included article. The primary outcome was mortality. The secondary outcomes included adverse events, infections, multiple organ dysfunction score, and length of stay at the hospital. Heterogeneity was measured by I value. An I value greater than 50% was considered to be substantial heterogeneity. Fixed effect analysis and random effect analysis were performed when needed.

**RESULTS:** A total of nine trials (3,490 patients) were included in the systematic review, and six trials were included in meta-analyses. There were no significant differences between hypertonic saline with dextran and lactated Ringer's solution in 1 day using two studies (2.91; 95% CI, 0.58-14.54; p = 0.19) and 28- to 30-day survival rates using another two studies (1.47; 95% CI, 0.30-7.18; p = 0.63). Adding dextran to hypertonic saline did not increase the survival rate (0.94; 95% CI, 0.65-1.34; p = 0.71). Overall, complications were comparable between all groups.

**LIMITATIONS:** The quality of some of the included studies is not optimal.

**CONCLUSIONS AND IMPLICATIONS OF KEY FINDINGS:** There is no beneficial effect of hypertonic saline with or without dextran in general traumatic patients. Further trials to evaluate its benefit in patients with penetrating trauma requiring surgery are warranted.

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

**J Arthroplasty. 2017 Mar 2. pii: S0883-5403(17)30188-2. doi: 10.1016/j.arth.2017.02.068. [Epub ahead of print]**

## Process Improvement Project Using Tranexamic Acid Is Cost-Effective in Reducing Blood Loss and Transfusions After Total Hip and Total Knee Arthroplasty.

**Demos H, Lin Z, Barfield W, Wilson S, Robertson D, Pellegrini V**

**BACKGROUND:** Tranexamic acid (TXA) has been associated with decreased blood loss and transfusion after total hip arthroplasty (THA) and total knee arthroplasty (TKA). The purpose of this study was to examine both transfusion utilization and the economic impact of a Process Improvement Project implementing TXA for THA and TKA.

**METHODS:** After standardization of TXA administration in THA and TKA patients, retrospective data were compared from 12 consecutive months before (group A, n = 336 procedures) and after (group B, n = 436 procedures) project initiation.

**RESULTS:** TXA administration increased with project implementation (group A = 3.57%, group B = 86.01%) and was associated with reductions in perioperative hemoglobin decrement (20.2%), patients transfused (45%), and number of units transfused per patient (61.9%). Cost savings were notable per patient ($128) and annually program wide ($55,884) with the primary THA subgroup contributing the most to the savings. No increase in adverse effects was observed.

**CONCLUSION:** Standardized administration of TXA is an effective and economically favorable blood-reduction strategy for patients undergoing elective THA or TKA. Although reduction in transfusions with TXA may be greater after TKA, the economic and clinical impact of transfusion reduction is more substantial in THA patients.

**J Trauma Acute Care Surg. 2017 Apr;82(4):728-732**

## Use of an evidence-based algorithm for patients with traumatic hemothorax reduces need for additional interventions.

**Dennis B, Gondek S, Guyer R, Hamblin S, Gunter O, Guillamondegui O**

**BACKGROUND:** Concerted management of the traumatic hemothorax is ill-defined. Surgical management of specific hemothoraces may be beneficial. A comprehensive strategy to delineate appropriate patients for additional procedures does not exist. We developed an evidence-based algorithm for hemothorax management. We hypothesize that the use of this algorithm will decrease additional interventions.

**METHODS:** A pre-/post-study was performed on all patients admitted to our trauma service with traumatic hemothorax from August 2010 to September 2013. An evidence-based management algorithm was initiated for the management of retained hemothoraces. Patients with length of stay (LOS) less than 24 hours or admitted during an implementation phase were excluded. Study data included age, Injury Severity Score, Abbreviated Injury Scale chest, mechanism of injury, ventilator days, intensive care unit (ICU) LOS, total hospital LOS, and interventions required. Our primary outcome was number of patients requiring more than 1 intervention. Secondary outcomes were empyema rate, number of patients requiring specific additional interventions, 28-day ventilator-free days, 28-day ICU-free days, hospital LOS, all-cause 6-month readmission rate. Standard statistical analysis was performed for all data.

**RESULTS:** Six hundred forty-two patients (326 pre and 316 post) met the study criteria. There were no demographic differences in either group. The number of patients requiring more than 1 intervention was significantly reduced (49 pre vs. 28 post, $p = 0.02$). Number of patients requiring VATS decreased (27 pre vs. 10 post, $p < 0.01$). Number of catheters placed by interventional radiology increased (2 pre vs. 10 post, $p = 0.02$). Intrapleural thrombolytic use, open thoracotomy, empyema, and 6-month readmission rates were unchanged. The "post" group more ventilator-free days (median, 23.9 vs. 22.5, $p = 0.04$), but ICU and hospital LOS were unchanged.

**CONCLUSION:** Using an evidence-based hemothorax algorithm reduced the number of patients requiring additional interventions without increasing complication rates. Defined criteria for surgical intervention allows for more appropriate utilization of resources.

**LEVEL OF EVIDENCE:** Therapeutic study, level IV.

**J Trauma Acute Care Surg. 2017 Jun;82(6):1080-1086.**

## Early tranexamic acid administration ameliorates the endotheliopathy of trauma and shock in an in vitro model.

**Diebel L, Martin J, Liberati D**

**BACKGROUND:** Systemic vascular endothelial injury is a consequence of trauma (T)/hemorrhagic shock (HS) which results in disturbances of coagulation, inflammation, and endothelial barrier integrity. The effect of T/HS on the endothelium (endotheliopathy of trauma [EoT]) is of intense research interest and may lead to EoT-directed therapies. Administration of tranexamic acid (TXA) in trauma patients is associated with a survival benefit and fewer complications if given early after injury. Mechanisms for this protective effect include the antifibrinolytic and anti-inflammatory effects of TXA. We hypothesized that "early" administration of TXA would abrogate vascular endothelial cell activation and injury after T/HS. This was studied in vitro.

**METHODS:** Confluent human umbilical vein endothelial cells were exposed to hydrogen peroxide and/or epinephrine to stimulate post-T/HS oxidant exposure and/or sympathoadrenal activation. TXA was added 15 minutes, 60 minutes, or 120 minutes after H2O2 and/or epinephrine challenge. Endothelial cell injury was indexed by cell monolayer permeability, intracellular adhesion molecule expression, soluble thrombomodulin, syndecan release (marker for glycocalyx injury), tissue type plasminogen activator (tPA), plasminogen activator inhibitor-1 (PAI-1) and angiopoietin-2/angiopoietin-1 ratio (APO-2/APO-1).

**RESULTS:** Endothelial activation and injury as indexed by permeability, ICAM expression, soluble thrombomodulin were increased by H2O2 and/or epinephrine exposure. Biomarkers of endothelial coagulation profile (tPA/PAI-1) demonstrated a profibrinolytic profile (increased tPA and tPA/PAI-1 ratio) after challenge by H2O2 and/or epinephrine. Vascular "leakiness" as indexed by APO-2/APO-1 ratio was also evident. The most profound effects were noted with H2O2/epinephrine exposure. TXA administration within 60 minutes of H2O2/epinephrine challenge abolished the adverse effects noted on the endothelial-glycocalyx "double barrier." TXA administration after 60 minutes was not protective.

**CONCLUSION:** Antifibrinolytic and other protective effects of TXA administration on endothelial injury are time-dependent. This study supports the concept that the clinical efficacy of TXA administration requires "early administration."

**Emerg Med J. 2015 Dec;32(12):939-45.**

## Confirmation of suboptimal protocols in spinal immobilisation?

**Dixon M, O'Halloran J, Hannigan A, Keenan S, Cummins N**

**BACKGROUND:** Spinal immobilisation during extrication of patients in road traffic collisions is routinely used despite the lack of evidence for this practice. In a previous proof of concept study (n=1), we recorded up to four times more cervical spine movement during extrication using conventional techniques than self-controlled extrication.

**OBJECTIVE:** The objective of this study was to establish, using biomechanical analysis which technique provides the minimal deviation of the cervical spine from the neutral in-line position during extrication from a vehicle in a larger sample of variable age, height and mass.

**METHODS:** A crew of two paramedics and four fire-fighters extricated 16 immobilised participants from a vehicle using six techniques for each participant. Participants were marked with biomechanical sensors and relative movement between the sensors was captured via high-speed infrared motion analysis cameras. A three-dimensional mathematical model was developed and a repeated-measures analysis of variance was used to compare movement across extrication techniques.

**RESULTS:** Controlled self-extrication without a collar resulted in a mean movement of 13.33° from the neutral in-line position of the cervical spine compared to a mean movement of 18.84° during one of the equipment-aided extrications. Two equipment-aided techniques had significantly higher movement ($p<0.05$) than other techniques. Both height ($p=0.003$) and mass ($p=0.02$) of the participants were significant independent predictors of movement.

**CONCLUSIONS:** These data support the findings of the proof of concept study, for haemodynamically stable patients controlled self-extrication causes less movement of the cervical spine than extrications performed using traditional prehospital rescue equipment.

**Curr Opin Anaesthesiol. 2017 Apr 19. doi: 10.1097/ACO.0000000000000477. [Epub ahead of print]**

# Providing anesthesia in resource-limited settings.

**Dohlman L**

**PURPOSE OF REVIEW:** The article reviews the reality of anesthetic resource constraints in low and middle-income countries (LMICs). Understanding these limitations is important to volunteers from high-income countries who desire to teach or safely provide anesthesia services in these countries.

**RECENT FINDINGS:** Recently published information on the state of anesthetic resources in LMICs is helping to guide humanitarian outreach efforts from high-income countries. The importance of using context-appropriate anesthesia standards and equipment is now emphasized. Global health experts are encouraging equal partnerships between anesthesia health care providers working together from different countries. The key roles that ketamine and regional anesthesia play in providing well tolerated anesthesia for cesarean sections and other common procedures is increasingly recognized.

**SUMMARY:** Anesthesia can be safely given in LMICs with basic supplies and equipment, if the anesthesia provider is trained and vigilant. Neuraxial and regional anesthesia and the use of ketamine as a general anesthetic appear to be the safest alternatives in low-resource countries. Environmentally appropriate equipment should be encouraged and pulse oximeters should be in every anesthetizing location. LMICs will continue to need support from outside sources until capacity building has made more progress.

**Eur J Med Chem. 2017 May 5;131:185-195.**

## Recent updates of carbapenem antibiotics.

**El-Gamal M, Brahim I, Hisham N, Aladdin R, Mohammed H, Bahaaeldin A**

**ABSTRACT:**
Carbapenems are among the most commonly used and the most efficient antibiotics since they are relatively resistant to hydrolysis by most β-lactamases, they target penicillin-binding proteins, and generally have broad-spectrum antibacterial effect. In this review, we described the initial discovery and development of carbapenems, chemical characteristics, in vitro/in vivo activities, resistance studies, and clinical investigations for traditional carbapenem antibiotics in the market; imipenem-cilastatin, meropenem, ertapenem, doripenem, biapenem, panipenem/betamipron in addition to newer carbapenems such as razupenem, tebipenem, tomopenem, and sanfetrinem. We focused on the literature published from 2010 to 2016.

**Orthop Clin North Am. 2017 Apr;48(2):109-115.**

## Effect of Tranexamic Acid on Transfusion Rates Following Total Joint Arthroplasty: A Cost and Comparative Effectiveness Analysis.

**Evangelista P, Aversano M, Koli E, Hutzler L, Inneh I, Bosco J, Iorio R**

**ABSTRACT:**
Tranexamic acid (TXA) is used to reduce blood loss in orthopedic total joint arthroplasty (TJA). This study evaluates the effectiveness of TXA in reducing transfusions and hospital cost in TJA. Participants undergoing elective TJA were stratified into 2 cohorts: those not receiving and those receiving intravenous TXA. TXA decreased total hip arthroplasty (THA) transfusions from 22.7% to 11.9%,and total knee arthroplasty (TKA) from 19.4% to 7.0%. The average direct hospital cost reduction for THA and TKA was $3083 and $2582, respectively. Implementation of a TJA TXA protocol significantly reduced transfusions in a safe and cost-effective manner.

**Dtsch Arztebl Int. 2017 Apr 7;114(14):237-243.**

## The First Aid and Hospital Treatment of Gunshot and Blast Injuries.

**Franke A, Bieler D, Friemert B, Schwab R, Kollig E, Güsgen C.**

**BACKGROUND:** When gunshot and blast injuries affect only a single person, first aid can always be delivered in conformity with the relevant guidelines. In contrast, when there is a dynamic casualty situation affecting many persons, such as after a terrorist attack, treatment may need to be focused on immediately life-threatening complications.

**METHODS:** This review is based on pertinent publications retrieved by a selective search in Medline and on the authors' clinical experience.

**RESULTS:** In a mass-casualty event, all initial measures are directed toward the survival of the greatest possible number of patients, in accordance with the concept of "tactical abbreviated surgical care." Typical complications such as airway obstruction, tension pneumothorax, and hemorrhage must be treated within the first 10 minutes. Patients with bleeding into body cavities or from the trunk must be given priority in transport; hemorrhage from the limbs can be adequately stabilized with a tourniquet. In-hospital care must often be oriented to the principles of "damage control surgery," with the highest priority assigned to the treatment of life-threatening conditions such as hemodynamic instability, penetrating wounds, or overt coagulopathy. The main considerations in initial surgical stabilization are control of bleeding, control of contamination and lavage, avoidance of further consequences of injury, and prevention of ischemia. Depending on the resources available, a transition can be made afterward to individualized treatment.

**CONCLUSION:** In mass-casualty events and special casualty situations, mortality can be lowered by treating immediately life-threatening complications as rapidly as possible. This includes the early identification of patients with life threatening hemorrhage. Advance preparation for the management of a mass casualty event is advisable so that the outcome can be as favorable as possible for all of the injured in special or tactical casualty situations.

**Scand J Trauma Resusc Emerg Med. 2017 Jan 19;25(1):5.**

## Prehospital intravenous fentanyl to patients with hip fracture: an observational cohort study of risk factors for analgesic non-treatment.

**Friesgaard K, Christensen E, Kirkegaard H, Bendtsen M, Jensen F, Nikolajsen L**

**BACKGROUND:** Patients with proximal femoral neck fracture have a high short-term mortality, a high risk of postoperative complications, and impaired quality of life. One of the challenges related to the prehospital treatment of these patients is to administer systemic opioids fast and properly. Effective analgesic prehospital treatment ought be initiated rapidly in order to alleviate the stress that follows acute pain, to facilitate transportation, and to improve quality of care. The objectives of this study were to explore the prevalence of prehospital administration of intravenous fentanyl to patients with proximal femoral neck fracture in the ambulances and to assess risk factors for analgesic non-treatment.

**METHODS:** This was a register-based observational cohort study of patients with proximal femoral neck fracture from the North Denmark Region transported by ambulance. The patients were identified via the Danish Interdisciplinary Hip Fracture Registry over a 3-year period from 1 July 2011 to 30 June 2014. This hospital registry contains data on several patient characteristics used for the risk factor analysis. Data on prehospital treatment (intravenous fentanyl) and patient monitoring were registered in an electronic prehospital patient record. A modified Poisson regression with robust standard errors was carried out with intravenous fentanyl as the primary binary outcome and the following explanatory variables: age, sex, Charlson Comorbidity Index score, housing, body mass index, type of fracture, fracture displacement, prior consultation with general practitioner, dispatch triage level, and time with ambulance personnel.

**RESULTS:** In total, 2,140 patients with proximal femoral neck fracture were transported by ambulance, of which 584 (27.3%, 95% CI: 25.4-29.2) were treated with intravenous fentanyl. Risk factors for non-treatment were: older age, male sex (RR 0.77, 95% CI: 0.64-0.91), institutional housing (RR 0.72, 95% CI: 0.56-0.92), medial fracture (RR 0.74, 95% CI: 0.60-0.92), short time with ambulance personnel, Charlson Comorbidity Index score > 1, year of fracture (2011), low levels of urgency at dispatch, and if seen by general practitioners prior to transport.

**DISCUSSION:** Education of ambulance personnel in assessing and treating patients with hip fracture seems to be required. Also, future studies should consider alternative or supportive pain treatment options with suitable analgesic effects and side effects.

**CONCLUSIONS:** Few patients with proximal femoral neck fracture were treated with intravenous fentanyl, and several risk factors were associated with prehospital analgesic non-treatment. Future prospective studies should explore covariates of socioeconomic, cultural, and psychological origin to provide further insight into the multifactorial causes of non-treatment of acute pain.

**J Neurotrauma. 2017 Apr 25. doi: 10.1089/neu.2016.4859. [Epub ahead of print]**

# Resuscitation with Lyophilized Plasma Is Safe and Improves Neurological Recovery in a Long-Term Survival Model of Swine Subjected to Traumatic Brain Injury, Hemorrhagic Shock, and Polytrauma.

**Georgoff P, Nikolian V, Halaweish I, Chtraklin K, Bruhn P, Eidy H, Rasmussen M, Li Y, Srinivasan A, Alam H**

**ABSTRACT:**
We have shown previously that fresh frozen plasma (FFP) and lyophilized plasma (LP) decrease brain lesion size and improve neurological recovery in a swine model of traumatic brain injury (TBI) and hemorrhagic shock (HS). In this study, we examine whether these findings can be validated in a clinically relevant model of severe TBI, HS, and polytrauma. Female Yorkshire swine were subjected to TBI (controlled cortical impact), hemorrhage (40% volume), grade III liver and splenic injuries, rib fracture, and rectus abdominis crush. The animals were maintained in a state of shock (mean arterial pressure 30-35 mm Hg) for 2 h, and then randomized to resuscitation with normal saline (NS), FFP, or LP (n = 5 swine/group). Animals were recovered and monitored for 30 d, during which time neurological recovery was assessed. Brain lesion sizes were measured via magnetic resonance imaging (MRI) on post-injury days (PID) three and 10. Animals were euthanized on PID 30. The severity of shock and response to resuscitation was similar in all groups. When compared with NS-treated animals, plasma-treated animals (FFP and LP) had significantly lower neurologic severity scores (PID 1-7) and a faster return to baseline neurological function. There was no significant difference in brain lesion sizes between groups. LP treatment was well tolerated and similar to FFP. In this clinically relevant large animal model of severe TBI, HS, and polytrauma, we have shown that plasma-based resuscitation strategies are safe and result in neurocognitive recovery that is faster than recovery after NS-based resuscitation.

**Wilderness Environ Med. 2017 Jun;28(2S):S18-S24.**

## The Transition to the Committee on Tactical Combat Casualty Care.

**Giebner S**

**ABSTRACT:**
The original Tactical Combat Casualty Care (TCCC) guidelines were published in a special supplement to Military Medicine in 1996 as the terminal deliverable of a 2-year development project funded by the United States Special Operations Command (USSOCOM). Two years later, the USSOCOM Biomedical Initiatives Steering Committee (BISC) promulgated its Task Statement 5-98, in which it called for the formation of a panel of subject matter experts to update the TCCC guidelines. This article discusses the formation of the Committee on Tactical Combat Casualty Care (CoTCCC) and the changes to the original guidelines that constituted the first update.

**Anesth Essays Res. 2017 Jan-Mar;11(1):23-27.**

# Comparative Study of Two Laryngeal Mask Airways: Proseal Laryngeal Mask Airway and Supreme Laryngeal Mask Airway in Anesthetized Paralyzed Adults Undergoing Elective Surgery.

**Gill R, Tarat A, Pathak D, Dutta S**

**CONTEXT:** Supraglottic airway devices can act as an alternative to endotracheal intubation in both normal and difficult airway. LMA Proseal (P-LMA) and LMA Supreme (S-LMA) alongwith acting as effective ventilating device, provide port for gastric drainage.

