Tactical Combat Casualty Care

Journal Article Abstracts

November 2013

References

Akoglu H, Akoglu E, Evman S, et al: Determination of the appropriate catheter length and place for needle thoracostomy by using computed tomography scans of pneumothorax patients. Injury 2013;44:1177-1182

Annane D, Siami S, Jaber S, et al: Effects of fluid resuscitation with colloids vs crystalloids on mortality in critically ill patients presenting with hypovolemic shock: the CRISTAL randomized trial. JAMA. 2013;310:1809-17

Anonymous: Abdominal aortic tourniquet use in Afghanistan. J Spec Oper Med 2013;13:1-2.

Bailey J, Morrison J, Rasmussen T: Military trauma system in Afghanistan: lessons for civil systems? Curr Opin Crit Care 2013;19:569-577

Blanca-López N, Ariza A, Doña I, et al: Hypersensitivity reactions to fluoroquinolones: analysis of the factors involved. Clin Exp Allergy 2013;43:560-567

Bogner J, Kutaiman A, Esguerra-Alcalen M, et al: Moxifloxacin in complicated skin and skin structure infections (cSSis): a prospective, international, non-interventional, observational study. Adv Ther 2013;30:630-43

Brunstetter T, Wasner C, Hart S, Burrow S: Rigid eye shields: a critical gap in the individual first aid kit. J Spec Oper Med 2013;13:26-28

Buschmann C, Kleber C: No more tension pneumothorax in unsuccessfully resuscitated patients with penetrating chest trauma at autopsy! Injury 2013;44:1659-60

Butler F, Dubose J, Otten E, et al: Management of open pneumothorax in Tactical Combat Casualty Care: TCCC Guidelines changed 13-02. J Spec Oper Med 2013;13:81-86

Bux J, Dickhörner D, Scheel E: Quality of freeze-dried (lyophilized) quarantined single-donor plasma. Transfusion 2013;Epub ahead of print

Cannon M: Law enforcement and the long gun: do we need a new face in the fight? J Emerg Med 2013;Epub ahead of print

Caterson E, Carty M, Weaver M, Holt E: Boston bombings: a surgical view of lessons learned for combat casualty care and the applicability to Boston's terrorist attack. J Craniofac Surg 2013;24:1061-1067

Chen C, Ming C, Ma C, et al: Prespective, randomized, study of ampicillin-sulbactam versus moxifloxacin monotherapy for the treatment of community-acquired complicated intra-abdominal infections. Surg Infect 2013;14:389-96

Croushorn J, Thomas G, McCord SR: Abdominal aortic tourniquet controls junctional hemorrhage from a gunshot wound of the axilla. J Spec Oper Med 2013;13:1-4

Duckett J, Fell P, Han K, et al: Introduction of the i-gel supraglottic airway device for prehospital airway management in a UK ambulance service. Emerg Med J 2013;Epub ahead of print

Duggan M, Rago A, Sharma U, et al: Self-expanding polyurethane polymer improves survival in a model of noncompressible massive abdominal hemorrhage. J Trauma Acute Care Surg 2013;74:1462-1467

Filanovsky Y, Miller P, Kao J: Myth: Ketamine should not be used as an induction agent for intubation in patients with head injury. CJEM 2010;12:154-7

Filips D, Logsetty S, Tan J, et al: The iTClamp controls junctional bleeding in a lethal swine exsanguination model. Prehosp Emerg Care 2013;Epub ahead of print

Galante J, Smith C, Sena M, et al: Identification of barriers to adaptation of battlefield technologies into civilian trauma in California. Mil Med 2013;178:1227-1230

Gebauer S, Hoopes D, Finlay E: From the battlefield to the palliative care arsenal: application of QuickClot© Combat Gauze™ for aggressive palliation of hemorrhagic shock in the setting of end-stage liver disease-associated compartment syndrome. J Pain Symptom Manage 2013;46:e6-e8

Gillies M, Habicher M, Jhanji S, et al: Incidence of postoperative death and acute kidney injury associated with IV hydroxyethyl starch use: systematic review and meta-analysis. Br J Anaesth 2013;Epub ahead of print

Glassberg E, Nadler R, Rasmussen TE, et al: Point-of-injury use of reconstituted freeze-dried plasma as a resuscitative fluid: a special report for prehospital trauma care. J Trauma Acute Care Surg 2013 Aug;75:S111-S114

Glassberg E, Lipsky A, Abramovich A, et al; A dynamic mass casualty incident at sea: lessons learned for the Mavi Marmara. J Trauma Acute Care Surg 2013;75:292-297

Goliasch G, Ruetzler A, Fischer H, et al: Evaluation of advanced airway management in absolutely inexperienced hands: a randomized manikin trial. Eur J Emerg Med 2013;20:310-314

Gruen R, Brohi K, Schreiber M,et al: Haemorrhage control in severely injured patients. Lancet 2012 380:1099-108

Grumbo R, Hoedebecke K, Berry-Cabán C, Mazur A: MEDEVAC use of ketamine for postintubation transport. J Spec Oper Med 2013;13:36-41

Hess J, Lelkens C, Holcomb J, Scalea T: Advances in military, field, and austere transfusion medicine in the last decade. Transfus Apher Sci 2013;Epub ahead of print

Jacobs L, Wade D, McSwain N, et al: The Hartford Consensus: THREAT, a medical disaster preparedness concept. J Am Coll Surg 2013;17:947-953

Jacobs L, McSwain N, Rotonda M, et al: Improving survival from active shooter events: The Hartford Consensus. J Trauma Acute Care Surg 2013;74:1399-1400

Jänig C, Marquardt S, Dietze T, Nitsche T: Laryngeal tube placement of manikin by laypersons: is there a possibility for “public access airway management”? Eur J Emerg Med 2013;Epub ahead of print

Katzenell U, Lipsky A, Abramovich A, et al: Prehospital intubation success rates among Israeli Defense Force providers: epidemiologic analysis and effect on doctrine. J Trauma Acute Care Surg 2013;75:S178-S183

Keneally R, Szpisjak D: Thoracic trauma in Iraq and Afghanistan. J Trauma Acute Care Surg 2013;74:1292-1297

Kheirabadi B, Terrazas I, Koller A, et al: Vented versus unvented chest seals for treatment of pneumothorax and prevention of tension pneumothorax in a swine model. J Trauma Acute Care Surg 2013. 75:150-6

Kilic T, Goksu E, Durmaz D, Yildiz G; Upper cervical spine movement during intubation with different intubation with different airway devices. Am J Emerg Med 2013;Epub ahead of print

Kim B, Zielinski M, Jenkins D, et al: The effects of prehospital plasma on patients with injury: a prehospital plasma resuscitation. J Trauma Acute Care Surg 2012;73:S49-S53

Kotora J, Henao J, Littlejohn L, Kircher S: Vented chest seals for prevention of tension pneumothorax in a communicating pneumothorax. J Emerg Med 2013;45:686-694

Kragh J, Burrows S, Wasner C, et al: Analysis of recovered tourniquets from casualties of Operation Enduring Freedom and Operation New Dawn. Mil Med 2013;178:806-810

Kragh J, Walters T, Westmoreland T, et al: Tragedy into drama: an American history of tourniquet use in the current. J Spec Oper Med 2013;13:5-25

Kunio N, Riha G, Watson K, et al: Chitosan-based advanced hemostatic dressing is associated with decreased blood loss in a swine uncontrolled hemorrhage model. Am J Surg 2013;Epub ahead of print

Lawnick M, Champion H, Gennarelli T, et al: Combat injury coding: a review and reconfiguration. J Trauma Acute Care Trauma 2013;75:573-581

Lee T, Watson K, Fabricant L, et al: Hyperosmolar reconstituted lyophilized plasma is an effective low-volume hemostatic resuscitation fluid for trauma. J Trauma Acute Care Surg 2013;75:369-375

Li Z, Fu X, Xing D, et al: Is tranexamic acid effective and safe in spinal surgery? A meta-analysis of randomized controlled trials. Eur Spine J 2013;Epub ahead of print

Lipsky A, Abramovich A, Nadler R, et al: Tranexamic acid in the prehospital setting: Israeli Defense Forces' initial experience. Injury 2013;Epub ahead of print

Mabry R, Nichols M, Shiner D, et al; A comparison of two open surgical cricothyroidotomy techniques by military medics using a cadaver model. Ann Emerg Med 2013;Epub ahead of print

McMullen J, Rodriquez D, Hart K, et al: Prevalence of prehospital hypoxemia and oxygen use in trauma. Mil Med 2013;178:1121-1125

McSwain N: Judgment based on knowledge: a history of Prehospital Trauma Life Support, 1970-2013. J Trauma Acute Care Surg 2013;75:1-7

Metzger A, Rees J, Segal N, et al: “Fluidless” resuscitation with permissive hypotension via impedance threshold device therapy compared with normal saline resuscitation in a porcine model of severe hemorrhage. J Trauma Acute Care Surg 2013;75:S203-S209

Millin M, Galvagno S, Khandker S, et al: Withholding and termination of resuscitation of adult cardiopulmonary arrest secondary to trauma: resource document to the joint NAEMSP-ACSCOT position statement. J Trauma Acute Care Surg 2013;75:459-467

Misgav M, Kenet G, Martinowitz U: Chitosan-based dressing for the treatment of external/accessible bleeding in children with bleeding tendency. J Pediatr Hematol Oncol 2013;Epub ahead of print

Morrison J, Stannard A, Rasmussen T, et al: Injury pattern and mortality of noncompressible torso hemorrhage in UK combat casualties. J Trauma Acute Care Surg 2013;75:S263-S268

Muniz G, Wampler D, Manifold C, et al; Promoting early diagnosis of hemodynamic instability during simulated hemorrhage with the use of a real-time decision-assist algorithm. J Trauma Acute Care Surg 2013;73:S184-S189

Myburgh JA, Mythen MG: Resuscitation fluids. N Engl J Med 2013;369:1243-1251

Nakstad A, Bredmose P, Sandberg M: Comparison of percutaneous device and the bougie-assisted surgical technique for emergency cricothyrotomy: an experimental study on a porcine model performed by air ambulance anaesthesiologists. Scand J Trauma Resusc Emerg Med 2013;21:59

Nessen S, Eastridge B, Cronk D, et al: Fresh whole blood use by forward surgical teams in Afghanistan is associated with improved survival compared to component therapy without platelets. Transfusion 2013;53:107S-113S

Polston R, Clumpner B, Kragh J, et al: No slackers in tourniquet use to stop bleeding. J Spec Oper Med 2013;13:12-19

Rasmussen K, Johansson P, Højskov M, et al: Hydroxyethyl starch reduces coagulation competence and increases blood loss during major surgery: results from a randomized controlled trial. Ann Surg 2013;Epub ahead of print

Robinson B, Cotton B, Pritts T, et al: Application of the Berlin definition in PROMMTT patients: the impact of resuscitation on the incidence of hypoxemia. J Trauma Acute Care Surg 2013;75:S61-S67

Rush S: Recent consideration in tactical medicine. J Spec Oper Med 2013;13:54-58

Singleton J, Gibb I, Bull A, et al: Primary blast lung injury prevalence and fatal injuries from explosions: insights from postmortem computed tomographic analysis of 121 improvised explosive device fatalities. J Trauma Acute Care Surg 2013;75:S269-S274

Singleton J, Gibb I, Hunt N, et al: Identifying future 'unexpected' survivors: a retrospective cohort study of fatal injury patterns in victims of improvised explosive devices. BMJ Open 2013;8:e003130

Smit K, Naudie D, Ralley F, et al: One dose of tranexamic acid is safe and effective in revision knee arthroplasty. J Arthroplasty 2013;Epub ahead of print

Stahel P, Mauffrey C, Smith W, et al: External fixation for acute pelvic ring injuries: decision making and technical options. J Trauma Acute Care Surg 2013;882-887

Strain J: CBRNE TC3: A hybrid approach to casualty care in the CBRNE environment. J Spec Oper Med 2013;13:44-53

Studer N, Horn G, Studer L, et al: Feasibility of supraglottic airway use by combat lifesavers on the modern battlefield. Mil Med 2013;178:1202-1207

Taylor D, Coleman M, Parker P: The evaluation of an abdominal aortic tourniquet for the control of pelvic and lower limb hemorrhage. Mil Med 2013;178:1196-1201

Van Sickle C, Schafer K, Mulligan J, et al: A sensitive shock index for real-time patient assessment during simulated hemorrhage. Aviat Space Environ Med. 2013;84:907-912

Voscopoulos C, Barker T, Listwa T, et al: A comparison of the speed, success rate, and retention of rescue airway devices placed by first-responder emergency medical technicians: a high-fidelity human patient simulation study. J Emerg Med 2013;44:784-789

Vu E, Schlamp R, Wand R, et al: Prehospital use of tranexamic acid for hemorrhagic shock in primary and secondary air medical evacuation. Air Med J 2013;32:289-292

Weppner J: Improved mortality from penetrating neck and maxillofacial trauma using Foley catheter balloon tamponade in combat. J Trauma Acute Care Surg 2013;75:220-224

Abstracts

Injury. 2013 Sep;44(9):1177-82. doi: 10.1016/j.injury.2012.10.005. Epub 2012 Oct 30.

Determination of the appropriate catheter length and place for needle thoracostomy by using computed tomography scans of pneumothorax patients.

Akoglu H, Akoglu EU, Evman S, Akoglu T, Altinok AD, Guneysel O, Onur OE, Eroglu SE.

INTRODUCTION: The primary goal of this study was to compare the chest wall thicknesses (CWT) at the 2nd intercostal space (ICS) at the mid-clavicular line (MCL) and 5th ICS at the mid-axillary line (MAL) in a population of patients with a CT confirmed pneumothorax (PTX). This result will help physicians to determine the optimum needle thoracostomy (NT) puncture site in patients with a PTX.

MATERIALS AND METHODS: All trauma patients who presented consecutively to A&E over a 12-month period were included. Among all the trauma patients with a chest CT (4204 patients), 160 were included in the final analysis. CWTs were measured at both sides and were compared in all subgroup of patients.

RESULTS: The average CWT for men on the 2nd ICS-MCL was 38mm and for women was 52mm; on the other hand, on the 5th ICS-MAL was 33mm for men and 38mm for women. On the 2nd ICS-MCL 17% of men and 48% of women; on the 5th ICS-MAL 13% of men and 33% of women would be inaccessible with a routine 5-cm catheter. Patients with trauma, subcutaneous emphysema and multiple rib fractures would have thicker CWT on the 2nd ICS-MCL. Patients with trauma, lung contusion, sternum fracture, subcutaneous emphysema and multiple rib fractures would have thicker CWT on the 5th ICS-MAL.

CONCLUSIONS: This study confirms that a 5.0-cm catheter would be unlikely to access the pleural space in at least 1/3 of female and 1/10 of male Turkish trauma patients, regardless of the puncture site. If NT is needed, the 5th ICS-MAL is a better option for a puncture site with thinner CWT.

JAMA. 2013 Nov 6;310(17):1809-17. doi: 10.1001/jama.2013.280502.

Effects of fluid resuscitation with colloids vs crystalloids on mortality in critically ill patients presenting with hypovolemic shock: the CRISTAL randomized trial.

Annane D, Siami S, Jaber S, Martin C, Elatrous S, Declère AD, Preiser JC, Outin H, Troché G, Charpentier C, Trouillet JL, Kimmoun A, Forceville X, Darmon M, Lesur O, Régnier J, Abroug F, Berger P, Clec'h C, Cousson J, Thibault L, Chevret S; CRISTAL Investigators.

IMPORTANCE: Evidence supporting the choice of intravenous colloid vs crystalloid solutions for management of hypovolemic shock remains unclear.

