Tactical Combat Casualty Care

Journal Article Abstracts

Committee on Tactical Combat Casualty Care
May 2019

References

Anderson K, Mora A, Bloom A, et al: Cardiac massage for trauma patients in the battlefield: An assessment for survivors. Resuscitation 2019 May;138:20-27

Andolfatto G, Innes K, Dick W, et al: Prehospital Analgesia With Intranasal Ketamine (PAIN-K): A Randomized Double-Blind Trial in Adults. Ann Emerg Med. 2019 Mar 27. pii: S0196-0644(19)30102-7

Antosh I, McGrane O, Capan E, et al: Improvised Ground Evacuation Platforms for Austere Special Operations Casualty Transport. J Spec Oper Med. Spring 2019;19:48-51

Aydin A, Bilge S, Aydin C, et al: The success of endotracheal intubation with a modified laryngoscope using night vision goggles. Ulus Travma Acil Cerrahi Derg 2018;24:97-103

Bailey J, Fisher A, Yazer M, et al: Changes in donor antibody titer levels over time in a military group O low-titer whole blood program. Transfusion. 2019 Apr;59:1499-1506

Barr J, Montgomery S: Helicopter MEDEVAC in the Korean War: did it matter? J Trauma Acute Care Surg 2019;Epub ahead of print

Benov A, Shkolnik I, GLassberg E, et al: Prehospital trauma experience of the Israel Defense Forces on the Syrian border 2013-2017. J Trauma Acute Care Surg 2019;Epub ahead of print

Bergese S, Melson T, Candiotti K, et al: A phase 3, randomized, placebo-controlled evaluation of the safety of intravenous meloxicam following major surgery. Clin Pharmacol Drug Dev 2019;Epub ahead of print

Bertoglio P, Guerrera F, Viti A, et al: Chest drain and thoracotomy for chest trauma. J Thorac Dis 2019;11:S186-S191

Beyer C, Johnson M, Galante J, DuBose J: Zones matter: hemodynamic effects of zone 1 vs zone 3 resuscitative endovascular balloon occlusion of the aorta placement in trauma patients. Injury. 2019;50:855-858

Braun J, Gertz S, Furer A, et al: The Promising Future of Drones in Prehospital Medical Care and its Application to Battlefield Medicine. J Trauma Acute Care Surg. 2019;Epub ahead of print

Butler F, Giebner S: Committee on Tactical Combat Casualty Care Meeting: San Antonio, TX 5-6 September 2018 Meeting Minutes. J Spec Oper Med. Spring 2019;19:136-145

Callcut R, Kornblith L, Conroy A, et al: The why and how our trauma patients die: a prospective multicenter Western Trauma Association study. J Trauma Acute Care 2019;86:864-870

Carr P, Rippey J, Cooke M, et al: Factors associated with peripheral intravenous cannulation first-time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open 2019;9:e022278

Casey J, Janzx D, Russell D, et al: Bag-masked ventilation during tracheal intubation or critically ill adults. N Eng J Med 2019;380:811-821

Chambers J, Seastedt K, Krell R, et al: "Stop the Bleed": A U.S. Military Installation's Model for Implementation of a Rapid Hemorrhage Control Program. Mil Med. 2019;184:67-71

Coccolini F, Pizzilli G, Corbella D, et al: Pre-hospital plasma in haemorrhagic shock management: current opinion and meta-analysis of randomized trials. World J Emerg Surg. 2019;14:6

Cooper R: Preparation for and management of “failed” laryngoscopy and/or intubation. Anesthesiology 2019;130:833-849

Couperus K, Kmiecik K, Kang C: IV DripAssist: an innovative way to monitor intravenous infusion away from an outlet? Mil Med 2019;184:322-325

Davis M, Rasmussen T; Winds of change in military medicine and combat casualty care. J Trauma Acute Care Surg 2019;Epub ahead of print

Do W, Forte D, Sheldon R, et al: Minimally invasive preperitoneal balloon tamponade and abdominal aortic junctional tourniquet versus open packing for pelvic fracture-associated hemorrhage: not all extrinsic compression is equal. J Trauma Acute Care Surg 2019;86:625-634

Donnally C, Rivera S, Rush A, et al: The 100 most influential spine fracture publications. J Spine Surg 2019;5:97-109

Dutta R, Kulkarni K, Steinman AM et al: Human responses to 5 heated hypothermia wrap systems in a cold environment. Wilderness Environ Med 2019;Epub ahead of print
Dutton R: Next-level thinking about mass casualty care. J Trauma Acute Care Surg 2019;86:368-369

Eastridge B, Holcomb J, Shackelford S: Outcomes of traumatic hemorrhagic shock and the epidemiology of preventable death from injury. Transfusion 2019;59:1423-1428

Eliason J, Derstine B, Horbal S, et al: CT Correlation of Skeletal Landmarks and Vascular Anatomy in Civilian Adult Trauma Patients: Implications for Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA). J Trauma Acute Care Surg. 2019 Mar 1; Epub ahead of print

Erdman M, Chardavoyne P, Olympia R: School nurses on the front lines of medicine: the approach to a student with severe traumatic bleeding. NASN Sch Nurse. 2019; Epub ahead of print

Espinosa A, Dybvik B, Medby C, Vangberg G: Implementation of a protocol for prehospital transfusion of low-titer, leukocyte-depleted whole blood for civilian bleeding patients. Transfus Apher Sci. 2019 Apr;58:212-215

Feld F: Removal of the long spine board from clinical practice: a historical perspective. J Athl Train 2018;53:752-755

Fenger-Eriksen C, D'Amore Lindholm A, Nørholt S, et al: Reduce perioperative blood loss in children undergoing craniosynotosis surgery using prolonged tranexamic acid infusion: a randomised trial. Br J Anaesth 2019;Br J Anaesth 2019;Epub ahead of print

Fisher A, Carius B, Corley J, et al: Conducting Fresh Whole Blood Transfusion Training. J Trauma Acute Care Surg. 2019 Apr 23; Epub ahead of print

Fisher A, Carius B, Lacroix J, et al: National Stop the Bleed Day: The impact of a social media campaign on the Stop the Bleed program. J Trauma Acute Care Surg. 2019; Epub ahead of print

Fitzgerald M, Lloyd-Donald P, Smit V, et al: Prehospital ground transport rapid sequence intubation for trauma and traumatic brain injury outcomes. Ann Surg 2019 Mar;269:e29-e30

George T, Jordan M, Bianchi W, et al: Impact of marine exposure on hemostatic gauzes using thromboelastography. J Spec Oper Med. Spring 2019;19(1):89-94.

Glaser J, Fischer A, Shackelford A, et al: A contemporary report on U.S. Military Guidelines for the use of whole blood and resuscitative endovascular balloon occlusion of the aorta (REBOA). J Trauma Acute Care Surg 2019;Epub ahead of print

Glass C, Parsons C, Raykar N, et al: An effective multi-modality model for single-session cricothyroidotomy training for trainees. Am J Surg 2019; Epub ahead of print

Glick Y, Furer, Glick K, et al: The Israeli Defense Forces point of injury antimicrobial treatment protocol- a new protocol and review of the literature. Mil Med 2019;184:78-82

Goobie S, Faraoni D: Tranexamic acid and perioperative bleeding in children: what do we still need to know? Curr Opin Anaesthesiol 2019 Jun;32:343-352

Goodnough R: THINK of Ketamine for Headache. J Emerg Med. 2019 Apr;56(4):455-456

Goolsby C, Rojas L, Moore K, et al: Layperson ability and willingness to use hemostatic dressings: a randomized, controlled trial. Prehosp Emerg Care. 2019 Mar 15:1-7

Guyette F, Sperry J, Peitzman A, et al: Prehospital blood product and crystalloid resuscitation in the severely injured patient: a secondary analysis of the prehospital air medical plasma trial. Ann Surg 2019;Epub ahead of print

Hapern P, Dang T, Epstein Y, et al: Six hours of manual ventilation with a bag-valve-mask device is feasible and clinically consistent. Crit Care Med 2019;47:e222-e226

Harcke H, Lawrence L, Gripp E, et al: Adult tourniquet for use in school-age emergencies. Pediatrics 2019;143:e20183447

Herder P, Lu M, LaPorta A, et al: Comparison of a novel trainer to a traditional swine model for training providers in lateral canthotomy and cantholysis. Mil Med 2019;184:342-346

Hoskin A, Mackey D, Keay L, et al: Eye Injuries across history and the evolution of eye protection. Acta Ophthalmol 2019; Epub ahead of print

Hossfeld B, Mahler O, Mayer B, et al: Necessity to depict difficult neck anatomy for training of cricothyroidotomy: A pilot study evaluating two surgical devices on a new hybrid training model. Eur J Anaesthesiol 2019;Epub ahead of print

How R, Glaser J, Schaub L, et al: Pre-hospital adenosine, lidocaine and magnesium has inferior survival compared to tactical combat casualty care resuscitation in a porcine model of prolonged hemorrhagic shock. J Trauma Acute Care Surg 2019;Epub ahead of print

Howard J, Kotwal R, Turner C, et al: Use of combat casualty care data to assess the US military trauma system during the Afghanistan and Iraq conflicts, 2001-2017. JAMA Surg 2019;Epub ahead of print

Jiang W, Shang L: Tranexamic acid can reduce blood loss in patients undergoing intertrochanteric fracture surgery: A meta-analysis. Medicine 2019;98:e14564

Jones C, Rodriguez R, Griffin R, et al: Complications Associated With Placement of Chest Tubes: A Trauma System Perspective. J Surg Res 2019 Jul;239:98-102

Juergens A, Odom B, Ren C, Meyers K: Success rates with digital intubation: comparing unassisted, stylet, and gum-elastic bougie techniques. Wilderness Environ Med 2019;30:52-55

Kasmaei V, Javadi A, Naseri Alavi S: Effects of tranexamic acid on reducing blood loss in pelvic trauma: A randomised double-blind placebo controlled study. J Clin Orthop Trauma 2019;10:286-289

Kauver D, Dubick M, Martin M: Large animals models or proximal aortic balloon occlusion in traumatic hemorrhage: review and identification of knowledge gaps relevant to expanded use. J Surg Res 2019;236:247-258

Khan M, Mujahid M: A review on recent advances in chitosan based composite for hemostatic dressings. Int J Biol Macromol 2019;124:137-147

King M, Jagannathan N: Airway management with a supraglottic airway for laparoscopic surgery: does device selection matter? J Clin Anesth 2019;56:134-135

Kirschner J, Hunter B: Is low-dose ketamine an effective alternative to opioids for acute pain? Ann Emerg Med 2019;75:e47-e49

Kragh J, Aden J, Dubick M: Limb Tourniquet Configuration: Preliminary Investigation of Problems and Principles. J Spec Oper Med Spring 2019;19:35-43.

Kulkarni K, Hildahl E, Dutta R, et al: Efficacy of head and torso rewarming using a human model for severe hypothermia. Wilderness Environ Med 2019;30:35-43

Lairet J, Bebarta V, Maddry J, et al: Prehospital interventions performed in Afghanistan between November 2009 and March 2014;Mil Med 2019;133-137

Lebin J, Akhavan A, Hippe D, et al: Psychiatric outcomes of patients with severe agitation following administration of prehospital ketamine. Acad Emerg Med 2019;Epub ahead of print

Lester E, Fox E, Holcomb J, et al: The impact of hypothermia on outcomes in massively transfused patients. J Trauma Acute Care Surg 2019; 86:458-463

Lewis R, Sharpe J, Berning B, et al: Impact of a simplified management algorithm on outcome following exsanguinating pelvic fractures: A 10-year experience. J Trauma Acute Care Surg. 2019;86:658-663

Liu C, Liu X, Liu C, et al: A highly efficient, in situ wet-adhesive dextran derivative sponge for rapid hemostasis. Biomaterials 2019;205:23-37

Lozada M, Cai S, Li M, et al: The Las Vegas mass shooting: An analysis of blood component administration and blood bank donations. J Trauma Acute Care Surg 2019;86:128-133

Luo X, He S, Lin Z, et al: Efficacy and safety of tranexamic acid for controlling bleeding during surgical treatment of intertrochanteric fragility fracture with proximal femoral nail anti-rotation: a randomized controlled trial. Indian J Orthop. 2019;53(2):263-269

Matsumoto S, Hayashida K, Akashi T, et al; Resuscitative endovascular balloon occlusion of the aorta (REBOA) for severe torso trauma in Japan: a descriptive study. World J Surg;43:1700-1707

McCrory B, Lowndes B, Thompson D, et al: Crossover Assessment of Intraoral and Cuffed Ventilation by Emergency Responders. Mil Med 2019;184:310-317

Merck L, Yeatts S, Silbergleit R, et al: The effect of goal-directed therapy on patient morbidity and mortality after traumatic brain injury: results from the progesterone for the treatment of traumatic brain injury III clinical trial. Crit Care Med 2019;47(5):623-631

Mesghali E, Fitter S, Bahjri K, Moussavi K: Safety of peripheral line administration of 3% hypertonic saline and mannitol in the emergency department. J Emerg Med 2019;Epub ahead of print

Messika J, Prat D, Sztrymf B: Tranexamic acid inhalations in nonmassive hemoptysis: a word of caution. Chest 2019;155:876

Morte D, Lammers D, Bingham J, et al: Tranexamic acid (TXA) administration following head trauma in a combat setting: does TXA result in improved neurologic outcomes? J Trauma Acute Care Surg 2019;Epub ahead of print

Nolte P, Uzun D, Häske D, et al: Analysis of cervical spine imbolization during patient transport in emergency medical services. Eur J Trauma Emerg Surg 2019;Epub ahead of print

Özkurtul O, Struck M, Fakler J, et al: Physician-based on-scene airway management in severely injured patients and in-hospital consequences: is the misplaced intubation an underestimated danger in trauma management? Trauma Surg Acute Care Open. 2019 Feb 8;4(1):e000271

Palanisamy A, Kinsella S: Spinal tranexamic acid- a new killer in town. Anaesthesia 2019;Epub ahead of print

Palmieri T, Homes J, Arnoldo B, et al: Restrictive transfusion strategy is more effective in massive burns: results from the TRIBE multicenter prospective randomized trial. Mil Med 2019;184:11-15

Paquette R, Bierle R, Wampler D, et al: External soft-tissue hemostatic clamp compared to a compression tourniquet as primary hemorrhage control device in pilot flow model study. Prehosp Disaster Med. 2019 Apr;34(2):175-181

Paradis T, Bekdache O, Bracco D, et al: Deployment of second-generation resuscitative endovascular balloon occlusion of the aorta for unresponsive hypotension in a polytrauma patient. Can J Surg 2019;62(2):142-144

Patel S, Robertson B, McConachie I: Catastrophic drug errors involving tranexamic acid administered during spinal anaesthesia. Anawsthesia 2019;Epub ahead of print

Pieper M, Vonderharr M, Knutson T, et al: Versatility with far forward damage control surgery: successful resuscitative thoracotomy in an HH-60 Black Hawk. J Spec Oper Med. Spring 2019;19(1):20-22.

Pusateri A, Butler F, Shackelford S, et al: The need for dried plasma - a national issue. Transfusion. 2019 Apr;59(S2):1587-1592

Renna M, van Zeller C, Abu-Hijleh F, et al: A one-year cost-utility analysis of REBOA versus RTACC for non-compressible torso haemorrhage. Trauma 2019;21:45-54

Rijnhout T, Wever K, Marinus R, et al: Is prehospital blood transfusion effective and safe in haemorrhagic trauma patients? A systematic review and meta-analysis. Injury 2019;50:1017-1027

Roberts T, Jones J, Choi J, et al: Thromboelastography on-the-go: evaluation on the TEG 6s device during ground and high-altitude aeromedical evacuation with extracorporeal life support. J Trauma Acute Care Surg 2019;Epub ahead of print

Ruetzler K, Leung S, Chmiela M, et al: Regurgitation and pulmonary aspiration during cardio-pulmonary resuscitation (CPR) with a laryngeal tube: a pilot crossover human cadaver study. PLoS One 2019;14:e0212704

Rupprecht H, Gaab K: Prehospital tracheotomy in a case of avulsion of the larynx with a comminuted fracture of the jawbone. Clin Exp Emerg Med 2019;Epub ahead of print

Sappenfield J, Grek S, Cooper L, et al: Reduced complications of supraclavicular approach in simulated central venous access: applicability to military medicine. Mil Med 2018;184:329-334

Schauer S, Fisher A, April M, et al: Battlefield analgesia: adherence to Tactical Combat Casualty Care Guidelines. J Spec Oper Med 2019;19:70-74

Schauer S, Naylor J, Bellamy M, et al: A descriptive analysis of causalities undergoing CASEVAC from the point-of-injury in the Department of Defense Trauma Registry. Mil Med 2019;Epub ahead of print

Schauer S, Naylor J, April M, et al: The prehospital trauma registry experience with intraosseous access. J Spec Oper Med. Spring 2019;19(1):52-55.

Schmutz A, Bohn E, Spaeth J, Heinrich S: Comprehensive evaluation of manikin-based airway training with second generation supraglottic airway devices. Ther Clin Risk Manag 2019;15:367-376

Seheult J, Stram M, Sperry J, et al: In silico model of the dilutional effects of conventional component therapy versus whole blood in the management of massively bleeding adult trauma patients. Transfusion 2019;59:146-158

Shah A, Kothera C, Dheer S: ThoraSite: A device to improve accuracy of lateral decompression needle and chest tube placement. J Trauma Acute Care Surg 2019;Epub ahead of print

Shank C, Walters B, Hadley M: Current topics in the management of acute traumatic spinal cord injury. Neurocrit Care. 2019 Apr;30:261-271

Sharrock A, Tai N, Perkins Z, et al: Management and outcome of 597 wartime penetrating lower extremity arterial injuries from an international military cohort. J Vasc Surg 2019;7:224-232

Sharwood L, Joseph A, Guo C,et al: Heterogeneous emergency department management of published recommendation defined hypotension in patients with acute traumatic spinal cord injury: A multi-centre overview. Emerg Med Australas. 2019 Apr 9. doi: 10.1111/1742-6723.13290

Sheppard F, Mitchell T, Cap A, et al: Prehospital whole blood resuscitation prevents coagulopathy and improves acid-base status at hospital arrival in a nonhuman primate hemorrhagic shock model. Transfusion 2019;Epub ahead of print

Sheu Y, Yu S, Huang T, et al: Comparison of the efficacy of a bougie and stylet in patients with endotracheal intubation: A meta-analysis of randomized controlled trials. J Trauma Acute Care Surg. 2019 May;86:902-908

Shinjo T, Izawa Y, Watanabe N, et al: The utility of resuscitative endovascular balloon occlusion of the aorta for temporary hemostasis after extensive bilateral lower extremity injuries: A case report. Radiol Case Rep. 2019;14:623-626

Skarupa D, Khan M, Hsu A, et al: Trends in civilian penetrating brain injury: a review of 26,871 patients. Am J Surg 2018;Epub ahead of print

Smith E, Sarani B, Shapiro G, et al: Incidence and cause of potentially preventable death after civilian public mass shooting in the US. J Am Coll Surg 2019;Epub ahead of print

Smith J, Simpson G, Heightman A: EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas JEMS 2019; April 1, 2018

Smith L, Caughey S, Liu S, et al: World trauma education: hemorrhage control training for healthcare providers in India. Trauma Surg Acute Care Open. 2019 Feb 18;4(1):e000263

Sørgjerd R, Sunde G, Heltne J: Comparison of two different intraosseous access methods in a physician-staffed helicopter emergency medical service- a quality assurance study. Scand J Trauma Resusc Emerg Med 2019;27:15

Sotomayor T, Bailey M, Dorton S: Using simulation to address a training gap in battlefield ocular trauma: a Lateral Canthotomy and Cantholysis (LCC) prototype training system. Mil Med 2019;184:335-341

Spaite D, Bobrow B, Keim S, et al: Association of statewide implementation of the prehospital traumatic brain injury treatment guidelines with patient survival following traumatic brain injury: The Excellence in Prehospital Injury Care (EPIC) Study. JAMA Surg. 2019 May 8:Epub ahead of print

Spitler C, Kiner D, Row E, et al: Tranexamic acid use in open reduction and internal fixation of fractures of the pelvis, acetabulum, and proximal femur: a randomized controlled trial. J Orthop Trauma 2019; Epub ahead of print

Stewart L, Shaikh F, Bradley W, et al: Combat-related extremity wounds: injury factors predicting early onset infections. Mil Med. 2019;184:83-91

Stuart S, Zarow G, Walchak A, et al: Pilot study of a novel swine model for controlling junctional hemorrhage using the iTClamp in conjunction with hemostatic agents. Mil Med 2019;184:367-373

Taylor D, Murphy J, Stolley Z; Low-resource tactical Combat Casualty Care Training for Peshmerga Units in remote areas of Kurdistan. J Spec Oper Med. Spring 2019;19:81-87

Viscusi E, Gan T, Bergese S, et al: Intravenous meloxicam for the treatment of moderate to severe acute pain: a pooled analysis of safety and opioid-reducing effects. Reg Anesth Pain Med 23019;Epub ahead of print

Wafaisade A, Caspers M, Bouillon B, et al: Changes in anaesthetic use for trauma patients in Germans HEMS- a retrospective study over a ten-year period. Scand J Trauma Resusc Emerg Med 2019;27:23

Wessels L, Wallace J, Bowie J, et al: Radiofrequency identification of the ER-REBOA: confirmation of placement without fluoroscopy. Mil Med 2019;184:e285-e289

Weymouth W, Long B, Koyfman A, Winckler C: Whole blood in trauma: a review for emergency clinicians. J Emerg Med 2019;56:491-498

Xue P, Yang J, Xu X, et al: The efficacy and safety of tranexamic acid in reducing perioperative blood loss in patients with multilevel thoracic spinal stenosis: A retrospective observational study. Medicine (Baltimore). 2018;97:e13643

Yumoto T, Mitsuhashi T, Yamakawa Y, et al: Impact of Cushing's sign in the prehospital setting on predicting the need for immediate neurosurgical intervention in trauma patients: a nationwide retrospective observational study. Scand J Trauma Resusc Emerg Med 2016;24:147

Zeeshan M, Hamidi M, Feinstein A, et al: 4-Factor prothrombin complex concentrate is associated with improved survival in trauma related hemorrhage: a nationwide propensity matched analysis. J Trauma Acute Care Surg. 2019;Epub ahead of print

Zhang L, Li R, Zhao X, et al: The relationship between colloid transfusion during surgical decompression hemicraniectomy period and postoperative pneumonia or long-term outcome after space-occupying cerebral infarction: a retrospective study. World Neurosurg. 2019 Feb;122:e1312-e1320

Zhu C, Cobb D, Jonas R, et al: Shock index and pulse pressure as triggers for massive transfusion. J Trauma Acute Care Surg 2019;Epub ahead of print

Zietlow J, Berns K, Jenkins D, Zietlow S: Prehospital use of ketamine: effectiveness in critically ill and injured patients. Mil Med 2019;184:542-544

Zwislewski A, Nanassy A, Meyer L, et al: Practice makes perfect: The impact of Stop the Bleed training on hemorrhage control knowledge, wound packing, and tourniquet application in the workplace. Injury 2019;50:864-868

Abstracts

Resuscitation. 2019 May;138:20-27

Cardiac massage for trauma patients in the battlefield: An assessment for survivors.

