Tactical Combat Casualty Care

Journal Article Abstracts

Committee on Tactical Combat Casualty Care
May 2015

References

Bach P, Sølling C: Failed needle decompression of bilateral spontaneous tension pneumothorax. Acta Anaesthesiol Scand 2015;Epub ahead of print

Bartz R, White W, Gan T: Perioperative clinical and economic outcomes associated with replacing first-generation high molecular weight hydroxyethyl starch (Hextend®) with low molecular weight hydroxyethyl starch (Voluven®) at a large medical center. Perioper Med 2015;4:2

Chapman M, Moore E, Chin T, et al: COMBAT: Initial experience with a randomized clinical trial of plasma-based resuscitation in the field for traumatic hemorrhagic shock. Shock 2015;Epub ahead of print

Chatfield-Ball C, Boyle P, Autier P, et al: Lessons learned from the casualties of war: battlefield medicine and its implication for global trauma care. J R Soc Med 2015;108:93-100

Clemency B, Tanski C, Rosenberg M, et al: Sufficient catheter length for pneumothorax needle decompression: a meta-analysis. Prehosp Disaster Med 2015;Epub ahead of print

Cunningham C: Only break glass in case of war? The difficulty with combat medic skills sustainment within our military treatment facilities. J Spec Oper Med 2015;15:91-92

Davies R: Should whole blood replace the shock pack? J R Army Med Corps 2015;Epub ahead of print

Drew B, Bennett B, Littlejohn L: Application of current hemorrhage control techniques for backcountry care: Part 1 - tourniquets and hemorrhage control adjuncts. Wilderness Environ Med 2015;Epub ahead of print

Garcia-Blanco J, Gegel B, Burgert J, et al: The effects of movement on hemorrhage when Quickclot® Combat Gauze™ is used in a hypothermic hemodiluted porcine model. J Spec Oper Med 2015;15:57-60

Gaydos S, Kelley A, Grandizio C, et al: Comparison of the effects of ketamine and morphine on performance of representative military tasks. J Emerg Med 2015;48:313-324

Gendler S, Nadler R, Erlich T, et al: Eye injury in the Israeli Defense Force: “An ounce of prevention is worth a pound of cure.” Injury 2015;Epub ahead of print.

Grissom T, Fang R: Topical hemostatic agents and dressings in the prehospital setting. Curr Opin Anaesthesiol:2015;28:210-216

Guyette F, Meier E, Newgard C, et al: A comparison of prehospital lactate and systolic blood pressure for predicting the need for resuscitative care in trauma transported by ground. J Trauma Acute Care Surg 2015;78:600-606

Hall S, Murphy M: Limitations of component therapy for massive haemorrhage: is whole blood the whole solution? Anaesthesia. 2015;70:511-514

Harvin J, Peirce C, Mims Mark, et al: The impact of tranexamic acid on mortality in injured patients with hyperfibrinolysis. J Trauma Acute Care Surg 2015;78:905-911

Hess J, Holcomb J:Resuscitating PROPPRly. Transfusion; Epub ahead of print

Hohertz B, Seupaul R, Holmes T: Are colloids better than crystalloids for fluid resuscitation in critically ill patients? Ann Emerg Med 2015;65:443-444

Holcomb J, Hoyt D: Comprehensive injury research. JAMA 2015;313:1463-1464

Ishii Y, Noguchi H, Sato J, et al: Effect of a single injection of tranexamic acid on blood loss after primary hybrid TKA. Knee 2015;Epub ahead of print.

Kheirabadi B, Valdez-Delgado K, Terrazas I, et al: Is limited prehospital resuscitation with plasma more beneficial than using a synthetic colloid? An experimental study in rabbits with parenchymal bleeding. J Trauma Acute Care 2015;78:752-759

King D, Larentzakis A, Ramly E, The Boston Trauma Collaborative: Tourniquet use at the Boston Marathon bombing: lost in translation. J Trauma Acute Care Surg 2015;78;594-599

Kragh J, Nam J, Beery K: Transfusion for shock in US Military casualties with and without tourniquet use. Ann Emerg Med 2015;65:290-296

Kragh J, Wallum T, Aden J, et al: Which improvised tourniquet windlasses work well and which ones won’t? Wilderness Environ Med 2015;Epub ahead of print

Kundu R, Das A, Basunia S, et al: Does a single loading dose of tranexamic acid reduce perioperative blood loss and transfusion requirements after total knee replacement surgery? A randomized, control trial. J Nat Sci Biol Med 2015;6:94-99

Landry J, Aberle S, Dennis A, Sztajnkrycer M: Emergency medical response in active-threat situations: training standards for law enforcement. FBI Law Enforcement Bulletin, March 2015

Littlejohn L, Bennett B, Drew B: Application of current hemorrhage control techniques for backcountry care: Part 2, hemostatic dressings and other adjuncts. Wilderness Environ Med 2015:Epub ahead of print

Mabry R: Challenges to improving combat casualty survival on the battlefield – analysis. Eurasia Review. 2015 February 21

Maciel J, Gifford E, Plurad D, et al: The impact of a massive transfusion protocol on outcomes among patients with abdominal aortic injuries. Ann Vasc Surg 2015;Epub ahead of print

Madershahian N, Scherner M, Pfister R, et al: Prophylactic intraoperative tranexamic acid administration and postoperative blood loss after transapical aortic valve implantation. J Cardiothorac Surg 2015;10:45

Martini W, Deguzman R, Rodriguez C, et al: Effect of ibuprofen dose on platelet aggregation and coagulation in blood samples from pigs. Mil Med 2015;180:80-85

McGarry A, Mott J, Kotwal R: A study of prehospital medical documentation by military medical providers during precombat training. J Spec Oper Med 2015;15:79-84

Mitchell T, Waldrep K, Sams V, et al: An 8-year review of Operation Enduring Freedom and Operation Iraqi Freedom Resuscitative Thoracotomies. Mil Med 2015;180:33-36

Motov S, Rockoff B, Cohen C, et al: Intravenous subdissociative-dose ketamine versus morphine for analgesia in the emergency department: a randomized controlled trial. Ann Emerg Med 2015;Epub ahead of print

Ng W, Jerath A, Wasowicz M: Tranexamic acid: a clinical review. Anaesthesiol Intensive Ther 2015;Epub a head of print

Norii T, Crandall C, Terasaka Y: Survival of severe blunt trauma patients treated with resuscitative endovascular balloon occlusion of the aorta compared with propensity score-adjusted untreated patients. J Trauma Acute Care Surg 2015;78:721-728

Pasley J, Miller C, DuBose J, et al: Intraosseous infusion rates under high pressure: a cadaveric comparison of anatomic sites. J Trauma Acute Care Surg 2015;78:295-299

Penn-Barwell J, Roberts S, Midwinter M, Bishop J: Improved survival in UK combat casualties from Iraq and Afghanstan:2003-2012. J Trauma Acute Care Surg 2015;78:1014-1020

Petz L, Tyner S, Barnard E, et al: Prehospital and en route analgesic use in the combat setting: a prospectively designed, multicenter, observational study. Mil Med 2015;180:14-18

Rhee P, Inaba K, Pandit V, et al: Early autologous fresh whole blood transfusion leads to less allogenic transfusion and is safe. J Trauma Acute Care Surg 2015;78:729-734

Robertson J, Koyfman A: Does tranexamic acid improve outcomes in patients undergoing urgent or emergency surgery? Ann Emerg Med 2015;65:445-446

Runcie H, Greene M: Femoral traction splints in mountain rescue prehospital care: to use or not to use? That is the question. Wilderness Environ Med 2015;Epub ahead of print

Rush S, Boccio E, Kharod C, D'Amore J: Evolution of pararescue medicine during Operation Enduring Freedom. Mil Med 2015;180;68-73

Schauer S, Bellamy M, Mabry R, Bebarta V: A comparison of the incidence of cricothyrotomy in the deployed setting to the emergency department at a level I military trauma center: a descriptive analysis. Mil Med 2015;180:60-63

Schauer S, Robinson J, Mabry R, Howard J: Battlefield Analgesia: TCCC guidelines are not being followed. J Spec Oper Med 2015;15:85-89

Schreiber M, Meier E, Tisherman S, et al: A controlled resuscitation strategy is feasible and safe in hypotensive trauma patients: results of a prospective randomized pilot trail. J Trauma Acute Care Surg 2015;78:687-697

Shackelford S, Butler F, Kragh J, et al: Optimizing the use of limb tourniquets in tactical combat casualty care: TCCC guidelines change 14-02. J Spec Oper Med 2015;15:17-31

Shackleford S, Fowler M, Schultz K, et al: Prehospital pain medication use by U.S. Forces. Mil Med 2015;180:304-309

Shemshaki H, Nourian S, Nourian N, et al: One step closer to sparing total blood loss and transfusion rate in total knee arthroplasty: a meta-analysis of different methods of tranexamic acid administration. Arch Orthop Trauma Surg 2015;Epub ahead of print

Shrestha B, Holcomb B, Camp E, et al: Damage-control resuscitation increases successful nonoperative management rates and survival after severe blunt liver injury. J Trauma Acute Care Surg. 2015 Feb;78:336-341

Slessor D, Hunter S: To be blunt: are we wasting our time? Emergency department thoracotomy following blunt trauma: a systemic review and meta-analysis. Ann Emerg Med 2015;65:297-307

Steinmann D, Ahne T, Heringhaus C, Goebel U: Comparison of airway management techniques for different access in a simulated motor vehicle entrapment scenario. Eur J Emerg Med 2015:Epub ahead of print

Strandenes G, Hervig T, Bjerkvig C, et al: The lost art of whole blood transfusion in austere environments. Curr Sports Med 2015;15:11-15

Surrett G, Franklin J, Wedmore I: Pain control in austere settings. Curr Sports Med Rep 2015;14:117-12

Tiba M, Draucker G, McCracken B, et al Use of pelvic hemostasis belt to control lethal pelvic arterial hemorrhage in a swine model. J Trauma Acute Care Surg 2015;78:524-529

Abstracts

Acta Anaesthesiol Scand. 2015 Apr 21 Epub ahead of

Failed needle decompression of bilateral spontaneous tension pneumothorax.

Bach PT, Sølling C.

Abstract:

This case report presents a young male admitted with primary bilateral spontaneous tension pneumothorax and severe respiratory distress. This is an extremely rare condition. The patient was on the verge of hypoxic cardiac arrest and the attempted needle thoracocentesis was unsuccessful. Needle thoracocentesi in the midclavicular line of the second intercostal space is widely used and recommended as first-line treatment of tension pneumothorax. Reviewing the literature, the procedure is not based on solid evidence. It has high failure rates and potentially serious complications. Alternatives to this approach are perhaps more appropriate. Correctly done, needle thoracocentesis has its place in the presence of a diagnosed or suspected tension pneumothorax when no other options are available. If needle thoracocentesis is chosen, then insertion in the mid-anterior axillary line of the 3rd-5th intercostal space is an appropriate alternative site. Otherwise, lateral thoracostomy, with or without chest tube insertion, is a safe procedure with a high success rate. It should be considered as the first-line treatment of tension pneumothorax, particularly in the unstable patient.

Perioper Med (Lond). 2015 Feb 26;4:2

Perioperative clinical and economic outcomes associated with replacing first-generation high molecular weight hydroxyethyl starch (Hextend®) with low molecular weight hydroxyethyl starch (Voluven®) at a large medical center.

Bartz RR, White WD, Gan TJ

BACKGROUND: Several plasma volume expander alternatives exist to enhance intravascular volume status in patients undergoing surgery. The optimal intravascular volume expander in the perioperative setting is currently unknown. Low molecular weight hetastarch, Voluven® (130/0.4), may have a better safety profile than high molecular weight hetastarch, Hextend® (450/0.7). We examined the clinical and cost outcomes of converting from Hextend® to Voluven® in a large tertiary medical center.

METHODS: Using a large electronic database, we retrospectively compared two different time periods (2009 and 2010) where the availability of semisynthetic colloids changed. Perioperative and postoperative outcomes including the use of red blood cells (RBC), platelets and coagulation factors, length of stay in the postoperative acute care unit (PACU), intensive care unit and hospital, as well as 30-day and 1-year mortality were compared. In addition, direct acquisition costs of all intraoperative and PACU colloids and crystalloid use were determined.

