Tactical Combat Casualty Care

Journal Article Abstracts

Committee on Tactical Combat Casualty Care
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References

Abbasi J: Expanding the health care response to mass violence. JAMA 2016;Epub ahead of print

Agaronov M, DiBattista A, Christenson E, et al: Perception of low-titer group A plasma and potential barriers to using this product: a blood center's experience serving community and academic hospitals. Transfus Apher Sci 2016;Epub ahead of print

Akgül T, Büget M, Salduz A, et al: Efficacy of preoperative administration of single high dose intravenous tranexamic acid in reducing blood loss in total knee arthroplasty: a prospective clinical study. Acta Othrop Traumatol Turc 2016;Epub ahead of print

Allen C, Straker R, Murray C, et al: Recent advances in forward surgical team training at eh U.S. Army Trauma Training Department. Mil Med 2016;181:553-559

Arnaud F, Maudlin-Jeronimo E, Higgins A: Adherence evaluation of vented chest seals in a swine model. Injury 2016;Epub ahead of print

Aziz M, Brambrink A, Healy D: Success of intubation rescue techniques after failed laryngoscopy in adults: A retrospective comparative analysis from the multicenter perioperative outcomes group. Anesthesiology 2016;Epub ahead of print

Bakhshayesh P, Boutefnouchet T, Tötterman A: Effectiveness of non-invasive external pelvic compression: a systematic review of the literature. Scand J Trauma Resusc Emerg Med 2016;

Baruch E, Kragh J, Berg A, et al: Confidence-competence mismatch and reasons for failure of non-medical tourniquet users. Prehosp Emerg Care 2016:Epub ahead of print

Bassett A, Auten J, Zieber T, Lunceford N: Early, prehospital activation of the walking blood bank based on mechanism of injury improves time to fresh whole blood transfusion. J Spec Oper Med 2016;16:5-8

Baxter M, Jacobson K, Albur M: Moxifloxacin should not be discounted in the treatment of bacterial meningitis. J Infect 2016;Epub ahead of print

Baylis J, St John A, Wang X, et al: Self-propelled dressings containing thrombin and tranexamic acid improve short-term survival in swine model of lethal junctional hemorrhage. Shock 2016;Epub ahead of print

Bebarta V, Garrett N, Boudreau S, Castaneda M: A prospective, randomized trial of intravenous hydroxocobalamin versus whole blood transfusion compared to no treatment for Class III hemorrhagic shock resuscitation in a prehospital swine model. Acad Emerg Med 2015;22:321-330

Berwick D, Downey A, Cornett E: A national trauma care system to achieve zero preventable deaths after injury: recommendations from a national academies of sciences, engineering, and medicine report. JAMA 2016;316:927-928

Blackman V, Cooper B, Puntillo K, Franck L: Prevalence and predictors of prehospital pain assessment and analgesic use in military trauma patients, 2010-2013. Prehosp Emerg Care 2016;Epub ahead of print

Bonnet M, Benhamou D: Management of postpartum hemorrhage. F1000Res 2016;Epub ahead of print

Brown J, Rosengart M, Forsythe R, et al: Not all prehospital time is equal: influence of scene time on mortality. J Trauma Acute Care Surg 2016;81:93-100

Bugden S, Shean K, Scott M, et al: Skin glue reduces the failure rate of emergency department-inserted peripheral intravenous catheters: a randomized controlled trial. Ann Emerg Med 2016;68:196-201

Chang R, Cardenas J, Wade C, Holcomb J: Advances in the understanding of trauma-induced coagulopathy. Blood 2016;Epub ahead of print

Choron R, Hazelton J, Hunter K, et al: Intra-abdominal packing with laparotomy pads and QuikClot™ during damage control laparotomy: a safety analysis. Injury 2016;Epub ahead of print

Daniel Y, Habas S, Cruc M: Prehospital endotracheal intubation in warm climates: caution is required. J Emerg Med 2016;Epub ahead of print

Dunn J, Kusnezov N, Schoenfeld A, et al: Vascular injuries in combat-specific soldiers during Operation Iraqi Freedom and Operation Enduring Freedom. Ann Vasc Surg 2016;Epub ahead of print

Eastman A, Chase J, Stark B: Survival Mindset. JEMS 2016;41:35-37

Eidenbenz D, Taffé P, Hugli O, et al: A two-year retrospective review of the determinants of pre-hospital analgesia administration by alpine helicopter emergency medical physicians to patients with isolated limb injury.

Evans C, Petersen A, Meier E, et al: Prehospital traumatic cardiac arrest: management and outcomes from the resuscitation outcomes consortium epistry-trauma and PROPHET registries. J Trauma Acute Care Surg 2016;81:285-293

Farrow L, Smith T, Ashcroft G, Myint P: A systematic review of tranexamic acid in hip fracture surgery. Br J Clin Pharmacol 2016;Epub ahead of print

Feinman M. Cotton B, Haut E: Optimal fluid resuscitation in trauma: type, timing and total. Curr Opin Crit Care 2016;20:366-372

Ferguson I, Shareef M, Burns B, Reid C: A human cadaveric workshop: one solution to competence in the face of rarity. Emerg Med Australas 2016;Epub ahead of print

Fletcher J, Yerimah G, Datta G: The false security of pelvic binders: 2 cases of missed injuries due to anatomical reduction. J Orthop Case Rep 2016;6:44-47

Fox A: Examining tranexamic acid. JEMS 2016;41:52-53

Furin M, Kohn M, Overberger R, Jaslow D: Out-of-hospital surgical airway management: does scope of practice equal actual practice? West J Emerg Med 2016;17:372-376

Gerhardt C, Glassberg E, Holcomb J, et al: 2016 Military Supplement Tactical Study of Care Originating in the Prehospital Environment (TACSCOPE): acute traumatic coagulopathy on the contemporary battlefield. Shock 2016;Epub ahead of print

Gibson R, Aden J, Dubick M, Kragh J: Preliminary comparison of pneumatic models of tourniquet for prehospital control of limb bleeding in a manikin model. J Spec Oper Med 2016;16:21-27

Hart D, McNeil M, Hegarty C, et al: Literature evidence on live animal versus synthetic models for training assessing trauma resuscitation prodecures. J Spec Oper Med 2016;16:44-51

Häske D, Stuke L, Bernhard M, et al: Comparison of the prehospital trauma life support recommendations and the German national guideline on treatment of patients with severe and mutilple injuries. J Trauma Acute Care Surg 2016;81:388-393

Heldenberg E, Givon A, Simon D, et al: Civilian casualties of terror-related explosions: the impact of vascular trauma on treatment and prognosis. J Trauma Acute Care Surg 2016;Epub ahead of print

Hernandez M, Laan D, Zimmerman S, et al: Tube thoracostomy: increased angle of insertion is associated with complications. J Trauma Acute Care Surg 2016;81:366-370

Heymans F, Feigl G, Graber S, et al: Emergency cricothyrotomy performed by surgical airway-naive medical personnel: a randomized crossover study in cadavers comparing three commonly used techniques. Anesthesiology 2016;Epub ahead of print

Higgs A, Maughon M, Ruland R, Reade M: Effect of uniform design on the speed of combat tourniquet application: a simulation study. Mil Med 2016;181:753-755

High K, Brywczynski J, Guillamondegui O: Safety and efficacy of thoracostomy in the air medical environment. Air Med J 2016;35:227-230

Hiller K, Karni R, Cai C, et al: Comparing success rate of anesthesia providers versus trauma surgeons in their use of palpation to identify the cricothyroid membrane in female subjects: a prospective observational study. Can J Anesth 2016;63:807-817

Hulsebos H, Bernard J: Consider autotransfusion in the field. Mil Med 2016;181:e945-e947

Jeffcoach D, Gallegos J, Jesty S, et al: Use of CPR in hemorrhagic shock, a dog model. J Trauma Acute Care Surg 2016;81:27-33

Jernigan P, Hoehn R, Cox D, et al: What if I don't have blood? Hextend is superior to 3% saline in an experimental model of far forward resuscitation after hemorrhage. Shock 2016;Epub ahead of print

Kendigelen P, Kamalak Z, Abat D: Should warm fresh whole blood be the first choice in acute massive hemorrhage in emergency conditions. Ulus Travma Acil Cerrahi Derg 2016;22:195-198

Kheirabadi B, Miranda N, Terrazas I, et al: Influences of limited resuscitation with plasma or plasma protein solutions on hemostasis survival of rabbits with noncompressible hemorrhage. J Trauma Acute Care Surg 2016;81:42-49

Kheirabadi B, Terrazas I, Miranda N, et al: Physiological consequences of Abdominal Aortic and Juctional Tourniquet (AAJT) application to control hemorrhage in a swine model. Shock 2016;Epub ahead of print

Klein Y, Arieli I, Sagiv S, et al: Cervical spine injuries in civilian victims of explosions: should cervical collars be used? J Trauma Acute Care Surg 2016;80:985-988

Kragh J, Aden J, Shackelford S, Dubick M: Preliminary measures of instructor learning in teaching junctional tourniquet users. J Spec Oper Med 2016;16:13-15

Kragh J, Dubick M: Battlefield tourniquets: lessons learned in moving current care toward best care an army medical department at way. US Army Med Dep J. 2016 Apr-Sep:29-36

Kragh J, Lunati M, Kharod C, et al: Assessment of groin application of junctional tourniquets in a manikin model. Prehosp Disaster Med 2016;31:1-6

Le T, Orman J, Stockinger Z, et al: The military injury severity score (mISS): a better predictor of combat mortality than injury severity score (ISS). J Trauma Acute Care Surg 2016;81:114-121

Leonard J, Zietlow J, Morris D, et al: A multi-institutional study of hemostatic gauze and tourniquets in rural civilian trauma. J Trauma Acute Care Surg 2016;Epub ahead of print

Lewis C, Naumann D, Crombie N, Midwinter M: Prehospital point-of-care lactate following trauma: a systematic review. J Trauma Acute Care Surg 2016;Epub ahead of print

Lopez A: The Hartford Consensus revisited: notes from the field. J Trauma Acute Care Surg 2016;80:868-869

Maddry J, Mora A, Savell S, et al: Combat MEDEVAC: a comparison of care by provider type for en route trauma care in theater and 30-day patient outcomes. J Trauma Acute Care Surg 2016;Epub ahead of print

Melchiors J, Todsen T, Nilsson P, et al: Self-directing simulation-based training of emergency cricothyroidotomy: a route to lifesaving skills. Eur Arch Otorhinolaryngol 2016;Epub ahead of print

Mora A, Ganem V, Ervin A, et al: En route use of analgesics in non-intubated, critically ill patients transported by U.S. Air Force critical care air transport teams. Mil Med 2016;181:145-151

Morimoto Y, Sugimoto T, Haba F, Sakahira H: A new hybrid sutureless patch repair utilizing chitosan for left ventricle rupture after myocardial infarction: a case report. Int J Surg Case Rep 2016;26:131-133

Muschart X, Vincent P: What's new for tranexamic acid? J Emerg Med 2016;Epub ahead of print

Plackett T, Nielsen J, Hahn C, Rames J: Accuracy and reliability of triage at the point of injury during Operation Enduring Freedom. J Spec Oper Med 2016;16:51-56

Powell E, Hinckley W, Gottula A, et al: Shorter times to packed red blood cell transfusion are associated with decreased risk of death in traumatically injured patients. J Trauma Acute Care Surg 2016;81:458-462

Rehn M, Hyldmo P, Magnusson V, et al: Scandinavian SSAI clinical practice guideline on pre-hospital airway. Acta Anaesthesiol Scand 2016;60:852-864

Rhee P, Moore E, Jospeh B, et al: Gunshot wounds: a review of ballistics, bullets, weapons, and myths. J Trauma Acute Care Surg 2016:853-867

Rosenstock C, Nørskov A, Wettersley J, et al: Emergency surgical airway management in Denmark: a cohort study of 452,461 patients registered in the Danish Anaesthesia Database. Br J Anaesth 2016;Epub ahead of print

Schauer S, Cunningham C, DeLorenzo R: Power to the people. J Spec Oper Med 2016;16:69-71

Semler M, Rice T: Saline is not the first choice for crystalloid resuscitation fluids. Crit Care Med 2016;1541-1544

Shafi S, Collinsworth A, Richter K, et al: Bundles of care for resuscitation from hemorrhagic shock and severe brain injury in trauma patients-translating knowledge into practice. J Trauma Acute Care Surg 2016;Epub ahead of print

Smith E, Shapiro G, Sarani B: The profile of wounding in civilian public mass shooting fatalities. J Trauma Acute Care Surg 2016;81:86-92

Smith I, James R, Dretzke J, Midwinter M: Pre-hospital blood product resuscitation for trauma: a systematic review. Shock 2016;Epub ahead of print

Sondeen J, Hanson M, Prince M, et al: Double-blinded, placebo-controlled study of early tranexamic acid treatment in swine uncontrolled hemorrhage model. J Trauma Acute Care Surg 2016;80:81-88

Streijger F, Lee J, Manouchehri N, et al: Responses of the acutely injured spinal cord to vibration that simulates transport in helicopters or mine-resistant-ambush-protected vehicles. J Neurotrauma 2016;Epub ahead of print

Sztajnkrycer M, Eastman A, Butler F: Hemorrhage control saves lives no matter the wounding pattern. J Trauma Acute Care Surg 2016;Epub ahead of print

Terkawi A, Larkin S, Tsang S, et al: Effects of hydroxyethyl starch 6% (130/0.4) on blood loss during cesarean delivery: a propensity-matched analysis. J Anesth 2016;Epub ahead of print

Vardon F, Mrozek S, Geeraerts T, Fourcade O: Accidental hypothermia in severe trauma. Anaesth Crit Care Pain Med 2016;Epub ahead of print

Wafaisade A, Lefering R, Bouillon B, et al: Prehospital administration of tranexamic acid in trauma patients. Crit Care 2016;20:143

Wall P, Weasel J, Rometti M, et al: Pressures under 3.8 cm, 5.1 cm, and side-by-side 3.8 cm-wide tourniquets. J Spec Oper Med 2016

Watson J, Pati S, Schreiber M: Plasma transfusion: history, current realities and novel improvements. Shock 2016;Epub ahead of print

Williams T, Neff L, Johnson M, et al: Extending resuscitative endovascular balloon occlusion of the aorta: endovascular variable aortic control in a lethal model of hemorrhagic shock. J Trauma Acute Care Surg 2016;81:294-301

Wolfson D, Tandoh M, Jindal M, et al: Adult intraosseous access by advanced EMTs: a statewide non-inferiority study. Prehosp Emerg Care 2016;Epub ahead of print

Yazer M, Jackson B, Sperry J, et al: Initial safety and feasibility of cold-stored uncrossmatched, whole blood transfusion in civilian trauma patients. J Trauma Acute Care Surg 2016;81:21-26

Young P: Saline is the solution for crystalloid resuscitation. Crit Care Med 2016;44:1538-

Zentai C, van der Meijden P, Braunschweig T, et al: Hemostatic therapy using tranexamic acid and coagulation factor concentrates in a model of traumatic liver injury. Anesth Analg 2016;123:38-48

Zielinski M, Wilson G, Johnson P, et al: Ideal hemoglobin transfusion target for resuscitation of massive-transfusion patients. Surgery 2016;Epub ahead of print

JAMA. 2016 Sep 13;316(10):1031-3.

Expanding the Health Care Response to Mass Violence.

Abbasi J.

Quote:

"As communities adapt to intentional mass casualty events, bystander training in bleeding control—much like cardiopulmonary resuscitation training—is increasingly seen as a critical element of an integrated response. In 2015, the White House announced the "Stop the Bleed" bystander bleeding-control training campaign, which grew out of the Hartford Consensus (http://bit.ly/29JgRkv). The American Medical Association's House of Delegates adopted new policy at the 2016 Annual Meeting to encourage state medical and specialty societies to promote bleeding control training for the public and professional responders.

A fully integrated trauma response to mass violence may end in the hospital, but it starts with civilians on the scene. "Since the large-scale events such as theBostonbombing and Orlando have happened, we have seen that the folks who are there on the scene at the time of the injury will act," Piazza said. In fact, in a nationally representative survey commissioned by the Hartford Consensus committee, more than 90% of respondents said they would be likely to help someone they didn't know who was bleeding (Jacobs LM et al. J Am Coll Surg. 2016;222[5]:948-955). "If they are equipped with knowledge and the skills to improvise and provide proper care,we have perhaps a better chance of saving more lives," Piazza added."

Transfus Apher Sci. 2016 Aug;55(1):141-5.

Perception of low-titer group A plasma and potential barriers to using this product: A blood center's experience serving community and academic hospitals.

Agaronov M, DiBattista A, Christenson E, Miller-Murphy R, Strauss D, Shaz BH.

BACKGROUND: To alleviate the shortage of AB plasma, an alternative plasma product, low-titer group A plasma (LTGAP), is now available. The product is indicated for emergency transfusions when the patient's blood group has not been identified. The product's defining anti-B titers vary across institutions, and at our blood center we define <1:100 as low-titer.

METHODS: We created two surveys and emailed them to hospital blood bank managers, supervisors, and medical directors who currently use LTGAP and those that have not ordered it. We calculated the amount of LTGAP that met our <1:100 cutoff. We searched our inventory database to obtain sales of LTGAP, AB, and all other types of plasma in 2014.

RESULTS: We learned from the surveys that the product is safe and being used as indicated for only life or limb-threatening emergencies until patient's blood group is known and specific products can be provided. Most common reasons for not using LTGAP were lack of need in non-trauma hospitals and limiting capabilities in blood bank software. Although sales of LTGAP increased by ~5% by end of the first year since introduction, sales of AB plasma remained relatively steady.

CONCLUSION: LTGAP appears to be a safe alternative to group AB plasma for emergency indications. By reviewing our percentage of group A plasma units that meet our low-titer cutoff and the current interest for the product, we can reduce the amount of units we titer each day by ~30% and can readjust that amount if there is increased interest. Besides lack of familiarity and limitations in computer software to incorporate LTGAP, the steady demand for AB plasma can potentially be attributed to trauma centers ordering more AB plasma than needed and potentially wasting it in nonurgent cases to avoid outdating the product and lack of institutional guidelines on when to switch from AB to type-specific plasma resulting in excess AB plasma being transfused.