OBJECTIVE: To test whether use of colloids compared with crystalloids for fluid resuscitation alters mortality in patients admitted to the intensive care unit (ICU) with hypovolemic shock.

DESIGN, SETTING, AND PARTICIPANTS: A multicenter, randomized clinical trial stratified by case mix (sepsis, trauma, or hypovolemic shock without sepsis or trauma). Therapy in the Colloids Versus Crystalloids for the Resuscitation of the Critically Ill (CRISTAL) trial was open label but outcome assessment was blinded to treatment assignment. Recruitment began in February 2003 and ended in August 2012 of 2857 sequential ICU patients treated at 57 ICUs in France, Belgium, North Africa, and Canada; follow-up ended in November 2012.

INTERVENTIONS: Colloids (n = 1414; gelatins, dextrans, hydroxyethyl starches, or 4% or 20% of albumin) or crystalloids (n = 1443; isotonic or hypertonic saline or Ringer lactate solution) for all fluid interventions other than fluid maintenance throughout the ICU stay.

MAIN OUTCOMES AND MEASURES: The primary outcome was death within 28 days. Secondary outcomes included 90-day mortality; and days alive and not receiving renal replacement therapy, mechanical ventilation, or vasopressor therapy.

RESULTS: Within 28 days, there were 359 deaths (25.4%) in colloids group vs 390 deaths (27.0%) in crystalloids group (relative risk [RR], 0.96 [95% CI, 0.88 to 1.04]; P= .26). Within 90 days, there were 434 deaths (30.7%) in colloids group vs 493 deaths (34.2%) in crystalloids group (RR, 0.92 [95% CI, 0.86 to 0.99]; P= .03). Renal replacement therapy was used in 156 (11.0%) in colloids group vs 181 (12.5%) in crystalloids group (RR, 0.93 [95% CI, 0.83 to 1.03]; P= .19). There were more days alive without mechanical ventilation in the colloids group vs the crystalloids group by 7 days (mean: 2.1 vs 1.8 days, respectively; mean difference, 0.30 [95% CI, 0.09 to 0.48] days; P= .01) and by 28 days (mean: 14.6 vs 13.5 days; mean difference, 1.10 [95% CI, 0.14 to 2.06] days; P= .01) and alive without vasopressor therapy by 7 days (mean: 5.0 vs 4.7 days; mean difference, 0.30 [95% CI, -0.03 to 0.50] days; P= .04) and by 28

days (mean: 16.2 vs 15.2 days; mean difference, 1.04 [95% CI, -0.04 to 2.10] days; P= .03).

CONCLUSIONS AND RELEVANCE: Among ICU patients with hypovolemia, the use of colloids vs crystalloids did not result in a significant difference in 28-day mortality. Although 90-day mortality was lower among patients receiving colloids, this finding should be considered exploratory and requires further study before reaching conclusions about efficacy.

J Spec Oper Med. 2013 Summer;13(2)

Abdominal Aortic Tourniquet use in Afghanistan.

Anonymous

ABSTRACT: The abdominal aortic tourniquet was used recently used in Afghanistan to control severe hemorrhage in a casualty who had traumatic bilateral amputations of the lower extremities. Experts from the medical provider's account of the tactical evaluation phase of care are provided.

Curr Opin Crit Care 2013;19:569-577

Military trauma system in Afghanistan: lessons for civil systems?

Bailey J, Morrison J, Rasmussen T

CONCLUSION: The trauma system in Afghanistan has evolved from primitive beginnings into a mature inclusive trauma system, driven by comprehensive registry outcomes data. This has enabled the challenges of a dispersed and austere battle space to be met with the delivery of forward damage control resuscitation by scalable clinical assets, reducing the time to capability and improving outcome. Transfer of this development from military to civilian trauma systems would provide an enduring benefit to the injured from lessons learned in war.

Clin Exp Allergy. 2013 May;43(5):560-7. doi: 10.1111/cea.12099.

Hypersensitivity reactions to fluoroquinolones: analysis of the factors involved.

Blanca-López N, Ariza A, Doña I, Mayorga C, Montañez MI, Garcia-Campos J, Gomez F, Rondón C, Blanca M, Torres MJ.

BACKGROUND: Hypersensitivity reactions to fluoroquinolones seem to be on the increase, especially immediate type reactions.

OBJECTIVE: The aim of this study was to determine whether several conditions, including gender, age, type of reaction, time interval between the reaction and the study, type of symptoms, the specific fluoroquinolone involved in the reaction and previous confirmed hypersensitivity to beta-lactams or to other drugs were factors contributing to the development of hypersensitivity to fluoroquinolones.

METHOD: We analysed retrospectively all patients attending our allergy department between January 2005 and December 2010 because of a reaction associated with fluoroquinolone administration. The diagnosis was confirmed by basophil activation test or drug provocation tests. In accordance with the results, patients were then classified as having hypersensitivity or non-hypersensitivity to fluoroquinolones.

RESULTS: A group of 218 patients was evaluated; 69 were confirmed as having hypersensitivity, 146 as non-hypersensitivity and 3 were excluded. Comparisons between groups showed that the allergic patients more often had a previous confirmed hypersensitivity to betalactams (P = 0.029), immediate reactions (P = 0.001) and anaphylaxis (P = 0.000), and moxifloxacin was the fluoroquinolone most frequently involved (P = 0.027). The logistic regression analysis showed three factors associated with the diagnosis of hypersensitivity reactions to fluoroquinolones: previous hypersensitivity to betalactams (OR: 4.571; 95% CI: 0.987-21.171; adjusted OR: 23.654; 95% CI: 1.529-365.853), immediate reactions (OR: 17.333; 95% CI: 4.374-68.691; adjusted OR: 52.493; 95% CI: 6.621-416.200) and reactions induced by moxifloxacin (OR: 3.091; 95% CI: 1.160-8.239; adjusted OR: 13.610; 95% CI: 2.419-76.565).

CONCLUSION: In patients who develop reactions to fluoroquinolones, hypersensitivity is more often confirmed in those with immediate reactions and when moxifloxacin is involved. Moreover, patients with hypersensitivity to betalactams are more prone to develop hypersensitivity reactions to fluoroquinolones.

Adv Ther. 2013 Jun;30(6):630-43.

Moxifloxacin in complicated skin and skin structure infections (cSSSIs): A prospective, international, non-interventional, observational study.

Bogner JR, Kutaiman A, Esguerra-Alcalen M, Heldner S, Arvis P.

INTRODUCTION: ARTOS was an international, prospective, non-interventional, non-controlled observational study designed to determine the effectiveness, safety, and tolerability of moxifloxacin under daily-life conditions in patients with complicated skin and skin structure infections (cSSSIs) treated in Europe, the Middle East, and Asia-Pacific region.

METHODS: Eligible patients included males and females who were hospitalized patients or outpatients requiring antibiotic therapy for cSSSIs and for whom the treating physician had elected to begin moxifloxacin therapy in accordance with its approved indications. Patients were assessed before therapy and then at one or two follow-up visits. Effectiveness was assessed with respect to improvement and resolution of signs and symptoms of cSSSIs and safety with respect to the nature and frequency of adverse events and adverse drug reactions.

RESULTS: A total of 6,594 patients were enrolled of whom 5,444 had data available for analysis; 4,692 patients received sequential intravenous/oral (IV/PO) moxifloxacin and 752 exclusively IV therapy. A majority of patients were aged between 40 and 79 years and had one or more comorbid conditions. Post-surgical wound infection, skin abscess, and diabetic foot infection were the cSSSIs most frequently diagnosed and treated with moxifloxacin, with almost 90% of infections rated moderate or severe. Treating physicians chose sequential moxifloxacin 400 mg for most patients, switching from IV to PO after 3-4 days. On average, treatment was maintained for 10 days. Treatment with moxifloxacin was associated with rapid relief in symptoms, with 93.2% of patients experiencing either complete resolution of symptoms or improvement at follow-up. Moxifloxacin was well tolerated with adverse drug reactions occurring in only 2% of patients.

CONCLUSIONS: This study, conducted in a 'real-world' setting, confirms the effectiveness and safety of moxifloxacin in the treatment of a wide spectrum of cSSSIs seen in routine clinical practice.

J Spec Oper Med. 2013 Fall;13(3):26-8.

Rigid eye shields: a critical gap in the individual first aid kit.

Brunstetter T, Wasner C, Hart S, Burrows S.

ABSTRACT: From 5% to 22% of all U.S. Department of Defense combat casualties between 2001 and 2010 suffered some form of ocular trauma. Ocular injuries have an inordinately dramatic impact on return to duty, retention, and reintegration; only 25% of warfighters with severe ocular trauma return to duty. After a traumatic ocular event, the likelihood of saving an eye and preserving vision depends on several factors, especially the treatment quality at the point of injury. Every major organization associated with combat casualty care (e.g., the U.S. Army Institute of Surgical Research, the Committee on Tactical Combat Casualty Care, and the Department of Defense/VA Vision Center of Excellence) emphasizes the importance of placing a rigid eye shield on known/suspected eye injuries at point of injury. On the battlefield, there is no better way to protect an injured eye from further damage than with an eye shield, but shields are not readily available in individual first aid kits. Therefore, it is highly recommended that each Service rapidly integrate at least one rigid eye shield into every individual first aid kit, making them immediately available to every warfighter.

Injury. 2013 Nov;44(11):1659-60. doi: 10.1016/j.injury.2013.03.025. Epub 2013 Apr 22.

No more tension pneumothorax in unsuccessfully resuscitated patients with penetrating chest trauma at autopsy!

Buschmann C, Kleber C.

QUOTE:

"To all emergency personnel out there: Please always perform bilateral chest decompression prior to termination of tCPR in patients with penetrating chest trauma!"

J Spec Oper Med. 2013 Fall;13(3):81-6.

Management of open pneumothorax in Tactical Combat Casualty Care: TCCC Guidelines Change 13-02.

Butler FK, Dubose JJ, Otten EJ, Bennett DR, Gerhardt RT, Kheirabadi BS, Gross KR, Cap AP, Littlejohn LF, Edgar EP, Shackelford SA, Blackbourne LH, Kotwal RS, Holcomb JB, Bailey JA.

ABSTRACT: During the recent United States Central Command (USCENTCOM) and Joint Trauma System (JTS) assessment of prehospital trauma care in Afghanistan, the deployed director of the Joint Theater Trauma System (JTTS), CAPT Donald R. Bennett, questioned why TCCC recommends treating a nonlethal injury (open pneumothorax) with an intervention (a nonvented chest seal) that could produce a lethal condition (tension pneumothorax). New research from the U.S. Army Institute of Surgical Research (USAISR) has found that, in a model of open pneumothorax treated with a chest seal in which increments of air were added to the pleural space to simulate an air leak from an injured lung, use of a vented chest seal prevented the subsequent development of a tension pneumothorax, whereas use of a nonvented chest seal did not. The updated TCCC Guideline for the battlefield management of open pneumothorax is: All open and/ or sucking chest wounds should be treated by immediately applying a vented chest seal to cover the defect. If a vented chest seal is not available, use a non-vented chest seal. Monitor the casualty for the potential development of a subsequent tension pneumothorax. If the casualty develops increasing hypoxia, respiratory distress, or hypotension and a tension pneumothorax is suspected, treat by burping or removing the dressing or by needle decompression. This recommendation was approved by the required two-thirds majority of the Committee on TCCC in June 2013.

Transfusion. 2013 Apr 15. doi: 10.1111/trf.12191. [Epub ahead of print]

Quality of freeze-dried (lyophilized) quarantined single-donor plasma.

Bux J, Dickhörner D, Scheel E.

BACKGROUND: Transfusion of plasma is a basic treatment for complex coagulopathies as well as in major blood loss. Early transfusion of plasma after trauma with major hemorrhage has been recommended by retrospective studies. However, the use of plasma is often hampered by the need to maintain a cold chain and the time needed for thawing fresh-frozen plasma (FFP). With freeze-dried (lyophilized) plasma (FDP) both difficulties can be avoided. Here we describe the production, quality characteristics, and our experiences with FDP.

STUDY DESIGN AND METHODS: Quarantine plasma samples were freeze-dried. The clotting factors fibrinogen, Factor (F)V, FVIII, FXI, von Willebrand factor (vWF), protein S, antithrombin, plasminogen, and plasmin inhibitor were determined after manufacturing and after storage at room temperature and refrigeration. Reported adverse transfusion events were evaluated and compared to that of FFP. Clinical effectiveness was estimated by inquiry among experienced users.

RESULTS: Lyophilization resulted in a loss of coagulation factor activity between 0% and up to 20% to 25% (FVIII, vWF). When stored refrigerated, coagulation factors did not lose more than 10% of their activities. Storage at room temperature for 24 months mainly affected vWF/ristocetin cofactor activity and fibrinogen activity. From 2007 to 2011 more than 230,000 units of FDP were delivered. There were no reports about clinical ineffectiveness. The frequency of transfusion reactions was not different from that of FFP.

CONCLUSION: Lyophilized plasma showed characteristics similar to FFP. Since FDP requires neither complex logistics nor time-consuming thawing, it allows rapid treatment of coagulopathies.

J Emerg Med. 2013 Nov;45(5):710-3. doi: 10.1016/j.jemermed.2013.01.026. Epub 2013 Aug 27.

Law enforcement and the long gun: do we need a new face in the fight?

Cannon M.

BACKGROUND: The threat of rifles in the hands of criminals is now well recognized within law enforcement. Current emergency response systems are not equipped to operate in this combat-like environment. Growing statistics indicate that of the peace officers that were killed in the line of duty in the United States nearly half died by gunfire evidence.

OBJECTIVE: As Emergency Medical Services ("EMS") training and standards evolve, the lessons learned from the Tactical Combat Casualty Care doctrine should be incorporated to improve the safety and outcomes of injured law enforcement officers. Statistics show that deaths by gunfire have the highest average percentage of all officer deaths. Although new weapons, armor, and tactics are continually evolving to meet the challenge of officer safety, in the past decade, little has changed in how our EMS system responds to a critically wounded officer.

DISCUSSION: Combat data from the US military leads us to believe that to save a wounded officer, emergency care must start immediately, regardless of the ongoing gun battle.

CONCLUSION: It is time for the emergency medical system to evolve to meet the critical needs of today's law enforcement environment.

J Craniofac Surg. 2013 Jul;24(4):1061-7. doi: 10.1097/SCS.0b013e31829ff967.

Boston bombings: a surgical view of lessons learned from combat casualty care and the applicability to Boston's terrorist attack.

Caterson EJ, Carty MJ, Weaver MJ, Holt EF.

ABSTRACT: The Boston bombing incident was a recent civilian mass casualty terrorist event that demonstrated effective transfer of the lessons of combat casualty care to inform effective civilian medical care. Thirty-nine patients were seen at Brigham and Women's Hospital and thirteen patients received emergency surgery in the first few hours after the event. The subsequent management, total hospital days 181, total number of operative procedures 72, and discharging service listing of these thirteen patients illustrate the intensive surgical resources necessary after a civilian bomb attack. Plastic surgery played a role in the multidisciplinary collaboration of the limb salvage efforts and this role can inform the importance of other plastic surgery contributions within mass casualty surgical management. We believe that prepositioned collaborative relationships of plastic surgery, vascular surgery, trauma surgery and orthopedic surgery may offer a model of collaboration for limb salvage that can be applied in military and mass casualty medical care if resources permit. In this attack, effective use of tourniquets was implemented by prehospital medical providers that saved lives and limbs and these actions reaffirm the important lessons learned from combat casualty care. Unfortunately, it is likely that more centers will deal with similar events in the future and it is imperative that we as a community of providers take what lessons we can from battlefield medicine and that we collectively prepare for and engage this future.