**AIM:** The objective of this study was to compare the two devices for effective ventilation and complications.

**SETTING AND DESIGN:** A prospective, randomized, single-blinded study was conducted in a tertiary care teaching hospital. Methods: 100 patients of ASA grade I-II undergoing elective surgery under general anaesthesia were included after ethical committee clearance and written consent. Patients were randomly allocated size 4 P-LMA (Group P) or S-LMA (Group S) (50 patients in each group). Insertion attempt, insertion time, oropharyngeal leak pressure (OLP) and complications were compared.

**RESULTS:** There was no difference demographically. The first insertion attempts were successful in 92% with P-LMA and 96% with S-LMA. Insertion time was faster in S-LMA. The mean OLP was 24.04 cmH2O in Group P and 20.05 cmH2O in Group S. Complications were cough, mild blood staining.

**CONCLUSION:** Both can act as an effective ventilatory devices. But where LMA Proseal provides a more effective glottic seal by having a greater OLP, single use LMA Supreme provides acceptable glottic seal with easier and faster insertion, therefore, it can be accepted as better alternative to LMA Proseal.

**AANA J. 2016 Dec;84(6):427-438.**

# AANA Journal Course: Update for Nurse Anesthetists-Part 5-Use of Tranexamic Acid in Preventing Postpartum Hemorrhage.

**Glymph D, Tubog T, Vedenikina M**

**ABSTRACT:**
Postpartum hemorrhage (PPH) continues to be a serious complication in both developed and underdeveloped countries. It remains the leading cause of maternal mortality in underdeveloped countries. Implementation of the World Health Organization guidelines of PPH treatment has reduced mortality. In addition, the prophylactic administration of tranexamic acid with uterotonic agents may contribute to the reduction of PPH. This evidence-based literature review of tranexamic acid will examine its mechanism of action as well as its effectiveness in prevention of PPH and blood loss reduction in elective surgery, obstetrics, and trauma.

**Mil Med. 2017 Mar;182(3):e1774-e1781.**

## Comparative Assessment of Three Approaches of Teaching Nonmedically Trained Persons in the Handling of Supraglottic Airways: A Randomized Controlled Trial.

**Hensel M, Schmidbauer W, Benker M, Schmieder P, Kerner T**

**BACKGROUND:** The use of supraglottic airways has been recommended in combat trauma airway management. To ensure an adequate airway management on the battlefield, suitable training concepts are sought to efficiently teach as many soldiers as possible. Our aim was to compare three approaches of teaching laypersons in the handling of supraglottic airways in a mannequin model.

**METHODS:** In this prospective randomized blinded study, 285 military service men without any medical background were divided into three groups and trained in the use of the Laryngeal Mask Airway Supreme (LMA) and the Laryngeal Tube Disposable (LT-D). The first group received a theoretical lecture, the second group was shown an instruction video, and the third group underwent a practical training. Immediately after instruction participants were asked to place the supraglottic airway and ventilate the mannequin within 60 seconds. The entire test was repeated 3 months later. Test results were evaluated with regard to success rate, insertion time, ability to judge the correct placement, and degree of difficulty.

**RESULTS:** Practical training showed the highest success rate when placing supraglottic airways immediately after the instruction (lecture: 68%, video: 74%, training: 94%); (training vs. lecture and training vs. video, $p < 0.001$) as well as 3 months later (lecture: 63%, video: 66%, training: 78%); (training vs. lecture, $p = 0.019$ and training vs. video, $p = 0.025$). Immediately after the instruction practical training was also superior in terms of insertion time, ability to judge the correct placement, and the self-rated degree of difficulty ($p < 0.001$). These effects were significantly reduced 3 months after the instruction. In comparison between supraglottic airways LT-D was superior to LMA regarding all the outcome parameters mentioned above ($p < 0.001$).

**DISCUSSION:** In this study, performed with personnel of the German Armed Forces, we have shown that persons without any medical and paramedical background are able to successfully place a supraglottic airway immediately following minimal instruction and after 3 months as well. Study participants achieved the best results after practical training followed by video presentation and finally lecture regardless of the airway device used. There are two possible reasons why practical training is the superior method. Firstly, the success is tied to more time spent with the learners. Secondly, practical training seems to be the best teaching method for various types of learners such as visual, auditory, reading/writing, and kinesthetic type. In addition the results of our study show that the LT-D is an ideal supraglottic airway in the hands of people inexperienced in airway management. In conclusion, our results show that practical training is the superior instruction method compared to theoretical lecture and presentation of an instruction video. Nevertheless, the presentation of an instruction video is a promising approach of teaching a maximum number of laypersons with minimal effort to correctly place supraglottic airways. To optimize the success rate of such a concept LT-Ds instead of LMAs should be used for airway management. The presented concepts hold promise for combat as well as for civilian emergency medicine.

**Injury. 2017 Apr;48(4):849-853.**

## Visually guided tube thoracostomy insertion comparison to standard of care in a large animal model.

**Hernandez M, Vogelsang D, Anderson J, Thiels C, Beilman G, Zielinski M, Aho J**

**INTRODUCTION:** Tube thoracostomy (TT) is a lifesaving procedure for a variety of thoracic pathologies. The most commonly utilized method for placement involves open dissection and blind insertion. Image guided placement is commonly utilized but is limited by an inability to see distal placement location. Unfortunately, TT is not without complications. We aim to demonstrate the feasibility of a disposable device to allow for visually directed TT placement compared to the standard of care in a large animal model.

**METHODS:** Three swine were sequentially orotracheally intubated and anesthetized. TT was conducted utilizing a novel visualization device, tube thoracostomy visual trocar (TTVT) and standard of care (open technique). Position of the TT in the chest cavity were recorded using direct thoracoscopic inspection and radiographic imaging with the operator blinded to results. Complications were evaluated using a validated complication grading system. Standard descriptive statistical analyses were performed.

**RESULTS:** Thirty TT were placed, 15 using TTVT technique, 15 using standard of care open technique. All of the TT placed using TTVT were without complication and in optimal position. Conversely, 27% of TT placed using standard of care open technique resulted in complications. Necropsy revealed no injury to intrathoracic organs.

**CONCLUSION:** Visual directed TT placement using TTVT is feasible and non-inferior to the standard of care in a large animal model. This improvement in instrumentation has the potential to greatly improve the safety of TT. Further study in humans is required.

**Trauma 2017;19:83-85**

## Enhancing national resilience: the citizenAID initiative.

**Hodgetts T, Porter K, Mahoney P, Thurgood A, McKinnie C**

**ABSTRACT:**
Prominent amongst the first aid techniques are those to stop external bleeding. It is external bleeding, particularly from limbs, that historically has represented a principal cause of avoidable death following blast and gunshot injury on the battlefield. This was the driver for the contemporary implementation of elastic dressings, tourniquets and topical haemostatics in the military community. The subsequent proven effectiveness of limb tourniquets is the rationale for describing the indications for use within citizenAID. While the imperative is always to optimise clinical care and to use approved commercial medical equipment, citizenAID recognises that in a mass casualty setting when equipment is not available, or it has been exhausted, it is acceptable to improvise.

**J Trauma Acute Care Surg. 2017 Apr 5. doi: 10.1097/TA.0000000000001484. [Epub ahead of print]**

## Multicenter Observational Prehospital Resuscitation on Helicopter Study (PROHS).

**Holcomb J, Swartz M, DeSantis S, Greene T, Fox E, Stein D, Bulger E, Kerby J, Goodman M, Schreiber M, Zielinski M, O'Keeffe T, Inaba K, Tomasek J, Podbielski J, Appana S, Yi M, Wade C; PROHS Study Group.**

**BACKGROUND:** Earlier use of in-hospital plasma, platelets and red blood cells (RBCs) has improved survival in trauma patients with severe hemorrhage. Retrospective studies have associated improved early survival with prehospital blood product transfusion (PHT). We hypothesized that PHT of plasma and/or RBCs would result in improved survival after injury in patients transported by helicopter.

**METHODS:** Adult trauma patients transported by helicopter from the scene to nine Level 1 trauma centers were prospectively observed from Jan-Nov 2015. Five helicopter systems had plasma and/or RBCs while the other four helicopter systems used only crystalloid resuscitation. All patients meeting predetermined high risk criteria were analyzed. Patients receiving PHT were compared to patients not receiving PHT. Our primary analysis compared mortality at 3 hours, 24 hours, and 30 days, using logistic regression to adjust for confounders and site heterogeneity to model patients who were matched on propensity scores.

**RESULTS:** 25,118 trauma patients were admitted, 2341 (9%) were transported by helicopter, of which 1058 (45%) met the highest risk criteria. 585/1058 patients were flown on helicopters carrying blood products. In the systems with blood available, prehospital median systolic blood pressure (125 vs 128) and GCS (7 vs 14) was significantly lower, while median ISS was significantly higher (21 vs 14). Unadjusted mortality was significantly higher in the systems with blood products available, at 3 (8.4% vs 3.6%), 24 (12.6% vs 8.9%) hours and 30 days (19.3% vs 13.3%). 24% of eligible patients received a prehospital transfusion. A median of 1 unit of RBCs and plasma were transfused prehospital. Of patients receiving PHT, 24% received only plasma, 7% received only RBCs and 69% received both. In the propensity score matching analysis (n=109), PHT was not significantly associated with mortality at any time point, although only 10% of the high risk sample were able to be matched.

**CONCLUSIONS:** Because of the unexpected imbalance in systolic blood pressure, GCS and ISS between systems with and without blood products on helicopters, matching was limited and the results of this study are inconclusive. With few units transfused to each patient and small outcome differences between groups, it is likely large, multicenter, randomized studies will be required to detect survival differences in this important population.

**Wilderness Environ Med. 2017 Jun;28(2S):S50-S60.**

## Tranexamic Acid Use in Prehospital Uncontrolled Hemorrhage.

**Huebner B, Dorlac W, Cribari C**

**ABSTRACT:**
The use of tranexamic acid (TXA) in the treatment of trauma patients was relatively unexplored until the landmark Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage-2 (CRASH-2) trial in 2010 demonstrated a reduction in mortality with the use of TXA. Although this trial was a randomized, double-blinded, placebo-controlled study incorporating >20,000 patients, numerous limitations and weaknesses have been described. As a result, additional studies have followed, delineating the potential risks and benefits of TXA administration. A systematic review of the literature to date reveals a mortality benefit of early (ideally <1 hour and no later than 3 hours after injury) TXA administration in the treatment of severely injured trauma patients (systolic blood pressure <90 mm Hg, heart rate >110). Combined with abundant literature showing a reduction in bleeding in elective surgery, the most significant benefit may be administration of TXA before the patient goes into shock. Those trials that failed to show a mortality benefit of TXA in the treatment of hemorrhagic shock acknowledged that most patients received blood products before TXA administration, thus confounding the results. Although the use of prehospital TXA in the severely injured trauma patient will become more clear with the trauma studies currently underway, the current literature supports the use of prehospital TXA in this high-risk population. We recommend considering a 1 g TXA bolus en route to definitive care in high-risk patients and withholding subsequent doses until hyperfibrinolysis is confirmed by thromboelastography.

**Transfusion. 2017 Apr 25. doi: 10.1111/trf.14123. [Epub ahead of print]**

# Concentrated lyophilized plasma used for reconstitution of whole blood leads to higher coagulation factor activity but unchanged thrombin potential compared with fresh-frozen plasma.

**Iapichino G, Ponschab M, Cadamuro J, Süssner S, Gabriel C, Dieplinger B, Egger M, Schlimp C, Bahrami S, Schöchl H**

**BACKGROUND:** During massive hemorrhage, it is recommended to transfuse red blood cells, platelet concentrate, and fresh-frozen plasma in a ratio close to 1:1:1. To avoid the thawing process of fresh frozen plasma, lyophilized plasma (LP) is increasingly used. Evidence is limited on the activity of coagulation factors in reconstituted blood using LP and concentrated LP versions.

**STUDY DESIGN AND METHODS:** Whole blood from ten healthy volunteers was separated into red blood cell, fresh frozen plasma, and platelet concentrate units. Aliquots of red blood cells and plasma concentrate were mixed with either fresh frozen plasma (200 mL) or LP at reconstitution ratios of 2:1:1, 1:1:1, and 1:1:2. LP was used either at the recommended standard volume of 200 mL (LP200) or was more concentrated at volumes of 100 and 50 mL (LP100 and LP50, respectively). The hemostatic capacity of each reconstituted whole blood sample was tested with blood cell counts, standard coagulation tests, factor activity, thrombin generation, and viscoelastic assays.

**RESULTS:** Hematocrit, platelet counts, and fibrinogen levels of the three ratios were similar between FFP200 and LP200 units but were lower compared with the corresponding ratios in LP100 and LP50 units. The activity of procoagulant and anticoagulant factors increased linearly with the increasing plasmatic fraction and, at 1:1:2 ratio, was significantly higher in LP50 units compared with FFP200 and LP200 units. Thrombin generation was similar throughout the four plasma groups at any ratio.

**CONCLUSIONS:** Decreasing the dilution volume of LP facilitates reaching higher hematocrit and coagulation protein levels without a relevant increase in thrombin generation. This is due to preserved balance between procoagulant and anticoagulant factors in the concentrated LP preparations.

**J Emerg Med. 2017 Jun;52(6):e217-e220.**

## Ultrasound Findings in Tension Pneumothorax: A Case Report.

**Inocencio M, Childs J, Chilstrom M, Berona K**

**BACKGROUND:** Delayed recognition of tension pneumothorax can lead to a mortality of 31% to 91%. However, the classic physical examination findings of tracheal deviation and distended neck veins are poorly sensitive in the diagnosis of tension pneumothorax. Point-of-care ultrasound is accurate in identifying the presence of pneumothorax, but sonographic findings of tension pneumothorax are less well described.

**CASE REPORT:** We report the case of a 21-year-old man with sudden-onset left-sided chest pain. He was clinically stable without hypoxia or hypotension, and the initial chest x-ray study showed a large pneumothorax without mediastinal shift. While the patient was awaiting tube thoracostomy, a point-of-care ultrasound demonstrated findings of mediastinal shift and a dilated inferior vena cava (IVC) concerning for tension physiology, even though the patient remained hemodynamically stable.

**WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?:** This case demonstrates a unique clinical scenario of ultrasound evidence of tension physiology in a clinically stable patient. Although this patient was well appearing without hypotension, respiratory distress, tracheal deviation, or distended neck veins, point-of-care ultrasound revealed mediastinal shift and a plethoric IVC. Given that the classic clinical signs of tension pneumothorax are not uniformly present, this case shows how point-of-care ultrasound may diagnose tension pneumothorax before clinical decompensation.

**Scand J Trauma Resusc Emerg Med. 2017 Feb 21;25(1):17.**

## Potential benefits of an integrated military/civilian trauma system: experiences from two major regional conflicts.

**Kashuk J, Peleg K, Glassberg E, Givon A, Radomislensky I, Kluger Y.**

**BACKGROUND:** Although differences of opinion and controversies may arise, lessons learned from military conflicts often translate into improvements in triage, resuscitation strategies, and surgical technique. Our fully integrated national trauma system, providing care for both military and civilian casualties, necessitates close cooperation between all aspects of both sectors. We theorized that lessons learned from two regional conflicts over 8 years, with resultant improved triage, reduced hospital length of stay, and sustained low mortality would aid performance improvement and provide evidence of overall trauma system maturation.

**METHODS:** We performed an 8 year, retrospective analysis of the Israeli National Trauma Registry prospective data base for all casualties presenting to level 1 and 2 trauma centers nationwide during an earlier conflict (W1) (7/12/06-8/14/06) and sought to compare results to those of a more recent war(W2), (7/08/14-08/26/14), as well as to compare our results to non-war civilian morbidity and mortality during the same time frame. Of particular interest were: casualty distributions, injuries/ISS, patterns of evacuation/triage, hospital length of stay, and mortality.

**RESULTS:** Data on 919 war casualties was available for evaluation. Of 490 evacuated during W1, 341 (70%) were transferred to Level 1 centers, compared with 307 (72%) from the 429 casualties in W2. In W2, significantly more severe injuries (ISS ≥16) were evacuated directly to level 1 centers (42, 76% vs. 20, 43% respectively; $p = 0.0007$). W2 vs. W1 saw a significant increase in evacuations using helicopter (219,51% vs. 180,37%; $p < 0.0001$) and increase in ISS ≥16: (66; 15.5% vs. 55; 11%, $p = 0.057$). In W2 vs. W1, less late inter-hospital transfers occurred: (48, 11% vs. 149, 30%, $p < 0.0001$); and there was a reduction in admission ≥ 7 days (90,22%vs 154,32%, $p = 0.0009$). These results persisted in logistic regression analyses, when controlling for ISS. Mortality was not significantly changed either overall or for injures with ISS ≥ 16: (1.2%in W1 vs. 1.9% in W2, $p = 0.59$, 10.9% in W1 vs. 10.6% in W2, $p = 1.0$, respectively). When compared to civilian related, (non-war) mortality during the same 8 year time frame, overall mortality was unchanged (1.6% vs.1.8%, $p = 0.38$), although there was a noteworthy significant decrease in mortality over time for ISS ≥ 16: 12.1 vs. 9.4 ($p = 0.012$), and a concomitant reduction in late inter-hospital transfers (9.8 vs. 7.5, $p < 0.0001$).

**CONCLUSION:** Despite more severe injuries in the most recent regional conflict, there was increased direct triage via helicopter to level 1 centers, reduced inter-hospital transfers, reduced hospital length of stay, and persistent low mortality. Although further assessment is required, these data suggest that via ongoing cooperation in a culture of improved preparedness, an integrated military/civilian national trauma network has also positively impacted civilian results via reduced mortality in ISS ≥ 16 and reduced late inter-hospital transfers. These findings support continued maturation of the system as a whole.

**J Bone Joint Surg Am. 2017 Mar 1;99(5):373-378.**

## Oral and Intravenous Tranexamic Acid Are Equivalent at Reducing Blood Loss Following Total Hip Arthroplasty: A Randomized Controlled Trial.

**Kayupov E, Fillingham Y, Okroj K, Plummer D, Moric M, Gerlinger T, Della Valle C**

**BACKGROUND:** Tranexamic acid is an antifibrinolytic that has been shown to reduce blood loss and the need for transfusions when administered intravenously in total hip arthroplasty. Oral formulations of the drug are available at a fraction of the cost of the intravenous preparation. The purpose of this randomized controlled trial was to determine if oral and intravenous formulations of tranexamic acid have equivalent blood-sparing properties.

**METHODS:** In this double-blinded trial, 89 patients undergoing primary total hip arthroplasty were randomized to receive 1.95 g of tranexamic acid orally 2 hours preoperatively or a 1-g tranexamic acid intravenous bolus in the operating room prior to incision; 6 patients were eventually excluded for protocol deviations, leaving 83 patients available for study. The primary outcome was the reduction of hemoglobin concentration. Power analysis determined that 28 patients were required in each group with a ±1.0 g/dL hemoglobin equivalence margin between groups with an alpha of 5% and a power of 80%. Equivalence analysis was performed with a two one-sided test (TOST) in which a p value of <0.05 indicated equivalence between treatments.

**RESULTS:** Forty-three patients received intravenous tranexamic acid, and 40 patients received oral tranexamic acid. Patient demographic characteristics were similar between groups, suggesting successful randomization. The mean reduction of hemoglobin was similar between oral and intravenous groups (3.67 g/dL compared with 3.53 g/dL; p = 0.0008, equivalence). Similarly, the mean total blood loss was equivalent between oral and intravenous administration (1,339 mL compared with 1,301 mL; p = 0.034, equivalence). Three patients (7.5%) in the oral group and one patient (2.3%) in the intravenous group were transfused, but the difference was not significant (p = 0.35). None of the patients in either group experienced a thromboembolic event.

**CONCLUSIONS:** Oral tranexamic acid provides equivalent reductions in blood loss in the setting of primary total hip arthroplasty, at a greatly reduced cost, compared with the intravenous formulation.