Acta Orthop Traumatol Turc. 2016 Aug;50(4):429-31

Efficacy of preoperative administration of single high dose intravenous tranexamic acid in reducing blood loss in total knee arthroplasty: A prospective clinical study.

Akgül T, Büget M, Salduz A, Edipoğlu İS, Ekinci M, Küçükay S, Şen C.

OBJECTIVE: The aim of this study was to analyze the effectiveness of a single dose of 20 mg/kg intravenous tranexamic acid (TXA), in reducing the blood loss in patients undergoing total knee arthroplasty (TKA).

MATERIAL AND METHOD: 70 patients (65.5 ± 8.1 years old) that have undergone TKA were divided in two groups. The 20 mg/kg IV TXA was given before the skin incision to one group (study group). On the control group, TKA was performed without TXA. The demographic data, body mass index, amount of bleeding and erythrocyte infusion during the operation, hemoglobin and hematocrit values (preoperative and 48th hour), the amount of drainage after the operation were compared between the groups.

RESULTS: The total amount of bleeding in the study group was 634.03 ± 182.88 ml and 1166.42 ± 295.92 ml in the control group ($p < 0.001$). Perioperative bleeding was 252.01 ± 144.13 ml in the study group and 431.33 ± 209.10 ml in the control group ($p = 0.018$). The drainage after the operation was 311.11 ± 141.64 ml at the 24th hour in the study group, 640.74 ± 279.43 ml at the 24th hour in the control group ($p < 0.001$). The drainage after 24th hour was 97.96 ± 115.86 ml in the study group and 112.96 ± 64.43 ml in the control group ($p = 0.584$).

CONCLUSION: A high, single dose of TXA intravenously given to the patient prior to the TKA significantly reduces the bleeding during the operation and within the postoperative 24 h. There is no significant change in the bleeding amount after the 24th hour following the operation.

Mil Med. 2016 Jun;181(6):553-9.

Recent Advances in Forward Surgical Team Training at the U.S. Army Trauma Training Department.

Allen CJ, Straker RJ, Murray CR, Hannay WM, Hanna MM, Meizoso JP, Manning RJ, Schulman CI, Seery JM, Proctor KG.

ABSTRACT: U.S. Army Forward Surgical Teams (FSTs) are elite, multidisciplinary units that are highly mobile, and rapidly deployable. The mission of the FST is to provide resuscitative and damage control surgery for stabilization of life-threatening injuries in austere environments. The Army Trauma Training Center began in 2001 at the University of Miami Ryder Trauma Center under the direction of COL T. E. Knuth, MC USA (Ret.), as a multimodality combination of lectures, laboratory exercises, and clinical experiences that provided the only predeployment mass casualty and clinical trauma training center for all FSTs. Each of the subsequent five directors has restructured the training based on dynamic feedback from trainees, current military needs, and on the rapid advances in combat casualty care. We have highlighted these evolutionary changes at the Army Trauma Training Center in previous reviews. Under the current director, LTC J. M. Seery, MC USA, there are new team-building exercises, mobile learning modules and simulators, and other alternative methods in the mass casualty exercise. This report summarizes the latest updates to the state of the art training since the last review.

Injury. 2016 Jun 4. pii: S0020-1383(16)30213-3.

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

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

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

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

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

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

Anesthesiology. 2016 Oct;125(4):656-66.

Success of Intubation Rescue Techniques after Failed Direct Laryngoscopy in Adults: A Retrospective Comparative Analysis from the Multicenter Perioperative Outcomes Group.

Aziz MF, Brambrink AM, Healy DW, Willett AW, Shanks A, Tremper T, Jameson L, Ragheb J, Biggs DA, Paganelli WC, Rao J, Epps JL, Colquhoun DA, Bakke P, Kheterpal S.

BACKGROUND: Multiple attempts at tracheal intubation are associated with mortality, and successful rescue requires a structured plan. However, there remains a paucity of data to guide the choice of intubation rescue technique after failed initial direct laryngoscopy. The authors studied a large perioperative database to determine success rates for commonly used intubation rescue techniques.

METHODS: Using a retrospective, observational, comparative design, the authors analyzed records from seven academic centers within the Multicenter Perioperative Outcomes Group between 2004 and 2013. The primary outcome was the comparative success rate for five commonly used techniques to achieve successful tracheal intubation after failed direct laryngoscopy: (1) video laryngoscopy, (2) flexible fiberoptic intubation, (3) supraglottic airway as part of an exchange technique, (4) optical stylet, and (5) lighted stylet.

RESULTS: A total of 346,861 cases were identified that involved attempted tracheal intubation. A total of 1,009 anesthesia providers managed 1,427 cases of failed direct laryngoscopy followed by subsequent intubation attempts (n = 1,619) that employed one of the five studied intubation rescue techniques. The use of video laryngoscopy resulted in a significantly higher success rate (92%; 95% CI, 90 to 93) than other techniques: supraglottic airway conduit (78%; 95% CI, 68 to 86), flexible bronchoscopic intubation (78%; 95% CI, 71 to 83), lighted stylet (77%; 95% CI, 69 to 83), and optical stylet (67%; 95% CI, 35 to 88). Providers most frequently choose video laryngoscopy (predominantly GlideScope [Verathon, USA]) to rescue failed direct laryngoscopy (1,122/1,619; 69%), and its use has increased during the study period.

CONCLUSIONS: Video laryngoscopy is associated with a high rescue intubation success rate and is more commonly used than other rescue techniques.

Scand J Trauma Resusc Emerg Med. 2016 May 18;24:73.

Effectiveness of non-invasive external pelvic compression: a systematic review of the literature.

Bakhshayesh P, Boutefnouchet T, Tötterman A.

INTRODUCTION: Pelvic fractures might carry a significant risk of bleeding. A wide variety of pelvic binders together with pelvic sheets are available and offer an adjunct to the initial management of poly-trauma patients with pelvic injuries. These devices are collectively referred to as pelvic circumferential compression devices (PCCDs). The aim of this study was to review the literature for evidence pertinent to the efficacy and safety of PCCDs.

METHODS: Using the PRISMA guidelines a systematic search on PubMed, Web of Science, CINAHL, Embase and Scopus was carried out. Articles included were in English language and published between 1999 and 2015. Studies included were appraised with narrative data synthesis.

RESULTS: Seven articles addressed mechanical properties of non-invasive external mechanical devices, six articles focused on physiological aspects, and three studies evaluated the pressure characteristics of these devices. We found 4 case reports regarding adverse effects. None of the studies identified addressed the cost effectiveness or pain relief issues related to the use of PCCDs.

CONCLUSIONS: Based on available literature, PCCDs are widely used in the initial management of patients with suspected pelvic bleeding. There is evidence to suggest that external compression reduces disrupted pelvic rings. There are some complications reported following application of PCCDs. Hemorrhagic source and physiological effectiveness of PCCDs needs to be addressed in future studies. In the meantime judicious application of PCCDs will continue to be recommended.

Prehosp Emerg Care. 2016 Aug 5:1-7.

Confidence-Competence Mismatch and Reasons for Failure of Non-Medical Tourniquet Users.

Baruch EN, Kragh JF, Berg AL, Aden JK, Benov A, Shina A, Shlaifer A, Ahimor A, Glassberg E, Yitzhak A.

OBJECTIVE: Tourniquet application is a lifesaving skill taught worldwide in first aid bleeding control courses. We observed performance among non-medical users of tourniquets in their confidence, competence, and reasons for failure.

METHODS: 179 Israeli military recruits without prior medical training underwent their standard first aid course where they learned Combat Application Tourniquet (CAT; Composite Resources, Rock Hill, SC, USA) use. After course completion, they self-reported confidence in tourniquet use. User performance was assessed 7-14 days later using a HapMed™ mannequin that assessed time, pressure, and blood loss. Competent performance required in aggregate: 1) use with pressure of 200 mmHg or more, 2) hemorrhage volume of less than 638 mL, and 3) correct placement of the tourniquet. For failed performance, a reason for failure was reported independently by both the user and an expert observer.

RESULTS: 45 of 179 user performances (25%) were competent. Users who reported high confidence had only a slightly higher chance of achieving competence in tourniquet application ($r = 0.17$, $p = 0.022$). The most common reason for failure was excess slack in the CAT's strap (experts 55%, users 39%), and too few turns of the windlass (23% and 31%, respectively) was the second most common reason. Expert and user evaluations had poor agreement ($\kappa = 0.44$, 95% CI 0.32-0.56).

CONCLUSION: The most common reason for failed use of tourniquets among non-medical users was excess slack in the tourniquet strap. Users self-evaluated their performance inaccurately and demonstrated a confidence-competence mismatch. These pitfalls in performance may help tourniquet instructors improve training of caregivers.

J Spec Oper Med. 2016 Summer;16(2):5-8.

Early, Prehospital Activation of the Walking Blood Bank Based on Mechanism of Injury Improves Time to Fresh Whole Blood Transfusion.

Bassett AK, Auten JD, Zieber TJ, Lunceford NL.

ABSTRACT: Balanced component therapy (BCT) remains the mainstay in trauma resuscitation of the critically battle injured. In austere medical environments, access to packed red blood cells, apheresis platelets, and fresh frozen plasma is often limited. Transfusion of warm, fresh whole blood (FWB) has been used to augment limited access to full BCT in these settings. The main limitation of FWB is that it is not readily available for transfusion on casualty arrival. This small case series evaluates the impact early, mechanism-of-injury (MOI)-based, pre-activation of the walking blood bank has on time to transfusion. We report an average time of 18 minutes to FWB transfusion from patient arrival. Early activation of the walking blood bank based on prehospital MOI may further reduce the time to FWB transfusion.

J Infect. 2016 Aug;73(2):173-4.

Moxifloxacin should not be discounted in the treatment of bacterial meningitis.

Baxter M, Jacobson K, Albur M.

Quotes:

“We would like to raise our view regarding the empirical use of a fluoroquinolone in the setting of penicillin contraindication (anaphylaxis) and in meningitis caused by penicillin and cephalosporin resistant Streptococcus pneumoniae.”

“We propose that moxifloxacin 400 mg once daily should be considered in the setting where penicillin use is contraindicated (anaphylaxis) or for isolates resistant to first line Beta lactam antibiotics.”

Shock. 2016 Sep;46(3 Suppl 1):123-8..

Self-Propelled Dressings Containing Thrombin and Tranexamic Acid Improve Short-Term Survival in a Swine Model of Lethal Junctional Hemorrhage.

Baylis JR, St John AE, Wang X, Lim EB, Statz ML, Chien D, Simonson E, Stern SA, Liggins RT, White NJ, Kastrup CJ.

ABSTRACT: Hemorrhage is the leading cause of preventable death in trauma, and hemorrhage from noncompressible junctional anatomic sites is particularly difficult to control. The current standard is QuikClot Combat Gauze packing, which requires 3 min of compression. We have created a novel dressing with calcium carbonate microparticles that can disperse and self-propel upstream against flowing blood. We loaded these microparticles with thrombin and tranexamic acid and tested their efficacy in a swine arterial bleeding model without wound compression. Anesthetized immature female swine received 5 mm femoral arteriotomies to induce severe junctional hemorrhage. Wounds were packed with kaolin-based QuikClot Combat Gauze (KG), propelled thrombin-microparticles with protonated tranexamic acid (PTG), or a non-propelling formulation of the same thrombin-microparticles with non-protonated tranexamic acid (NPTG). Wounds were not compressed after packing. Each animal then received one 15 mL/kg bolus of hydroxyethyl starch solution followed by Lactated Ringer as needed for hypotension (maximum: 100 mL/kg) for up to 3 h. Survival was improved with PTG (3-h survival: 8/8, 100%) compared with KG (3/8, 37.5%) and NPTG (2/8, 25%) ($P<0.01$). PTG animals maintained lower serum lactate and higher hemoglobin concentrations than NPTG ($P<0.05$) suggesting PTG decreased severity of subsequent hemorrhagic shock. However, total blood loss, Lactated Ringer infusion volumes, and mean arterial pressures of surviving animals were not different between groups ($P>0.05$). Thus, in this swine model of junctional arterial hemorrhage, gauze with self-propelled, prothrombotic microparticles improved survival and 2 indicators of hemorrhagic shock when applied without compression, suggesting this capability may enable better treatment of non-compressible junctional wounds.

Acad Emerg Med. 2015 Mar;22(3):321-30.

A prospective, randomized trial of intravenous hydroxocobalamin versus whole blood transfusion compared to no treatment for Class III hemorrhagic shock resuscitation in a prehospital swine model.

Bebarta VS, Garrett N, Boudreau S, Castaneda M.

OBJECTIVES: The objective was to compare systolic blood pressure (sBP) over time in swine that have had 30% of their blood volume removed (Class III shock) and treated with intravenous (IV) whole blood or IV hydroxocobalamin, compared to nontreated control animals.

METHODS: Thirty swine (45 to 55 kg) were anesthetized, intubated, and instrumented with continuous femoral and pulmonary artery pressure monitoring. Animals were hemorrhaged a total of 20 mL/kg over a 20-minute period. Five minutes after hemorrhage, animals were randomly assigned to receive 150 mg/kg IV hydroxocobalamin solubilized in 180 mL of saline, 500 mL of whole blood, or no treatment. Animals were monitored for 60 minutes thereafter. A sample size of 10 animals per group was determined based on a power of 80% and an alpha of 0.05 to detect an effect size of at least a 0.25 difference (>1 standard deviation) in mean sBP between groups. sBP values were analyzed using repeated-measures analysis of variance (RANOVA). Secondary outcome data were analyzed using repeated-measures multivariate analysis of variance (RMANOVA).

RESULTS: There were no significant differences between hemodynamic parameters of IV hydroxocobalamin versus whole blood versus control group at baseline (MANOVA; Wilks' lambda; $p = 0.868$) or immediately post-hemorrhage (mean sBP = 47 mm Hg vs. 41 mm Hg vs. 37 mm Hg; mean arterial pressure = 39 mm Hg vs. 28 mm Hg vs. 34 mm Hg; mean serum lactate = 1.2 mmol/L vs. 1.4 mmol/L vs. 1.4 mmol/L; MANOVA; Wilks' lambda; $p = 0.348$). The outcome RANOVA model detected a significant difference by time between groups ($p < 0.001$). Specifically, 10 minutes after treatment, treated animals showed a significant increase in mean sBP compared to non-treated animals (mean sBP = 76.3 mm Hg vs. 85.7 mm Hg vs. 51.1 mm Hg; $p < 0.001$). RMANOVA modeling of the secondary data detected a significant difference in mean arterial pressure, heart rate, and serum lactate ($p < 0.001$). Similar to sBP, 10 minutes after treatment, treated animals showed a significant increase in mean arterial pressure compared to non-treated animals (mean arterial pressure = 67.7 mm Hg vs. 61.4 mm Hg vs. 40.5 mm Hg). By 10 minutes, mean heart rate was significantly slower in treated animals compared to non-treated animals (mean heart rate = 97.3 beats/min vs. 95.2 beats/min vs. 129.5 beats/min; $p < 0.05$). Serum lactate, an early predictor of shock, continued to rise in the control group, whereas it did not in treated animals. Thirty minutes after treatment, serum lactate values of treated animals were significantly lower compared to non-treated animals ($p < 0.05$). This trend continued throughout the 60-minute observation period such that 60-minute values for lactate were 1.4 mmol/L versus 1.1 mmol/L versus 3.8 mmol/L. IV hydroxocobalamin produced a statistically significant increase in systemic vascular resistance compared to control, but not whole blood, with a concomitant decrease in cardiac output.

CONCLUSIONS: Intravenous hydroxocobalamin was more effective than no treatment and as effective as whole blood transfusion, in reversing hypotension and inhibiting rises in serum lactate in this prehospital, controlled, Class III swine hemorrhage model.

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

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

Berwick DM, Downey AS, Cornett EA.

Quote:

"Since antiquity, with respect to advancing the care of the injured,"war has been a very efficient schoolmaster." Innovation in trauma care has once again accelerated, spurred by the significant burden of injury from more than a decade of war in Afghanistan and Iraq. During those recent wars, the percentage of wounded service members who died of their injuries reached the lowest point in recorded wartime history — 9.3% in Afghanistan and Iraq compared with 23% during the VietnamWar. Effective bleeding-control measures, improved resuscitation techniques,and aggressive neurocritical care interventions are among many advances that saved lives on the battlefield that otherwise would have been lost. For example, an estimated 1000 to 2000 lives were saved by widespread use of tourniquets.

Military medical forces did not begin the recent wars with these capabilities. These interventions developed in response to the urgency from increasing numbers of US service members who died of potentially survivable injuries. That urgency was inconsistent with reliance on slow and costly clinical trials to inform improvements in trauma care practices. It drove the Military Health System and its nascent Joint Trauma System to embrace, instead, a culture of continuous performance improvement and a more agile approach to advancing combat casualty care."

Conclusions

"The progress made by the military's trauma system by applying learning health system principles is remarkable but fragile.Valuable wartime advances and lessons learned are at risk of being lost, and regression and inconsistency do a great disservice to the US Armed Forces service members. In addition, the hundreds of thousands of civilians who have sustained trauma deserve the benefits of care improvements achieved in military medicine. The nation should and, with proper leadership, can do better for the soldiers, sailors, airmen, and marines it sends into harm's way. And every US resident should have the best possible chance for survival and functional recovery after injury.When it comes to trauma care, where people live ought not to determine if they live."

Prehosp Emerg Care. 2016 May 19:1-15.

Prevalence and Predictors of Prehospital Pain Assessment and Analgesic Use in Military Trauma Patients, 2010-2013.

Blackman VS, Cooper BA, Puntillo K, Franck LS.

INTRODUCTION: Pain is the most common symptom in patients presenting for prehospital (PH) care. Research in civilian emergency medical systems has shown wide variability in PH pain assessment and analgesic practices, yet a minimal amount is known about pain assessment and analgesic intervention practices in the military, particularly when PH care is delivered in a combat zone.