Surg Infect (Larchmt). 2013 Aug;14(4):389-96. doi: 10.1089/sur.2012.017. Epub 2013 Jul 16.

Prospective, randomized, study of ampicillin-sulbactam versus moxifloxacin monotherapy for the treatment of community-acquired complicated intra-abdominal infections.

Chen CW, Ming CC, Ma CJ, Shan YS, Yeh YS, Wang JY.

BACKGROUND: The ideal antimicrobial treatment for intra-abdominal infections (IAIs) in the setting of fast-paced emergency departments (EDs) should be effective, convenient, and of limited resource utilization. Antibiotic monotherapy is a feasible option for this. We conducted a study in which we compared two regimens for antibiotic monotherapy recommended by published guidelines in ED patients with community-acquired, complicated IAIs (cIAIs).

METHODS: The study was a prospective, randomized, study of ampicillin-sulbactam versus moxifloxacin for cIAIs. After the diagnosis of cIAI was established, patients were assigned randomly to receive either moxifloxacin 400 mg intravenously (IV) qd followed by moxifloxacin 400 mg orally (PO) qd, or ampicillin-sulbactam 1.5 g IV qid followed by ampicillin-sulbactam 750 mg PO q12h. Source control procedures were used for all patients and all had complete follow-up. The primary efficacy variable for the study was the clinical response at the test-of-cure visit.

RESULTS: A total of 116 patients were enrolled for prospective evaluation and randomized assignment to treatment with ampicillin-sulbactam (n=55) or moxifloxacin (n=61). At the test-of-cure evaluation, the overall clinical failure rate was 13.8%. The clinical failure rates in the ampicillin-sulbactam and moxifloxacin groups were 16.4% (9/55) and 11.5% (7/61), respectively (p=0.446). With regard to infection site, the clinical failure rate in cIAIs consisting of lower gastrointestinal (GI) tract infection was significantly lower in the moxifloxacin than in the ampicillin-sulbactam group (4.3% vs. 19.6%; p=0.024). According to multivariable analysis, independent risk factors for treatment failure were the time to ED presentation >24 h (odds ratio [OR] 6.8; 95% CI 1.3-36.2; p=0.024) and ampicillin-sulbactam therapy (OR 9.5; 95% CI 1.1-76.6; p=0.033).

CONCLUSIONS: A significant difference existed in the clinical responses of the two groups. As compared with ampicillin-sulbactam, moxifloxacin was more effective for the treatment of community-acquired cIAIs of the lower GI tract. A higher risk of treatment failure for antibiotic therapy was found for patients presenting to the ED with symptoms of cIAIs lasting >24 h. Alternative antimicrobial agents should be considered for treating these patients.

J Spec Oper Med. 2013 Fall;13(3):1-4.

Abdominal aortic tourniquet controls junctional hemorrhage from a gunshot wound of the axilla.

Croushorn J, Thomas G, McCord SR.

ABSTRACT: Junctional hemorrhage, bleeding from the areas at the junction of the trunk and its appendages, is a difficult problem in trauma. These areas are not amenable to regular tourniquets as they cannot fit to give circumferential pressure around the extremity. Junctional arterial injuries can rapidly lead to death by exsanguination, and out-of-hospital control of junctional bleeding can be lifesaving. The present case report describes an off-label use of the Abdominal Aortic Tourniquet™ in the axilla and demonstrates its safety and effectiveness of stopping hemorrhage from a challenging wound. To our knowledge, the present report is the first human use of a junctional tourniquet to control an upper extremity junctional hemorrhage.

Emerg Med J. 2013 Apr 10. [Epub ahead of print]

Introduction of the i-gel supraglottic airway device for prehospital airway management in a UK ambulance service.

Duckett J, Fell P, Han K, Kimber C, Taylor C.

AIM: To clinically review the use of basic and advanced airway management techniques within the North East Ambulance Service National Health Service Foundation Trust (NEAS) for cardiac arrests following the introduction of the i-gel.

METHOD: Two retrospective clinical audits were carried out over a monthly period (May 2011 and January 2012) using electronic and paper NEAS patient records.

RESULTS: This audit confirmed that a range of basic and/or advanced airway management techniques are being successfully used to manage the airways of cardiac arrest patients. I-gel is emerging as a popular choice for maintaining and securing the airway during prehospital cardiopulmonary resuscitation. Success rates for i-gel insertion are higher (94%, 92%) than endotracheal (ET) tube insertion (90%, 86%). Documentation of the airway management method was poor in 11% of the records. The Quality Improvement Officers addressed this by providing individual feedback.

CONCLUSIONS: I-gel shows a higher success rate in cardiac arrest patients compared to the ET tube. Staff who chose to use methods other than i-gel indicated this was a confidence issue when using new equipment. The re-audit indicated an upward trend in the popularity of i-gel; insertion is faster with a higher success rate, which allows the crew to progress with the other resuscitation measures more promptly. Airway soiling and aspiration beforehand have been reasons staff resort to ET intubation. It is anticipated by the authors that i-gel will emerge as the first choice of airway management device in prehospital cardiac arrests.

J Trauma Acute Care Surg. 2013 Jun;74(6):1462-7. doi: 10.1097/TA.0b013e31828da937.

Self-expanding polyurethane polymer improves survival in a model of noncompressible massive abdominal hemorrhage.

Duggan M, Rago A, Sharma U, Zugates G, Freyman T, Busold R, Caulkins J, Pham Q, Chang Y, Mejaddam A, Beagle J, Velmahos G, deMoya M, Zukerberg L, Ng TF, King DR.

BACKGROUND: Intracavitary noncompressible hemorrhage remains a significant cause of preventable death on the battlefield. Two dynamically mixed and percutaneously injected liquids were engineered to create an in situ self-expanding polymer foam to facilitate hemostasis in massive bleeding. We hypothesized that intraperitoneal injection of the polymer could achieve conformal contact with sites of injury and improve survival in swine with lethal hepatoportal injury.

METHODS: High grade hepatoportal injury was created in a closed abdominal cavity, resulting in massive noncoagulopathic, noncompressible hemorrhage. Animals received either standard battlefield fluid resuscitation (control, n = 12) or fluid resuscitation plus intraperitoneal injection of hemostatic foam (polymer, n = 15) and were monitored for 3 hours. Blood loss was quantified, and all hepatoportal injuries were inspected for consistency.

RESULTS: Before intervention, all animals initially experienced severe, profound hypotension and near-arrest (mean arterial pressure at 10 minutes, 21 [5.3] mm Hg). Overall survival at 3 hours was 73% in the polymer group and 8% in the control group ($p = 0.001$). Median survival time was more than 150 minutes in the polymer group versus 23 minutes (19-41.5 minutes) in the control group ($p < 0.001$), and normalized blood loss in the polymer group was 0.47 (0.30) g/kg per minute versus 3.0 (1.3) g/kg per minute in the controls ($p = < 0.001$). All hepatoportal injuries were anatomically similar, and the polymer had conformal contact with injured tissues.

CONCLUSION: Intraperitoneal polymer injection during massive noncompressible hemorrhage reduces blood loss and improves survival in a lethal, closed-cavity, hepatoportal injury model. Chronic safety and additional efficacy studies in other models are needed.

CJEM. 2010 Mar;12(2):154-7.

Myth: Ketamine should not be used as an induction agent for intubation in patients with head injury.

Filanovsky Y, Miller P, Kao J.

CONCLUSION: Based on its pharmacological properties, ketamine appears to be the perfect agent for the induction of head-injured patients for intubation. The evidence for neuroprotection in humans remains inconclusive at this time. However, more recent prospective data examining ketamine usage as a sedative agent in patients treated with mechanical ventilation suggests that there is no association with increased ICP in head injury. Despite limited evidence specific to its use as an induction agent, we feel that additional consideration must be paid to the possible usage of ketamine for RSI in patients with head injury, especially when alternative agents that do not cause hypotension are unavailable.

Prehosp Emerg Care. 2013 Oct-Dec;17(4):526-32. doi: 10.3109/10903127.2013.818177. Epub 2013 Aug 22.

The iTClamp controls junctional bleeding in a lethal swine exsanguination model.

Filips D, Logsetty S, Tan J, Atkinson I, Mottet K.

OBJECTIVE: Severe hemorrhage is a leading cause of death and difficult to control even by trained medical personnel. Current interventions have significant limitations in the prehospital setting; therefore, a need exists for a new and effective treatment. iTraumaCare has designed a temporary wound closure device, the iTClamp, which controls external hemorrhage from open wounds within compressible zones. The device approximates the wound edges, sealing the skin within a pressure bar, enabling creation of a hematoma and subsequent clot formation. The objective of this study is to test the effectiveness of the iTClamp to control external bleeding due to a major vascular injury to the groin in an in vivo swine model.

METHODS: Twenty Yorkshire-cross male swine were enrolled in this study. A complex groin injury was created by complete excision of the femoral artery and vein along with some surrounding muscle. The animals were divided into four treatment groups: control (no treatment), early iTClamp treatment, late iTClamp treatment, and standard gauze treatment. Survival rate, survival time, and blood loss were the primary endpoints. Physiologic parameters (heart rate, blood pressure, oxygen saturation) were monitored throughout the experiment and blood samples were collected to analyze partial thromboplastin time and fibrinogen.

RESULTS: All (100%) of the animals treated with the iTClamp lived through the end of the experiment, compared to 60% in standard gauze treated and 0% of untreated control animals (early and late iTClamp vs. control and standard gauze, Fisher's exact, $p = 0.003$). Both the early iTClamp and late iTClamp treatment groups survived significantly longer than the untreated control pigs (Mann-Whitney U-test, $p < 0.009$). External blood loss was significantly lower in animals treated with the iTClamp (early) compared to no treatment (Mann-Whitney U-test, $p < 0.008$). There was no significant change in physiologic or hematologic parameters between treatment groups.

CONCLUSIONS: The iTClamp showed statistically significant improvement in survival, survival time, and estimated blood loss when compared to no treatment. This proof-of-concept study demonstrates the potential of the iTClamp to control severe bleeding and prevent blood loss.

Mil Med. 2013;178(11):1227-30. doi: 10.7205/MILMED-D-13-00127.

Identification of barriers to adaptation of battlefield technologies into civilian trauma in California.

Galante JM, Smith CA, Sena MJ, Scherer LA, Tharratt RS.

OBJECTIVE: To characterize the adoption of routine battlefield medical techniques (tourniquets, hemostatic agents, and tactical combat casualty care into civilian prehospital trauma care and to identify the barriers to their use in the state of California through anonymous electronic survey of local emergency medical services agency (LEMSA) directors.

RESULTS: The response rate for this survey was 50% (14/28). The majority of LEMSA directors (86%) were emergency medicine physicians. Tourniquets were used by 57% of respondents. The top three reasons cited for not using tourniquets included different injury patterns in civilian trauma, no proven benefit of use, and increased risk of complications. Hemostatic agents were used even less frequently in civilian practice (7%) but had similar barriers to use. Only 36% of LEMSA directors use tactical combat casualty care with tactical emergency medical services, but when used, respondents had higher usage of tourniquets. Overall lack of training, no proven benefit, and expense were the reasons cited for not incorporating military medical techniques.

CONCLUSIONS: Tourniquets, hemostatic agents, and tactical medical care are the integral components of battlefield medicine and have been lifesaving in these settings. The barriers to this transition are multifactorial. Physicians familiar with these technologies should become advocates for their integration in civilian trauma patient care.

J Pain Symptom Manage. 2013 Oct;46(4):e6-8. doi: 10.1016/j.jpainsymman.2013.07.008.

From the battlefield to the palliative care arsenal: application of QuickClot© Combat Gauze™ for aggressive palliation of hemorrhagic shock in the setting of end-stage liver disease-associated compartment syndrome.

Gebauer S, Hoopes D, Finlay E.

QUOTE:

"In our patient, off-label use of QCG resulted in temporary stabilization of hemorrhagic shock and decreased transfusion requirements. Before application of the QCG, pressure dressings were repeatedly soaked within minutes of changes. The patient's blood was visible on bedding, hospital bed, and floor, and family members were visibly disturbed. Because of the rapid, uncontrolled bleeding, the options considered were an operative attempt to achieve hemostasis, which was thought to involve a high risk of death in the operating room, or the application of QCG."

Br J Anaesth. 2013 Oct 17. [Epub ahead of print]

Incidence of postoperative death and acute kidney injury associated with i.v. 6% hydroxyethyl starch use: systematic review and meta-analysis.

Gillies MA, Habicher M, Jhanji S, Sander M, Mythen M, Hamilton M, Pearse RM.

BACKGROUND: Trials suggest that the use of IV hydroxyethyl starch (HES) solutions is associated with increased risk of death and acute kidney injury (AKI) in critically ill patients. It is uncertain whether similar adverse effects occur in surgical patients.

METHODS: Systematic review and meta-analysis of trials in which patients were randomly allocated to 6% HES solutions or alternative i.v. fluids in patients undergoing surgery. Ovid Medline, Embase, Cinhal, and Cochrane Database of Systematic Reviews were searched for trials comparing 6% HES with clinically relevant non-starch comparator. The primary end-point was hospital mortality. Secondary endpoints were requirement for renal replacement therapy (RRT) and author-defined AKI. Pre-defined subgroups were cardiac and non-cardiac surgery.

RESULTS: Four hundred and fifty-six papers were identified; of which 19 met the inclusion criteria. In total, 1567 patients were included in the analysis. Dichotomous outcomes were expressed as a difference of proportions [risk difference (RD)]. There was no difference in hospital mortality [RD 0.00, 95% confidence interval (CI) -0.02, 0.02], requirement for RRT (RD -0.01, 95% CI -0.04, 0.02), or AKI (RD 0.02, 95% CI -0.02 to 0.06) between compared arms overall or in predefined subgroups.

CONCLUSIONS: We did not identify any differences in the incidence of death or AKI in surgical patients receiving 6% HES. Included studies were small with low event rates and low risk of heterogeneity. Narrow CIs suggest that these findings are valid. Given the absence of demonstrable benefit, we are unable to recommend the use of 6% HES solution in surgical patients.

2013 Aug;75(2 Suppl 2):S111-4. doi: 10.1097/TA.0b013e318299d217.

Point-of-injury use of reconstituted freeze dried plasma as a resuscitative fluid: a special report for prehospital trauma care.

Glassberg E, Nadler R, Rasmussen TE, Abramovich A, Erlich T, Blackbourne LH, Kreiss Y.

QUOTE:

"This special report describes the broader implications of prehospital fluid resuscitation in the context of what is the first reported case of point-of-injury use of reconstituted, lyophilized single-donor freeze dried plasma (FDP) as a resuscitative fluid. The Israeli Defense Force Medical Corps (IDF-MC) has deployed FDP as another step in the evolution of casualty care to bring damage-control resuscitation closer to the point of injury as part of the multidisciplinary efforts to improve trauma victims' outcome."

J Trauma Acute Care Surg. 2013 Aug;75(2):292-7. doi: 10.1097/TA.0b013e318294662d.

A dynamic mass casualty incident at sea: lessons learned from the Mavi Marmara.

Glassberg E, Lipsky AM, Abramovich A, Sergeev I, Hochman O, Ash N.

BACKGROUND: Mass casualty incidents (MCIs) represent one of the most difficult prehospital challenges faced by medical personnel. When they occur at sea, this challenge may be further complicated by isolation, distance, vessel structure, number of passengers, and limited evacuation means.

METHODS: We describe our experience and lessons learned from a dynamic MCI in an austere environment at sea.