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

**J Spec Oper Med. Spring 2017;17(1):72-75.**

## A Perspective on the Potential for Battlefield Resuscitative Endovascular Balloon Occlusion of the Aorta.

**Knight R**

**ABSTRACT:**
Resuscitative endovascular balloon occlusion of the aorta (REBOA) has a place in civilian trauma centers in the United States, and British physicians performed the first prehospital REBOA, proving the concept viable for civilian emergency medical service. Can this translate into battlefield REBOA to stop junctional hemorrhage and extend "golden hour" rings in combat? If yes, at what level is this procedure best suited and what does it entail? This author's perspective, after treating patients on the battlefield and during rotary wing evacuation, is that REBOA may have a place in prehospital resuscitation but patient and provider selection are paramount. The procedure, although simple in description, is quite complicated and can cause major physiologic changes best dealt with by experienced providers. REBOA is incapable of extending the golden hour limiting the procedure's utility.

**J Trauma Acute Care Surg. 2017 May;82(5):827-835.**

## Novel oral anticoagulants and trauma: The results of a prospective American Association for the Surgery of Trauma Multi-Institutional Trial.

**Kobayashi L, Barmparas G, Bosarge P, Brown C, Bukur M, Carrick M, Catalano R, Holly-Nicolas J, Inaba K, Kaminski S, Klein AL, Kopelman T, Ley E, Martinez E, Moore F, Murry J, Nirula R, Paul D, Quick J, Rivera O, Schreiber M, Coimbra R; AAST Multicenter Prospective Observational Study of Trauma Patients on Novel Oral Anticoagulants Study Group.**

**BACKGROUND:** The number of anticoagulated trauma patients is increasing. Trauma patients on warfarin have been found to have poor outcomes, particularly after intracranial hemorrhage (ICH). However, the effect of novel oral anticoagulants (NOAs) on trauma outcomes is unknown. We hypothesized that patients on NOAs would have higher rates of ICH, ICH progression, and death compared with patients on traditional anticoagulant and antiplatelet agents.

**METHODS:** This was a prospective observational trial across 16 trauma centers. Inclusion criteria was any trauma patient admitted on aspirin, clopidogrel, warfarin, dabigatran, rivaroxaban, or apixaban. Demographic data, admission vital signs, mechanism of injury, injury severity scores, laboratory values, and interventions were collected. Outcomes included ICH, progression of ICH, and death.

**RESULTS:** A total of 1,847 patients were enrolled between July 2013 and June 2015. Mean age was 74.9 years (SD ± 13.8), 46% were female, 77% were non-Hispanic white. At least one comorbidity was reported in 94% of patients. Blunt trauma accounted for 99% of patients, and the median Injury Severity Score was 9 (interquartile range, 4-14). 50% of patients were on antiplatelet agents, 33% on warfarin, 10% on NOAs, and 7% on combination therapy or subcutaneous agents. Patients taking NOAs were not at higher risk for ICH on univariate (24% vs. 31%) or multivariate analysis (incidence rate ratio, 0.78; confidence interval 0.61-1.01, $p = 0.05$). Compared with all other agents, patients on aspirin (90%, 81 mg; 10%, 325 mg) had the highest rate (35%) and risk (incidence rate ratio, 1.27; confidence interval, 1.13-1.43; $p < 0.001$) of ICH. Progression of ICH occurred in 17% of patients and was not different between medication groups. Study mortality was 7% and was not significantly different between groups on univariate or multivariate analysis.

**CONCLUSION:** Patients on NOAs were not at higher risk for ICH, ICH progression, or death.

**Scand J Trauma Resusc Emerg Med. 2017 Jan 5;25(1):2.**

# The Norwegian guidelines for the prehospital management of adult trauma patients with potential spinal injury.

**Kornhall D, Jørgensen J, Brommeland T, Hyldmo P, Asbjørnsen H, Dolven T, Hansen T, Jeppesen E**

**ABSTRACT:**
The traditional prehospital management of trauma victims with potential spinal injury has become increasingly questioned as authors and clinicians have raised concerns about over-triage and harm. In order to address these concerns, the Norwegian National Competence Service for Traumatology commissioned a faculty to provide a national guideline for pre-hospital spinal stabilisation. This work is based on a systematic review of available literature and a standardised consensus process. The faculty recommends a selective approach to spinal stabilisation as well as the implementation of triaging tools based on clinical findings. A strategy of minimal handling should be observed.

**Wilderness Environ Med. 2017 Jun;28(2S):S33-S38.**

## Junctional Hemorrhage Control for Tactical Combat Casualty Care.

**Kotwal R, Butler F**

**ABSTRACT:**
During historic, as well as more recent, conflicts, most combat casualties who die from their injuries do so in the prehospital setting. Although many of the injuries incurred by these casualties are nonsurvivable, a number of injuries are still potentially survivable. Of those injuries that are potentially survivable, the majority are truncal, junctional, and extremity hemorrhage. Novel and effective approaches directed toward prehospital hemorrhage control have emerged in recent years, some of which can prove useful in the management of junctional hemorrhage whether in a military or civilian setting. An initial comprehensive review of junctional tourniquets was conducted by the Department of Defense Committee on Tactical Combat Casualty Care in 2013. The objective of this article is to provide an updated review of junctional hemorrhage control efforts and devices as they apply primarily to military prehospital trauma management and Tactical Combat Casualty Care and to prompt further consideration and application of these devices in nonmilitary prehospital, austere, and wilderness environments. Four junctional tourniquets are currently cleared by the Food and Drug Administration (FDA) for junctional hemorrhage control, and 1 junctional tourniquet is also FDA-cleared for pelvic stabilization. As junctional hemorrhage control efforts progress, scientists need to continue to conduct research and clinicians need to continue to monitor the performance of junctional tourniquets, especially in conjunction with morbidity and mortality outcomes, for both military and civilian trauma patients.

**J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S9-S15.**

# Leadership and a casualty response system for eliminating preventable death.

**Kotwal R, Montgomery H, Miles E, Conklin C, Hall M, McChrystal S**

**ABSTRACT:**
Combat casualties who die from their injuries do so primarily in the prehospital setting. Although most of these deaths result from injuries that are nonsurvivable, some are potentially survivable. Of injuries that are potentially survivable, most are from hemorrhage. Thus, military organizations should direct efforts toward prehospital care, particularly through early hemorrhage control and remote damage control resuscitation, to eliminate preventable death on the battlefield. A systems-based approach and priority of effort for institutionalizing such care was developed and maintained by medical personnel and command-directed by nonmedical combatant leaders within the 75th Ranger Regiment, U.S. Army Special Operations Command. The objective of this article is to describe the key components of this prehospital casualty response system, emphasize the importance of leadership, underscore the synergy achieved through collaboration between medical and nonmedical leaders, and provide an example to other organizations and communities striving to achieve success in trauma as measured through improved casualty survival.

**BMC Anesthesiol. 2017 Feb 2;17(1):19.**

## Evaluation of the optimal cuff volume and cuff pressure of the revised laryngeal tube "LTS-D" in surgical patients.

**Kriege M, Alflen C, Eisel J, Ott T, Piepho T, Noppens R**

**BACKGROUND:** Recent case reports have indicated significant cuff overinflation when using the standard filling volume based on the manufacturer's recommendations in older models of laryngeal tubes. The aim of this study was to determine the minimum cuff pressure needed to perform standardized ventilation without leakage in the new, revised model of the laryngeal tube "LTS-D".

**METHODS:** After ethical approval, LTS-D was placed for ventilation in 60 anesthetized patients. The cuff was inflated to the recommended volume (#3: 60 ml, #4: 80 ml, and #5: 90 ml). After evaluation of the initial cuff pressure (CP), the CP was lowered in 10 cmH2O steps until a minimal cuff pressure of 30 cmH2O was achieved. The absence of an audible leak was required for a step-by-step reduction in the CP. Evacuated cuff volume, success rate, and airway injuries were documented. Data were expressed as medians (interquartile ranges [IQRs]). The comparison of CPs and cuff volumes was performed using the Mann-Whitney test.

**RESULTS:** After initial inflation, the CP ranged from 105 cmH2O [90-120; #5] to 120 cmH2O [110-120; #3]. Lowering the CP to 60 cmH2O resulted in a reduced cuff volume ranging from 47 ml [44-54; #3] to 77 ml [75-82; #5] compared to the initial inflation ($p < 0.001$). Leakage occurred more frequently when the CP was lowered to 40 cmH2O compared to the initial inflation (44/54 [81%]; $p < 0.01$). Using a CP between 50 cmH2O and 60 cmH2O, a leakage rate of 3/54 (5%) was observed, compared to a rate of 11/54 (21%) when using a CP lower than 50 cmH2O. The overall success rate was 90%, and airway injury occurred in 7% of patients (4/60).

**CONCLUSION:** We found significant overinflation of the revised LTS-D using the recommended volume for initial cuff inflation. A CP of 60 cmH2O was found to be sufficient for ventilation in the majority of patients evaluated. Checking and adjusting the CP in laryngeal tubes is mandatory to avoid overinflation.

**J Clin Diag Res. 2016 Sep;10(9):ZC37-ZC40**

# Hemostasis and Post-operative Care of Oral Surgical Wounds by Hemcon Dental Dressing in Patients on Oral Anticoagulant Therapy: A Split Mouth Randomized Controlled Clinical Trial.

**Kumar K, Kumar J Sarvagna J, Gadde P Chikkaboriah S**

**INTRODUCTION:** Hemostasis is a fundamental management issue post-operatively in minor oral surgical procedures. To ensure safety and therapeutic efficacy in patients, under oral anti coagulant therapy, is complicated by necessity for frequent determination of prothrombin time or international normalised ratio.

**AIM:** The aim of the study was to determine whether early hemostasis achieved by using Hemcon Dental Dressing (HDD) will affect post-operative care and surgical healing outcome in minor oral surgical procedures.

**MATERIALS AND METHODS:** A total of 30 patients, aged 18 years to 90 years, except those allergic to seafood, who consented to participate, were enrolled into this study. Patients were required to have two or more surgical sites so that they would have both surgical and control sites. All patients taking Oral Anticoagulation Therapy (OAT) were included for treatment in the study without altering the anticoagulant regimens. Institutional Review Board approval was obtained for the same. The collected data was subjected to statistical analysis using unpaired t-test.

**RESULTS:** All HDD surgically treated sites achieved hemostasis in 1.49 minutes and control wounds in 4.06 minutes ($p < 0.001$). Post-operative pain at HDD treated sites (1.87,1.27 on 1(st) and 3(rd) day respectively) was significantly lower than the control sites (4.0,1.87 on 1(st) and 3(rd) day respectively) p-value (0.001, 0.001 respectively). HDD treated oral surgery wounds achieved statistically significant improved healing both at 1(st) and 3(rd) post-operative days ($p <0.0001$).

**CONCLUSION:** The HDD has been proven to be a clinically effective hemostatic dressing material that significantly shortens bleeding time following minor oral surgical procedures under local anaesthesia, including those patients taking OAT. Patients receiving the HDD had improved surgical wound healing as compared to controls.

**BMC Anesthesiol. 2017 Jan 6;17(1):3. doi: 10.1186/s12871-016-0291-1.**

# I-Gel is a suitable alternative to endotracheal tubes in the laparoscopic pneumoperitoneum and trendelenburg position.

**Lai C, Liu C, Wu C, Tsai F, Tseng P, Fan S**

**BACKGROUND:** The use of supraglottic airway devices (SADs) in surgeries with laparoscopic pneumoperitoneum and Trendelenburg (LPT) positioning is controversial due to concerns about insufficient pulmonary ventilation and aspiration. In this prospective, randomized-controlled trial, we evaluated whether the i-gel, a new second generation SAD, provides an effective alternative to an endotracheal tube (ETT) by comparing respiratory parameters and perioperative respiratory complications in non-obese patients.

**METHODS:** In a randomized controlled trial, forty anesthetized patients with ASA I-II were divided into equally sized i-gel and ETT groups. We evaluated the respiratory parameters in the supine and LPT position in comparison between the two groups. The leak fraction was our primary outcome, which was defined as the leak volume divided by the inspired tidal volume. The leak volume was the difference between the inspired and expired tidal volumes. We also monitored pulmonary aspiration and respiratory complications during the perioperative period.

**RESULTS:** In the LPT position, there were no differences in the leak fraction (median [IQR]) between the i-gel and ETT groups (6.20[3.49] vs 6.38[3.71] %, P = 0.883). In the i-gel group, notably less leakage was observed in the LPT position than in the supine position (median [IQR]: 7.01[3.73] %). This phenomenon was not observed in the ETT group. The rate of postoperative sore throat was also significantly lower in the i-gel group than in the ETT group (3/17 vs 9/11). No vomitus nor any signs associated with aspiration were noted in our patients after extubation in the follow-up prior to discharge.

**CONCLUSIONS:** The i-gel provides a suitable alternative to an ETT for surgeries with LPT positioning in non-obese patients.

**Scand J Trauma Resusc Emerg Med. 2017 Apr 24;25(1):43.**

## Hypothermia in trauma victims at first arrival of ambulance personnel: an observational study with assessment of risk factors.

**Lapostolle F, Couvreur J, Koch F, Savary D, Alhéritière A, Galinski M, Sebbah J, Tazarourte K, Adnet F**

**BACKGROUND:** Hypothermia is common in trauma victims and is associated with increased mortality, however its causes are little known. The objective of this study was to identify the risk factors associated with hypothermia in prehospital management of trauma victims.

**METHODS:** This was an ancillary analysis of data recorded in the HypoTraum study, a prospective multicenter study conducted by the emergency medical services (EMS) of 8 hospitals in France. Inclusion criteria were: trauma victim, age over 18 years, and victim receiving prehospital care from an EMS team and transported to hospital by the EMS team in a medically equipped mobile intensive care unit. The following data were recorded: victim demographics, circumstances of the trauma, environmental factors, patient presentation, clinical data and time from accident to EMS arrival. Independent risk factors for hypothermia were analyzed in a multivariate logistic regression model.

**RESULTS:** A total of 461 trauma patients were included in the study. Road traffic accidents (N = 261; 57%) and falls (N = 65; 14%) were the main causes of trauma. Hypothermia (<35 °C) was present in 136/461 cases (29%). Independent factors significantly associated with the presence of hypothermia were: a low GCS (Odds Ratio (OR) = 0,87 ([0,81-0,92]; p < 0.0001), a low air temperature (OR = 0,93 [0,91-0,96]; p < 0.0001) and a wet patient (OR = 2,08 [1,08-4,00]; p = 0.03).

**CONCLUSION:** The incidence of hypothermia was high on EMS arrival at the scene. Body temperature measurement and immediate thermal protection should be routine, and special attention should be given to patients who are wet.

**LEVEL OF EVIDENCE:** Prospective, multicenter, open, observational study; Level IV.

**J Trauma Acute Care Surg. 2017 Apr 5. doi: 10.1097/TA.0000000000001488. [Epub ahead of print]**

# Relative device stability of anterior vs. axillary needle decompression for tension pneumothorax during casualty movement: Preliminary analysis of a human cadaver model.

**Leatherman M, Held J, Fluke L, McEvoy C, Inaba K, Grabo D, Martin M, Earley A, Ricca R, Polk T**

**BACKGROUND:** Tension pneumothorax (tPTX) remains a significant cause of potentially preventable death in military and civilian settings. The current pre-hospital standard of care for tPTX is immediate decompression with a 14 gauge 8cm angiocatheter (14G AC); however, failure rates may be as high as 17-60%. Alternative devices, such as 10G AC, modified Veress needle (mVN) and laparoscopic trocar (LT), have shown to be potentially more effective in animal models; however, little is known about the relative insertional safety or mechanical stability during casualty movement.

**METHODS:** Seven soft-embalmed cadavers were intubated and mechanically ventilated. Chest wall thickness (CWT) was measured at the 2nd intercostal space (ICS) at the midclavicular line (2MCL) and the 5th ICS along the anterior axillary line (5AAL). CO2 insufflation created a PTX and needle decompression was then performed with a randomized device. Insertional depth was measured between hub and skin before and after simulated casualty transport. Thoracoscopy was used to evaluate for intrapleural placement and/or injury during insertion and after movement. Cadaver demographics, device displacement, device dislodgment, and injuries were recorded. Three decompressions were performed at each site (2MCL/5AAL), totaling 12 events per cadaver.

**RESULTS:** 84 decompressions were performed. Average cadaver age was 59 years old and BMI was 24 kg/m. The CWT varied between cadavers due to subcutaneous emphysema, but the average was 39mm at the 2MCL and 31mm at the 5AAL. Following movement, the 2MCL site was more likely to become dislodged than the 5AAL (67% vs 17%, p=0.001). Median displacement also differed between 2MCL and 5AAL (23mm vs 2mm, p=0.001). No significant differences were noted in dislodgement or displacement between devices. Five minor lung injuries were noted at the 5AAL position.

**CONCLUSION:** Preliminary results from this human cadaver study suggest the 5AAL position is a more stable and reliable location for thoracic decompression of tPTX during combat casualty transport.

**J Trauma Acute Care Surg. 2017 Jun;82(6):1063-1072.**

## 3% NaCl adenosine, lidocaine, Mg2+ (ALM) bolus and 4 hours "drip" infusion reduces noncompressible hemorrhage by 60% in a rat model.

**Letson H, Dobson G**

**BACKGROUND:** Noncompressible torso hemorrhage is the leading cause of potentially survivable trauma in far-forward combat environments. Our aim was to examine the effect of small-volume 3% NaCl adenosine, lidocaine, and Mg (ALM) bolus and 0.9% NaCl/ALM "drip" on survivability and cardiac/gut/kidney function in a rat model of hepatic hemorrhage and shock.

**METHODS:** Male Sprague-Dawley rats (428 ± 4 g) were anesthetized and randomly assigned to one of five groups (n = 16): (1) Sham, (2) No treatment, (3) Saline controls, (4) ALM therapy, and (5) Hextend. Animals were ventilated, instrumented with single or double laparotomy for tissue probe insertion, and hemorrhage induced by liver resection. After 15 minutes, a single 3% NaCl ± ALM bolus (0.7 ml/kg) was injected IV (phase 1) and after 60 minutes, 4 hours 0.9% NaCl ± ALM stabilization "drip" (0.5 ml/kg/h) was administered (phase 2), with 1-hour monitoring.

**RESULTS:** Mortality for Shams (no resection) was 0% (25%); No treatment, 87.5% (100%); Saline controls, 37.5% (75%); ALM therapy, 0% (25%), and Hextend, 87.5% (100%) (double laparotomy in parentheses). Hextend-treated animals died during the first 20 minutes of phase 2. A single ALM bolus during phase 1 led to a 2.4-fold higher cardiac output and improved hemodynamics. 3% NaCl ALM bolus increased tissue pO2 and flow in gut and kidney during phase 1 and, during ALM "drip" in phase 2, tissue pO2 decreased but flow continued to rise, indicating increased tissue O2 extraction and delivery. During phase 2, CO, ejection fraction, and fractional shortening decreased and were erratic in all groups except ALM treatment. ALM therapy led to up to 60% less bleeding over 6 hours compared to Saline controls and 75% less bleeding than Hextend.

**CONCLUSIONS:** Small-volume ALM therapy significantly reduced mortality and internal bleeding compared to Saline controls or Hextend-treated rats. Hextend increased mortality, severe bleeding, and microvascular-organ injury.

**J Trauma Acute Care Surg. 2017 Apr 27. doi: 10.1097/TA.0000000000001482. [Epub ahead of print]**

## Inefficacy of standard vital signs for predicting mortality and the need for prehospital life-saving interventions in blunt trauma patients transported via helicopter: A repeated call for new measures.

**Liu N, Holcomb J, Wade CE, Salinas J.**

**OBJECTIVE:** The aim of this study was to investigate the efficacy of traditional vital signs for predicting mortality and the need for prehospital life-saving interventions (LSIs) in blunt trauma patients requiring helicopter transport to a Level I trauma center. Our hypothesis was that standard vital signs are not sufficient for identifying or determining treatment for those patients most at risk.