Anderson K, Mora A, Bloom A, Maddry J, Bebarta V

INTRODUCTION: Survival from traumatic cardiopulmonary arrest (TCA) has been reported at a rate as low as 0-2.6% in the civilian pre-hospital setting, and many consider resuscitation of this group to be futile. The aim of this investigation was to describe patients who received cardiac massage during TCA in a battlefield setting; we also aimed to identify predictors of survival.

METHODS: We conducted a review of the Department of Defense Trauma Registry to identify patients who received cardiac massage in the battlefield between 2007 and 2014. Patients were also grouped according to location of cardiac arrest: pre-hospital (PH) and in-hospital (IH). The groups were compared and evaluated by injury, transport time, type of resuscitation, and pre-hospital procedures. Outcome variables included survival to discharge and 30-day survival. Categorical variables were analysed using chi-square or Fisher's exact tests. Wilcoxon tests were performed for continuous variables. Regression modelling was used to assess for predictors of survival.

RESULTS: 75 of all 582 patients (13%, 95% CI 10-16) survived to 30 days, and all survivors were transported out of the battlefield; 23 PH (7.8%, 95% CI 5.2-12) and 52 IH (17%, 95% CI 13-22) patients survived to 30 days ($p < 0.001$). Closed-chest cardiac massage with the administration of intravenous medications was associated with 30-day survival among IH patients.

CONCLUSIONS: We report a 13% survival to 30 days among all patients receiving cardiac massage in a battlefield setting. Closed-chest cardiac massage predicted survival among IH TCA victims who also received intravenous medications in this review of combat-related TCA.

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Prehospital Analgesia With Intranasal Ketamine (PAIN-K): A Randomized Double-Blind Trial in Adults.

Andolfatto G, Innes K, Dick W, Jenneson S, Willman E, Stenstrom R, Zed P, Benoit G

STUDY OBJECTIVE: We compare intranasal ketamine with intranasal placebo in providing pain reduction at 30 minutes when added to usual paramedic care with nitrous oxide.

METHODS: This was a randomized double-blind study of out-of-hospital patients with acute pain who reported a verbal numeric rating scale (VNRS) pain score greater than or equal to 5. Exclusion criteria were younger than 18 years, known ketamine intolerance, nontraumatic chest pain, altered mental status, pregnancy, and nasal occlusion. Patients received usual paramedic care and were randomized to receive either intranasal ketamine or intranasal saline solution at 0.75 mg/kg. The primary outcome was the proportion of patients with VNRS score reduction greater than or equal to 2 at 30 minutes. Secondary outcomes were pain reduction at 15 minutes, patient-reported comfort, satisfaction scores, nitrous oxide consumption, and incidence of adverse events.

RESULTS: One hundred twenty subjects were enrolled. Seventy-six percent of intranasal ketamine patients versus 41% of placebo patients reported a greater than or equal to 2-point VNRS reduction at 30 minutes (difference 35%; 95% confidence interval 17% to 51%). Median VNRS reduction at 15 minutes was 2.0 and 1.0 and at 30 minutes was 3.0 and 1.0 for ketamine and placebo, respectively. Improved comfort at 15 and 30 minutes was reported for 75% versus 57% and 61% versus 46% of ketamine and placebo patients, respectively. Sixty-two percent of patients (95% confidence interval 49% to 73%) versus 20% (95% confidence interval 12% to 32%) reported adverse events with ketamine and placebo, respectively. Adverse events were minor, with no patients requiring physical or medical intervention.

CONCLUSION: Added to nitrous oxide, intranasal ketamine provides clinically significant pain reduction and improved comfort compared with intranasal placebo, with more minor adverse events.

J Spec Oper Med. Spring 2019;19(1):48-51.

Improvised Ground Evacuation Platforms for Austere Special Operations Casualty Transport.

Antosh I, McGrane O, Capan E, Dominguez J, Hofmann L

ABSTRACT:
There are no established ground medical-evacuation systems within Special Operations Command Africa (SOCAFRICA), given the austere and varied environments. Transporting the injured casualty requires ingenuity and modification of existing vehicles. The Expeditionary Resuscitative Surgical Team (ERST) assigned to SOCAFRICA used four unconventional means for ground evacuation. This is a retrospective review of the various modes of ground transportation used by the ERST-3 during deployment with SOCAFRICA. All hand-carried litter and air evacuation platforms were excluded. Over 9 months, four different ground casualty platforms were used after they were modified: (1) Mine-Resistant Ambush-Protected All-Terrain Vehicle (MAT-V; Oshkosh Defense); (2) MRZR-4 ("Razor"; Polaris Industries); (3) nonstandard tactical vehicles, (NSTVs; Toyota HiLux); and (4) John Deere TH 6x4 ("Gator"). Use of all vehicle platforms was initially rehearsed and then they were used on missions for transport of casualties. Each of the four methods of ground evacuation includes a description of the talon litter setup, the necessary modifications, the litter capacity, the strengths and weaknesses, and any summary recommendations for that platform. Understanding and planning for ground casualty evacuation is necessary in the austere environment. Although each modified vehicle was used successfully to transfer the combat casualty with an ERST team member, consideration should be given to acquisition of the MAT-V medical-specific vehicle. Understanding the currently available modes of ground casualty evacuation transport promotes successful transfer of the battlefield casualty to the next echelon of care.

Ulus Travma Acil Cerrahi Derg. 2018 Mar;24(2):97-103

The success of endotracheal intubation with a modified laryngoscope using night vision goggles.

Aydın A, Bilge S, Aydın C, Bilge M, Çevik E, Eryılmaz M.

BACKGROUND: Endotracheal intubation (ETI) procedure in the combat area differs from prehospital trauma life support procedures because of the danger of gunfire and the dark environment. We aimed to determine the success, difficulty degree, and duration of ETI procedures with a classical laryngoscope (CL) in a bright room and with a modified laryngoscope (ML) model in a dark room.

METHODS: All interventions were performed by a combatant medical staff of 10 members. We developed an ML model to obtain a tool that can be used in combination with night vision goggles (NVGs) to perform ETI at night. The procedures were performed using a CL with the naked eye in a bright room and using a ML with NVGs in a dark room. The ETI procedure that used the ML was performed by engaging and locking the blade on the handle either in the mouth (ML-IM) or outside of the mouth (ML-OM).

RESULTS: The mean completion times for the ETI procedures, namely Day-CL, ML-OM+NVG, and ML-IM+NVG, performed by the operators were 14.46, 26.9, and 32.38 s, respectively. The ML-OM+NVG and ML-IM+NVG procedures were significantly longer than the Day-CL procedure ($p<0.05$). The ML-IM+NVG procedure was significantly longer than the ML-OM+NVG procedure ($p<0.05$). All ETI procedures were found to be 100% successful. The Day-CL procedure was easier than the ML-OM+NVG and ML-IM+NVG procedures ($p>0.05$).

CONCLUSION: The ETI procedure is applicable using NVGs in dark conditions on the battlefield. Medical interventions performed using NVGs in the dark should be a part of the basic training provided in tactical emergency medicine.

Transfusion. 2019 Apr;59(S2):1499-1506

Changes in donor antibody titer levels over time in a military group O low-titer whole blood program.

Bailey J, Fisher A, Yazer M, Howard J, Corley J, Miles E, Cap A

BACKGROUND: The ability to rapidly administer whole blood (WB) at the point of injury is an important intervention to save lives. This can be accomplished using low titer group O WB donors. Titers of immunoglobulin M anti-A and anti-B might change over time. This study describes titer testing in a large series of donors.

STUDY DESIGN AND METHODS: Data were collected retrospectively from the Armed Services Blood Program and the Theater Medical Data Store. Soldiers assigned to the 75th Ranger Regiment were screened and titered upon completion of training or before deployment or during periodic unit readiness activities. A Ranger group O low-titer (ROLO) donor was defined as having titers of both anti-A and -B of less than 256 by immediate spin testing.

RESULTS: Between May 2015 and January 2017, of a total of 2237 participating soldiers, 1892 (84.5%) soldiers underwent antibody titering once, while 266 (11.9%) were titered twice, 62 (2.8%) were titered three times, and 17 (0.8%) were titered at least four times. The mean age was 26.5 ± 6.5, and 2197 (98.2%) were male. A total of 69.5% of donors met ROLO donor criteria on the first test. The percentage of donors meeting universal-donor criteria increased to 83.5% on the second test, 91.1% on the third test, and 100% on the fourth and fifth tests.

CONCLUSIONS: With successive titer testing, it appears that individuals display a tendency toward lower titers. This may indicate that titer testing may not be required after the second test if donors have been identified initially as low titer.

J Trauma Acute Care Surg. 2019;Epub ahead of print

Helicopter MEDEVAC in the Korean War: Did it Matter?

Barr J, Montgomery S

BACKGROUND: Due to M*A*S*H and other popular portrayals, helicopter evacuation of casualties has been closely linked to the Korean War. We sought to investigate their role in military medicine during this conflict.

MATERIALS AND METHODS: This study incorporated a thorough review of the original source documents dating to the Korean War that are housed in the National Archives, the Military History Institute, and other repositories.

RESULTS: Medical evacuation helicopters entered the war late, after the United Nations forces had suffered the majority of their casualties. There were relatively few helicopters in the country, and a combination of mechanical and personnel issues kept many grounded. Technological constraints limited their efficacy. Military policy forbade rescues from the front lines, and inter-hospital transfers comprised a significant percentage of their missions.

CONCLUSIONS: Helicopters did not appreciably decrease the average time from wounding to surgical care, nor did they evacuate a statistically significant number of casualties, and ultimately they had minimal effect on military medicine. However, the war did provide helicopters the opportunity to prove themselves conceptually, leading to their widespread usage in Vietnam, in later conflicts, and ultimately in civilian health care systems.

STUDY TYPE: Historical Reflection

LEVEL OF EVIDENCE: Not applicable.

J Thorac Dis. 2019 Feb;11(Suppl 2):S186-S191

Chest drain and thoracotomy for chest trauma.

Bertoglio P, Guerrera F, Viti A, Terzi A, Ruffini E, Lyberis P, Filosso P

ABSTRACT: Traumas are the leading cause of death in the first four decades of life. Nevertheless, thoracic traumas only seldom require invasive procedures. In particular, chest drain placement is required in case of pleural disruption causing haemothorax, pneumothorax or haemopneumothorax. Although large-bore chest drains have been traditionally used in case of haemothorax, recent evidences seem to question this routine, showing good performances of small-bore and pig tail drains. Although it is a common procedures, experience and training is needed to avoid complications which might be even lethal. Surgical exploration after thoracic trauma is rare, accounting for less than 3% of traumas. Penetrating traumas more likely require surgical exploration compared to blunt trauma. Anterolateral thoracotomy is usually performed in this setting, but also clamshell or hemi-clamshell approach can be used. In selected patients, minimally invasive techniques can be performed. Large randomized trials are still needed to assess and standardized the role of new tools and procedures in the thoracic trauma setting.

Injury. 2019 Apr;50(4):855-858

Zones matter: Hemodynamic effects of zone 1 vs zone 3 resuscitative endovascular balloon occlusion of the aorta placement in trauma patients.

Beyer C, Johnson M, Galante J, DuBose J

INTRODUCTION: Resuscitative endovascular balloon occlusion of the aorta (REBOA) has emerged as a therapy for hemorrhagic shock to limit ongoing bleeding and support proximal arterial pressures. Current REBOA algorithms recommend zone selection based on suspected anatomic location of injury rather than severity of shock. We examined the effects of Zone 1 versus Zone 3 REBOA in patients enrolled in the American Association for the Surgery of Trauma Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery (AORTA) Registry.

PATIENTS AND METHODS: The prospective observational AORTA Registry was queried from November 2013 to November 2017. Patients who received REBOA were included if their initial systolic blood pressure (SBP) was less than 90 mmHg upon arrival and they were not receiving cardiopulmonary resuscitation.

RESULTS: There were 762 patients recorded in the AORTA database during the study period. Of these, 245 underwent REBOA and 99 patients met inclusion criteria. The initial balloon position was Zone 1 in 55 patients, Zone 3 in 36 patients, and unknown or Zone 2 in 8 patients. The change in proximal SBP was greater after REBOA in the Zone 1 group compared to the Zone 3 group (58 ± 4 mmHg vs 41 ± 4 mmHg, P = 0.008). The zone of occlusion was significantly associated with the change in proximal SBP in a linear regression analysis which included initial SBP, Glasgow Coma Scale score, and Injury Severity Score (Coefficient 26.82, 95% Confidence Interval 8.11-45.54, P = 0.006).

CONCLUSIONS: In the hypotensive trauma patient, initial Zone 1 REBOA provides maximal hemodynamic support. Algorithms recommending initial Zone 3 placement for hypotensive trauma patients should be reconsidered.

J Trauma Acute Care Surg. 2019;Epub ahead of print

The Promising Future of Drones in Prehospital Medical Care and its Application to Battlefield Medicine.

Braun J, Gertz S, Furer A, Bader T, Frenkel H, Chen J, Glassberg E, Nachman D

ABSTRACT: Unmanned aerial vehicles (UAV), commonly referred to as drones, have been made widely available in recent years leading to an exponential growth in their roles and applications. The rapidly developing field of medical drones is on the verge of revolutionizing pre-hospital medicine enabling advanced healthcare delivery to once-inaccessible patients. The aim of this review is to clarify the basic technical properties of currently available medical drones and review recent advances and their usefulness in military and civilian healthcare missions. A thorough search was conducted using conventional medical literature databases and non-medical popular search engines. The results indicate increasingly rapid incorporation of UAVs into search and rescue missions, telemedicine assignments, medical supply routes, public health surveillance and disaster management. Medical drones appear to be of great benefit for improving survivability of deployed forces on and off the battlefield. The emerging aerial medical delivery systems appear to provide particularly promising solutions for bridging some of the many serious gaps between third world healthcare systems and their western counterparts and between major metropolitan centers and distant rural communities. The global nature of drone-based health-care delivery needs points to a need for an international effort between collaborating civilian and military medical forces in order to harness the currently available resources and novel emerging technologies for broader life-saving capabilities.

Study type: Review label of evidence: V.

J Spec Oper Med. Spring 2019;19(1):136-145.

Committee on Tactical Combat Casualty Care Meeting: San Antonio, TX 5-6 September 2018 Meeting Minutes.

Butler FK Jr, Giebner S.

ABSTRACT: The published minutes of the September 2018 meeting of the Committee on Tactical Combat Casualty Care.

J Trauma Acute Care Surg. 2019 May;86(5):864-870

The why and how our trauma patients die: A prospective Multicenter Western Trauma Association study.

Callcut R, Kornblith L, Conroy A, Robles A, Meizoso J, Namias N, Meyer D, Haymaker A, Truitt M, Agrawal V, Haan J, Lightwine K, Porter J, San Roman J, Biffl W, Hayashi M, Sise M, Badiee J, Recinos G, Inaba K, Schroeppel T, Callaghan E, Dunn J, Godin S, McIntyre R Jr, Peltz E, O'Neill P, Diven C, Scifres A, Switzer E, West M, Storrs S, Cullinane D, Cordova J, Moore E, Moore H, Privette A, Eriksson E, Cohen M; Western Trauma Association Multicenter Study Group.

BACKGROUND: Historically, hemorrhage has been attributed as the leading cause (40%) of early death. However, a rigorous, real-time classification of the cause of death (COD) has not been performed. This study sought to prospectively adjudicate and classify COD to determine the epidemiology of trauma mortality.

METHODS: Eighteen trauma centers prospectively enrolled all adult trauma patients at the time of death during December 2015 to August 2017. Immediately following death, attending providers adjudicated the primary and contributing secondary COD using standardized definitions. Data were confirmed by autopsies, if performed.

RESULTS: One thousand five hundred thirty-six patients were enrolled with a median age of 55 years (interquartile range, 32-75 years), 74.5% were male. Penetrating mechanism (n = 412) patients were younger (32 vs. 64, $p < 0.0001$) and more likely to be male (86.7% vs. 69.9%, $p < 0.0001$). Falls were the most common mechanism of injury (26.6%), with gunshot wounds second (24.3%). The most common overall primary COD was traumatic brain injury (TBI) (45%), followed by exsanguination (23%). Traumatic brain injury was nonsurvivable in 82.2% of cases. Blunt patients were more likely to have TBI (47.8% vs. 37.4%, $p < 0.0001$) and penetrating patients exsanguination (51.7% vs. 12.5%, $p < 0.0001$) as the primary COD. Exsanguination was the predominant prehospital (44.7%) and early COD (39.1%) with TBI as the most common later. Penetrating mechanism patients died earlier with 80.1% on day 0 (vs. 38.5%, $p < 0.0001$). Most deaths were deemed disease-related (69.3%), rather than by limitation of further aggressive care (30.7%). Hemorrhage was a contributing cause to 38.8% of deaths that occurred due to withdrawal of care.

CONCLUSION: Exsanguination remains the predominant early primary COD with TBI accounting for most deaths at later time points. Timing and primary COD vary significantly by mechanism. Contemporaneous adjudication of COD is essential to elucidate the true understanding of patient outcome, center performance, and future research.

LEVEL OF EVIDENCE: Epidemiologic, level II.

J Trauma Acute Care Surg 2019;Epub ahead of print

Prehospital Trauma Experience of the Israel Defense Forces on the Syrian Border 2013-2017.

Benov A, Shkolnik I, Glassberg E, Nadler R, Gendler S, Antebi B, Chen J, Fink N, Bader T

BACKGROUND: The Israeli Defense Force Medical Corps (IDF-MC) is routinely collecting pre-hospital data to establish a pre-hospital registry. Since February 2013, Israel has been providing medical care to Syrian refugees. This unique humanitarian aid begins in pre-hospital settings and typically culminates in Israeli civilian hospitals. This report describes the accumulated experience of the IDF-MC to provide Syrian refugees with prehospital treatment.

METHODS: Care provided by IDF-MC medical teams, including pre-hospital casualty care, is regularly documented and after-action reports are conducted. Records of casualties arriving at the Israeli-Syrian border from February 16th, 2013 to December 31th 2017 were prospectively extracted from the IDF Trauma Registry. Patients who did not have a casualty card were excluded. The database included demographic information, injury signature and treatment given.

RESULTS: During the study period, 2785 Syrian casualties were treated, of whom 2339 were trauma victims. The most common mechanism of injury was penetrating (60.4%). Pre-hospital life-saving interventions included 127 endotracheal intubations, 30 cricothyroidotomies, 55 chest decompressions, and 58 tourniquets for extremity hemorrhage control. Remote Damage Control Resuscitation included reconstituted freeze-dried Plasma (FDP; n=75) and transexamic acid (TXA; n=222 casualties) with no adverse effects.

CONCLUSIONS: The experience of the IDF-MC teams in caring for civilian casualties along a hostile international border is unique. In this capacity, the IDF-MC has demonstrated effectiveness in providing life-saving and resuscitative interventions including TXA and FDP. In this experience, tourniquets have been effective in controlling hemorrhage when applied early and endotracheal intubation and cricothyroidotomy have provided effective airway options in select patients. Prehospital combat casualty care presents a significant challenge both in terms of providing adequate care and in terms of data collection and analysis. The experience described in this paper is one example of effective, ongoing pre-hospital data gathering process. Efforts to provide medical relief to victims of the Syrian civil war continue to this day. While we hope for a better future, as long as these lessons continue to accumulate, it is our obligation to use them to support improvement of trauma care and hopefully save more lives.

LEVEL OF EVIDENCE: Study type - therapeutic III.

Clin Pharmacol Drug Dev. 2019;Epub ahead of print

A Phase 3, Randomized, Placebo-Controlled Evaluation of the Safety of Intravenous Meloxicam Following Major Surgery.

Bergese S, Melson T, Candiotti K, Ayad S, Mack R, McCallum S, Du W, Gomez A, Marcet J

ABSTRACT: An intravenous (IV) formulation of meloxicam is being studied for moderate to severe pain management. This phase 3, randomized, multicenter, double-blind, placebo-controlled trial evaluated the safety of once-daily meloxicam IV 30 mg in subjects following major elective surgery. Eligible subjects were randomized (3:1) to receive meloxicam IV 30 mg or placebo administered once daily. Safety was evaluated via adverse events, clinical laboratory tests, vital signs, wound healing, and opioid consumption. The incidence of adverse events was similar between meloxicam IV- and placebo-treated subjects (63.0% versus 65.0%). Investigators assessed most adverse events as mild or moderate in intensity and unrelated to treatment. Adverse events of interest (injection-site reactions, bleeding, cardiovascular, hepatic, renal, thrombotic, and wound-healing events) were similar between groups. Over the treatment period, meloxicam IV was associated with a 23.6% (P = .0531) reduction in total opioid use (9.2 mg morphine equivalent) compared to placebo-treated subjects. The results suggest that meloxicam IV had a safety profile similar to that of placebo with respect to numbers and frequencies of adverse events and reduced opioid consumption in subjects with moderate to severe postoperative pain following major elective surgery.