RESULTS: Following an armed attack on navy operators boarding the MV Mavi Marmara, a vessel heading for Gaza, the Israel Defense Forces' medical teams triaged and cared for 62 casualties, among them 9 soldiers; 9 additional casualties were declared dead at the scene. The injured, including 10 triaged as severely wounded, were all evacuated to Israeli hospitals within several hours of the start of the event. Despite the austere conditions and the severity of injuries, all of the injured passengers were able to return to their home countries, and all soldiers returned to duty. Multiple issues were identified as requiring changes or heightened awareness so as to be better prepared for future events of this special nature.

CONCLUSION: The primary lessons learned related to difficulties in functioning without effective communication, maintaining command and control, coordinating serial evacuation of casualties who were being triaged in parallel, planning for an event with lengthy evacuation times, resolving real-time ethical dilemmas, and preparing our providers mentally. As MCIs tend to be unexpected, preplanning, using pre-established manuals, and drilling for them may prove crucial in such extreme events. Importantly, the lessons learned from this event, with its unique synthesis of multiple contributing factors, remain relevant even in less austere settings.

Eur J Emerg Med. 2013 Oct;20(5):310-4. doi: 10.1097/MEJ.0b013e328358455e.

Evaluation of advanced airway management in absolutely inexperienced hands: a randomized manikin trial.

Goliasch G, Ruetzler A, Fischer H, Frass M, Sessler DI, Ruetzler K.

AIMS: Endotracheal intubation (ETI) and basic ventilation techniques (i.e. mouth-to-mouth/nose, bag-valve-mask ventilation) require skills and training. As an alternative, supraglottic airway devices (SAD) are efficient and technically easy to insert. We therefore evaluated the time to ventilation, success rate, and skill retention for various airway management approaches by medical laypersons using a manikin model.

METHODS: Fifty medical laypersons with no previous experience whatsoever in airway management or resuscitation were enrolled. All participants received a 1-h-long theoretical lecture and a practical demonstration of mouth-to-mouth ventilation, ETI, and six SAD. Afterwards, the laypersons performed mouth-to-mouth ventilation and used each of the seven airway-management systems on an advanced patient simulator (SimMan) in a random sequence. All participants were re-evaluated 3 months later without any further practical or theoretical demonstration.

RESULTS: The success rates for ETI were 74% during the first evaluation and 64% during the second, whereas the success rate for all six SAD was 100% during all application attempts. The success rate for mouth-to-mouth ventilation was 86% initially and 84% 3 months later. The time to adequate mouth-to-mouth ventilation was 15 ± 13 s initially and 16 ± 7 s subsequently. ETI required 53 ± 21 s during the initial evaluation and 44 ± 16 s 3 months later.

CONCLUSION: A variety of SAD all proved to reliably secure airways quickly, even in the hands of complete novices. The SAD were much more effective than ETI, which often failed, and were even superior to mouth-to-mouth ventilation. SAD may thus be an appropriate first-line approach to field ventilation.

www.thelancet.com, 2012 Sep 22;380(9847):1099-108. doi: 10.1016/S0140-6736(12)61224-0.

Haemorrhage control in severely injured patients.

Gruen RL, Brohi K, Schreiber M, Balogh ZJ, Pitt V, Narayan M, Maier RV.

ABSTRACT: Most surgeons have adopted damage control surgery for severely injured patients, in which the initial operation is abbreviated after control of bleeding and contamination to allow ongoing resuscitation in the intensive-care unit. Developments in early resuscitation that emphasise rapid control of bleeding, restrictive volume replacement, and prevention or early management of coagulopathy are making definitive surgery during the first operation possible for many patients. Improved topical haemostatic agents and interventional radiology are becoming increasingly useful adjuncts to surgical control of bleeding. Better understanding of trauma-induced coagulopathy is paving the way for the replacement of blind, unguided protocols for blood component therapy with systemic treatments targeting specific deficiencies in coagulation. Similarly, treatments targeting dysregulated inflammatory responses to severe injury are under investigation. As point-of-care diagnostics become more suited to emergency environments, timely targeted intervention for haemorrhage control will result in better patient outcomes and reduced demand for blood products. Our Series paper describes how our understanding of the roles of the microcirculation, inflammation, and coagulation has shaped new and emerging treatment strategies.

J Spec Oper Med. 2013 Fall;13(3):36-41.

MEDEVAC use of ketamine for post-intubation transport.

Grumbo R, Hoedebecke K, Berry-Caban C, Mazur A.

ABSTRACT: The use of traditional sedatives and analgesics in intubated patients can have undesired hemodynamic consequences with increases in sedation exacerbating hypotension and potentially avoidable morbidity and mortality. This project compared 50 intubated patients using traditional analgesics and sedatives to 20 intubated patients using ketamine with the hypothesis that there would be a significant difference in subsequent blood pressure drop between the two groups. Though the results did not prove to be statistically significant within this small study, the authors did observe a trend toward significance. Additionally, some hypotensive patients had traditional analgesics and sedatives withheld altogether, which did not occur within the ketamine group. Due to the reduced side-effect profile, deployed medical providers should have increased training with and use of ketamine in the pre-hospital setting.

Transfus Apher Sci. 2013 Jul 12. pii: S1473-0502(13)00222-X. doi: 10.1016/j.transci.2013.06.015. [Epub ahead of print]

Advances in military, field, and austere transfusion medicine in the last decade.

Hess JR, Lelkens CC, Holcomb JB, Scalea TM.

ABSTRACT: Two decades of war in south-west Asia has demonstrated the essential role of primary resuscitation with blood products in the care of critically injured soldiers. This idea has been widely adopted and is being critically tested in civilian trauma centers. The need for red cells, plasma and platelets to be immediately available in remote locations creates a logistic burden that will best be eased by innovative new blood products such as longer-stored liquid RBCs, freeze-dried plasma, small-volume frozen platelets, and coagulation factor concentrates such as fibrinogen concentrates and prothrombin complex concentrates. Such products have long shelf-lives, low logistic burdens of weight, fragility, or needs for processing prior to use. Developing and fielding a full family of such products will improve field medical care and make products available in the evacuation chain. It also will allow treatment in other austere environments such as the hundreds of small hospitals in the US which serve as Levels 3 and 4 trauma centers but do not currently have thawed plasma or platelets available. Such small trauma centers currently care for half of all the trauma patients in the country. Proving the new generation of blood products work, will help assure their widest availability in emergencies.

J Trauma Acute Care Surg. 2013 Jun;74(6):1399-400. doi: 10.1097/TA.0b013e318296b237.

Improving survival from active shooter events: the Hartford Consensus.

Jacobs LM, McSwain NE Jr, Rotondo MF, Wade D, Fabbri W, Eastman AL, Butler FK Jr, Sinclair J; Joint Committee to Create a National Policy to Enhance Survivability from Mass Casualty Shooting Events.

QUOTES:

"The recent mass casualty shooting events in the United States have had a profound effect on all segments of society. The medical, law enforcement, fire/rescue, and EMS communities have each felt the need to respond. It is important that these efforts occur in a coordinated manner to generate policies that will enhance survival of the victims of these events. Such policies must provide a synchronized multi-agency approach that is immediately available within the communities affected by such tragedies.

The American College of Surgeons brought together senior leaders from all the aforementioned disciplines to produce a document that will stimulate discussion and ultimately lead to strategies to improve survival for the victims. A day-long conference on April 2, 2013, in Hartford, Connecticut obtained input from medical, law enforcement, fire/rescue, EMS first responders, and military experts. The conference relied upon data and evidence from existing military and recent civilian experiences, and was sensitive to the multiple agencies that play a role in responding to mass casualty shootings. The meeting, known as the Hartford Consensus Conference, produced a concept paper entitled ''Improving Survival from Active Shooter Events.'' The purpose of this document is to promote local, state, and national policies to improve survival in these uncommon, but horrific events. The following short essay describes methods to minimize loss of life in these terrible incidents."

"Life threatening injuries in active shooter incidents such as those in Fort Hood, Tucson, and Aurora are similar to those encountered in combat settings. Military experience has shown that the number one cause of preventable death in victims of penetrating trauma is hemorrhage. Tactical Combat Casualty Care (TCCC) programs, when implemented with strong leadership support, have produced dramatic reductions in preventable death.

Recognizing that active shooter incidents can occur in any community, the Hartford Consensus encourages the use of existing techniques and equipment, validated by over a decade of well-documented clinical evidence. The Hartford Consensus recommends that an integrated active shooter response should include the critical actions contained in the acronym **THREAT**:

1. **T**hreat suppression
2. **H**emorrhage control
3. **R**apid **E**xtraction to safety
4. **A**ssessment by medical providers
5. **T**ransport to definitive care"

J Am Coll Surg. 2013 Nov;217(5):947-53. doi: 10.1016/j.jamcollsurg.2013.07.002.

The Hartford Consensus: THREAT, a medical disaster preparedness concept.

Jacobs LM, Wade DS, McSwain NE, Butler FK, Fabbri WP, Eastman AL, Rotondo M, Sinclair J, Burns KJ.

QUOTE:

"Very few scientific data exist describing the use of lifesaving medical/EMS skills by police officers. Although many progressive police departments have chosen to introduce training and issue equipment based on TCCC guidelines, there is an ongoing dialogue about which TCCC interventions are appropriate for transition to the civilian sectors. Without regard to the system used, the Hartford Consensus insists that some form of basic "tactical" medical training is essential for every law enforcement officer. The rationale is simple: law enforcement officers will be the first responders to any mass injury incident involving violence (active shooters or domestic bombings and explosions). Once the immediate threat is contained or stopped, law enforcement officers should play an essential role as the bridge between the law enforcement phase of the operation and the integrated rescue response.

If it is accepted that effective lifesaving interventions performed on the battlefield translate effectively when performed in the civilian law enforcement environment, then hemorrhage control training is simple and easily retained. It should be included in every basic law enforcement academy and in-service training across the United States. In a study of more than 1,200 lifesaving interventions performed on the battlefield, hemorrhage control techniques had the lowest incidence of error compared with airway or pneumothorax maneuvers. These techniques, once taught, are well retained among learners; police officers and other first responders should be no exception. Additionally, these techniques are not complicated. Simple tourniquet application has been taught without difficulty to undergraduates with no medical knowledge. Law enforcement officers will likely benefit in terms of lives saved through a few hours of training and being issued the correct equipment without the need for expensive, timely certifications. It is critical, however, that deployment of tourniquets and other equipment be accompanied by training in their use."

Eur J Emerg Med. 2013 Jul 24. [Epub ahead of print]

Laryngeal tube placement on manikin by laypersons: is there a possibility for 'public access airway management'?

Jänig C, Marquardt S, Dietze T, Nitsche T.

ABSTRACT: Mouth-to-mouth ventilation is often refused by laypersons because of hygienic reasons. Supraglottic airway devices (SADs) might reduce the adverse effects of mouth-to-mouth ventilation. We tried to verify the possibility for untrained laypersons to use SADs properly after having read written instructions only. The participants were told to ventilate a manikin using a laryngeal tube (LT). The time to ventilation and the rate of success were recorded. After a practical skill demonstration, a second placement of the LT was performed. A successful placement of the LT was achieved by 53% after the first and 98% after the second attempt. Time to ventilation was 124 s (±45 s) for the first attempt and 12 s (±2.75 s) for the second attempt. Delivering ventilation through an SAD is a reasonable way for laypersons. After a prior hands-on training, the placement can be performed in an adequate time frame with high success rates.

J Trauma Acute Care Surg. 2013 Aug;75(2 Suppl 2):S178-83. doi: 10.1097/TA.0b013e318299d650.

Prehospital intubation success rates among Israeli Defense Forces providers: epidemiologic analysis and effect on doctrine.

Katzenell U, Lipsky AM, Abramovich A, Huberman D, Sergeev I, Deckel A, Kreiss Y, Glassberg E.

BACKGROUND: Advanced airway management is composed of a set of vital yet potentially difficult skills for the prehospital provider, with widely different clinical guidelines. In the military setting, there are few data available to inform guideline development. We reevaluated our advanced airway protocol in light of our registry data to determine if there were a preferred maximum number of endotracheal intubation (ETI) attempts; our success with cricothyroidotomy (CRIC) as a backup procedure; and whether there were cases where advanced airway interventions should possibly be avoided.

METHODS: This is a descriptive, registry-based study conducted using records of the Israel Defense Forces Trauma Registry at the research section of the Trauma and Combat Medicine Branch, Surgeon General's Headquarters. We included all casualties for whom ETI was the initial advanced airway maneuver, and the number of ETI attempts was known. Descriptive statistics were used.

RESULTS: Of 5,553 casualties in the Israel Defense Forces Trauma Registry, 406 (7.3%) met the inclusion criteria. Successful ETI was performed in 317 casualties (78%) after any number of ETI attempts; an additional 46 (11%) underwent CRIC, and 43 (11%) had advanced airway efforts discontinued. ETI was successful in 45%, 36%, and 31% of the first, second, and third attempts, respectively, with an average of 28% success over all subsequent attempts. CRIC was successful in 43 (93%) of 46 casualties in whom it was attempted. Of the 43 casualties in whom advanced airway efforts were discontinued, 29 (67%) survived to hospital discharge.

CONCLUSION: After the first ETI attempt, success with subsequent attempts tended to fall, with minimal improvement in overall ETI success seen after the third attempt. Because CRIC exhibited excellent success as a backup airway modality, we advocate controlling the airway with CRIC if ETI efforts have failed after two or three attempts. We recommend that providers reevaluate whether definitive airway control is truly necessary before each attempt to control the airway.

J Trauma Acute Care Surg. 2013 May;74(5):1292-7. doi: 10.1097/TA.0b013e31828c467d.

Thoracic trauma in Iraq and Afghanistan.

Keneally R, Szpisjak D.

BACKGROUND: Thoracic injuries are common among civilian trauma and have a high associated mortality. The use of body armor and exposure to different mechanisms of injury in combat setting could lead to different injury patterns and incidences from those found in peacetime.

METHODS: Thoracic trauma incidence rates and mortality risks were calculated from data extracted from the Joint Theatre Trauma Registry.

RESULTS: Among patients injured in military operations in Iraq and Afghanistan, 10.0% sustained thoracic injuries and had a mortality rate of 10.5%. Penetrating injuries were the most common mechanism of injury. The most common thoracic injury was pulmonary contusion. The highest mortality rate was in the subset of patients with thoracic vascular injuries or flail chest. The variables most strongly associated with mortality were number of units of blood transfused, admission base deficit, international normalization ratio, pH, Abbreviated Injury Scale scores for head and neck regions, and Injury Severity Score. Blunt injuries had the same mortality risk as penetrating injuries.

CONCLUSION: Combat-related thoracic trauma is common and associated with significant mortality in Iraq and Afghanistan.

J Trauma Acute Care Surg. 2013 Jul;75(1):150-6.

Vented versus unvented chest seals for treatment of pneumothorax and prevention of tension pneumothorax in a swine model.

Kheirabadi BS, Terrazas IB, Koller A, Allen PB, Klemcke HG, Convertino VA, Dubick MA, Gerhardt RT, Blackbourne LH.

BACKGROUND: Unvented chest seals (CSs) are currently recommended for the management of penetrating thoracic injuries in the battlefield. Since no supporting data exist, we compared the efficacy of a preferred unvented with that of a vented CS in a novel swine model of pneumothorax (PTx).

METHODS: An open chest wound was created in the left thorax of spontaneously air-breathing anesthetized pigs (n = 8). A CS was applied over the injury, then tension PTx was induced by incremental air injections (0.2 L) into the pleural cavity via a cannula that was also used to measure intrapleural pressure (IP). Both CS were tested on each pig in series. Tidal volume (V(T)), respiratory rate, IP, heart rate, mean arterial pressure, cardiac output, central venous pressure, pulmonary arterial pressure, venous and peripheral oxygen saturations (SvO2, SpO2) were recorded. Tension PTx was defined as a mean IP equal to or greater than +1 mm Hg plus significant (20-30%) deviation in baseline levels of the previously mentioned parameters and confirmed by chest x-ray study. PaO2 and PaCo2 were also measured.