**METHODS:** This study involved prehospital trauma patients suffering from blunt trauma (motor vehicle/cycle collision) and transported from the point of injury via helicopter. Means and standard deviations for vital signs and Glasgow coma scale scores (GCS) were obtained for non-LSI versus LSI and survivor versus non-survivor patient groups and then compared using Wilcoxon statistical tests. Variables with statistically significant differences between patient groups were then used to develop multivariate logistic regression models for predicting mortality and/or the need for prehospital LSIs. Receiver-operating characteristic (ROC) curves were also obtained in order to compare these models.

**RESULTS**: A final cohort of 195 patients was included in the analysis. 30 (15%) patients received a total of 39 prehospital LSIs. Of these, 12 (40%) died. In total, 33 (17%) patients died. Of these, 21 (74%) did not receive prehospital LSIs. Model variables were field heart rate, lowest systolic blood pressure, shock index, pulse pressure, and GCS components. Using vital signs alone, ROC curves demonstrated poor prediction of LSI needs, mortality, and non-survivors who did not receive LSIs (area under the curve [AUC], AUCs: 0.72, 0.65, and 0.61). When using both vital signs and GCS, ROC curves still demonstrated poor prediction of non-survivors overall and non-survivors who did not receive LSIs
(AUCs: 0.67, 0.74).

**CONCLUSION:** The major implication of this study was that traditional vital signs cannot identify or determine treatment for many prehospital blunt trauma patients who are at great risk. This study reiterated the need for new measures in order to improve blunt trauma triage and prehospital care.

**Int J Surg. 2017 May;41:34-43.**

## A comparison of combined intravenous and topical administration of tranexamic acid with intravenous tranexamic acid alone for blood loss reduction after total hip arthroplasty: A meta-analysis.

**Liu X, Liu J, Sun G**

**BACKGROUND:** The optimal dose and protocol of tranexamic acid (TXA) for reducing blood loss in total hip arthroplasty (THA) is controversial. Intravenous TXA (IV-TXA) and combined IV-TXA with topical TXA are the two common protocol after THA. A meta-analysis of randomized controlled trials (RCTs) to compare the efficacy and safety of combined IV and topical TXA with IV-TXA alone in reducing blood loss after THA.

**METHODS:** PubMed, Medline, Embase, Web of Science, the Cochrane Library, China Wanfang database and Google database were searched from the inception to February 2017 to identify RCTs that comparing combined IV and topical TXA with IV-TXA alone for patients prepared for primary THA. Total blood loss, hidden blood loss, transfusion rate, hemoglobin drop, length of hospital stay and the occurrence of deep venous thrombosis (DVT) were pooled to comprehensive analyses the efficacy and safety of combined IV and topical TXA with IV-TXA alone. Software Stata 12.0 was used to calculated relevant data.

**RESULTS:** Six RCTs involving 747 patients were finally included in the meta-analysis. Combined TXA decrease the volume of total blood loss and hidden blood loss by 250.37 ml (MD = -250.37; 95% CI: -376.43 to -124.31, P = 0.000) and 117.23 ml respectively (MD = -117.23; 95% CI: 228.38 to -6.07, P = 0.091). Meanwhile, combined TXA can also decrease the transfusion rate by 9.1% (RR = 0.32; 95% CI: 0.17 to 0.63; P = 0.001). No significant differences were seen in hemoglobin drop, the length of hospital stay and the occurrence of DVT between the two groups (P > 0.05).

**CONCLUSIONS:** Our meta-analysis suggests that the combined application of IV and topical TXA for patients undergoing THA may reduce the total blood loss compared with IV use alone without increasing the risk of postoperative complications. However, due to the quality and number of included studies, more studies were need to further identify the optimal dose for combine IV-TXA.

**Scand J Trauma Resusc Emerg Med. 2017 Feb 14;25(1):12**

## Pre-hospital transfusion of packed red blood cells in 147 patients from a UK helicopter emergency medical service.

**Lyon R, de Sausmarez E, McWhirter E, Wareham G, Nelson M, Matthies A, Hudson A, Curtis L, Russell M; Kent, Surrey & Sussex Air Ambulance Trust.**

**BACKGROUND:** Early transfusion of packed red blood cells (PRBC) has been associated with improved survival in patients with haemorrhagic shock. This study aims to describe the characteristics of patients receiving pre-hospital blood transfusion and evaluate their subsequent need for in-hospital transfusion and surgery.

**METHODS:** The decision to administer a pre-hospital PRBC transfusion was based on clinical judgment. All patients transfused pre-hospital PRBC between February 2013 and December 2014 were included. Pre-hospital and in-hospital records were retrospectively reviewed.

**RESULTS:** One hundred forty-seven patients were included. 142 patients had traumatic injuries and 5 patients had haemorrhagic shock from a medical origin. Median Injury Severity Score was 30. 90% of patients receiving PRBC had an ISS of >15. Patients received a mean of 2.4(±1.1) units of PRBC in the pre-hospital phase. Median time from initial emergency call to hospital arrival was 114 min (IQR 103-140). There was significant improvement in systolic ($p < 0.001$), diastolic ($p < 0.001$) and mean arterial pressures ($p < 0.001$) with PRBC transfusion but there was no difference in HR ($p = 0.961$). Patients received PRBC significantly faster in the field than waiting until hospital arrival. At the receiving hospital 57% required an urgent surgical or interventional radiology procedure. At hospital arrival, patients had a mean lactate of 5.4(±4.4) mmol/L, pH of 6.9(±1.3) and base deficit of -8.1(±6.7). Mean initial serum adjusted calcium was 2.26(±0.29) mmol/L. 89% received further blood products in hospital. No transfusion complications or significant incidents occurred and 100% traceability was achieved.

**DISCUSSION:** Pre-hospital transfusion of packed red cells has the potential to improve outcome for trauma patients with major haemorrhage. The pre-hospital time for trauma patients can be several hours, suggesting transfusion needs to start in the pre-hospital phase. Hospital transfusion research suggests a 1:1 ratio of packed red blood cells to plasma improves outcome and further research into pre-hospital adoption of this strategy is needed.

**CONCLUSION:** Pre-hospital PRBC transfusion significantly reduces the time to transfusion for major trauma patients with suspected major haemorrhage. The majority of patients receiving pre-hospital PRBC were severely injured and required further transfusion in hospital. Further research is warranted to determine which patients are most likely to have outcome benefit from pre-hospital blood products and what triggers should be used for pre-hospital transfusion.

**Rev Col Bras Cir. 2016 Dec;43(6):493-499.**

# Emergency cricothyrotomy: temporary measure or definitive airway? A systematic review.

**Macêdo M, Guimarães R, Ribeiro S, Sousa K**

**ABSTRACT:**
Being a fast and safe method in the hands of well trained professionals in both prehospital and intrahospital care, Cricothyrotomy has been broadly recommended as the initial surgical airway in the scenario "can't intubate, can't ventilate", and is particularly useful when the obstruction level is above or at the glottis. Its prolonged permanence, however, is an endless source of controversy. In this review we evaluate the complications of cricothyrotomy and the need of its routine conversion to tracheotomy through a search on PubMed, LILACS and SciELO electronic databases with no restriction to the year or language of the publication. In total, we identified 791 references, retrieved 20 full text articles, and included nine studies in our review. The incidence of short-term complications ranged from zero to 31.6%, and the long-term complications, from zero to 7.86%. Subglotic stenosis was the main long-term reported complication, even though it was quite infrequent, occurring only in 2.9 to 5%. The frequency of conversion to tracheostomy varied from zero to 100%. Although a small frequency of long-term complications was found for emergency cricothyrotomy, the studies' low level of evidence does not allow the recommendation of routine use of cricothyrotomy as a secure definitive airway.

**J Spec Oper Med. Spring 2017;17(1):1-8.**

## A Modern Case Series of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) in an Out-of-Hospital, Combat Casualty Care Setting.

**Manley JD, Mitchell BJ, DuBose JJ, Rasmussen TE.**

**BACKGROUND:** Resuscitative endovascular balloon occlusion of the aorta (REBOA) is used to mitigate bleeding and sustain central aortic pressure in the setting of shock. The ER-REBOA™ catheter is a new REBOA technology, previously reported only in the setting of civilian trauma and injury care. The use of REBOA in an out-of-hospital setting has not been reported, to our knowledge.

**METHODS:** We present a case series of wartime injured patients cared for by a US Air Force Special Operations Surgical Team at an austere location fewer than 3km (5-10 minutes' transport) from point of injury and 2 hours from the next highest environment of care-a Role 2 equivalent.

**RESULTS:** In a 2-month period, four patients presented with torso gunshot or fragmentation wounds, hemoperitoneum, and class IV shock. Hand-held ultrasound was used to diagnose hemoperitoneum and facilitate 7Fr femoral sheath access. ER-REBOA balloons were positioned and inflated in the aorta (zone 1 [n = 3] and zone 3 [n = 1]) without radiography. In all cases, REBOA resulted in immediate normalization of blood pressure and allowed induction of anesthesia, initiation of whole-blood transfusion, damage control laparotomy, and attainment of surgical hemostasis (range of inflation time, 18-65 minutes). There were no access- or REBOA -related complications and all patients survived to achieve transport to the next echelon of care in stable condition.

**CONCLUSION:** To our knowledge, this is the first series to demonstrate the feasibility and effectiveness of REBOA in modern combat casualty care and the first to describe use of the ER-REBOA catheter. Use of this device by nonsurgeons and surgeons not specially trained in vascular surgery in the out-of-hospital setting is useful as a stabilizing and damage control adjunct, allowing time for resuscitation, laparotomy, and surgical hemostasis.

**Blood Transfus. 2017 Mar;15(2):153-157**

## Modelling the effects of blood component storage lesions on the quality of haemostatic resuscitation in massive transfusion for trauma.

**Mays J, Hess J**

**BACKGROUND:** All blood components undergo loss of potency during storage. These loss-of-potency storage lesions are important in trauma resuscitation because they reduce the haemostatic capacity of mixtures of components that attempt to reconstitute whole blood. Even red cell storage-related loss of potency, which averages 17% with modern additive solutions, is important because 6 units of red cells must be given to achieve the effect of 5 fully potent units.

**MATERIALS AND METHODS:** Loss of potency of stored units of red blood cells, plasma, platelets, and cryoprecipitate were summed for dilutional, storage-related, pathogen reduction-related, and splenic sequestration-related causes and expressed as fractional plasma coagulation factor concentrations and platelet counts.

**RESULTS:** Production of reconstituted whole blood from 1:1:1 unit ratios of red cells:plasma:platelets is associated with a 38% loss of plasma coagulation factor concentration and 56% loss of platelets. Storage losses of 17% for red cells, 10% for coagulation factors, and 30% for platelets are additive to pathogen reduction-related losses of 18% for coagulation factors and 30% for platelets.

**DISCUSSION:** Component preparation and storage-related losses of potency for all blood components are serious problems for trauma resuscitation. Even red cell storage contributes to this problem and this can be made better in ways that can save many lives each year.

**Injury. 2017 May;48(5):1074-1081.**

## Fibrinogen is an independent predictor of mortality in major trauma patients: A five-year statewide cohort study.

**McQuilten Z, Wood E, Bailey M, Cameron P, Cooper D.**

**INTRODUCTION:** Fibrinogen may be reduced following traumatic injury due to loss from haemorrhage, increased consumption and reduced synthesis. In the absence of clinical trials, guidelines for fibrinogen replacement are based on expert opinion and vary internationally. We aimed to determine prevalence and predictors of low fibrinogen on admission in major trauma patients and investigate association of fibrinogen levels with patient outcomes.

**PATIENTS AND METHODS:** Data on all major trauma patients (January 2007-July 2011) identified through a prospective statewide trauma registry in Victoria, Australia were linked with laboratory and transfusion data. Major trauma included any of the following: death after injury, injury severity score (ISS) >15, admission to intensive care unit requiring mechanical ventilation, or urgent surgery for intrathoracic, intracranial, intra-abdominal procedures or fixation of pelvic or spinal fractures. Associations between initial fibrinogen level and in-hospital mortality were analysed using multiple logistic regression.

**RESULTS:** Of 4773 patients identified, 114 (2.4%) had fibrinogen less than 1g/L, 283 (5.9%) 1.0-1.5g/L, 617 (12.9%) 1.6-1.9g/L, 3024 (63.4%) 2-4g/L and 735 (15%) >4g/L. Median fibrinogen was 2.6g/L (interquartile range 2.1-3.4). After adjusting for age, gender, ISS, injury type, pH, temperature, Glasgow Coma Score (GCS), initial international normalised ratio and platelet count, the lowest fibrinogen categories, compared with normal range, were associated with increased in-hospital mortality (adjusted odds ratio [OR] for less than 1g/L 3.28 [95% CI 1.71-6.28, p<0.01], 1-1.5g/L adjusted OR 2.08 [95% CI 1.36-3.16, p<0.01] and 1.6-1.9g/L adjusted OR 1.39 [95% CI 0.97-2.00, p=0.08]). Predictors of initial fibrinogen <1.5g/L were younger age, lower GCS, systolic blood pressure <90mmHg, chest decompression, penetrating injury, ISS >25 and lower pH and temperature.

**CONCLUSIONS:** Initial fibrinogen levels less than the normal range are independently associated with higher in-hospital mortality in major trauma patients. Future studies are warranted to investigate whether earlier and/or greater fibrinogen replacement improves clinical outcomes.

**J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S26-S32.**

## Volumetric control of whole blood collection in austere environments.

**Meledeo M, Fisher A, Peltier G, Miles EA, Muse W, Kerr W, Nessen S, Cap A**

**INTRODUCTION:** Fresh whole blood transfusions are a powerful tool in prehospital care; however, the lack of equipment such as a scale in field situations frequently leads to collections being under- or overfilled, leading to complications for both patient and physician. This study describes two methods for simple, rapid control of collection bag volume: (1) a length of material to constrict the bag, and (2) folding/clamping the bag.

**METHOD:** Whole blood collection bags were allowed to fill with saline via gravity. Paracord, zip-tie, beaded cable tie, or tourniquet was placed around the bag at circumferences of 6 to 8.75 inches. A hemostat was used to clamp folds of 1 to 1.5 inches. Several units were drawn during training exercises of the 75th Ranger Regiment with volume controlled by three methods: vision/touch estimation, constriction by paracord, and clamping with hemostat.

**RESULTS:** Method validation in the Terumo 450-mL bag indicated that paracord, zip-tie, and beaded cable tie lengths of 6.5 inches or clamping 1.25 inches with a hemostat provided accurate filling. The volume variance was significantly lower when using the beaded cable tie. Saline filling time was approximately 2 minutes. With the Fenwal 450-mL bag, the beaded cable tie gave best results; even if incorrectly placed by one/two beads, the volume was still within limits. In training exercises, the use of the cord/clamp greatly reduced the variability; more bags were within limits.

**CONCLUSIONS:** Both constricting and clamping allow for speed and consistency in blood collection. The use of common cord is appealing, but knot tying induces inevitable variability; a zip/cable tie is easier. Clamping was quicker but susceptible to high variance and bag rupturing. With proper methodological training, appropriate volumes can be obtained in any environment with minimal tools.

**Am J Surg. 2016 Dec;212(6):1222-1230**

## Resuscitative endovascular balloon occlusion of the aorta for control of noncompressible truncal hemorrhage in the abdomen and pelvis.

**Moore L, Martin C, Harvin J, Wade C, Holcomb J**

**BACKGROUND:** Noncompressible truncal hemorrhage is a leading cause of potentially preventable death in trauma and acute care surgery patients. These patients are at high risk of exsanguination before potentially life-saving surgical intervention may be performed. Temporary aortic occlusion is an effective means of augmenting systolic blood pressure and perfusion of the heart and brain in these patients. Aortic occlusion temporarily controls distal bleeding until permanent hemostasis can be achieved. The traditional method for temporary aortic occlusion is via resuscitative thoracotomy with cross clamping of the descending aorta. While effective, resuscitative thoracotomy is highly invasive and may worsen blood loss, hypothermia, and coagulopathy by opening an otherwise uninjured body cavity. Resuscitative endovascular balloon occlusion of the aorta (REBOA) achieves temporary aortic occlusion using an occlusive balloon catheter that is introduced into the aorta via endovascular access of the common femoral artery. For this reason it is thought that REBOA could provide a less-invasive method for temporary aortic occlusion. Our purpose is to describe our experience with the implementation of REBOA at our Level 1 trauma center.

**METHODS:** A retrospective case series describing all cases of REBOA performed at a prominent level 1 trauma center between October 2011 and September 2015. The study inclusion criteria were any patient that received a REBOA procedure in the acute phases after injury. There were no exclusion criteria. Data were collected from electronic medical records and the hospital's trauma registry.

**RESULTS:** A total of 31 patients underwent REBOA during the study period. The median age of REBOA patients was 47 (interquartile range [IQR] = 27 to 63) and 77% were male. A majority (87%) of patients sustained blunt trauma. The median injury severity score was 34 (IQR = 22 to 42). The overall survival rate was 32% but varied greatly between subgroups. Balloon inflation resulted in a median increase in systolic blood pressure of 55-mm Hg (IQR 33 to 60), in cases where the data were available (n = 20). A return to spontaneous circulation was noted in 60% of patients who had arrested before REBOA (n = 10). Overall, early death by hemorrhage was 28% with only 2 deaths in the emergency department before reaching the operating room.

**CONCLUSIONS:** REBOA is an effective method for achieving temporary aortic occlusion in trauma patients with noncompressible truncal hemorrhage. Balloon inflation correlated with increased blood pressure and temporary hemorrhage control in a vast majority of patients.

**Injury. 2017 Apr;48(4):833-840**

## Intra-pelvic pressure changes after pelvic fracture: A cadaveric study quantifying the effect of a pelvic binder and limb bandaging over a bolster.

**Morris R, Loftus A, Friedmann Y, Parker P, Pallister I**

**INTRODUCTION:** Unstable pelvic fractures can be life-threatening due to catastrophic haemorrhage. Non-invasive methods of reducing and stabilising these injuries include pelvic binder application and also lower limb bandaging over a knee-flexion bolster. Both of these methods help close the pelvic ring and should tamponade bleeding. This study aimed to quantify the intra-pelvic pressure changes that occurred with 3 different manoeuvres: lower limb bandaging over a bolster; a Trauma Pelvic Orthotic Device (T-POD) pelvic binder, and a combination of both.

**METHODS:** Following a pilot study with 2 soft embalmed cadavers, a formal study with 6 unembalmed cadavers was performed. For each specimen an unstable pelvic injury was created (OA/OTA 61-C1) by dividing the pelvic ring anteriorly and posteriorly. A 3-4cm manometric water-filled balloon was placed in the retropubic space and connected to a 50ml syringe and water manometer via a 3-way tap. A baseline pressure of 8cmH2O (equating to the average central venous pressure) was used for each cadaver. Steady intra-pelvic pressures (more reliably reflecting the pressures achieved following an intervention) were used in the subsequent statistical analysis, using R statistical language and Rstudio. Paired t-test or Wilcoxon's rank sum test were used (depending on the normality of the dataset) to determine the impact of each intervention on the intra-pelvic pressure.

**RESULTS:** The mean steady intra-pelvic pressures were significantly greater than the baseline pressure for each intervention. The binder and limb bandaging over a bolster alone increased the mean steady pelvic pressures significantly to 24 (SE=5) ($p<0.036$) and 15.5 (SE=2) ($p<0.02$) cm H2O respectively. Combining these interventions further increased the mean steady pressure to 31 (SE=7) cm H2O. However, this was not significantly greater than pressures for each of the individual interventions.

**DISCUSSION:** Both lower limb bandaging over a bolster and pelvic binder application significantly increased intra-pelvic pressure above the baseline pressure. This was further increased through combining these interventions, which could be useful clinically to augment haemorrhage control in these fractures.

**CONCLUSION:** Lower-limb bandaging over a bolster, and pelvic binder application, both significantly increased intra-pelvic pressures, and were greatest in combination. These findings support the use of these techniques to facilitate non-surgical haemorrhage control.