BMJ Open. 2019 Apr 2;9(4):e022278

Factors associated with peripheral intravenous cannulation first-time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics.

Carr P, Rippey J, Cooke M, Trevenen M, Higgins N, Foale A, Rickard C

OBJECTIVES: This study aimed to identify the incidence of and factors associated with peripheral intravenous catheter/cannula (PIVC) first time insertion success (FTIS) in the emergency department (ED).

DESIGN: Prospective cohort study.

SETTING: Two tertiary EDs in Western Australia.

PARTICIPANTS: 879 ED patients.

PRIMARY OUTCOME: To identify factors affecting FTIS using univariate and multivariate logistic regression modelling. We created four models: patient factors only; clinician factors only; products and technology factors only and all factors model. We assessed each model's performance using area under the receiver operating characteristic curve.

RESULTS: A total of 1201 PIVCs were inserted in 879 patients. The mean age was 60.3 (SD 22) years with slightly more females (52%). The FTIS rate was 73%, with 128 (15%) requiring a second attempt and 83 (9%) requiring three or more attempts. A small percentage (3%) had no recorded number of subsequent attempts. FTIS was related to the following patient factors: age (for a 1-year increase in age: OR 0.99, 95% CI 0.983 to 0.998; p=0.0097); and target vein palpability: (always palpable vs never palpable: OR 3.53 95% CI 1.64 to 7.60; only palpable with tourniquet vs never palpable: OR 2.20, 95% CI 1.06 to 4.57; p=0.0014). Clinician factors related to FTIS include: clinicians with greater confidence (p<0.0001) and insertion experience (301-1000 vs <301: OR 1.54, 95% CI 1.02 to 2.34; >1000 vs <301: OR 2.07, 95% CI 1.41 to 3.04; p=0.0011). The final all factors model combining patient factors; clinician factors and product and technology factors has greater discriminative ability than specific factors models. It has a sensitivity of 74.26%, specificity of 57.69%, positive predictive value of 82.87% and negative predictive value of 44.85%.

CONCLUSION: A clinical decision, matching patients who have no palpable veins and are older, with clinicians with greater confidence and experience, will likely improve FTIS.

N Engl J Med. 2019 Jun 20;380(25):2482

Bag-Mask Ventilation during Tracheal Intubation of Critically Ill Adults. Reply.

Casey J, Rice T, Semler M

BACKGROUND: Hypoxemia is the most common complication during tracheal intubation of critically ill adults and may increase the risk of cardiac arrest and death. Whether positive pressure ventilation with a bag-mask device (bag-mask ventilation) during tracheal intubation of critically ill adults prevents hypoxemia without increasing the risk of aspiration remains controversial.

METHODS: In a multicenter, randomized trial conducted in seven intensive care units in the United States, we randomly assigned adults undergoing tracheal intubation to receive either ventilation with a bag-mask device or no ventilation between induction and laryngoscopy. The primary outcome was the lowest oxygen saturation observed during the interval between induction and 2 minutes after tracheal intubation. The secondary outcome was the incidence of severe hypoxemia, defined as an oxygen saturation of less than 80%.

RESULTS: Among the 401 patients enrolled, the median lowest oxygen saturation was 96% (interquartile range, 87 to 99) in the bag-mask ventilation group and 93% (interquartile range, 81 to 99) in the no-ventilation group (P = 0.01). A total of 21 patients (10.9%) in the bag-mask ventilation group had severe hypoxemia, as compared with 45 patients (22.8%) in the no-ventilation group (relative risk, 0.48; 95% confidence interval [CI], 0.30 to 0.77). Operator-reported aspiration occurred during 2.5% of intubations in the bag-mask ventilation group and during 4.0% in the no-ventilation group (P = 0.41). The incidence of new opacity on chest radiography in the 48 hours after tracheal intubation was 16.4% and 14.8%, respectively (P = 0.73).

CONCLUSIONS: Among critically ill adults undergoing tracheal intubation, patients receiving bag-mask ventilation had higher oxygen saturations and a lower incidence of severe hypoxemia than those receiving no ventilation.

Mil Med. 2019 Mar 1;184(3-4):67-71

"Stop the Bleed": A U.S. Military Installation's Model for Implementation of a Rapid Hemorrhage Control Program.

Chambers J, Seastedt K, Krell R, Caterson E, Levy M, Turner N

CONCLUSION: The STB initiative has the opportunity to save lives, not only in the public arena but on military installations worldwide. It is critical we educate, train, and prepare for mass casualty events to save lives in our current environment. We have launched our STB initiative here at JBA and hope our program serves as a potential model for other installations to proceed with developing their own in-garrison hemorrhage control program. Implementation at other military installations will likely require minor modifications given the needs and resources present at each individual facility. While, these needs can easily be met with affordable and customizable hemorrhage control kits requiring little maintenance as in our custom kits, caution should be exercised related to extensive modification of kits. The training is equally versatile, and can be targeted to health care professionals and the lay person at large focusing on hemorrhage control through trainings such as TCCC, B-Con, or SABC. Our goal is for every active duty and civilian member of our base be educated in effective hemorrhage control, with ready access to hemorrhage control kits throughout the base. We believe this should be a DoD-wide initiative, and it merits consideration for dedicated funding to support this public health program at other installations.

World J Emerg Surg. 2019 Feb 15;14:6

Pre-hospital plasma in haemorrhagic shock management: current opinion and meta-analysis of randomized trials.

Coccolini F, Pizzilli G, Corbella D, Sartelli M, Agnoletti V, Agostini V, Baiocchi G, Ansaloni L, Catena F

Background: Trauma-induced coagulopathy is one of the most difficult issues to manage in severely injured patients. The plasma efficacy in treating haemorrhagic-shocked patients is well known. The debated issue is the timing at which it should be administered. Few evidences exist regarding the effects on mortality consequent to the use of plasma alone given in pre-hospital setting. Recently, two randomized trials reported interesting and discordant results. The present paper aims to analyse data from those two randomized trials in order to obtain more univocal results.

Methods: A systematic review with meta-analysis of randomized controlled trials (RCTs) of pre-hospital plasma vs. usual care in patients with haemorrhagic shock.

Results: Two high-quality RCTs have been included with 626 patients (295 in plasma and 331 in usual care arm). Twenty-four-hour mortality seems to be reduced in pre-hospital plasma group (RR = 0.69; 95% CI = 0.48-0.99). Pre-hospital plasma has no significant effect on 1-month mortality (RR = 0.86; 95% CI = 0.68-1.11) as on acute lung injury and on multi-organ failure rates (OR = 1.03; 95% CI = 0.71-1.50, and OR = 1.30; 95% CI = 0.92-1.86, respectively).

Conclusions: Pre-hospital plasma infusion seems to reduce 24-h mortality in haemorrhagic shock patients. It does not seem to influence 1-month mortality, acute lung injury and multi-organ failure rates. Level of evidence:

Level I Study type: Systematic review with Meta-analysis.

Anesthesiology. 2019 May;130(5):833-849

Preparation for and Management of "Failed" Laryngoscopy and/or Intubation.

Cooper R

ABSTRACT: An airway manager's primary objective is to provide a path to oxygenation. This can be achieved by means of a facemask, a supraglottic airway, or a tracheal tube. If one method fails, an alternative approach may avert hypoxia. We cannot always predict the difficulties with each of the methods, but these difficulties may be overcome by an alternative technique. Each unsuccessful attempt to maintain oxygenation is time lost and may incrementally increase the risk of hypoxia, trauma, and airway obstruction necessitating a surgical airway. We should strive to optimize each effort. Differentiation between failed laryngoscopy and failed intubation is important because the solutions differ. Failed facemask ventilation may be easily managed with a supraglottic airway or alternatively tracheal intubation. When alveolar ventilation cannot be achieved by facemask, supraglottic airway, or tracheal intubation, every anesthesiologist should be prepared to perform an emergency surgical airway to avert disaster.

Mil Med. 2019 Mar 1;184(Suppl 1):322-325

IV DripAssist: An Innovative Way to Monitor Intravenous Infusions Away From an Outlet?

Couperus K, Kmiecik K, Kang C

ABSTRACT: Intravenous (IV) administration of fluids and medications are a significant part of patient treatment. In austere environments, typical methods of counting drops from gravity drips or infusion pumps both have limitations such as accuracy, weight, and need for power. The DripAssist device calculates drip rates by counting drops in IV tubing drip chambers and may provide a useful patient safety monitor adjunct. The protocol was IRB approved, prospective, and designed as a pilot study involving 28 Madigan Army Medical Center Emergency Department personnel. After a brief didactic introduction to the device for clinical staff with no prior experience using the device, participants were timed setting three normal saline infusions at rates of 250 mL/h, 125 mL/h and 83 mL/h with 15gtt/mL tubing. Participants filled out a survey on perceived ease of use and utility of the device compared to pumps and manual counting. Most participants felt the DripAssist device was easy to understand and set up, but nurses and physician assistants were more likely than medics to perceive a benefit versus IV pumps or gravity drips. The DripAssist device may offer a safe, low-weight, functional tool which could improve care in a variety of resource-limited environments. However, additional studies using the device during actual field exercises would be beneficial.

J Trauma Acute Care Surg. 2019 Apr 25. doi: 10.1097/TA.0000000000002349. [Epub ahead of print]

Winds of Change in Military Medicine and Combat Casualty Care.

Davis M, Rasmussen T

Abstract: Not available

J Trauma Acute Care Surg. 2019 Apr;86(4):625-634

Minimally invasive preperitoneal balloon tamponade and abdominal aortic junctional tourniquet versus open packing for pelvic fracture-associated hemorrhage: Not all extrinsic compression is equal.

Do W, Forte D, Sheldon R, Weiss J, Barron M, Sokol K, Black G, Hegge S, Eckert M, Martin M

BACKGROUND: Minimally invasive preperitoneal balloon tamponade (PPB) and abdominal aortic junctional tourniquets (AAJT) have been proposed as alternatives to open preperitoneal packing (OP) for the management of pelvic fracture-associated hemorrhage. We hypothesized that the PPB (SpaceMaker Pro) and AAJT would result in similar rates of survival and blood loss versus OP.

METHODS: Thirty-two swine underwent creation of a combined open-book pelvic fracture and major iliac vascular injuries. Animals were randomized to no intervention (n = 7), OP (n = 10), PPB (n = 9), or AAJT (n = 6) at a mean arterial pressure <40 mm Hg following initiation of uncontrolled hemorrhage. Survival (up to 60 minutes + 10 minutes after intervention reversal), hemodynamics, extraperitoneal pressures, blood loss, and associated complications were compared between groups.

RESULTS: Prior to injury, no difference was measured between groups for weight, hemodynamics, lactate, and hematocrit (all $p > 0.05$). The injury was uniformly lethal without intervention, with survival time (mean) of 5 minutes, peak preperitoneal pressure (PP) of 14 mm Hg, blood loss of 960 g, and peak lactate of 2.6 mmol/L. Survival time was 44 minutes with OP versus 60 minutes with PPB and AAJT ($p < 0.01$). Peak PP (mm Hg) was 19 with OP, 23 with PPB, and 23 with AAJT ($p > 0.05$). Blood loss (g) was 850 with OP, 930 with PPB, and 600 with AAJT ($p > 0.05$). Peak lactate (mmol/L) was 3.3 with OP, 4.3 with PPB, and 6.3 with AAJT ($p < 0.01$). Only 33% of AAJT animals survived intervention reversal versus 60% for OP and 67% for PPB ($p < 0.01$). Necropsy revealed bowel/bladder injury in 50% of AAJT subjects versus 0% in all other arms ($p < 0.01$).

CONCLUSION: Preperitoneal balloon tamponade is a safe and potentially effective alternative to OP for the management of lethal pelvic fracture-associated hemorrhage. Abdominal aortic junctional tourniquet offers a similar survival benefit to PPB but has concerning rates of ischemia-reperfusion and compressive abdominal organ injury.

J Spine Surg. 2019 Mar;5(1):97-109

The 100 most influential spine fracture publications.

Donnally C, Rivera S, Rush A, Bondar K, Boden A, Wang M

Background: Management of spine fractures has advanced considerably even over the past decade. A review of the current and historical literature can lead to a better appreciation of current management protocols. This is the first comprehensive review of the most influential articles related to spine fracture management. The purpose of this study is to identify and analyze the 100 most cited publications in spine fracture management.

Methods: Using the Clarivate Analytics Web of Science, search phrases were used to identify publications pertaining to spine fractures (110,809 publications). The 100 most cited articles were isolated. The frequency of citations, year of publication, country of origin, journal of publication, level-of-evidence (LOE), article type, and contributing authors/institutions were recorded. We also highlighted the ten most cited articles (per year) from the past decade.

Results: The publications included ranged from 1953-2010, with the majority published between 2000-2009 (n=41). Total citations ranged from 154 to 1,076. A LOE of IV had the plurality at 36%. The most cited article was "The 3 Column Spine and Its Significance in The Classification of Acute Thoracolumbar Spinal-Injuries" (Spine 1983) by F Denis. The majority of papers originated in the United States (n=65), and the highest number were published in Spine (n=27). Osteoporotic fractures were the specific topic in 34 publications. In the past decade, the article with the most citations/year was "A Randomized Trial of Vertebroplasty for Osteoporotic Spinal Fractures" by DF Kalmes in 2009.

Conclusions: Despite less time for citation than other decades, the 2000s contain the plurality of the influential publications. This may indicate that some of the most important changes to spine fracture management pertain to improved imaging modalities and surgical technologies. This review provides a guide for a comprehensive understanding of the historical and current literature pertaining to spine fracture management.

Wilderness Environ Med. 2019 Jun;30(2):163-176

Human Responses to 5 Heated Hypothermia Wrap Systems in a Cold Environment.

Dutta R, Kulkarni K, Steinman A, Gardiner P, McDonald G, Giesbrecht G

INTRODUCTION: We compared the effectiveness of 5 heated hypothermia wrap systems.

METHODS: Physiologic and subjective responses were determined in 5 normothermic subjects (1 female) for 5 heated hypothermia wraps (with vapor barrier and chemical heat sources) during 60 min of exposure to a temperature of -22°C. The 5 systems were 1) user-assembled; 2) Doctor Down Rescue Wrap; 3) hypothermia prevention and management kit (HPMK); 4) MARSARS Hypothermia Stabilizer Bag; and 5) Wiggy's Victims Casualty Hypothermia Bag. Core and skin temperature, metabolic heat production, skin heat loss, and body net heat gain were determined. Subjective responses were also evaluated for whole body cold discomfort, overall shivering rating, overall temperature rating, and preferential ranking.

RESULTS: The Doctor Down and user-assembled systems were generally more effective, with higher skin temperatures and lower metabolic heat production; they allowed less heat loss, resulting in higher net heat gain ($P<0.05$). HPMK had the lowest skin temperature and highest shivering heat production and scored worse than the other 4 systems for the "whole body cold discomfort" and "overall temperature" ratings ($P<0.05$).

CONCLUSIONS: The user-assembled and Doctor Down systems were most effective, and subjects were coldest with the HPMK system. However, it is likely that any of the tested systems would be viable options for wilderness responders, and the choice would depend on considerations of cost; volume, as it relates to available space; and weight, as it relates to ability to carry or transport the system to the patient.

J Trauma Acute Care Surg. 2019 Feb;86(2):368-369

Next-level thinking about mass casualty care.

Dutton R

QUOTE:
"Seen in this light, the work by Lozado et al. falls in the middle of the science progression triangle—the trauma system level. The authors found that the postevent surge in blood donation was too late to help the victims—because death from hemorrhage occurs in the first hours after injury 9—and led to the unfortunate waste of a precious resource. They advocate for a change in public rhetoric following mass-casualty events, combined with a prospective system for redirecting societal motivation into scheduled blood donations over the ensuing months.
While it is hard to argue with the methodology or results of this work, it is worth a brief consideration of how generalizable the findings might be. Overall, medical outcomes of the Las Vegas shooting were better than expected. Patients reached definitive care quickly, in-hospital triage was relatively accurate and adequate resources were available. Sunrise Hospital was able to open a dozen operating rooms within hours of the event (S. Davidson, personal communication).

In many ways, the system got lucky: confusion in the EMS transport network was offset by the presence of multiple trauma centers; failure of the cell phone network was mitigated by public news broadcasts describing the magnitude of the event, enabling spontaneous return to the hospital of off-duty personnel; Sunday-night blood supplies were at their weekly high, and occurrence of the event just before evening change-of-shift made it easy to keep additional staff."

Transfusion. 2019 Apr;59(S2):1423-1428

Outcomes of traumatic hemorrhagic shock and the epidemiology of preventable death from injury.

Eastridge B, Holcomb J, Shackelford S

ABSTRACT: The majority of potentially preventable deaths after trauma are related to hemorrhage and occur early after injury, with the largest number of deaths occurring before hospital arrival. Approximately one-fourth of trauma deaths may be potentially preventable through early medical and surgical interventions. Interventions dedicated to bleeding control and hemostatic resuscitation have demonstrated merit in decreasing hemorrhagic injury mortality. Advancing these novel strategies to the casualty in the prehospital phase of care, particularly in tactical or austere environments, may prove beneficial for hemorrhage mitigation to temporize the window of survival to definitive care. Future studies of resuscitation and survival after traumatic injury must include analysis of prehospital deaths to fully understand the outcomes of early interventions.

J Trauma Acute Care Surg. 2019 Mar 1; Epub ahead of print

CT Correlation of Skeletal Landmarks and Vascular Anatomy in Civilian Adult Trauma Patients: Implications for Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA).

Eliason J, Derstine B, Horbal S, Wang N, Holcombe S, Chiu C, Ross B, Bromwell B, Morrison J, Wang S

BACKGROUND: REBOA is a valuable resuscitative adjunct in a variety of clinical settings. In resource-limited or emergency environments, REBOA may be required with delayed or absent image-guidance or verification. Catheter insertion lengths may be informed by making CT correlations of skeletal landmarks with vascular lengths.

METHODS: 2247 trauma patients with CT imaging between 2000-2015 at a single civilian tertiary care center were identified, yielding 1789 patients with adequate contrast opacification of the arterial system in the chest, abdomen, and pelvis. Individual scans were analyzed using MATLAB software, with custom high-throughput image processing algorithms applied to correlate centerline vascular anatomy with musculoskeletal landmarks. Data were analyzed using R version 3.3.

RESULTS: The median centerline distance from the skin access to the aortic bifurcation was longer by 0.3 cm on the right than on the left side. Median Aortic Zone I length was 21.6 (IQR, 20.3-22.9) cm, while Zone III was 8.7 (7.8-9.5) cm. Torso extent (TE) correlation to Zone I was much higher than for Zone III (R2 0.58 vs 0.26 (right) and 0.58 vs. 0.27 (left), $p<0.001$). Assuming a 4 cm balloon length, optimal fixed insertion length would be 48 cm and 28 cm for Zones I and III (Error 0.4% vs 33.3%), respectively, although out of zone placements can be reduced if adjusted for TE (Error 0% vs 26.4%).

CONCLUSIONS: CT morphometry suggests a fixed REBOA catheter insertion length of 48 cm for Zone I and 28 cm for Zone III is optimal (on average, for average-height individuals), with improved accuracy by formulaic adjustments for torso extent. High residual error for Zone III placement may require redesign of existing catheter balloon lengths or consideration of the relative risk associated with placing the balloon catheter too low or too high.

LEVEL OF EVIDENCE:

NASN Sch Nurse. 2019 Mar 28: Epub ahead of print

School Nurses on the Front Lines of Medicine: The Approach to a Student With Severe Traumatic Bleeding.

Erdman M, Chardavoyne P, Olympia R

ABSTRACT: With the continued threat of mass casualty incidents in schools and surrounding communities, it is essential for school nurses to be knowledgeable regarding the recognition of hemorrhagic shock due to massive bleeding and the acute management of these victims. In the past decade, increased interest and research in acute bleeding control have led to published evidence-based guidelines to reduce morbidity and mortality for victims of violent acts. It is essential that healthcare providers, including nurses who are the first responders in schools, are aware of methods to assess and control massive bleeding. This article summarizes the most up-to-date recommendations for the management of children with traumatic bleeding.

Transfus Apher Sci. 2019 Apr;58(2):212-215

Implementation of a protocol for prehospital transfusion of low-titer, leukocyte-depleted whole blood for civilian bleeding patients.

Espinosa A, Dybvik B, Medby C, Vangberg G

ABSTRACT: Blood component therapy is considered the gold standard for the treatment of the massively bleeding patient, but it can be challenging to perform outside the hospital environment. The successful experience from the military shows that whole blood can efficiently provide treatment for massively bleeding patients. Whole blood transfusion has been in use in Norway to some extent in paediatric cardiac surgery, but no major interest has been paid from the blood centres to implement the use of whole blood as an alternative or a supplement to traditional blood component therapy. On the other hand, the increasing number of reports showing a potential benefit of whole blood and the availability of the last generation whole blood leukocyte filters, allowing the platelets to remain in the blood product, has led to the first experiences with prehospital use of whole blood in Norway. Our institution is completing the planning of a program for the use of prehospital whole blood transfusion in the civilian setting, following the same trend at two other hospitals in Norway.

J Athl Train. 2018 Aug;53(8):752-755

Removal of the Long Spine Board From Clinical Practice: A Historical Perspective.

Feld F

ABSTRACT: Since the early 1970s, initial management of patients with suspected spinal injuries has involved the use of a cervical collar and long spine board for full immobilization, which was thought to prevent additional injury to the cervical spine. Despite a growing body of literature demonstrating the detrimental effects and questionable efficacy of spinal immobilization, the practice continued until 2013, when the National Association of EMS Physicians issued a position statement calling for a reduction in the use of spinal immobilization and a shift to spinal-motion restriction. This article examines the literature that prompted the change in spinal-injury management and the virtual elimination of the long spine board as a tool for transport.