RESULTS: A total of 4,888 adult subjects were compared of which 1,878 received Hextend® (pre-conversion) and 2,759 received Voluven® (post-conversion) during two separate 7-month periods within 1 year apart, with the remainder receiving Plasmanate. The patients were similar in terms of patient demographics, preoperative comorbidities, ASA status, emergency surgery, types of surgery, intraoperative, and PACU times. In unadjusted outcomes, patients in the Hextend® group received more lactated Ringer's than in the Voluven® group (2,220 + 1,312 vs. 1,946 ± 1,097 ml; $P < 0.0001$). The use of albumin (Plasmanate) was reduced from 10.5% of patients to 1.1% when Voluven® was substituted for Hextend®. Unadjusted outcomes were similar in each group including hospital LOS, percent change from baseline creatinine and receipt of intraoperative and PACU blood product administration. However, overall unadjusted total fluid costs were greater in the Voluven® compared to Hextend® group ($116.7 compared to $59.3; $P < 0.001$).

CONCLUSIONS: Conversion from Hextend® to Voluven® in the perioperative period resulted in decreased albumin use and was not associated with changes in clinical outcomes and short- and long-term mortality. The conversion was associated with decreases in crystalloid use and an increase in colloid use and hence IV fluid acquisition costs in the Voluven® group.

Shock. 2015 Mar 17. [Epub ahead of print]

COMBAT: Initial experience with a randomized clinical trial of plasma-based resuscitation in the field for traumatic hemorrhagic shock.

Chapman MP, Moore EE, Chin TL, Ghasabyan A, Chandler J, Stringham J, Gonzalez E, Moore HB, Banerjee A, Silliman CC, Sauaia A.

Abstract:

The existing evidence shows great promise for plasma as the first resuscitation fluid in both civilian and military trauma. We embarked on the Control of Major Bleeding After Trauma (COMBAT) trial with the support of the Department of Defense, in order to determine if plasma-first resuscitation yields hemostatic and survival benefits. The methodology of the COMBAT study represents not only three years of development work, but the integration of nearly two-decades of technical experience with the design and implementation of other clinical trials and studies. Herein, we describe the key features of the study design, critical personnel and infrastructural elements, and key innovations. We will also briefly outline the systems engineering challenges entailed by this study. COMBAT is a randomized, placebo controlled, semi-blinded prospective Phase IIB clinical trial, conducted in a ground ambulance fleet based at a Level I trauma center, and part of a multicenter collaboration. The primary objective of COMBAT is to determine the efficacy of field resuscitation with plasma first, compared to standard of care (normal saline). To date we have enrolled 30 subjects in the COMBAT study. The ability to achieve intervention with a hemostatic resuscitation agent in the closest possible temporal proximity to injury is critical and represents an opportunity to forestall the evolution of the "bloody vicious cycle". Thus, the COMBAT model for deploying plasma in first response units should serve as a model for RCTs of other hemostatic resuscitative agents.

J R Soc Med. 2015 Mar;108(3):93-100. doi: 10.1177/0141076815570923.

Lessons learned from the casualties of war: battlefield medicine and its implication for global trauma care.

Chatfield-Ball C, Boyle P, Autier P, van Wees SH, Sullivan R

Abstract:

According to the Global Burden of Disease, trauma is now responsible for five million deaths each year. High-income countries have made great strides in reducing trauma-related mortality figures but low-middle-income countries have been left behind with high trauma-related fatality rates, primarily in the younger population. Much of the progress high-income countries have made in managing trauma rests on advances developed in their armed forces. This analysis looks at the recent advances in high-income military trauma systems and the potential transferability of those developments to the civilian health systems particularly in low-middle-income countries. It also evaluates some potential lifesaving trauma management techniques, proven effective in the military, and the barriers preventing these from being implemented in civilian settings.

Prehosp Disaster Med. 2015 Apr 10:1-5. [Epub ahead of print]

Sufficient Catheter Length for Pneumothorax Needle Decompression: A Meta-Analysis.

Clemency BM, Tanski CT, Rosenberg M, May PR, Consiglio JD, Lindstrom HA

INTRODUCTION: Needle thoracostomy is the prehospital treatment for tension pneumothorax. Sufficient catheter length is necessary for procedural success. The authors of this study determined minimum catheter length needed for procedural success on a percentile basis.

METHODS: A meta-analysis of existing studies was conducted. A Medline search was performed using the search terms: needle decompression, needle thoracentesis, chest decompression, pneumothorax decompression, needle thoracostomy, and tension pneumothorax. Studies were included if they published a sample size, mean chest wall thickness, and a standard deviation or confidence interval. A PubMed search was performed in a similar fashion. Sample size, mean chest wall thickness, and standard deviation were found or calculated for each study. Data were combined to create a pooled dataset. Normal distribution of data was assumed. Procedural success was defined as catheter length being equal to or greater than the chest wall thickness.

RESULTS: The Medline and PubMed searches yielded 773 unique studies; all study abstracts were reviewed for possible inclusion. Eighteen papers were identified for full manuscript review. Thirteen studies met all inclusion criteria and were included in the analysis. Pooled sample statistics were: n=2,558; mean=4.19 cm; and SD=1.37 cm. Minimum catheter length needed for success at the 95th percentile for chest wall size was found to be 6.44 cm.

Discussion: A catheter of at least 6.44 cm in length would be required to ensure that 95% of the patients in this pooled sample would have penetration of the pleural space at the site of needle decompression, and therefore, a successful procedure. These findings represent Level III evidence.

J Spec Oper Med. 2015 Spring;15(1):90-2.

Only break glass in case of war?

Cunningham CW.

Quotes:

" The past 13-plus years of combat have advanced combat casualty care in significant ways. One area of great improvement has been in the continued refinement and education of our combat medics and self aid/buddy aid of non-medics through expert-developed Tactical Combat Casualty Care (TCCC) guidelines. Even with these improvements, more than 80% of combat deaths occurred in the prehospital setting, and more than 25% of those were potentially preventable, as highlighted by Eastridge et al.1 Kotwal et al.2 described a prehospital medicine emphasis program that resulted in zero preventable deaths. The difference in these rates illustrates the importance of a comprehensive prehospital training and sustainment program with commander emphasis."

"Lieutenant General Horoho clearly states "our garrison-based healthcare facilities are an extension of the battlefield," but the majority of our MTFs do not conduct usual business in that fashion. Commanders, clinical leaders, administrators, providers, and nurses speak more in terms of workload generation and preparation for the next Joint Commission site visit and rarely, if ever, about preparing for the next war."

"….while combat medic sustainment should be a goal shared by all within the AMEDD and Army, we must concentrate our focus and efforts on continued combat readiness and skills sustainment in a period of force reduction and planned decreased large-scale combat operations. Success of this program requires collaboration and coordination with line units and MTFs, experienced physicians, physician assistants, nurses, and senior noncommissioned officers as local advocates and instructors, as well as buy-in by local medical command and nursing leadership, for it to succeed and flourish. We must keep combat preparedness as a constant goal, and combat medics as the second largest military occupational specialty within the Army are a major part of this preparedness."

J R Army Med Corps. 2015 Mar 27. Epub ahead of print

Should whole blood replace the shock pack?

Davies RL.

Abstract:

When haemorrhage occurs on the battlefield, the soldier rapidly loses whole blood; it therefore stands to reason that the optimum fluid for resuscitation is whole blood. Indeed, this was the case for the first 250 years of transfusion practice, but since the 1970s component therapy has been used, with little evidence for that change. It is hardly surprising that 'balanced' component therapy, which seeks to replicate whole blood, has been found to offer the best results in resuscitation. This article explores the role of whole blood in resuscitation and how it may be useful in the contemporary military environment.

Wilderness Environ Med. 2015 Feb 19. pii: S1080-6032(14)00279-8. doi: 10.1016/j.wem.2014.08.016. [Epub ahead of print]

Application of Current Hemorrhage Control Techniques for Backcountry Care: Part One, Tourniquets and Hemorrhage Control Adjuncts.

Drew B, Bennett BL, Littlejohn L

Abstract:

Decade-long advancements in battlefield medicine have revolutionized the treatment of traumatic hemorrhage and have led to a significant reduction in mortality. Older methods such as limb elevation and pressure points are no longer recommended. Tourniquets have had a profound effect on lives saved without the commonly feared safety issues that have made them controversial. Unique tourniquet designs for inguinal and abdominal regions are now available for areas not amenable to current fielded extremity tourniquets. This article, the first of two parts, reviews the literature for advancements in prehospital hemorrhage control for any provider in the austere setting. It emphasizes the significant evidence-based advances in tourniquet use on the extremities that have occurred in battlefield trauma medicine since 2001 and reviews the newer junctional tourniquet devices. Recommendations are made for equipment and techniques for controlling hemorrhage in the wilderness setting.

J Spec Oper Med. 2015 Spring;15(1):57-60.

The Effects of Movement on Hemorrhage When QuikClot® Combat Gauze™ Is Used in a Hypothermic Hemodiluted Porcine Model.

Garcia-Blanco J, Gegel B, Burgert J, Johnson S, Johnson D.

BACKGROUND: The purpose of this study was to compare the effectiveness of QuikClot® Combat Gauze™ (QCG) to a control wound dressing to withstand movement in a porcine model with hemodilution and hypothermia.

DESIGN: This was a prospective study with a between-subjects experimental design. Twenty-six Yorkshire swine were randomly assigned to two groups: QCG (n = 13) or a control dressing (n = 13).

METHODS: The subjects were exsanguinated to 30% of the blood volume; hypothermia was induced for 10 minutes. The hemostatic agent, QCG, was placed into the wound, followed by standard wound packing. If hemostasis was achieved, 5L of crystalloid solution were rapidly administered intravenously, and the wound was again observed for rebleeding. If no bleeding occurred, the extremity on the side of the injury was systematically moved through flexion, extension, abduction, and adduction sequentially 10 times or until rebleeding occurred.

RESULTS: An independent t test indicated there were significant differences in the number of movements before rebleeding between the QCG group (mean ± standard deviation [SD], 32.92 ± 14.062) and the control group (mean ± SD, 6.15 ± 15.021) ($p < .0001$).

CONCLUSION: QCG produces a robust clot that can withstand more movement than a control dressing.

J Emerg Med. 2015 Mar;48(3):313-24. doi: 10.1016/j.jemermed.2014.06.047. Epub 2014 Sep 27.

Comparison of the effects of ketamine and morphine on performance of representative military tasks.

Gaydos SJ, Kelley AM, Grandizio CM, Athy JR, Walters PL

BACKGROUND: When providing care under combat or hostile conditions, it may be necessary for a casualty to remain engaged in military tasks after being wounded. Prehospital care under other remote, austere conditions may be similar, whereby an individual may be forced to continue purposeful actions despite traumatic injury. Given the adverse side-effect profile of intramuscular (i.m.) morphine, alternative analgesics and routes of administration are of interest. Ketamine may be of value in this capacity.

OBJECTIVES: To delineate performance decrements in basic soldier tasks comparing the effects of the standard battlefield analgesic (10 mg i.m. morphine) with 25 mg i.m. ketamine.

METHODS: Representative military skills and risk propensity were tested in 48 healthy volunteers without pain stimuli in a double-blind, placebo-controlled, crossover design.

RESULTS: Overall, participants reported more symptoms associated with ketamine vs. morphine and placebo, chiefly dizziness, poor concentration, and feelings of happiness. Performance decrements on ketamine, when present, manifested as slower performance times rather than procedural errors.

CONCLUSIONS: Participants were more symptomatic with ketamine, yet the soldier skills were largely resistant to performance decrements, suggesting that a trained task skill (autonomous phase) remains somewhat resilient to the drugged state at this dosage. The performance decrements with ketamine may represent the subjects' adoption of a cautious posture, as suggested by risk propensity testing whereby the subject is aware of impairment, trading speed for preservation of task accuracy. These results will help to inform the casualty care community regarding appropriate use of ketamine as an alternative or opioid-sparing battlefield analgesic.

Injury. 2015 Jan 30. pii: S0020-1383(15)00061-3. doi: 10.1016/j.injury.2015.01.035. [Epub ahead of print]

Eye injury in the Israeli Defense Force: "An ounce of prevention is worth a pound of cure"

Gendler S, Nadler R, Erlich T, Fogel O, Shushan G, Glassberg E

BACKGROUND: The eye occupies 0.1% of the total body surface yet it accounts for 8-13% of battle injuries in modern warfare worldwide. Protective eyewear can prevent over 90% of these eye injuries in both military and civilian settings. This study presents an analysis of a military casualty database and describes the proportion and distribution of eye injuries among Israel Defense Force (IDF) Soldiers.

METHODS: All trauma patients recorded in the IDF Trauma Registry (ITR) in whom ocular injury related to combat or to training was documented were reviewed.

RESULTS: There were 129 patients with documented eye injury sustained during combat or training between 1997 and 2013: 75% of injuries were related to combat and the remainder occurred during training. Penetrating fragmental injuries accounted for 74% of combat related injuries and 28% of training related injuries. Sixty-six percent (66%) of these casualties were subsequently re-classified as no longer fit for combat duties. Combat related injuries resulted in a higher incidence of severe injuries compared to training related injuries ($P<0.05$).