OBJECTIVE: To describe prehospital (PH) pain care practices for U.S. military personnel injured in Iraq and Afghanistan 2010-2013 and explore potential relationships to explain variation.

METHODS: An exploratory retrospective, cross-sectional study of Department of Defense Trauma Registry data from 2010 to 2013 was performed. Demographic, clinical, or health system variables for associations with three outcomes: 1) pain assessment documentation; 2) pain severity (0-10 scale); and 3) analgesic administration (yes/no). Including only variables with significant associations, backward stepwise regression was used to develop explanatory models for each outcome.

RESULTS: Patient records (n = 3,317) were evaluated for documentation of PH pain assessment and analgesic administration. The prevalence of PH pain score documentation was 37.8% (n = 1,253). Overall, the proportion of records with PH pain scores increased over time: 19.8% (2010), 35.1% (2011), 58.2% (2012), and 62.2% (2013). Severity of pain scores ranged 0-10; mean = 5.5 (SD = 3.1); median = 6 (IQR = 3-8). Analgesics were reported for 50.8% (n = 1,684), of whom 38.3% had a pain severity score documented. The pain assessment documentation model included any documented vital signs, injury year, and mechanism of injury and explained 19.3% of the variance in documentation. The pain severity model included vital signs and injury severity score (ISS) and explained 5.0% of the variance in severity. The analgesic model included any vital signs, pain severity, trauma type, mechanism of injury, ISS, and year.

CONCLUSIONS: Pain assessment and treatment documentation improved each year, but remain suboptimal. Available data yielded poor prediction of the outcomes of interest, emphasizing the importance of individual assessment. Analgesic effectiveness could not be evaluated.

F1000Res. 2016 Jun 27;5. pii: F1000 Faculty Rev-1514.

Management of postpartum haemorrhage.

Bonnet MP, Benhamou D.

ABSTRACT: Postpartum Haemorrhage (PPH) is a major cause of maternal morbidity and mortality. Treatment of acquired coagulopathy observed in severe PPH is an important part of PPH management, but is mainly based on literature in trauma patients, and data thus should be interpreted with caution. This review describes recent advances in transfusion strategy and in the use of tranexamic acid and fibrinogen concentrates in women with PPH.

Trauma Acute Care Surg. 2016 Jul;81(1):93-100.

Not all prehospital time is equal: Influence of scene time on mortality.

Brown JB, Rosengart MR, Forsythe RM, Reynolds BR, Gestring ML, Hallinan WM, Peitzman AB, Billiar TR, Sperry JL.

BACKGROUND: Trauma is time sensitive, and minimizing prehospital (PH) time is appealing. However, most studies have not linked increasing PH time with worse outcomes because raw PH times are highly variable. It is unclear whether specific PH time patterns affect outcomes. Our objective was to evaluate the association of PH time interval distribution with mortality.

METHODS: Patients transported by emergency medical services in the Pennsylvania trauma registry from 2000 to 2013 with a total PH time (TPT) of 20 minutes or longer were included. TPT was divided into three PH time intervals: response, scene, and transport time. The number of minutes in each PH time interval was divided by TPT to determine the relative proportion each interval contributed to TPT. A prolonged interval was defined as any one PH interval contributing equal to or greater than 50% of TPT. Patients were classified by prolonged PH interval or no prolonged PH interval (all intervals < 50% of TPT). Patients were matched for TPT, and conditional logistic regression determined the association of mortality with PH time pattern, controlling for confounders. PH interventions were explored as potential mediators, and PH triage criteria used identify patients with time-sensitive injuries.

RESULTS: There were 164,471 patients included. Patients with prolonged scene time had increased odds of mortality (odds ratio, 1.21; 95% confidence interval, 1.02-1.44; p = 0.03). Prolonged response, transport, and no prolonged interval were not associated with mortality. When adjusting for mediators including extrication and PH intubation, prolonged scene time was no longer associated with mortality (odds ratio, 1.06; 95% confidence interval, 0.90-1.25; p = 0.50). Together, these factors mediated 61% of the effect between prolonged scene time and mortality. Mortality remained associated with prolonged scene time in patients with hypotension, penetrating injury, and flail chest.

CONCLUSION: Prolonged scene time is associated with increased mortality. PH interventions partially mediate this association. Further study should evaluate whether these interventions drive increased mortality because they prolong scene time or by another mechanism, as reducing scene time may be a target for intervention.

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

Ann Emerg Med. 2016 Aug;68(2):196-201.

Skin Glue Reduces the Failure Rate of Emergency Department-Inserted Peripheral Intravenous Catheters: A Randomized Controlled Trial.

Bugden S, Shean K, Scott M, Mihala G, Clark S, Johnstone C, Fraser JF, Rickard CM.

STUDY OBJECTIVE: Peripheral intravenous catheters are the most common invasive device in health care yet have very high failure rates. We investigate whether the failure rate could be reduced by the addition of skin glue to standard peripheral intravenous catheter care.

METHODS: We conducted a single-site, 2-arm, non-blinded, randomized, controlled trial of 380 peripheral intravenous catheters inserted into 360 adult patients. The standard care group received standard securement. The skin glue group received standard securement plus cyanoacrylate skin glue applied to the skin insertion site. The primary outcome was peripheral intravenous catheter failure at 48 hours, regardless of cause. Secondary outcomes were the individual modes of peripheral intravenous catheter failure: infection, phlebitis, occlusion, or dislodgement.

RESULTS: Peripheral intravenous catheter failure was 10% lower (95% confidence interval -18% to -2%; P=.02) with skin glue (17%) than standard care (27%), and dislodgement was 7% lower (95% confidence interval -13% to 0%; P=.04). Phlebitis and occlusion were less with skin glue but were not statistically significant. There were no infections.

CONCLUSION: This study supports the use of skin glue in addition to standard care to reduce peripheral intravenous catheter failure rates for adult emergency department patients admitted to the hospital.

Blood. 2016 Aug 25;128(8):1043-9.

Advances in the understanding of trauma-induced coagulopathy.

Chang R, Cardenas JC, Wade CE, Holcomb JB.

ABSTRACT: Ten percent of deaths worldwide are due to trauma, and it is the third most common cause of death in the United States. Despite a profound upregulation in procoagulant mechanisms, one-quarter of trauma patients present with laboratory-based evidence of trauma-induced coagulopathy (TIC), which is associated with poorer outcomes including increased mortality. The most common causes of death after trauma are hemorrhage and traumatic brain injury (TBI). The management of TIC has significant implications in both because many hemorrhagic deaths could be preventable, and TIC is associated with progression of intracranial injury after TBI. This review covers the most recent evidence and advances in our understanding of TIC, including the role of platelet dysfunction, endothelial activation, and fibrinolysis. Trauma induces a plethora of biochemical and physiologic changes, and despite numerous studies reporting differences in coagulation parameters between trauma patients and uninjured controls, it is unclear whether some of these differences may be "normal" after trauma. Comparisons between trauma patients with differing outcomes and use of animal studies have shed some light on this issue, but much of the data continue to be correlative with causative links lacking. In particular, there are little data linking the laboratory-based abnormalities with true clinically evident coagulopathic bleeding. For these reasons, TIC continues to be a significant diagnostic and therapeutic challenge.

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

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

Choron RL, Hazelton JP, Hunter K, Capano-Wehrle L, Gaughan J, Chovanes J, Seamon MJ(7).

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

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

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

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

J Emerg Med. 2016 Sep;51(3):262-4.

Prehospital Endotracheal Intubation in Warm Climates: Caution is Required.

Daniel Y, Habas S, Cruc M.

BACKGROUND: Out-of-hospital endotracheal intubation is a frequent procedure for trauma care. Nevertheless, in warm climates, sunlight and heat can interfere with the flow of the usual procedure. They can affect the equipment and hinder the operator. There are few data on this issue. The presentation of this case highlights three common complications that may occur when intubating under a hot and bright sun.

CASE REPORT: A 23-year-old man had a car accident in Djibouti, at 11:00 a.m., in broad sunlight. The heat was scorching. Due to a severe head trauma, with a Glasgow Coma Scale score of 8, it was decided to perform an endotracheal intubation. The operator faced three problems: the difficulty of seeing inside the mouth in the bright sunlight, the softening of the tube under the influence of the heat, and the inefficiency of colorimetric CO2 detectors in the warm atmosphere in confirming the proper endotracheal tube placement. WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?: Solutions are simple, but must be known and planned ahead, prior to beginning the procedure: Putting a jacket over his head while doing the laryngoscopy would solve the problem of dazzle; adjuncts like a stylet or gum elastic bougie have to be used at the outset to fix the softening problem; alternative methods to exhaled CO2 detection, such as the syringe aspiration technique, to confirm the proper tube placement, should be available.

Ann Vasc Surg. 2016 May 27. pii: S0890-5096(16)30364-8.

Vascular Injuries in Combat-Specific Soldiers during Operation Iraqi Freedom and Operation Enduring Freedom.

Dunn JC, Kusnezov N, Schoenfeld AJ, Orr JD, Cook PJ, Belmont PJ Jr.

BACKGROUND: This study sought to identify vascular injury patterns among combat-specific cavalry scout personnel within the Iraq and Afghanistan Wars.

METHODS: The Armed Forces Medical Examiner System and Joint Theater Trauma Registry were queried for all injuries with the cavalry scout designation from 2003 to 2011, including those both wounded in action (WIA) and killed in action (KIA). A description of vascular injury, combat causality care statistics, mechanism of injury, and demographic data were recorded.

RESULTS: Sixteen percent (n = 111) of the 701 cavalry scouts with a combat wound sustained a vascular injury. Among cavalry scouts sustaining vascular injuries, 69% were caused by an explosive mechanism of injury, 63% were KIA, and 29% had a major extremity amputation. Cavalry scout soldiers with a vascular injury were significantly more likely to result from explosion ($P < 0.0001$), be KIA ($P < 0.0001$), and occur in Iraq ($P < 0.0001$). The rate of noncompressible arterial injury was 65%. WIA cavalry scout soldiers with a compressible vascular injury with clear documentation of prehospital tourniquet utilization arrived at a Medical Treatment Facility in 67% of cases with a tourniquet in place. Of these transported with a prehospital tourniquet 83% survived.

CONCLUSIONS: The high rates of KIA and extremity amputation among cavalry scout soldiers with a vascular injury denotes the lethality of these combat injuries. Uniformly equipping soldiers with battlefield tourniquets and educating them on their prehospital use might improve the survivorship of those service members sustaining a compressible vascular injury.

JEMS. 2016 Apr;41(4):35-7.

SURVIVAL MINDSET.

Eastman AL, Chase J, Stark BJ.

Quote:

"Fourteen years of con□支ict in Afghanistan and Iraq have completely transformed battlefield trauma care in the U.S. military. The Committee on Tactical Combat Casualty Care (CoTCCC), in partnership with the National Association of EMTs (NAEMT), provides an excellent evidence-based source of medical information for EMS providers with its Tactical Combat Casualty Care (TCCC) course.

Although developed by the military, the curriculum serves as the source for which other courses, such as Tactical Emergency Casualty Care (TECC), rely on heavily. Until recently, the CoTCCC outlined a single, 16-hour course encompassing BLS and ALS interventions for individuals providing medical care in a hostile setting. Since May 2015, however, the TCCC course is now offered in two versions: an all-combatant (TCCC-AC) eight-hour course and a 16-hour medical provider (TCCC-MP) course. Like other NAEMT programs, successful completion of either option results in certification and Continuing Education Coordinating Board for Emergency Medical Services approved continuing education units.

The two distinct curriculums were developed to address requests to the CoTCCC by military medical leaders to facilitate standardized training for non-medical combatants. Both the 75th Ranger Regiment as well as the Canadian Armed Forces attributed the large reduction in preventable deaths in Afghanistan and Iraq in significant part to training all members, including non-medical combatants, in TCCC."

Anaesthesia. 2016 Jul;71(7):779-87.

A two-year retrospective review of the determinants of pre-hospital analgesia administration by alpine helicopter emergency medical physicians to patients with isolated limb injury.

Eidenbenz D, Taffé P, Hugli O, Albrecht E, Pasquier M.

ABSTRACT: Up to 75% of pre-hospital trauma patients experience moderate to severe pain but this is often poorly recognized and treated with insufficient analgesia. Using multi-level logistic regression analysis, we aimed to identify the determinants of pre-hospital analgesia administration and choice of analgesic agent in a single helicopter-based emergency medical service, where available analgesic drugs were fentanyl and ketamine. Of the 1156 patients rescued for isolated limb injury, 657 (57%) received analgesia. Mean (SD) initial pain scores (as measured by a numeric rating scale) were 2.8 (1.8), 3.3 (1.6) and 7.4 (2.0) for patients who did not receive, declined, and received analgesia, respectively ($p < 0.001$). Fentanyl as a single agent, ketamine in combination with fentanyl and ketamine as a single agent were used in 533 (84%), 94 (14%) and 10 (2%) patients, respectively. A high initial on-scene pain score and a presumptive diagnosis of fracture were the main determinants of analgesia administration. Fentanyl was preferred for pediatric patients and ketamine was preferentially administered for severe pain by physicians who had more medical experience or had trained in anesthesia.

J Trauma Acute Care Surg. 2016 Aug;81(2):285-93.

Prehospital traumatic cardiac arrest: Management and outcomes from the resuscitation outcomes consortium epistry-trauma and PROPHET registries.

Evans CC, Petersen A, Meier EN, Buick JE, Schreiber M, Kannas D, Austin MA; Resuscitation Outcomes Consortium Investigators.

BACKGROUND: Traumatic arrests have historically had poor survival rates. Identifying salvageable patients and ideal management is challenging. We aimed to (1) describe the management and outcomes of prehospital traumatic arrests; (2) determine regional variation in survival; and (3) identify Advanced Life Support (ALS) procedures associated with survival.

METHODS: This was a secondary analysis of cases from the Resuscitation Outcomes Consortium Epistry-Trauma and Prospective Observational Prehospital and Hospital Registry for Trauma (PROPHET) registries. Patients were included if they had a blunt or penetrating injury and received cardiopulmonary resuscitation. Logistic regression analyses were used to determine the association between ALS procedures and survival.

RESULTS: We included 2,300 patients who were predominately young (Epistry mean [SD], 39 [20] years; PROPHET mean [SD], 40 [19] years), males (79%), injured by blunt trauma (Epistry, 68%; PROPHET, 67%), and treated by ALS paramedics (Epistry, 93%; PROPHET, 98%). A total of 145 patients (6.3%) survived to hospital discharge. More patients with blunt (Epistry, 8.3%; PROPHET, 6.5%) vs. penetrating injuries (Epistry, 4.6%; PROPHET, 2.7%) survived. Most survivors (81%) had vitals on emergency medical services arrival. Rates of survival varied significantly between the 12 study sites ($p = 0.048$) in the Epistry but not PROPHET ($p = 0.14$) registries.Patients in the PROPHET registry who received a supraglottic airway insertion or intubation experienced decreased odds of survival (adjusted OR, 0.27; 95% confidence interval, 0.08-0.93; and 0.37; 95% confidence interval, 0.17-0.78, respectively) compared to those receiving bag-mask ventilation. No other procedures were associated with survival.

CONCLUSIONS: Survival from traumatic arrest may be higher than expected, particularly in blunt trauma and patients with vitals on emergency medical services arrival. Although limited by confounding and statistical power, no ALS procedures were associated with increased odds of survival.

LEVEL OF EVIDENCE: Prognostic study, level IV.

Br J Clin Pharmacol. 2016 Aug 4. doi: 10.1111/bcp.13079. [Epub ahead of print]

A systematic review of tranexamic acid in hip fracture surgery.

Farrow LS, Smith TO, Ashcroft GP, Myint PK.

AIM: To systematically examine and quantify the efficacy and safety of tranexamic acid in hip fracture surgery.

METHODS: A systematic literature search was conducted using Medline, EMBASE, AMED, CiNAHL, and the Cochrane Central Registry of Controlled Trials. Two assessors independently screened search outputs for potentially relevant article which met the eligibility criteria. The primary outcome measure was requirement of post-operative blood transfusion. Risk of bias assessment was performed using the Cochrane Collaboration's risk of bias tool for randomized controlled trials (RCTs) and the ROBINS-I tool for observational studies. Meta-analysis was performed to estimate risk ratio (RR), risk difference (RD) and mean difference (MD) values for dichotomous and continuous data outcomes, respectively. The interpretation of each outcome was made using the GRADE approach.

RESULTS: Of 102 studies identified, seven met the inclusion criteria including a total of 770 participants (TXA: 341; Control: 429). On meta-analysis, intravenous TXA resulted in a 46% risk reduction in blood transfusion requirement compared to a placebo/control group (RR: 0.54; 95% CI: 0.35-0.85; I(2) : 78%; Inconsistency (χ(2)) P = <0.0001; n = 750). There was also a significantly higher post-operative hemoglobin for TXA versus placebo/control (MD: 0.81; 95% CI: 0.45-1.18; I(2) : 46%; Inconsistency (χ(2)) P = 0.10; n = 638). There was no increased risk of thromboembolic events (RD: 0.01; 95% CI: -0.03, 0.05; I(2) : 68%; Inconsistency (χ(2)) P = 0.007, n = 683).

CONCLUSION: There is moderate quality evidence that TXA reduces blood transfusion in hip fracture surgery, with low quality evidence suggesting no increased risk of thrombotic events. These findings are consistent with TXA use in other orthopedic procedures.

Curr Opin Crit Care. 2014 Aug;20(4):366-72.

Optimal fluid resuscitation in trauma: type, timing, and total.

Feinman M, Cotton BA, Haut ER.

PURPOSE OF REVIEW: This review article explores the recent literature regarding the optimal type and amount of intravenous fluids for the trauma patient from the time of injury through their ICU stay. It discusses damage control principles as well as targeted resuscitation utilizing new technology.

RECENT FINDINGS: In the prehospital arena, intravenous fluids have been associated with worse patient outcomes due to increased coagulopathy and time to definitive care. Once in the trauma bay, damage control resuscitation principles apply to the severely injured patient. Large volume crystalloid infusion increases mortality. The best patient outcomes have been found with transfusion of blood products in a ratio that closely mimics whole blood. Thrombelastography is a useful adjunct in resuscitation and can help guide the judicious use of blood products. New technology can help providers ascertain when a patient is appropriately resuscitated by determining adequate global and regional perfusion.