Br J Anaesth. 2019 Jun;122(6):760-766

Reduced perioperative blood loss in children undergoing craniosynostosis surgery using prolonged tranexamic acid infusion: a randomised trial.

Fenger-Eriksen C, D'Amore Lindholm A, Nørholt S, von Oettingen G, Tarpgaard M, Krogh L, Juul N, Hvas A, Rasmussen M

BACKGROUND: Tranexamic acid (TXA) reduces intraoperative blood loss and transfusion during paediatric craniosynostosis surgery. Additional reduction of postoperative blood loss may further reduce exposure to allogeneic blood products. We studied the effect of combined intra- and postoperative TXA treatment on postoperative blood loss in children.

METHODS: Thirty children admitted for craniosynostosis surgery were randomised to combined intra- and postoperative TXA treatment or placebo. The primary endpoint was postoperative blood loss. Secondary endpoints included total blood loss, transfusion requirements, and clot stability evaluated by tissue plasminogen activator-stimulated clot lysis assay.

RESULTS: TXA reduced postoperative blood loss by 18 ml kg-1 (95% confidence interval 8.9) and total blood loss from a mean of 52 ml kg-1 (standard deviation [SD]; 20) ml kg-1 to 28 (14) ml kg-1 (P<0.001). Intraoperative red blood cell (RBC) and fresh frozen plasma (FFP) transfusions were reduced in the treatment group from RBC 14.0 (5.2) ml kg-1 to 8.2 (5.1) ml kg-1 (P=0.01) and from FFP 13.0 (6.3) ml kg-1 to 7.8 (5.9) ml kg-1 (P=0.03). Postoperative RBC transfusion median was 5 (inter-quartile range [IQR] 0-6) ml kg-1 in the placebo group and 0 (0-5.7) ml kg-1 in the TXA group. Resistance to lysis was higher in the treatment group (P<0.001).

CONCLUSIONS: Combined intra- and postoperative tranexamic acid treatment reduced postoperative and overall blood loss and transfusion requirements. Improved clot stability represents a possible mechanism for blood loss reduction.

J Trauma Acute Care Surg. 2019 Apr 23; Epub ahead of print

Conducting Fresh Whole Blood Transfusion Training.

Fisher A, Carius B, Corley J, Dodge P, Miles E, Taylor A

ABSTRACT: Fresh whole blood is the optimal resuscitation fluid for casualties in hemorrhagic shock according to the Committee on Tactical Combat Casualty Care and has demonstrated to improve outcomes in severely wounded patients. Like all medical interventions, fresh whole blood transfusions are not without risks, but similarly can be mitigated through increased training to develop provider knowledge and proficiency. To date, no literature has been published regarding the proper technique to conduct fresh whole blood transfusion training. This article provides a structured foundation to establish a standardized fresh whole blood transfusion training program in order to increase skill and preparedness for fresh whole blood protocol implementation. Using these techniques in a training environment, providers will be able to provide optimal resuscitation in hemorrhagic shock in austere environments.

J Trauma Acute Care Surg. 2019; Epub ahead of print

National Stop the Bleed Day: The impact of a social media campaign on the Stop the Bleed program.

Fisher A, Carius B, Lacroix J, Dodge P, Dodd J, Soderlund E, Thompson D, Loos P, Fannin J, Montgomery H, Gestring M

INTRODUCTION: National Stop-the-Bleed Day (NSTBD) was created to increase public awareness of the official Stop-the-Bleed® initiative and the Bleeding Control Basic course. The goal was to develop and employ an effective national social media strategy that would encourage and support efforts already in place to train the public in basic bleeding control techniques.

METHODS: March 31, 2018 was designated as NSTBD. Analysis focused on a two-week window centered on NSTBD. The number of courses offered, number of instructors registered and total number of students trained overall during this period was derived from the American College of Surgeons (ACS) website bleedingcontrol.org. Courses not registered with the ACS were not included. Data on overall website activity was also included for analysis.

RESULTS: 43 states and 18 countries participated in NSTBD. During the study period, there were 1884 courses registered on the bleedingcontrol.org (Figure 1). Comparatively, over a four-month period from August - November, 2017, the mean number of registered courses per month was 834. There were 34699 students trained during the two-week study period (Figure 2) as opposed to August - November 2017, the mean number of people trained per month was 9626. In addition, 576 new B-Con instructors were certified during this time window. Additionally, the international coordinators reported 1500 students were trained during the study period. During this time, the ACS reported a significant increase in website activity. This included 10,530 new visitors, 12772 visitors overall and 35342 page views recorded during the study period.

CONCLUSION: The NSTBD effort was successful in generating widespread interest for the Stop-the-Bleed® initiative. The use of a targeted social media campaign in this context was successful in driving people to available training opportunities while also increasing awareness of the overall effort. While only in its early stages, the NSTBD concept is a good one and should be developed further in coming years.

LEVEL OF EVIDENCE: Retrospective, Level V.

Ann Surg. 2019 Mar;269(3):e29-e30

Prehospital Ground Transport Rapid Sequence Intubation for Trauma and Traumatic Brain Injury Outcomes.

Fitzgerald M, Lloyd-Donald P, Smit V, Mathew J, Kim Y, Tee J, Dewan Y, Mitra B

QUOTE:

"We suggest that headlining the only positive, yet potentially flawed, finding of 4 secondary outcomes when the primary outcome has been refuted demands further assessment of prehospital RSI. Neurotrauma represents a significant personal, societal, and economic global health burden. It is clinically important to review any intervention as we attempt to reach an international consensus on the management of those with severe brain injury.

It is possible that a subgroup of patients, such as those transported by air or those with prolonged transport times, may benefit from prehospital RSI. However, it is equally possible that patients in urban areas, those in hemorrhagic shock and/or patients with surgically treatable brain injury may be harmed. Despite the extensively cited RCT, equipoise continues to exist and pending further trials, sound clinical judgment, which includes consideration of the benefits of early access to definitive care, should be applied before routine prehospital intubation after trauma."

J Spec Oper Med. Spring 2019;19(1):89-94.

Impact of Marine Exposure on Hemostatic Gauzes Using Thromboelastography.

George T, Jordan M, Bianchi W, Boboc M, Zarow GJ, Natarajan R, Walchak AC, Roszko PJD.

BACKGROUND: Military forces render emergency care in marine environments, where care for exsanguination is challenging. However, the effect of saltwater on the functionality of hemostatic agents is unknown. In this study, we used thromboelastography (TEG) to quantify the effect of saltwater on the efficacy of five gauze products.

METHODS: Blood from 24 healthy adult men was diluted by 30% with hetastarch to mimic hemodilution. Dry and saltwater-soaked Kerlix™, ChitoGauze®, Combat Gauze®, NuStat™, and WoundClot™ were contrasted in terms of the TEG parameters of speed of clot initiation (R), clot amplification (K), α angle (i.e., clot formation rate), and maximum amplitude of clot (MA), using repeated-measures analysis of variance at the $p < .05$ statistical significance threshold.

RESULTS: Compared with untreated dilute blood, R was significantly faster when any dry or wet gauze was added, with the fastest R values recorded for Combat Gauze. K and α angle findings were mixed. MA was greater than diluted blood for dry hemostatic gauze, but in the wet condition, only the MA for Combat Gauze was significantly greater than that of diluted blood.

CONCLUSION: Gauze products, wet or dry, improved clotting compared to diluted blood without gauze. Saltwater exposure did not significantly detract from this benefit. Our findings suggest that Combat Gauze may be the choice hemostatic gauze for maritime environments.

J Trauma Acute Care Surg. 2019 Apr 12; Epub ahead of print

Pre-hospital adenosine, lidocaine and magnesium has inferior survival compared to tactical combat casualty care resuscitation in a porcine model of prolonged hemorrhagic shock.

How R, Glaser J, Schaub L, Fryer D, Ozuna K, Morgan C, Sams V, Cardin S

BACKGROUND: Adenosine, lidocaine, and magnesium (ALM) is a cardioplegic agent shown to improve survival by improving cardiac function, tissue perfusion, and coagulopathy in animal models of shock. We hypothesized pre-hospital ALM treatment in hemorrhagic shock would improve survival compared to current Tactical Combat Casualty Care (TCCC) resuscitation beyond the Golden Hour.

METHODS: Swine were randomized to: 1) TCCC, 2) 2cc/kg vehicle control (VC), 3) 2cc/kg ALM+drip, 4) 4cc/kg ALM+drip, 5) 4cc/kg ALM+delayed drip at 0.5cc/kg/hr, 6) 4cc/kg vehicle control, 7) 4cc/kg ALM for 15 mins + delayed drip at 3cc/kg/hr. Animals underwent pressure controlled hemorrhage to MAP of 30mmHg (S=0). Treatment was administered at T=0. After 120 minutes of simulated pre-hospital care (T=120) blood product resuscitation commenced. Physiologic variables were recorded and labs were drawn at specified time points.

RESULTS: TCCC demonstrated superior survival to all other agents. VC and ALM groups had lower mean arterial pressures (MAPs) and systolic blood pressures (SBPs) compared to TCCC. Except for the vehicle control groups, lactate levels remained similar with correction of base deficit after pre-hospital resuscitation in all groups. Kidney function and liver function remained comparable across all groups. Compared to baseline values, TCCC demonstrated significant hypocoagulability.

CONCLUSION: ALM, as administered in this study, is inferior to current Hextend®-based resuscitation for survival from prolonged hemorrhagic shock in this model. In survivors, ALM groups had lower SBPs and MAPs, but provided a protective effect on coagulopathy as compared to TCCC. ALM does not appear to be a suitable low volume replacement to current TCCC resuscitation. The reduced coagulopathy compared to TCCC warrants future studies of ALM, perhaps as a therapeutic adjunct.

Am J Surg. 2019 Jan 30; Epub ahead of print

An effective multi-modality model for single-session cricothyroidotomy training for trainees.

Glass C, Parsons C, Raykar N, Watkins A, Jinadasa S, Fleishman A, Gupta A

BACKGROUND: We piloted a curriculum combining a flipped classroom with two-stage narration, role-play, and partial task trainer simulation to teach this critical skill to trainees.

METHODS: This "flipped classroom" module (2012-2018) for open and percutaneous cricothyroidotomy (OC and PC) required participants to watch two 4 min training videos for OC and PC. The simulation session consisted of a 45-min hands-on simulation of OC and PC in which participants rotated between the roles of operator, narrator, and critiquer. Median performance scores were calculated.

RESULTS: 103 trainees were evaluated. The median performance score was 14 out of maximum 14 (range: 9-14) across all trainees for OC. The median performance score was 13 out of maximum 13 (range: 3-13) across all trainees for PC.

CONCLUSION: A multi-modality approach including the flipped classroom, role-play, and partial task trainer simulation is an efficient and effective method for teaching trainees proficiency in short, single operator procedures.

Mil Med. 2019 Mar 1;184(Suppl 1):78-82

The Israeli Defense Forces Point of Injury Antimicrobial Treatment Protocol – A New Protocol and Review of the Literature.

Glick Y, Furer A, Glick K, Yitzhak A, Brosh T

INTRODUCTION: Combat wound infection is a common and serious complication, leading to significant morbidity and mortality. In 2005, a point of injury antimicrobial protocol was published by the Israel Defense Forces, in which Moxifloxacin was chosen. During 2016-2017, a revision of this protocol was performed and concluded with the publication of an updated protocol. The purpose of this report is to present this process and the revised protocol, together with a review of the literature.

METHODS: We searched "Medline" and "Google Scholar" for studies dealing with antimicrobial prophylaxis in trauma, for militaries' point of injury antimicrobial protocol protocols and for established surgical antimicrobial prophylaxis protocols.

RESULTS: Point of injury antimicrobial protocol is aimed at preventing early infection and its complications. The choice of Moxifloxacin for this purpose may not be optimal since Moxifloxacin spectrum might be overly broad, there is scant evidence supporting it for this indication, and the available preparation does not meet distinctive technical requirements. Contrarily, Ceftriaxone seemed to have suitable microbiological, pharmacological and technical features.

CONCLUSION: Point of injury antimicrobial protocol should be used especially when evacuation and definitive surgical treatment are delayed. According to present scientific data and operational needs, Ceftriaxone was chosen for most penetrating injuries, with Metronidazole addition for penetrating abdominal and cranial trauma.

Curr Opin Anaesthesiol. 2019 Jun;32(3):343-352

Tranexamic acid and perioperative bleeding in children: what do we still need to know?

Goobie S, Faraoni D

PURPOSE OF REVIEW: Perioperative bleeding and blood product transfusion are associated with significant morbidity and mortality. Prevention and optimal management of bleeding decreases risk and lowers costs. Tranexamic acid (TXA) is an antifibrinolytic agent that reduces bleeding and transfusion in a broad number of adult and pediatric surgeries, as well as in trauma and obstetrics. This review highlights the current pediatric indications and contraindications of TXA. The efficacy and safety profile, given current and evolving research, will be covered.

RECENT FINDINGS: Based on the published evidence, prophylactic or therapeutic TXA administration is a well-tolerated and effective strategy to reduce bleeding, decrease allogeneic blood product transfusion, and improve pediatric patients' outcomes. TXA is now recommended in recent guidelines as an important part of pediatric blood management protocols.

SUMMARY: Based on TXA pharmacokinetics, the authors recommend a dosing regimen of between 10 to 30 mg/kg loading dose followed by 5 to 10 mg/kg/h maintenance infusion rate for pediatric trauma and surgery. Maximal efficacy and minimal side-effects with this dosage regime will have to be determined in larger prospective trials including high-risk groups. Furthermore, future research should focus on determining the ideal TXA plasma therapeutic concentration for maximum efficacy and minimal side-effects.

J Emerg Med. 2019 Apr;56(4):455-456

THINK of Ketamine for Headache.

Goodnough R

QUOTE:

"The THINK (Treatment of Headache with Intranasal Ketamine) trial is a timely addition to the literature (9). Benish et al. report a well-designed, prospective, single-blind trial comparing 1–2 doses of intranasal ketamine (0.75 mg/kg, with the option for 0.25 mg/kg 30 min later) to i.v. metoclopramide (10 mg) and diphenhydramine (25 mg) (9). Providers could opt to administer i.v. ketorolac (30 mg) or dexamethasone (10 mg) in the control arm (9). Ketamine displayed a clinically significant decrease in pain at 30 min (mean change in VAS 29.0 mm), though it was not superior to the control arm (mean change in VAS 22.2 mm) (9). A decrease in 13–18 mm has been described as clinically significant (1,3). The intervention and control arm showed similar rates of adverse effects (65.4 and 66.7%, respectively); though there was a higher incidence of mood changes and feelings of unreality in the ketamine group, the study was not powered to detect these differences (9). The majority (80%) of the control arm additionally received i.v. ketorolac, which implies a similar effectiveness of intranasal ketamine to the combined administration of i.v. diphenhydramine, metoclopramide, and NSAID therapy at 30 min (9). The disparate outcomes demonstrated by previously published literature on ketamine in management of primary headache compared to the THINK trial may be reflective of variations in ketamine dosing, routes, or rate of infusion, or by the selection of metoclopramide rather than other dopamine antagonists. Amidst the current opioid epidemic, comfort with ketamine as a viable intervention for pain relief adds to the emergency medicine provider's armamentarium of nonopioid analgesics and, therefore, the investigation of ketamine to manage pain from primary headache is appealing. Further, the intranasal route of administration may limit the need for placement of i.v. lines or administration of multiple parenteral medications in this population."

Prehosp Emerg Care. 2019 Mar 15:1-7. doi: 10.1080/10903127.2019.1593566

Layperson Ability and Willingness to Use Hemostatic Dressings: A Randomized, Controlled Trial.

Goolsby C, Rojas L, Moore K, Kretz E, Singletary E, Klimczak V, Charlton N.

BACKGROUND: The Hartford Consensus and Stop the Bleed Campaign empower the public to stop bleeding. While evidence for civilian tourniquet use is mounting, there is limited evidence regarding the public's ability to use hemostatic dressings. This study seeks to determine if laypeople can apply hemostatic dressings, and which hemostatic dressing they can use most successfully.

METHODS: 360 layperson participants in Maryland and Virginia completed 4 arms of this randomized, prospective controlled trial: plain gauze (control), z-folded gauze, s-rolled gauze, and injectable sponge (experimental) arms. Participants watched a standardized video, practiced hands-on dressing application, and were assessed applying the dressing via checklists and feedback mechanisms for pressure, timing, and packing. Participants completed pre and post questionnaires regarding willingness to use hemostatic dressings.

RESULTS: Overall, 202 participants (56%) applied the dressings correctly, and 83 (92%) applied the injectable sponges correctly. This is a significant difference from the other arms ($p < 0.001$), and OR 17.2 (95% CI 6.8 - 48.1) compared to control. 38 participants (40%) correctly applied plain gauze, while 37 (43%) and 44 (48%) participants correctly applied z-folded and s-rolled gauzes. The primary reasons for failure were not holding pressure long enough (n = 103, 65%) and not applying adequate pressure (n = 64, 41%). Participants in all arms had significant improvements in willingness to use hemostatic dressings: 154 (43.6%) participants pre vs. 344 (97.5%) post study participation ($p < 0.001$).

CONCLUSIONS: More than half of laypeople can apply hemostatic dressings, and they are most successful applying injectable sponges. Brief education increases laypeople's reported willingness to use hemostatic dressings. Educators and planners should consider including injectable sponges in their Stop the Bleed programs and products.

LEVEL OF EVIDENCE: II (RCT with significant difference. One negative criterion for observer blinding).

Ann Surg. 2019;Epub ahead of print

Prehospital Blood Product and Crystalloid Resuscitation in the Severely Injured Patient: A Secondary Analysis of the Prehospital Air Medical Plasma Trial.

Guyette F, Sperry J, Peitzman A, Billiar T, Daley B, Miller R, Harbrecht B, Claridge J, Putnam T, Duane T, Phelan H, Brown J

MINI: Hemorrhage is the primary cause of preventable trauma death. Secondary analyses of scene patients from the PAMPer trial demonstrated that prehospital packed red blood cell and plasma had the greatest reduction in 30-day mortality compared with crystalloid-only resuscitation. Patients with hemorrhagic shock should receive prehospital blood products when available, preferably packed red blood cell and plasma.

OBJECTIVE: The aim of this study was to determine whether prehospital blood products reduce 30-day mortality in patients at risk for hemorrhagic shock compared with crystalloid only resuscitation.

SUMMARY OF BACKGROUND DATA: Hemorrhage is the primary cause of preventable death after injury. Large volume crystalloid resuscitation can be deleterious. The benefits of prehospital packed red blood cells (PRBCs), plasma, or transfusion of both products among trauma patients is unknown compared with crystalloid.

METHODS: Secondary analysis of the multicenter PAMPer trial was performed on hypotensive injured patients from the scene. The trial randomized 27 helicopter bases to prehospital plasma or standard resuscitation. Standard resuscitation at the sites was equally divided between crystalloid and crystalloid + PRBC. This led to 4 prehospital resuscitation groups: crystalloid only; PRBC; plasma; and PRBC+plasma. Cox regression determined the association between resuscitation groups and risk-adjusted 30-day mortality. The dose effect of resuscitation fluids was also explored.

RESULTS: Four hundred seven patients were included. PRBC+plasma had the greatest benefit [hazard ratio (HR) 0.38; 95% confidence interval (95% CI) 0.26-0.55, P < 0.001], followed by plasma (HR 0.57; 95% CI 0.36-0.91, P = 0.017) and PRBC (HR 0.68; 95% CI 0.49-0.95, P = 0.025) versus crystalloid only. Mortality was lower per-unit of PRBC (HR 0.69; 95% CI 0.52-0.92, p = 0.009) and plasma (HR 0.68; 95% CI 0.54-0.88, P = 0.003). Crystalloid volume was associated with increasedmortality among patients receiving blood products (HR 1.65; 95% CI 1.17-2.32, P = 0.004).

CONCLUSION: Patients receiving prehospital PRBC+plasma had the greatest mortality benefit. Crystalloid only had the worst survival. Patients with hemorrhagic shock should receive prehospital blood products when available, preferably PRBC+plasma. Prehospital whole blood may be ideal in this population.

Crit Care Med. 2019 Mar;47(3):e222-e226

Six Hours of Manual Ventilation With a Bag-Valve-Mask Device Is Feasible and Clinically Consistent.

Halpern P, Dang T, Epstein Y, Van Stijn-Bringas Dimitriades D, Koenig K

OBJECTIVES: Manual ventilation of intubated patients is a common intervention. It requires skill as well as physical effort and is typically restricted to brief periods. Prolonged manual ventilation may be unavoidable in some scenarios, for example, extreme mass casualty incidents. The present study tested whether nurses are capable of appropriately manually ventilating patients for 6 hours.

DESIGN: Volunteers performed ventilation on an electronic simulator for 6 hours while their own cardiorespiratory variables and the quality of the delivered ventilation were measured and recorded. The volunteers scored their perceived level of effort on a standard Borg Scale.

SETTING: Research laboratory at the Emergency Department, Tel Aviv Medical Center.

SUBJECTS: Ten nursing staff members of the Tel Aviv Sourasky Medical Center, 25-43 years old.

INTERVENTIONS: Volunteers ventilated manually a lung simulator for 6 hours.

MEASUREMENTS AND MAIN RESULTS: The subjects' physiologic states, including blood pressure, heart rate, respiratory rate, and oxygen saturation, showed no significant changes over time. The quality of delivered ventilation was somewhat variable, but it was stable on the average: average tidal volume ranged between 524.8 and 607.0 mL ($p = 0.33$). There was a slight but significant increase (7.3-10.9 L/min [$p = 0.048$]) in minute volume throughout the test period, reaching values consistent with mild hyperventilation. The subjects scored their perceived working effort as very light to fairly light, with a nonsignificant gradual increase in the Borg score as the study progressed.