CONCLUSIONS: Despite optimal medical care, the majority of soldiers who sustain eye injuries during military service suffer from substantial disability and most are no longer fit for combat service. A majority are discharged from military service. Protective eyewear could potentially prevent penetrating fragmental wounds which are the most common cause of injury. Further research on optimal orbital protection is critical for both the military and the civilian sectors.

Curr Opin Anaesthesiol. 2015 Apr;28(2):210-6. doi: 10.1097/ACO.0000000000000166.

Topical hemostatic agents and dressings in the prehospital setting.

Grissom TE(1), Fang R.

PURPOSE OF REVIEW: Death from exsanguinating hemorrhage remains a priority in the management of combat casualties and civilian trauma patients with truncal and junctional injuries. Appropriate use of hemostatic agents and dressings in the prehospital setting may allow for earlier control and an improved survival rate.

RECENT FINDINGS: Third-generation chitosan-based hemostatic agents and dressings appear to be equally efficacious to the dressing currently deployed by the US military forces in the management of hemorrhage not amenable to tourniquet placement. Unfortunately, a lack of clinical trials places a heavy reliance on anecdotal reports and laboratory studies in agent selection and application.

SUMMARY: Efficacy of currently available hemostatic agents and dressings appears to have plateaued in recent years although new agents and delivery mechanisms under development may improve control in cases of severe hemorrhage.

J Trauma Acute Care Surg. 2015 Mar;78(3):600-6.

A comparison of prehospital lactate and systolic blood pressure for predicting the need for resuscitative care in trauma transported by ground.

Guyette FX, Meier EN, Newgard C, McKnight B, Daya M, Bulger EM, Powell JL, Brasel KJ, Kerby JD, Egan D, Sise M, Coimbra R, Fabian TC, Hoyt DB; ROC Investigators.

BACKGROUND: Reliance on prehospital trauma triage guidelines misses patients with serious injury. Lactate is a biomarker capable of identifying high-risk trauma patients. Our objective was to compare prehospital point-of-care lactate (P-LAC) with systolic blood pressure (SBP) for predicting the need for resuscitative care (RC) in trauma patients transported by ground emergency medical services.

METHODS: This is a prospective observational study at nine sites within the Resuscitation Outcomes Consortium conducted from March 2011 to August 2012. Lactate was measured on patients with a prehospital SBP of 100 mm Hg or less who were transported by emergency medical services to a Level I or II trauma center. Patients were followed up for the need for RC, defined as any of the following within 6 hours of emergency department arrival: blood transfusion of 5 U or greater; intervention for hemorrhage including thoracotomy, laparotomy, pelvic fixation, or interventional radiology embolization; or death.

RESULTS: A total of 387 patients had a lactate value and presented with SBP between 71 mm Hg and 100 mm Hg, and 70 (18%) required RC. With the use of a P-LAC decision rule (≥2.5 mmol/L) that yielded the same specificity as that of SBP of 90 mm Hg or less (48%), the observed sensitivities for RC were 93% (95% confidence interval [CI], 84-98%) for P-LAC of 2.5 mmol/L or greater and 67% (95% CI, 55-78%) for SBP of 90 mm Hg or less (McNemar's test, $p < 0.001$). P-LAC has an estimated area under the curve of 0.78 (95% CI, 0.73-0.83), which is statistically superior to that of SBP (0.59; 95% CI, 0.53-0.66) and shock index (heart rate / SBP) (0.66; 95% CI, 0.60-0.74).

CONCLUSION: P-LAC obtained at the scene is associated with the need for RC. P-LAC is superior to other early surrogates for hypoperfusion (SBP and shock index) in predicting the need for RC in trauma patients with 70 mm Hg < SBP ≤ 100 mm Hg.

LEVEL OF EVIDENCE: Prognostic study, level II.

Anaesthesia. 2015 May;70(5):511-4

Limitations of component therapy for massive haemorrhage: is whole blood the whole solution?

Hall S, Murphy MF.

Quotes:

"In the modern era of blood component usage, transfusion of whole blood is almost entirely restricted to the military and to developing countries, where resources for separation and processing of blood are not available. The US military transfuses fresh warm blood for life-threatening injuries with bleeding where any required individual component is not available, or when there is ongoing life-threatening bleeding despite transfusion in a 1:1:1 ratio of plasma, platelets and red cells [11]. Under these circumstances, blood is neither leucocytereduced nor stored, and therefore contains near-physiological levels of factor VIII and viable platelets. However, as has been known for more than a century, even fresh warm blood requires anticoagulation and in this issue of Anaesthesia Ponschab et al. demonstrate that a 13% dilution of whole blood occurs immediately the donation is added to storage solution."

"In conclusion, the optimal transfusion management of massive haemorrhage associated with trauma is yet to be established. There are many recommended schedules for massive transfusion protocols but, as yet, there is no consensus about the initial ratio of red cells, plasma and platelets that should be employed. The use of fresh whole blood or replication of fresh whole blood may appear attractive as an answer to this dilemma, but it is not the complete answer, particularly if the coagulopathy is primarily due to consumption of fibrinogen, which requires other means for its replacement. A potential solution is more aggressive supplementation with fibrinogen either in a fixed, predetermined amount of cryoprecipitate or fibrinogen concentrate, or as guided by point-of-care haemostasis testing."

J Trauma Acute Care Surg. 2015 May;78(5):905-11

The impact of tranexamic acid on mortality in injured patients with hyperfibrinolysis.

Harvin JA, Peirce CA, Mims MM, Hudson JA, Podbielski JM, Wade CE, Holcomb JB, Cotton BA.

BACKGROUND: In 2011, supported by data from two separate trauma centers, we implemented a protocol to administer tranexamic acid (TXA) in trauma patients with evidence of hyperfibrinolysis (HF) on admission. The purpose of this study was to examine whether the use of TXA in patients with HF determined by admission rapid thrombelastography was associated with improved survival.

METHODS: Following institutional review board approval, we evaluated all trauma patients 16 years or older admitted between September 2009 and September 2013. HF was defined as LY-30 of 3% or greater. Patients with LY-30 less than 3.0% were excluded. Patients were divided into those who received TXA (TXA group) and those who did not (no-TXA group). After univariate analyses, a purposeful, logistic regression model was developed a priori to evaluate the impact of TXA on mortality (controlling for age, sex, Injury Severity Score (ISS), arrival physiology, and base deficit).

RESULTS: A total of 1,032 patients met study criteria. Ninety-eight (10%) received TXA, and 934 (90%) did not. TXA patients were older (median age, 37 years vs. 32 years), were more severely injured (median ISS, 29 vs. 14), had a lower blood pressure (median systolic blood pressure 103 mm Hg vs. 125 mm Hg), and were more likely to be in shock (median, base excess, -5 mmol/dL vs. -2 mmol/dL), all $p < 0.05$. Twenty-three percent of the patients had a repeat thrombelastography within 6 hours; 8.8% of the TXA patients had LY-30 of 3% or greater on repeat rapid thrombelastography (vs. 10.1% in the no-TXA group, $p = 0.679$). Unadjusted in-hospital mortality was higher in the TXA group (40% vs. 17%, $p < 0.001$). There were no differences in venous thromboembolism (3.3% vs. 3.8%). Logistic regression failed to find a difference in in-hospital mortality among those receiving TXA (odds ratio, 0.74; 95% confidence interval, 0.38-1.40; p 0.80).

CONCLUSION: In the current study, the use of TXA was not associated with a reduction in mortality. Further studies are needed to better define who will benefit from an administration of TXA.

LEVEL OF EVIDENCE: Therapeutic study, level IV.

Transfusion. 2015 Apr 10; Epub ahead of print

Resuscitating PROPPRly.

Hess JR, Holcomb JB.

Quotes:

"Eleven years ago, the authors spoke, Baghdad to Baltimore, concerning a US soldier injured by an improvised explosive device who received 18 units of red blood cells (RBCs) in additive solution (AS) only to die of uncontrolled hemorrhage complicated by profound dilutional coagulopathy before any type specific plasma could be thawed and transfused. Fresh whole blood might have been an answer but was rarely immediately available. We agreed that keeping 4 units of thawed AB plasma available at all times so that a balanced infusion of a 1:1 ratio of plasma:RBCs could be given for primary resuscitation of massive injury was logical. The blood bank director agreed, and the new system worked dramatically well. Resuscitations were faster, hemorrhage appeared easier to control, use of crystalloid was reduced with less lung and tissue edema, and mortality appeared to improve. By the end of 2004, 1:1 resuscitation was an accepted local clinical practice. In 2006, apheresis platelets (PLTs) became available and 1:1:1 (plasma: PLTs:RBCs) appeared to work even better. By 2006, Damage Control Resuscitation was a Joint Theater Trauma System guideline and in 2008 was validated in a retrospective cohort of 466 massively transfused civilian patients at 16 large US trauma centers."

"The lack of an effect on total mortality at 24 hours and 30 days has confused some observers. Trauma specialists know that successful resuscitation and most preventable hemorrhagic mortality occur in the first 3 hours of care in modern trauma centers.5,17,18 Efficacy of resuscitation is most efficiently measured at this "end-of-resuscitation" time when mortality from competing causes is lower. However, the US Food and Drug Administration (FDA) required the 24-hour and 30-day safety endpoints as conditions of granting the investigational new drug (IND) exemption required to conduct the trial under the exception from informed consent regulation in the US code. As a result, the PROPPR trial is strong on safety data, but the reader needs to know where to look for the efficacy signal. Nevertheless, the message is clear."

"In this issue of TRANSFUSION, Novak and colleagues 21 at the 12 participating PROPPR trauma centers, including the authors of this commentary, describe how they set up transfusion service procedures and protocols to support the trial's requirement to have thawed plasma at the bedside within 10 minutes of admission. Nine of the sites used prethawed AB plasma, while three sites used prethawed group A either titered for anti-B or not to meet their needs for emergency plasma for resuscitation. Each service met the goal of rapidly providing plasma to the patient's bedside and did so with minimal wastage. The improvement in survival after severe hemorrhage would not have been possible without this effort. The authors also thank the supporting blood centers for enabling the trial and making new products such as AB and pretested A low-titer-B liquid plasma and apheresis-derived frozen plasma in jumbo units more widely available."

Ann Emerg Med. 2015 Apr;65(4):443-4.

Are colloids better than crystalloids for fluid resuscitation in critically ill patients?

Hohertz B, Seupaul RA, Holmes TM

Quotes:

“Seventy trials reported mortality data, with a total of 20,407 patients. Because of the heterogeneity of colloid solutions used in these trials, outcomes were stratified by fluid type rather than type of injury. Authors scored allocation concealment, assigning “high risk of bias” to the poorest-quality and “low risk of bias” to the best-quality trials. Of these 70 trials, only 17 were considered to have adequate allocation concealment, as reflected in the number of unclear scores given for allocation concealment. No prespecified subgroup analyses were conducted.”

“The pooled data for each colloid type in this review demonstrated no reduction in mortality for any of the commonly used colloid solutions. Moreover, the use of hydroxyethyl starch may increase the risk of death. Given the added expense of colloid solutions, it would seem unwise to use them in lieu of crystalloids for the resuscitation of critically ill patients. Current guideline recommendations should be updated according to the findings from recent trials and this systematic review.”

JAMA. 2015 Apr 14;313(14):1463-4.

Comprehensive injury research.

Holcomb JB, Hoyt DB

Quotes:

"In World War II, soldiers admitted to trauma units had an expected mortality of 30%. This was reduced to 24% in Vietnam, and now, in the Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) wars, case fatality rates have declined to less than 10%. Improved survival from battlefield injuries resulted from the military's much greater emphasis on the development of a coordinated trauma system that was constantly undergoing reevaluation. In the September 2014 issue of JAMA Surgery, Langan and colleagues report the results from 57,179 soldiers admitted to forward combat hospital units from 2002 to 2011. With time, injury severity scores increased; however, survival improved. Better outcomes were associated with implementation of damage control resuscitation (DCR) protocols that, among other elements, emphasize less use of crystalloid and greater use of red blood cells (RBCs) and fresh-frozen plasma (FFP) (in a 1:1 FFP:RBC ratio). The use of DCR was associated with a reduction in deaths occurring within 7 days after injury from 10% to 6%."

"In contrast to the decreasing death rate after combat injury this past decade, worldwide injury-associated mortality has increased by more than 20%. During the same 13 years, when about 6830 deaths resulted from battle injuries, more than 2 million civilian deaths resulted from injury in the United States. Worldwide, injury accounts for more deaths than malaria, tuberculosis, and HIV combined. Because injury is largely a disease of young people, death after injury is the leading cause of life-years lost between the ages of 1 and 75 years, and injury costs in the United States are estimated at more than $400 billion a year. While trauma deaths are increasing, cancer-, heart disease–, and HIV-related death rates are in decline. Given the cost and scope of trauma, there is a need for greater attention to trauma research and performance of wellexecuted clinical trials. There is no national strategy for a comprehensive clinical research in trauma, nor is there a National Institutes of Health (NIH) institute devoted to one of the greatest sources of morbidity and mortality."