SUMMARY: During the resuscitation of the acutely injured patient, crystalloids should be limited in favor of blood components. Damage control principles apply until definitive hemostasis is obtained, at which point the focus should change to targeted resuscitation using traditional global endpoints of resuscitation in conjunction with determinants of regional perfusion.

Emerg Med Australas. 2016 May 13. doi: 10.1111/1742-6723.12601.

A human cadaveric workshop: One solution to competence in the face of rarity.

Ferguson IM, Shareef MZ, Burns B, Reid C.

ABSTRACT: Competent performance of cricothyroidotomy, lateral canthotomy and resuscitative thoracostomy is an expected standard for Australasian emergency physicians, but infrequent exposure to these procedures could impair physician confidence, reducing the likelihood of their execution in a critical timeframe. Training to perform these procedures is a recognized challenge for non-surgeons, and cadaver-based training is one method of addressing this need. We describe a 1 day cadaver-based workshop for emergency medicine doctors and briefly report on its impact on physician confidence. This workshop appeared effective in increasing the confidence of emergency medicine physicians to carry out rarely performed life and sight-saving procedures and also provides an opportunity for senior clinicians to increase compliance with continuing profession development schemes.

J Orthop Case Rep. 2016 Jan-Mar;6(1):44-7.

The False Security of Pelvic Binders: 2 Cases of Missed Injuries due to Anatomical Reduction.

Fletcher J, Yerimah G, Datta G.

INTRODUCTION: Pelvic injuries are common in high energy trauma. It is now a standard practice to reduce the potential space for hemorrhage with the use of pelvic binders and slings in the resuscitative scenario as this has been shown to reduce mortality. Most trauma centers have CT based trauma protocols so that alongside increased awareness of pelvic injuries, there is a higher detection rate of pelvic fractures.

CASE REPORT: We present two cases of high energy pelvic injuries that were missed on initial presentation. In both the instances, pelvic binders were applied with the level of anatomical reduction being achieved meaning that pelvic injuries were missed on the initial CT scan reports.

CONCLUSION: CT scans continue to be an essential tool in the management of trauma, especially with regards to pelvic injuries. The increased availability and improvements in imaging techniques has confirmed CT scans as an important tool in the detection of life threatening injuries, resulting in a marked reduction in the overall number of pelvic fractures missed. However, these cases highlight the fact that the orthopedic surgeon should not reply on an essentially 'normal' CT scan report and when possible, one must perform an accurate clinical assessment of the patient with the involvement of a pelvic specialist at an early stage if there is any suspicion of a pelvic injury. Repeated reporting of the initial CT scan additionally reduces the incidence of missed injuries.

JEMS. 2016 May;41(5):52-3, 62.

EXAMINING TRANEXAMIC ACID.

Fox A.

CONCLUSION

The ongoing search for hemorrhage control has led the trauma community to embrace multiple methods and medications that have ultimately never panned out. In the case of TXA, the newest in a long list of medications with promise to stop nonsurgical bleeding, we've only seen one study that meets gold standard criteria for research in the form of a randomized prospective controlled trial.

In that study, however, there are multiple methodologic flaws that should provide pause to all those who might be involved with the care of the trauma patient. Additionally, we now know that all bleeding in the trauma patient isn't the same. Administering a medication without information that can currently only be provided in a trauma center can actually be harmful to our patients.

While on the surface it's easy to see why some groups have an unbridled enthusiasm for TXA, in reality, there's little at this moment to suggest its use will actually stop bleeding in all patients being taken care of in mature trauma systems. There are too many unanswered questions about the use of TXA in regions with mature trauma systems. We don't know, for example, the optimal dosing, patient population, timing, drug interactions, side effects or complications that exist in relation to our trauma patients.

Similar to what we saw with Factor VII several years ago, highly coordinated and expeditious trauma care that includes rapid transport, modern resuscitative techniques (i.e., balanced transfusions) and rapid movement of the patient to definitive treatment is what has been shown to be the major factors that contribute to success.

Although our natural tendency is a desire to provide some intervention for sick patients, the best prehospital care of the bleeding trauma patient should focus on rapid transport. Rapid delivery of a trauma patient in shock without an intervention isn't a failure of prehospital care. Ultimately, the best care of the bleeding trauma patient is in the hospital, and, until good data supports it prehospital use, TXA should be reserved for prospective studies and in-hospital use.

West J Emerg Med. 2016 May;17(3):372-6.

Out-of-Hospital Surgical Airway Management: Does Scope of Practice Equal Actual Practice?

Furin M, Kohn M, Overberger R, Jaslow D.

INTRODUCTION: Pennsylvania, among other states, includes surgical airway management, or cricothyrotomy, within the paramedic scope of practice. However, there is scant literature that evaluates paramedic perception of clinical competency in cricothyrotomy. The goal of this project is to assess clinical exposure, education and self-perceived competency of ground paramedics in cricothyrotomy.

METHODS: Eighty-six paramedics employed by four ground emergency medical services agencies completed a 22-question written survey that assessed surgical airway attempts, training, skills verification, and perceptions about procedural competency. Descriptive statistics were used to evaluate responses.

RESULTS: Only 20% (17/86, 95% CI [11-28%]) of paramedics had attempted cricothyrotomy, most (13/17 or 76%, 95% CI [53-90%]) of whom had greater than 10 years experience. Most subjects (63/86 or 73%, 95% CI [64-82%]) did not reply that they are well-trained to perform cricothyrotomy and less than half (34/86 or 40%, 95% CI [30-50%]) felt they could correctly perform cricothyrotomy on their first attempt. Among subjects with five or more years of experience, 39/70 (56%, 95% CI [44-68%]) reported 0-1 hours per year of practical cricothyrotomy training within the last five years. Half of the subjects who were able to recall (40/80, 50% 95% CI [39-61%]) reported having proficiency verification for cricothyrotomy within the past five years.

CONCLUSION: Paramedics surveyed indicated that cricothyrotomy is rarely performed, even among those with years of experience. Many paramedics felt that their training in this area is inadequate and did not feel confident to perform the procedure. Further study to determine whether to modify paramedic scope of practice and/or to develop improved educational and testing methods is warranted.

Shock. 2016 Sep;46(3 Suppl 1):104-7.

Tactical Study of Care Originating in the Prehospital Environment (Tacscope): Acute Traumatic Coagulopathy on the Contemporary Battlefield.

Gerhardt RT, Glassberg E, Holcomb JB, Mabry RL, Schreiber MB, Spinella PC.

BACKGROUND: Uncontrolled major hemorrhage and delayed evacuation remain substantial contributors to potentially survivable combat death, along with mission, environment, terrain, logistics, and hostile action. Life-saving interventions and the onset of acute traumatic coagulopathy (ATC) may also contribute.

OBJECTIVE: Analyze US casualty records from the DoD Trauma Registry, using International Normalized Ratio (INR) of 1.5 for onset of ATC.

METHODS: Retrospective cohort study from September 2007 to June 2011, inclusive. Independent variable was INR. Primary dependent variables were transfusion volume, massive transfusion (MT) defined as >10 units RBC/fresh whole blood in first 24 h, and 30-day survival. We used T test and chi-square analysis. Our IRB reviewed and exempted this study.

RESULTS: In total, 8,913 cases were available. Fifty one percent had complete data with INR. Of excluded cases, 98.9% survived, average injury severity scales (ISS) was 7 (IQR 1-8), and less than 1% received MT. Among included cases, 98.5% survived, average ISS was 10 (IQR 2-14), average INR was 1.16 (CI95 1.14-1.17), and 2.7% received MT. There were 383 cases with ATC (8.4%). After stratification, we found that ATC cases were more likely to die (odds ratio (OR) 28, CI 16-48), receive MT (OR 9.6, CI 6.4-14.4), and were acidotic (pH 7.27 (7.24-7.31) vs. 7.38 (7.38-7.39)). Other significant differences included Injury Severity Score, Revised Trauma Score, blast mechanism, and penetrating injury.

CONCLUSION: ATC is substantially associated with greater injury severity, MT, and mortality. Prehospital identification of MT casualties may expedite triage and evacuation, and enable remote damage control resuscitation to delay ATC onset and improve outcomes.

J Spec Oper Med. 2016 Summer;16(2):21-7.

Preliminary Comparison of Pneumatic Models of Tourniquet for Prehospital Control of Limb Bleeding in a Manikin Model.

Gibson R, Aden JK 3rd, Dubick MA, Kragh JF Jr.

BACKGROUND: Emergency tourniquet use has been associated with hemorrhage control and improved survival during the wars since 2001, but little is known of the differential performance of pneumatic tourniquet models. The purpose of this study was to compare the performance of three models of pneumatic tourniquets in a laboratory setting to aid a possible decision to field test suitable models for medic preference.

METHODS: A laboratory experiment was designed to test the effectiveness of tourniquets on a manikin thigh. Three models (one Emergency and Military Tourniquet [EMT] and two Tactical Pneumatic Tourniquets differing in width: 2 in. and 3 in. [TPT3]) were compared with the standard-issue Combat Application Tourniquet of a strap-and-windlass design. Two users conducted 40 tests each on a right-thigh manikin (HapMed Leg Tourniquet Trainer) with a simulated above-knee amputation injury. Measurements included effectiveness in hemorrhage control, pulse stoppage distal to the tourniquet, time to stop bleeding, blood loss, and pressure.

RESULTS: All four models were 100% effective in both hemorrhage control and pulse stoppage distal to the tourniquet. The TPT3 had the slowest mean time to stop bleeding and the highest mean blood loss. The EMT had the least mean pressure. An inter-user difference was found only for mean pressure.

CONCLUSIONS: All models of tourniquet performed equally well for both the critical outcome of effectiveness and the important outcome of pulse stoppage, whereas results for secondary outcomes (time, pressure, and blood loss) differed by model. The EMT had best performance for every type of measurement.

J Spec Oper Med. 2016 Summer;16(2):44-51.

Literature Evidence on Live Animal Versus Synthetic Models for Training and Assessing Trauma Resuscitation Procedures.

Hart D, McNeil MA, Hegarty C, Rush R Jr, Chipman J, Clinton J, Reihsen T, Sweet R.

ABSTRACT: There are many models currently used for teaching and assessing performance of trauma-related airway, breathing, and hemorrhage procedures. Although many programs use live animal (live tissue [LT]) models, there is a congressional effort to transition to the use of non-animal- based methods (i.e., simulators, cadavers) for military trainees. We examined the existing literature and compared the efficacy, acceptability, and validity of available models with a focus on comparing LT models with synthetic systems. Literature and Internet searches were conducted to examine current models for seven core trauma procedures. We identified 185 simulator systems. Evidence on acceptability and validity of models was sparse. We found only one underpowered study comparing the performance of learners after training on LT versus simulator models for tube thoracostomy and cricothyrotomy. There is insufficient data-driven evidence to distinguish superior validity of LT or any other model for training or assessment of critical trauma procedures.

J Trauma Acute Care Surg. 2016 Aug;81(2):388-93.

Comparison of the Prehospital Trauma Life Support recommendations and the German national guideline on treatment of patients with severe and multiple injuries.

Häske D, Stuke L, Bernhard M, Heller AR, Schweigkofler U, Gliwitzky B, Münzberg M.

BACKGROUND: The Prehospital Trauma Life Support (PHTLS) concept is well established throughout the world. The aim is to improve prehospital care for patients with major trauma. In 2011, a German Level 3 (S3) evidence- and consensus-based guideline on the treatment of patients with severe and multiple injuries was published. The scope of this study was the systematic comparison between the educational content of the worldwide PHTLS concept and the German S3 Guideline.

METHODS: A total of 62 key recommendations of the German S3 Guideline were compared with the content of the English PHTLS manual (eighth edition). Depending on the level of agreement, the recommendations were categorized as (1) agreement, (2) minor variation, or (3) major variation. Comparison was done via a rating system by a number of international experts in the field of out-of-hospital trauma care. The Delphi method was used to get the final statements by indistinct or board-ranged ratings.

RESULTS: Overall, there was no conformity in 12%. In 68% a total agreement and in 88% conformity with slight differences of minor variations were found between the key recommendations of the guideline and the PHTLS manual. The PHTLS primary assessment has a large conformity for the following individual priorities: airway, 92%; breathing, 92%; circulation, 63%; disability, 100%; exposure, 89%.

CONCLUSIONS: According to our comparison, the PHTLS manual is largely compatible with the German S3 Guideline from 2011. The 12% divergent statements concern mainly fluid resuscitation. Minor deviations in the prehospital care are due to a national guideline with an emergency medical service with emergency physicians (S3 Guideline) and a global PHTLS concept.

J Trauma Acute Care Surg. 2016 Sep;81(3):435-40.

Civilian casualties of terror-related explosions: The impact of vascular trauma on treatment and prognosis.

Heldenberg E, Givon A, Simon D, Bass A, Almogy G, Peleg K; Israeli Trauma Group.

OBJECTIVES: A high prevalence (10%) of vascular trauma (VT) was previously described in terror-related trauma as compared with non-terror-related trauma (1%), in a civilian setting. No data regarding outcome of VT casualties of improvised explosive device (IED) explosions, in civilian settings, are available. The aim of the current study is to present the prognosis of civilian casualties of IED explosions with and without VT.

METHODS: A retrospective analysis of the Israeli National Trauma Registry was performed. All patients in the registry from September 2000 to December 2005 who were victims of explosions were included. These patients were subdivided into patients with VT (n = 109) and non-VT (NVT) (n = 1,152). Both groups were analyzed according to mechanism of trauma, type and severity of injury, and treatment.

RESULTS: Of 1,261 explosion casualties, there were 109 VT victims (8.6%). Patients with VT tended to be more complex, with a higher injury severity score (ISS): 17.4% with ISS 16 to 24 as compared with only 10.5%. In the group of critically injured patients (ISS, 25-75), 51.4% had VT compared with only 15.5% of the NVT patients. As such, a heavy share of hospitals' resources were used-trauma bay admission (62.4%), operating rooms (91.7%), and intensive care unit beds (55.1%). The percentage of VT patients who were admitted for more than 15 days was 2.3 times higher than that observed among the NVT patients. Lower-extremity VT injuries were the most prevalent. Although many resources are being invested in treating this group of patients, their mortality rate is approximately five times more than NVT (22.9% vs. 4.9%).

CONCLUSIONS: Vascular trauma casualties of IED explosions are more complex and have poorer prognosis. Their higher ISS markedly increases the hospital's resource utilization, and as such, it should be taken into consideration either upon the primary evacuation from the scene or when secondary modulation is needed in order to reduce the burden of the hospitals receiving the casualties.

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

J Trauma Acute Care Surg. 2016 Aug;81(2):366-70.

Tube thoracostomy: Increased angle of insertion is associated with complications.

Hernandez MC, Laan DV, Zimmerman SL, Naik ND, Schiller HJ, Aho JM.

INTRODUCTION: Tube thoracostomy (TT), considered a routine procedure, has significant complications. Current recommendations for placement rely on surface anatomy. There is no information to guide operators regarding angle of insertion relative to chest wall. We aim to determine if angle of insertion is associated with complications of TT.

METHODS: We performed a retrospective review of adult trauma patients who necessitated TT at a Level I trauma center over a 2-year period (January 2012 to December 2013). Tube thoracostomies performed intraoperatively or using radiological guidance were excluded. Thoracic anteroposterior or posteroanterior radiographs were reviewed to determine the angle of insertion of TT relative to the thoracic wall. A previously validated classification method was used to categorize complications. Descriptive and univariate statistics were used to compare angle of insertion and complicated versus uncomplicated TT.

RESULTS: Review identified 154 patients who underwent a total of 246 TT placed for emergent trauma. All patients had a post-procedural chest x-ray. We identified 90 complications (37%) over the study period. One hundred forty-four of the TTs reviewed had an angle of insertion less than 45 degrees of which there were 27 complications (19%). One hundred two of the TTs had an angle greater than 45 degrees and 63 complications (62%); $p < 0.0001$.

CONCLUSIONS: Tube thoracostomy insertion is inherently dangerous. Placement of TT using a higher angle of insertion greater than 45 degrees is associated with increased complications. Further prospective studies quantifying TT angle of insertion on outcomes are needed.

LEVEL OF EVIDENCE: Therapeutic study, level

Anesthesiology. 2016 Aug;125(2):295-303.

Emergency Cricothyrotomy Performed by Surgical Airway-naive Medical Personnel: A Randomized Crossover Study in Cadavers Comparing Three Commonly Used Techniques.

Heymans F, Feigl G, Graber S, Courvoisier DS, Weber KM, Dulguerov P.

BACKGROUND: When conventional approaches to obtain effective ventilation and return of effective spontaneous breathing fail, surgical airway is the last rescue option. Most physicians have a limited lifetime experience with cricothyrotomy, and it is unclear what method should be taught for this lifesaving procedure. The aim of this study is to compare the performance of medical personnel, naive to surgical airway techniques, in establishing an emergency surgical airway in cadavers using three commonly used cricothyrotomy techniques.

METHODS: Twenty medical students, without previous knowledge of surgical airway techniques, were randomly selected from their class. After training, they performed cricothyrotomy by three techniques (surgical, Melker, and QuickTrach II) in a random order on 60 cadavers with comparable biometrics. The time to complete the procedure, rate of success, and number of complications were recorded. A success was defined as the correct placement of the cannula within the trachea in 3 min.

RESULTS: The success rates were 95, 55, and 50% for surgical cricothyrotomy, QuickTrach, and Melker, respectively (P = 0.025). The majority of failures were due to cannula misplacement (15 of 20). In successful procedures, the mean procedure time was 94 ± 35 s in the surgical group, 77 ± 34 in the QuickTrach II group, and 149 ± 24 in the Melker group (P < 0.001). Few significant complications were found in successful procedures. No cadaver biometric parameters were correlated with success of the procedure.

CONCLUSION: Surgical airway-naive medical personnel establish emergency cricothyrotomy more efficiently and safely with the surgical procedure than with the other two commonly used techniques.