CONCLUSIONS: Manual ventilation of intubated patients can be performed continuously for 6 hours without excessive physical effort on the part of the operator. The quality of delivered ventilation was clinically adequate for all of them. There was a mild but significant trend toward hyperventilation, albeit within safe clinical levels, which was due to an increasing ventilatory rate rather than an increase in tidal volume.

Pediatrics. 2019 Jun;e20183447.

Adult Tourniquet for Use in School-Age Emergencies.

Harcke H, Lawrence L, Gripp E, Kecskemethy H, Kruse R, Murphy S

BACKGROUND: Gunshot injuries are a leading cause of morbidity and mortality in the pediatric population. The Pediatric Trauma Society supports the use of tourniquets for exsanguinating hemorrhage in severe extremity trauma. The Combat Application Tourniquet (CAT) used with success in adults has not been prospectively tested in children. Our objective with this study was to determine if the CAT is successful in arresting extremity arterial blood flow in school-aged children.

METHODS: Sixty school-aged volunteers (ages 6-16 years) recruited by age cohort had the CAT applied to an upper arm and thigh while peripheral pulse was monitored by Doppler. The number of windlass turns (maximum allowed: 3 [1080°]) required to arrest arterial pulse was recorded. Success was analyzed by BMI percentile for age and extremity circumference.

RESULTS: The CAT was successful in occluding arterial blood flow as detected by Doppler pulse in all 60 (100%) of the upper extremities tested. In the lower extremity, 56 (93%) had successful occlusion. The 3-turn maximum allowed by the protocol was not adequate in some obese, older subjects (BMI >30). In both the upper and lower extremity, the number of turns required to occlude blood flow gradually increased with an increase in arm and thigh circumference.

CONCLUSIONS: Prospective testing of a cohort of school-aged children 6 to 16 years revealed the CAT tourniquet to be suitable for use in both the upper and lower extremity.

Mil Med. 2019 Mar 1;184(Suppl 1):342-346. doi: 10.1093/milmed/usy389.

Comparison of a Novel Trainer to a Traditional Swine Model for Training Providers in Lateral Canthotomy and Cantholysis.

Herder P, Lu M, LaPorta A, Ross D, Calvano C, Enzenauer R

RESEARCH OBJECTIVE: Military personnel are at greater risks of head and facial traumas and permanent blindness from orbital compartment syndrome in modern warfare. Rapid treatment must be implemented with a low-risk surgical remedy: lateral canthotomy and cantholysis (LCC). Traditional training of LCC is primarily performed using an animal tissue trainer (ATT); however, limitations to these types of trainers exist. Therefore, our research objectives were focused on highlighting the effectiveness, benefits, and vision-saving potential of learning LCC on a synthetic trainer.

METHODS: Participants included 22 second-year medical students and 6 healthcare professionals. A pre-quiz assessed baseline knowledge. Next, an experienced ophthalmologist provided an overview and instruction. Subjects were randomized to either the synthetic trainer or the ATT and then switched to the other model for comparison. After performing LCC procedures on both models, a post-quiz and survey were administered.

RESULTS: Participants found the synthetic trainer easier to use than the ATT model ($p < 0.01$). There was no statistically significant preference ($p = 0.23$), or preference of practical eye anatomy ($p = 0.26$) between the trainers. Post-quiz results demonstrated an overall improvement from pre-quiz scores for participants ($p < 0.001$).

CONCLUSIONS: The synthetic trainer is comparable to the traditional swine model for training LCC procedures, and should be considered as a future training platform.

Acta Ophthalmol. 2019; Epub ahead of print

Eye Injuries across history and the evolution of eye protection.

Hoskin A, Mackey D, Keay L, Agrawal R, Watson S

PURPOSE: To describe the history of eye injuries and the consequent evolution of eye protection.

METHODS: A comprehensive search of Medline and the grey literature using the terms 'ocular trauma' and 'eye protection' or 'injury prevention' and 'history'. References were used to identify other relevant publications. Publications were classified according to the setting of eye injury: occupational, recreational or combat-related.

RESULTS: Eye protection has been described in a wide range of sources, including in literature and art. With advances in eye protection material and design, as well as government and societal promotion of appropriate eye protection usage in the workplace, the epidemiology of ocular trauma has changed over time. In developed countries, the use of eye protection in the workplace has reduced the proportion of occupation-related eye injuries over the last century, with a higher proportion occurring during sports or at home. New protection devices and policies have evolved to meet this change.

CONCLUSION: Vision loss has broad implications for the individual and for society and despite available prevention strategies, ocular trauma is a significant cause of preventable monocular and bilateral vision loss. The use of appropriate eye protection has reduced the burden of ocular trauma. History provides lessons for informing current eye protection and eye injury prevention strategies.

Eur J Anaesthesiol. 2019;Epub ahead of print

Necessity to depict difficult neck anatomy for training of cricothyroidotomy: A pilot study evaluating two surgical devices on a new hybrid training model.

Hossfeld B, Mahler O, Mayer B, Kulla M, Helm M

BACKGROUND: Everyone dealing with airway emergencies must be able to accomplish cricothyroidotomy, which cannot be trained in real patients. Training models are necessary.

OBJECTIVE: To evaluate the suitability of a hybrid training model combining synthetic and porcine parts to depict variable neck anatomy.

DESIGN: Model-based comparative trial.

SETTING: Armed Forces Hospital Ulm, Germany, August 2018.

INTERVENTION: On four anatomical neck variations (long slim/long obese/short slim/short obese) we performed two surgical approaches to cricothyroidotomy (SurgiCric II vs. ControlCric).

PARTICIPANTS: Forty-eight volunteers divided into two groups based on their personal skill level: beginners group and proficient performers group.

MAIN OUTCOME MEASURES: Time to completion was recorded for each procedure. Once the operator had indicated completion, the correct anatomical tube placement was confirmed by dissection and structures were inspected for complications. Primary outcomes were successful tracheal placement of an airway tube and time needed to achieve a patent airway. Secondary outcome was assessment of complications.

RESULTS: Overall, 384 procedures were performed. Median time to completion was 74 s. In total, 284 procedures (74%) resulted in successful ventilation. Time to completion was longer in short obese than in long slim and the risk of unsuccessful procedures was increased in short obese compared with long slim. Even if ControlCric resulted in faster completion of the procedure, its use was less successful and had an increased risk of complications compared with SurgiCric II. Proficient performers group performed faster but had an increased risk of injuring the tracheal wall compared with beginners group.

CONCLUSION: Participants had difficulties in performing cricothyroidotomy in obese models, but various and difficult anatomical situations must be expected in airway management and therefore must be taught. A new hybrid model combining porcine and synthetic materials offers the necessary conditions for the next step in training of surgical airway procedures.

TRIAL REGISTRATION: The study was performed without human tissue or living animals, and was therefore exempted from ethical review by the University of Ulm Ethical Committee, Germany (Chairperson Prof Dr C. Lenk) on 9 August 2018. Hence a protocol number was not attributed.

J Trauma Acute Care Surg. 2019;Epub ahead of

Pre-hospital adenosine, lidocaine and magnesium has inferior survival compared to tactical combat casualty care resuscitation in a porcine model of prolonged hemorrhagic shock.

How R, Glaser J, Schaub L, Fryer D, Ozuna K, Morgan C, Sams V, Cardin S

BACKGROUND: Adenosine, lidocaine, and magnesium (ALM) is a cardioplegic agent shown to improve survival by improving cardiac function, tissue perfusion, and coagulopathy in animal models of shock. We hypothesized pre-hospital ALM treatment in hemorrhagic shock would improve survival compared to current Tactical Combat Casualty Care (TCCC) resuscitation beyond the Golden Hour.

METHODS: Swine were randomized to: 1) TCCC, 2) 2cc/kg vehicle control (VC), 3) 2cc/kg ALM+drip, 4) 4cc/kg ALM+drip, 5) 4cc/kg ALM+delayed drip at 0.5cc/kg/hr, 6) 4cc/kg vehicle control, 7) 4cc/kg ALM for 15 mins + delayed drip at 3cc/kg/hr. Animals underwent pressure controlled hemorrhage to MAP of 30mmHg (S=0). Treatment was administered at T=0. After 120 minutes of simulated pre-hospital care (T=120) blood product resuscitation commenced. Physiologic variables were recorded and labs were drawn at specified time points.

RESULTS: TCCC demonstrated superior survival to all other agents. VC and ALM groups had lower mean arterial pressures (MAPs) and systolic blood pressures (SBPs) compared to TCCC. Except for the vehicle control groups, lactate levels remained similar with correction of base deficit after pre-hospital resuscitation in all groups. Kidney function and liver function remained comparable across all groups. Compared to baseline values, TCCC demonstrated significant hypocoagulability.

CONCLUSION: ALM, as administered in this study, is inferior to current Hextend®-based resuscitation for survival from prolonged hemorrhagic shock in this model. In survivors, ALM groups had lower SBPs and MAPs, but provided a protective effect on coagulopathy as compared to TCCC. ALM does not appear to be a suitable low volume replacement to current TCCC resuscitation. The reduced coagulopathy compared to TCCC warrants future studies of ALM, perhaps as a therapeutic adjunct.

STUDY TYPE: Translational Animal Model LEVEL OF EVIDENCE: N/A.

JAMA Surg. 2019;Epub ahead of print

Use of Combat Casualty Care Data to Assess the US Military Trauma System During the Afghanistan and Iraq Conflicts, 2001-2017.

Howard J, Kotwal R, Turner C, Janak J, Mazuchowski E, Butler F, Stockinger Z, Holcomb B, Bono R, Smith D

Importance: Although the Afghanistan and Iraq conflicts have the lowest US case-fatality rates in history, no comprehensive assessment of combat casualty care statistics, major interventions, or risk factors has been reported to date after 16 years of conflict.

Objectives: To analyze trends in overall combat casualty statistics, to assess aggregate measures of injury and interventions, and to simulate how mortality rates would have changed had the interventions not occurred.

Design, Setting, and Participants: Retrospective analysis of all available aggregate and weighted individual administrative data compiled from Department of Defense databases on all 56 763 US military casualties injured in battle in Afghanistan and Iraq from October 1, 2001, through December 31, 2017. Casualty outcomes were compared with period-specific ratios of the use of tourniquets, blood transfusions, and transport to a surgical facility within 60 minutes. Main Outcomes and Measures: Main outcomes were casualty status (alive, killed in action [KIA], or died of wounds [DOW]) and the case-fatality rate (CFR). Regression, simulation, and decomposition analyses were used to assess associations between covariates, interventions, and individual casualty status; estimate casualty transitions (KIA to DOW, KIA to alive, and DOW to alive); and estimate the contribution of interventions to changes in CFR.

Results: In aggregate data for 56 763 casualties, CFR decreased in Afghanistan (20.0% to 8.6%) and Iraq (20.4% to 10.1%) from early stages to later stages of the conflicts. Survival for critically injured casualties (Injury Severity Score, 25-75 [critical]) increased from 2.2% to 39.9% in Afghanistan and from 8.9% to 32.9% in Iraq. Simulations using data from 23 699 individual casualties showed that without interventions assessed, CFR would likely have been higher in Afghanistan (15.6% estimated vs 8.6% observed) and Iraq (16.3% estimated vs 10.1% observed), equating to 3672 additional deaths (95% CI, 3209-4244 deaths), of which 1623 (44.2%) were associated with the interventions studied: 474 deaths (12.9%) (95% CI, 439-510) associated with the use of tourniquets, 873 (23.8%) (95% CI, 840-910) with blood transfusion, and 275 (7.5%) (95% CI, 259-292) with prehospital transport times.

Conclusions and Relevance: Our analysis suggests that increased use of tourniquets, blood transfusions, and more rapid prehospital transport were associated with 44.2% of total mortality reduction. More critically injured casualties reached surgical care, with increased survival, implying improvements in prehospital and hospital care.

Medicine (Baltimore). 2019 Mar;98(11):e14564

Tranexamic acid can reduce blood loss in patients undergoing intertrochanteric fracture surgery: A meta-analysis.

Jiang W, Shang L.

BACKGROUND: This meta-analysis aimed to assess whether administration tranexamic acid (TXA) could reduce blood loss and transfusion requirements in patients undergoing intertrochanteric fracture surgery.

METHODS: We performed an electronic search of PubMed (1950-October 2018), EMBASE (1974-October 2018), the Cochrane Library (October 2018 Issue 3), the Google database (1950-October 2018), and the Chinese Wanfang database (1950-October 2018). Studies were included in accordance with Population, Intervention, Comparison, Outcomes, and Setting (PICOS) including criteria. Intertrochanteric fracture patients prepared for surgery were selected. Administration with TXA and the placebo or no interventions were considered as an intervention and comparators, respectively. Measures related to total blood loss, blood loss in drainage, hemoglobin on postoperative day were analyzed. A fixed/random-effects model was used according to the heterogeneity assessed by the I statistic. Data analysis was performed using Stata 12.0 software.

RESULTS: A total of five RCTs with 584 patients (TXA group=289, control group=298) were included in the meta-analysis. Based on the results, administration of TXA was associated with a reduction in total blood loss, blood loss in drainage, need for transfusion, length of hospital stay, and occurrence of hematoma ($P<.05$). Administration of TXA increased the hemoglobin level at 3 days after surgery ($P<.05$). There were no significant differences between the two groups in terms of the occurrence of deep venous thrombosis, pulmonary embolism, or infection ($P>.05$).

CONCLUSION: Administration of TXA is associated with reduced total blood loss, postoperative hemoglobin decline, and transfusion requirements in patients with intertrochanteric fractures. Additional high-quality RCTs should be conducted in the future.

J Surg Res. 2019 Jul;239:98-102

Complications Associated With Placement of Chest Tubes: A Trauma System Perspective.

Jones C, Rodriguez R, Griffin R, McGwin G, Jansen J, Kerby J, Bosarge P

BACKGROUND: The insertion of a chest tube is a common procedure in trauma care, and the Advanced Trauma Life Support program teaches the insertion of chest tubes as an essential and life-saving skill. It is also recognized that the insertion of chest tubes is not without risks or complications. The purpose of this study was to evaluate complications of chest tube placement in a level 1 trauma center compared with those placed in surrounding referral hospitals.

METHODS: A retrospective matched cohort study of trauma patients was performed between those who underwent chest tube placement at the level 1 trauma center and those with a chest tube placed before transfer to the level 1 center between 2004 and 2013. Conditional logistic regression was used to compare the likelihood of complications and death between chest tube placement groups.

RESULTS: Four thousand two hundred and sixteen trauma patients had a chest tube placed at the level 1 center, and 364 patients had a chest tube placed at an outside hospital before transfer. Two hundred and eighty-one patients were matched. Patients with a chest tube placed outside the trauma center had an increased likelihood of malposition (OR 7.2, 95% CI 3.6-14.6), residual hemothorax (OR 6.3, 95% CI 3.4-11.6), residual pneumothorax (OR 6.7, 95% CI 3.9-11.4), and having a second chest tube placed (OR 3.77, 95% CI 2.37-6.01). However, the patients with a chest tube placed outside of the trauma center were also less likely to develop pneumonia (OR 0.32, 95% CI 0.14-0.73). There were no differences in the odds of developing an empyema, the need for video-assisted thoracoscopic surgery, thoracotomy, or death.

CONCLUSIONS: There are opportunities for improving the care of patients who require chest tubes at both referring hospitals and the receiving trauma center. Improving the care of patients who require intercostal drainage requires a systems-based approach, focusing on training and quality improvement.

Wilderness Environ Med. 2019 Mar;30(1):52-55

Success Rates with Digital Intubation: Comparing Unassisted, Stylet, and Gum-Elastic Bougie Techniques.

Juergens, Odom B, Ren C, Meyers K

INTRODUCTION: The utility of digital intubation, especially in an austere environment with limited equipment, has been previously described. However, evidence supporting best practices for its technique is limited. We seek to quantify the time to intubation and the rate of successful placement of the tube for digital intubation using different approaches and assistance devices.

METHODS: Using a manikin, digital intubation was performed with an endotracheal tube alone, with an endotracheal tube and a 14-French stylet, or with a gum-elastic bougie. All 3 techniques were performed in a crossover fashion at the manikin's side and head. Three trials per technique and position were performed. Outcomes measured were the time to intubation and the successful placement of the tube.

RESULTS: A total of 72 timed trials were performed. A significant difference did not exist between practitioners being positioned at the head vs side in terms of time or successful placement rate. There was no difference between the time to intubation in the tube-only and stylet-assisted groups, but the bougie-assisted group was significantly slower than the others. The stylet-assisted technique was significantly more successful than the other 2 techniques.

CONCLUSIONS: In a manikin model, stylet-assisted digital intubation was the most successful technique tested and allowed intubation to be accomplished just as quickly as with an endotracheal tube alone. Bougie-assisted digital intubation was slower and may not be as helpful as when it is used as an adjunct with direct laryngoscopy. Further research is needed to determine the utility of these adjuncts on live subjects.

J Clin Orthop Trauma. 2019 Mar-Apr;10(2):286-289

Effects of tranexamic acid on reducing blood loss in pelvic trauma: A randomised double-blind placebo controlled study.

Monsef Kasmaei V, Javadi A, Naseri Alavi S

Background: Management of pelvic trauma is complicated with patients' instability and remains high in skeletal injuries. The patients usually are young and in middle age and the management of bleeding is more important. The aim of this study is to assess the effects of Tranexamic Acid in Reducing Blood Loss in pelvic trauma: A Randomised Double-Blind Placebo Controlled Study.

Method and materials: In this randomized clinical trial study 106 patients with Pelvic Trauma (PT) were randomly divided into two groups. The case group received 1 g Intravenous TXA for loading dose and 3 dose per 8 h for the maintenance and control group received only serum 0.9% N.S (Normal Saline) or placebo. The Hemoglobin (Hb), Hematocrit (HCT), Pulse Rate (PR) and Blood Pressure (BP) was checked at admission, 24 h, 48 h and 72 h after admission.

Results: From 106 patients 61(%57.54) male and 45 (%42.46) female patients enrolled to the study. The mean age was 48.14 ± 13.54 and the range was 18-60 years old. There was no difference between two groups based on Blood Pressure at admission, 24 h, 48 h and 72 h after admission. There was a significant difference between two groups in 24 h, 48 h and 72 h after admission based on Hb and HCT amount.

Conclusion: based on our findings it appears that TXA can reduce bleeding amount in the first, second and third 24 h after surgery based on Hb and HCT without any effect on systolic and diastolic BP and PR. In other hand no side effect reported by any patients.

J Surg Res. 2019 Apr;236:247-258

Large Animal Models of Proximal Aortic Balloon Occlusion in Traumatic Hemorrhage: Review and Identification of Knowledge Gaps Relevant to Expanded Use.

Kauvar D, Dubick M, Martin M

BACKGROUND: The aim of this study was to review and summarize the large animal data on resuscitative endovascular balloon occlusion of the aorta (REBOA) for traumatic hemorrhage and identify knowledge gaps pertinent to the proposed broader use of the technique in prehospital situations.

METHODS: A review of published large animal models of traumatic hemorrhage incorporating REBOA with a primary outcome of the effect of aortic occlusion was performed. Data were collected on experimental protocols, hemodynamic effects, resuscitation requirements, mortality, metabolic and tissue consequences of induced ischemia-reperfusion, and effects on hemorrhage volume and other injuries.

RESULTS: A limited number of REBOA studies exist, and there is variability in the species and size of animals used. Various controlled and uncontrolled hemorrhage protocols have been studied, and a number of balloon devices used. Hemodynamic effects of occlusion were consistent as were basic systemic physiological effects. Minimal study of the effects of partial aortic occlusion and hemodynamic and metabolic physiology distal to the balloon has been performed, and partial or complete occlusion times >90 min have not been studied.

CONCLUSIONS: Significant knowledge gaps exist, which are potentially relevant to the expanded use of REBOA. Investigation into the physiology of partial occlusion and the metabolic effects and potential mitigation strategies for large-scale ischemia and reperfusion are particularly needed.

Int J Biol Macromol. 2019 Mar 1;124:138-147

A review on recent advances in chitosan based composite for hemostatic dressings.

Khan M, Mujahid M

ABSTRACT: High mortality rate in potentially survivable casualties due to severe hemorrhage is a major challenge in today's battlefield because technological advancements have revolutionized the combat tactics and complicated the type and severity associated with wound grades. Quality of pre-hospital care prior to patient evacuation is crucial in determining the survival rate in injured patients. To deal with this challenge, considerable improvements in the hemostatic dressings have been introduced and pre-hospital care has been upgraded in many tactical combat casually care guidelines. Combat Gauze has been widely used bandage which is now been replaced by different chitosan based hemostatic dressings. It not only exhibits anti-bacterial activity but also induces hemostasis via direct interaction with erythrocytes and platelets. Its hemostasis mechanism is not dependent on host coagulation pathway which makes it an ideal dressing to stop bleeding in coagulopathic patients. Different generations of chitosan bandages have been developed to overcome the limitations of previous ones. This review provides performance analysis of chitosan bandage generations and discusses the progress made in its fabrication methods during the recent years.

J Clin Anesth. 2019 Sep;56:134-135

Airway management with a supraglottic airway for laparoscopic surgery: Does device selection matter?

King M, Jagannathan N

QUOTE:

"To date, randomized studies have suggested that aspiration is no more common during procedures with an SGA when compared to an endotracheal tube. Due to the rarity of an aspiration event, however, designing a randomized study with enough power to determine equivalence of aspiration rates between SGAs and endotracheal tubes is prohibitively difficult. A definitive answer to this question will likely require the utilization of large data sets to determine rates of success and complications during laparoscopic and other procedures and, as such, an analysis would require hundreds of thousands of patients in a multi-center effort. The advocacy of using second-generation SGAs for dynamic procedures such as laparoscopic surgery by airway specialty societies such as the Difficult Airway Society, Society for Airway Management, or European Airway Management Society may also encourage anesthesiologists to be more accepting of this practice, but further evidence would be needed to support an official endorsement.