"Because deaths from trauma are increasing, more research is needed to better understand how to manage injured patients. Increased attention to trauma care reduced deaths in the military and may do the same for the civilian population. Creation of a National Institute for Trauma Care would be a good place to start if the goal is to reduce the currently increasing number of trauma deaths in the United States."

Knee. 2015 Jan 17. pii: S0968-0160(15)00004-6.

Effect of a single injection of tranexamic acid on blood loss after primary hybrid TKA.

Ishii Y, Noguchi H, Sato J, Tsuchiya C, Toyabe SI

BACKGROUND: Control of perioperative blood loss is important in total knee arthroplasty (TKA), especially cementless or hybrid TKA. There is increasing interest in the use of tranexamic acid (TXA) for this purpose, however, studies to date have mainly evaluated the effects of various TXA administration regimens on patients who have undergone cemented TKA. We sought to determine (1) whether administration of TXA reduces blood loss after hybrid TKA, and (2) whether an autologous blood reinfusion system is necessary in TKA patients who are treated with TXA.

METHODS: Ninety-five patients (100 knees) who underwent hybrid primary TKA (cemented tibia, uncemented femur) were included in this study. The initial 50 knees were treated without TXA and the following 50 were treated with TXA. Intravenous TXA (1000mg) was administered shortly before deflation of the tourniquet. All continuous variables were expressed as median values.

RESULTS: Total volumes of blood lost at postoperative 1day were 590mL and 150mL and autotransfusion of collected blood was performed in 88% and 16% of patients in the without and with TXA groups, respectively. A median volume of 400mL of collected blood was returned to the patients in the without TXA group, and 0mL to the patients in the with TXA group. The calculated volumes of blood lost were 761mL and 683mL (p=0.2250), respectively.

CONCLUSIONS: One intravenous injection of 1000mg TXA may help to control postoperative blood loss and reduce the need for postoperative autologous blood reinfusion after hybrid TKA.

LEVEL OF EVIDENCE: Level II.

J Trauma Acute Care Surg. 2015 Apr;78(4):752-9

Is limited prehospital resuscitation with plasma more beneficial than using a synthetic colloid? An experimental study in rabbits with parenchymal bleeding.

Kheirabadi BS, Valdez-Delgado KK, Terrazas IB, Miranda N, Dubick MA.

BACKGROUND: Reports of survival benefits of early transfusion of plasma with red blood cells (1:1 ratio) in trauma patients suggest that plasma may be a better fluid to replace Hextend for battlefield resuscitation. We studied possible advantages of prehospital resuscitation with plasma compared with Hextend or albumin in a model of uncontrolled hemorrhage.

METHODS: Male New Zealand white rabbits (3.3 ± 0.1 kg) were anesthetized, instrumented, and subjected to a splenic injury with uncontrolled bleeding. Ten minutes after injury (mean arterial pressure [MAP] < 40 mm Hg), the rabbits received small and equal volumes (15 mL/kg) of rabbit plasma (n = 10), Hextend (n = 10), or 5% human albumin (n = 9) or no fluid. Fluids were administered in two bolus injections (20 minutes apart) and targeted to a MAP of 65 mm Hg. Animals were monitored for 2.5 hours or until death, and their blood losses were measured. Arterial blood samples were collected at different times and analyzed for ABG, CBC, and coagulation tests.

RESULTS: There were no differences in baseline measures among groups. Splenic injury caused similar hemorrhages (9.1 ± 0.4 mL/kg at 10 minutes) and decreased MAP in all subjects. Subsequent resuscitation initiated additional bleeding. At 60 minutes after injury (20 minutes after resuscitation), longer activated partial thromboplastin time and lower fibrinogen concentrations were apparent compared with baseline values with differences among groups. Thrombelastography analysis indicated faster and stronger clot formation with plasma and albumin resuscitation than with Hextend use. Shock indices were increased in all groups, but smaller changes were measured in the albumin group. Total blood loss did not differ among resuscitated rabbits but was higher ($p < 0.05$) than among nonresuscitated animals. Survival rates were 11% (untreated), 40% (Hextend and plasma), and 89% (albumin, $p < 0.05$).

CONCLUSION: Resuscitation with plasma or albumin better preserved coagulation function than did Hextend. However, despite these improvements, plasma resuscitation did not reduce blood loss or improve survival, while albumin administration seemed beneficial.

J Trauma Acute Care Surg. 2015 Mar;78(3):594-9.

Tourniquet use at the Boston Marathon bombing: Lost in translation.

King DR, Larentzakis A, Ramly EP; Boston Trauma Collaborative.

BACKGROUND: The Boston Marathon bombing was the first major, modern US terrorist event with multiple, severe lower extremity injuries. First responders, including trained professionals and civilian bystanders, rushed to aid the injured. The purpose of this review was to determine how severely bleeding extremity injuries were treated in the prehospital setting in the aftermath of the Boston Marathon bombing.

METHODS: A database was created and populated by all the Boston Level I trauma centers following the Boston Marathon bombing. Data regarding specific injuries, extremities affected, demographics, prehospital interventions (including tourniquet types), and outcomes were extracted.

RESULTS: Of 243 injured, 152 patients presented to the emergency department within 24 hours. Of these 152 patients, there were 66 (63.6% female) experiencing at least one extremity injury, with age ranging from younger than 15 years to 71 years, and with a median Injury Severity Score (ISS) of 10 (range, 1-38). Of the 66 injured patients, 4 had upper limbs affected, 56 had injuries on the lower limbs only, and 6 had combined upper and lower limbs affected. The extremity Abbreviated Injury Scale (AIS) scores had a median of 3 (range, 1-4). There were 17 lower extremity traumatic amputations in 15 patients. In addition, there were 10 patients with 12 lower extremities experiencing major vascular injuries. Of 66 injured patients, 29 patients had recognized extremity exsanguination at the scene. In total, 27 tourniquets were applied: 16 of 17 traumatic amputations, 5 of 12 lower extremities with major vascular injuries, and 6 additional limbs with major soft tissue injury. All tourniquets were improvised, and no commercial, purpose-designed tourniquets were identified. Among all 243 patients, mortality was 0%.

CONCLUSION: After the Boston Marathon bombings, extremity exsanguination at the point of injury was either left untreated or treated with an improvised tourniquet in the prehospital environment. An effective, prehospital extremity hemorrhage control posture should be translated to all civilian first responders in the United States and should mirror the military's posture toward extremity bleeding control. The prehospital response to extremity exsanguination after the Boston Marathon bombing demonstrates that our current practice is an approach, lost in translation, from the battlefield to the homeland.

LEVEL OF EVIDENCE: Epidemiologic study, level V.

Ann Emerg Med. 2015 Mar;65(3):290-6

Transfusion for shock in US military war casualties with and without tourniquet use.

Kragh JF Jr, Nam JJ, Berry KA, Mase VJ Jr, Aden JK 3rd, Walters TJ, Dubick MA, Baer DG, Wade CE, Blackbourne LH

STUDY OBJECTIVE: We assess whether emergency tourniquet use for transfused war casualties admitted to military hospitals is associated with survival.

METHODS: A retrospective review of trauma registry data was made of US casualties in Afghanistan and Iraq. Patients with major limb trauma, transfusion, and tourniquet use were compared with similar patients who did not receive tourniquet use. A propensity-matching analysis was performed by stratifying for injury type and severity by tourniquet-use status. Additionally, direct comparison without propensity matching was made between tourniquet use and no-tourniquet use groups.

RESULTS: There were 720 casualties in the tourniquet use and 693 in the no-tourniquet use groups. Of the 1,413 casualties, 66% (928) also had nonextremity injury. Casualties with tourniquet use had worse signs of hemorrhagic shock (admission base deficit, admission hemoglobin, admission pulse, and transfusion units required) than those without. Survival rates were similar between the 2 groups (1% difference; 95% confidence interval -2.5% to 4.2%), but casualties who received tourniquets had worse shock and received more blood products. In propensity-matched casualties, survival rates were not different (2% difference; 95% confidence interval -6.7% to 2.7%) between the 2 groups.

CONCLUSION: Tourniquet use was associated with worse shock and more transfusion requirements among hospital-admitted casualties, yet those who received tourniquets had survival rates similar to those of comparable, transfused casualties who did not receive tourniquets.

Wilderness Environ Med. 2015 Mar 11. pii: S1080-6032(15)00007-1. doi: 10.1016/j.wem.2014.12.028. [Epub ahead of print]

Which Improvised Tourniquet Windlasses Work Well and Which Ones Won't?

Kragh JF Jr, Wallum TE, Aden JK 3rd, Dubick MA, Baer DG

OBJECTIVE: Improvised tourniquets in first aid are recommended when no scientifically designed tourniquet is available. Windlasses for mechanical advantage can be a stick or pencil and can be used singly or multiply in tightening a tourniquet band, but currently there is an absence of empiric knowledge of how well such windlasses work. The purpose of the present study was to determine the performance of improvised tourniquets in their use by the type and number of windlasses to improve tourniquet practice.

METHODS: A simulated Leg Tourniquet Trainer was used as a manikin thigh to test the effectiveness of improvised tourniquets of a band-and-windlass design. Two users made 20 tests each with 3 types of windlasses. Tests started with 1 representative of a given type (eg, 1 pencil), then continued with increasing numbers of each windlass type until the user reached 100% effectiveness as determined by cessation of simulated blood flow. Windlass types included chopsticks, pencils, and craft sticks.

RESULTS: Effectiveness percentages in stopping bleeding were associated inversely with breakage percentages. Pulse stoppage percentages were associated inversely with breakage. The windlass turn numbers, time to stop bleeding, the number of windlasses, and the under-tourniquet pressure were associated inversely with breakage. The windlass type was associated with breakage; at 2 windlasses, only chopsticks were without breakage. Of those windlass types that broke, 20.7% were chopsticks, 26.1% were pencils, and 53.2% were craft sticks.

CONCLUSIONS: A pair of chopsticks as an improvised tourniquet windlass worked better than pencils or craft sticks.

J Nat Sci Biol Med. 2015 Jan-Jun;6(1):94-9

Does a single loading dose of tranexamic acid reduce perioperative blood loss and transfusion requirements after total knee replacement surgery? A randomized, controlled trial.

Kundu R, Das A, Basunia SR, Bhattacharyya T, Chattopadhyay S, Mukherjee A

BACKGROUND: Total knee replacement (TKR) is associated with high-perioperative blood loss, which often requires allogenic blood transfusion. Among the many strategies to decrease the need for allogenic transfusion, tranexamic acid (TA) is used systemically in perioperative setting with promising outcome. Here we evaluated the efficacy of single preoperative bolus dose of TA on reduction in blood loss and red blood cell transfusion in patients undergoing unilateral TKR.

MATERIALS AND METHODS: 70, American Society of Anesthesiologists I-II patients scheduled for unilateral TKR were included. Patients were randomly allocated into two groups to receive either TA (Group-TA; 20 mg/kg diluted to 25 cc with normal saline) or an equivalent volume of normal saline (Group P). Hemoglobin concentration, packed cell volume, platelet count, fibrinogen level, D-dimer level was measured preoperatively and at 6(th) and 24(th) h postoperative period.

RESULTS: In Group P more blood, colloid and crystalloid solutions were used to replace the blood loss. 27 patients in Group TA did not require transfusion of any blood products compared to 6 patients in Group P ($P < 0.0001$) and only 3 units of blood was transfused in Group TA where as a total of 32 units of blood was transfused in Group P. Despite the more numerous transfusions, Hb% after 6 h and 24 h in Group P were considerably low in comparison with Group TA ($P < 0.0001$).

CONCLUSION: Tranexamic acid while significantly reducing blood loss caused by TKR surgery collaterally reduced the need for postoperative blood transfusion.

FBI Law Enforcement Bulletin, March 2015

Emergency medical response in active-threat situations: training standards for law enforcement.

Landry J, Aberle S, Dennis A, Sztajnkrycer M

Quotes:

"In an active threat situation, emergency medical services (EMS) personnel may be unable to access the scene. This could require law enforcement officers to render care without EMS assistance to themselves, injured colleagues, or victims. A care gap of this type occurred in two recent high profile active shooter incidents."

"Law enforcement inherently is a dangerous profession. In the past decade an average of 54 officers were killed on duty each year—in 2012 there were 48 victims.[3] In a previous study, 41 percent of officers surveyed reported that they had responded to the scene of a seriously injured colleague, and 70 percent of those officers stated that they arrived prior to emergency medical services."