Mil Med. 2016 Aug;181(8):753-5.

Effect of Uniform Design on the Speed of Combat Tourniquet Application: A Simulation Study.

Higgs AR, Maughon MJ, Ruland RT, Reade MC.

BACKGROUND: Tourniquets are issued to deployed members of both the United States (U.S. military and the Australian Defence Force (ADF). The ease of removing the tourniquet from the pocket of the combat uniform may influence its time to application. The ADF uniform uses buttons to secure the pocket, whereas the U.S. uniform uses a hook and loop fastener system. National differences in training may influence the time to and effectiveness of tourniquet application.

OBJECTIVES: To compare the time taken to retrieve and apply a tourniquet from the pocket of the Australian and the U.S. combat uniform and compare the effectiveness of tourniquet application.

METHODS: Twenty participants from both nations were randomly selected. Participants were timed on their ability to remove a tourniquet from their pockets and then apply it effectively.

RESULTS: The U.S. personnel removed their tourniquets in shorter time (median 2.5 seconds) than Australians (median 5.72 seconds, $p < 0.0001$). ADF members (mean 41.36 seconds vs. 58.87 seconds, $p < 0.037$) applied the tourniquet more rapidly once removed from the pocket and trended to apply it more effectively ($p = 0.1$).

CONCLUSIONS: The closure system of pockets on the combat uniform might influence the time taken to apply a tourniquet. Regular training might also reduce the time taken to apply a tourniquet effectively.

Air Med J. 2016 Jul-Aug;35(4):227-30.

Safety and Efficacy of Thoracostomy in the Air Medical Environment.

High K, Brywczynski J, Guillamondegui O.

OBJECTIVE: The use of thoracostomy to treat tension pneumothorax is a core skill for prehospital providers. Tension pneumothoraces are potentially lethal and are often encountered in the prehospital environment.

METHODS: The authors reviewed the prehospital electronic medical records of patients who had undergone finger thoracostomy (FT) or tube thoracostomy (TT) while under the care of air medical crewmembers. Demographic data were obtained along with survival and complications.

RESULTS: During the 90-month data period, 250 patients (18 years of age or older) underwent FT/TT, with a total of 421 procedures performed. The mean age of patients was 44.8 years, with 78.4% being male and 21.6% being female; 98.4% of patients had traumatic injuries. Cardiopulmonary resuscitation was required in 65.2% of patients undergoing FT/TT; 34.8% did not require cardiopulmonary resuscitation. Thirty percent of patients exhibited clinical improvement such as increasing systolic blood pressure, oxygen saturation, improved lung compliance, or a release of blood or air under tension. Patients who experienced complications such as tube dislodgement or empyema made up 3.4% of the cohort.

CONCLUSION: The results of this study suggest that flight crews can use FT/TT in their practice on patients with actual or potential pneumothoraces with limited complications and generate clinical improvement in a subset of patients.

Can J Anaesth. 2016 Jul;63(7):807-17.

Comparing success rates of anesthesia providers versus trauma surgeons in their use of palpation to identify the cricothyroid membrane in female subjects: a prospective observational study.

Hiller KN, Karni RJ, Cai C, Holcomb JB, Hagberg CA.

PURPOSE: The primary aim of this study was to compare the success rates of anesthesia providers vs trauma surgeons in their use of palpation to identify the cricothyroid membrane (CTM). The secondary aim was to explore whether prior training and experience performing surgical airways affected the success rates for identifying the CTM.

METHODS: Four female adults participated in this prospective observational study. The participants had varying measurements of neck anatomy that were known or theorized to affect the accuracy of identifying the CTM location. For test purposes, the subjects were positioned with optimal neck extension via placement of a shoulder roll. Anesthesia providers (n = 57) and surgeons (n = 14) of various training levels and clinical experience marked the presumed CTM location on each subject. These palpation markings were then referenced against the ultrasound-confirmed CTM location, and the success rates for identifying the CTM were compared between groups.

RESULTS: The overall success rate using palpation to identify the CTM was ≤ 50%, and there were no differences in success rates between the anesthesia providers and trauma surgeons (16% vs 26%, respectively; absolute difference, -10%; 95% confidence interval, -23 to 3; P = 0.15). Furthermore, there were no significant differences in the success rates for identifying the CTM based on either clinical experience or emergency surgical airway experience.

CONCLUSION: The success rates for identifying the CTM using palpation were low and not significantly different for anesthesia providers and surgeons, collectively, as well as for the various levels of training. Anesthesiologists' ability to mark the CTM location correctly did not improve with years of experience.

Mil Med. 2016 Aug;181(8):e945-7.

Consider Autotransfusion in the Field.

Hulsebos H, Bernard J.

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

J Trauma Acute Care Surg. 2016 Jul;81(1):27-33.

Use of CPR in hemorrhagic shock, a dog model.

Jeffcoach DR, Gallegos JJ, Jesty SA, Coan PN, Chen J, Heidel RE, Daley BJ.

INTRODUCTION: Cardiopulmonary resuscitation was designed for sudden cardiac events usually triggered by thrombotic phenomena. Despite this, it is routinely used in trauma resuscitations as per the American Heart guidelines. There is no data supporting the use of chest compressions in hemorrhagic shock. An evidence-based cardiopulmonary resuscitation (CPR) protocol has been developed for dogs. We sought to determine the effects and outcomes of chest compressions in hemorrhagic shock in a canine model.

METHODS: Eighteen dogs were randomized to three treatment groups-chest compressions only after hemorrhagic shock (CPR), CPR with fluid resuscitation after hemorrhagic shock (CPR + FLU), and fluid resuscitation alone after hemorrhagic shock (FLU). Under anesthesia, dogs were hemorrhaged until pulse was lost; they were maintained pulseless for 30 minutes and then resuscitated over 20 minutes. Vital signs and laboratory values were recorded at determined intervals. Echocardiography was performed throughout the study. Upon termination of the study, kidney, liver, heart, and brain tissue histology was evaluated for end organ damage. Statistical significance was $p < 0.05$ with a Bonferroni correction for multiple comparisons.

RESULTS: Blood loss and mean time to loss of pulse were similar between the groups. Dogs in the CPR group had significantly lower mean arterial pressure and higher pulse at all points compared to CPR + FLU and FLU ($p < 0.05$). Ejection fraction was lower in the CPR group at 5 and 10 minutes compared to the other groups ($p < 0.05$). Vital signs and laboratory results between CPR + FLU and FLU were equivalent. Two of six dogs in the CPR group died, while no dogs died in the CPR + FLU or FLU groups. Dogs in the CPR group were found to have more episodes of end organ damage.

CONCLUSION: There was no benefit to chest compressions in the hypovolemic animals. Chest compressions in addition to fluid did not reverse signs of shock better than fluid alone. Further research is needed to define if there is a role of CPR in the trauma patient with hemorrhagic shock.

Shock. 2016 Sep;46(3 Suppl 1):148-53.

What If I Don't Have Blood? Hextend is Superior to 3% Saline in an Experimental Model of Far Forward Resuscitation After Hemorrhage.

Jernigan PL, Hoehn RS, Cox D, Heyl J, Dorlac WC, Pritts TA.

INTRODUCTION: Hypertonic crystalloid solutions, colloids, and fresh whole blood (FWB) have all been proposed for prehospital resuscitation after hemorrhage. However, there are no direct comparisons of the efficacy of these different fluids. We compared Hextend, 3% hypertonic saline (HS), and FWB in a porcine model of hemorrhagic shock.

MATERIALS AND METHODS: Female swine (n=5/group) underwent splenectomy and pressure-controlled hemorrhage followed by resuscitation with Hextend, 3% HS, or FWB. They were maintained at a target mean arterial pressure (MAP) for 4 h, holding or infusing fluid as necessary. Sham animals for comparison underwent splenectomy alone.

RESULTS: The mean volume required to maintain target MAP was significantly higher for 3% HS (1,016±386 mL) than for Hextend (346±299 mL, $P<0.05$). After 4 h of resuscitation, the MAP in the 3% HS group (44±3 mmHg) was significantly lower than shams (56±7 mmHg, $P<0.05$). Three percent HS recipients had a significantly worse metabolic acidosis and anemia than shams or FWB recipients, as well as significant increases in serum sodium and chloride. Serum interleukin-6 was significantly elevated in 3% HS and FWB recipients relative to Hextend recipients (105.3±58.6 and 97.2±21 vs. 38.6±27.1 pcg/mL, $P<0.05$).

CONCLUSIONS: HS performed inferiorly to Hextend as a volume expanding resuscitative fluid after hemorrhage. On the basis of our data, we would recommend the use of Hextend over 3% saline in far forward resuscitation after hemorrhage.

Ulus Travma Acil Cerrahi Derg. 2016 Mar;22(2):195-8.

Should warm fresh whole blood be the first choice in acute massive hemorrhage in emergency conditions?

Kendigelen P, Kamalak Z, Abat D.

ABSTRACT: Early management of rapid massive hemorrhage requires early administration of blood products and rapid surgical control of bleeding. Professionals in peripheral hospitals with limited resources often work under conditions similar to those in the military. Described in the present report are 3 cases in which warm fresh whole blood (WFWB) was used in patients with massive bleeding who presented to a peripheral hospital that had no blood products suitable for emergency conditions. Described first is the case of a 16-year-old female patient who underwent emergency cesarean section. The patient had massive bleeding from the uterus due to atony. Her hemoglobin (Hb) dropped to 3.5 g/dL. Six units of WFWB were transfused during surgery. Hemodynamic parameters and complete blood count (CBC) stabilized. She was transferred from the intensive care unit (ICU) to obstetrics on day 2 and was discharged on day 7. Described second is the case of a 35-year-old female patient who also underwent emergency cesarean section, and for whom massive bleeding was due to uterine atony. Hb dropped to 2 g/dL and hematocrit (HCT) to 5.4%. Nine units of WFWB were transfused, after which hemodynamic and laboratory parameters stabilized. The patient was extubated the following day, transferred from the ICU to obstetrics on day 3, and was discharged on day 8. Described third is the case of a 36-year-old male patient with stab injuries and hemorrhagic shock who underwent emergency surgery. The patient had injuries to the right renal artery and kidney. Nine units of WFWB were transfused due to continued hemorrhage during surgery. Following surgical control of bleeding and transfusion, hemodynamic parameters improved. The patient was transferred from the ICU on day 5 and discharged on day 10. WFWB transfusion nearly disappeared from civilian medicine after blood was separated into components, and whole blood is not usually available at blood banks. In massive transfusions, WFWB effectively replaces red blood cells (RBCs), platelets, plasma volume, and coagulation factors, while preventing hypothermia and dilutional coagulopathy. Blood components go through biochemical, biomechanical, and immunological changes during long storage, the duration of which affects both transfusion efficacy and associated risks. In the future, with the use of fast donor tests, fast ABO compatibility tests, platelet-sparing leukocyte filters, and developments in pathogen-decreasing technology, fresh whole blood (FWB) may be the first choice for massive transfusion. Future studies will reveal new procedures.

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

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

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

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

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

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

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

Shock. 2016 Sep;46(3 Suppl 1):160-6.

Physiological Consequences of Abdominal Aortic and Junctional Tourniquet (AAJT) Application to Control Hemorrhage in a Swine Model.

Kheirabadi BS, Terrazas IB, Miranda N, Voelker AN, Grimm R, Kragh JF Jr, Dubick MA.

INTRODUCTION: Specialized tourniquets such as Abdominal Aortic and Junctional Tourniquet (AAJT) have been deployed for control of junctional hemorrhage with limited information concerning their efficacy and safety. We examined physiological effects of a 2-h abdominal application of AAJT to control groin hemorrhage in a swine model.

METHODS: Anesthetized pigs were subjected to 25% controlled hemorrhage and a groin arterial injury. Resulting hemorrhage from the groin wound was controlled for 2 h by applying AAJT on each pig's abdomen. After AAJT removal, the artery was repaired and blood flow was fully restored for 1 h. CT angiography and blood analyses were done and tissues collected for histology. Experiments were conducted in three groups of pigs (n=6/group): mechanically ventilated (MV); spontaneously breathing (SB); and spontaneously breathing during AAJT application but transitioned to mechanical ventilation (SB-MV) before AAJT release.

RESULTS: AAJT application produced sharp increases in blood pressure and heart rate. SB animals experienced labored and rapid respiration, but their PaO2 and PaCO2 were unaffected. Their respiration suddenly stopped when the AAJT was released requiring manual respiratory assistance. However, three pigs in SB group eventually died from cardiac and respiratory arrests, which coincided with hyperkalemia and metabolic acidosis that occurred after reflow. These changes were less severe in other groups. Other measures including increased hematocrit, tissue injury biomarkers, and kidney function indicators were similar in all groups. Histological changes were mild and reversible.

CONCLUSION: The ischemia-induced hyperkalemia and metabolic acidosis associated with AAJT application are life-threatening in spontaneously breathing subjects. Cardiopulmonary resuscitation appears necessary when AAJT is released to prevent life-threatening consequences.

J Trauma Acute Care Surg. 2016 Jun;80(6):985-8.

Cervical spine injuries in civilian victims of explosions: Should cervical collars be used?

Klein Y, Arieli I, Sagiv S, Peleg K, Ben-Galim P.

BACKGROUND: Semirigid cervical collars (SRCCs) are routinely applied to victims of explosions as part of the prehospital trauma protocols. Previous studies have shown that the use of SRCC in penetrating injuries is not justified because of the scarcity of unstable cervical spine injuries and the risk of obscuring other neck injuries. Explosion can inflict injuries by fragments penetration, blast injury, blunt force, and burns. The purpose of the study was to determine the occurrence of cervical spine instability without irreversible neurologic deficit and other potentially life-threatening nonskeletal neck injuries among victims of explosions. The potential benefits and risks of SRCC application in explosion-related injuries were evaluated.

METHODS: This is a retrospective cohort study of all explosion civilian victims admitted to Israeli hospitals during the years 1998 to 2010. Data collection was based on the Israeli national trauma registry and the hospital records and included demographic, clinical, and radiologic details of all patients with documented cervical spine injuries.

RESULTS: The cohort included 2,267 patients. All of them were secondary to terrorist attacks. SRCC was applied to all the patients at the scene. Nineteen patients (0.83%) had cervical spine fractures. Nine patients (0.088%) had unstable cervical spine injury. All but one had irreversible neurologic deficit on admission. A total of 151 patients (6.6%) had potentially life-threatening penetrating nonskeletal neck injuries.

CONCLUSION: Unstable cervical spine injuries secondary to explosion are extremely rare. The majority of unstable cervical spine fractures were secondary to penetrating injuries, with irreversible neurologic deficits on admission. The application of SRCC did not seem to be of any benefit in these patients and might pose a risk of obscuring other neck injuries. We recommend that SRCC will not be used in the prehospital management of victims of explosions.

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

J Spec Oper Med. 2016 Summer;16(2):13-5.

Preliminary Measures of Instructor Learning in Teaching Junctional Tourniquet Users.

Kragh JF Jr, Aden JK 3rd, Shackelford S, Dubick MA.

BACKGROUND: The objective of the present study was to assess the effect of instructor learning on student performance in use of junctional tourniquets.

METHODS: From a convenience sample of data available after another study, we used a manikin for assessment of control of bleeding from a right groin gunshot wound. Blood loss was measured by the instructor while training users. The data set represented a group of 30 persons taught one at a time. The first measure was a plot of mean blood loss volumes for the sequential users. The second measure was a plot of the cumulative sum (CUSUM) of mean blood loss (BL) volumes for users.

RESULTS: Mean blood loss trended down as the instructor gained experience with each newly instructed user. User performance continually improved as the instructor gained more experience with teaching. No plateau effect was observed within the 30 users. The CUSUM plot illustrated a turning point or cusp at the seventh user. The prior portion of the plot (users 1-7) had the greatest improvement; performance did not improve as much thereafter. The improvement after the seventh user was the only change detected in the instructor's trend of performance.

CONCLUSIONS: The instructor's teaching experience appeared to directly affect user performance; in a model of junctional hemorrhage, the volume of blood loss from the manikin during junctional tourniquet placement was a useful metric of instructor learning. The CUSUM technique detected a small but meaningful change in trend where the instructor learning curve was greatest while working with the first seven users.

US Army Med Dep J. 2016 Apr-Sep;(2-16):29-36.

Battlefield Tourniquets: Lessons Learned in Moving Current Care Toward Best Care in an Army Medical Department at War.

Kragh JF Jr, Dubick MA.

ABSTRACT: Bleeding prevention and control by tourniquet use by out-of-hospital caregivers is a major breakthrough in military medicine of current wars. The present review documents developments in tourniquet practices since 2001 among the US military services for aid in improving doctrine, policy, and especially care in wars to come. Tourniquets are an adjunct for resuscitation in self-care and buddy aid and today are issued to all military servicepersons who deploy into a combat zone. In the US Army, virtually every Soldier is trained in first aid tourniquet use; since 2009 they are instructed early and often to use them early and often. Despite substantial knowledge gains among the services in tourniquet use and resulting improvements in casualty survival, current evidence shows persistent difficulties in achieving best care with tourniquet use for individual trauma patients. Nevertheless, contemporary tourniquet use incorporates key lessons learned over the last 14 years of war that include: (1) tourniquet use reliably stops bleeding from limb wounds and prevents mortality in prehospital settings; and (2) brief tourniquet use appears to be safe. These 2 lessons have become so evident that civilian emergency medical systems have begun using them, albeit unevenly. Collection and interpretation of data of casualties with tourniquet use have showed that such intervention has lifesaving benefit through 2 mechanisms: control of both ongoing hemorrhage and shock severity. The next generation of interventions in bleeding control involves developing the skill sets, education, and standards of tourniquet users which may improve hemorrhage control in wars to come.

Prehosp Disaster Med. 2016 Aug;31(4):358-63.

Assessment of Groin Application of Junctional Tourniquets in a Manikin Model.

Kragh JF, Lunati MP, Kharod CU, Cunningham CW, Bailey JA, Stockinger ZT, Cap AP, Chen J, Aden JK, Cancio LC.