In summary, Yoon and colleagues' analysis has provided greater insight for clinicians to select a specific type of SGA for laparoscopic procedures in order to optimize obtainable airway pressures needed to adequately ventilate the lungs. Their work joins a growing body of literature that increasingly supports the safe use of second-generation SGAs in suitable patients having laparoscopic surgery. While available randomized studies demonstrate low risks of aspiration when using an SGA for laparoscopy, the rarity of the event makes it difficult to fully characterize its use in this setting. In the future, the use of large data sets may provide adequate numbers of patients required to delineate the overall complication rates when using SGAs versus tracheal intubation."

Ann Emerg Med. 2019 May;73(5):e47-e49

Is Low-Dose Ketamine an Effective Alternative to Opioids for Acute Pain?

Kirschner J, Hunter B

ABSTRACT: No abstract available.

J Spec Oper Med. Spring 2019;19(1):35-43.

Limb Tourniquet Configuration: Preliminary Investigation of Problems and Principles.

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

BACKGROUND: A tourniquet's readiness during emergencies depends on how it is configured. We investigated configuration so ways of improving readiness can be developed.

METHODS: This study was conducted at the Institute of Surgical Research in 2018 as sequential investigations by one user of Combat Application Tourniquets (C-A-Ts) in a band-and-rod design.

RESULTS: Each tourniquet comes packaged with paper instructions for use, which include directions on how to configure it in preparation for caregiving. The paper and video instructions for use omit tensioning of the tourniquet in configuration, and the video misconfigured a time strap over the rod. In first-aid classrooms, we saw unwitting learners troubleshoot that misconfiguration. Problems with configuration were also seen in caregiving and with tourniquets stowed in kits. In deliberate practice, we self-applied a tourniquet to a thigh. In configuration after each of 100 uses, tourniquet elongation due to tensioning averaged 2.4 in was important for restoring the tourniquet to its full length. During configuration, if the C-A-T's stabilization plate slid along the band, out of position, the user slid the plate back into position. In various ways of testing other C-A-Ts, elongations averaged from 0.4 in to 0.9 in, depending on whether the tourniquet was self-applied or applied to a firm manikin. Elongation increments accrued as the tourniquet's band flattened. Configuration time averaged 22 seconds, and accrued experience improved the compactness of configuration.

CONCLUSION: People are too often unreliable at putting C-A-Ts into the optimal configuration for use. That ready-to-use configuration includes the tourniquet being at its full length, having the stabilization plate positioned correctly along the band, and having the strap fastened to its clip of origin. When used, tourniquets had normal, small elongations in part due to band flattening. This tourniquet study showed the importance of optimal configuration to first-aid readiness practices.

Wilderness Environ Med. 2019 Mar;30(1):35-43

Efficacy of Head and Torso Rewarming Using a Human Model for Severe Hypothermia.

Kulkarni K, Hildahl E, Dutta R, Webber S, Passmore S, McDonald G, Giesbrecht G

INTRODUCTION: To evaluate the rewarming effectiveness of a similar amount of heat (from a charcoal heater) applied to either the head or torso in a human model for severe hypothermia in which shivering is pharmacologically inhibited in mildly hypothermic subjects.

METHODS: Six male subjects were cooled on 3 different occasions, each in 8°C water for 60 min, or to a lowest core temperature of 35°C. Shivering was inhibited by intravenous meperidine (1.5 mg·kg-1), administered during the last 10 min of the cold-water immersion. Subjects then exited from the cold water, were dried, and were placed in a 3-season sleeping bag for 120 min in one of the following conditions: spontaneous rewarming only, charcoal heater on the head, or charcoal heater on the torso. Supplemental meperidine (to a maximum cumulative dose of 3.3 mg·kg-1) was administered as required during rewarming to suppress shivering.

RESULTS: No significant differences were found in the postcooling afterdrop amount or core rewarming rates among the 3 conditions (0.8°C·h-1). During the last 30 min of rewarming the net heat gain was significantly higher in the head (85.8±25.3 W) and torso (81.5±6.3 W) conditions compared with the spontaneous condition (56.9±12 W) ($P<0.05$).

CONCLUSIONS: In our study, head and torso warming had the same core rewarming rates when shivering was pharmacologically inhibited in mildly hypothermic subjects. Therefore, in non-shivering cold subjects, head warming is a viable alternative if torso warming is contraindicated (eg, when performing cardiopulmonary resuscitation or working on open chest wounds).

Mil Med. 2019 Mar 1;184(Suppl 1):133-137. doi: 10.1093/milmed/usy311.

Prehospital Interventions Performed in Afghanistan Between November 2009 and March 2014.

Lairet J, Bebarta V, Maddry J, Reeves L, Mora A, Blackbourne L(6), Rasmussen T(7).

OBJECTIVE: Care provided to a casualty in the prehospital combat setting can influence subsequent medical interactions and impact patient outcomes; therefore, we aimed to describe the incidence of specific prehospital interventions (lifesaving interventions (LSIs)) performed during the resuscitation and transport of combat casualties.

METHODS: We performed a prospective observational, IRB approved study between November 2009 and March 2014. Casualties were enrolled as they were cared for at nine U.S. military medical facilities in Afghanistan. Data were collected using a standardized collection form. Determination if a prehospital intervention was performed correctly, performed incorrectly, or was necessary but was not performed (missed LSIs) was made by the receiving facility's medical provider.

RESULTS: Two thousand one hundred and six patients met inclusion criteria. The mean age was 25 years and 98% were male. The most common mechanism of injury was explosion 57%. There were 236 airway interventions attempted, 183 chest procedures, 1,673 hemorrhage control, 1,698 vascular access, and 1,066 hypothermia preventions implemented. There were 142 incorrectly performed interventions and 360 were missed.

CONCLUSIONS: In our study, the most commonly performed prehospital LSI in a combat setting were for vascular access and hemorrhage control. The most common incorrectly performed and missed interventions were airway interventions and chest procedures respectively.

Acad Emerg Med. 2019;Epub ahead of print

Psychiatric Outcomes of Patients With Severe Agitation Following Administration of Prehospital Ketamine.

Lebin J, Akhavan A, Hippe D, Gittinger M, Pasic J, McCoy A, Vrablik M

BACKGROUND: Ketamine is an emerging drug used in the management of undifferentiated, severe agitation in the prehospital setting. However, prior work has indicated that ketamine may exacerbate psychotic symptoms in patients with schizophrenia. The objective of this study was to describe psychiatric outcomes in patients who receive prehospital ketamine for severe agitation.

METHODS: This is a retrospective cohort study, conducted at two tertiary academic medical centers, utilizing chart review of patients requiring prehospital sedation for severe agitation from January 1, 2014, to June 30, 2016. Patients received either intramuscular (IM) versus intravenous (IV) ketamine or IM versus IV benzodiazepine. The primary outcome was psychiatric inpatient admission with secondary outcomes including ED psychiatric evaluation and non-psychiatric inpatient admission. Generalized estimating equations and Fisher's exact tests were used to compare cohorts.

RESULTS: During the study period, 141 patient encounters met inclusion with 59 (42%) receiving prehospital ketamine. There were no statistically significant differences between the ketamine and benzodiazepine cohorts for psychiatric inpatient admission (6.8% vs. 2.4%, difference = 4.3%, 95% CI = -2% to 12%, p = 0.23) or ED psychiatric evaluation (8.6% vs. 15%, difference = -6.8%, 95% CI = -18% to 5%, p = 0.23). Patients with schizophrenia who received ketamine did not require psychiatric inpatient admission (17% vs. 10%, difference = 6.7%, 95% CI = -46% to 79%, p = 0.63) or ED psychiatric evaluation (17% vs. 50%, difference = -33%, 95% CI = -100% to 33%, p = 0.55) significantly more than those who received benzodiazepines, although the subgroup was small (n = 16). While there was no significant difference in the nonpsychiatric admission rate between the ketamine and benzodiazepine cohorts (35% vs. 51%, p = 0.082), nonpsychiatric admissions in the benzodiazepine cohort were largely driven by intubation (63% vs. 3.8%, difference = 59%, 95% CI = 38% to 79%, p < 0.001).

CONCLUSIONS: Administration of prehospital ketamine for severe agitation was not associated with an increase in the rate of psychiatric evaluation in the emergency department or psychiatric inpatient admission when compared with benzodiazepine treatment, regardless of the patient's psychiatric history.

J Trauma Acute Care Surg. 2019 Mar;86(3):458-463

The impact of hypothermia on outcomes in massively transfused patients.

Lester E, Fox E, Holcomb J, Brasel K, Bulger E, Cohen M, Cotton B, Fabian T, Kerby J, O'Keefe T, Rizoli S, Scalea T, Schreiber M, Inaba K; PROPPR study group.

BACKGROUND: Hypothermia is associated with poor outcomes after injury. The relationship between hypothermia during contemporary large volume resuscitation and blood product consumption is unknown. We evaluated this association, and the predictive value of hypothermia on mortality.

METHODS: Patients predicted to receive massive transfusion at 12 level 1 trauma centers were randomized in the Pragmatic Randomized Optimal Platelet and Plasma Ratios (PROPPR) trial and were grouped into those who were hypothermic (<36°C) or normothermic (36-38.5°C) within the first 6 hours of emergency department arrival. The impact of hypothermia or normothermia on the volume of blood product required during the first 24 hours was determined via negative binomial regression, adjusting for treatment arm, injury severity score, mechanism, demographics, pre-emergency department fluid volume, blood administered before becoming hypothermic, pulse and systolic blood pressure on arrival, and the time exposed to hypothermic or normothermic temperatures.

RESULTS: Of 680 patients, 590 had a temperature measured during the first 6 hours in hospital, and 399 experienced hypothermia. The mean number of red blood cell (RBC) units given to all patients in the first 24 hours of admission was 8.8 (95% confidence interval [CI], 7.9-9.6). In multivariable analysis, every 1°C decrease in temperature below 36.0°C was associated with a 10% increase (incidence rate ratio, 0.90; 95% CI, 0.89-0.92; $p < 0.00$) in consumption of RBCs during the first 24 hours of admission. There was no association between RBC administration and a temperature above 36°C. Hypothermia on arrival was an independent predictor of mortality, with an adjusted odds ratio of 2.7 (95% CI, 1.7-4.5; $p < 0.00$) for 24-hour mortality and 1.8 (95% CI, 1.3-2.4; $p < 0.00$) for 30-day mortality.

CONCLUSION: Hypothermia is associated with increase in blood product consumption and mortality. These findings support the maintenance of normothermia in trauma patients and suggest that further investigation on the impact of cooling or rewarming during massive transfusion is warranted.

LEVEL OF EVIDENCE: Prognostic, level III.

J Trauma Acute Care Surg. 2019 Apr;86(4):658-663

Impact of a simplified management algorithm on outcome following exsanguinating pelvic fractures: A 10-year experience.

Lewis R, Sharpe J, Berning B, Fabian T, Croce M, Magnotti L

BACKGROUND: Optimal management of exsanguinating pelvic fractures remains controversial. Our previous experience suggested that management decisions based on a defined algorithm were associated with a significant reduction in transfusion requirements and mortality. Based on these outcomes, a clinical pathway (PW) for the management of exsanguinating pelvic fractures was developed. The purpose of this study was to evaluate the impact of this PW on outcomes.

METHODS: Consecutive patients over 10 years with blunt pelvic fractures subsequent to the implementation of the clinical PW were identified. Patients with hemodynamically unstable pelvic fractures are managed initially with a pelvic orthotic device. For those with continued hemodynamic instability and no extra-pelvic source of hemorrhage, pelvic angiography was performed followed by elective pelvic fixation. Patients managed according to the PW were compared with those patients whose management deviated (DEV) from the PW.

RESULTS: There were 3,467 patients identified. Three hundred twelve (9%) met entry criteria: 246 (79%) comprised the PW group and 66 (21%) the DEV group. injury severity, as measured by Injury Severity Score (35 vs. 36; $p = 0.55$), admission Glasgow Coma Scale (10 vs. 10; $p = 0.58$), admission BE (-7.4 vs. -6.4, $p = 0.38$), admission SBP (107 vs. 104, $p = 0.53$), and PRBC requirements during initial resuscitation (6.1 units vs. 6.6 units, $p = 0.22$) were similar between the groups. Pelvic orthotic device use was 48% in the DEV group ($p < 0.001$). Twenty-four percent of the PW group required angiography compared with 74% of the DEV group ($p < 0.001$). Forty-eight-hour transfusions (11 vs. 16, $p = 0.01$) and mortality (35% vs. 48%, $p = 0.04$) were reduced in the PW group compared with the DEV group. Pathway adherence was identified as an independent predictor of both decreased transfusions ($\beta = -5.8$, $p = 0.002$) via multiple linear regression and decreased mortality (hazard ratio, 0.74; 95% confidence interval, 0.42-0.98) via multivariable cox proportional hazards analysis.

CONCLUSION: Adherence to a defined clinical PW simplified the management of exsanguinating pelvic fractures and contributed to a reduction in both transfusion requirements and mortality.

LEVEL OF EVIDENCE: Prognostic, level III.

Biomaterials. 2019 Jun;205:23-37

A highly efficient, in situ wet-adhesive dextran derivative sponge for rapid hemostasis.

Liu C, Liu X, Liu C, Wang N, Chen H, Yao W, Sun G, Song Q, Qiao W

ABSTRACT: Uncontrolled hemorrhage is closely related to the high risk of death. However, local hemostats still have various defects and side effects. Herein, an aldehyde dextran (PDA) sponge with proper absorption and adhesion properties is developed for hemorrhage control. PDA sponge with pore size of ~30-50 μm fabricated by lyophilization not only absorbs blood quickly (47.7 g/g), but also possesses strong tissue adhesion (~100 kPa). PDA sponge with low cytotoxicity and hemolysis achieves effective hemostasis and remarkable blood loss reduction in the ear vein, femoral artery and liver injuries of rabbit models. Furthermore, the exploration of hemostatic mechanisms related to tissue, blood, plasma, cells and coagulation system indicates that PDA sponge can significantly accelerate coagulation by rapid wound block, fast cells aggregation and initiation, and high coagulation factors concentration, instead of by the coagulation cascade activation. Importantly, this hemostat exhibits excellent biodegradability and nearly no skin irritation. Overall, the biodegradable and tissue adhesive PDA sponge will be a promising quick-hemostatic dressing for uncontrollable hemorrhage.

J Trauma Acute Care Surg. 2019 Jan;86(1):128-133

The Las Vegas mass shooting: An analysis of blood component administration and blood bank donations.

Lozada M, Cai S, Li M, Davidson S, Nix J, Ramsey G.

BACKGROUND: The deadliest mass shooting in modern United States history occurred on October 1, 2017, in Las Vegas, killing 58 and overwhelming hospitals with more than 600 injured. The scope of the tragedy offers insight into medical demands, which may help guide preparedness for future mass shooting incidents.

METHODS: Retrospective, de-identified, health care institution-provided data from all hospitals and blood banks providing care to Las Vegas shooting victims were gathered. Study authors independently reviewed all data and cross-referenced it for verification. Main outcomes and measures include the number of victims requiring hospital and intensive care admission, the amount and types of blood components transfused during the first 24 hours, and the amount of blood donated to local blood banks following the Las Vegas mass shooting.

RESULTS: Two hundred twenty patients required hospital admission, 68 of them to critical care. Nearly 500 blood components were transfused during the first 24 hours in a red blood cell-to-plasma-to-platelet ratio of 1:0.54:0.81. Public citizens donated almost 800 units of blood immediately after the shooting; greater than 17% of this donated blood went unused.

CONCLUSIONS: The amount of blood components transfused per patient admitted was similar in magnitude to other mass casualty events, and available blood supply met patient demand. The public call for blood donors was not necessary to meet immediate demand and led to resource waste. Preparation for future mass shooting incidents should include training the community in hemorrhage control, encouraging routine blood donation, and avoiding public calls for blood donation unless approved by local blood suppliers.

LEVEL OF EVIDENCE: Therapeutic study, level V.

Indian J Orthop. 2019 Mar-Apr;53(2):263-269

Efficacy and Safety of Tranexamic Acid for Controlling Bleeding During Surgical Treatment of Intertrochanteric Fragility Fracture with Proximal Femoral Nail Anti-rotation: A Randomized Controlled Trial.

Luo X, He S, Lin Z, Li Z, Huang C, Li Q

Background: Intertrochanteric fragility fracture (IFF) treated with proximal femoral nail anti-rotation (PFNA) is associated with significant hidden blood loss and high blood transfusion rate. The purpose of the present study was to evaluate the efficacy and safety of tranexamic acid (TXA) in reducing blood loss in these patients.

Materials and Methods: Consecutive eligible patients were recruited and randomly assigned to a TXA group or a control group. The TXA group received 15 mg/kg body weight of TXA intravenously 15 min before incision and the same dose 3 h later. The control group received 100 mL of saline intravenously 15 min before incision. The efficacy outcomes included the total perioperative blood loss, postoperative transfusion rate, postoperative hemoglobin level, and length of the hospital stay. The safety outcomes were the incidence of thrombotic events and the mortality rate within 6 weeks after surgery.

Results: We had 44 patients in the TXA group and 46 patients in the control group for the final analysis. The TXA group had significantly lower total perioperative blood loss than the control group (384.5 ± 366.3 mL vs. 566.2 ± 361.5 mL; $P < 0.020$). Postoperative transfusion rate was 15.9% in the TXA group versus 36.9% in the control group ($P = 0.024$). Each group had one patient with postoperative deep venous thrombosis. In the control group, three patients had cerebral infarction, and one patient died within 6 weeks after the operation.

Conclusion: Intravenous TXA is effective in reducing total perioperative blood loss and transfusion rate in IFF treated with PFNA. No increased risk of thrombotic events was observed with the use of TXA; however, this study was underpowered for detecting this outcome. Further research is necessary before TXA can be recommended for high-risk patients.

World J Surg. 2019 Jul;43(7):1700-1707

Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) for Severe Torso Trauma in Japan: A Descriptive Study.

Matsumoto S, Hayashida K, Akashi T, Jung K, Sekine K, Funabiki T, Moriya T

BACKGROUND: Resuscitative endovascular balloon occlusion of the aorta (REBOA) has the potential to be an alternative to open aortic cross-clamping (ACC). However, its practical indication remains unknown. We examined the usage trend of REBOA and ACC in Japan for severe torso trauma and investigated whether these procedures were associated with the time of death distribution based on a large database from the Japan Trauma Data Bank (JTDB).

METHODS: The JTDB from 2004 to 2014 was reviewed. Eligible patients were restricted to those with severe torso trauma, which was defined as an abbreviated injury scale score of ≥4. Patients were classified into groups according to the aortic occlusion procedures. The primary outcomes were the rates of REBOA and ACC use according to the clinical situation. We also evaluated whether the time of death distribution for the first 8 h differed based on these procedures.

RESULTS: During the study period, a total of 21,533 patients met our inclusion criteria. Overall, REBOA was more commonly used than ACC for patients with severe torso trauma (2.8% vs 1.5%). However, ACC was more frequently used in cases of thoracic injury and cardiac arrest. Regarding the time of death distribution, the cumulative curve for death in REBOA cases was elevated much more slowly and mostly flat for the first 100 min.

CONCLUSIONS: REBOA is more commonly used compared to ACC for patients with severe torso trauma in Japan. Moreover, it appears that REBOA influences the time of death distribution in the hyperacute phase.

Mil Med. 2019 Mar 1;184(Suppl 1):310-317

Crossover Assessment of Intraoral and Cuffed Ventilation by Emergency Responders.

McCrory B, Lowndes B, Thompson D, Wadman M, Sztajnkrycer M, Walker R, Lomneth C, Hallbeck M

OBJECTIVES: A cuffed bag valve mask (BVM) is the most common device used by emergency medical responders to ventilate patients. The BVM can be difficult for users to seal around the patient's mouth and nose. An intraoral mask (IOM) with snorkel-like design may facilitate quicker and better ventilation particularly under austere conditions.

METHODS: Both a BVM and IOM were utilized by 27 trained emergency medical technicians and paramedics to ventilate a lightly embalmed cadaver. Ventilation efficacy, workload, and usability were assessed for both devices across four study conditions.

RESULTS: The IOM was superior to the BVM in delivered tidal volume ratio (measure of leak, $p < 0.03$) and minute ventilation ($p < 0.0001$). Workload, ergonomic and usability assessments indicated that the IOM facilitated gripping through the reduced hand interface size ($p < 0.01$), decreased user effort ($p < 0.001$), and reduced upper limb workload ($p = 0.0088$).

CONCLUSIONS: In the assessed model, the IOM represented a better choice for airway management than the standard cuffed BVM. An emergency medical device that is intuitive, efficacious and less demanding has the potential to reduce responder stress and improve resuscitation efforts, especially during austere rescue and patient transport.

Crit Care Med. 2019 May;47(5):623-631

The Effect of Goal-Directed Therapy on Patient Morbidity and Mortality After Traumatic Brain Injury: Results From the Progesterone for the Treatment of Traumatic Brain Injury III Clinical Trial.

Merck L, Yeatts S, Silbergleit R, Manley G, Pauls Q, Palesch Y, Conwit R, Le Roux P, Miller J, Frankel M, Wright D

OBJECTIVES: To estimate the impact of goal-directed therapy on outcome after traumatic brain injury, our team applied goal-directed therapy to standardize care in patients with moderate to severe traumatic brain injury, who were enrolled in a large multicenter clinical trial.

DESIGN: Planned secondary analysis of data from Progesterone for the Treatment of Traumatic Brain Injury III, a large, prospective, multicenter clinical trial.

SETTING: Forty-two trauma centers within the Neurologic Emergencies Treatment Trials network.

PATIENTS: Eight-hundred eighty-two patients were enrolled within 4 hours of injury after non-penetrating traumatic brain injury characterized by Glasgow Coma Scale score of 4-12.