" During active threat scenarios, there was no consistent relationship found between the respondent level of civilian medical training and the correct approach to bleeding management. However, the scenario-based questions had limited real world applicability, and the number of scenarios evaluated was small. In contrast, in 3 out of 4 case-based scenarios, individuals who reported receiving military-style TCCC training were more likely to select the correct responses than those who had not received this training. This suggests that TCCC training is at least equivalent to conventional medical instruction at the CFR/EMR level or higher for evaluating this element of tactical medical decisionmaking. TCCC curriculum was developed for combatants in a military environment and has not been validated for use in a civilian population. Data indicates that law enforcement injury patterns differ significantly from the military experience, thus, potentially limiting the real-world use of TCCC skills for law enforcement officers. However, the fundamental priorities and tactical concepts of TCCC for providing care under fire are equally important to law enforcement. A civilian counterpart, the Committee on Tactical Emergency Casualty Care (CoTECC), currently is developing guidelines based on the military tactical medicine experience."

Wilderness Environ Med. 2015 Feb 19. pii: S1080-6032(14)00282-8. doi: 10.1016/j.wem.2014.08.018. [Epub ahead of print]

Application of Current Hemorrhage Control Techniques for Backcountry Care: Part Two, Hemostatic Dressings and Other Adjuncts.

Littlejohn L, Bennett BL, Drew B

Abstract:

Decade-long advances in battlefield medicine have revolutionized the treatment of traumatic hemorrhage and have led to a significant reduction in mortality. Part one of this review covered the use of tourniquets on the extremities and the newer devices for use in junctional areas. Part two focuses on the use of hemostatic agents or dressings, pelvic binders, and tranexamic acid. Field applicable hemostatic dressings are safe and effective in controlling hemorrhage not amenable to extremity tourniquet application, and newer agents with increasing efficacy continue to be developed. Most of these agents are inexpensive and lightweight, making them ideal products for use in wilderness medicine. The use of pelvic binders to stabilize suspected pelvic fractures has gained new interest as these products are developed and refined, and the prehospital use of tranexamic acid, a potent antifibrinolytic, has been found to be life saving in patients at risk of death from severe hemorrhage. Recommendations are made for equipment and techniques for controlling hemorrhage in the wilderness setting.

Eurasia Review. 2015 February 21

Challenges to improving combat Casualty survival on battlefield – analysis

Mabry, RL

Quotes:

"The United States has achieved unprecedented survival rates (as high as 98 percent) for casualties arriving alive to a combat hospital. Official briefings, informal communications, and even television documentaries such as "CNN Presents Combat Hospital" highlight the remarkable surgical care taking place overseas. Military physicians, medics, corpsmen, and other providers of battlefield medical care are rightly proud of this achievement. Commanders and their troops can be confident that once a wounded Servicemember reaches the combat hospital, his or her care will be the best in the world. Combat casualty care, however, does not begin at the hospital. It begins in the field at the point of injury……"

"The Services' medical departments repeatedly cite the reduction of case fatality rates to historically low levels as a major medical accomplishment during operations in Iraq and Afghanistan. While seemingly positive, this statistic tells only part of the story. The case fatality rate, or the percentage of those injured who died, reflects multiple factors including weapons and tactics, protective equipment, and medical care. In other words, current data equally support the conclusion that the enemy's lack of regular combat units, artillery, and armor (the major casualty producers in conventional warfare) and reliance instead on improvised explosive devices is plausibly just as responsible."

"As a call to action, the following steps offer a potential way forward to overcome these five challenges:

- Adopt the Israel Defense Forces or similar model of combat casualty care focus and make an institutional commitment to eliminating potentially preventable death. Allow careful study of these deaths to drive the training, research, and development agenda.
- Establish leadership of battlefield care at the most senior level, and hold the Service medical departments accountable for improving it.
- Obtain data and metrics from the point of injury and throughout the continuum of care, and use this information to drive evidence-based decisions.
- Commit to training physician, nursing, and allied health providers to become "combat medical specialists" and placing them in key operational and institutional positions to leverage improvements in training, doctrine, research, and development.
- Direct research funds toward solving prehospital clinical problems, and balance these funds to include research on training, organization, and leadership, not just material solutions.
- Evolve the current paradigm of military medicine from an organization culture chiefly focused on full-time beneficiary care in fixed facilities and part-time combat casualty care—the "HMO that goes war"—toward an organizational culture that treats battlefield care delivery as its essential core mission. This need not lessen the importance or scope of beneficiary care and, if agilely executed, could enhance the prestige and cachet of the beneficiary mission."

Ann Vasc Surg. 2015 May;29(4):764-9.

The impact of a massive transfusion protocol on outcomes among patients with abdominal aortic injuries.

Maciel JD, Gifford E, Plurad D, de Virgilio C, Bricker S, Bongard F, Neville A, Smith J, Putnam B, Kim D

BACKGROUND: Injuries of the abdominal aorta are uncommon and associated with a high mortality. The purpose of this study was to examine the impact of an institutional massive transfusion protocol (MTP) on outcomes in patients with injuries of the abdominal aorta.

METHODS: A 12.5-year retrospective analysis of a Level 1 trauma center database to identify patients with abdominal aortic injuries was conducted. Demographics, associated injuries and severity, operative procedures, resuscitation requirements, and outcomes were compared among patients before and after implementation of an MTP.

RESULTS: Of the 46 patients with abdominal aortic injuries, 29 (63%) were in the pre-MTP group and 17 (37%) were in the post-MTP group. The mean age of the entire cohort was 32 ± 17 years and the two most common mechanisms of injury were gunshot wounds (63%) followed by motor vehicle collisions (24%). Thirteen patients (28%) underwent an emergency department thoracotomy and 11 patients (24%) sustained concomitant inferior vena cava injuries. There was a significant reduction in the volume of pre- and intraoperative crystalloids administered between the pre- and post-MTP groups. Intraoperatively, the use of tranexamic acid was increased in the post-MTP group ($P < 0.001$). A statistically significant difference in achievement of a low packed red blood cells to fresh frozen plasma ratio was observed for the post- versus the pre-MTP group (88% vs. 30%, $P = 0.015$). Overall survival was improved among post- versus pre-MTP patients (47% vs. 14%, $P = 0.03$).

CONCLUSIONS: Abdominal aortic injuries continue to represent a challenge and remain associated with a high mortality. Modern improvements in damage control resuscitation techniques including implementation of an institutional MTP may improve outcomes in patients with these injuries.

J Cardiothorac Surg. 2015 Mar 28;10(1):45.

Prophylactic intraoperative tranexamic acid administration and postoperative blood loss after transapical aortic valve implantation.

Madershahian N, Scherner M, Pfister R, Rudolph T, Deppe AC, Slottosch I, Kuhn E, Choi YH, Wahlers T

OBJECTIVES: Antifibrinolytics are widely used in cardiac surgery to save blood perioperatively. In the present study we evaluated the hemostatic effects of tranexamic acid (TXA) to decrease bleeding tendency and transfusion requirements in high-risk patients following transapical aortic valve implantation (TA-AVI).

METHODS: A retrospective analysis was performed on aortic stenosis patients undergoing TA-AVI with or without intraoperative TXA administration to determine postoperative blood loss and transfusion requirements. From January 2009 to August 2010 in total 92 patients were treated without intraoperative TXA administration, from August 2010 to July 2011 54 patients received TXA intraoperatively.

RESULTS: Early postoperative (24 h) blood loss was significantly lower in TXA-group than in non-TXA group (327 ± 274 mL vs. 481.1 ± 318.8 mL; p = 0.003). In the TXA group 53.7% of patients received allogeneic blood products during the hospital stay as compared to 72.8% in the non-TXA group (p = 0.242). TXA group required fewer transfusions (2.1 ± 1.9 vs. 2.9 ± 3.5 Units; p = 0.046) and had no increased incidence of thrombotic or neurological complications. There was no significant difference in the length of ICU, hospital stay, or 30-day mortality. Administration of tranexamic acid was found to be significantly associated with lower blood loss postoperatively (p = 0.002). Furthermore, there was a significant correlation between the postoperative blood loss (p = 0.036) and red blood cell transfusion (p = 0.001) with 30-day mortality.

CONCLUSION: Low dose prophylactic intraoperative administration of tranexamic acid appears to be effective in reducing postoperative bleeding and the need for allogeneic blood products following TA-AVI.

Mil Med. 2015 Mar;180(3 Suppl):80-5.

Effect of Ibuprofen dose on platelet aggregation and coagulation in blood samples from pigs.

Martini WZ, Deguzman R, Rodriguez CM, Guerra J, Martini AK, Pusateri AE, Dubick MA

INTRODUCTION: Ibuprofen is commonly used by Soldiers in the deployed environment. This study investigated its dose-effects on in vitro coagulation.

METHODS: Blood samples were collected from 4 normal healthy pigs and were processed to make platelet-adjusted (100×10(3)/μL) blood samples. Ibuprofen was added to the samples at doses of 0 μg/mL (control), recommended oral dose (163 μg/mL, 1×), 2×, 4×, 8×, 10×, 12×, 16×, and 20×. Arachidonic acid or collagen-stimulated platelet aggregation was assessed at 15 minutes after the addition of ibuprofen. Coagulation was assessed with measurements of prothrombin time (PT) and activated partial thromboplastin time (aPTT), and thrombelastography by Rotem.

RESULTS: A robust inhibition of ibuprofen on arachidonic acid-induced platelet aggregation was observed at all doses tested. Collagen-stimulated platelet aggregation was inhibited to 71%±5% and 10%±5% of the control values at ibuprofen doses of 4× and 20×, respectively (both $p<0.05$). No changes were observed in PT at any dose, but aPTT was prolonged at dose of 16× and 20×. Rotem measurements of coagulation time, clot formation time, maximum clot firmness, and A10 were compromised at dose 16× and 20× (all $p<0.05$).

CONCLUSION: Ibuprofen inhibited platelet aggregation at recommended doses, but did not compromise aPTT or coagulation profile until at 16 times the recommended doses and higher. Further effort is needed to clarify whether there are different dose-responses between human and pig blood samples in trauma situations.

J Spec Oper Med. 2015 Spring;15(1):79-84.

A study of prehospital medical documentation by military medical providers during precombat training.

McGarry AB, Mott JC, Kotwal RS.

Abstract:

Documentation of medical care provided is paramount for improving performance and ultimately reducing morbidity and mortality. However, documentation of prehospital trauma care on the battlefield has historically been suboptimal. Modernization of prehospital documentation tools have aligned data and information to be gathered with up-to-date treatment being rendered through Tactical Combat Casualty Care (TCCC) protocols and practices. Our study was conducted to evaluate TCCC Card completion, and accuracy of card completion, by military medical providers conducting precombat training through the Tactical Combat Medical Care Course. Study results do not show a deficiency in TCCC documentation training as provided by this course which should translate to adequate ability to accurately document prehospital trauma care on the battlefield. Leadership emphasis and community acceptance is required to increase compliance with prehospital documentation.

Mil Med. 2015 Mar;180(3 Suppl):33-6.

An 8-year review of operation enduring freedom and operation iraqi freedom resuscitative thoracotomies.

Mitchell TA, Waldrep KB, Sams VG, Wallum TE, Blackbourne LH, White CE

BACKGROUND: Appropriate indications for resuscitative thoracotomy (RT) in an austere environment continue to evolve; the aim of this study was to determine survival and to analyze demographics of survivors within U.S. military personnel undergoing RT.

METHODS: A retrospective review was performed of all U.S. soldiers who underwent thoracotomy in theater during Operation Iraqi Freedom and Operation Enduring Freedom. After individualized review, patients in extremis or who lost pulses and had their thoracotomy performed within 10 minutes of arrival to the emergency department were included. The primary outcome was survival at final hospital discharge, and secondary outcomes included demographics associated with survival.

RESULTS: Between January 2003 and May 2010, 81 U.S. military personnel met inclusion criteria for RT in theater. As low as 6.7% (3/45) of patients receiving prehospital cardiopulmonary resuscitation were alive at final hospital discharge. Survival from RT after explosive/blast injury, penetrating (gunshot wound), and blunt trauma were 16.3% (8/49), 0% (0/28), and 0% (0/4), respectively. Patients with primary explosive/blast extremity trauma undergoing RT had a survival of 27.3% (6/22). Higher initial oxygen saturations, larger volume of crystalloids and blood products infused, and higher extremity abbreviated injury score were all associated with survival.

CONCLUSIONS: Combat casualties who present pulseless or in extremis who were injured as a result of an explosive/blast injury mechanism resulting in a primary extremity injury may have a survival benefit from undergoing a RT in an austere environment.