**Mil Med. 2017 Mar;182(S1):53-58.**

## Slack Reducing Band Improves Combat Application Tourniquet Pressure Profile and Hemorrhage Control Rate.

**Nachman D, Benov A, Shovali A, Nirit Y, Nadler R, Avraham Y, Glassberg E**

**BACKGROUND:** The Combat Application Tourniquet (CAT) is the tourniquet of choice in the Israeli defense forces. Applying the device loosely before windlass twisting is a main pitfall in CAT application. This study objective is to assess the effectiveness of a novel design modification of the CAT, aiming to prevent loose applications, by minimizing the slack.

**METHODS:** Using the HapMed leg tourniquet trainer, an above the knee traumatic amputation was simulated. Active duty combatants and Special Forces basic medics were randomly assigned to apply the modified (n = 67) or conventional CAT (n = 65) once. Applied pressure, hemorrhage control status, time to stop the bleeding, and estimated blood volume loss were measured.

**RESULTS:** Using the modified CAT, the mean (±SD) pressure applied was significantly higher compared to the conventional one (231.49 ± 37.84 mm Hg vs. 213.31 ± 45.51 mm Hg, $p < 0.05$). Hemorrhage control rate was 86.6% in the modified CAT group versus 67.7% in the conventional CAT group ($p < 0.05$). Analyzing only the applications that succeeded in hemorrhage control, blood loss (171.12 ± 72.43 mL vs.187.75 ± 91.72 mL, $p > 0.05$) and time to stop bleeding (27.27 ± 13.15 seconds vs. 27.5 ± 11.25 seconds, $p > 0.05$) were similar.

**CONCLUSIONS:** The modified CAT demonstrated an upgraded pressure profile and hemorrhage control rate, potentially indicating its improved efficacy.

**Hernia. 2017 Jun;21(3):391-396.**

## A randomized clinical study on postoperative pain comparing between the supraglottic airway device and endotracheal tubing in transabdominal preperitoneal repair (TAPP).

**Nagahisa Y, Hashida K, Matsumoto R, Kawashima R, Okabe M, Kawamoto K**

**BACKGROUND:** Transabdominal preperitoneal (TAPP) repair is the most widely used laparoscopic technique for the treatment of inguinal hernia in Japan. Many studies have shown that in comparison with open hernia repair, laparoscopic repair results in less pain and a shorter convalescence. However, postoperative pain remains a concern. One possible cause of postoperative pain in the early postoperative phase is strain or cough on removal of the endotracheal tube. Use of a supraglottic airway (SGA) device helps to avoid such complaints. We evaluated postoperative pain after TAPP repair using the SGA for general anesthesia.

**METHODS:** We evaluated the postoperative pain in 146 patients with inguinal hernia repaired by TAPP in our hospital between May 2013 and May 2016. A total of 144 adult patients of American Society of Anesthesiologists physical status I and II who underwent needlescopic TAPP surgery were randomly allocated to one of two groups of 72 patients: group A (SGA), in which the patient's airway was secured with an appropriately sized I-gel, and group B (endotracheal tube), in which the airway was secured under laryngoscopy.

**RESULTS:** There was no significant difference between the groups regarding patient background, postoperative hospital stay, and operation time, and TAPP was performed safely in all cases. In the analysis of postoperative pain, the mean Numerical Rating Scale score of peak pain in group A was significantly less than that of group B (2.10 ± 2.05 vs 2.90 ± 2.65; $p = 0.043$). In group A, the percentage of patients who had an NRS score of 0 was 51.4% 30 min after surgery, 62.5% after 6 h and 68.1% at POD1, and compared to group B, the NRS scores were significantly higher at POD1 ($p = 0.003$), and the level of postoperative pain in group A tended to decrease earlier than that in group B.

**CONCLUSIONS:** The results of this study are the first to show that an SGA device can reduce postoperative pain after laparoscopic surgery.

**J Emerg Med. 2017 Apr;52(4):562-564.**

## Allergic Reaction to Ketamine as Monotherapy for Procedural Sedation.

**Nguyen T, Baker B, Ferguson J**

**BACKGROUND:** Ketamine is a cyclohexamine derivative that acts as a noncompetitive N-methyl D-aspartate receptor antagonist. Its use for procedural sedation is recommended by national clinical policy. However, its immunogenic potential is not well documented.

**CASE REPORT:** We report a case of allergic reaction associated with the administration of intravenous ketamine for procedural sedation in a 16-year-old male. Minutes after administration, the patient developed a morbilliform, erythematous rash that extended to the upper and lower torso and resolved with intravenous diphenhydramine. It is most likely that this allergic reaction was caused by a ketamine-induced histamine release that has been described in vitro.

**WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?:** This is the first case report in which ketamine was used as monotherapy in the emergency department for the facilitation of procedural sedation that resulted in an allergic reaction. Supportive measures, including advanced airway procedures and hemodynamic support, may be necessary in more severe anaphylactic cases. Providers should be aware of this potential adverse effect when using ketamine for procedural sedation.

**Clin Orthop Surg. 2017 Mar;9(1):43-49.**

## Is Intraoperative Use of QuikClot Combat Gauze Effective for Hemostasis after Total Knee Arthroplasty?

**Noh J, Lee J, Nam Y, Choi K**

**BACKGROUND:** To assess the hemostatic effect of QuikClot Combat Gauze (QCG) compared to that of standard gauze during cruciate-retaining total knee arthroplasty (TKA).

**METHODS:** Sixty knees underwent TKA using a pneumatic tourniquet in this prospective randomized study. After implantation of the femoral and tibial components and hardening of the bone cement, the tourniquet was deflated and QCG (group 1) or standard gauze (group 2) was packed into the joint cavity for 5 minutes for hemostasis. Perioperative bleeding volume and blood transfusion volume were compared between two groups.

**RESULTS:** The mean intraoperative bleeding volume was 64.7 ± 12.7 mL in group 1 and 63.9 ± 9.2 mL in group 2 ($p = 0.808$). The mean postoperative blood drainage was 349.0 ± 170.6 mL in group 1 and 270.1 ± 136.3 mL in group 2 ($p = 0.057$). The average postoperative blood transfusion volume was 323.7 ± 325.9 mL in group 1 and 403.6 ± 274.8 mL in group 2 ($p = 0.314$).

**CONCLUSIONS:** QCG was not significantly effective for reducing perioperative bleeding volume or the blood transfusion rate compared with standard gauze during TKA.

**J Vet Emerg Crit Care (San Antonio). 2017 Jan;27(1):96-107.**

## The influence of Ringer's lactate or HES 130/0.4 administration on the integrity of the small intestinal mucosa in a pig hemorrhagic shock model under general anesthesia.

**Ortiz A, Vala H, Venâncio C, Mesquita J, Silva A, Gonzalo-Orden J, Ferreira D**

**OBJECTIVE:** To determine the effect of fluid resuscitation with 2 different physiological solutions, Ringer's lactate (RL) and hydroxyethyl starch (HES) 130/0.4, on histological lesions of the small intestinal mucosa in anesthetized pigs subjected to severe acute bleeding.

**DESIGN:** Prospective experimental study.

**SETTING:** University teaching hospital.

**ANIMALS:** Twenty-eight healthy Large White pigs, 3 months of age.

**INTERVENTIONS:** Pigs were subjected to severe acute bleeding (30 mL/kg) under total intravenous anesthesia with propofol and remifentanil. Pigs were randomly allocated to 3 groups: Group 1 (n = 11) received RL solution (25 mL/kg) after bleeding; Group 2 (n = 11) received HES 130/0.4 solution (20 mL/kg) after bleeding; and Group 3 (n = 6) volume replacement nor induced bleeding. Pigs were euthanized and the small intestine was harvested for histopathological analysis.

**MEASUREMENTS AND MAIN RESULTS:** The small intestine was histologically evaluated and the presence of the following lesions were characterized: edema, congestion, hyperemia, hemorrhage, inflammatory infiltration, cellular degeneration, necrosis, and epithelial detachment. Mucosal loss percentage (%ML) and crypt:interstitium ratio (C:I) were also assessed. In the duodenum, jejunum, and ileum, and the entire small intestine, the %ML was significantly higher in Group 1, than in Groups 2 and 3. Hyperemia in the small intestine was significantly higher in pigs resuscitated with HES 130/0.4 compared to pigs resuscitated with RL.

**CONCLUSIONS AND CLINICAL RELEVANCE:** In a setting of controlled hemorrhage, resuscitation with HES 130/0.4 was associated with a lower percentage of mucosal loss on the small intestine, compared with resuscitation with RL solution. Our study also suggests that the duodenum may be more sensitive to hypovolemia induced by severe hemorrhage.

**Prehosp Emerg Care. 2017 Apr 17:1-8**

## Prehospital Predictors of Traumatic Spinal Cord Injury in Victoria, Australia.

**Oteir A, Smith K, Stoelwinder J, Middleton J, Cox S, Sharwood LN, Jennings P**

**OBJECTIVES:** To identify the predictors of traumatic spinal cord injury (TSCI) and describe the differences between confirmed and potential TSCI cases in the prehospital setting.

**METHODS:** A retrospective cohort study including all adult patients over a six-year period (2007-12) with potential TSCI who were attended and transported by Ambulance Victoria (AV). We extracted potential TSCI cases from the AV data warehouse and linked with the Victorian State Trauma Registry to compare with final hospital diagnosis.

**RESULTS:** We included a total of 106,059 patients with potential TSCI in the study, with 257 having a spinal cord injury confirmed at hospital (0.2%). The median [First and third Quartiles] age of confirmed TSCI cases was 49 [32-69] years, with males comprising 84.1%. Confirmed TSCI were mainly due to falls (44.8%) and traffic incidents (40.5%). AV spinal care guidelines had a sensitivity of 100% to detect confirmed TSCI. There were several factors associated with a diagnosis of TSCI. These were meeting AV Potential Major Trauma criteria, male gender, presence of neurological deficit, presence of an altered state of consciousness, high falls (> 3 meters), diving, or motorcycle or bicycle collisions.

**CONCLUSION:** This study identified several predictors of TSCI including meeting AV Potential Major Trauma criteria, male gender, presence of neurological deficit, presence of an altered state of consciousness, high falls (> 3 meters), diving, or motorcycle or bicycle collisions. Most of these predictors are included in NEXUS and/or CCR criteria, however, Potential Major Trauma criteria have not previously been linked to the presence of TSCI. Therefore, Emergency Medical Systems are encouraged to integrate similar Potential Major Trauma criteria into their guidelines and protocols to further improve the provider's accuracy in identifying TSCI and to be more selective in their spinal immobilization, thereby reducing unwarranted adverse effects of this practice.

**Emerg Med Australas. 2017 Feb;29(1):40-47. doi: 10.1111/1742-6723.12704. Epub 2016 Oct 27.**

## Systematic review and meta-analysis of first-pass success rates in emergency department intubation: Creating a benchmark for emergency airway care.

**Park L, Zeng I, Brainard A**

**OBJECTIVE:** Many EDs have begun to evaluate their airway performance. The first-pass success (FPS) rate is a commonly used marker of proficiency, and has been associated with rates of adverse events. The aim of this systematic review and meta-analysis is to quantify the ED FPS rates and summarise the rates of adverse events associated with endotracheal intubation.

**METHODS:** A structured literature search was performed through MEDLINE and EMBASE. Research published since 2000 was included if it prospectively collected data on all patients intubated in the ED and reported the FPS rates. Data on demographics, indication, FPS rates, adverse events, proportion by RSI and proportion by emergency medicine doctors were extracted. Pooled mean FPS rates were estimated using a random effects model.

**RESULTS:** The literature search generated 21,162 articles. Full-text review identified 16 publications for meta-analysis. This included a total of 42 081intubations from 83 institutions, in 10 countries. The FPS rate was 84.1% (95% confidence interval [CI] 80.1-87.4] in the 'ED-All' group and 81.8% (95% CI 76.3-86.2) in the 'Trauma-Only' group. The incidence rates of commonly reported adverse events were hypoxia 6.4% (95% CI 2.5-11.9), hypotension 3.0% (95% CI 1.5-4.9), oesophageal intubation 3.5% (95% CI 2.3-4.9), greater than three attempts 0.8% (95% CI 0.4-1.4), cricothyrotomy 0.3% (95% CI 0.1-0.5) and peri-intubation cardiac arrest 0.6% (95% CI 0.2-1.0).

**CONCLUSION:** Research published in the last 16 years shows a mean ED FPS rate of 84.1%. This represents the best available published data that can be used to benchmark emergency airway performance.

**World J Surg. 2017 May;41(5):1184-1192**

## Collective Review of the Status of Rapid Sequence Intubation Drugs of Choice in Trauma in Low- and Middle-Income Settings (Prehospital, Emergency Department and Operating Room Setting).

**Pillay L, Hardcastle T**

**INTRODUCTION:** Establishing a definitive airway in order to ensure adequate ventilation and oxygenation is an important aspect of resuscitation of the polytrauma patient.

**AIM:** To review the relevant literature that compares the different drugs used for rapid sequence intubation (RSI) of trauma patients, specifically reviewing: premedication, induction agents and neuromuscular blocking agents across the prehospital, emergency department and operating room setting, and to present the best practices based on the reviewed evidence.

**METHOD:** A literature review of rapid sequence intubation in the trauma population was carried out, specifically comparison of the drugs used (induction agent, neuromuscular blocking drugs and adjuncts).

**DISCUSSION:** Studies involving the comparison of drugs used in RSI in, specifically, the trauma patient are sparse. The majority of studies have compared induction agents, etomidate, ketamine and propofol, as well as the neuromuscular blocking agents, succinylcholine and rocuronium.

**CONCLUSION:** There currently exists great variation in the practice of RSI; however, in trauma the RSI armamentarium is limited to agents that maintain hemodynamic stability, provide adequate intubating conditions in the shortest time period and do not have detrimental effects on cerebral perfusion pressure. Further, multicenter randomized controlled studies to confirm the benefits of the currently used agents in trauma are required.

**J Oral Maxillofac Surg. 2017 Jun;75(6):1118-1123.**

## The Use of a Chitosan-Derived Hemostatic Agent for Postextraction Bleeding Control in Patients on Antiplatelet Treatment.

**Pippi R, Santoro M, Cafolla A**

**PURPOSE:** The current approach for tooth extraction in patients receiving antiplatelet treatment requires the use of local hemostatic agents without previous thromboembolic treatment interruption. The aim of the present study was to evaluate the effectiveness of an extra-alveolar hemostatic agent, the HemCon Dental Dressing (HDD), in controlling postsurgical bleeding.

**MATERIALS AND METHODS:** Routine, atraumatic tooth extractions were performed in a single session under local anesthesia without a vasoconstrictor and without interruption of antiplatelet therapy. All patients underwent extraction of 2 teeth in the same session, with each in a different dental hemi-arch, and the hemostatic method to be used was randomly chosen: in the test site, the HDD was applied, whereas in the control site, a common hemostatic sponge (CollaPlug, Zimmer Dental) was applied and stabilized in situ with a suture. For each surgery, 2 different times were measured: the time required for hemostatic agent application and the time required for hemostasis achievement. Postoperative pain and healing quality also were evaluated.

**RESULTS:** Twenty outpatients were enrolled. The mean application time was considerably shorter in the test group than in the control group; the mean bleeding time in the control group was considerably shorter than in the test group; pain values were lower in the test group than in the control group, especially at suture removal; and postextraction socket healing was better in the test group than in the control group.

**CONCLUSION:** HDD seems to be a valid and safe alternative in treating postextraction sockets in outpatients under single-drug antiplatelet treatment in the absence of surgical wound lacerations.

**Scand J Trauma Resusc Emerg Med. 2017 Mar 4;25(1):24.**

## Can we rely on out-of-hospital blood samples? A prospective interventional study on the pre-analytical stability of blood samples under prehospital emergency medicine conditions.

**Prottengeier J, Jess N, Harig F, Gall C, Schmidt J, Birkholz T**

**BACKGROUND:** Prehospital intravenous access provides the opportunity to sample blood from an emergency patient at the earliest possible moment in the course of acute illness and in a state prior to therapeutic interventions. Our study investigates the pre-analytical stability of biomarkers in prehospital emergency medicine and will answer the question whether an approach of blood sampling out in the field will deliver valid laboratory results.

**METHODS:** We prepared pairs of blood samples from healthy volunteers and volunteering patients post cardio-thoracic surgery. While one sample set was analysed immediately, the other one was subjected to a worse-than-reality treatment of 60 min time-lapse and standardized mechanical forces outside of the hospital through actual ambulance transport. We investigated 21 parameters comprising blood cells, coagulation tests, electrolytes, markers of haemolysis and markers of cardiac ischemia. Bland-Altman analysis was used to investigate differences between test groups. Differences between test groups were set against the official margins of test accuracy as given by the German Requirements for Quality Assurance of Medical Laboratory Examinations.

**RESULTS:** Agreement between immediate analysis and our prehospital treatment is high as demonstrated by Bland-Altman plotting. Mechanical stress and time delay do not produce a systematic bias but only random inaccuracy. The limits of agreement for the tested parameters are generally within clinically acceptable ranges of variation and within the official margins as set by the German Requirements for Quality Assurance of Medical Laboratory Examinations.

**DISCUSSION:** We subjected blood samples to a standardized treatment marking a worse-than-reality scenario of prehospital time delay and transport. Biomarkers including indicators of myocardial ischemia showed high pre-analytical stability.

**CONCLUSION:** We conclude the validity of blood samples from a prehospital environment.

**Clin Spine Surg. 2017 Mar 23. doi: 10.1097/BSD.0000000000000532. [Epub ahead of print]**

# Perioperative Management of Blood Loss in Spine Surgery.

**Qureshi R, Puvanesarajah V, Jain A, Hassanzadeh H.**

**ABSTRACT:**
Spine procedures are associated with high rates of blood loss which can result in a greater need for transfusions. Repeated exposure to blood products is associated with risks and adverse reactions such as transfusion-related acute lung injury, fluid shifting, and infections. With the higher number of spine procedures and the increasing open surgery times associated with difficult procedures, excessive blood loss has become more prevalent. Perioperative methods have been established to combat the excessive blood loss and decrease the need for blood products. Preoperatively, anemia and coagulopathy screening is standard at least 4 weeks before elective procedures. Erythropoietin, iron loading or transfusions are used to decrease preoperative anemia, a predisposing factor for blood loss. Autologous pre-donation of blood has been shown to be ineffective and decreases preoperative hemoglobin levels. Intraoperatively, antifibrinolytics such as tranexamic acid and aminocaproic acid are used to decrease blood loss. In addition, fibrinogen concentrates, thromboelastometry, acute normovolemic hemodilution, controlled hypotension, and temperature regulation are some of the techniques used to decrease blood loss and the need for transfusions. Postoperatively, fibrin sealants, shed blood salvage, and erythropoietin or intravenous iron are used in management of blood loss, especially in instances when the patient refuses blood products.

**J Surg Res. 2017 May 15;212:159-166.**

## Hemodynamic effects of the Abdominal Aortic and Junctional Tourniquet in a hemorrhagic swine model.

**Rall J, Ross J, Clemens M, Cox J, Buckley T, Morrison J**

**BACKGROUND:** Torso hemorrhage constitutes a leading cause of battlefield mortality. The Abdominal Aortic and Junctional Tourniquet (AAJT) uses a pneumatic bladder to compress the aorta reducing pelvic and lower extremity perfusion; however, concern exists over the risk of caval compression exacerbating hypotension after application.

**METHODS:** Male swine (70-90 kg) were randomized into four groups of 10: presence or absence of hemorrhage and AAJT placement. After a 40% hemorrhage, a 15-min period of hypovolemia was observed before the AAJT application. All animals received two 500 mL boluses of Hextend separated by 30 min. Cardiovascular, pulmonary, and oxygenation values were compared among groups.