MEASUREMENTS AND MAIN RESULTS: Physiologic goals were defined a priori in order to standardize care across 42 sites participating in Progesterone for the Treatment of Traumatic Brain Injury III. Physiologic data collection occurred hourly; laboratory data were collected according to local ICU protocols and at a minimum of once per day. Physiologic transgressions were predefined as substantial deviations from the normal range of goal-directed therapy. Each hour where goal-directed therapy was not achieved was classified as a "transgression." Data were adjudicated electronically and via expert review. Six-month outcomes included mortality and the stratified dichotomy of the Glasgow Outcome Scale-Extended. For each variable, the association between outcome and either: 1) the occurrence of a transgression or 2) the proportion of time spent in transgression was estimated via logistic regression model.

RESULTS: For the 882 patients enrolled in Progesterone for the Treatment of Traumatic Brain Injury III, mortality was 12.5%. Prolonged time spent in transgression was associated with increased mortality in the full cohort for hemoglobin less than 8 gm/dL ($p = 0.0006$), international normalized ratio greater than 1.4 ($p < 0.0001$), glucose greater than 180 mg/dL ($p = 0.0003$), and systolic blood pressure less than 90 mm Hg ($p < 0.0001$). In the patient subgroup with intracranial pressure monitoring, prolonged time spent in transgression was associated with increased mortality for intracranial pressure greater than or equal to 20 mm Hg ($p < 0.0001$), glucose greater than 180 mg/dL ($p = 0.0293$), hemoglobin less than 8 gm/dL ($p = 0.0220$), or systolic blood pressure less than 90 mm Hg ($p = 0.0114$). Covariates inversely related to mortality included: a single occurrence of mean arterial pressure less than 65 mm Hg ($p = 0.0051$) or systolic blood pressure greater than 180 mm Hg ($p = 0.0002$).

CONCLUSIONS: The Progesterone for the Treatment of Traumatic Brain Injury III clinical trial rigorously monitored compliance with goal-directed therapy after traumatic brain injury. Multiple significant associations between physiologic transgressions, morbidity, and mortality were observed. These data suggest that effective goal-directed therapy in traumatic brain injury may provide an opportunity to improve patient outcomes.

J Emerg Med. 2019 Apr;56(4):431-436

Safety of Peripheral Line Administration of 3% Hypertonic Saline and Mannitol in the Emergency Department.

Mesghali E, Fitter S, Bahjri K, Moussavi K

BACKGROUND: Hypertonic saline (HTS) and mannitol are frequently utilized in the emergency department (ED) to manage elevations in intracranial pressure (ICP).

OBJECTIVE: The objective of this study was to compare the incidence of extravasation injury when HTS or mannitol was administered via peripheral i.v. line (PIV).

METHODS: This retrospective cohort study evaluated adult and pediatric patients given either 3% HTS or mannitol via PIV while in the ED. The primary outcome was extravasation incidence.

RESULTS: One hundred and ninety-two patients were included, of which 85 (44%) received HTS and 107 (56%) received mannitol. Patients who received HTS were younger (27.5 ± 24.3 years vs. 53.9 ± 22.3 years; $p < 0.001$); 55.3% of patients given HTS received it for traumatic brain injury (TBI) versus 38.3% of patients given mannitol ($p = 0.021$); and 44.9% of patients given mannitol received it for intracerebral hemorrhage versus 21.2% of patients given HTS ($p = 0.001$). There was no incidence of extravasation in either group. Patients who received HTS had lower ICP measurement 24 h post admission (2.107 ± 5.5 mm Hg vs. 4.236 ± 8.1 mm Hg; $p = 0.047$) and higher Glasgow Coma Scale (GCS) score upon discharge (GCS 14; interquartile range [IQR] 3-15 vs. GCS 3; IQR 3-14.2; $p = 0.004$). In-hospital mortality was higher in the mannitol group (54.7% vs. 32.9%; $p = 0.003$). Duration of mechanical ventilation was shorter in those patients who received HTS (1 day; IQR 0-56 days vs. 2 days; IQR 0-56 days; $p = 0.023$).

CONCLUSIONS: There were no incidences of extravasation among patients given 3% HTS or mannitol. Clinicians should reconsider recommendations to restrict HTS or mannitol to central lines.

Chest. 2019 Apr;155(4):876. doi: 10.1016/j.chest.2018.12.027.

Tranexamic Acid Inhalations in Nonmassive Hemoptysis: A Word of Caution.

Messika J, Prat D, Sztrymf B

ABSTRACT: No abstract available

J Trauma Acute Care Surg. 2019 Mar 22;Epub ahead of print]

Tranexamic Acid (TXA) Administration Following Head Trauma in a Combat Setting: Does TXA Result in Improved Neurologic Outcomes?

Morte D, Lammers D, Bingham J, Kuckelman J, Eckert M, Martin M

BACKGROUND: Tranexamic acid (TXA) has been shown to decrease mortality and blood product requirements in severely injured patients. TXA has also been hypothesized to prevent secondary brain injury in patients with TBI. While prior studies have demonstrated improved neurologic outcomes associated with TXA administration in severely injured pediatric patients, no such studies have been performed in adults.

METHODS: A retrospective review of all adult trauma admissions to North Atlantic Treaty Organization hospitals in Iraq and Afghanistan between 2008-2015. Univariate and multivariate analysis was used to identify factors associated with TXA administration. Patients without a documented head abbreviated injury scale (AIS) were excluded. Patients were propensity matched based on demographics, mechanism of injury, injury scores (AIS/ISS), presenting Glasgow Coma Score (GCS), initial vitals/labs, and initial transfusion requirement. Primary outcomes were in-hospital mortality and neurologic outcomes measured by discharge GCS scores. Secondary outcomes were respiratory failure and rates of thromboembolic events.

RESULTS: 4476 injured patients 18 years or older were evaluated. 265 (5.9%) of these patients required a massive transfusion in the first 24 hours and 174 (3.9%) received TXA. TXA patients had significantly higher ISS, more penetrating injuries, lower presenting GCS, higher incidence of severe head injury (AIS>3), and higher transfusion requirements. 92 patients were included in the propensity matched cohort. Of these, patients who received TXA had significantly lower mortality rate (0% vs 10.1%, p=0.02) and improvement of GCS to 14-15 irrespective of admission GCS compared to patients who did not receive TXA (100% vs 87%, p=0.01). There were no significant differences in number of thromboembolic events recorded between the two groups.

CONCLUSIONS: TXA administration in adult combat trauma patients was independently associated with decreased mortality and improved neurologic outcomes, with no increase in thromboembolic events. Further study of the possible mechanisms and effect of TXA on brain injury and neurologic outcomes is warranted.

LEVEL OF EVIDENCE: Level IV; Therapeutic.

Eur J Trauma Emerg Surg. 2019 Apr 27. doi: 10.1007/s00068-019-01143-z. [Epub ahead of print]

Analysis of cervical spine immobilization during patient transport in emergency medical services.

Nolte P, Uzun D, Häske D, Weerts J, Münzberg M, Rittmann A, Grützner P, Kreinest M

PURPOSE: It remains controversial how to immobilize the cervical spine (CS) in trauma patients. Therefore, we analyzed different CS immobilization techniques during prehospital patient transport.

METHODS: In this explorative, biomechanical analysis of immobilization techniques conducted in a standardized setting, we recorded CS motion during patient transport using a wireless human motion tracker on a volunteer. To interpret spinal movement a benchmark called motionscore (MS) was developed based on biomechanics of the injured spine.

RESULTS: We found the best spinal motion restriction using a spine board, head blocks and immobilization straps with and without a cervical collar (CC) (MS 45 vs. 27). Spinal motion restriction on a vacuum mattress with CC and head blocks was superior to no CC or head blocks (MS 103 vs. 152). An inclined vacuum mattress was more effective with head blocks than without (MS 124 vs. 187). Minimal immobilization with an ambulance cot, CC, pillow and tape was slightly superior to a vacuum mattress with CC and head blocks (MS 92 vs. 103). Minimal immobilization without CC showed the lowest spinal motion restriction (MS 517).

CONCLUSIONS: We suggest an immobilization procedure customized to the individual situation. A spine board should be used whenever spinal motion restriction is indicated and the utilization is possible. In some cases, CS immobilization by a vacuum mattress with CC and head blocks could be more beneficial. In an unstable status of the patient, minimal immobilization may be performed using an ambulance cot, pillow, CC and tape to minimize time on scene caused by immobilization.

Trauma Surg Acute Care Open. 2019 Feb 8;4(1):e000271

Physician-based on-scene airway management in severely injured patients and in-hospital consequences: is the misplaced intubation an underestimated danger in trauma management?

Özkurtul O, Struck M, Fakler J, Bernhard M, Seinen S, Wrigge H, Josten C

Background: Endotracheal intubation (ETI) is the gold standard for the out-of-hospital emergency airway management in severely injured patients. Due to time-critical circumstances, poor patient presentation and hostile environments, it may be prone for mechanical complications and failure.

Methods: In a retrospective study (January 2011 to December 2013), all patients who underwent out-of-hospital ETI before admittance to a level 1 trauma center were analyzed consecutively. Patients with supraglottic airways, being under cardiopulmonary resuscitation and interfacility transports were excluded. The main study endpoint was the incidence of unrecognized tube malposition; secondary endpoints were Glasgow Outcome Scale (GOS) and in-hospital mortality adjusted to on-scene Glasgow Coma Scale (GCS), Injury Severity Score (ISS), Abbreviated Injury Scale head (AIS head), and on-scene time.

Results: Out of 1176 patients, 151 underwent out-of-hospital ETI. At hospital admission, tube malpositions were recognized in nine patients (5.9%). Accidental and unrecognized esophageal intubation was detected in five patients (3.3%) and bronchial intubation in four patients (2.7%). Although ISS (p=0.053), AIS head (p=0.469), on-scene GCS (p=0.151), on-scene time (p=0.530), GOS (p=0.748) and in-hospital mortality (p=0.431) were similar compared with correctly positioned ETI tubes, three esophageal intubation patients died due to hypoxemic complications.

Discussion: In our study sample, out-of-hospital emergency ETI in severely injured patients was associated with a considerable tube misplacement rate. For safety, increased compliance to consequently use available technologies (eg, capnography, video laryngoscopy) for emergency ETI should be warranted.

Level of evidence: Level of Evidence IIA.

Anaesthesia. 2019 Jul;74(7):831-833

Spinal tranexamic acid - a new killer in town.

Palanisamy A, Kinsella S

ABSTRACT: No abstract available

Mil Med. 2019 Mar 1;184(Suppl 1):11-15

Restrictive Transfusion Strategy Is More Effective in Massive Burns: Results of the TRIBE Multicenter Prospective Randomized Trial.

Palmieri T, Holmes J, Arnoldo B, Peck M, Cochran A, King B, Dominic W, Cartotto R, Bhavsar D, Tredget E, Stapelberg F, Mozingo D, Friedman B, Sen S, Taylor S, Pollock B

OBJECTIVES: Studies suggest that a restrictive transfusion strategy is safe in burns, yet the efficacy of a restrictive transfusion policy in massive burn injury is uncertain. Our objective: compare outcomes between massive burn (≥60% total body surface area (TBSA) burn) and major (20-59% TBSA) burn using a restrictive or a liberal blood transfusion strategy.

METHODS: Patients with burns ≥20% were block randomized by age and TBSA to a restrictive (transfuse hemoglobin <7 g/dL) or liberal (transfuse hemoglobin <10 g/dL) strategy throughout hospitalization. Data collected included demographics, infections, transfusions, and outcomes.

RESULTS: Three hundred and forty-five patients received 7,054 units blood, 2,886 in massive and 4,168 in restrictive. Patients were similar in age, TBSA, and inhalation injury. The restrictive group received less blood (45.57 ± 47.63 vs. 77.16 ± 55.0, $p < 0.03$ massive; 11.0 ± 16.70 vs. 16.78 ± 17.39, $p < 0.001$) major). In massive burn, the restrictive group had fewer ventilator days ($p < 0.05$). Median ICU days and LOS were lower in the restrictive group; wound healing, mortality, and infection did not differ. No significant outcome differences occurred in the major (20-59%) group ($p > 0.05$).

CONCLUSIONS: A restrictive transfusion strategy may be beneficial in massive burns in reducing ventilator days, ICU days and blood utilization, but does not decrease infection, mortality, hospital LOS or wound healing.

Can J Surg. 2019 Apr 1;62(2):142-144

Deployment of second-generation resuscitative endovascular balloon occlusion of the aorta for unresponsive hypotension in a polytrauma patient

Paradis T, Bekdache O, Bracco D, Grushka J, Razek T, Lasry D, Beckett A

Summary: Noncompressible hemorrhagic control remains one of the most challenging areas in damage control medicine and continues to be a leading cause of preventable death. For decades, emergency thoracotomy or laparotomy and aortic cross clamping have remained the gold standard intervention. Recently, there has been a movement toward less invasive techniques for noncompressible hemorrhagic control, such as resuscitative endovascular balloon occlusion of the aorta (REBOA). The REBOA technique involves inflation of an endovascular balloon within the abdominal aorta proximal to the vascular injury to temporarily inhibit bleeding. Although the literature is robust on this new technique, skepticism remains about whether REBOA is superior to aortic cross clamping, as it has been associated with complications including organ and limb ischemia, limb amputation, femoral aneurysm, and thrombosis.

Prehosp Disaster Med. 2019 Apr;34(2):175-181

External Soft-Tissue Hemostatic Clamp Compared to a Compression Tourniquet as Primary Hemorrhage Control Device in Pilot Flow Model Study.

Paquette R, Bierle R, Wampler D, Allen P, Cooley C, Ramos R, Michalek J, Gerhardt R

INTRODUCTION: Acute blood loss represents a leading cause of death in both civilian and battlefield trauma, despite the prioritization of massive hemorrhage control by well-adopted trauma guidelines. Current Tactical Combat Casualty Care (TCCC) and Tactical Emergency Casualty Care (TECC) guidelines recommend the application of a tourniquet to treat life-threatening extremity hemorrhages. While extremely effective at controlling blood loss, the proper application of a tourniquet is associated with severe pain and could lead to transient loss of limb function impeding the ability to self-extricate or effectively employ weapons systems. As a potential alternative, Innovative Trauma Care (San Antonio, Texas USA) has developed an external soft-tissue hemostatic clamp that could potentially provide effective hemorrhage control without the aforementioned complications and loss of limb function. Thus, this study sought to investigate the effectiveness of blood loss control by an external soft-tissue hemostatic clamp versus a compression tourniquet.

HYPOTHESIS: The external soft-tissue hemostatic clamp would be non-inferior at controlling intravascular fluid loss after damage to the femoral and popliteal arteries in a normotensive, coagulopathic, cadaveric lower-extremity flow model using an inert blood analogue, as compared to a compression tourniquet.

METHODS: Using a fresh cadaveric model with simulated vascular flow, this study sought to compare the effectiveness of the external soft-tissue hemostatic clamp versus the compression tourniquet to control fluid loss in simulated trauma resulting in femoral and posterior tibial artery lacerations using a coagulopathic, normotensive, cadaveric-extremity flow model. A sample of 16 fresh, un-embalmed, human cadaver lower extremities was used in this randomized, balanced two-treatment, two-period, two-sequence, crossover design. Statistical significance of the treatment comparisons was assessed with paired t-tests. Results were expressed as the mean and standard deviation (SD).

RESULTS: Mean intravascular fluid loss was increased from simulated arterial wounds with the external soft-tissue hemostatic clamp as compared to the compression tourniquet at the lower leg (119.8mL versus 15.9mL; P <.001) and in the thigh (103.1mL versus 5.2mL; P <.001).

CONCLUSION: In this hemorrhagic, coagulopathic, cadaveric-extremity experimental flow model, the use of the external soft-tissue hemostatic clamp as a hasty hemostatic adjunct was associated with statistically significant greater fluid loss than with the use of the compression tourniquet. Paquette R, Bierle R, Wampler D, Allen P, Cooley C, Ramos R, Michalek J, Gerhardt RT. External soft-tissue hemostatic clamp compared to a compression tourniquet as primary hemorrhage control device in pilot flow model study.

Anaesthesia. 2019 Jul;74(7):904-914

Catastrophic drug errors involving tranexamic acid administered during spinal anaesthesia.

Patel S, Robertson B, McConachie I

ABSTRACT: We have reviewed accidental spinal administration of tranexamic acid. We performed a MEDLINE search of cases of administration of tranexamic acid during epidural or spinal anaesthesia between 1960 and 2018. No reports of epidural administration were identified. We identified 21 cases of spinal tranexamic acid administration. Life-threatening neurological and/or cardiac complications, requiring resuscitation and/or intensive care, occurred in 20 patients; 10 patients died. We used a Human Factors Analysis Classification System model to analyse any contributing factors, and the reports were also assessed using four published recommendations for the reduction in neuraxial drug error. In 20 cases, ampoule error was the cause; in the last case a spinal catheter was mistaken for an intravenous catheter. All were classified as skill-based errors. Several human factors related to organisational policy; dispensing and storage of drugs and preparation for spinal anaesthesia tasks were present. All errors could have been prevented by implementing the four published recommendations.

J Spec Oper Med. Spring 2019;19(1):20-22.

Versatility With Far Forward Damage Control Surgery: Successful Resuscitative Thoracotomy in an HH-60 Black Hawk.

Pieper M, Vonderharr M, Knutson T, Sullivan J, Allison C, Englert Z

ABSTRACT: The military conflicts of the past 17 years have taught us many lessons, including the evolution of the tiered trauma system with en route resuscitation. The evolution of the conflict has begun to limit the reach of this standard trauma system. Recent evidence suggests that 95% of early deaths resulting from traumatic injuries may be prevented if the patient can undergo damage control surgery within 23 minutes of injury. US Military Surgical Resuscitation Teams have been developed to shorten this time from injury to surgical care, as illustrated by this case report.

Transfusion. 2019 Apr;59(S2):1587-1592

The need for dried plasma - a national issue.

Pusateri A, Butler F, Shackelford S, Sperry J, Moore E, Cap A, Taylor A, Homer M, Hoots W, Weiskopf R, Davis M

ABSTRACT: Recent studies have demonstrated that early transfusion of plasma or RBCs improves survival in patients with severe trauma and hemorrhagic shock. Time to initiate transfusion is the critical factor. It is essential that transfusion begin in the prehospital environment when transport times are longer than approximately 15 to 20 minutes. Unfortunately, logistic constraints severely limit the use of blood products in the prehospital setting, especially in military, remote civilian, and mass disaster circumstances, where the need can be most acute. US military requirements for logistically supportable blood products are projected to increase dramatically in future conflicts. Although dried plasma products have been available and safely used in a number of countries for over 20 years, there is no dried plasma product commercially available in the United States. A US Food and Drug Administration-approved dried plasma is urgently needed. Considering the US military, disaster preparedness, and remote civilian trauma perspectives, this is an urgent national health care issue.

Trauma. 2019 Jan;21(1):45-54

A one-year cost-utility analysis of REBOA versus RTACC for non-compressible torso haemorrhage.

Renna M, van Zeller C, Abu-Hijleh F, Tong C, Gambini J, Ma M

Introduction: Major trauma is a leading cause of death and disability in young adults, especially from massive non-compressible torso haemorrhage. The standard technique to control distal haemorrhage and maximise central perfusion is resuscitative thoracotomy with aortic cross-clamping (RTACC). More recently, the minimally invasive technique of resuscitative endovascular balloon occlusion of the aorta (REBOA) has been developed to similarly limit distal haemorrhage without the morbidity of thoracotomy; cost-utility studies on this intervention, however, are still lacking. The aim of this study was to perform a one-year cost-utility analysis of REBOA as an intervention for patients with major traumatic non-compressible abdominal haemorrhage, compared to RTACC within the U.K.'s National Health Service.

Methods: A retrospective analysis of the outcomes following REBOA and RTACC was conducted based on the published literature of survival and complication rates after intervention. Utility was obtained from studies that used the EQ-5D index and from self-conducted surveys. Costs were calculated using 2016/2017 National Health Service tariff data and supplemented from further literature. A cost-utility analysis was then conducted.

Results: A total of 12 studies for REBOA and 20 studies for RTACC were included. The mean injury severity scores for RTACC and REBOA were 34 and 39, and mean probability of death was 9.7 and 54%, respectively. The incremental cost-effectiveness ratio of REBOA when compared to RTACC was £44,617.44 per quality-adjusted life year. The incremental cost-effectiveness ratio, by exceeding the National Institute for Health and Clinical Effectiveness's willingness-to-pay threshold of £30,000/quality-adjusted life year, suggests that this intervention is not cost-effective in comparison to RTACC. However, REBOA yielded a 157% improvement in utility with a comparatively small cost increase of 31.5%.

Conclusion: Although REBOA has not been found to be cost-effective when compared to RTACC, ultimately, clinical experience and expertise should be the main factor in driving the decision over which intervention to prioritise in the emergency context.

Injury. 2019 May;50(5):1017-1027

Is prehospital blood transfusion effective and safe in haemorrhagic trauma patients? A systematic review and meta-analysis.

Rijnhout T, Wever K, Marinus R, Hoogerwerf N, Geeraedts L, Tan E

BACKGROUND: Life-threatening haemorrhage accounts for 40% mortality in trauma patients worldwide. After bleeding control is achieved, circulating volume must be restored. Early in-hospital transfusion of blood components is already proven effective, but the scientific proof for the effectiveness of prehospital blood-component transfusion (PHBT) in trauma patients is still unclear.

OBJECTIVE: To systematically review the evidence for effectiveness and safety of PHBT to haemorrhagic trauma patients.

METHODS: CINAHL, Cochrane, EMBASE, and Pubmed were searched in the period from 1988 until August 1, 2018. Meta-analysis was performed for matched trauma patients receiving PHBT with the primary outcomes 24-hour mortality and long-term mortality. Secondary outcome measure was adverse events as a result of PHBT.

RESULTS: Trauma patients who received PHBT with simultaneous use of packed red blood cells (pRBCs) and plasma showed a statistically significant reduction in long-term mortality (OR = 0.51; 95% CI, 0.36-0.71; P < 0.0001) but no difference in 24-hour mortality (OR = 0.47, 95% CI, 0.17-1.34; P = 0.16). PHBT with individual use of pRBCs showed no difference in long-term mortality (OR = 1.18; 95% CI, 0.93-1.49; P = 0.17) or 24-hour mortality (OR = 0.92; 95% CI, 0.46-1.85; P = 0.82). In a total of 1341 patients who received PHBT, 14 adverse events were reported 1.04%, 95% CI 0.57-1.75%.