Introduction: To aid in preparation of military medic trainers for a possible new curriculum in teaching junctional tourniquet use, the investigators studied the time to control hemorrhage and blood volume lost in order to provide evidence for ease of use. Hypothesis Models of junctional tourniquet could perform differentially by blood loss, time to hemostasis, and user preference.

METHODS: In a laboratory experiment, 30 users controlled simulated hemorrhage from a manikin (Combat Ready Clamp [CRoC] Trainer) with three iterations each of three junctional tourniquets. There were 270 tests which included hemorrhage control (yes/no), time to hemostasis, and blood volume lost. Users also subjectively ranked tourniquet performance. Models included CRoC, Junctional Emergency Treatment Tool (JETT), and SAM Junctional Tourniquet (SJT). Time to hemostasis and total blood loss were log-transformed and analyzed using a mixed model analysis of variance (ANOVA) with the users represented as random effects and the tourniquet model used as the treatment effect. Preference scores were analyzed with ANOVA, and Tukey's honest significant difference test was used for all post-hoc pairwise comparisons.

RESULTS: All tourniquet uses were 100% effective for hemorrhage control. For blood loss, CRoC and SJT performed best with least blood loss and were significantly better than JETT; in pairwise comparison, CRoC-JETT ($P>0.5$, all models).

CONCLUSION: The CRoC and SJT performed best in having least blood loss, CRoC performed best in having least time to hemostasis, and users did not differ in preference of model. Models of junctional tourniquet performed differentially by blood loss and time to hemostasis.

J Trauma Acute Care Surg. 2016 Jul;81(1):114-21.

The Military Injury Severity Score (mISS): A better predictor of combat mortality than Injury Severity Score (ISS).

Le TD, Orman JA, Stockinger ZT, Spott MA, West SA, Mann-Salinas EA, Chung KK, Gross KR.

BACKGROUND: The Military Injury Severity Score (mISS) was developed to better predict mortality in complex combat injuries but has yet to be validated.

METHODS: US combat trauma data from Afghanistan and Iraq from January 1, 2003, to December 31, 2014, from the US Department of Defense Trauma Registry (DoDTR) were analyzed. Military ISS, a variation of the ISS, was calculated and compared with standard ISS scores.Receiver operating characteristic curve, area under the curve, and Hosmer-Lemeshow statistics were used to discriminate and calibrate between mISS and ISS. Wilcoxon-Mann-Whitney, t test and χ tests were used, and sensitivity and specificity calculated. Logistic regression was used to calculate the likelihood of mortality associated with levels of mISS and ISS overall.

RESULTS: Thirty thousand three hundred sixty-four patients were analyzed. Most were male (96.8%). Median age was 24 years (interquartile range [IQR], 21-29 years). Battle injuries comprised 65.3%. Penetrating (39.5%) and blunt (54.2%) injury types and explosion (51%) and gunshot wound (15%) mechanisms predominated. Overall mortality was 6.0%.Median mISS and ISS were similar in survivors (5 [IQR, 2-10] vs. 5 [IQR, 2-10]) but different in non-survivors, 30 (IQR, 16-75) versus 24 (IQR, 9-23), respectively ($p < 0.0001$). Military ISS and ISS were discordant in 17.6% (n = 5,352), accounting for 56.2% (n = 1,016) of deaths. Among cases with discordant severity scores, the median difference between mISS and ISS was 9 (IQR, 7-16); range, 1 to 59. Military ISS and ISS shared 78% variability (R = 0.78).Area under the curve was higher in mISS than in ISS overall (0.82 vs. 0.79), for battle injury (0.79 vs. 0.76), non-battle injury (0.87 vs. 0.86), penetrating (0.81 vs. 0.77), blunt (0.77 vs. 0.75), explosion (0.81 vs. 0.78), and gunshot (0.79 vs. 0.73), all $p < 0.0001$. Higher mISS and ISS were associated with higher mortality. Compared with ISS, mISS had higher sensitivity (81.2 vs. 63.9) and slightly lower specificity (80.2 vs. 85.7).

CONCLUSION: Military ISS predicts combat mortality better than does ISS.

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

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

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

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

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

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

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

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

LEVEL OF EVIDENCE: Therapeutic study, level V.

J Trauma Acute Care Surg. 2016 Oct;81(4):748-55.

Prehospital point-of-care lactate following trauma: A systematic review.

Lewis CT, Naumann DN, Crombie N, Midwinter MJ.

BACKGROUND: Serum lactate serves as a surrogate marker for global tissue hypoxia following traumatic injury and has potential to guide resuscitation. Portable, handheld point-of-care monitoring devices enable lactate values to be readily available in the prehospital environment. The current review examines the utility of prehospital lactate (pLa) measurement in the management of trauma.

METHODS: MEDLINE and EMBASE databases were searched using predefined criteria (pLa measurement, trauma patients) until March 10, 2016. Studies were examined for lactate measurement as an intervention, prognostic indicator, and utilization in the guidance of goal-directed therapy. The Newcastle-Ottawa Scale was used to assess risk of bias, and quality of evidence was evaluated using the Grading of Recommendations, Assessment, Development, and Evaluation system. Data were unsuitable for meta-analysis and are presented in narrative form.

RESULTS: Of 2,415 articles of interest, seven met the inclusion criteria, all of which were observational studies, including 2,085 trauma patients. Lactate sampling techniques, timings, and thresholds were heterogeneous. No studies used pLa to guide intervention. Elevated pLa may be an independent prognostic marker of critical illness in trauma patients, particularly in blunt trauma. Prehospital lactate measurement may be more sensitive than systolic blood pressure in determining need for resuscitative care. Early lactate measurement may be particularly useful in the detection of occult hypoperfusion, with elevated pLa detectable within 30 minutes of injury. All current studies were assessed as being of "low" or "very low" quality and were at risk of bias. Considerable logistical barriers to pLa measurement exist.

CONCLUSIONS: Prehospital point-of-care lactate monitoring for trauma has been variably performed. There is a paucity of evidence relating to its use. The limited data available show feasibility and potential clinical utility, and further investigation is warranted to establish whether lactate might give meaningful guidance during prehospital triage and trauma patient resuscitation.

LEVEL OF EVIDENCE: Systematic review, level IV.

J Trauma Acute Care Surg. 2016 Jun;80(6):868-9.

The Hartford Consensus revisited: Notes from the field.

Lopez A Jr.

Quotes:

“I am a police officer for a major metropolitan city in the United States. On December 8, 2015, I was critically injured in the line of duty. After several major surgeries and spending several weeks in the hospital, I was introduced to a particular article in the Journal titled, ‘‘Improving survival from active shooter events: the Hartford Consensus.’’

“December 8 started as a regular shift for me on patrol. I was assigned to the Narcotics Team, and my main duties were to proactively seek out narcotics users and dealers. At approximately 11:21 AM, I conducted a traffic stop on a vehicle for several traffic violations. As the vehicle pulled over, the front seat passenger rapidly exited and began to run away. I began to exit my patrol unit, and as I did, I was immediately struck by three .45-caliber handgun bullets.”

“One of my fellow officers was the first person to arrive on scene. This officer is a veteran of our armed forces and has had combat medical training. In addition, he was prepared to save lives - he had a tourniquet on his pistol belt. This officer correctly applied the tourniquet to my left leg and was able to control the bleeding. The ambulance was next to arrive on scene, and the paramedics quickly cut away my clothing and evaluated my injuries. The paramedics then quickly applied tourniquets to my left arm and right thigh. The paramedics and my fellow officer loaded me into the rear of the ambulance and transported me to the hospital. Once at the hospital, the paramedics explained to the emergency department doctors what my injuries were and what they had done to aide in saving my life up to that point. I was taken into emergency surgery, and thanks to the surgeons, my life was saved, as were all of my appendages.”

“It is easy to see how the Hartford Consensus recommendations can be applied to my critical incident and to any critical incident where traumatic injuries are present. As long as first responders are properly trained and equipped with the tourniquet, there is no reason that lives cannot be saved by these important pieces of medical equipment. I owe my life to the first officer on scene who quickly applied the tourniquet to my left thigh.”

J Trauma Acute Care Surg. 2016 May 27.

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

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

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

METHODS: We conducted an IRB approved, retrospective record review of patients traumatically injured in combat, evacuated by MEDEVAC from the point of injury POI, between 2011 and 2014. Data abstracted included injury description, provider type, procedures performed, medications administered, survival, and 30-day outcomes. Subjects were grouped according to provider type: Medics, Paramedics, and ADV (advanced providers to include nurses, physician assistants, and physicians). Groups were compared. Analyses were performed using chi-square tests for categorical variables and ANOVA tests (Kruskal-Wallis tests) for continuous variables. A p-value < 0.05 was considered significant.

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

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

LEVEL OF EVIDENCE: Level III, therapeutic.

Eur Arch Otorhinolaryngol. 2016 Jul 5.

Self-directed simulation-based training of emergency cricothyroidotomy: a route to lifesaving skills.

Melchiors J, Todsen T, Nilsson P, Kohl AP, Bøttger M, Charabi B, Konge L, von Buchwald C.

ABSTRACT: The emergency cricothyroidotomy (EC) is a critical procedure. The high cost of failures increases the demand for evidence-based training methods. The aim of this study was to present and evaluate self-directed video-guided simulation training. Novice doctors were given an individual 1-h simulation training session. One month later, an EC on a cadaver was performed. All EC's were video recorded. An assessment tool was used to rate performance. Performance was compared with a pass/fail level for the EC. We found a high reliability, based on Pearson's r (0.88), and a significant progression of skill during training ($p < 0.001$). Eleven out of 14 succeeded in creating an airway on the cadaver in 64 s (median, range 39-86 s), but only four achieved a passing score. Our 1-h training protocol successfully raised the competence level of novice doctors; however, the training did not ensure that all participants attained proficiency.

Mil Med. 2016 May;181(5 Suppl):145-51.

En Route Use of Analgesics in Nonintubated, Critically Ill Patients Transported by U.S. Air Force Critical Care Air Transport Teams.

Mora AG, Ganem VJ, Ervin AT, Maddry JK, Bebarta VS.

INTRODUCTION: U.S. Critical Care Air Transport Teams (CCATTs) evacuate critically ill patients with acute pain in the combat setting. Limited data have been reported on analgesic administration en route, and no study has reported analgesic use by CCATTs. Our objective was to describe analgesics used by CCATTs for nonintubated, critically ill patients during evacuation from a combat setting.

METHODS: We conducted an institutional review board-approved, retrospective review of CCATT records. We included nonintubated, critically ill patients who were administered analgesics in flight and were evacuated out of theater (2007-2012). Demographics, injury description, analgesics and anesthetics, and predefined clinical adverse events were recorded. Data were presented as mean ± standard deviation or percentage (%).

RESULTS: Of 1,128 records, we analyzed 381 subjects with the following characteristics: age 26 ± 7.0 years; 98% male; and 97% trauma (70% blast, 17% penetrating, 11% blunt, and 3% burn). The injury severity score was 19 ± 9. Fifty-one percent received morphine, 39% hydromorphone, 15% fentanyl, and 5% ketamine. Routes of delivery were 63% patient-controlled analgesia (PCA), 32% bolus intravenous (IV) administration, 24% epidural delivery, 21% continuous IV infusions, and 9% oral opioids. Patients that were administered local anesthetics (nerve block or epidural delivery) with IV opioids received a lower total dose of opioids than those who received opioids alone. No differences were associated between analgesics and frequency of complications in flight or postflight.

CONCLUSION: About half of nonintubated, critically ill subjects evacuated out of combat by CCATT received morphine and more than half had a PCA. In our study, ketamine was not frequently used and pain scores were rarely recorded. However, we detected an opioid-sparing effect associated with local anesthetics (regional nerve blocks and epidural delivery).

Int J Surg Case Rep. 2016;26:131-3.

A new hybrid sutureless patch repair utilizing chitosan for left ventricle rupture after myocardial infarction: A case report.

Morimoto Y, Sugimoto T, Haba F, Sakahira H.

INTRODUCTION: There are many publications reporting the use of TachoSil sheets for sutureless repair. Trauma doctors have recently reported that chitosan-based sheets can efficiently achieve hemostasis for active bleeding.

PRESENTATION OF CASE: An 85-year-old man was diagnosed with left ventricle free wall rupture that caused cardiac tamponade and cardiogenic shock. Extracorporeal membrane oxygenator (ECMO) was started immediately and surgical repair was planned. Bleeding occurred from a 1-cm tear in the center of the necrotic area in the territory of the left circumflex artery. The tear was treated with a chitosan-based HemCon Bandage. After hemostasis of the myocardium was achieved, the bandage was peeled off and a patch repair was performed using collagen fleece with fibrinogen-based impregnation. His condition subsequently improved. The tracheal tube was extubated and ECMO was removed 2days after the surgery. One month later, the patient had no complications at his postoperative follow-up visit.

DISCUSSION: To our knowledge, this is the first report of a hybrid patch repair utilizing chitosan-based sheets for a left ventricle rupture after myocardial infarction. Further studies are necessary to evaluate the short- and long-term efficacy of this procedure, and these results must be compared with those of classical surgical repairs.

CONCLUSION: The new hybrid sutureless patch utilizing chitosan was demonstrated as safe, easy and effective.

J Emerg Med. 2016 Sep;51(3):332-3.

What's New for Tranexamic Acid?

Muschart X, Vincent P.

Quotes:

“The Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage (CRASH)-2 study, with more than 20,000 patients, showed that, compared with a placebo, survival was higher when TXA was given shortly after accidents involving massive bleeding. Administration of TXA (1 g in 10 m, followed by further administration of a 1-g dose over the next 8 h) should hence be considered as soon as possible (within 3 h) for patients with blood loss from trauma.”

“In summary, TXA is a most useful drug, with a substantial cost–benefit ratio. It is inexpensive and easy to administer, while having few contraindications. In light of its many attributes, TXA is included in the list of essential medicines that has been compiled by the World Health Organization.”

J Spec Oper Med. 2016 Spring;16(1):51-6.

Accuracy and Reliability of Triage at the Point of Injury During Operation Enduring Freedom.

Plackett TP, Nielsen JS, Hahn CD, Rames JM.

BACKGROUND: Accurate point-of-injury reports and casualty evacuation requests allow for optimal resource utilization. However, the accuracy of these reports has not been previously studied.

METHODS: All trauma patients treated at one of three forward surgical elements (FSE) in Western Afghanistan during May-August 2012 were prospectively included. North American Treaty Organization (NATO) 9-line medical evacuation request and mechanism, injuries, signs, and treatments (MIST) reports were compared to the initial findings on arrival to the FSE.

RESULTS: There were 179 casualty evacuation reports and 298 patients. NATO 9-line and/or MIST reports were available for 70% of these. Triage was accurate for 77%, but there was 17% overtriage and 6% undertriage (k = .619). The number of patients was accurate in 95% of reports, the mechanism of injury was accurate for 98%, and the body region involved was accurate for 92% (k = .850, .943, and .870, respectively). There was no difference between the mean vital signs at the point of injury or on arrival at the FSE. When analyzed individually, however, there was no correlation between each casualty's pulse, mean arterial pressure, or respiratory rate between the two time points.

DISCUSSION: There was a high degree of correlation between the triage category of casualty evacuation reports and the patient's actual medical needs. There was also a highly significant association with the number of patients, mechanism of injury, and bodily injuries. However, there was discordance between the vital signs at an individual level, which may represent regression toward the resuscitation threshold.

J Trauma Acute Care Surg. 2016 Sep;81(3):458-62.

Shorter times to packed red blood cell transfusion are associated with decreased risk of death in traumatically injured patients.

Powell EK, Hinckley WR, Gottula A, Hart KW, Lindsell CJ, McMullan JT.

BACKGROUND: Hemorrhage is a leading cause of death in traumatically injured patients. Currently, the importance of earlier administration of packed red blood cells (pRBC) to improve outcomes is limited. We evaluated the association of earlier pRBC administration and mortality when compared with later transfusion initiation.

METHODS: This single-center retrospective cohort study of trauma patients transported by a single helicopter service from the scene of injury to an urban academic trauma center included patients receiving at least one unit of pRBC within 24 hours of hospital arrival. The final cohort included patients transported to the trauma center between March 11, 2010, and October 30, 2013. The helicopter service carries two units of pRBC for protocol-driven prehospital transfusion. Logistic regression was used to model odds of death, and 95% confidence intervals were calculated.

RESULTS: The 94 patients meeting inclusion criteria had a mean (SD) age of 43 (19) years; 87 (93%) of 94 were white, 66 (70%) of 94 were male, and 88(94%) of 94 sustained blunt force injuries. Median Injury Severity Score was 29 (range, 2-75), and 31 (33%) of 94 died within 30 days. Most patients [82/94 (87%)] received their first pRBC transfusion during transport or within one hour of arrival at the emergency department (ED). For the 82 patients receiving a first pRBC transfusion within one hour of ED arrival, each 10-minute increase in time to transfusion increased the odds of death [OR, 1.27 (95% CI, 1.01-1.62; p = 0.044)], controlling for TRISS. At 30 days, 29/82 (35%) patients who received a pRBC transfusion within one hour of ED arrival, and 2 (16%) of 12 patients who received delayed transfusion were deceased (difference, 19%; 95% CI, -5% to 42%).

CONCLUSION: In this study, delays in time to pRBC administration of as short a 10 minutes were associated with increased odds of death for patients receiving ultra-early pRBC transfusion. Expedient prehospital and ED transfusion capabilities may improve outcomes after trauma.

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

Acta Anaesthesiol Scand. 2016 Aug;60(7):852-64.

Scandinavian SSAI clinical practice guideline on pre-hospital airway management.

Rehn M, Hyldmo PK, Magnusson V, Kurola J, Kongstad P, Rognås L, Juvet LK, Sandberg M.

BACKGROUND: The Scandinavian society of anaesthesiology and intensive care medicine task force on pre-hospital airway management was asked to formulate recommendations following standards for trustworthy clinical practice guidelines.

METHODS: The literature was systematically reviewed and the grading of recommendations assessment, development and evaluation (GRADE) system was applied to move from evidence to recommendations.