**RESULTS:** The AAJT was effective in reducing blood flow to the femoral arteries in both hemorrhaged and nonhemorrhaged animals ($P < 0.001$ for both groups). Hemorrhage resulted in significant decrease in mean arterial pressure compared with sham controls ($23.5 \pm 2.4$ versus $61.6 \pm 7.8$ mm Hg, respectively, $P < 0.001$). AAJT application, compared with untreated controls, resulted in a significant increase in mean arterial pressure and systemic vascular resistance but not in cardiac output, oxygenation, and central venous pressure. Furthermore, no indication of overresuscitation injury was present as evidenced by pulmonary artery pressure and pulmonary histology.

**CONCLUSIONS:** AAJT application in an animal model of severe shock results in a favorable hemodynamic profile because of afterload support. The present study did not demonstrate any adverse consequences because of caval compression, bowel injury, or pulmonary dysfunction. In addition, there does not appear to be any particular intravenous fluid economy achieved by AAJT application.

**J Trauma Acute Care Surg. 2017 Apr 4. doi: 10.1097/TA.0000000000001469. [Epub ahead of print]**

## Combat Casualty Care Research for the Multi-Domain Battlefield.

**Rasmussen T, Baer D, Remick K, Ludwig G**

**Quote:**
"To narrow the anticipated gaps in care, the military's Science & Technology program will focus on sponsoring research with an eye towards innovative far-term solutions (i.e. for 2025 and beyond), and accepting risk in near term, more incremental improvements. As detailed in the *Ahead of the Curve* and *In the Golden Hour* publications, the areas of research interest include topics such as hemorrhage control devices and resuscitation strategies; both mechanical resuscitation and replacement of lost blood volume and oxygen carrying capacity. Other topics within the Tactical Combat Casualty Care area such as establishing and maintaining a suitable airway, optimal pain control and even anesthesia will be pursued. Additionally, new approaches to organ support and functional organ replacement will be a priority as will approaches to better diagnose, resuscitate, and treat traumatic brain injury. Research will be conducted to develop better ways to manage burn and large soft tissue wounds (including craniomaxillofacial) and the sequela of infection and sepsis that commonly result from their presence. Finally, methods to manage the mangled extremity and improve limb salvage in the prolonged field care environment will be emphasized as a research priority.6,7 Anticipating advances in applied science over the coming decades, the military's research program will also look to support projects which integrate artificial intelligence, synthetic biology, decision-support, tele-enabled care, and miniaturization technologies into the previous list of research areas."

**Disaster Mil Med. 2017 Jan 17;3:2. doi: 10.1186/s40696-017-0030-2. eCollection 2017.**

# Fluid resuscitation in haemorrhagic shock in combat casualties.

**Ravi P, Puri B**

**ABSTRACT:**
This brief update reviews the recent literature available on fluid resuscitation from hemorrhagic shock and considers the applicability of this evidence for use in resuscitation of combat casualties in the combat casualty care (CCC) environment. A number of changes need to be incorporated in the CCC guidelines: (1) dried plasma (DP) is added as an option when other blood components or whole blood are not available; (2) the wording is clarified to emphasize that Hetastarch is a less desirable option than whole blood, blood components, or DP and should be used only when these preferred options are not available; (3) the use of blood products in certain tactical field care settings where this option might be feasible (FSC, GH) is discussed; (4) 1:1:1 damage control resuscitation (DCR) with plasma: packed red blood cells (PRBC): platelets is preferred to 1:1 DCR with plasma: PRBC when platelets are available; and (5) the 30-min wait between increments of resuscitation fluid administered to achieve clinical improvement or target blood pressure has been eliminated. Also included is an order of precedence for resuscitation fluid options. There should be an emphasis on hypotensive resuscitation in order to minimize (1) interference with the body's hemostatic response and (2) the risk of complications of over resuscitation. Hetastarch is retained as the preferred option over crystalloids when blood products are not available because of its smaller volume and the potential for long evacuations in the military setting.

**Ann Emerg Med. 2017 Mar 25. pii: S0196-0644(17)30194-4.**

## When to Pick the Nose: Out-of-Hospital and Emergency Department Intranasal Administration of Medications.

**Rech M, Barbas B, Chaney W, Greenhalgh E, Turck C**

**ABSTRACT:**
The intranasal route for medication administration is increasingly popular in the emergency department and out-of-hospital setting because such administration is simple and fast, and can be used for patients without intravenous access and in situations in which obtaining an intravenous line is difficult or time intensive (eg, for patients who are seizing or combative). Several small studies (mostly pediatric) have shown midazolam to be effective for procedural sedation, anxiolysis, and seizures. Intranasal fentanyl demonstrates both safety and efficacy for the management of acute pain. The intranasal route appears to be an effective alternative for naloxone in opioid overdose. The literature is less clear on roles for intranasal ketamine and dexmedetomidine.

**J Vet Emerg Crit Care (San Antonio). 2017 Jan;27(1):23-34.**

## Comparison of the effects of a balanced crystalloid-based and a saline-based tetrastarch solution on canine whole blood coagulation and platelet function.

**Reuteler A, Axiak-Flammer S, Howard J, Adamik K**

**OBJECTIVE:** To evaluate the effects of a 6% hydroxyethyl starch (130/0.42) solution in either a buffered, electrolyte-balanced (HES-BAL), or a saline (HES-SAL) carrier solution on canine platelet function and whole blood coagulation.

**DESIGN:** Prospective, randomized study.

**SETTING:** University teaching hospital.

**ANIMALS:** Thirty-seven client-owned dogs undergoing general anesthesia for arthroscopy or imaging studies.

**INTERVENTIONS:** Dogs received a 15 mL/kg intravenous bolus of HES-SAL (n = 13), HES-BAL (n = 14), or a modified Ringer's solution (n = 10) over 30-40 minutes. Coagulation was analyzed using a Platelet Function Analyzer-100 (closure time [CtPFA ]), and whole blood thromboelastometry (ROTEM) with extrinsically (ex-tem and fib-tem) and intrinsically (in-tem) activated assays, which assessed clotting time (CT), clot formation time (CFT), maximal clot firmness (MCF), and lysis index (LI). Coagulation samples were assayed prior to fluid administration (T0), and 5 minutes (T1), and 3 hours (T2) following fluid bolus administration, respectively.

**RESULTS:** Both HES solutions resulted in impaired platelet function as indicated by a significant prolongation of CtPFA at T1 as compared to T0, but which resolved by T2. An IV bolus of Ringer's solution did not alter platelet function. In both HES groups, whole blood coagulation was significantly impaired at T1 as indicated by a significant increase in in-tem CFT, and a significant decrease in ex-tem, in-tem, and fib-tem MCF compared to T0. Furthermore, a significant increase in ex-tem CFT at T1 compared to T0 was found in the HES-SAL group. With the exception of in-tem MCF after HES-BAL, these effects were not present at T2. No significant differences were found in CtPFA or any ROTEM variable at any time point between HES-SAL and HES-BAL.

**CONCLUSION:** Administration of a single bolus of 15 mL/kg 6% HES 130/0.42 results in significant but short-lived impairment of canine platelet function and whole blood coagulation, regardless of carrier solution.

**J Trauma Acute Care Surg. 2017 Apr 27. doi: 10.1097/TA.0000000000001476. [Epub ahead of print]**

# Field and en route REBOA: A feasible military reality?

**Reva VA(1), Hörer T, Makhnovskiy AI, Sokhranov MV, Samokhvalov IM, DuBose JJ.**

**BACKGROUND:** Severe non-compressible torso hemorrhage (NCTH) remains a leading cause of potentially preventable death in modern military conflicts. Resuscitative endovascular occlusion of the aorta (REBOA) has demonstrated potential as an effective adjunct to the treatment of NCTH in the civilian early hospital and even pre-hospital settings - but the application of this technology for military pre-hospital use has not been well described. We aimed to assess the feasibility of both field and en route pre-hospital REBOA in the military exercise setting simulating a modern armed conflict.

**METHODS:** Two adult male Sus Scrofa underwent simulated junctional combat injury in the context of a planned military training exercise. Both underwent zone I REBOA in conjunction with standard tactical combat casualty care (TCCC) interventions - one during point of injury care and the other during en route flight care. Animals were sequentially evacuated to two separate Forward Surgical Teams (FSTs) by rotary wing platform where the balloon position was confirmed by chest X-Ray. Animals then underwent different damage control thoracic and abdominal procedures before euthanasia.

**RESULTS:** The first swine underwent immediate successful REBOA at the point of injury 7:30 minutes after the injury. It required 6 minutes total from initiation of procedure to effective aortic occlusion. Total occlusion time was 60 minutes. In the second animal, the REBOA placement procedure was initiated immediately after take-off (17:40 minutes after the injury). Although the movements and vibration of flight were not significant impediments, we only succeeded to put a 6-Fr sheath into a femoral artery during the 14 minutes flight due to lighting and visualization challenges. After the sheath had been upsized in the FST, the REBOA catheter was primarily placed in zone I followed by its replacement to zone III. Both animals survived to study completion and the termination of training. No complications were observed in either animal.

**CONCLUSION:** Our study demonstrates the potential feasibility of REBOA for use during tactical field and en route (flight) care of combat casualties. Further study is needed to determine the optimal training and utilization protocols required to facilitate the effective incorporation of REBOA into military pre-hospital care capabilities.

**Am J Emerg Med. 2017 Feb 13. pii: S0735-6757(17)30114-6. doi: 10.1016/j.ajem.2017.02.026. [Epub ahead of print]**

# Ketamine as a first-line treatment for severely agitated emergency department patients.

**Riddell J, Tran A, Bengiamin R, Hendey G, Armenian P**

**OBJECTIVE:** Emergency physicians often need to control agitated patients who present a danger to themselves and hospital personnel. Commonly used medications have limitations. Our primary objective was to compare the time to a defined reduction in agitation scores for ketamine versus benzodiazepines and haloperidol, alone or in combination. Our secondary objectives were to compare rates of medication redosing, vital sign changes, and adverse events in the different treatment groups.

**METHODS:** We conducted a single-center, prospective, observational study examining agitation levels in acutely agitated emergency department patients between the ages of 18 and 65 who required sedation medication for acute agitation. Providers measured agitation levels on a previously validated 6-point sedation scale at 0-, 5-, 10-, and 15-min after receiving sedation. We also assessed the incidence of adverse events, repeat or rescue medication dosing, and changes in vital signs.

**RESULTS:** 106 patients were enrolled and 98 met eligibility criteria. There was no significant difference between groups in initial agitation scores. Based on agitation scores, more patients in the ketamine group were no longer agitated than the other medication groups at 5-, 10-, and 15-min after receiving medication. Patients receiving ketamine had similar rates of redosing, changes in vital signs, and adverse events to the other groups.

**CONCLUSION:** In highly agitated and violent emergency department patients, significantly fewer patients receiving ketamine as a first line sedating agent were agitated at 5-, 10-, and 15-min. Ketamine appears to be faster at controlling agitation than standard emergency department medications.

**J Emerg Med. 2017 Apr;52(4):417-425.**

## Emergency Department Pain Management in Adult Patients With Traumatic Injuries Before and After Implementation of a Nurse-Initiated Pain Treatment Protocol Utilizing Fentanyl for Severe Pain.

**Ridderikhof M, Schyns F, Schep N, Lirk P, Hollmann M, Goslings J**

**BACKGROUND:** Pain management in the emergency department (ED) remains suboptimal. Nursing staff protocols could improve this, but studies show divergent results.

**OBJECTIVE:** Our aim was to evaluate a nurse-initiated pain-management protocol in adult patients with traumatic injuries in the short and in the long term, utilizing fentanyl for severe pain.

**METHODS:** In this pre-post implementation study, ED patients were included during three periods. The protocol allowed nurses to administer acetaminophen, non-steroidal anti-inflammatory drugs, or fentanyl autonomously, based on Numeric Rating Scale pain scores. Primary outcome was frequency of analgesic administration at 6 and 18 months after implementation. Secondary outcomes were pain awareness, occurrence of adverse events, and pain treatment after discharge.

**RESULTS:** Five hundred and twelve patients before implementation were compared with 507 and 468 patients at 6 and 18 months after implementation, respectively. Analgesic administration increased significantly at 18 months (from 29% to 36%; p = 0.016), not at 6 months (33%; p = 0.19) after implementation. Pain awareness increased from 30% to 51% (p = 0.00) at 6 months and to 56% (p = 0.00) at 18 months, due to a significant increase in pain assessment: 3% to 30% (p = 0.00) and 32% (p = 0.00), respectively. Post-discharge pain treatment increased significantly at 18 months compared to baseline (from 25% to 33%; p = 0.016) and to 6 months (from 24% to 33%; p = 0.004). No adverse events were recorded.

**CONCLUSIONS:** Implementation of a nurse-initiated pain-management protocol only increases analgesic administration in adult patients with traumatic injuries in the long term. Auditing might have promoted adherence. Pain awareness increases significantly in the short and the long term.

**Disaster Mil Med. 2015 Mar 25;1:8.**

## Pre-hospital intra-osseous freeze dried plasma transfusion: a case report.

**Rottenstreich M, Malka I, Glassberg E, Schwartz O, Tarif B**

**BACKGROUND:** Hemorrhage and coagulopathy are among the leading causes of death in combat and are considered the leading causes of preventable deaths. Plasma, in the form of Fresh Frozen Plasma (FFP) is considered a key component in the Damage Control Resuscitation performed within hospitals. Freeze-Dried Plasma (FDP) can be stored at room temperature and therefore is potentially useful in pre-hospital conditions. Our case report join to few cases where FDP was administered at the point of injury. It is also unique as it describes an intra- osseous administration given to pediatric patient.

**CASE REPORT:** M.S. otherwise healthy 13 year old girl was injured due to gunshots and grenade blast. On the first triage by the IDF medical teams she suffered from: Severe hemorrhagic shock, (Blood pressure could not be measured, Heart rate 163), superficial wounds to her face, (forehead and Rt. Eye), gunshot wounds with active bleeding from her Lt. Arm and her RT. Knee (Mangled Extremity Severity Score (MESS) 8) and open fractures of left elbow and right thigh. A peripheral intravenous catheter was established and 1 g tranexamic acid in 500 ml of Hartman fluid were administered. Due to difficulties in establishing a functioning intra-venous line, an intra-osseous catheter was established and one unit of FDP (250 ml) was given in the field. She was transferred by a military medical team to a regional civilian hospital for further treatment. Upon arrival to the hospital her blood pressure and heart rate were significantly improved. After three weeks of hospitalization M.S. was discharged and she was returned to her homeland.

**CONCLUSION:** We have described the successful use of FDP for pre hospital resuscitation of a 13 year old girl suffering from severe hemorrhagic shock as a result of gunshots and grenade blast. This case report demonstrates that intra-osseous FDP administration for as part pre hospital resuscitation of children has a favorable outcome.

**J Emerg Med. 2017 Apr 10. pii: S0736-4679(17)30153-1. doi: 10.1016/j.jemermed.2017.02.016. [Epub ahead of print]**

# Securing a Chest Tube Properly: A Simple Framework for Teaching Emergency Medicine Residents and Assessing Their Technical Abilities.

**Ruparel R, Laack T, Brahmbhatt R, Rowse P, Aho J, AlJamal Y, Kim B, Morris D, Farley D, Campbell R**

**BACKGROUND:** Quality-improvement efforts at our institution have identified chest tube dislodgement as a preventable complication of tube thoracostomy. Because proper fixation techniques are not well described in the literature and are seldom formally taught, techniques vary among residents.

**OBJECTIVE:** Our aim was to develop and test a framework for teaching and assessing chest tube securement.

**METHODS:** A repeated-measures study design was used. At baseline, 19 emergency medicine residents (program years 1-3) placed and secured a chest tube in a cadaver. After a 45-min proficiency-based teaching session using a low-cost chest tube simulator (approximate cost, $5), each resident again placed and secured a chest tube in a cadaver, followed by 3-month retention testing. All securements were evaluated by two raters using a four-point checklist and a five-point global assessment scale (GAS). The checklist addressed suture selection, tying knots down to the tube, wound approximation, and tube displacement relative to skin.

**RESULTS:** After the initial educational intervention, median scores for the group improved significantly over baseline for the GAS ($p < 0.001$), checklist ($p < 0.001$), and amount of displacement ($p = 0.01$). At 3 months, GAS, checklist, and displacement scores did not differ significantly from the immediate post-test scores. Inter-rater reliability was substantial, with weighted $\kappa$ values of .77 for the GAS and .70 for the checklist.

**CONCLUSIONS:** Quality of chest tube securement by emergency medicine residents can be significantly improved with an inexpensive chest tube simulator and a brief workshop. The four-point checklist served as a reliable and effective means for teaching and assessing chest tube securement.

**World J Surg. 2017 Jul;41(7):1790-1795.**

## Population-Based Autopsy Study of Traumatic Fatalities.

**Saar S, Lomp A, Laos J, Mihnovitš V, Šalkauskas R, Lustenberger T, Väli M, Lepner U, Talving P**

**BACKGROUND:** Injuries result in 5.8 million global fatalities annually and are the leading cause of death in younger individuals. Nevertheless, population-based autopsy investigations on traumatic deaths are scarce. We set out to study all consecutive autopsies on traumatic fatalities performed in a 5-year time segment in Estonia.

**METHODS:** After the ethics review board approval, all consecutive autopsies after blunt or penetrating deaths occurring in prehospital or in-hospital settings between January 1, 2009, and December 31, 2013, were retrospectively reviewed using the National Forensic Medicine Database. Fatalities due to suffocation, intoxication, burns, or freezing were excluded. Data collection included demographics, mechanism of injuries, cause of death, and a detailed injury profile. Primary outcome was cause of death. Secondary outcomes included injury patterns.

**RESULTS:** Overall, 1344 autopsies were included. 75.7% of deaths were following blunt trauma. Mean age was 50.4 ± 18.5 years, and 77.1% were male. A total of 71.8% of deaths occurred in the prehospital setting. Accidents, assaults, and suicides constituted 64.4, 20.5, and 15.2% of deaths, respectively. A total of 51.1% of injury fatalities had a positive blood alcohol level (BAL). Mean injury severity score was 39.7 ± 23.9. Most common cause of death was due to head injuries at 50.5% followed by hemorrhage at 30.4%. Cardiac and aortic injuries were the predominant cause of hemorrhage-related fatalities.

**CONCLUSIONS:** The current population-based investigation documented brain injury as the predominant cause of death followed by cardiac and aortic injuries. High incidence of positive BAL among injury fatalities requires national initiatives for alcohol harm reduction and law enforcement efforts

**J Arthroplasty. 2017 Feb 14. pii: S0883-5403(17)30107-9. doi: 10.1016/j.arth.2017.02.008. [Epub ahead of print]**

# Tranexamic Acid Was Safe in Arthroplasty Patients With a History of Venous Thromboembolism: A Matched Outcome Study.

**Sabbag O, Abdel M, Amundson A, Larson D, Pagnano M**

**BACKGROUND:** In contemporary total hip arthroplasties (THAs) and total knee arthroplasties (TKAs), intravenous tranexamic acid (IV TXA) has proved efficacious in decreasing blood loss and transfusion. Interested in expanding the use of IV TXA to patients with a prior venous thromboembolic event (VTE), we sought out to determine the risk of recurrent VTE with TXA administration during primary THA and TKA.

**METHODS:** We retrospectively reviewed 1262 patients (1620 cases) with a history of VTE who underwent primary THA or TKA between 2000 and 2012. IV TXA was given in 258 (16%) of the cases and not given in 1362 (84%). VTE rates were evaluated at 90 days postoperatively. Given the rarity of recurrent VTEs, patients who experienced a recurrent VTE were 2:1 retrospectively matched against patients in the cohort with a history of VTE who did not experience a recurrent VTE using age (±5 years), sex, body mass index (±5 kg/m(2)), American Society of Anesthesiologist score, and type of chemoprophylaxis.