Ann Emerg Med. 2015 Mar 26. pii: S0196-0644(15)00191-2.

Intravenous Subdissociative-Dose Ketamine Versus Morphine for Analgesia in the Emergency Department: A Randomized Controlled Trial.

Motov S, Rockoff B, Cohen V, Pushkar I, Likourezos A, McKay C, Soleyman-Zomalan E, Homel P, Terentiev V, Fromm C

STUDY OBJECTIVE: We assess and compare the analgesic efficacy and safety of subdissociative intravenous-dose ketamine with morphine in emergency department (ED) patients.

METHODS: This was a prospective, randomized, double-blind trial evaluating ED patients aged 18 to 55 years and experiencing moderate to severe acute abdominal, flank, or musculoskeletal pain, defined as a numeric rating scale score greater than or equal to 5. Patients were randomized to receive ketamine at 0.3 mg/kg or morphine at 0.1 mg/kg by intravenous push during 3 to 5 minutes. Evaluations occurred at 15, 30, 60, 90, and 120 minutes. Primary outcome was reduction in pain at 30 minutes. Secondary outcome was the incidence of rescue analgesia at 30 and 60 minutes.

RESULTS: Forty-five patients per group were enrolled in the study. The primary change in mean pain scores was not significantly different in the ketamine and morphine groups: 8.6 versus 8.5 at baseline (mean difference 0.1; 95% confidence interval -0.46 to 0.77) and 4.1 versus 3.9 at 30 minutes (mean difference 0.2; 95% confidence interval -1.19 to 1.46; P=.97). There was no difference in the incidence of rescue fentanyl analgesia at 30 or 60 minutes. No statistically significant or clinically concerning changes in vital signs were observed. No serious adverse events occurred in either group. Patients in the ketamine group reported increased minor adverse effects at 15 minutes post-drug administration.

CONCLUSION: Subdissociative intravenous ketamine administered at 0.3 mg/kg provides analgesic effectiveness and apparent safety comparable to that of intravenous morphine for short-term treatment of acute pain in the ED.

Anaesthesiol Intensive Ther. 2015 Mar 23. doi: 10.5603/AIT.a2015.0011. [Epub ahead of print]

Tranexamic acid: a clinical review.

Ng WC, Jerath A, Wasowicz M(1).

Abstract:

Blood loss and subsequent transfusions are associated with major morbidity and mortality. The use of antifibrinolytics can reduce blood loss in cardiac surgery, trauma, orthopedic surgery, liver surgery and solid organ transplantation, obstetrics and gynecology, neurosurgery and non-surgical diseases. The evidence of their efficacy has been mounting for years. Tranexamic Acid (TXA), a synthetic lysine-analogue antifibrinolytic, was first patented in 1957 and its use has been increasing in contrast to aprotinin, a serine protease inhibitor antifibrinolytic. This review aims to help acute care physicians navigate through the clinical evidence available for TXA therapy, develop appropriate dose regimens whilst minimizing harm, as well as understand its broadening scope of applications. Many questions remain unanswered regarding other clinical effects of TXA such as anti-inflammatory response to cardiopulmonary bypass, the risk of thromboembolic events, adverse neurological effects such as seizures, and its morbidity and mortality, all of which necessitate further clinical trials on its usage and safety in various clinical settings.

J Trauma Acute Care Surg. 2015 Apr;78(4):721-8.

Survival of severe blunt trauma patients treated with resuscitative endovascular balloon occlusion of the aorta compared with propensity score-adjusted untreated patients.

Norii T, Crandall C, Terasaka Y.

BACKGROUND: Despite a growing call for use of resuscitative endovascular balloon occlusion of the aorta (REBOA) for critically uncontrolled hemorrhagic shock, there is limited evidence of treatment efficacy. We compared the mortality between patients who received a REBOA with those who did not, adjusting for the likelihood of treatment and injury severity, to measure efficacy.

METHODS: We analyzed observational prospective data from the Japan Trauma Data Bank (2004-2011) to compare the mortality between adult patients who received a REBOA with those who did not. To adjust for potential treatment bias, we calculated the likelihood of REBOA treatment via a propensity score (PS) using available pretreatment variables (vital signs, age, sex, as well as anatomic and physiologic injury severity) and matched treated patients to up to five similar PS untreated patients. We compared survival to discharge between treated and untreated groups using conditional logistic regression and Cox proportional hazards regression.

RESULTS: Of 45,153 patients who met inclusion, 452 patients (1.0%) received REBOA placement. These patients were seriously injured (median Injury Severity Score [ISS], 35) and had high mortality (76%). Patients who did not receive a REBOA had significantly lower injury severity (median ISS, 13; $p < 0.0001$) and lower mortality (16%). After matching REBOA patients with controls with similar PSs for treatment, the crude conditional odds ratio of survival by REBOA treatment was 0.30 (95% confidence interval, 0.23-0.40).

CONCLUSION: REBOA treatment is associated with higher mortality compared with similarly ill trauma patients who did not receive a REBOA. The higher observed mortality among REBOA-treated patients may signal "last ditch" efforts for severity not otherwise identified in the trauma registry.

LEVEL OF EVIDENCE: Epidemiologic study, level III; therapeutic study, level IV.

J Trauma Acute Care Surg. 2015 Feb;78(2):295-9.

Intraosseous infusion rates under high pressure: a cadaveric comparison of anatomic sites.

Pasley J, Miller CH, DuBose JJ, Shackelford SA, Fang R, Boswell K, Halcome C, Casey J, Cotter M, Matsuura M, Relph N, Tarmey NT, Stein DM.

BACKGROUND: When traditional vascular access methods fail, emergency access through the intraosseous (IO) route can be lifesaving. Fluids, medications, and blood components have all been delivered through these devices. We sought to compare the performance of IO devices placed in the sternum, humeral head, and proximal tibia using a fresh human cadaver model.

METHODS: Commercially available IO infusion devices were placed into fresh human cadavers: sternum (FAST-1), humeral head (EZ-IO), and proximal tibia (EZ-IO). Sequentially, the volume of 0.9% saline infused into each site under 300 mm Hg pressure over 5 minutes was measured. Rates of successful initial IO device placement and subjective observations related to the devices were also recorded.

RESULTS: For 16 cadavers over a 5-minute bolus infusion, the total volume of fluid infused at the three IO access sites was 469 (190) mL for the sternum, 286 (218) mL for the humerus, and 154 (94) mL for the tibia. Thus, the mean (SD) flow rate infused at each site was as follows: (1) sternum, 93.7 (37.9) mL/min; (2) humerus, 57.1 (43.5) mL/min; and (3) tibia, 30.7 (18.7) mL/min. The tibial site had the greatest number of insertion difficulties.

CONCLUSION: This is the first study comparing the rate of flow at the three most clinically used adult IO infusion sites in an adult human cadaver model. Our results showed that the sternal site for IO access provided the most consistent and highest flow rate compared with the humeral and tibial insertion sites. The average flow rate in the sternum was 1.6 times greater than in the humerus and 3.1 times greater than in the tibia.

J Arthroplasty. 2014 Aug;29(8):1528-31. doi: 10.1016/j.arth.2014.03.011.

Comparison of intravenous versus topical tranexamic acid in total knee arthroplasty: a prospective randomized study.

Patel JN, Spanyer JM, Smith LS, Huang J, Yakkanti MR, Malkani AL

Abstract:

The purpose of this study was to compare the efficacy of topical Tranexamic Acid (TXA) versus Intravenous (IV) Tranexamic Acid for reduction of blood loss following primary total knee arthroplasty (TKA). This prospective randomized study involved 89 patients comparing topical administration of 2.0g TXA, versus IV administration of 10mg/kg. There were no differences between the two groups with regard to patient demographics or perioperative function. The primary outcome measure, perioperative change in hemoglobin level, showed a decrease of 3.06 ± 1.02 in the IV group and 3.42 ± 1.07 in the topical group (P = 0.108). There were no statistical differences between the groups in preoperative hemoglobin level, lowest postoperative hemoglobin level, or total drain output. One patient in the topical group required blood transfusion (P = 0.342). Based on our study, topical Tranexamic Acid has similar efficacy to IV Tranexamic Acid for TKA patients.

Trauma Acute Care Surg. 2015 May;78(5):1014-20.

Improved survival in UK combat casualties from Iraq and Afghanistan: 2003-2012.

Penn-Barwell JG,Roberts SA, Midwinter MJ, Bishop JR.

BACKGROUND: The United Kingdom was at war in Iraq and Afghanistan for more than a decade. Despite assertions regarding advances in military trauma care during these wars, thus far, no studies have examined survival in UK troops during this sustained period of combat. The aims of this study were to examine temporal changes of injury patterns defined by body region and survival in a population of UK Military casualties between 2003 and 2012 in Iraq and Afghanistan.

METHODS: The UK Military Joint Theatre Trauma Registry was searched for all UK Military casualties (survivors and fatalities) sustained on operations between January 1, 2003, and December 31, 2012. The New Injury Severity Score (NISS) was used to stratify injury severity.

RESULTS: There were 2,792 UK Military casualties sustaining 14,252 separate injuries during the study period. There were 608 fatalities (22% of all casualties). Approximately 70% of casualties injured in hostile action resulted from explosive munitions. The extremities were the most commonly injured body region, involved in 43% of all injuries. The NISS associated with a 50% chance of survival rose each year from 32 in 2003 to 60 in 2012.

CONCLUSION: An improvement in survival during the 10-year period is demonstrated. A majority of wounds are a result of explosive munitions, and the extremities are the most commonly affected body region. The authors recommend the development of more sophisticated techniques for the measuring of the performance of combat casualty care systems to include measures of morbidity and functional recovery as well as survival.

LEVEL OF EVIDENCE: Epidemiologic study, level III.

Mil Med. 2015 Mar;180(3 Suppl):14-8

Prehospital and en route analgesic use in the combat setting: a prospectively designed, multicenter, observational study.

Petz LN, Tyner S, Barnard E, Ervin A, Mora A, Clifford J, Fowler M, Bebarta VS.

BACKGROUND: Combat injuries result in acute, severe pain. Early use of analgesia after injury is known to be beneficial. Studies on prehospital analgesia in combat are limited and no prospectively designed study has reported the use of analgesics in the prehospital and en route care setting. Our objective was t0 describe the current use of prehospital analgesia in the combat setting.

METHODS: This prospectively designed, multicenter, observational, prehospital combat study was undertaken at medical treatment facilities (MTF) in Afghanistan between October 2012 and September 2013. It formed part of a larger study aimed at describing the use of lifesaving interventions in combat. On arrival at the MTF, trained on-site investigators enrolled eligible patients and completed standardized data capture forms, which included the name, dose, and route of administration of all prehospital analgesics, and the type of provider who administered the drug. Physiological data were retrospectively ascribed as soon as practicable. The study was prospectively approved by the Brooke Army Medical Center institutional review board.

RESULTS: Data were collected on 228 patients, with 305 analgesia administrations recorded. The predominant mechanism of injury was blast (50%), followed by penetrating (41%), and blunt (9%). The most common analgesic used was ketamine, followed by morphine. A combination of analgesics was given to 29% of patients; the most common combination was ketamine and morphine. Intravenous delivery was the most commonly used route (55%). Patients transported by the UK Medical Emergency Response Team (MERT) or U.S. Air Medical Evacuation (Dust-off) team were more likely to receive ketamine than those evacuated by U.S. Pararescue Jumpers (Pedro). Patients transported by Medical Emergency Response Team or Pedro were more likely to receive more than 1 drug. Patients who received only ketamine had a higher pulse rate ($p<0.005$) and lower systolic blood pressure ($p=0.01$) than other groups, and patients that received hydromorphone had a lower respiratory rate ($p=0.04$).

CONCLUSIONS: In our prospectively designed, multicenter, observational, prehospital combat study, ketamine was the most commonly used analgesic drug. The most frequently observed combination of drugs was ketamine and morphine. The intravenous route was used for 55% of drug administrations

J Trauma Acute Care Surg. 2015 Apr;78(4):729-34

Early autologous fresh whole blood transfusion leads to less allogeneic transfusions and is safe.

Rhee P, Inaba K, Pandit V, Khalil M, Siboni S, Vercruysse G, Kulvatunyou N,Tang A, Asif A, O'Keeffe T, Joseph B.

BACKGROUND: The practice of transfusing ones' own shed whole blood has obvious benefits such as reducing the need for allogeneic transfusions and decreasing the need for other fluids that are typically used for resuscitation in trauma. It is not widely adopted in the trauma setting because of the concern of worsening coagulopathy and the inflammatory process. The aim of this study was to assess outcomes in trauma patients receiving whole blood autotransfusion (AT) from hemothorax.