RESULTS: PTx produced immediate breathing difficulty and significant rises in IP and pulmonary arterial pressure and falls in V(T), SpO2, and SvO2. Both CSs returned these parameters to near baseline within 5 minutes of application. After vented CS was applied, serial air injections up to 2 L resulted in no significant change in the previously mentioned parameters. After unvented CS application, progressive deterioration of all respiratory parameters and onset of tension PTx were observed in all subjects after approximately 1.4-L air injection.

CONCLUSION: Both vented and unvented CSs provided immediate improvements in breathing and blood oxygenation in our model of penetrating thoracic trauma. However, in the presence of ongoing intrapleural air accumulation, the unvented CS led to tension PTx, hypoxemia, and possible respiratory arrest, while the vented CS prevented these outcomes.

Am J Emerg Med. 2013 Jul;31(7):1034-6. doi: 10.1016/j.ajem.2013.03.029. Epub 2013 May 20.

Upper cervical spine movement during intubation with different airway devices.

Kılıç T, Goksu E, Durmaz D, Yıldız G.

BACKGROUND: Prevention of secondary neurologic injury is critical during the airway management of a trauma patient. Trauma patients are assumed to have an unstable cervical spine (C-spine) until proven otherwise: orotracheal intubation during airway management may result in a certain amount of C-spine movement. This study, therefore, aimed to compare C-spine movement within different advanced airway devices (Macintosh blade, McCoy Blade, LMA, I-LMA, and Combitube) during airway management.

MATERIALS AND METHODS: A total of 3 fresh frozen cadavers were used. The cadavers were consecutively intubated by 4 different postgraduate year residents with LMA4, I-LMA5, Combitube (37F), Macintosh 3, and McCoy blades. The cinefluoroscopic view of the entire intubation process was recorded, and vertebral body angles were calculated.

RESULTS: At the C0C1 level, compared with the McCoy laryngoscope (median, 7°), the LMA (median, 2.5°) and the Combitube (median, 1.5°) caused less extension of the cervical vertebra. In addition, the Combitube (median, -1°) and the I-LMA (median, -2°) caused less extension of the C2C3 region when compared with the Macintosh laryngoscope (median, 3°). There was no significant difference between groups at the C1C2, C3C4, and C4C5 segments.

CONCLUSION: Supraglottic devices used during airway management cause C-spine movement less or equal to conventional laryngoscopes. Furthermore, because of ease of training and blind insertion, supraglottic devices can be safely used with trauma patients when C-spine integrity is a concern.

J Trauma Acute Care Surg. 2012 Aug;73(2 Suppl 1):S49-53. doi: 10.1097/TA.0b013e31826060ff.

The effects of prehospital plasma on patients with injury: a prehospital plasma resuscitation.

Kim BD, Zielinski MD, Jenkins DH, Schiller HJ, Berns KS, Zietlow SP.

BACKGROUND: The prehospital resuscitation of the exsanguinating patient with trauma is time and resource dependent. Rural trauma care magnifies these factors because transportation time to definitive care is increased. To address the early resuscitation needs and trauma-induced coagulopathy in the exsanguinating patient with trauma an aeromedical prehospital thawed plasma-first transfusion protocol was used.

METHODS: Retrospective review of trauma and flight registries between February 1, 2009, and May 31, 2011, was performed. The study population included all patients with traumatic injury transported by rotary wing aircraft who met criteria for massive transfusion protocol

RESULTS: A total of 59 patients identified over 28 months met criteria for initiation of aeromedical initiation of prehospital blood product resuscitation. Nine patients received thawed plasma-first protocol compared with 50 controls. The prehospital plasma group was more commonly on warfarin (22 vs. 2%, $p = 0.036$) and had a greater degree of coagulopathy measured by international normalized ratio at baseline (2.6 vs. 1.5, $p = 0.004$) and trauma center arrival (1.6 vs. 1.3, $p < 0.001$). The prehospital plasma group had a predicted mortality nearly three times greater than controls based on Trauma and Injury Severity Score (0.24 vs. 0.66, $p = 0.005$). The use of prehospital plasma resuscitation led to a plasma-red blood cell ratio that more closely approximated a 1:1 resuscitation en route (1.3:1.0 vs. not applicable, $p < 0.001$), at 30 minutes (1.3:1.0 vs. 0.14:1.0, $p < 0.001$), at 6 hours (0.95:1.0 vs. 0.42:1.0, $p < 0.001$), and at 24 hours (1.0:1.0 vs. 0.45:1.0, $p < 0.001$). An equivalent amount of packed red blood cells were transfused between the groups. Despite more significant hypotension, less crystalloid was used in the prehospital thawed plasma group, through 24 hours after injury (6.3 vs. 16.4 L, $p = 0.001$).

CONCLUSION: Use of plasma-first resuscitation in the helicopter system creates a field ready, mobile blood bank, allowing early resuscitation of the patient demonstrating need for massive transfusion. There was early treatment of trauma-induced coagulopathy. Although there was not a survival benefit demonstrated, there was resultant damage control resuscitation extending to 24 hours in the plasma-first cohort.

J Emerg Med 2013;45:686-694

Vented chest seals for prevention of tension pneumothorax in a communicating pneumothorax.

Kotora J, Henao J, Littlejohn L, Kircher S

BACKGROUND: Tension pneumothorax accounts for 3%–4% of combat casualties and 10% of civilian chest trauma. Air entering a wound via a communicating pneumothorax rather than by the trachea can result in respiratory arrest and death. In such cases, the Committee on Tactical Combat Casualty Care advocates the use of unvented chest seals to prevent respiratory compromise.

OBJECTIVE: A comparison of three commercially available vented chest seals was undertaken to evaluate the efficacy of tension pneumothorax prevention after seal application.

METHODS: A surgical thoracostomy was created and sealed by placing a shortened 10-mL syringe barrel (with plunger in place) into the wound. Tension pneumothorax was achieved via air introduction through a Cordis to a maximum volume of 50 mL/kg. A 20% drop in mean arterial pressure or a 20% increase in heart rate confirmed hemodynamic compromise. After evacuation, one of three vented chest seals (HyFin ®, n = 8; Sentinel ®, n = 8, SAM ®, n = 8) was applied. Air was injected to a maximum of 50 mL/kg twice, followed by a 10% autologous blood infusion, and finally, a third 50 mL/kg air bolus. Survivors completed all three interventions, and a 15-min recovery period.

RESULTS: The introduction of 29.0 (±11.5) mL/kg of air resulted in tension physiology. All three seals effectively evacuated air and blood. Hemodynamic compromise failed to develop with a chest seal in place.

CONCLUSIONS: HyFin ®, SAM ®, and Sentinel ® vented chest seals are equally effective in evacuating blood and air in a communicating pneumothorax model. All three prevented tension pneumothorax formation after penetrating thoracic trauma.

Mil Med. 2013 Jul;178(7):806-10. doi: 10.7205/MILMED-D-12-00491.

Analysis of recovered tourniquets from casualties of Operation Enduring Freedom and Operation New Dawn.

Kragh JF Jr, Burrows S, Wasner C, Ritter BA, Mazuchowski EL, Brunstetter T, Johnston KJ, Diaz GY, Hodge D, Harcke HT Jr.

BACKGROUND: Tourniquet use recently became common in war, but knowledge gaps remain regarding analysis of recovered devices. The purpose of this study was to analyze tourniquets to identify opportunities for improved training.

METHODS: We analyzed tourniquets recovered from deceased service members serving in support of recent combat operations by a team at Dover Air Force Base from 2010 to 2012. Device makes and models, breakage, deformation, band routing, and windlass turn numbers were counted.

RESULTS: We recovered 824 tourniquets; 390 were used in care and 434 were carried unused. Most tourniquets were recommended by the Committee on Tactical Combat Casualty Care (Combat Application Tourniquet [CAT] or Special Operations Forces Tactical Tourniquet). The band was routed once through the buckle in 37% of used CATs, twice in 62%, and 1% had none. For tourniquets with data, the windlass turn number averaged 3.2 (range, 0-9). The CAT windlass turn number was associated positively with tourniquet deformation as moderate or severe deformation began at 2 turns, increased in likelihood stepwise with each turn, and became omnipresent at 7 or more.

CONCLUSIONS: Tourniquet counts, band routings, windlass turn numbers, and deformation rates are candidate topics for instructors to refine training.

J Spec Oper Med. 2013 Fall;13(3):5-25.

Tragedy into drama: an American history of tourniquet use in the current war.

Kragh JF Jr, Walters TJ, Westmoreland T, Miller RM, Mabry RL, Kotwal RS, Ritter BA, Hodge DC, Greydanus DJ, Cain JS, Parsons DS, Edgar EP, Harcke T, Baer DG, Dubick MA, Blackbourne LH, Montgomery HR, Holcomb JB, Butler FK.

ABSTRACT: Although the scientific results of recent tourniquet advances in first aid are well recorded, the process by which tourniquet use advances were made is not. The purpose of the present report is to distill historical aspects of this tourniquet story during the current wars in Afghanistan and Iraq to aid scientists, leaders, and clinicians in the process of development of future improvements in first aid.

METHODS: The process of how developments of this tourniquet story happened recently is detailed chronologically and thematically in a who did what, when, where, why, and how way.

RESULTS: Initially in these wars, tourniquets were used rarely or were used as a means of last resort. Such delay in tourniquet use was often lethal; subsequently, use was improved incrementally over time by many people at several organizations. Three sequential keys to success were (1) unlocking the impasse of enacting doctrinal ideas already approved, (2) reaching a critical density of both tourniquets and trained users on the battlefield, and (3) capturing their experience with tourniquets. Other keys included translating needs among stakeholders (such as casualties, combat medics, providers, trainers, and decision-makers) and problem-solving logistic snags and other issues. Eventually, refined care was shown to improve survival rates. From all medical interventions evidenced in the current wars, the tourniquet broke rank and moved to the forefront as the prehospital medical breakthrough of the war.

CONCLUSION: The recorded process of how tourniquet developments in prehospital care occurred may be used as a reference for parallel efforts in first aid such as attempts to improve care for airway and breathing problems.

Am J Surg. 2013 May;205(5):505-10. doi: 10.1016/j.amjsurg.2013.01.014. Epub 2013 Mar 14.

Chitosan-based advanced hemostatic dressing is associated with decreased blood loss in a swine uncontrolled hemorrhage model.

Kunio NR, Riha GM, Watson KM, Differding JA, Schreiber MA, Watters JM.

BACKGROUND: The purpose of this study was to compare standard gauze (SG) and advanced hemostatic dressings in use by military personnel in a no-hold model.

METHODS: A randomized, controlled trial was conducted using 36 swine. Animals underwent femoral arteriotomy, followed by 60 seconds of uncontrolled hemorrhage. After hemorrhage, packing with 1 of 3 dressings-SG, Combat Gauze (CG), or Celox Rapid gauze (XG)-and a 500-mL bolus of Hextend were initiated. Pressure was not held after packing, and animals were followed for 120 minutes. Physiologic parameters were monitored continuously, and electrolyte and hematologic laboratory assessments were performed before injury and 30 and 120 minutes after injury. Dressing failure was determined if bleeding occurred outside the wound.

RESULTS: All animals survived to study end. Baseline characteristics were similar between groups. No statistical difference was seen in initial blood loss or dressing success rate (SG, 10 of 12; CG, 10 of 12; and XG, 12 of 12). Secondary blood loss was significantly less with XG (median, 12.8 mL; interquartile range, 8.8 to 39.7 mL) compared with SG (median, 44.7 mL; interquartile range, 17.8 to 85.3 mL; P = .02) and CG (median, 31.9 mL; interquartile range, 18.6 to 69.1 mL; P = .05). Packing time was significantly shorter with XG (mean, 37.1 ± 6.2 seconds) compared with SG (mean, 45.2 ± 6.0 seconds; P < .01) and CG (mean, 43.5 ± 5.6 seconds; P = .01).

CONCLUSIONS: XG demonstrated shorter application time and decreased secondary blood loss in comparison with both SG and CG. These differences may be of potential benefit in a care-under-fire scenario.

J Trauma Acute Care Surg. 2013 Oct;75(4):573-81. doi: 10.1097/TA.0b013e3182a53bc6.

Combat injury coding: a review and reconfiguration.

Lawnick MM, Champion HR, Gennarelli T, Galarneau MR, D'Souza E, Vickers RR, Wing V, Eastridge BJ, Young LA, Dye J, Spott MA, Jenkins DH, Holcomb J, Blackbourne LH, Ficke JR, Kalin EJ, Flaherty S.

BACKGROUND: The current civilian Abbreviated Injury Scale (AIS), designed for automobile crash injuries, yields important information about civilian injuries. It has been recognized for some time, however, that both the AIS and AIS-based scores such as the Injury Severity Score (ISS) are inadequate for describing penetrating injuries, especially those sustained in combat. Existing injury coding systems do not adequately describe (they actually exclude) combat injuries such as the devastating multi-mechanistic injuries resulting from attacks with improvised explosive devices (IEDs).

METHODS: After quantifying the inapplicability of current coding systems, the Military Combat Injury Scale (MCIS), which includes injury descriptors that accurately characterize combat anatomic injury, and the Military Functional Incapacity Scale (MFIS), which indicates immediate tactical functional impairment, were developed by a large tri-service military and civilian group of combat trauma subject-matter experts. Assignment of MCIS severity levels was based on urgency, level of care needed, and risk of death from each individual injury. The MFIS was developed based on the casualty's ability to shoot, move, and communicate, and comprises four levels ranging from "Able to continue mission" to "Lost to military." Separate functional impairments were identified for injuries aboard ship. Preliminary evaluation of MCIS discrimination, calibration, and casualty disposition was performed on 992 combat-injured patients using two modeling processes.

RESULTS: Based on combat casualty data, the MCIS is a new, simpler, comprehensive severity scale with 269 codes (vs. 1999 in AIS) that specifically characterize and distinguish the many unique injuries encountered in combat. The MCIS integrates with the MFIS, which associates immediate combat functional impairment with minor and moderate-severity injuries. Predictive validation on combat datasets shows improved performance over AIS-based tools in addition to improved face, construct, and content validity and coding inter-rater reliability. Thus, the MCIS has greater relevance, accuracy, and precision for many military-specific applications.

CONCLUSION: Over a period of several years, the Military Combat Injury Scale and Military Functional Incapacity Scale were developed, tested and validated by teams of civilian and tri-service military expertise. MCIS shows significant promise in documenting the nature, severity and complexity of modern combat injury.

J Trauma Acute Care Surg. 2013 Sep;75(3):369-75. doi: 10.1097/TA.0b013e31829bb67c.

Hyperosmolar reconstituted lyophilized plasma is an effective low-volume hemostatic resuscitation fluid for trauma.

Lee TH, Watson K, Fabricant L, Barton J, Differding J, Kremenevskiy I, Sands C, Wiles C, Watters JM, Schreiber MA.

BACKGROUND: We performed this study to optimize reconstituted lyophilized plasma (LP) into a minimal volume fluid that provides effective hemostatic resuscitation for trauma while minimizing logistical limitations.

METHODS: We performed a prospective, blinded animal study. Plasma was lyophilized following whole blood collection from anesthetized swine. The minimal volume needed for reconstitution was determined, and this solution was evaluated for safe infusion into the swine. Reconstituted LP was analyzed for electrolyte content, osmolarity, and coagulation factor activity. Twenty swine were anesthetized and subjected to a validated model of polytrauma and hemorrhagic shock (including a Grade V liver injury), then randomized to resuscitation with LP reconstituted to either 100% of the original plasma volume (100%LP) or the minimal volume LP fluid. Physiologic data were monitored, and blood loss and hematocrit were measured. Coagulation status was evaluated using thrombelastography.