**RESULTS:** VTE recurrence was not significantly greater in those who received TXA (2.3%; 6/258) compared to those who did not receive TXA (1.8%; 25/1362; P = .6). When the 31 patients who experienced a recurrent VTE were 2:1 matched to control patients, IV TXA was not associated with any increase in the risk of recurrent VTE (odds ratio, 0.9; P = .9).

**CONCLUSION:** Patients with a history of VTE had a low risk of recurrent VTE (2%) after contemporary THA and TKA, and that rate was not increased with the use of IV TXA.

**J Trauma Acute Care Surg. 2017 May;82(5):845-852.**

## 1: 1 Transfusion strategies are right for the wrong reasons.

**Savage S, Zarzaur B, Brewer B, Lim G, Martin A, Magnotti L, Croce M, Pohlman T**

**BACKGROUND:** Early assessment of clot function identifies coagulopathies after injury. Abnormalities include a hypercoagulable state from excess thrombin generation, as well as an acquired coagulopathy. Efforts to address coagulopathy have resulted in earlier, aggressive use of plasma emphasizing 1:1 resuscitation. The purpose of this study was to describe coagulopathies in varying hemorrhagic profiles from a cohort of injured patients.

**METHODS:** All injured patients who received at least one unit of packed red blood cells (PRBC) in the first 24 hours of admission from September 2013 to May 2015 were eligible for inclusion. Group-Based Trajectory Modeling, using volume of transfusion over time, was used to identify specific hemorrhagic phenotypes. The thromboelastography profile of each subgroup was characterized and group features were compared.

**RESULTS:** Four hemorrhagic profiles were identified among 330 patients-minimal (MIN, group 1); patients with large PRBC requirements later in the hospital course (LH, group 2); massive PRBC usage (MH, group 3), and PRBC transfusion limited to shortly after injury (EH, group 4). All groups had an R-time shorter than the normal range (3.2-3.5, $p$ = NS). Patients in group 3 had longer K-times (1.8 vs. 1.2-1.3, $p < 0.05$), significantly flatter α-angles (66.7 vs. 70.4-72.8, $p < 0.05$), and significantly weaker clot strength (MA 54.6 vs. 62.3-63.6, $p < 0.05$). Group 3 had greater physiologic derangements at admission and worse overall outcomes.

**CONCLUSION:** Hemorrhagic profiles suggest a rapid onset of clot formation in all subgroups but significantly suppressed thrombin burst and diminished clot strength in the most injured. Patients are both hypercoagulable, with early and precipitous clot formation, and also have a demonstrable hypocoagulability. The exact cause of traumatic hypocoagulability is likely multifactorial. Goal-directed resuscitation, as early as institution of the massive transfusion protocol, may be more effective in resuscitating the most coagulopathic patients.

**Turk J Emerg Med. 2016 Jul 4;17(1):1-3.**

# Pneumocephalus in a patient with multiple stab wounds.

**Savran Y, Karacam V, Bayram B, Yaka E, Karabay N.**

**ABSTRACT:**
Pneumocephalus is a complication of trauma to the chest and many iatrogenic interventions. It may arise due to systemic air embolism or retrograde cerebral venous air embolism which is an extremely rare complication. We report a 26-years-old female patient who presented to the Emergency Department suffering of multiple stab wounds. She was in a state of shock and after first aid and evaluation she was operated successfully. In the early postoperative period generalized tonic clonic convulsions were observed following cardiopulmonary resuscitation due to sudden cardiovascular collapse. Brain computerized tomography demonstrated free air in intracranial and extracranial venous structures. Pneumocephalus was diagnosed which may be due to a wide spectrum of etiologies including thorax or spinal stab wounds, tube thoracostomy, cardiopulmonary resuscitation or even central venous catheterization. Unfortunately, the patient ended up with brain death despite all effort. In conclusion, we recommend physicians to be aware of this catastrophic complication while taking care of patients with stab wounds.

**Am J Emerg Med. 2016 Apr;34(4):726-9.**

## Cervical spine immobilization may be of value following firearm injury to the head and neck.

**Schubl S, Robitsek R, Sommerhalder C, Wilkins K, Klein T, Trepeta S, Ho V**

**BACKGROUND:** Penetrating injuries to the head and neck may not be able to cause unstable fractures without concomitant spinal cord injury, rendering prehospital spinal immobilization (PHSI) ineffectual, and possibly harmful. However, this premise is based on reports including predominantly chest and abdominal injuries, which are unlikely to cause cervical spine (CS) injuries.

**METHODS:** We performed a retrospective review of all patients presenting with a penetrating wound to the head or neck over a 4-year period at an urban, level 1 trauma center to determine if there was a benefit of PHSI.

**RESULTS:** One hundred seventy-two patients were identified, of which 16 (9.3%) died prior to CS evaluation. Of 156 surviving patients, mechanism was gunshot wound (GSW) in 36 (28%) and stab wound (SW) in 120 (72%). Fifty-eight patients had PHSI placed (37%), and GSW patients' odds of having PHSI were greater than SW patients (OR 2.3; CI 1.08-4.9). Eight of 156 surviving patients eventually died (5.1%), and the odds of mortality were greater among those that had PHSI than those without (OR 5.54; CI 1.08-28.4). Six (3.8%; 5 GSW, 1 SW) patients had a CS fracture. Two GSW patients (5.6%) had unstable CS fractures with a normal neurological exam at initial evaluation.

**CONCLUSIONS:** Of patients with a GSW to the head or neck that survived to be evaluated, 5.6% had unstable fractures without an initial neurologic deficit. PHSI may be appropriate in this population. Further studies are warranted prior to a determination that PHSI is unnecessary in penetrating head and neck injuries.

**J Pain Res. 2017 Apr 5;10:787-795.**

## Subanesthetic ketamine for pain management in hospitalized children, adolescents, and young adults: a single-center cohort study.

**Sheehy K, Lippold C, Rice A, Nobrega R, Finkel J, Quezado Z**

**BACKGROUND:** Subanesthetic doses of ketamine, an N-methyl-d-aspartate receptor antagonist used as an adjuvant to opioid for the treatment of pain in adults with acute and chronic pain, have been shown, in some instances, to improve pain intensity and to decrease opioid intake. However, less is known about the role of ketamine in pain management in children, adolescents, and young adults.

**PURPOSE:** We examined the effects of subanesthetic ketamine on pain intensity and opioid intake in children, adolescents, and young adults with acute and chronic pain syndromes treated in an inpatient setting.

**METHODS:** This is a longitudinal cohort study of patients treated with subanesthetic ketamine infusions in regular patient care units in a tertiary pediatric hospital. Primary outcomes included changes in pain scores and morphine-equivalent intake.

**RESULTS:** The study cohort included 230 different patients who during 360 separate hospital admissions received subanesthetic ketamine infusions for pain management. Overall, ketamine infusions were associated with significant reductions in mean pain scores from baseline (mean pain scores 6.64 [95% CI: 6.38-6.90]) to those recorded on the day after discontinuation of ketamine (mean pain scores 4.38 [95% CI: 4.06-4.69]), $p<0.001$. Importantly, the effect of ketamine on pain scores varied according to clinical diagnosis ($p=0.011$), infusion duration ($p=0.004$), and pain location ($p=0.004$). Interestingly, greater reductions in pain scores were observed in patients with cancer pain and patients with pain associated with pancreatitis and Crohn's disease. There were no records of psychotomimetic side effects requiring therapy.

**CONCLUSION:** These data suggest that administration of subanesthetic ketamine for pain management is feasible and safe in regular inpatient care units and may benefit children, adolescents, and young adults with acute and chronic pain. This study is informative and can be helpful in determining sample and effect sizes when planning clinical trials to determine the role of subanesthetic ketamine infusions for pain management in pediatric patients.

**Ann Emerg Med. 2017 May;69(5):667-668.**

## Ketamine Causing Apnea?

**Shiber J**

**Quote:**
“During the last 3 years, I have used ketamine frequently in the ICU to accomplish percutaneous endoscopic gastrostomy tube placement after ischemic and hemorrhagic strokes in patients who have been successfully extubated but do not regain the ability to swallow. I typically use a total of 1 to 1.5 mg/kg intravenously to complete the 30- to 40-minute procedure, and my patients have not had any episodes of apnea. I have also used a ketamine infusion during several days on 2 different occasions in nonintubated patients with nonconvulsive status epilepticus whose living will or family requested no intubation or mechanical ventilation, again without any episodes of apnea. I would question the claim that “It is probable that critically ill patients have higher rates of apnea with ketamine administration.”

**Br J Surg. 2017 May;104(6):710-717**

## Effectiveness of early administration of tranexamic acid in patients with severe trauma.

**Shiraishi A, Kushimoto S, Otomo Y, Matsui H, Hagiwara A, Murata K; Japanese Observational Study for Coagulation and Thrombolysis in Early Trauma (J-OCTET) investigators.**

**BACKGROUND:** A reduction in mortality with the early use of tranexamic acid has been demonstrated in severely injured patients who are bleeding. However, the modest treatment effect with no reduction in blood transfusion has raised concerns. The aim of the present study was to estimate the effectiveness of regular use of tranexamic acid in severely injured patients.

**METHODS:** This multicentre observational study used retrospectively collected data from consecutive injured patients (Injury Severity Score at least 16) treated in 15 Japanese academic institutions in 2012. A propensity score-matched analysis compared patients who did or did not receive tranexamic acid administration within 3 h of injury. Study outcomes included 28-day all-cause and cause-specific mortality, and need for blood transfusion.

**RESULTS:** Of 796 eligible subjects, 281 were treated with tranexamic acid. Propensity score matching selected a total of 500 matched subjects (250 in each group). Tranexamic acid administration was associated with lower 28-day mortality (10·0 versus 18·4 per cent; difference -8·4 (95 per cent c.i. -14·5 to -2·3) per cent) and lower 28-day mortality from primary brain injury (6·0 versus 13·2 per cent; difference -7·2 (-12·3 to -2·1) per cent). However, there was no significant difference between groups in the need for blood transfusion (33·2 versus 34·8 per cent; difference -1·6 (-9·9 to 6·7) per cent).

**CONCLUSION:** Early tranexamic acid use was associated with reduced mortality in severely injured patients, in particular those with a primary brain injury.

**J Trauma Acute Care Surg. 2017 Feb 23. doi: 10.1097/TA.0000000000001403. [Epub ahead of print]**

## Point of injury tourniquet application during Operation Protective Edge - what de we learn?

**Shlaifer A, Yitzhak A, Baruch E, Shina A, Satanovsky A, Shovali A, Almog O, Glassberg E.**

**BACKGROUND:** Hemorrhage is a leading cause of preventable death on the battlefield. Timely tourniquet application to massively bleeding extremity wounds is critical for casualty survival albeit with reported adverse effects to extremity integrity. The aim of this study was to describe the immediate and short term outcomes of point of injury (POI) tourniquet applications during 'Operation Protective Edge' (OPE).

**METHODS:** A case series study regarding tourniquet application at the POI during OPE was collected. The data gathered included reports by medical providers at the POI, aerial and land evacuation vehicles, and receiving hospitals. Variables collected included, the number of tourniquet applications, caregiver level, tourniquet type, limb characters, tourniquet effectiveness, in-hospital procedures, complications and short term limb outcome.

**RESULTS:** During OPE, the Israeli Defense Forces Medical Corps (IDF-MC) treated 704 casualties. Out of these, 90 casualties were treated with 119 tourniquets out of which 79 survived. Penetrating trauma was the mechanism of injury in 97.8% (88/90) of the casualties. Injuries sustained from Improvised explosive devices (IED) and shrapnel were related to the use of more than one tourniquet per casualty and per limb (p=0.034). The success rate of the first tourniquet was reported to be 70% (84/119), regardless of caregiver level (P=0.56), tourniquet type (P=0.16) or limb characters (p=0.48). 25.7% of the tourniquets (27/105) were converted to direct pressure dressings enroute to receiving hospitals two of the conversions failed and thus a new tourniquet was applied. Fasciotomy was performed on 8 casualties (a single limb in each). Vascular injury was presumed to be the indication for fasciotomy in three of these cases, in the other five limbs (6%, 5/85) no vascular involvement was discovered during surgery and the fasciotomy is suspected as tourniquet related. 7%) 6/85) suffered from neurological sequela that could not be explained by their primary injury. Total complication rate was 11.7% (10/85) (one patient had both fasciotomy and neural complication without vascular injury)

**CONCLUSION:** Tourniquet use on the battlefield is a simple method of eliminating preventable death, we believe that clinical practice guidelines should promote liberal use of tourniquets by trained combatants and medical personnel with abilities to convert to direct pressure hemorrhage control when possible since an unjustified tourniquet application risks low rates minor morbidity whereas a justifiable tourniquet not applied may be lethal.

**J Trauma Acute Care Surg. 2017 Apr 27. doi: 10.1097/TA.0000000000001535. [Epub ahead of print]**

## Leukocyte Filtration Lesion Impairs Functional Coagulation in Banked Whole Blood.

**Siletz A, Burruss S, Gruber T, Ziman A, Marder V, Cryer H**

**BACKGROUND:** Whole blood (WB) transfusion is a promising alternative to component therapy in hemostatic resuscitation. Use of banked WB requires filtration of white blood cells (leukoreduction) and an established shelf life during which WB retains coagulant capacities. The goal of this study was to define the time course of coagulation stability in leukoreduced compared to unfiltered WB under standard refrigeration conditions.

**METHODS:** Twelve WB units were donated by healthy volunteers after routine screening. Five units underwent standard leukocyte filtration and five did not. Two units were aliquoted into filtered and unfiltered samples, with platelets added to each sample on Day 14. Units were stored at 4°C and sampled on days 0, 1, 2, 3, 4, 5, 6, 7, 10, 14, 21, 28, and 35 for immediate thromboelastogram (TEG) analysis, and centrifuged and stored at -80°C for later Calibrated Automated Thrombogram (CAT) and coagulation factor assays.

**RESULTS:** K-dependent factors and fibrinogen were low normal, decreased slightly over 35 days, and were similar between unfiltered and filtered units. Labile factors were better preserved in filtered units, although unfiltered units did not show impaired coagulation over 35 days. Filtered blood had delayed clot initiation on days 0, 1, and 2 as measured by TEG R ($p<0.021$); slower clot progression (TEG α-angle) on days 0, 1, 2, 3, 4, 5, and 6 ($p<0.023$); weaker final clot (TEG MA) on all days ($p<0.0001$). Thrombin generation was delayed on day 28 ($p=0.046$) and decreased on days 10, 21, 28, and 35 ($p<0.034$). Addition of platelets to filtered WB rescued TEG MA.

**CONCLUSIONS:** Filtered WB had decreased functional clotting capacity and thrombin generation and may not be suitable for hemostatic resuscitation as the sole blood product.

**BMC Anesthesiol. 2017 Feb 20;17(1):26.**

# A preliminary assessment of the LMA protector™ in non-paralysed patients.

**Sng B, Ithnin F, Mathur D, Lew E, Han N, Sia A**

**BACKGROUND:** The LMA Protector™ is the latest CE marked single use supraglottic airway device. This airway device provides access and functional separation of the respiratory and digestive tracts. There are two ports (male, female ports) to provide suction in the laryngeal region and insertion of the gastric tube. The aim of our study is to assess the ease of use, airway quality, device positioning, airway leak and complications associated with initial clinical experience in LMA Protector™ usage.

**METHODS:** This is an initial investigation of LMA Protector™ airway device. We conducted a preliminary assessment in the anaesthetised women who underwent minor gynaecological procedures with spontaneous ventilation in order to evaluate the performance of the airway device.

**RESULTS:** Insertion was successful on first and second attempts in 23 (88.5%) and 3 (11.5%) respectively. Median [IQR (range)] insertion time was 19 [17-21(14-58)] seconds. Airway leak pressure was 25.5 [23-29(21-30] cmH2O. On fibreoptic examination via the device, vocal cords were visible in all 26 patients. There were no alternative airway use or airway manipulations required during maintenance of anaesthesia. Six patients had sore throat 24 h after procedures and there was no dysphagia or hoarseness.

**CONCLUSION:** This pilot study of the LMA protector shows that the device is easily inserted with fast insertion time, providing a reliable and adequate airway seal.

**J Trauma Acute Care Surg. 2017 Apr 27. doi: 10.1097/TA.0000000000001532. [Epub ahead of print]**

# Incompatible Type A Plasma Transfusion in Patients Requiring Massive Transfusion Protocol: Outcomes of an EAST Multicenter Study.

**Stevens W, Morse B, Bernard A, Davenport D, Sams V, Goodman M, Dumire R, Carrick M, McCarthy P, Stubbs J, Pritts T, Dente C, Luo-Owen X, Gregory J, Turay D, Gomaa D, Quispe J, Fitzgerald CA, Haddad N, Choudhry A, Quesada J, Zielinski MD.**

**INTRODUCTION:** With a relative shortage of type AB plasma, many centers have converted to type A plasma for resuscitation of patients whose blood type is unknown. The goal of this study is to determine outcomes for trauma patients who received incompatible plasma transfusions as part of a massive transfusion protocol (MTP).

**METHODS:** As part of an EAST multi-institutional trial, registry and blood bank data were collected from 8 trauma centers for trauma patients (age ≥ 15 years) receiving emergency release plasma transfusions as part of MTPs from January 2012 - August 2016. Incompatible type A plasma was defined as transfusion to patient blood type B or AB.

**RESULTS:** Of the 1536 patients identified, 92% received compatible plasma transfusions and 8% received incompatible type A plasma. Patient characteristics were similar except for greater penetrating injuries (48% vs. 36%, p=.01) in the incompatible group. In the incompatible group, patients were transfused more plasma units at 4 hours (median 9 vs. 5, p<.001) and overall for stay (11 vs. 9, p=.03). No hemolytic transfusion reactions were reported. Two TRALI events were reported in the compatible group. Between incompatible and compatible groups, there was no difference in the rates of ARDS (6% vs. 8%, p=.589), thromboembolic events (9% vs. 7%, p=.464), sepsis (6% vs. 8%, p=.589), or acute renal failure (8% vs. 8%, p=.860). Mortality at 6 (17% vs. 15%, p=.775) and 24 hours (25% vs. 23%, p=.544) and at 28 days or discharge (38% vs. 35%, p=.486) were similar between groups. Multivariate regression demonstrated that ISS, older age and more RBC transfusion at 4 hours were independently associated with death at 28 days or discharge; ISS and more RBC transfusion at 4 hours were predictors for morbidity. Incompatible transfusion was not an independent determinant of mortality or morbidity.

**CONCLUSION:** Transfusion of type A plasma to blood groups B and AB appears relatedly transfusions as part of a MTP.

**Prehosp Disaster Med. 2017 Jun;32(3):284-288.**

# A Descriptive Analysis of Tactical Casualty Care Interventions Performed by Law Enforcement Personnel in the State of Wisconsin, 2010-2015.

**Stiles C, Cook C, Sztajnkrycer M**

**INTRODUCTION:** Based upon military experience, law enforcement has developed guidelines for medical care during high-threat conditions. The purpose of the current study was to provide a descriptive analysis of reported outcomes of law enforcement medical interventions.

**METHODS:** This was a descriptive analysis of a convenience sample of cases submitted to the Wisconsin Tactical Medicine Initiative (Wisconsin USA), after the provision of successful patient care, between January 2010 and December 2015. The study was reviewed by the Mayo Foundation Institutional Review Board (Rochester, Minnesota USA) and deemed exempt.

**RESULTS:** Nineteen agencies submitted information during the study period. Of the 56 episodes of care reported, four (7.1%) cases involved care provided to injured officers while 52 (92.9%) involved care to injured civilians, including suspects. In at least two cases, on-going threats existed during the provision of medical care to an injured civilian. Law enforcement rendered care prior to Emergency Medical Services (EMS) arrival in all but two cases.

**CONCLUSIONS:** The current case series demonstrates the life-saving potential for law enforcement personnel trained and equipped under current Tactical Combat Casualty Care (TCCC)/ Committee on Tactical Emergency Casualty Care (C-TECC) tactical casualty care guidelines. Although originally developed to save the lives of wounded combat personnel, in the civilian sector, the training appears more likely to save victims rather than law enforcement personnel.