METHODS: This is a multi-institutional retrospective study of all trauma patients who received autologous whole blood transfusion from hemothorax from two Level I trauma centers. Patients who received AT were matched to patients who did not receive AT (No-AT) using propensity score matching in a 1:1 ratio for admission age, sex, mechanism, type of injury, Injury Severity Score (ISS), Glasgow Coma Scale (GCS) score, systolic blood pressure, heart rate, hemoglobin, international normalized ratio (INR), prothrombin time, partial prothrombin time, and lactate. AT was defined as transfusion of autologous blood from patient's hemothorax, which was collected from the chest tubes and anticoagulated with citrate phosphorous dextrose. Outcome measures were in-hospital complications, 24-hour INR, and mortality. In-hospital complications were defined as adult respiratory distress syndrome, sepsis, disseminated intravascular coagulation, renal insufficiency, and transfusion-related acute lung injury.

RESULTS: A total of 272 patients (AT, 136; No-AT, 136) were included. There was no difference in admission age ($p = 0.6$), ISS ($p = 0.56$), head Abbreviated Injury Scale (AIS) score ($p = 0.42$), systolic blood pressure ($p = 0.88$), and INR ($p = 0.62$) between the two groups. There was no significant difference in in-hospital complications ($p = 0.61$), mortality ($p = 0.51$), and 24-hour postadmission INR (0.31) between the AT and No-AT groups. Patients who received AT had significantly lower packed red blood cell ($p = 0.01$) and platelet requirements ($p = 0.01$). Cost of transfusions ($p = 0.01$) was significantly lower in the AT group compared with the No-AT group.

CONCLUSION: The autologous transfusion of the patient's shed blood collected through chest tubes for hemothorax was found to be safe without complications in this study. It also reduced the need for allogeneic transfusions and decreased hospital costs. This study demonstrates safety data that would help in designing larger prospective multicenter studies to determine whether this practice is truly safe and effective.

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

Ann Emerg Med. 2015 Apr;65(4):445-6

Does tranexamic acid improve outcomes in patients undergoing urgent or emergency surgery?

Robertson J, Koyfman A

Quotes:

"Five trials were included in the qualitative analysis, but only 3 (N=260) met criteria for the quantitativemeta-analysis. These trials by Sadeghi and Mehr-Aein,(1) Zufferey et al, (2) and Pfizer, (3) compared tranexamic acid versus standard care without tranexamic acid in surgeries for hip or femur shaft fractures. All study participants received the minimum tranexamic acid bolus dose of 15 mg/kg intravenously at surgery. None of the participants were judged to have coagulopathies. The 3 trials were judged by the authors to be clinically and statistically homogeneous. The investigators judged the risk of bias to be low or unclear and there were no disagreements.

"There was no effect of tranexamic acid on mortality (risk ratio approximately =1); however, there was imprecision around this estimate (95% CI 0.14 to 7.30) according to the 3 trials. Alternatively, the use of tranexamic acid appeared to reduce the probability of requiring a blood transfusion by an estimated 30% but may have increased the risk of deep venous thrombosis or stroke. There were no reported myocardial infarctions or pulmonary emboli in any of the studies."

"In conclusion, this meta-analysis reported a 30% reduction in the need for transfusions with the administration of tranexamic acid at the time of emergency hip and femur fracture surgery. However, given themultiple limitations of this systematic review, the benefits and potential harms of administration in the ED remain unknown."

Wilderness Environ Med. 2015 Mar 24. pii: S1080-6032(15)00075-7. doi: 10.1016/j.wem.2015.01.006. [Epub ahead of print]

Femoral Traction Splints in Mountain Rescue Prehospital Care: To Use or Not to Use? That Is the Question.

Runcie H, Greene M

OBJECTIVES: To determine the incidence of femur fractures in mountain rescue in England and Wales. To investigate the attitudes of rescuers toward the use of femoral traction splints. To review the literature for evidence on the use of traction splints in prehospital medicine and test the hypothesis that femoral traction splints reduce morbidity and mortality in patients with a fractured femur.

METHODS: The Mountain Rescue England and Wales database was searched for cases of suspected fractured femur occurring between 2002 and 2012, a questionnaire was sent to all mountain rescue teams in England and Wales, and a literature review was performed. Relevant articles were critically reviewed to identify the evidence base for the use of femoral traction splints.

RESULTS: Femur fractures are uncommon in mountain rescue, with an incidence of suspected femur fractures on scene at 9.3 a year. Traction splints are used infrequently; 13% of the suspected femur fractures were treated with traction. However, rescuers have a positive attitude toward traction splints and perceive few disadvantages to their use. No trials demonstrate that traction splints reduce morbidity or mortality, but a number describe complications resulting from their use.

CONCLUSIONS: Femur fractures are rare within mountain rescue. Traction splints may be no more effective than other methods of splinting in prehospital care. We failed to identify evidence that supports the hypothesis that traction splints reduce morbidity or mortality. We advocate the use of a femoral traction splints but recognize that other splints may also be appropriate in this environment.

Mil Med. 2015 Mar;180(3 Suppl):68-73

Evolution of Pararescue medicine during operation Enduring Freedom.

Rush S, Boccio E, Kharod CU, D'Amore J

Abstract:

This article highlights recent advances made in U.S. Air Force Pararescue Medical Operations in relation to tactical evacuation procedures. Most of these changes have been adopted and adapted from civilian medicine practice, and some have come from shared experiences with partner nations. Patient assessment includes a more comprehensive evaluation for hemorrhage and indications for hemorrhagic control. Ketamine has replaced morphine and fentanyl as the primary sedative used during rapid sequence intubation and procedural sedation. There has been an increasing use of the bougie to clear an airway or nasal cavity that becomes packed with debris. Video laryngoscopy provides advantages over direct laryngoscopy, especially in situations where there are environmental constraints such as the back of a Pave Hawk helicopter. Intraosseous access has become popular to treat and control hemorrhagic shock when peripheral intravenous access is impractical or impossible. Revisions to patient treatment cards have improved the efficacy and compliance of documentation and have made patient handoff more efficient. These improvements have only been possible because of the concerted efforts of U.S. Air Force and partner platforms operating in Afghanistan.

Mil Med. 2015 Mar;180(3 Suppl):60-3.

A comparison of the incidence of cricothyrotomy in the deployed setting to the emergency department at a level 1 military trauma center: a descriptive analysis.

Schauer SG, Bellamy MA, Mabry RL, Bebarta VS

Abstract:

Airway management is a critical skill of emergency medicine physicians and prehospital providers. Airway compromise is the cause of 1.8% of battlefield deaths. Cricothyrotomy is a critical, lifesaving procedure. In this study, we conducted a retrospective descriptive analysis comparing the incidence of cricothyrotomies in the deployed setting versus the incidence in a military level 1 trauma center emergency department (ED) setting in San Antonio, Texas. The deployed/in-theater procedures were performed from September 2007 to July 2009. The ED procedures were performed from April 2010 to February 2012. Over these study periods, 28 cricothyrotomies were performed in the deployed setting against a backdrop of 11,492 trauma admissions compared to 4 cricothyrotomies performed during 2,741 trauma admissions in the ED setting. The per admission incidence of deployed cricothyrotomies was 0.24% versus an incidence of 0.15% in the ED (p=0.46). We conclude that this rare, lifesaving procedure is performed more often in the deployed setting than the ED, but this difference was not statistically significant.

J Spec Oper Med. 2015 Spring;15(1):85-9.

Battlefield Analgesia: TCCC Guidelines Are Not Being Followed.

Schauer SG, Robinson JB, Mabry RL, Howard JT.

BACKGROUND: Service members injured in combat often experience moderate to severe acute pain. Early and effective pain control in the prehospital setting has been shown to reduce the sequelae of untreated pain. Current data suggest that lack of point-of-injury (POI) analgesia has significant, downstream effects on healthcare quality and associated costs.

METHODS: This was a process improvement project to determine the current rate of adherence to existing prehospital pain management guidelines. The records of patients who had sustained a major injury and met current Tactical Combat Casualty Care (TCCC) criteria for POI analgesia from July 2013 through March 2014 were reviewed to determine if pain medication was given in accordance with existing guidelines, including medication administration and routes. On 31 October 2013, the new TCCC guidelines were released. The "before" period was from July 2013 through October 2013. The “after" period was from November 2013 through March 2014.

RESULTS: During the project period, there were 185 records available for review, with 135 meeting TCCC criteria for POI analgesia (68 pre-, 66 post-intervention). Prior to 31 October 2013, 17% of study patients received analgesia within guidelines at the POI compared with 35% in the after period. The most common medication administered pre- and post-release was oral transmucosal fentanyl citrate. Special Operations Forces had higher adherence rates to TCCC analgesia guidelines than conventional forces, but these still were low.

CONCLUSION: Less than half of all eligible combat casualties receive any analgesia at the POI. Further research is needed to determine the etiology of such poor adherence to current TCCC guidelines.

J Trauma Acute Care Surg. 2015 Apr;78(4):687-95; discussion 695-7.

A controlled resuscitation strategy is feasible and safe in hypotensive trauma patients: results of a prospective randomized pilot trial.

Schreiber MA, Meier EN, Tisherman SA, Kerby JD, Newgard CD, Brasel K, Egan D, Witham W, Williams C, Daya M, Beeson J, McCully BH, Wheeler S, Kannas D, May S, McKnight B, Hoyt DB; ROC Investigators.

BACKGROUND: Optimal resuscitation of hypotensive trauma patients has not been defined. This trial was performed to assess the feasibility and safety of controlled resuscitation (CR) versus standard resuscitation (SR) in hypotensive trauma patients.

METHODS: Patients were enrolled and randomized in the out-of-hospital setting. Nineteen emergency medical services (EMS) systems in the Resuscitation Outcome Consortium participated. Eligible patients had an out-of-hospital systolic blood pressure (SBP) of 90 mm Hg or lower. CR patients received 250 mL of fluid if they had no radial pulse or an SBP lower than 70 mm Hg and additional 250-mL boluses to maintain a radial pulse or an SBP of 70 mm Hg or greater. The SR group patients received 2 L initially and additional fluid as needed to maintain an SBP of 110 mm Hg or greater. The crystalloid protocol was maintained until hemorrhage control or 2 hours after hospital arrival.

RESULTS: A total of 192 patients were randomized (97 CR and 95 SR). The CR and SR groups were similar at baseline. The mean (SD) crystalloid volume administered during the study period was 1.0 L (1.5) in the CR group and 2.0 L (1.4) in the SR group, a difference of 1.0 L (95% confidence interval [CI], 0.6-1.4). Intensive care unit-free days, ventilator-free days, renal injury, and renal failure did not differ between the groups. At 24 hours after admission, there were 5 deaths (5%) in the CR group and 14 (15%) in the SR group (adjusted odds ratio, 0.39; 95% CI, 0.12-1.26). Among patients with blunt trauma, 24-hour mortality was 3% (CR) and 18% (SR) with an adjusted odds ratio of 0.17 (0.03-0.92). There was no difference among patients with penetrating trauma (9% vs. 9%; adjusted odds ratio, 1.93; 95% CI, 0.19-19.17).

CONCLUSION: CR is achievable in out-of-hospital and hospital settings and may offer an early survival advantage in blunt trauma. A large-scale, Phase III trial to examine its effects on survival and other clinical outcomes is warranted.

LEVEL OF EVIDENCE: Therapeutic study, level I.

J Spec Oper Med. 2015 Spring;15(1):17-31.

Optimizing the Use of Limb Tourniquets in Tactical Combat Casualty Care: TCCC Guidelines Change 14-02.

Shackelford SA, Butler FK Jr, Kragh JF Jr, Stevens RA, Seery JM, Parsons DL, Montgomery HR, Kotwal RS, Mabry RL, Bailey JA.

Conclusions:

" 1. A decrease in the frequency of preventable deaths has been achieved though widespread training, and dissemination and use of tourniquets. The likelihood of tourniquet morbidity had been reduced through selection of better devices, more training of potential users, and more rapid evacuation. To minimize complications, it is important that training emphasize early conversion of tourniquets that are no longer needed; tourniquets must be frequently reassessed to ensure that hemorrhage is stopped and venous tourniquets avoided, particularly when evacuation time is long.

2. Tourniquets that are no longer needed should be converted to hemostatic or pressure dressings as soon as possible if the criteria for safe removal are met to reduce tourniquet pain and minimize the risks of complications. If the tourniquet is still on the extremity 2 hours after placement, a mandatory reassessment of the continued need for the tourniquet should occur.

3. The goals of tourniquet placement are to stop both bleeding and the distal pulse. Tactical and clinical situations dictate which goal(s) can be monitored; however, the likelihood of maximum benefit and minimum risk occurs only when both goals are attained.