RESULTS: The minimal volume of reconstituted LP safe for infusion in swine was 50% of the original plasma volume (50%LP). The 50%LP had higher electrolyte concentrations, osmolarity, and increased coagulation factor activity levels by volume compared with 100%LP ($p < 0.05$). Blood loss, hematocrit, mean arterial pressure, and heart rate did not differ between animals receiving 100%LP ($n = 10$) or 50%LP ($n = 10$) at any time point ($p > 0.05$). International normalized ratio and thrombelastography parameters were not different between groups (R time, α angle, or maximal amplitude, $p > 0.05$).

CONCLUSION: Resuscitation with 50%LP fluid was well tolerated and equally effective compared with 100%LP, with respect to physiologic and hemostatic properties. The smaller volume of fluid necessary to reconstitute hypertonic LP makes it logistically superior to 100%LP for first responders and may reduce adverse effects of large-volume resuscitation.

Eur Spine J. 2013 Sep;22(9):1950-7. doi: 10.1007/s00586-013-2774-9. Epub 2013 May 9.

Is tranexamic acid effective and safe in spinal surgery? A meta-analysis of randomized controlled trials.

Li ZJ, Fu X, Xing D, Zhang HF, Zang JC, Ma XL.

PURPOSE: The present meta-analysis aimed at assessing the effectiveness and safety of tranexamic acid (TXA) in reducing blood loss and transfusion in spinal surgery.

METHODS: Systematic searches of all studies published through March 2012 were identified from PubMed, EMBase, Cochrane library, Science Direct, and other databases. Only randomized controlled trials (RCTs) were included in the present study. Two independent reviewers searched and assessed the literature. Mean difference (MD) of blood loss and blood transfusions, risk ratios (RR) of transfusion rate and of deep vein thrombosis rate in the TXA-treated group versus placebo group were pooled throughout the study. The meta-analysis was conducted by RevMan 5.1 software.

RESULTS: Six placebo-controlled RCTs encompassing 411 patients met the inclusion criteria for our meta-analysis. The use of TXA significantly reduced both total blood loss [MD = -285.35, 95 % CI (-507.03 to -63.67), P = 0.01] as well as the number of patients requiring blood transfusion [RR = 0.71, 95 % CI (0.54-0.92), P = 0.01]. None of the patients in the treatment group had deep-vein thrombosis (DVT) or pulmonary embolism.

CONCLUSIONS: Intravenous use of TXA for patients undergoing spinal surgery is effective and safe. It reduces total blood loss and the need for blood transfusion, particularly in the using of high dosage of TXA (≥ 15 mg/kg), yet does not increase the risk of postoperative DVT. Due to the limitation of the quality of the evidence currently available, high-quality RCTs are required.

Injury. 2013 Sep 7. pii: S0020-1383(13)00384-7. doi: 10.1016/j.injury.2013.08.025. [Epub ahead of print]

Tranexamic acid in the prehospital setting: Israeli Defense Forces' initial experience.

Lipsky AM, Abramovich A, Nadler R, Feinstein U, Shaked G, Kreiss Y, Glassberg E.

BACKGROUND: The leading cause of preventable death in the military setting is haemorrhage. Accumulating evidence has established the benefit of tranexamic acid (TXA), an antifibrinolytic, for treating traumatic haemorrhage in the hospital setting. The use of TXA in the prehospital setting, however, has not been previously described. The present study details our initial experience with a field protocol that advances TXA administration to (or as close as possible to) the point of injury.

METHODS: We present a series of all casualties treated with TXA by Israel Defense Forces' (IDF) prehospital advanced life support providers between December 2011 and February 2013. Data were abstracted from the IDF Trauma Registry at the Research Section of the Trauma and Combat Medicine Branch, Surgeon General's Headquarters.

RESULTS: Forty casualties who received TXA in the prehospital setting were identified. Most casualties were male (n=35; 88%) and young adults (median 28 years). The mechanism of injury was penetrating in 22 cases (55%). TXA was administered earlier than it could have been in the hospital setting without delaying evacuation. There were no reports of adverse outcomes that could be reasonably attributed to TXA. Casualties who received TXA per protocol were sicker than those who received it not per protocol.

CONCLUSIONS: We have shown that TXA may be successfully given in the prehospital setting without any apparent delays in evacuation. In light of recent evidence, the ability to give TXA closer to the time of wounding represents an important step towards improving the survival of trauma victims with haemorrhage, even before definitive care is available. While this may be especially relevant in austere combat environments, there is likely benefit in the civilian sector as well. The safety profile of TXA is an important consideration as prehospital personnel tended to overtreat casualties without indications for TXA per protocol. We suggest that TXA be considered a viable option for use by advanced life support providers at or near the point of injury.

Ann Emerg Med. 2013 Oct 2. pii: S0196-0644(13)01338-3. doi: 10.1016/j.annemergmed.2013.08.025. [Epub ahead of print]

A comparison of two open surgical cricothyroidotomy techniques by military medics using a cadaver model.

Mabry RL, Nichols MC, Shiner DC, Bolleter S, Frankfurt A.

STUDY OBJECTIVE: The CricKey is a novel surgical cricothyroidotomy device combining the functions of a tracheal hook, stylet, dilator, and bougie incorporated with a Melker airway cannula. This study compares surgical cricothyroidotomy with standard open surgical versus CricKey technique.

METHODS: This was a prospective crossover study using human cadaveric models. Participants included US Army combat medics credentialed at the emergency medical technician-basic level. After a brief anatomy review and demonstration, participants performed in random order standard open surgical cricothyroidotomy and CricKey surgical cricothyroidotomy. The primary outcome was first-pass success, and the secondary outcome measure was procedural time.

RESULTS: First-attempt success was 100% (15/15) for CricKey surgical cricothyroidotomy and 66% (10/15) for open surgical cricothyroidotomy (odds ratio 16.0; 95% confidence interval 0.8 to 326). Surgical cricothyroidotomy insertion was faster for CricKey than open technique (34 versus 65 seconds; median time difference 28 seconds; 95% confidence interval 16 to 48 seconds).

CONCLUSION: Compared with the standard open surgical cricothyroidotomy technique, military medics demonstrated faster insertion with the CricKey. First-pass success was not significantly different between the techniques.

Mil Med. 2013 Oct;178(10):1121-5. doi: 10.7205/MILMED-D-13-00126.

Prevalence of prehospital hypoxemia and oxygen use in trauma patients.

McMullan J, Rodriquez D, Hart KW, Lindsell CJ, Vonderschmidt K, Wayne B, Branson R.

OBJECTIVE: This study estimates the prevalence of injured patients requiring prehospital supplemental oxygen based on existing recommendations, and determines whether actual use exceeds those recommendations.

METHODS: Prehospital oxygen use and continuous peripheral oxygen saturation measurements were prospectively collected on a purposive sample of injured civilians transported to an urban level 1 trauma center by paramedics. Structured chart review determined injury characteristics and outcomes. Supplemental oxygen administration indications were hypoxemia (peripheral oxygen saturation ≤ 90%), hemorrhagic shock (systolic blood pressure < 100 mmHg), or paramedic suspicion of traumatic brain injury.

RESULTS: Paramedics enrolled 224/290 screened subjects. Median (range) age was 34 (18-84) years, 48.7% were nonwhite, 75.4% were male, and Injury Severity Score was 5 (1-75). Half (54.5%) were admitted; 36.2% sustained a penetrating injury. None underwent prehospital endotracheal intubation. Hypoxemia occurred in 86 (38.4%), paramedics suspected traumatic brain injury in 22 (9.8%), and 20 (8.9%) were hypotensive. Any indication for supplemental oxygen (107/224 [47.8%, 95%CI 41.3%-54.3%]) and prehospital administration of oxygen (141/224 [62.9%, 95%CI 56.2%-69.2%]) was common. Many (35/141 [24.8%]) received oxygen without indication.

CONCLUSIONS: On the basis of current guidelines, less than half of adult trauma patients have an indication for prehospital supplemental oxygen, yet is frequently administered in the absence of clinical indication.

J Trauma Acute Care Surg. 2013 Jul;75(1):1-7. doi: 10.1097/TA.0b013e31829c1d70.

Scott B. Frame, MD Memorial Lecture. Judgment based on knowledge: a history of prehospital trauma life support, 1970-2013.

McSwain NE Jr.

CONCLUSION: PHTLS has had a good acceptance throughout the world. That is because of the people in the pictures that I have shown, as well as a lot of people whom we have not had time to show today. It is what these hard working unselfish individuals have done to make PHTLS and its associated projects such as an international standard.

Three-quarters-of-a-million providers in sixty-one countries taught by 7,500 instructors have taken PHTLS since it started. It has been of remarkable importance and of tremendous impact, but we also can't forget the impact of the companion course, Basic Trauma Life Support (now known as International Trauma Life Support) that was started by Dr. John Campbell, an emergency physician in Alabama, supported by Alabama ACEP. He sent me a copy of his initial book along with a nice letter. John has also a major impact in teaching people how to take care of patients. These photographs are of the current members of the PHTLS committee, as well as other who that are actively involved in PHTLS (Fig. 8). Will Chapleau has really been the leader of PHTLS and has made it work. I cannot say enough about him and his work. You are all familiar with his work with ATLS and many of the things within the American College of Surgeons, but he has made PHTLS what it is. We know that our patients, our trauma patients, are cared for by the PHTLS standards that were strongly supported by Scott Frame a long time ago. I'm sorry that he's not here with this today in his body, but I know that his spirit is standing here on the podium with me today just as Joyce is sitting in the audience.

Thank you very much for allowing me to honor Scott with this lecture.

J Trauma Acute Care Surg. 2013 Aug;75(2 Suppl 2):S203-9. doi: 10.1097/TA.0b013e318299d5d0.

"Fluidless" resuscitation with permissive hypotension via impedance threshold device therapy compared with normal saline resuscitation in a porcine model of severe hemorrhage.

Metzger A, Rees J, Segal N, McKnite S, Matsuura T, Convertino VA, Gerhardt RT, Lurie KG.

BACKGROUND: One approach to improve outcomes after trauma and hemorrhage is to follow the principles of permissive hypotension by avoiding intravascular overpressure and thereby preventing dislodgement of platelet plugs early in the clotting process. We hypothesized that augmentation of negative intrathoracic pressure (nITP) by treatment with an impedance threshold device would improve hemodynamics without compromising permissive hypotension or causing hemodilution, whereas aggressive fluid resuscitation with normal saline (NS) would result in hemodilution and SBPs that are too high for permissive hypotension and capable of clot dislodgement.

METHODS: Thirty-four spontaneously breathing anesthetized female pigs (30.6 ± 0.5 kg) were subjected to a fixed 55% hemorrhage over 30 minutes; block randomized to nITP, no treatment, or intravenous bolus of 1-L NS; and evaluated over 30 minutes. Results are reported as mean ± SEM.

RESULTS: Average systolic blood pressures (SBPs) (mm Hg) 30 minutes after the study interventions were as follows: nITP, 82.1 ± 2.9; no treatment, 69.4 ± 4.0; NS 89.3 ± 5.2. Maximum SBPs during the initial 15 minutes of treatment were as follows: nITP, 88.0 ± 4.3; no treatment, 70.8 ± 4.3; and NS, 131 ± 7.6. After 30 minutes, mean pulse pressure (mm Hg) was significantly higher in the nITP group (nITP, 32.3 ± 2.2) versus the no-treatment group (21.5 ± 1.5 controls) ($p < 0.05$), and the mean hematocrit was 25.2 ± 0.8 in the nITP group versus 19 ± 0.6 in the NS group ($p < 0.001$).

CONCLUSION: In this porcine model of hemorrhagic shock, nITP therapy significantly improved SBP and pulse pressure for 30 minutes without overcompensation compared with controls with no treatment. By contrast, aggressive fluid resuscitation with NS but not nITP resulted in a significant rise in SBP to more than 100 mm Hg within minutes of initiating therapy that could cause a further reduction in hematocrit and clot dislodgment.

J Trauma Acute Care Surg. 2013 Sep;75(3):459-67. doi: 10.1097/TA.0b013e31829cfaea.

Withholding and termination of resuscitation of adult cardiopulmonary arrest secondary to trauma: resource document to the joint NAEMSP-ACSCOT position statements.

Millin MG, Galvagno SM, Khandker SR, Malki A, Bulger EM; Standards and Clinical Practice Committee of the National Association of EMS Physicians (NAEMSP); Subcommittee on Emergency Services–Prehospital of the American College of Surgeons' Committee on Trauma (ACSCOT).

ABSTRACT: In the setting of traumatic cardiopulmonary arrest, protocols that direct emergency medical service (EMS) providers to withhold or terminate resuscitation, when clinically indicated, have the potential to decrease unnecessary use of warning lights and sirens and save valuable public health resources. Protocols to withhold resuscitation should be based on the determination that there are no obvious signs of life, the injuries are obviously incompatible with life, there is evidence of prolonged arrest, and there is a lack of organized electrocardiographic activity. Termination of resuscitation is indicated when there are no signs of life and no return of spontaneous circulation despite appropriate field EMS treatment that includes minimally interrupted cardiopulmonary resuscitation. Further research is needed to determine the appropriate duration of cardiopulmonary resuscitation before termination of resuscitation and the proper role of direct medical oversight in termination of resuscitation protocols. This article is the resource document to the position statements, jointly endorsed by the National Association of EMS Physicians and the American College of Surgeons' Committee on Trauma, on withholding and termination of resuscitation in traumatic cardiopulmonary arrest.

J Pediatr Hematol Oncol. 2013 Apr 11. [Epub ahead of print]

Chitosan-based Dressing for the Treatment of External/Accessible Bleedings in Children With Bleeding Tendency.

Misgav M, Kenet G, Martinowitz U.

INTRODUCTION: Bleeding episodes in patients with congenital or acquired bleeding disorders are usually managed with factor concentrates or blood products. However, external and accessible bleeds may effectively be managed with topical hemostasis.

MATERIALS AND METHODS: After the application of the Hemcon, a Food and Drug Administration-approved chitosan-based hemostatic dressing was used as the "last resort" to successfully control external bleeds in 2 patients with severe bleeding disorders. We describe a single-center experience with this dressing, including its use in pediatric patients as the first mode of therapy.

RESULTS: A total of 5 patients (median age 2 y) with severe bleeding disorders were treated with topical chitosan-based dressing for a total of 6 bleeding episodes. The dressing was used either after the failure of extensive systemic therapy or as the first choice of treatment. In 4 of the 6 episodes, bleeding ceased immediately alleviating the need for systemic therapy. There was no rebleeding after the removal of the dressing and no adverse events or local skin reactions were recorded.

CONCLUSION: Hemostatic dressings, such as the chitosan, should be encouraged for the treatment of external/accessible bleeds, especially among the pediatric patients with bleeding tendency.

J Trauma Acute Care Surg. 2013 Aug;75(2 Suppl 2):S263-8. doi: 10.1097/TA.0b013e318299da0a.

Injury pattern and mortality of noncompressible torso hemorrhage in UK combat casualties.

Morrison JJ, Stannard A, Rasmussen TE, Jansen JO, Tai NR, Midwinter MJ.

BACKGROUND: Hemorrhage following traumatic injury is a leading cause of military and civilian mortality. Noncompressible torso hemorrhage (NCTH) has been identified as particularly lethal, especially in the prehospital setting.