**J Neurotrauma. 2016 Dec 15;33(24):2217-2226**

# Responses of the Acutely Injured Spinal Cord to Vibration that Simulates Transport in Helicopters or Mine-Resistant Ambush-Protected Vehicles.

**Streijger F, Lee J, Manouchehri N, Melnyk A, Chak J, Tigchelaar S, So K, Okon E, Jiang S, Kinsler R, Barazanji K, Cripton P, Kwon B**

**ABSTRACT:**
In the military environment, injured soldiers undergoing medical evacuation via helicopter or mine-resistant ambush-protected vehicle (MRAP) are subjected to vibration and shock inherent to the transport vehicle. We conducted the present study to assess the consequences of such vibration on the acutely injured spinal cord. We used a porcine model of spinal cord injury (SCI). After a T10 contusion-compression injury, animals were subjected to 1) no vibration (n = 7-8), 2) whole body vibration at frequencies and amplitudes simulating helicopter transport (n = 8), or 3) whole body vibration simulating ground transportation in an MRAP ambulance (n = 7). Hindlimb locomotor function (using Porcine Thoracic Injury Behavior Scale [PTIBS]), Eriochrome Cyanine histochemistry and biochemical analysis of inflammatory and neural damage markers were analyzed. Cerebrospinal fluid (CSF) expression levels for monocyte chemoattractant protein-1 (MCP-1), interleukin (IL)-6, IL-8, and glial fibrillary acidic protein (GFAP) were similar between the helicopter or MRAP group and the unvibrated controls. Spared white/gray matter tended to be lower in the MRAP-vibrated animals than in the unvibrated controls, especially rostral to the epicenter. However, spared white/gray matter in the helicopter-vibrated group appeared normal. Although there was a relationship between the extent of sparing and the extent of locomotor recovery, no significant differences were found in PTIBS scores between the groups. In summary, exposures to vibration in the context of ground (MRAP) or aeromedical (helicopter) transportation did not significantly impair functional outcome in our large animal model of SCI. However, MRAP vibration was associated with increased tissue damage around the injury site, warranting caution around exposure to vehicle vibration acutely after SCI.

**J Investig Med High Impact Case Rep. 2017 Jan 1;5(1):2324709616689376. doi: 10.1177/2324709616689376. eCollection 2017 Jan-Mar.**

# Ertapenem-Induced Encephalopathy in a Patient With Normal Renal Function.

**Sutton S, Jumper M, Cook S, Edun B, Wyatt M**

**ABSTRACT:**
Drug-induced neurotoxicity is a rare adverse reaction associated with ertapenem. Encephalopathy is a type of neurotoxicity that is defined as a diffuse disease of the brain that alters brain function or structure. We report a patient with normal renal function who developed ertapenem-induced encephalopathy manifesting as altered mental status, hallucinations, and dystonic symptoms. The patient's symptoms improved dramatically following ertapenem discontinuation, consistent with case reports describing ertapenem neurotoxicity in renal dysfunction. Since clinical evidence strongly suggested ertapenem causality, we utilized the Naranjo Scale to estimate the probability of an adverse drug reaction to ertapenem. Our patient received a Naranjo Scale score of 7, suggesting a probable adverse drug reaction, with a reasonable temporal sequence to support our conclusion.

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

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

**Tribble D, Li P, Warkentien T, Lloyd B, Schnaubelt E, Ganesan A, Bradley W, Aggarwal D, Carson M, Weintrob A, Murray C**

**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 Trauma Acute Care Surg. 2016 Apr;80(4):568-74**

## Damage-control resuscitation and emergency laparotomy: Findings from the PROPPR study.

**Undurraga Perl V, Leroux B, Cook M, Watson J, Fair K, Martin D, Kerby J,Williams C, Inaba K, Wade C, Cotton B, Del Junco D, Fox E, Scalea T, Tilley B, Holcomb J, Schreiber M; PROPPR Study Group.**

**BACKGROUND:** The Pragmatic Randomized Optimal Platelet and Plasma Ratios (PROPPR) trial has demonstrated that damage-control resuscitation, a massive transfusion strategy targeting a balanced delivery of plasma-platelet-red blood cell in a ratio of 1:1:1, results in improved survival at 3 hours and a reduction in deaths caused by exsanguination in the first 24 hours compared with a 1:1:2 ratio. In light of these findings, we hypothesized that patients receiving 1:1:1 ratio would have improved survival after emergency laparotomy.

**METHODS:** Severely injured patients predicted to receive a massive transfusion admitted to 12 Level I North American trauma centers were randomized to 1:1:1 versus 1:1:2 as described in the PROPPR trial. From these patients, the subset that underwent an emergency laparotomy, defined previously in the literature as laparotomy within 90 minutes of arrival, were identified. We compared rates and timing of emergency laparotomy as well as postsurgical survival at 24 hours and 30 days.

**RESULTS:** Of the 680 enrolled patients, 613 underwent a surgical procedure, 397 underwent a laparotomy, and 346 underwent an emergency laparotomy. The percentages of patients undergoing emergency laparotomy were 51.5% (174 of 338) and 50.3% (172 of 342) for 1:1:1 and 1:1:2, respectively ($p = 0.20$). Median time to laparotomy was 28 minutes in both treatment groups. Among patients undergoing an emergency laparotomy, the proportions of patients surviving to 24 hours and 30 days were similar between treatment arms; 24-hour survival was 86.8% (151 of 174) for 1:1:1 and 83.1% (143 of 172) for 1:1:2 ($p = 0.29$), and 30-day survival was 79.3% (138 of 174) for 1:1:1 and 75.0% (129 of 172) for 1:1:2 ($p = 0.30$).

**CONCLUSION:** We found no evidence that resuscitation strategy affects whether a patient requires an emergency laparotomy, time to laparotomy, or subsequent survival.

**LEVEL OF EVIDENCE:** Therapeutic study, level IV.

**J Trauma Acute Care Surg. 2017 Apr 27. doi: 10.1097/TA.0000000000001520. [Epub ahead of print]**

## Platelet transfusions reduce fibrinolysis but do not restore platelet function during trauma hemorrhage.

**Vulliamy P, Gillespie S, Gall LS, Green L, Brohi K, Davenport RA.**

**INTRODUCTION:** Platelets play a critical role in hemostasis with aberrant function implicated in trauma-induced coagulopathy. However, the impact of massive transfusion protocols on platelet function during trauma hemorrhage is unknown. The aim of this study was to characterize the effects of platelet transfusion on platelet aggregation and fibrinolytic markers during hemostatic resuscitation.

**METHODS:** Trauma patients enrolled into the prospective Activation of Coagulation and Inflammation in Trauma (ACIT) study between January 2008 and November 2015 who received at least four units of packed red blood cells (PRBCs) were included. Blood was drawn in the emergency department within 2 hours of injury and at intervals after every 4 units of PRBCs transfused. Platelet aggregation was assessed in whole blood with multiple electrode aggregometry. Plasma proteins were quantified by enzyme-linked immunosorbent assay.

**RESULTS:** Of 161 patients who received 4 or more PRBCs as part of their initial resuscitation, 44 received 8-11 units and 28 received 12 units or more. At each time point during bleeding, platelet aggregation was similar in patients who had received a platelet transfusion compared to those who had only received other blood products ($p>0.05$ for all time points). Platelet transfusion during the 4PRBC intervals was associated with a decrease in maximum lysis on rotational thromboelastometry (start of interval 6% [2-12] vs end of interval 2% [0-5], $p=0.001$), an increase in plasminogen activator inhibitor-1 (PAI-1; start of interval: 35.9 +/- 14.9 vs end of interval: 66.7 +/- 22.0, $p=0.007$) and a decrease in tissue plasminogen activator (start of interval: 26.2 +/- 10.5 vs end of interval: 19.0 +/- 5.1, $p=0.04$). No statistically significant changes in these parameters occurred in intervals which did not contain platelets.

**CONCLUSION:** Current hemostatic resuscitation strategies do not appear to restore platelet aggregation during active hemorrhage. However, stored platelets may attenuate fibrinolysis by providing an additional source of PAI-1. Further investigation into the effects of early platelet transfusion on platelet function, haemostatic and clinical outcomes during bleeding are warranted.

**LEVEL OF EVIDENCE:** Prospective observational study, level III.

**Mil Med. 2017 Mar;182(3):e1709-e1712.**

# Widespread Use of Prescription Nonsteroidal Anti-Inflammatory Drugs Among U.S. Army Active Duty Soldiers.

**Walker L, Zambraski E, Williams R**

**INTRODUCTION:** Nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly used to treat pain and inflammation by inhibiting prostaglandin synthesis. There is a high incidence of musculoskeletal injuries in the military, which would validate the widespread use of NSAIDs. This study determined the amount and specific types of NSAIDs being prescribed to U.S. Army active duty soldiers.

**METHODS AND MATERIALS:** This study was a quantitative study which utilized an existing database of de-identified data; therefore, institutional review board approval was not required. Data pertaining to NSAID prescriptions issued to active duty soldiers for fiscal years 2006, 2011, and 2014 were obtained from the Department of Defense Pharmacy Data Transactions Service data warehouse, which contains all outpatient prescriptions. The data include the number of soldiers receiving NSAID prescriptions (i.e., utilizers) as well as the number of prescriptions given for each specific NSAID.

**RESULTS:** In 2006, 2011, and 2014, the numbers of active duty utilizers were 348,031, 435,364, and 418,579, respectively. For the entire active duty Army, the percentage of soldiers who were receiving NSAID prescriptions was approximately 69% in 2006, 77% in 2011, and 82% in 2014. The number of NSAIDs prescribed was 740,090 in 2006; 898,291 in 2011; and 857,964 in 2014. Celecoxib, the only cyclooxygenase-2 inhibitor prescribed in the United States accounted for 2.4% of these NSAID prescriptions in 2006, 6.3% in 2011, and 7.1% in 2014. During all 3 years, the number of prescriptions filled was almost twice the number of utilizers, indicating that many individuals were receiving more than one prescription. Female soldiers received almost twice the number of prescriptions per individual as male soldiers. The use of over-the-counter NSAIDs, which are widely available, was not accounted for in this study; therefore, total NSAID use is likely higher than reported.

**CONCLUSION:** The vast majority of U.S. Army active duty soldiers are being prescribed NSAIDs. These data raise concerns because of the potential adverse effects that NSAIDs have on gastrointestinal, renal, and cardiovascular function, as well as bone health. Additional studies are warranted to determine the actual amounts of NSAIDs being used and the specific conditions for which they are being prescribed.

**Prehosp Emerg Care. 2017 May-Jun;21(3):322-326.**

## Use of Intranasal Naloxone by Basic Life Support Providers.

**Weiner S, Mitchell P, Temin E, Langlois B, Dyer K**

**STUDY OBJECTIVES:** Intranasal delivery of naloxone to reverse the effects of opioid overdose by Advanced Life Support (ALS) providers has been studied in several prehospital settings. In 2006, in response to the increase in opioid-related overdoses, a special waiver from the state allowed administration of intranasal naloxone by Basic Life Support (BLS) providers in our city. This study aimed to determine: 1) if patients who received a 2-mg dose of nasal naloxone administered by BLS required repeat dosing while in the emergency department (ED), and 2) the disposition of these patients.

**METHODS:** This was a retrospective review of patients transported by an inner-city municipal ambulance service to one of three academic medical centers. We included patients aged 18 and older that were transported by ambulance between 1/1/2006 and 12/12/2012 and who received intranasal naloxone by BLS providers as per a state approved protocol. Site investigators matched EMS run data to patients from each hospital's EMR and performed a chart review to confirm that the patient was correctly identified and to record the outcomes of interest. Descriptive statistics were then generated.

**RESULTS:** A total of 793 patients received nasal naloxone by BLS and were transported to three hospitals. ALS intervened and transported 116 (14.6%) patients, and 11 (1.4%) were intubated in the field. There were 724 (91.3%) patients successfully matched to an ED chart. Hospital A received 336 (46.4%) patients, Hospital B received 210 (29.0%) patients, and Hospital C received 178 (24.6%) patients. Mean age was 36.2 (SD 10.5) years and 522 (72.1%) were male; 702 (97.1%) were reported to have abused heroin while 21 (2.9%) used other opioids. Nasal naloxone had an effect per the prehospital record in 689 (95.2%) patients. An additional naloxone dose was given in the ED to 64 (8.8%) patients. ED dispositions were: 507 (70.0%) discharged, 105 (14.5%) admitted, and 112 (15.5%) other (e.g., left against medical advice, left without being seen, or transferred).

**CONCLUSIONS:** Only a small percentage of patients receiving prehospital administration of nasal naloxone by BLS providers required additional doses of naloxone in the ED and the majority of patients were discharged.

**Crit Care Med. 2017 Apr;45(4):623-629.**

## Increased Time to Initial Antimicrobial Administration Is Associated With Progression to Septic Shock in Severe Sepsis Patients.

**Whiles B, Deis A, Simpson S**

**OBJECTIVES:** To determine if time to initial antimicrobial is associated with progression of severe sepsis to septic shock.

**DESIGN:** Retrospective cohort.

**SETTING:** Six hundred fifty-six bed urban academic medical center.

**PATIENTS:** Emergency department patients greater than or equal to 18 years old with severe sepsis and/or septic shock and antimicrobial administration within 24 hours. Patients with shock on presentation were excluded.

**INTERVENTIONS:** Not available.

**MEASUREMENTS AND MAIN RESULTS:** We identified 3,929 severe sepsis patients, with overall mortality 12.8%. Nine hundred eighty-four patients (25.0%) progressed to septic shock. The median time to antimicrobial was 3.77 hours (interquartile range = 1.96-6.42) in those who progressed versus 2.76 hours (interquartile range = 1.60-4.82) in those who did not ($p < 0.001$). Multivariate logistic regression demonstrated that male sex (odds ratio = 1.18; 95% CI, 1.01-1.36), Charlson Comorbidity Index (odds ratio = 1.18; 95% CI, 1.11-1.27), number of infections (odds ratio = 1.05; 95% CI, 1.02-1.08), and time to first antimicrobial (odds ratio = 1.08; 95% CI, 1.06-1.10) were associated with progression. Each hour until initial antimicrobial administration was associated with a 8.0% increase in progression to septic shock. Additionally, time to broad-spectrum antimicrobial was associated with progression (odds ratio = 1.06; 95% CI, 1.05-1.08). Time to initial antimicrobial was also associated with in-hospital mortality (odds ratio = 1.05; 95% CI, 1.03-1.07).

**CONCLUSIONS:** This study emphasizes the importance of early, broad-spectrum antimicrobial administration in severe sepsis patients admitted through the emergency department, as longer time to initial antimicrobial administration is associated with increased progression of severe sepsis to septic shock and increased mortality.

**Mil Med. 2017 Mar;182(S1):226-229**

# Blast Wave Dynamics at the Cornea as a Function of Eye Protection Form and Fit.

**Williams S, Harding T, Statz J, Martin J**

**ABSTRACT:**
A shock tube and anthropomorphic headforms were used to investigate eye protection form and fit using eyewear on the Authorized Protective Eyewear List in primary ocular blast trauma experiments. Time pressure recordings were obtained from highly linear pressure sensors mounted at the cornea of instrumented headforms of different sizes. A custom shock tube produced highly reliable shock waves and pressure recordings were collected as a function of shock wave orientation and protective eyewear. Eyewear protection coefficients were calculated as a function of a new metric of eyewear fit. In general, better protection was correlated with smaller gaps between the eyewear and face. For oblique angles, most spectacles actually potentiated the blast wave by creating higher peak pressures at the cornea. Installing foam around the perimeter of the spectacle lens to close the gap between the lens and face resulted in significantly lower pressure at the cornea. In conclusion, current eye protection, which was designed to reduce secondary and tertiary blast injuries, provides insufficient protection against primary blast injury.

**Med Devices (Auckl). 2016 Nov 2;9:383-388.**

# A new laryngeal mask supraglottic airway device with integrated balloon line: a descriptive and comparative bench study.

**Zhou Y, Jew K**

**ABSTRACT:**
Laryngeal masks are invasive devices for airway management placed in the supraglottic position. The Shiley™ laryngeal mask (Shiley™ LM) features an integrated inflation tube and airway shaft to facilitate product insertion and reduce the chance of tube occlusion when patients bite down. This study compared the Shiley LM to two other disposable laryngeal mask devices, the Ambu(®) AuraStraight™ and the LMA Unique™. Overall device design, tensile strength, flexibility of various structures, and sealing performance were measured. The Shiley LM is structurally stronger and its shaft is more resistant to compression than the other devices. The Shiley LM is generally less flexible than the other devices, but this relationship varies with device size. Sealing performance of the devices was similar in a bench assay. The results of this bench study demonstrate that the new Shiley LM resembles other commercially available laryngeal mask devices, though it exhibits greater tensile strength and lower flexibility.

**J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S70-S78.**

# Prehospital blood transfusion programs: Capabilities and lessons learned.

**Zielinski M, Stubbs J, Berns K, Glassberg E, Murdock A, Shinar E, Sunde GA, Williams S, Yazer M, Zietlow S, Jenkins D**

**ABSTRACT:**
The Trauma and Hemostasis Oxygenation Research (THOR) network has met in Bergen, Norway every summer over the past six years in an effort to have experts in transfusion, blood banking, military medicine, and trauma surgery exchange ideas, share their experiences, and set an agenda to move the science of remote damage control resuscitation forward. These lessons include the experiences of the Norwegian military with freeze-dried plasma and the whole blood resuscitation, lessons from extreme remote damage control resuscitation situations on oceanic cruises, and remote blood product resuscitation techniques at Mayo Clinic and the University of Pittsburgh.

**Anesth Analg. 2017 May;124(5):1547-1554.**

## Posttransfusion Increase of Hematocrit per se Does Not Improve Circulatory Oxygen Delivery due to Increased Blood Viscosity.

**Zimmerman R, Tsai A, Salazar Vázquez B, Cabrales P, Hofmann A, Meier J, Shander A, Spahn D, Friedman J, Tartakovsky D, Intaglietta M.**

**BACKGROUND:** Blood transfusion is used to treat acute anemia with the goal of increasing blood oxygen-carrying capacity as determined by hematocrit (Hct) and oxygen delivery (DO2). However, increasing Hct also increases blood viscosity, which may thus lower DO2 if the arterial circulation is a rigid hydraulic system as the resistance to blood flow will increase. The net effect of transfusion on DO2 in this system can be analyzed by using the relationship between Hct and systemic blood viscosity of circulating blood at the posttransfusion Hct to calculate DO2 and comparing this value with pretransfusion DO2. We hypothesized that increasing Hct would increase DO2 and tested our hypothesis by mathematically modeling DO2 in the circulation.

**METHODS:** Calculations were made assuming a normal cardiac output (5 L/min) with degrees of anemia ranging from 5% to 80% Hct deficit. We analyzed the effects of transfusing 0.5 or more units of 300 cc of packed red blood cells (PRBCs) at an Hct of 65% and calculated microcirculatory DO2 after accounting for increased blood viscosity and assuming no change in blood pressure. Our model accounts for O2 diffusion out of the circulation before blood arriving to the nutritional circulation and for changes in blood flow velocity. The immediate posttransfusion DO2 was also compared with DO2 after the transient increase in volume due to transfusion has subsided.

**RESULTS:** Blood transfusion of up to 3 units of PRBCs increased DO2 when Hct (or hemoglobin) was 60% lower than normal, but did not increase DO2 when administered before this threshold.

**CONCLUSIONS:** After accounting for the effect of increasing blood viscosity on blood flow owing to increasing Hct, we found in a mathematical simulation of DO2 that transfusion of up to 3 units of PRBCs does not increase DO2, unless anemia is the result of an Hct deficit greater than 60%. Observations that transfusions occasionally result in clinical improvement suggest that other mechanisms possibly related to increased blood viscosity may compensate for the absence of increase in DO2.