4. Tourniquets placed during CUF should be positioned clearly proximal to the bleeding site(s). If the site of life-threatening bleeding is not readily apparent, the tourniquet should be placed high and tight (as proximal as possible) on the injured extremity as soon as possible.

5. Single-slit routing of the C-A-T band through the buckle is effective and may reduce blood loss and time for application; this method is recommended during the CUF phase."

Mil Med. 2015 Mar;180(3):304-9.

Prehospital pain medication use by U.S. Forces in Afghanistan.

Shackelford SA, Fowler M, Schultz K, Summers A, Galvagno SM, Gross KR, Mabry RL, Bailey JA, Kotwal RS, Butler FK

Abstract:

We report the results of a process improvement initiative to examine the current use and safety of prehospital pain medications by U.S. Forces in Afghanistan. Prehospital pain medication data were prospectively collected on 309 casualties evacuated from point of injury (POI) to surgical hospitals from October 2012 to March 2013. Vital signs obtained from POI and flight medics and on arrival to surgical hospitals were compared using one-way analysis of variance test. 119 casualties (39%) received pain medication during POI care and 283 (92%) received pain medication during tactical evacuation (TACEVAC). Morphine and oral transmucosal fentanyl citrate were the most commonly used pain medications during POI care, whereas ketamine and fentanyl predominated during TACEVAC. Ketamine was associated with increase in systolic blood pressure compared to morphine (+7 ± 17 versus -3 ± 14 mm Hg, p = 0.04). There was no difference in vital signs on arrival to the hospital between casualties who received no pain medication, morphine, fentanyl, or ketamine during TACEVAC. In this convenience sample, fentanyl and ketamine were as safe as morphine for prehospital use within the dose ranges administered. Future efforts to improve battlefield pain control should focus on improved delivery of pain control at POI and the role of combination therapies.

Arch Orthop Trauma Surg. 2015 Apr;135(4):573-88

One step closer to sparing total blood loss and transfusion rate in total knee arthroplasty: a meta-analysis of different methods of tranexamic acid administration.

Shemshaki H, Nourian SM, Nourian N, Dehghani M, Mokhtari M, Mazoochian F

BACKGROUND: Tranexamic acid (TXA) in orthopedics has recently been gaining favor due to its efficacy and ease of use, both in intravenous (IV) and intra-articular (IA) usage. However, because of safety concerns with IV administration, there has been a growing interest in the IA use of TXA to prevent bleeding.

MATERIALS AND METHODS: This study conducted a systematic review and meta-analysis that included 31 randomized, controlled trials in which the effect of systemic and topical TXA on total blood loss (TBL), rates of transfusion, and thromboembolic events was investigated.

RESULTS: Compared to the control, the IA administration of TXA led to the significant reduction of mean TBL ($p < 0.001$), rate of transfusion ($p < 0.001$), and reduction of rate of thromboembolic events ($p = 0.29$). Compared to the control group, the IV administration of TXA resulted in significant reduction of mean TBL ($p < 0.001$), rate of transfusion ($p < 0.001$), and rate of thromboembolic events ($p = 0.66$). Although no significant differences in efficacy and safety between the IA and IV administration of TXA were found, the IA method was safer than the IV method in that it reduced rate of transfusion and thromboembolic events.

CONCLUSION: This study showed that TXA leads to significant reductions in TBL and the rate of allogeneic transfusions. Generally, no significant difference was detected between IA and IV administration of TXA; however, more studies with focus on safety and efficacy are warranted.

J Trauma Acute Care Surg. 2015 Feb;78(2):336-41

Damage-control resuscitation increases successful non-operative management rates and survival after severe blunt liver injury.

Shrestha B, Holcomb JB, Camp EA, Del Junco DJ, Cotton BA, Albarado R, Gill BS, Kozar RA, Kao LS, McNutt MK, Moore LJ, Love JD, Tyson GH 3rd, Adams PR, Khan S, Wade CE.

BACKGROUND: Non-operative multidisciplinary management for severe (American Association for the Surgery of Trauma Grades IV and V) liver injury has been use for two decades. We have previously shown that Damage Control Resuscitation (DCR) using low-volume, balanced resuscitation improves survival of severely injured trauma patients; however, little attention has been paid to organ-specific outcomes. We wanted to determine if implementation of DCR has improved survival and successful nonoperative management after severe blunt liver injury.

METHODS: A retrospective study was performed on all adult trauma patients with severe blunt liver injury who were admitted from 2005 to 2011. Patients were divided into pre-DCR (2005-2008) and DCR (2009-2011) groups. Patients who died before leaving the emergency department (ED) were excluded. Outcomes (resuscitation products used, survival, and length of stay) were then compared by univariate and multivariate analyses.

RESULTS: Between 2005 and 2011, 29,801 adult trauma patients were admitted, and 1,412 (4.7%) experienced blunt liver injury. Of these, 244 (17%) sustained Grade IV and V injuries, with 206 patients surviving to leave the ED. The pre-DCR group (2005-2008) was composed of 108 patients, and the DCR group (2009-2011) had 98 patients. The groups were not different in demographics as well as prehospital and ED vital signs or Injury Severity Score (ISS). No change in operative or interventional radiology techniques occurred in this time frame. The DCR cohort had an increase in successful nonoperative management (from 54% to 74%, $p < 0.01$) as well as a reduction in initial 24-hour packed red blood cell (median, from 13 U to 6.5 U; $p < 0.01$), plasma (median, from 13 U to 8 U; $p < 0.01$), and crystalloid (median, from 5,800 mL to 4,100 mL; $p < 0.01$) administration. The DCR treatment was associated with improved survival, from 73% to 94% ($p < 0.01$).

CONCLUSION: In patients with severe blunt liver injury, DCR was associated with less crystalloid and blood product use, a higher successful non-operative management rate, and improved survival. Resuscitation technique may improve outcomes after severe liver injury.

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

Ann Emerg Med. 2015 Mar;65(3):297-307.e16.

To be blunt: are we wasting our time? Emergency department thoracotomy following blunt trauma: a systematic review and meta-analysis.

Slessor D, Hunter S

STUDY OBJECTIVE: The role of emergency department (ED) thoracotomy after blunt trauma is controversial. The objective of this review is to determine whether patients treated with an ED thoracotomy after blunt trauma survive and whether survivors have a good neurologic outcome.

METHODS: A structured search was performed with MEDLINE, EMBASE, CINAHL, and PubMed. Inclusion criteria were ED thoracotomy or out-of-hospital thoracotomy, cardiac arrest or periarrest, and blunt trauma. Outcomes assessed were mortality and neurologic result. The articles were appraised with the system designed by the Institute of Health Economics of Canada. A fixed-effects model was used to meta-analyze the data. Heterogeneity was assessed with the I(2) statistic.

RESULTS: Twenty-seven articles were included in the review. All were case series. Of 1,369 patients who underwent an ED thoracotomy, 21 (1.5%) survived with a good neurologic outcome. All 21 patients had vital signs present on scene or in the ED and a maximum duration of cardiopulmonary resuscitation of 11 to 15 minutes. Thirteen studies were included in the meta-analysis. If there were either vital signs or signs of life present in the ED, the probability of a poor outcome was 99.2% (95% confidence interval 96.4% to 99.7%).

CONCLUSION: There may be a role for ED thoracotomy after blunt trauma, but only in a limited group of patients. Good outcomes have been achieved for patients who had vital signs on admission and for patients who received an ED thoracotomy within 15 minutes of cardiac arrest. The proposed guideline should be used to determine which patients should be considered for an ED thoracotomy, according to level 4 evidence.

Eur J Emerg Med. 2015 Feb 24. [Epub ahead of print]

Comparison of airway management techniques for different access in a simulated motor vehicle entrapment scenario.

Steinmann D, Ahne T, Heringhaus C, Goebel U.

BACKGROUND: Emergency airway management can be particularly challenging in patients entrapped in crashed cars because of limited access. The aim of this study was to analyse the feasibility of four different airway devices in various standardized settings utilized by paramedics and emergency physicians.

METHODS: Twenty-five paramedics and 25 emergency physicians were asked to perform advanced airway management in a manikin entrapped in a car's left front seat, with access to the patient through the opened driver's door or access from the back seat. Available airway devices included Macintosh and Airtraq laryngoscopes, as well as laryngeal mask airway (LMA) Supreme and the Laryngeal Tube. The primary endpoints were successful placement, along with attempts needed to do so, and time for successful placement. The secondary endpoints included Cormack-Lehane grades and rating of the difficulty of the technique with the different devices.

RESULTS: The overall intubation and placement success rates were equal for the Macintosh and Airtraq laryngoscopes as well as the LMA Supreme and Laryngeal Tube, with access from the back seat being superior in terms of placement time and ease of use. Supraglottic airway devices required half of the placement time and were easier to use compared with endotracheal tubes (with placement times almost >30 s). Paramedics and emergency physicians achieved equal overall successful placement rates for all devices.

CONCLUSION: Both scenarios of securing the airway seem suitable in this manikin study, with access from the back seat being superior. Although all airway devices were applicable by both groups, paramedics and emergency physicians, supraglottic device placement was faster and always possible at the first attempt. Therefore, the LMA Supreme and the Laryngeal Tube are attractive alternatives for airway management in this context if endotracheal tube placement fails. Furthermore, supraglottic device placement, while the patient is still in the vehicle, followed by a definitive airway once the patient is extricated would be a worthwhile alternative course of action.

Curr Sports Med Rep. 2015 Mar-Apr;14(2):129-34

The lost art of whole blood transfusion in austere environments.

Strandenes G, Hervig TA, Bjerkvig CK, Williams S, Eliassen HS, Fosse TK, Torvanger H, Cap AP.

Abstract:

The optimal resuscitation fluid for uncontrolled bleeding and hemorrhagic shock in both pre-and in-hospital settings has been an ongoing controversy for decades. Hemorrhage continues to be a major cause of death in both the civilian and military trauma population, and survival depends on adequacy of hemorrhage control and resuscitation between onset of bleeding and arrival at a medical treatment facility. The terms far-forward and austere are defined, respectively, as the environment where professional health care providers normally do not operate and a setting in which basic equipment and capabilities necessary for resuscitation are often not available. The relative austerity of a treatment setting may be a function of timing rather than just location, as life-saving interventions must be performed quickly before hemorrhagic shock becomes irreversible. Fresh whole blood transfusions in the field may be a feasible life-saving procedure when facing significant hemorrhage.

Curr Sports Med Rep. 2015 Mar-Apr;14(2):117-22

Pain control in austere settings.

Surrett G, Franklin J, Wedmore I.

Abstract:

Sporting events, particularly "extreme" sports, are becoming increasingly more austere and thus further from readily available fixed facility medical care. The provider caring for acute injuries in these more remote locations will be faced with the need to treat pain in the injured athlete. This review provides a stepwise approach to safe and effective pain control in the austere environment.

J Trauma Acute Care Surg. 2015 Mar;78(3):524-9.

Use of pelvic hemostasis belt to control lethal pelvic arterial hemorrhage in a swine model.

Tiba MH, Draucker GT, McCracken BM, Alam HB, Eliason JL, Ward KR.

BACKGROUND: Hemorrhage is the leading cause of death for both civilian and battlefield injuries. Hemorrhage from pelvic vascular wounds is of concern since it is difficult to control before surgical intervention. This has resulted in renewed interest in developing presurgical endovascular approaches to hemorrhage control. However, it is likely that other short-term techniques may be needed as a bridge to such approaches. We tested a prototype device called the pelvic hemostasis belt (PHB) for its ability to reduce or halt blood flow in a lethal model of pelvic arterial injury.

METHODS: Seventeen male swine, 42 (5.2) kg were anesthetized, instrumented, and then randomized into three groups (control, military anti-shock trousers [MAST], and PHB). Animals underwent laparotomy with placement of a 4-0 stainless steel monofilament suture through the right iliac artery. The laparotomy was closed, and the iliac suture was exteriorized. Hemorrhage was produced by pulling the suture through the iliac artery. In both PHB and MAST groups, the devices were applied over the pelvis and lower abdomen for 60 minutes, followed by release and monitoring for 30 minutes or until the animal expired. Hetastarch (500 mL) was infused immediately after commencement of hemorrhage.

RESULTS: All PHB group animals and only two from the MAST group survived for 60 minutes. Mean (SD) survival time for the control group was 13 (12.3) minutes. Log-rank (Mantel-Cox) survival analysis demonstrated a significant difference in survival time when comparing all groups ($p < 0.0001$) as well as when comparing PHB and MAST groups ($p = 0.018$). Significant differences were noted between groups in mean arterial pressure, lactate, and central venous hemoglobin oxygen saturation levels.

CONCLUSION: The PHB was successful in improving survival for 60 minutes after a lethal vascular injury. Such a device may be helpful to bridge endovascular methods of hemorrhage control.