METHODS: All patients sustaining NCTH between August 2002 and July 2012 were identified from the UK Joint Theatre Trauma Registry. NCTH was defined as injury to a named torso axial vessel, pulmonary injury, solid-organ injury (Grade 4 or greater injury to the liver, kidney, or spleen) or pelvic fracture with ring disruption. Patients with ongoing hemorrhage were identified using either a systolic blood pressure of less than 90 mm Hg or the need for immediate surgical hemorrhage control. Data on injury pattern and location as well as cause of death were analyzed using univariate and multivariate analyses.

RESULTS: During 10 years, 296 patients were identified with NCTH, with a mortality of 85.5%. The majority of deaths occurred before hospital admission (n = 222, 75.0%). Of patients admitted to hospital, survivors (n = 43, 14.5%) had a higher median systolic blood pressure (108 [43] vs. 89 [46], p = 0.123) and Glasgow Coma Scale (GCS) (14 [12] vs. 3 [0], p < 0.001) compared with in-hospital deaths (n = 31, 10.5%). Hemorrhage was the more common cause of death (60.1%), followed by central nervous system disruption (30.8%), total body disruption (5.1%), and multiple-organ failure (4.0%). On multivariate analysis, major arterial and pulmonary hilar injury are most lethal with odds ratio (95% confidence interval) of 16.44 (5.50-49.11) and 9.61 (1.06-87.00), respectively.

CONCLUSION: This study demonstrates that the majority of patients sustaining NCTH die before hospital admission, with exsanguination and central nervous system disruption contributing to the bulk cause of death. Major arterial and pulmonary hilar injuries are independent predictors of mortality.

J Trauma Acute Care Surg. 2013 Aug;75(2 Suppl 2):S184-9. doi: 10.1097/TA.0b013e31829b01db.

Promoting early diagnosis of hemodynamic instability during simulated hemorrhage with the use of a real-time decision-assist algorithm.

Muniz GW, Wampler DA, Manifold CA, Grudic GZ, Mulligan J, Moulton S, Gerhardt RT, Convertino VA.

BACKGROUND: This study aimed to test the hypothesis that the addition of a real-time decision-assist machine learning algorithm by emergency medical system personnel could shorten the time needed to identify an unstable patient during a hemorrhage profile as compared with vital sign information alone.

METHODS: Fifty emergency medical team-paramedics from a large, urban fire department participated as subjects. Subjects viewed a monitor screen on two occasions as follows: (1) display of standard vital signs alone and (2) with the addition of an index (Compensatory Reserve Index) associated with estimated central blood volume status. The subjects were asked to push a computer key at any point in the sequence they believed the patient had become unstable based on information provided by the monitor screen. The average difference in time to identify hemodynamic instability between experimental and control groups was assessed by paired, two-tailed t test and reported with 95% confidence intervals (95% CI).

RESULTS: The mean (SD) amount of time required to identify an unstable patient was 18.3 (4.1) minutes (95% CI, 17.2-19.4 minutes) without the algorithm and 10.7 (4.2) minutes (95% CI, 9.5-11.9 minutes) with the algorithm ($p < 0.001$).

CONCLUSION: In a simulated patient encounter involving uncontrolled hemorrhage, the use of a monitor that estimates central blood volume loss was associated with early identification of impending hemodynamic instability. Physiologic monitors capable of early identification and estimation of the physiologic capacity to compensate for blood loss during hemorrhage may enable optimal guidance for hypotensive resuscitation. They may also help identify casualties benefitting from forward administration of plasma, antifibrinolytics and procoagulants in a remote damage-control resuscitation model.

N Engl J Med. 2013 Sep 26;369(13):1243-51. doi: 10.1056/NEJMra1208627.

Resuscitation fluids.

Myburgh JA, Mythen MG.

QUOTE:

"Although the use of resuscitation fluids is one of the most common interventions in medicine, no currently available resuscitation fluid can be considered to be ideal. In light of recent high quality evidence, a reappraisal of how resuscitation fluids are used in acutely ill patients is now required (Table 2). The selection, timing, and doses of intravenous fluids should be evaluated as carefully as they are in the case of any other intravenous drug, with the aim of maximizing efficacy and minimizing iatrogenic toxicity."

Scand J Trauma Resusc Emerg Med. 2013 Jul 26;21(1):59. [Epub ahead of print]

Comparison of a percutaneous device and the bougie-assisted surgical technique for emergency cricothyrotomy: an experimental study on a porcine model performed by air ambulance anaesthesiologists.

Nakstad AR, Bredmose PP, Sandberg M.

BACKGROUND: A large number of techniques and devices for cricothyroidotomy have been developed. In this study, the PortexTM Cricothyroidotomy Kit (PCK, Smiths Medical Ltd, Hythe, UK) was compared with the bougie-assisted emergency surgical cricothyrotomy technique (BACT).

METHODS: Twenty air ambulance anaesthesiologists performed emergency cricothyrotomy on a cadaveric porcine airway model using both PCK and BACT. Baseline performance and performance after the intensive training package were recorded. Success rate, time to secured airway and tracheal damage were the primary endpoints, and confidence rating was a secondary endpoint.

RESULTS: During baseline testing, success rates for PCK and BACT were 60% and 95%, respectively. Tracheal injury rate with PCK was 60% while no such injury was found in BACT. A lecture was given and skills were trained until the participants were able to perform five consecutive successful procedures with both techniques. In the post-training test, all participants were successful with either technique. The mean time to successful insertion was reduced by 15.7 seconds (from 36.3 seconds to 20.6 seconds, $p< 0.001$) for PCK and by 7.8 seconds (from 44.9 seconds to 37.1 seconds, $p=0.021$) for BACT. In the post-training scenario, securing the airway with PCK was significantly faster than with BACT ($p<0.001$). Post-training tracheal laceration occurred in six (30%) of the PCK procedures and in none of the BACT procedures ($p=0.028$).The self-evaluated confidence level was measured both pre- and post-training using a confidence scale with 10 indicating maximum amount of confidence. The median values increased from 4 to 8 for PCK and from 6.5 to 9.5 for BACT. All participants reported that BACT was their preferred technique.

CONCLUSIONS: Testing the base-line PCK skills of prehospital anaesthesiologists revealed low confidence, sub-optimal performance and a very high failure rate. The BACT technique demonstrated a significantly higher success rate and no tracheal damage. In spite of PCK being a significantly faster technique in the post-training test, the anaesthesiologists still reported a higher confidence in BACT. Limitations of the cadaveric porcine airway may have influenced this study because the airway did not challenge the clinicians with realistic tissue bleeding.

Transfusion. 2013 Jan;53 Suppl 1:107S-113S. doi: 10.1111/trf.12044.

Fresh whole blood use by forward surgical teams in Afghanistan is associated with improved survival compared to component therapy without platelets.

Nessen SC, Eastridge BJ, Cronk D, Craig RM, Berséus O, Ellison R, Remick K, Seery J, Shah A, Spinella PC.

BACKGROUND: In Afghanistan, a substantial portion of resuscitative combat surgery is performed by US Army forward surgical teams (FSTs). Red blood cells (RBCs) and fresh frozen plasma (FFP) are available at these facilities, but platelets are not. FST personnel frequently encounter high-acuity patient scenarios without the ability to transfuse platelets. An analysis of the use of fresh whole blood (FWB) at FSTs therefore allows for an evaluation of outcomes associated with this practice.

STUDY DESIGN AND METHODS: A retrospective analysis was performed in prospectively collected data from all transfused patients at six FSTs from December 2005 to December 2010. Univariate analysis was performed, followed by two separate propensity score analyses. In-hospital mortality was predicted with the use of a conditional logistic regression model that incorporated these propensity scores. Subset analysis included evaluation of patients who received uncrossmatched Type O FWB compared with those who received type-specific FWB.

RESULTS: A total of 488 patients received a blood transfusion. There were no significant differences in age, sex, or Glasgow Coma Scale in those who received or did not receive FWB. Injury Severity Scores were higher in patients transfused FWB. In our adjusted analyses, patients who received RBCs and FFP with FWB had improved survival compared with those who received RBCs and FFP without FWB. Of 94 FWB recipients, 46 FWB recipients (49%) were given uncrossmatched Type O FWB, while 48 recipients (51%) received type-specific FWB. There was no significant difference in mortality between patients that received uncrossmatched Type O and type-specific FWB.

CONCLUSIONS: The use of FWB in austere combat environments appears to be safe and is independently associated with improved survival to discharge when compared with resuscitation with RBCs and FFP alone. Mortality was similar for patients transfused uncrossmatched Type O compared with ABO type-specific FWB in an austere setting.

J Spec Oper Med. 2013 Summer;13(2):12-9.

No slackers in tourniquet use to stop bleeding.

Polston RW, Clumpner BR, Kragh JF Jr, Jones JA, Dubick MA, Baer DG.

ABSTRACT: Tourniquets on casualties in war have been loose in 4%?9% of uses, and such slack risks death from uncontrolled bleeding. A tourniquet evidence gap persists if there is a mechanical slack-performance association.

OBJECTIVE: The purpose of the present study was to determine the results of tourniquet use with slack in the strap versus no slack before windlass turning, in order to develop best practices. Methods: The authors used a tourniquet manikin 254 times to measure tourniquet effectiveness, windlass turns, time to stop bleeding, and blood volume lost at 5 degrees of strap slack (0mm, 25mm, 50mm, 100mm, and 200mm maximum).

RESULTS: When comparing no slack (0mm) to slack (any positive amount), there were increases with slack in windlass turns ($p < .0001$, 3-fold), time to stop bleeding ($p < .0001$, 2-fold), and blood volume lost ($p < .0001$, 2-fold). When comparing no slack to 200mm slack, the median results showed an increase in slack for windlass turns ($p < .0001$), time to stop bleeding ($p < .0001$), and blood volume lost ($p < .0001$).

CONCLUSIONS: Any slack presence in the strap impaired tourniquet performance. More slack had worse results. Trainers can now instruct tourniquet users with concrete guidance.

Ann Surg. 2013 Oct 4. [Epub ahead of print]

Hydroxyethyl Starch Reduces Coagulation Competence and Increases Blood Loss During Major Surgery: Results From a Randomized Controlled Trial.

Rasmussen KC, Johansson PI, Højskov M, Kridina I, Kistorp T, Thind P, Nielsen HB, Ruhnau B, Pedersen T, Secher NH.

OBJECTIVE: This study evaluated whether administration of hydroxyethyl starch (HES) 130/0.4 affects coagulation competence and influences the perioperative blood loss.

BACKGROUND: Artificial colloids substitute blood volume during surgery; with the administration of HES 130/0.4 (Voluven, Fresenius Kabi, Uppsala, Sweden) only a minor effect on coagulation competence is expected.

METHODS: Eighty patients were scanned for enrolment in the study, and 40 patients fulfilled the inclusion criteria. Two patients withdrew their consent to participate in the study, and 5 patients were excluded. Thus, 16 patients were randomized to receive lactated Ringer's solution and 17 to receive HES 130/0.4.

RESULTS: Among the patients receiving HES 130/0.4, thrombelastography indicated reduced clot strength ($P < 0.001$) and blinded evaluation of the perioperative blood loss was 2.2 (range 0.5 to 5.0) versus 1.4 (range 0.5 to 2.4) L in the patients who received HES 130/0.4 or lactated Ringer, respectively ($P < 0.038$). The patients in the lactated Ringer's group, however, received more fluid ($P < 0.0001$) than those in the HES 130/0.4 group. There was no significant difference between the 2 groups with regard to frequency of reoperations or the length of hospital stay, but use of HES 130/0.4 was both more expensive and less efficacious than the use of lactated Ringer.

CONCLUSIONS: Administration of HES 130/0.4 reduced clot strength and perioperative hemorrhage increased by more than 50%, while administration of lactated Ringer's solution provoked an approximately 2.5 times greater positive volume balance at the end of surgery.

J Trauma Acute Care Surg. 2013 Jul;75(1 Suppl 1):S61-7. doi: 10.1097/TA.0b013e31828fa408.

Application of the Berlin definition in PROMMTT patients: the impact of resuscitation on the incidence of hypoxemia.

Robinson BR, Cotton BA, Pritts TA, et al:

BACKGROUND: Acute lung injury following trauma resuscitation remains a concern despite recent advances. With the use of the PROMMTT study population, the risk of hypoxemia and potential modifiable risk factors are studied.

METHODS: Patients with survival for 24 hours or greater with at least one intensive care unit day were included in the analysis. Hypoxemia was categorized using the Berlin definition for adult respiratory distress syndrome: none (PaO_2 -to-FIO_2 ratio [P/F] > 300 mm Hg), mild (P/F, 201-300 mm Hg), moderate (P/F, 101-200 mm Hg) or severe (P/F ≤ 100 mm Hg). The cohort was dichotomized into those with none or mild hypoxemia and those with moderate or severe injury. Early resuscitation was defined as that occurring 0 hour to 6 hours from arrival; late resuscitation was defined as that occurring 7 hours to 24 hours. Multivariate logistic regression models were developed controlling for age, sex, mechanisms of injury, arrival physiology, individual Abbreviated Injury Scale (AIS) scores, blood transfusions, and crystalloid administration.

RESULTS: Of the patients 58.7% (731 of 1,245) met inclusion criteria. Hypoxemia occurred in 69% (mild, 24%; moderate, 28%; severe, 17%). Mortality was highest (24%) in the severe group. During early resuscitation (0-6 h), logistic regression revealed age (odd ratio [OR], 1.02; 95% confidence interval [CI], 1.00-1.04), chest AIS score (OR, 1.31; 95% CI, 1.10-1.57), and intravenously administered crystalloid fluids given in 500 mL increments (OR, 1.12; 95% CI, 1.01-1.25) as predictive of moderate or severe hypoxemia. During late resuscitation, age (OR, 1.02; 95% CI, 1.00-1.04), chest AIS score (OR, 1.33; 95% CI, 1.11-1.59), and crystalloids given during this period (OR, 1.05; 95% CI, 1.01-1.10) were also predictive of moderate-to-severe hypoxemia. Red blood cell, plasma, and platelet transfusions (whether received during early or late resuscitation) failed to demonstrate an increased risk of developing moderate/severe hypoxemia.

CONCLUSION: Severe chest injury, increasing age, and crystalloid-based resuscitation, but not blood transfusions, were associated with increased risk of developing moderate-to-severe hypoxemia following injury.

J Spec Oper Med. 2013 Summer;13(2):54-8.

Recent consideration in tactical medicine.

Rush S.

ABSTRACT: A philosophical approach to tactical and remote medicine should be reflected in the gear (e.g., equipment and technology) chosen as well as the protocols used. The gear needs to be lightweight and small volume. Asmuch as possible, it should have multiple uses, and there should be no redundancy with other items. When modern technology (e.g., hemostatic gauze, pulse oximeters, etc.) allows it to have unique applications, it should be used. Otherwise, if simple basic gear works, it should remain a staple (e.g., cravats). Protocols should reflect the goal to provide thorough care in an efficient manner. They should be straightforward and scaleable and be capable of being trained in a fashion that will allow them to become automatic under duress. These guiding principles establish a basis from which the Special Operations Forces/Tactical Medic or PJ can operate to maximal effectiveness. This article will describe current thinking in Pararescue as it relates to gear and protocols.

J Trauma Acute Care Surg. 2013 Aug;75(2 Suppl 2):S269-74. doi: 10.1097/TA.0b013e318299d93e.

Primary blast lung injury prevalence and fatal injuries from explosions: insights from postmortem computed tomographic analysis of 121 improvised explosive device fatalities.

Singleton JA, Gibb IE, Bull AM, Mahoney PF, Clasper JC.

BACKGROUND: Primary blast lung injury (PBLI) is an acknowledged cause of death in explosive blast casualties. In contrast to vehicle occupants following an in-vehicle explosion, the injury profile, including PBLI incidence, for mounted personnel following an external explosion has yet to be as well defined.