RESULTS: We recommend that all emergency medical service (EMS) providers consider to: apply basic airway manoeuvres and airway adjuncts (good practice recommendation); turn unconscious non-trauma patients into the recovery position when advanced airway management is unavailable (good practice recommendation); turn unconscious trauma patients to the lateral trauma position while maintaining spinal alignment when advanced airway management is unavailable [strong recommendation, low quality of evidence (QoE)]. We suggest that intermediately trained providers use a supraglottic airway device (SAD) or basic airway manoeuvres on patients in cardiac arrest (weak recommendation, low QoE). We recommend that advanced trained providers consider using an SAD in selected indications or as a rescue device after failed endotracheal intubation (ETI) (good practice recommendation). We recommend that ETI should only be performed by advanced trained providers (strong recommendation, low QoE). We suggest that videolaryngoscopy is considered for ETI when direct laryngoscopy fails or is expected to be difficult (weak recommendation, low QoE). We suggest that advanced trained providers apply cricothyroidotomy in 'cannot intubate, cannot ventilate' situations (weak recommendation, low QoE).

CONCLUSION: This guideline for pre-hospital airway management includes a combination of techniques applied in a stepwise fashion appropriate to patient clinical status and provider training.

J Trauma Acute Care Surg. 2016 Jun;80(6):853-67.

Gunshot wounds: A review of ballistics, bullets, weapons, and myths.

Rhee PM, Moore EE, Joseph B, Tang A, Pandit V, Vercruysse G.

Quotes:

"….the purpose of this review was to provide the fundamental facts regarding gunshot wounds, ballistics, bullets, and weapons."

"Muzzle velocity is defined as the speed at which the bullet leaves the barrel of the weapon and is used to calculate the muzzle energy, which equates to wounding potential. It is important to keep in mind that bullets do not accelerate after leaving the barrel of the weapon. A bullet discharged downward does technically accelerate because of forces of gravity, but friction has more of a negative effect on the bullet than the positive effect of gravity. Thus, the kinetic energy of the bullet generally decreases after firing at a logarithmic rate. As a result, the energy of impact on the target object is also determined by the distance of the target object from the muzzle of the gun. The farther an object is from the muzzle of the weapon, the less energy is imparted to that object."

"Thus, both mass and velocity contribute to the energy of the projectile. Mass or size of the bullet is directly proportional to the resulting energy, while the square of its velocity is directly related to the overall energy of the projectile. As a result, for a constant velocity, if the mass is doubled, then the energy is doubled. However, the velocity of the bullet is a more important determinant of tissue injury because if the velocity of the bullet is doubled, the energy increases four times (Table 3). Gunshot wounds are classified according to the speed of the projectile, as low, medium, or high velocity."

Br J Anaesth. 2016 Sep;117 Suppl 1:i75-i82.

Emergency surgical airway management in Denmark: a cohort study of 452,461 patients registered in the Danish Anaesthesia Database.

Rosenstock CV, Nørskov AK, Wetterslev J, Lundstrøm LH; Danish Anaesthesia Database.

BACKGROUND: The emergency surgical airway (ESA) is the final option in difficul airway management. We identified ESA procedures registered in the Danish Anaesthesia Database (DAD) and described the performed airway management.

METHODS: We extracted a cohort of 452,461 adult patients undergoing general anaesthesia and tracheal intubation from the DAD from June 1, 2008 to March 15, 2014. Difficult airway management involving an ESA was retrieved for analysis and compared with hospitals files. Two independent reviewers evaluated airway management according to the ASAs'2003 practice guideline for difficult airway management.

RESULTS: In the DAD cohort 27 out of 452,461 patients had an ESA representing an incidence of 0.06 events per thousand (95% CI; 0.04 to 0.08). A total of 12,149/452,461 patients underwent Ear-Nose and Throat (ENT) surgery, giving an ESA incidence among ENT patients of 1.6 events per thousand (95% CI; 1.0-2.4). A Supraglottic Airway Device and/or the administration of a neuromuscular blocking agent before ESA were used as a rescue in 6/27 and 13/27 of the patients, respectively. In 19/27 patients ENT surgeons performed the ESA's and anaesthetists attempted 6/27 of the ESAs of which three failed. Reviewers evaluated airway management as satisfactory in 10/27 patients.

CONCLUSIONS: The incidence of ESA in the DAD cohort was 0.06 events per thousand. Among ENT patients, the ESA Incidence was 1.6 events per thousand. Airway management was evaluated as satisfactory for 10/27 of the patients. ESA performed by anaesthetists failed in half of the patients.

J Spec Oper Med. 2016 Spring;16(1):69-71.

Power To The People.

Schauer SG, Cunningham CW, DeLorenzo RA.

Quotes:

“Unlike many military skills, application of medical skills requires an even greater degree of cognitive performance that stresses the more difficult “why,” even more than the mechanics of the “how,” making degradation occur at an even greater pace. In essence, the 68W is denied a clinical ladder within the MOS that both recognizes and rewards advancement in lifesaving skills and proficiency in battlefield medicine.”

“We propose three strategies:

1. A follow-through on the warrior culture within Medical Command that embraces advanced training for Combat Medics in all units and especially within the MTFs. Priority should be given for implementation of high-quality courses designed to train and certify lifesaving skills for Medics.
2. Change policy to reflect promotional credit for Medics who achieve and verify advanced medical training, such as AEMT, Paramedic, or Critical Care Flight Medic.
3. Establishment of clinical awards and a recognition system within units and MTFs that are designed to highlight the clinical accomplishments of enlisted Medics.

If fully implemented, these and similar strategies can achieve a strong swing within the clubs already in the bag, and, importantly, position the Medic to fully exploit the material advancements in the pipeline.”

Crit Care Med 2016 Aug;44(8):1541-4. doi: 10.1097/CCM.0000000000001941.

Saline Is Not the First Choice for Crystalloid Resuscitation Fluids.

Semler MW, Rice TW

Quote:

"With 154 mmol/L each of sodium and chloride, saline is isotonic to extracellular fluid but contains a chloride concentration 50% higher than plasma and a strong ion difference of zero (Table 1). As a result, rapid administration of large volumes of saline reliably produces a hyperchloremic metabolic acidosis (2). In contrast, the chemical composition of balanced crystalloids is designed to approximate that of extracellular fluid (Table 1). By replacing a portion of the chloride content with bicarbonate, or rapidly metabolized/excreted organic anions, such as L-lactate, acetate, or gluconate, balanced crystalloids provide a more physiologic chloride concentration and strong ion difference. These differences in crystalloid composition have long been known to affect patients' serum chloride levels and acid-base balance, but mounting data suggest that crystalloid choice may also directly impact organ function and even survival."

CONCLUSION:

"Millions of liters of IV crystalloid are given to critically ill patients across the world every year, most of it saline. If balanced crystalloids produce even slightly better outcomes than saline, the result could be lower morbidity and mortality for thousands of patients. A large randomized trial comparing saline to balanced crystalloids (in a manner that carefully accounts for patients' baseline risk and "dose" of fluid exposure) is urgently needed. Until such a definitive trial is completed, the similar availability and cost of each crystalloid, established safety of balanced crystalloids, and mounting concerns about acidosis, acute kidney injury, and mortality with saline argue that saline should not be the first choice fluid for crystalloid resuscitation."

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

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

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

BACKGROUND: Hemorrhagic shock and traumatic brain injury (TBI) are the 2 leading causes of death after injuries. Evidence-based practice guidelines for managing patients with these conditions have been developed, but their adoption remains suboptimal. Bundles of care for other conditions have been shown to improve compliance with evidence-based practices and patient outcomes. We sought to develop evidence-based bundles of care for early management of hemorrhagic shock and severe TBI.

METHODS: We conducted a literature review to identify current treatment recommendations and supporting evidence for hemorrhagic shock and severe TBI. A multispecialty panel of 14 experienced surgeons, physicians, nurses and a former trauma patient reviewed the recommendations. The Delphi method was used to reach consensus.

RESULTS: After an extensive literature review and three rounds of the Delphi process, the panel recommended 5 interventions for managing each condition. The bundle for resuscitation from hemorrhagic shock include: 1) Activate massive transfusion protocol; 2) Measure lactate or base deficit upon arrival; 3) Transfuse packed red blood cells, plasma, and platelets in a 1:1:1 ratio; 4) Measure coagulopathy using viscoelastic methods upon arrival; and 5) Do not use large volume crystalloid resuscitation. The bundle for early management of severe TBI included: 1) Avoid and treat hypoxia; 2) Avoid and treat hypotension; 3) Avoid excessive hyperventilation; 4) Evaluate and treat intracranial hypertension; and 5) Do not use steroids.

CONCLUSIONS: We have proposed 2 evidence-based bundles of care for the early management of injured patients presenting with hemorrhagic shock and severe TBI. Further studies are needed to assess implementation of these bundles and their impact on patient outcomes.

LEVEL OF EVIDENCE: Level III (Therapeutic/Care Management)

J Trauma Acute Care Surg. 2016 Jul;81(1):86-92.

The profile of wounding in civilian public mass shooting fatalities.

Smith ER, Shapiro G, Sarani B.

BACKGROUND: The incidence and severity of civilian public mass shootings (CPMS) continue to rise. Initiatives predicated on lessons learned from military woundings have placed strong emphasis on hemorrhage control, especially via use of tourniquets, as means to improve survival. We hypothesize that both the overall wounding pattern and the specific fatal wounds in CPMS events are different from those in military combat fatalities and thus may require a new management strategy.

METHODS: A retrospective study of autopsy reports for all victims involved in 12 CPMS events was performed. Civilian public mass shootings was defined using the FBI and the Congressional Research Service definition. The site of injury, probable site of fatal injury, and presence of potentially survivable injury (defined as survival if prehospital care is provided within 10 minutes and trauma center care within 60 minutes of injury) was determined independently by each author.

RESULTS: A total 139 fatalities consisting of 371 wounds from 12 CPMS events were reviewed. All wounds were due to gunshots. Victims had an average of 2.7 gunshots. Relative to military reports, the case fatality rate was significantly higher, and incidence of potentially survivable injuries was significantly lower. Overall, 58% of victims had gunshots to the head and chest, and only 20% had extremity wounds. The probable site of fatal wounding was the head or chest in 77% of cases. Only 7% of victims had potentially survivable wounds. The most common site of potentially survivable injury was the chest (89%). No head injury was potentially survivable. There were no deaths due to exsanguination from an extremity.

CONCLUSION: The overall and fatal wounding patterns following CPMS are different from those resulting from combat operations. Given that no deaths were due to extremity hemorrhage, a treatment strategy that goes beyond use of tourniquets is needed to rescue the few victims with potentially survivable injuries.

LEVEL OF EVIDENCE: Prognostic/epidemiologic study, level IV; therapeutic/care management study, level V.

Shock. 2016 Jul;46(1):3-16.

Prehospital Blood Product Resuscitation for Trauma: A Systematic Review.

Smith IM, James RH, Dretzke J, Midwinter MJ.

INTRODUCTION: Administration of high ratios of plasma to packed red blood cells is a routine practice for in-hospital trauma resuscitation. Military and civilian emergency teams are increasingly carrying prehospital blood products (PHBP) for trauma resuscitation. This study systematically reviewed the clinical literature to determine the extent to which the available evidence supports this practice

METHODS: Bibliographic databases and other sources were searched to July 2015 using keywords and index terms related to the intervention, setting, and condition. Standard systematic review methodology aimed at minimizing bias was used for study selection, data extraction, and quality assessment (protocol registration PROSPERO: CRD42014013794). Synthesis was mainly narrative with random effects model meta-analysis limited to mortality outcomes.

RESULTS: No prospective comparative or randomized studies were identified. Sixteen case series and 11 comparative studies were included in the review. Seven studies included mixed populations of trauma and non-trauma patients. Twenty-five of 27 studies provided only very low quality evidence. No association between PHBP and survival was found (OR for mortality: 1.29, 95% CI: 0.84-1.96, P=0.24). A single study showed improved survival in the first 24 h. No consistent physiological or biochemical benefit was identified, nor was there evidence of reduced in-hospital transfusion requirements. Transfusion reactions were rare, suggesting the short-term safety of PHBP administration.

CONCLUSIONS: While PHBP resuscitation appears logical, the clinical literature is limited, provides only poor quality evidence, and does not demonstrate improved outcomes. No conclusions as to efficacy can be drawn. The results of randomized controlled trials are awaited.

J Trauma Acute Care Surg. 2016 Jan;80(1):81-8.

Double-blinded, placebo-controlled study of early tranexamic acid treatment in swine uncontrolled hemorrhage model.

Sondeen JL, Hanson MA, Prince MD, de Guzman R, Polykratis IA, Aden JK 3rd, Cap AP, Dubick MA.

BACKGROUND: Tranexamic acid (TXA) is an antifibrinolytic drug that was shown to increase survival in trauma patients, but the mechanisms remain unclear. The purpose of this double-blinded, randomized placebo-controlled study was to determine if TXA with hypotensive resuscitation with Hextend (HEX) or fresh frozen plasma (FFP) reduced blood loss (BL) and improved survival in a model of uncontrolled hemorrhage.

METHODS: Instrumented, anesthetized pigs (n = 11 per group) were subjected to 24-mL/kg controlled hemorrhage, followed by transection of the spleen. After 15 minutes of bleeding, TXA (1.43 mg/kg/min) or normal saline (NS) was given over 10 minutes, and then 15-mL/kg HEX or FFP was administered. At 90 minutes, a second infusion of TXA or NS was given. BL, coagulation status, and 5-hour survival were determined. Tissue plasminogen activator (tPA) was added to blood samples collected before and after TXA administration to confirm that the TXA inhibited fibrinolysis. In addition, a comparison of a dose response to tPA-induced fibrinolysis was made between swine and human plasma in vitro.

RESULTS: TXA prevented the rise in d-dimers that occurred after spleen injury. However, there was no significant effect of TXA on survival or BL compared with NS with HEX (HEX + NS, 17 ± 2 mL/kg vs. HEX + TXA, 17 ± 2 mL/kg) or FFP (FFP + NS, 7 ± 2 mL/kg vs. FFP + TXA, 12 ± 3 mL/kg), while FFP significantly reduced BL and increased survival compared with HEX in the NS-treated animals. The tPA-induced fibrinolysis was inhibited in the blood from TXA-treated animals, yet in fibrinolysis sensitivity studies, human plasma was 30 times more sensitive to tPA-induced fibrinolysis than swine plasma.

CONCLUSION: TXA did not reduce BL, even though TXA was antifibrinolytic in the pigs. The possibility remains that the pig is highly resistant to fibrinolysis and not a good model to study the effects of antifibrinolytics or that fibrinolysis is not a major factor in bleeding from splenic injury.

J Neurotrauma. 2016 Jul 5. [Epub ahead of print]

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

Streijger F, Lee JH, Manouchehri N, Melnyk AD, Chak J, Tigchelaar S, So K, Okon EB, Jiang S, Kinsler R, Barazanji K, Cripton PA, Kwon BK.

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

J Trauma Acute Care Surg. 2016 Oct;81(4):806-7.

Hemorrhage control saves lives no matter the wounding pattern.

Sztajnkrycer MD, Eastman AL, Butler FK.

Quotes:

"We read with interest the article by Smith et al entitled "The profile of wounding in civilian public mass shooting fatalities". This paper brings much needed data to a complex and highly charged topic. The authors are to be commended for the robust effort of obtaining and analyzing 139 autopsy reports from 12 different events. Their findings will aid in further development of the medical response to these events."

"The rapid control of extremity hemorrhage is intuitive and simple for civilian lay providers to perform, and therefore as the authors note should not be discounted. Improved external hemorrhage control techniques have been the major factor in reducing the number of preventable deaths in combat casualties during the prehospital phase of care. Both the American College of Surgeons and the American College of Emergency Physicians have joined the US Military in recommending that tourniquets and hemostatic dressings be a high-priority component of prehospital trauma care."

"The goal in prehospital trauma care is to ensure that every life that can be saved is saved. Emergency personnel and the general public should not solely prepare for mass shooting events, but rather should take an all-hazards approach to safety and preparedness in mass violence events. Prehospital trauma care in both the military and civilian sectors should continue to emphasize tourniquets and hemostatic dressings as valuable tools for controlling external hemorrhage and ensuring that preventable deaths among trauma victims, including those injured in active shooter and terrorist bombing incidents, are eliminated to the greatest extent possible."

J Anesth. 2016 Oct;30(5):796-802.

Effects of hydroxyethyl starch 6 % (130/0.4) on blood loss during cesarean delivery: a propensity-matched analysis.

Terkawi AS, Larkin SK, Tsang S, Sheeran JS, Tiouririne M.

BACKGROUND: Hydroxyethyl starch is commonly used in the obstetric patient population to prevent hypotension during cesarean delivery. Evidence suggests hetastarch is associated with a dysfunction in coagulation cascade. We hypothesized that hetastarch use to prevent spinal hypotension during cesarean delivery would be associated with an increase in blood loss when compared to crystalloid use.

METHODS: We performed a retrospective review of patients who underwent elective cesarean delivery under spinal anesthesia at the University of Virginia between 2011 and 2014. Data from 819 patients was used. Blood loss was the primary outcome. Propensity score-matching was used to match patients who received hetastarch (treatment group) with those who did not receive hetastarch (control group).

RESULTS: Genetic matching resulted in 196 patients in the hetastarch group and 182 patients in the control group. There was no difference in estimated blood loss ($p = 0.068$), calculated blood loss ($p = 0.720$), total intraoperative fluid intake ($p = 0.289$), urine output ($p = 0.421$), Apgar 1 min ($p = 0.830$), Apgar 5 min ($p = 0.138$), phenylephrine consumption ($p = 0.742$), postoperative day 1 (POD1) hematocrit ($p = 0.070$) and POD1 platelets ($p = 0.233$). However, there was a statistically significant difference (but clinically irrelevant) in hematocrit difference between the day of admission and POD1 (mean difference 0.47, $p = 0.024$), and ephedrine consumption (mean difference 2 mg, $p = 0.017$) in favor of the control group.

CONCLUSIONS: Our study did not find an association between increased perioperative blood loss and hetastarch use in patients presenting for elective cesarean delivery.

Anaesth Crit Care Pain Med. 2016 May 13. pii: S2352-5568(16)30030-3.