METHODS: This retrospective study identified 146 cases of UK military personnel killed by improvised explosive devices (IEDs) between November 2007 and July 2010. With the permission of Her Majesty's Coroners, relevant postmortem computed tomography imaging was analyzed. PBLI was diagnosed by postmortem computed tomography. Injury, demographic, and relevant incident data were collected via the UK Joint Theatre Trauma Registry.

RESULTS: Autopsy results were not available for 1 of 146 cases. Of the remaining 145 IED fatalities, 24 had catastrophic injuries (disruptions), making further study impossible, leaving 121 cases; 79 were dismounted (DM), and 42 were mounted (M). PBLI was noted in 58 cases, 33 (79%) of 42 M fatalities and 25 (32%) of 79 DM fatalities ($p < 0.0001$). Rates of associated thoracic trauma were also significantly greater in the M group ($p < 0.006$ for all). Fatal head (53% vs. 23%) and thoracic trauma (23% vs. 8%) were both more common in the M group, while fatal lower extremity trauma (7% vs. 48%) was more commonly seen in DM casualties ($p < 0.0001$ for all).

CONCLUSION: Following IED strikes, mounted fatalities are primarily caused by head and chest injuries. Lower extremity trauma is the leading cause of death in dismounted fatalities. Mounted fatalities have a high incidence of PBLI, suggesting significant exposure to primary blast. This has not been reported previously. Further work is required to determine the incidence and clinical significance of this severe lung injury in explosive blast survivors. In addition, specific characteristics of the vehicles should be considered**.**

BMJ Open. 2013 Aug 1;3(8). pii: e003130. doi: 10.1136/bmjopen-2013-003130.

Identifying future 'unexpected' survivors: a retrospective cohort study of fatal injury patterns in victims of improvised explosive devices.

Singleton JA, Gibb IE, Hunt NC, Bull AM, Clasper JC.

OBJECTIVES: To identify potentially fatal injury patterns in explosive blast fatalities in order to focus research and mitigation strategies, to further improve survival rates from blast trauma.

DESIGN: Retrospective cohort study.

PARTICIPANTS: UK military personnel killed by improvised explosive device (IED) blasts in Afghanistan, November 2007-August 2010.

SETTING: UK military deployment, through NATO, in support of the International Security Assistance Force (ISAF) mission in Afghanistan.

DATA SOURCES: UK military postmortem CT records, UK Joint Theatre Trauma Registry and associated incident data.

MAIN OUTCOME MEASURES: Potentially fatal injuries attributable to IEDs.

RESULTS: We identified 121 cases, 42 mounted (in-vehicle) and 79 dismounted (on foot), at a point of wounding. There were 354 potentially fatal injuries in total. Leading causes of death were traumatic brain injury (50%, 62/124 fatal injuries), followed by intracavity haemorrhage (20.2%, 25/124) in the mounted group, and extremity haemorrhage (42.6%, 98/230 fatal injuries), junctional haemorrhage (22.2%, 51/230 fatal injuries) and traumatic brain injury (18.7%, 43/230 fatal injuries) in the dismounted group.

CONCLUSIONS: Head trauma severity in both mounted and dismounted IED fatalities indicated prevention and mitigation as the most effective strategies to decrease resultant mortality. Two-thirds of dismounted fatalities had haemorrhage implicated as a cause of death that may have been anatomically amenable to prehospital intervention. One-fifth of the mounted fatalities had haemorrhagic trauma which currently could only be addressed surgically. Maintaining the drive to improve all haemostatic techniques for blast casualties, from point of wounding to definitive surgical proximal vascular control, alongside the development and application of novel haemostatic interventions could yield a significant survival benefit. Prospective studies in this field are indicated.

J Arthroplasty. 2013 Sep;28(8 Suppl):112-5. doi: 10.1016/j.arth.2013.05.036. Epub 2013 Aug 13.

One dose of tranexamic acid is safe and effective in revision knee arthroplasty.

Smit KM, Naudie DD, Ralley FE, Berta DM, Howard JL.

ABSTRACT: Revision total knee arthroplasty (TKA) has been associated with an increased risk of perioperative blood loss. Tranexamic acid (TXA) has been proven to be safe and effective in preventing blood loss in primary TKA. The purpose of this study was to evaluate the effect of TXA on blood loss and transfusion rates in revision TKA. We performed a retrospective comparative study on 424 patients who had undergone revision TKA between January 2006 and March 2010. A total of 178 patients did not receive TXA while 246 patients received one intraoperative dose of 20mg/kg of TXA given prior to tourniquet release. There was a significant reduction in hemoglobin loss (42±16g/L vs 38±15g/L, P=0.005), transfusion rates (30.3% vs 16.7%, P=0.001) and average amount transfused (1.1±1.9units vs 0.5±1.1units, P=0.001) in the TXA group. There was no significant difference in recorded major adverse events with the administration of TXA.

J Spec Oper Med. 2013 Summer;13(2):44-53.

CBRNE TC3: A hybrid approach to casualty care in the CBRNE environment.

Strain JW 2nd.

ABSTRACT: The implementation of Tactical Combat Casualty Care (TCCC) guidelines for the Operation Enduring Freedom and Operation Iraqi Freedom contingency operations has dramatically reduced preventable combat deaths. A study of these principles and their application to medical treatment in the chemical, biological, radiological, nuclear, and high-yield explosives (CBRNE), weapons of mass destruction (WMD) environment is presented as a potential readiness and force multiplier for units engaged in this area of operations. Preparing medical operators for support of WMD sampling and mitigation missions requires extensive preventive medicine and post-exposure and downrange trauma threat preparedness. Training and equipping CBRN operators with treatment skills and appropriate interventional material requires pre-implementation planning specific to WMD threats (e.g., anthrax, radiation, organophosphates, and contaminated trauma). A scenario-based study reveals the tactics, techniques, and procedures for training, resourcing, and fielding the CBRN operator of the future.

Mil Med. 2013;178(11):1202-7. doi: 10.7205/MILMED-D-13-00250.

Feasibility of supraglottic airway use by combat lifesavers on the modern battlefield.

Studer NM, Horn GT, Studer LL, Armstrong JH, Danielson PD.

BACKGROUND: Airway compromise is a contributor to preventable mortality on the battlefield. Supraglottic airway devices are an accepted intervention for these casualties. Combat Medics, civilian prehospital care providers, and lay civilians have demonstrated proficiency with supraglottic airways. However, the Combat Lifesaver (CLS) course includes no instruction on their use.

OBJECTIVE: The purpose of this study was to assess feasibility of instructing CLS students to use a supraglottic airway (the King LT-D); compare their timed performance with that of Special Operations Combat Medics (SOCM); and assess their confidence utilizing the device.

METHODS: After standardized instruction, students were timed and evaluated in the placement of a King LT-D in a manikin. Student confidence was assessed by Likert-scaled surveys, and free response remarks collected before and after training.

RESULTS: 27 of 28 CLS students successfully used a King LT-D airway device in under 60 seconds following brief instruction. Placement times were not significantly different from those of SOCM. Self-rated confidence scores improved from an initial 1.4/5 to 4.9/5 following manikin trials. Both CLS and SOCM recommended the airway for future battlefield CLS use.

CONCLUSIONS: CLS students are capable and confident in the use of a supraglottic airway device after only brief instruction.

Mil Med. 2013;178(11):1196-201. doi: 10.7205/MILMED-D-13-00223.

The evaluation of an abdominal aortic tourniquet for the control of pelvic and lower limb hemorrhage.

Taylor DM, Coleman M, Parker PJ.

ABSTRACT: Despite improved body armor, hemorrhage remains the leading cause of preventable death on the battlefield. Trauma to the junctional areas such as pelvis, groin, and axilla can be life threatening and difficult to manage. The Abdominal Aortic Tourniquet (AAT) is a prehospital device capable of preventing pelvic and proximal lower limb hemorrhage by means of external aortic compression. The aim of the study was to evaluate the efficacy of the AAT. Serving soldiers under 25 years old were recruited. Basic demographic data, height, weight, blood pressure, and abdominal girth were recorded. Doppler ultrasound was used to identify blood flow in the common femoral artery (CFA). The AAT was applied while the CFA flow was continuously monitored. The balloon was inflated until flow in the CFA ceased or the maximum pressure of the device was reached. A total of 16 soldiers were recruited. All participants tolerated the device. No complications were reported. Blood flow in the CFA was eliminated in 15 out of 16 participants. The one unsuccessful subject was above average height, weight, body mass index, and abdominal girth. This study shows the AAT to be effective in the control of blood flow in the pelvis and proximal lower limb and potentially lifesaving.

Aviat Space Environ Med. 2013 Sep;84(9):907-12.

A sensitive shock index for real-time patient assessment during simulated hemorrhage.

Van Sickle C, Schafer K, Mulligan J, Grudic GZ, Moulton SL, Convertino VA.

BACKGROUND: Shock index [SI = the ratio of heart rate (HR) to systolic arterial pressure (SAP)] is a metric used to diagnose patients at risk of impending hemorrhagic shock. We hypothesized that a metric called the compensatory reserve index (CRI), derived using computer modeling with continuous feature extraction from arterial waveforms, would provide an earlier indicator of cardiovascular instability than SI during progressive central hypovolemia.

METHODS: There were 15 subjects (men = 8; women = 7) who underwent progressive reduction in central blood volume induced by lower body negative pressure (LBNP) until SAP < 90 mmHg. CRI was normalized on a scale of 1 (normovolemia) to 0 (circulatory volume at which instability occurs) and displayed on a colored bar. The times at which the CRI equaled 0.6 (threshold of green to amber) or 0.3 (threshold of amber to red) were compared to a clinical threshold of SI > or = 0.9.

RESULTS: A SI > or = 0.9 required 22.4 +/- 6.2 min (95% CI = 19 to 25.8 min). CRI reached 0.6 (amber) at 12.5 +/- 4.9 min (95% CI = 9.8 to 15.3 min) when SI = 0.61 +/- 0.03, and became 0.3 (red) at 20.3 +/- 5.1 min (95% CI = 17.5 to 23.1 min) when SI = 0.81 +/- 1.4.

CONCLUSIONS: CRI provided a significantly earlier indicator of impending hemodynamic decompensation than SI > or = 0.9 during progressive LBNP. These results support the notion that the CRI represents an improved 'shock index' as an indicator of impending hemorrhagic shock compared to standard vital signs.

J Emerg Med. 2013 Apr;44(4):784-9. doi: 10.1016/j.jemermed.2012.07.045. Epub 2012 Sep 12.

A comparison of the speed, success rate, and retention of rescue airway devices placed by first-responder emergency medical technicians: a high-fidelity human patient simulation study.

Voscopoulos C, Barker T, Listwa T, Nelson S, Pozner C, Liu X, Zane R, Antoine JA.

BACKGROUND: Current airway management for most first-responder basic emergency medical technicians (EMT-Bs) does not include the use of blind-advanced-airway devices.

OBJECTIVE: To compare the speed, success rates, and skill retention with which EMT-Bs providers can place three blind-advanced-airway devices.

METHODS: Prospective study of 43 EMT-Bs trained in the use of the Esophageal-Tracheal-Combitube(®) (ETC), King LT(®) (KLT), and Laryngeal Mask Airway(™) (LMA). The time it took each participant to place each device correctly and ventilate a human patient simulator was assessed. Primary outcome measures were the success rate of proper insertion for each device and time interval from initiation of mouth insertion to initiation of chest rise. To assess skill retention, at 3 months the providers were reassessed under exact conditions.

RESULTS: At Day 1, times required to place an ETC, LMA, and KLT were 32.7 ± 12.3, 19.2 ± 6.2, and 20.1 ± 6.6 s, respectively. Using paired t-tests, LMA and KLT were faster than ETC, $p < 0.0001$. At 3 months, pair-wise comparisons showed the ETC took longer to place than the KLT and LMA, $p < 0.0001$; and the LMA took longer to place than the KLT, $p = 0.0034$ (36.4 ± 13.1 ETC, 24.8 ± 12.4 LMA, 19.0 ± 6.9 KLT). There was no statistical difference of failures in placing any device.

CONCLUSIONS: Comparison of three rescue airway devices placed by EMT-Bs providers showed that it takes significantly longer to place an ETC compared to an LMA and KLT both on Day 1 and 3 months later. Three-month retention studies revealed that it took significantly longer to place an LMA compared to the KLT.

Air Med J. 2013 Sep-Oct;32(5):289-92. doi: 10.1016/j.amj.2013.05.001.

Prehospital use of tranexamic acid for hemorrhagic shock in primary and secondary air medical evacuation.

Vu EN, Schlamp RS, Wand RT, Kleine-Deters GA, Vu MP, Tallon JM.

INTRODUCTION: Major hemorrhage remains a leading cause of death in both military and civilian trauma. We report the use of tranexamic acid (TXA) as part of a trauma exanguination/massive transfusion protocol in the management of hemorrhagic shock in a civilian primary and secondary air medical evacuation (AME) helicopter EMS program.

METHODS: TXA was introduced into our CCP flight paramedic program in June 2011. Indications for use include age > 16 years, major trauma (defined a priori based on mechanism of injury or findings on primary survey), and heart rate (HR) > 110 beats per minute (bpm) or systolic blood pressure (SBP) < 90 mmHg. Our protocol, which includes 24-hour online medical oversight, emphasizes rapid initiation of transport, permissive hypotension in select patients, early use of blood products (secondary AME only), and infusion of TXA while en route to a major trauma center.

RESULTS: Over a 4-month period, our CCP flight crews used TXA a total of 13 times. Patients had an average HR of 111 bpm [95% CI 90.71-131.90], SBP of 91 mmHg [95% CI 64.48-118.60], and Glascow Coma Score of 7 [95% CI 4.65-9.96]. For primary AME, average response time was 33 minutes [95% CI 19.03-47.72], scene time 22 minutes [95% CI 20.23-24.27], and time to TXA administration 32 minutes [95% CI 25.76-38.99] from first patient contact. There were no reported complications with the administration of TXA in any patient.

CONCLUSION: We report the successful integration of TXA into a primary and secondary AME program in the setting of major trauma with confirmed or suspected hemorrhagic shock. Further studies are needed to assess the effect of such a protocol in this patient population.

J Trauma Acute Care Surg. 2013 Aug;75(2):220-4. doi: 10.1097/TA.0b013e3182930fd8.

Improved mortality from penetrating neck and maxillofacial trauma using Foley catheter balloon tamponade in combat.

Weppner J.

BACKGROUND: The military medical community has promoted use of Foley catheter balloon tamponade in the initial management of vascular injury owing to neck or maxillofacial trauma. The aim of the study was to compare outcomes with Foley catheter tamponade with those obtained with traditional use of external pressure.

METHODS: This retrospective cohort study evaluated all cases of persistent bleeding caused by penetrating neck or maxillofacial trauma received at one forward aid station between December 2009 and October 2011. Cohorts included those who were treated with Foley catheter tamponade and those managed with external pressure. Which treatment option was applied depended solely on the availability of Foley catheters at the time. The effectiveness of each technique in controlling initial and delayed hemorrhage is described, and the impact on mortality is analyzed using the Student's t test and Fisher's exact test.

RESULTS: Seventy-seven subjects met the inclusion criteria with 42 subjects in the Foley group and 35 subjects in the external pressure group. A statistically significant difference was found between the groups regarding delayed failure, experienced by three patients (7%) in the Foley group and nine patients (26%) in the external pressure group ($p < 0.05$). The difference in mortality, 5% (two patients) in the Foley tamponade group and 23% (eight patients) in the external pressure group, was statistically significant ($p < 0.05$).

CONCLUSION: For penetrating neck and maxillofacial injuries in a combat environment, Foley catheter balloon tamponade significantly reduced mortality when compared with direct pressure techniques through its effect on preventing delayed bleeding.