Accidental hypothermia in severe trauma.

Vardon F, Mrozek S, Geeraerts T, Fourcade O.

ABSTRACT: Hypothermia, along with acidosis and coagulopathy, is part of the lethal triad that worsen the prognosis of severe trauma patients. While accidental hypothermia is easy to identify by a simple measurement, it is no less pernicious if it is not detected or treated in the initial phase of patient care. It is a multifactorial process and is a factor of mortality in severe trauma cases. The consequences of hypothermia are many: it modifies myocardial contractions and may induce arrhythmias; it contributes to trauma-induced coagulopathy; from an immunological point of view, it diminishes inflammatory response and increases the chance of pneumonia in the patient; it inhibits the elimination of anaesthetic drugs and can complicate the calculation of dosing requirements; and it leads to an over-estimation of coagulation factor activities. This review will detail the pathophysiological consequences of hypothermia, as well as the most recent principle recommendations in dealing with it.

Crit Care. 2016 May 12;20(1):143.

Prehospital administration of tranexamic acid in trauma patients.

Wafaisade A, Lefering R, Bouillon B, Böhmer AB, Gäßler M, Ruppert M; Trauma Register DGU.

BACKGROUND: Evidence on prehospital administration of the antifibrinolytic tranexamic acid (TXA) in civilian trauma populations is scarce. The aim was to study whether prehospital TXA use in trauma patients was associated with improved outcomes.

METHODS: The prehospital database of the ADAC (General German Automobile Club) Air Rescue Service was linked with the TraumaRegister of the German Trauma Society to reidentify patients documented in both registries. Primarily admitted trauma patients (2012 until 2014) who were treated with TXA during the prehospital phase were matched with patients who had not received prehospital TXA, applying propensity score-based matching.

RESULTS: The matching yielded two identical cohorts (n = 258 in each group), since there were no significant differences in demographics or injury characteristics (mean Injury Severity Score 24 ± 14 [TXA] vs. 24 ± 16 [control]; p = 0.46). The majority had sustained blunt injury (90.3 % vs. 93.0 %; p = 0.34). There were no differences with respect to prehospital therapy, including rates of intubation, chest tube insertion or both administration of i.v. fluids and catecholamines. During ER treatment, the TXA cohort received fewer numbers of red blood cells and plasma units, but without reaching statistical significance. Incidences of organ failure, sepsis or thromboembolism showed no significant differences as well, although data were incomplete for these parameters. Early mortality was significantly lower in the TXA group (e.g., 24-h mortality 5.8 % [TXA] vs. 12.4 % [control]; p = 0.01), and mean time to death was 8.8 ± 13.4 days vs. 3.6 ± 4.9 days, respectively (p = 0.001). Overall hospital mortality was similar in both groups (14.7 % vs. 16.3 %; p = 0.72). The most pronounced mortality difference was observed in patients with a high propensity score, reflecting severe injury load.

CONCLUSIONS: This is the first civilian study, to our knowledge, in which the effect of prehospital TXA use in trauma patients has been examined. TXA was associated with prolonged time to death and significantly improved early survival. Until further evidence emerges, the results of this study support the use of TXA during prehospital treatment of severely injured patients.

J Spec Oper Med. 2016 Summer;16(2):28-35.

Pressures Under 3.8 cm, 5.1 cm, and Side-by-Side 3.8 cm-Wide Tourniquets.

Wall PL, Weasel J, Rometti M, Birkholz S, Gildemaster Y, Grulke L, Sahr SM, Buising CM.

BACKGROUND: Applications of wider tourniquet are expected to occlude arterial flow at lower pressures. We examined pressures under 3.8cm-wide, 5.1cm-wide, and side-by-side-3.8cm-wide nonelastic strap-based tourniquets.

METHODS: Ratcheting Medical Tourniquets (RMT) were applied mid-thigh and mid-arm for 120 seconds with Doppler-indicated occlusion. The RMTs were a Single Tactical RMT (3.8cm-wide), a Wide RMT (5.1cm-wide), and Paired Tactical RMTs (7.6cm-total width). Tightening completion was measured at one-tooth advance past arterial occlusion, and paired applications involved alternating tourniquet tightening.

RESULTS: All 96 applications on the 16 recipients reached occlusion. Paired tourniquets had the lowest occlusion pressures ($\rho < .05$). All pressures are given as median mmHg, minimum-maximum mmHg. Thigh application occlusion pressures were Single 256, 219-299; Wide 259, 203-287; Distal of Pair 222, 183-256; and Proximal of Pair 184, 160-236. Arm application occlusion pressures were Single 230, 189-294; Wide 212, 161-258; Distal of Pair 204, 193-254, and Proximal of Pair 168, 148-227. Pressure increases with the final tooth advance were greater for the 2 teeth/cm Wide than for the 2.5 teeth/cm Tacticals ($\rho < .05$). Thigh final tooth advance pressure increases were Single 40, 33-49; Wide 51, 37-65; Distal of Pair 13, 1-35; and Proximal of Pair 15, 0-30. Arm final tooth advance pressure increases were Single 49, 41-71; Wide 63, 48-77; Distal of Pair 3, 0-14; and Proximal of Pair 23, 2-35. Pressure decreases occurred under all tourniquets over 120 seconds. Thigh pressure decreases were Single 41, 32-75; Wide 43, 28-62; Distal of Pair 25, 16-37; and Proximal of Pair 22, 15-37. Arm pressure decreases were Single 28, 21-43; Wide 26, 16-36; Distal of Pair 16, 12-35; and Proximal of Pair 12, 5-24. Occlusion losses before 120 seconds occurred predominantly on the thigh and with paired applications ($\rho < .05$). Occlusion losses occurred in six Paired thigh applications, two Single thigh applications, and one Paired arm application.

CONCLUSIONS: Side-by-side tourniquets achieve occlusion at lower pressures than single tourniquets. Additionally, pressure decreases under tourniquets over time; so all tourniquet applications require reassessments for continued effectiveness.

Shock. 2016 Jul 1. [Epub ahead of print]

Plasma Transfusion: History, Current Realities and Novel Improvements.

Watson JJ, Pati S, Schreiber MA.

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

J Trauma Acute Care Surg. 2016 Aug;81(2):294-301.

Extending resuscitative endovascular balloon occlusion of the aorta: Endovascular variable aortic control in a lethal model of hemorrhagic shock.

Williams TK, Neff LP, Johnson MA, Ferencz SA, Davidson AJ, Russo RM, Rasmusse TE.

BACKGROUND: The duration of use and efficacy of resuscitative endovascular balloon occlusion of the aorta (REBOA) is limited by distal ischemia. We developed a hybrid endovascular-extracorporeal circuit variable aortic control (VAC) device to extend REBOA duration in a lethal model of hemorrhagic shock to serve as an experimental surrogate to further the development of endovascular VAC (EVAC) technologies.

METHODS: Nine Yorkshire-cross swine were anesthetized, instrumented, splenectomized, and subjected to 30% liver amputation. Following a short period of uncontrolled hemorrhage, REBOA was instituted for 20 minutes. Automated variable occlusion in response to changes in proximal mean arterial pressure was applied for the remaining 70 minutes of the intervention phase using the automated extracorporeal circuit. Damage-control surgery and whole blood resuscitation then occurred, and the animals were monitored for a total of 6 hours.

RESULTS: Seven animals survived the initial surgical preparation. After 20 minutes of complete REBOA, regulated flow was initiated through the extracorporeal circuit to simulate VAC and provide perfusion to distal tissue beds during the 90-minute intervention phase. Two animals required circuit occlusion for salvage, while five animals tolerated sustained, escalating restoration of distal blood flow before surgical hemorrhage control. Animals tolerating distal flow had preserved renal function, maintained proximal blood pressure, and rapidly weaned from complete REBOA.

CONCLUSION: We combined a novel automated, extracorporeal circuit with complete REBOA to achieve EVAC in a swine model of uncontrolled hemorrhage. Our approach regulated proximal aortic pressure, alleviated supranormal values above the balloon, and provided controlled distal aortic perfusion that reduced ischemia without inducing intolerable bleeding. This experimental model serves as a temporary surrogate to guide future EVAC catheter designs that may provide transformational approaches to hemorrhagic shock.

Prehosp Emerg Care. 2016 Aug 5:1-7. [Epub ahead of print]

Adult Intraosseous Access by Advanced EMTs: A Statewide Non-Inferiority Study.

Wolfson DL, Tandoh MA, Jindal M, Forgione PM, Harder VS.

OBJECTIVE: Intraosseous (IO) access is increasingly being used as an alternative to peripheral intravenous access, which is often difficult or impossible to establish in critically ill patients in the prehospital setting. Until recently, only Paramedics performed adult IO access. In 2014, Vermont Emergency Medical Services (EMS) expanded the Advanced Emergency Medical Technicians (AEMTs) scope of practice to include IO access in adult patients. This study compares successful IO access in adults performed by AEMTs compared to Paramedics in the prehospital setting.

METHODS: All Vermont EMS patient encounters between January 1, 2013 and November 30, 2015 were examined, and 543 adult patients with a documented IO access insertion attempt were identified. The proportion of successful IO insertions was compared between AEMTs and Paramedics using a Chi-Squared statistic and a non-inferiority test.

RESULTS: There was no significant difference in the percentage of successful IO access between AEMTs and Paramedics [95.2% and 95.6%, respectively; P = 0.84]. The confidence interval around this 0.4% difference (95% confidence interval = -4.2, 3.2) was within a pre-specified delta of ±10% indicating non-inferiority of AEMTs compared to Paramedics.

CONCLUSIONS: This study's finding that successful IO access was not different among AEMTs and Paramedics lends evidence in support of expanding the scope of practice of AEMTs to include establishing IO access in adults.

J Trauma Acute Care Surg. 2016 Jul;81(1):21-6.

Initial safety and feasibility of cold-stored uncrossmatched whole blood transfusion in civilian trauma patients.

Yazer MH, Jackson B, Sperry JL, Alarcon L, Triulzi DJ, Murdock AD.

BACKGROUND: The transfusion of cold-stored uncrossmatched whole blood (WB) has not been extensively used in civilian trauma resuscitation. This report details the initial experience with the safety and feasibility of using WB in this setting after a change of practice at a Level 1 trauma center was instituted.

METHODS: Up to two units of uncrossmatched group O positive WB that was leukoreduced using a platelet-sparing filter from male donors were transfused to male trauma patients with hypotension secondary to bleeding. Hemolytic marker haptoglobin and reports of transfusion reactions in these patients were followed. Additionally, transfusion volumes and outcomes were compared to a historical cohort of male trauma patients who received at least one red blood cell (RBC) unit, but not WB, during the first 24 hours of admission.

RESULTS: There were 47 WB patients who were transfused with a mean (SD) of 1.74 (0.61) WB units. The median haptoglobin concentration on post-WB transfusion Day 1 was 25.1 (9.3) mg/dL in 7 of 30 non-group O recipients. No adverse reactions in temporal relation to the WB transfusions were reported. There were 145 male historical control patients identified who were resuscitated with component therapy; the median volume of incompatible plasma transfused to the WB versus component therapy group was not significantly different (1,000 vs. 800 mL, respectively; $p = 0.38$); the mean plasma:RBC (0.99 [0.47] vs. 0.77 [0.73], respectively; $p = 0.006$) and platelet:RBC (0.72 [0.40] vs. 0.51 [0.734], respectively; $p < 0.0001$) ratios were significantly higher in the WB group.

CONCLUSION: Transfusion of two units of cold-stored uncrossmatched WB is feasible and seems to be safe in civilian trauma resuscitation. Determining the efficacy of WB with regard to reducing the number of blood products transfused in the first 24 hours or improving recipient survival will require a larger randomized trial.

LEVEL OF EVIDENCE: Therapeutic study, level IV.

Crit Care Med 2016 Aug;44(8):1538-40. doi: 10.1097/CCM.0000000000001844.

Saline Is the Solution for Crystalloid Resuscitation.

Young P

Quote:

"Saline (0.9%) is the dominant IV crystalloid fluid in North America (23). Fundamentally, this is a debate about where the threshold for practice change lies. I submit that the current level of evidence falls far below that threshold. The substantial and important work described in the studies outlined in this "Viewpoint" has paved the way for a definitive large-scale randomized controlled trial. The Australian and New Zealand Intensive Care Society Clinical Trials Group will soon begin enrolling patients into the Plasma-Lyte 148 versUs saline (PLUS) trial, an 8,800 participant double-blind randomized controlled trial with a primary end point of day 90 mortality. PLUS will definitively establish the relative efficacy and safety of buffered crystalloid compared with 0.9% saline in critically ill patients with high mortality risk. Until the results of PLUS are known, 0.9% saline should remain the first choice for crystalloid fluid resuscitation. It is a choice supported by level I evidence (5, 12). The alternatives are fluids that have either not been shown to be superior to saline in randomized controlled trials in critically ill patients (i.e., Plasma-Lyte 148) (13) or have not been tested in large-scale randomized controlled trials at all (e.g., Ringer lactate). Saline is the first choice crystalloid fluid and is supported by 150 years of clinical experience (24). Our options are to stick with what is tried and tested or to change to more expensive fluids on the basis of inductive physiologic reasoning and observational data that are subject to bias and confounding."

Anesth Analg. 2016 Jul;123(1):38-48.

Hemostatic Therapy Using Tranexamic Acid and Coagulation Factor Concentrates in a Model of Traumatic Liver Injury.

Zentai C, van der Meijden PE, Braunschweig T, Hueck N, Honickel M, Spronk HM, Rossaint R, Grottke O.

BACKGROUND: The potential clinical benefits of targeted therapy with coagulation factor concentrates (e.g., fibrinogen) and antifibrinolytic agents (e.g., tranexamic acid [TXA]) for the treatment of trauma-induced coagulopathy are increasingly recognized. We hypothesized that human fibrinogen concentrate (FC) and prothrombin complex concentrate (PCC), administered as combined therapy with TXA, would provide additive effects for reducing blood loss in an animal trauma model.

METHODS: Thirty-six pigs were subjected to 2 consecutive blunt liver injuries, resulting in severe hemorrhagic shock and coagulopathy. Intervention comprised saline (control group); TXA (15 mg kg, TXA group); TXA and FC (90 mg kg, TXA-FC); or TXA, FC, and PCC (20 U kg, TXA-FC-PCC). Blood loss, thromboelastometry (ROTEM), measures of thrombin generation, platelet activation, and global coagulation variables were monitored for 4 hours. Tissue sections were examined to determine the occurrence of thromboembolic events.

RESULTS: Total blood loss was similar in the TXA-FC and TXA-FC-PCC groups (mean ± SD: 1012 ± 86 mL and 1037 ± 118 mL, respectively; P = 1.000). These values were both lower (P < 0.001) than the TXA group (1579 ± 306 mL). Blood loss in all 3 intervention groups was lower (P < 0.001) than in the control group (2376 ± 478 mL). After trauma and resuscitation, but before study intervention, plasma fibrinogen levels were severely depleted (median for the whole study population: 66 mg dL; interquartile range: 51-108 mg dL) and clot strength was decreased (EXTEM whole-blood maximum clot firmness [MCF]: 53 ± 5 mm). Compared with controls, TXA inhibited fibrinolysis and stabilized MCF and clotting time. The addition of FC restored and stabilized hemostasis to a greater extent than TXA alone; the addition of PCC had no statistically significant impact on blood loss, clot strength (MCF), or clotting time, but it increased thrombin generation. There were no significant differences among the study groups regarding platelet activation. No thrombi or microthrombi were observed in any group at necropsy.

CONCLUSIONS: The early use of TXA and FC reduced blood loss and improved coagulation measurements in a porcine model of blunt liver injury and hemorrhagic shock. FC, administered in addition to TXA, was highly effective in reducing blood loss. The lack of statistically significant reduction in blood loss when PCC was added to TXA and FC may be attributable to the absence of thrombin generation impairment in this model.

Surgery. 2016 Jul 20. pii: S0039-6060(16)30197-0.

Ideal hemoglobin transfusion target for resuscitation of massive-transfusion patients.

Zielinski MD, Wilson GA, Johnson PM, Polites SF, Jenkins DH, Harmsen WS, Holcomb JB, Wade CE, Del Junco DJ, Fox EE, Stubbs JR.

BACKGROUND: Overtransfusion of packed red blood cells is known to increase the risk of death in stable patients. With the delineation of minimum transfusion ratios in hemorrhaging patients complete, attention must be turned to the other end of the massive transfusion spectrum-that of defining the maximum transfusion of packed red blood cells. We aimed to define the ideal hemoglobin range 24 hours after anatomic hemostasis associated with the lowest mortality.

METHODS: Massive-transfusion patients (≥10 units packed red blood cells within 24 hours) were reviewed from 2010-2013. The hemoglobin 24 ± 6 hours after anatomic hemostasis was used to stratify patients into undertransfusion (<8.0 g/dL), hemoglobin transfusion target (8.0-11.9 g/dL), and overtransfusion (>12.0 g/dL) groups; patients not surviving to 24 hours were excluded.

RESULTS: We identified 418 patients (351 [84%] in the hemoglobin transfusion target group, 38 [9%] in the undertransfusion group, and 29 [7%] in the overtransfusion group) with an overall mortality of 18%. Undertransfusion patients had the greatest risk of death (odds ratio 3.3; 95% confidence interval 1.6-6.7) followed by overtransfusion patients (odds ratio 2.5; 95% confidence interval 1.1-5.6). Though pretransfusion hemoglobin was similar (9.5 ± 2.2 g/dL vs 9.5 ± 2.3 g/dL), overtransfusion patients had greater hemoglobin values during massive transfusion (8.3 ± 3.0 g/dL vs 6.9 ± 1.4 g/dL), persisting until hospital dismissal/death (11.4 ± 2.3 g/dL vs 9.6 ± 1.1 g/dL). In total, 657.4 excess packed red blood cell units were transfused (1.9 ± 1.5 per patient).

CONCLUSION: Overtransfusion patients had increased mortality, comparable to undertransfusion patients, despite younger age and fewer comorbidities. Shorter massive transfusion durations foster a scenario in which patients are at greater risk of overtransfusion.