CONCLUSIONS: PHBT with simultaneous use of both pRBCs and plasma resulted in a significant reduction in the odds for long-term mortality. However, based on mainly poor quality evidence no hard conclusion can be drawn about a possible survival benefit for haemorrhagic trauma patients receiving PHBT. Overall, PHBT is safe but results of currently ongoing randomised controlled trials have to be awaited to demonstrate a survival benefit.

STUDY TYPE: Systematic review and meta-analysis.

J Trauma Acute Care Surg. 2019; Epub ahead of print

Thromboelastography On-the-Go: Evaluation of the TEG 6s Device During Ground and High-Altitude Aeromedical Evacuation with Extracorporeal Life Support.

Roberts T, Jones J, Choi J, Sieck K, Harea G, Wendorff D, Beely B, Karaliou V, Cap A, Davis M, Cancio L, Sams V, Batchinsky A

BACKGROUND: Coagulation monitoring capabilities during transport are limited. Thromboelastography (TEG) is a whole-blood clotting test measuring clot formation, stabilization and fibrinolysis; and is traditionally performed in a laboratory. We evaluated a new point-of-care TEG analyzer, TEG 6s (Haemonetics; Braintree, MA), in a large animal model of combat-relevant trauma managed with extracorporeal life support (ECLS) during ground and high-altitude aeromedical evacuation. The objective was to compare TEG 6s used during transport vs. the predicate device, TEG 5000, used in the laboratory. We hypothesized that TEG 6s would be comparable to TEG 5000 during dynamically changing transport conditions.

METHODS: TEG parameters (R, K, Angle, MA, LY30) derived by TEG 6s and TEG 5000 were compared during transport of 8 swine. TEG 6s was transported with animals during ground transport and flight. TEG 5000 was stationary in an adjacent building. TEG 6s activated clotting time (ACT) was compared to a Hemochron Junior ACT analyzer (Accriva Diagnostics; San Diego, CA). Statistics were performed using SAS 9.4 with Deming regressions, Spearman correlations and average differences compared.

RESULTS: Correlation between devices was stronger at sea-level (R r=0.7413, K r=0.7115, Angle r=0.7192, MA r=0.8386, LY30 r=0.9099) than during high-altitude transport (R r=0.4787, K r=0.4007, Angle r =0.3706, MA r=0.6573, LY30 r=0.8481). Method agreement was comparable during stationary operation (R r=0.7978, K r=0.7974, Angle r=0.7574, MA r=0.7841, LY30 r=0.9140) vs. ground transport (R r=0.7927, K r=0.6246, Angle r=0.6967, MA r=0.9163, LY30 r=0.8603). TEG 6s ACT trended higher than Hemochron ACT when subjects were heparinized (average difference=1442±1703 sec) without a methodological difference by Deming regression.

CONCLUSIONS: Mobile TEG 6s during ground and altitude transport is feasible and provides unprecedented information to guide coagulation management. Future studies should assess the precision and accuracy of TEG 6s during transport of critically ill.

LEVEL OF EVIDENCE: Basic science paper, does not require level of evidence.

PLoS One. 2019 Feb 27;14(2):e0212704

Regurgitation and pulmonary aspiration during cardio-pulmonary resuscitation (CPR) with a laryngeal tube: A pilot crossover human cadaver study.

Ruetzler K, Leung S, Chmiela M, Rivas E, Szarpak L, Khanna S, Mao G, Drake R, Sessler D, Turan A

BACKGROUND: High-quality chest compressions are imperative for Cardio-Pulmonary-Resuscitation (CPR). International CPR guidelines advocate, that chest compressions should not be interrupted for ventilation once a patient's trachea is intubated or a supraglottic-airway-device positioned. Supraglottic-airway-devices offer limited protection against pulmonary aspiration. Simultaneous chest compressions and positive pressure ventilation both increase intrathoracic pressure and potentially enhances the risk of pulmonary aspiration. The hypothesis was, that regurgitation and pulmonary aspiration is more common during continuous versus interrupted chest compressions in human cadavers ventilated with a laryngeal tube airway.

METHODS: Twenty suitable cadavers were included, and were positioned supine, the stomach was emptied, 500 ml of methylene-blue-solution instilled and laryngeal tube inserted. Cadavers were randomly assigned to: 1) continuous chest compressions; or, 2) interrupted chest compressions for ventilation breaths. After 14 minutes of the initial designated CPR strategy, pulmonary aspiration was assessed with a flexible bronchoscope. The methylene-blue-solution was replaced by 500 ml barium-sulfate radiopaque suspension. 14 minutes of CPR with the second designated ventilation strategy was performed. Pulmonary aspiration was then assessed with a conventional chest X-ray.

RESULTS: Two cadavers were excluded for technical reasons, leaving 18 cadavers for statistical analysis. Pulmonary aspiration was observed in 9 (50%) cadavers with continuous chest compressions, and 7 (39%) with interrupted chest compressions (P = 0.75).

CONCLUSION: Our pilot study indicate, that incidence of pulmonary aspiration is generally high in patients undergoing CPR when a laryngeal tube is used for ventilation. Our study was not powered to identify potentially important differences in regurgitation or aspiration between ongoing vs. interrupted chest compression. Our results nonetheless suggest that interrupted chest compressions might better protect against pulmonary aspiration when a laryngeal tube is used for ventilation.

Clin Exp Emerg Med. 2019;Epub ahead of print

Prehospital tracheotomy in a case of avulsion of the larynx with a comminuted fracture of the jawbone.

Rupprecht H, Gaab K

ABSTRACT: Emergency physicians in the field are sometimes confronted with cases wherein patients cannot be intubated and ventilated. In some cases, cricothyrotomy, the method of choice for securing an emergency airway, may not have a successful outcome. We report a rare case of a 35-yearold male patient with avulsion of the larynx and a comminuted fracture of the jawbone, due to entrapment in a dung excavator. Prehospital tracheotomy was successfully performed. In cases with crush injuries to the larynx, anatomic structures, including the ligamentum conicum, are destroyed. In addition, massive subcutaneous emphysema blurs the anatomical key structures; hence, only a tracheotomy can prevent a lethal outcome.

Mil Med. 2019 Mar 1;184(Suppl 1):329-334

Reduced Complications of Supraclavicular Approach in Simulated Central Venous Access: Applicability to Military Medicine.

Sappenfield J, Grek S, Cooper L, Lizdas D, Lampotang S

ABSTRACT: In a study with 76 anesthesia providers on a mixed reality simulator, central venous access via the supraclavicular approach to the subclavian vein, without ultrasonography required less attempts compared to the infraclavicular approach. Participants had shorter times to venous access and larger improvements in confidence. Results from this simulation-based study indicate that the supraclavicular approach may deserve consideration as an alternative approach for central venous access in deployed military environments. The use of ultrasonography during the supraclavicular approach to the subclavian vein is also described which may improve its safety profile. This technique could be more appropriate in scenarios when central venous access is preferred over intraosseous access for patients being transported to another location for further care.

J Spec Oper Med. Spring 2019;19(1):70-74.

Battlefield Analgesia: Adherence to Tactical Combat Casualty Care Guidelines.

Schauer S, Fisher A, April M, Carter R, Cunningham C, Aden J, Fernandez J DeLorenzo R

BACKGROUND: Low rates of prehospital analgesia, as recommended by Tactical Combat Casualty Care (TCCC) guidelines, have been demonstrated in the Joint Theaters combat setting. The reasons for this remain unclear. This study expands on previous reports by evaluating a larger prehospital dataset for determinants of analgesia administration.

METHODS: This was part of an approved quality assurance project evaluating adherence to TCCC guidelines across multiple modalities. Data were from the Prehospital Trauma Registry, which existed from January 2013 through September 2014, and comprises data from TCCC cards, Department of Defense 1380 forms, and after-action reports to provide real-time feedback to units on prehospital medical care.

RESULTS: Of 705 total patient encounters, there were 501 documented administrations of analgesic medications given to 397 patients. Of these events, 242 (34.3%) were within TCCC guidelines. Special Operations Command had the highest rate of overall adherence, but rates were still low (68.5%). Medical officers had the highest rates of overall administration. The low rates of administration and adherence persisted across all subgroups.

CONCLUSION: Rates of analgesia administration remained low overall and in subgroup analyses. Medical officers appeared to have higher rates of compliance with TCCC guidelines for analgesia administration, but overall adherence to TCCC guidelines was low. Future research will be aimed at finding methods to improve administration and adherence rates.

Mil Med. 2019 Feb 22;Epub ahead of print

A Descriptive Analysis of Causalities Undergoing CASEVAC from the Point-of-Injury in the Department of Defense Trauma Registry.

Schauer S, Naylor J, Bellamy M, Maddry J, April M

INTRODUCTION: The recent conflicts in Iraq and Afghanistan entail an asymmetric battlefield without clearly defined forward lines of troops as seen in previous wars. Accordingly, the United States military medical services have increasingly adopted casualty evacuation (CASEVAC) platforms. We describe CASEVAC events reported within the Department of Defense Trauma Registry (DODTR).

MATERIALS AND METHODS: This is a secondary analysis of previously published data from two datasets spanning from 2007 through 2017. We isolated casualties within our dataset that had a documented evacuation method from the point-of-injury other than dedicated medical evacuation platforms (e.g., MEDEVAC, etc.).

RESULTS: During OPERATION IRAQI FREEDOM, three casualties underwent CASEVAC. The median age was 30 and all were male. Most sustained injuries from explosives (67%) and the median composite injury scores were low (10). The most frequent seriously injured body region was the thorax (67%). All survived to hospital discharge. During operations in Afghanistan (OPERATION ENDURING FREEDOM, OPERATION FREEDOMS SENTINEL, OPERATION NEW DAWN), 248 casualties underwent CASEVAC. The median age was 28 and most (96%) were male. Most sustained injuries from explosives (58%) and the median injury score was low (9). The most frequent seriously injured body region was the extremities (24%). Most (97%) survived to hospital discharge. During OPERATION INHERENT RESOLVE, 247 casualties underwent CASEVAC. The median age was 21 and most (96%) were male. The majority sustained injuries from explosives (61%) and the median injury score was low (9). The most frequent seriously injury body region was the extremities (27%). Most survived to hospital discharge (94%).

CONCLUSIONS: In our dataset, CASEVAC events most frequently involved US military personnel service members with most surviving to hospital discharge. Developing new terminology that distinguishes different types of CASEVAC would allow for more accurate future analyses of casualty evacuation and outcomes - such as those transports that are truly in a non-medical versus the various medical platforms that do not fall with into the confines of the MEDEVAC platforms.

J Spec Oper Med. Spring 2019;19(1):52-55.

The Prehospital Trauma Registry Experience with Intraosseous Access.

Schauer SG, Naylor JF, April MD, Fisher AD, Cunningham CW, Fernandez JRD, Shreve BP, Bebarta VS.

BACKGROUND: Peripheral intravenous (IV) cannulation is often difficult to obtain in a patient with hemorrhagic shock, delaying the appropriate resuscitation of critically ill patients. Intraosseous (IO) access is an alternative method. To date, few data exist on use of this procedure by ground forces in Afghanistan. Here, we compare patient characteristics and concomitant interventions among patients undergoing IO access versus those undergoing IV access only.

METHODS: We obtained data from the Prehospital Trauma Registry (PHTR). When possible, patients were linked to the Department of Defense Trauma Registry for outcome data. To develop the cohorts, we searched for all patients with documented IO or IV access placement. Those with both IO and IV access documented were placed in the IO group.

RESULTS: Of the 705 available patients in the PHTR, we identified 55 patients (7.8% of the population) in the IO group and 432 (61.3%) in the IV group. Among patients with documentation of access location, the most common location was the tibia (64.3%; n = 18). Compared with patients with IV access, those who underwent IO access had higher urgent evacuation rates (90.9% versus 72.4%; p = .01) and air evacuation rates (58.2% versus 14.8%; p < .01). The IO cohort had significantly higher rates of interventions for hypothermia, chest seals, chest tubes, needle decompressions, and tourniquets, but a significantly lower rate of analgesic administration (ρ ≤ .05).

CONCLUSION: Within the registry, IO placement was relatively low (<10%) and used in casualties who received several other life-saving interventions at a higher rate than casualties who had IV access. Incidentally, lower proportions of analgesia administration were detected in the IO group compared with the IV group, despite higher intervention rates.

Ther Clin Risk Manag. 2019 Mar 1;15:367-376

Comprehensive evaluation of manikin-based airway training with second generation supraglottic airway devices.

Schmutz A, Bohn E, Spaeth J, Heinrich S

Background: Supraglottic airway devices (SADs) are an essential second line tool during difficult airway management after failed tracheal intubation. Particularly for such challenging situations the handling of an SAD requires sufficient training. We hypothesized that the feasibility of manikin-based airway management with second generation SADs depends on the type of manikin.

Methods: Two airway manikins (TruCorp AirSim® and Laerdal Resusci Anne® Airway Trainer™) were evaluated by 80 experienced anesthesia providers using 5 different second generation SADs (LMA® Supreme™ [LMA], Ambu® AuraGain™, i-gel®, KOO™-SGA and LTS-D™). The primary outcome of the study was feasibility of ventilation measured by assessment of the manikins' lung distention. As secondary outcome measures, oropharyngeal leakage pressure (OLP), ease of gastric tube insertion the insertion time, position and subjective assessments were evaluated.

Results: Ventilation was feasible with all combinations of SAD and manikin. By contrast, an OLP exceeding 10 cm H2O could be reached with most of the SADs in the TruCorp but with the LTS-D only in the Laerdal manikin. Gastric tube insertion was successful in above 90% in the Laerdal vs 87% in the TruCorp manikin ($P<0.009$). Insertion times differed significantly between manikins. The SAD positions were better in the Laerdal manikin for LMA, Ambu, i-gel and LTS-D. Participant's assessments were superior in the Laerdal manikin for LMA, Ambu, i-gel and KOO-SGA.

Conclusions: Ventilation is possible with all combinations. However, manikins are variable in their ability to adequately represent additional functions of second generation SADs. In order to achieve the best performance during training, the airway manikin should be chosen depending on the SAD in question.

Transfusion. 2019 Jan;59(1):146-158

In silico model of the dilutional effects of conventional component therapy versus whole blood in the management of massively bleeding adult trauma patients.

Seheult J, Stram M, Sperry J, Spinella P, Triulzi D, Yazer M

BACKGROUND: There are multiple approaches to the blood product and fluid resuscitation of a bleeding trauma patient. An in silico model of different trauma resuscitation strategies was constructed to predict their effects on the volumes of the different body fluid compartments and on several important hemostatic factors.

STUDY DESIGN AND METHODS: This multi-compartment dynamic deterministic model comprised four interconnected modules (hemostatic, resuscitation, body fluid compartment, and dilutional coagulopathy). The model was divided into five resuscitation phases with simulations using six different resuscitation strategies: whole blood (WB) only, conventional component therapy (CCT) only or 10 units of WB followed by CCT, with either 1 L of crystalloid or 1.5 units of WB or red blood cells in the prehospital phase.

RESULTS: At the end of the simulations using 1 L of crystalloid fluids in the prehospital resuscitation phase, the use of WB led to a 1.4 g/dL higher hemoglobin concentration, 32 mg/dL higher fibrinogen concentration, and 0.9 L lower total extracellular fluid volume compared to CCT. Prehospital blood product transfusion in place of crystalloid resulted in higher hemoglobin and fibrinogen concentrations and a lower international normalized ratio throughout the resuscitation regardless of the resuscitation strategy used. Throughout both the prehospital crystalloid and prehospital blood product transfusion simulations, the hemoglobin and fibrinogen concentrations and platelet counts were higher, and the international normalized ratio was lower, when WB was used compared to CCT.

CONCLUSIONS: This model predicted improved hemostatic factor levels and a smaller total extracellular fluid volume volume when WB was transfused instead of CCT to bleeding trauma patients.

J Trauma Acute Care Surg. 2019 Mar 1;Epub ahead of print

ThoraSite: A device to improve accuracy of lateral decompression needle and chest tube placement.

Shah A, Kothera C, Dheer S

BACKGROUND: Multiple reports have detailed an unacceptably high error rate in the siting of decompression needles and tubes and describe associated iatrogenic injuries. The objective of the current study was to measure the accuracy of the novel ThoraSite template for identifying an acceptable intercostal space (ICS) for lateral needle or tube thoracostomy.

METHODS: Two trained operators used the ThoraSite to place radiopaque needles in the left and right lateral chests of 12 cadavers. An independent radiologist reviewed fluoroscopy images to determine the primary outcome: the ICS in which each needle was placed. Secondary outcomes were ICS's palpable through ThoraSite's Safe Zone; needle placement relative to the anterior (AAL) and mid-axillary (MAL) lines; and percent correct placement (defined as the 3, 4, or 5 ICS from 1cm anterior to the AAL to 1cm posterior to the MAL).

RESULTS: The 6 female and 6 male cadavers spanned 4'11" (150cm) to 6'7" (201cm), 80lb (36kg) to 350lb (159kg), and 16 kg/m to 42 kg/m BMI. All 24 needles were placed in either the 3 (4/24 needles, 17%); 4 (10/24 needles, 42%); or 5 ICS (10/24 needles, 42%). In 10/24 assessments (42%), two ICS's were palpable in ThoraSite's Safe Zone. All palpable ICS's were either the 3 (8/34, 24%); 4 (15/34, 44%); or 5 ICS (11/34, 32%). 23/24 needles (96%) were inserted from 1cm anterior to the AAL to 1cm posterior to the MAL. 23/24 needle placements (96%) were correct.

CONCLUSIONS: ThoraSite use was associated with needle placement in the 3, 4, or 5 ICS in an area roughly spanning the AAL to MAL in anatomically diverse cadavers. By facilitating appropriate needle/tube placement, ThoraSite use may decrease iatrogenic injuries. Future study involving representative users may be useful to further evaluate ThoraSite accuracy.

LEVEL OF EVIDENCE: Level IV STUDY TYPE: Therapeutic and care management.

Neurocrit Care. 2019 Apr;30(2):261-271

Current Topics in the Management of Acute Traumatic Spinal Cord Injury.

Shank C, Walters B, Hadley M

ABSTRACT: Acute traumatic spinal cord injury (SCI) affects more than 250,000 people in the USA, with approximately 17,000 new cases each year. It continues to be one of the most significant causes of trauma-related morbidity and mortality. Despite the introduction of primary injury prevention education and vehicle safety devices, such as airbags and passive restraint systems, traumatic SCI continues to have a substantial impact on the healthcare system. Over the last three decades, there have been considerable advancements in the management of patients with traumatic SCI. The advent of spinal instrumentation has improved the surgical treatment of spinal fractures and the ability to manage SCI patients with spinal mechanical instability. There has been a concomitant improvement in the nonsurgical care of these patients with particular focus on care delivered in the pre-hospital, emergency room, and intensive care unit (ICU) settings. This article represents an overview of the critical aspects of contemporary traumatic SCI care and notes areas where further research inquiries are needed. We review the pre-hospital management of a patient with an acute SCI, including triage, immobilization, and transportation. Upon arrival to the definitive treatment facility, we review initial evaluation and management steps, including initial neurological assessment, radiographic assessment, cervical collar clearance protocols, and closed reduction of cervical fracture/dislocation injuries. Finally, we review ICU issues including airway, hemodynamic, and pharmacological management, as well as future directions of care.

J Vasc Surg. 2019 Jul;70(1):224-232

Management and outcome of 597 wartime penetrating lower extremity arterial injuries from an international military cohort.

Sharrock A, Tai N, Perkins Z, White J, Remick K, Rickard R, Rasmussen T

OBJECTIVE: Vascular injury is a leading cause of death and disability in military and civilian settings. Most wartime and an increasing amount of civilian vascular trauma arises from penetrating mechanisms of injury due to gunshot or explosion. The objective of this study was to provide a comprehensive examination of penetrating lower extremity arterial injury and to characterize long-term limb salvage and differences related to mechanisms of injury.

METHODS: The military trauma registries of the United States and the United Kingdom were analyzed to identify service members who sustained penetrating lower limb arterial injury (2001-2014). Treatment and limb salvage data were studied and comparisons made of patients whose penetrating vascular trauma arose from explosion (group 1) vs gunshot (group 2). Standardized statistical testing was used, with Bonferroni corrections for multiple comparisons.

RESULTS: The cohort consisted of 568 combat casualties (mean age, 25.2 years) with 597 injuries (explosion, n = 416; gunshot, n = 181). Group 1 had higher Injury Severity Score ($P < .05$) and Mangled Extremity Severity Score ($P < .0001$), required more blood transfusion ($P < .05$), and had more tibial ($P < .01$) and popliteal ($P < .05$) arterial injuries; group 2 had more profunda femoris injuries ($P < .05$). Initial surgical management for the whole cohort included vein interposition graft (33%), ligation (31%), primary repair with or without patch angioplasty (16%), temporary vascular shunting (15%), and primary amputation (6%). No difference in patency of arterial reconstruction was found between group 1 and group 2, although group 1 had a higher incidence of primary (13% vs 2%; $P < .05$) and secondary (19% vs 9%; $P < .05$) amputation. Similarly, longer term freedom from amputation was lower for group 1 than for group 2 (68% vs 89% at 5.5 years; Cox hazard ratio, 0.30; $P < .0001$), as was physical functioning (36-Item Short Form Health Survey data; mean, 39.80 vs 43.20; $P < .05$).

CONCLUSIONS: The majority of wartime lower extremity arterial injuries result from an explosive mechanism that preferentially affects the tibial vasculature and results in poorer long-term limb salvage compared with those injured with firearms. The mortality associated with immediate limb salvage attempts is low, and delayed amputations occur weeks later, affording the patient involvement in the decision-making and rehabilitation planning. We recommend assertive attempts at vascular repair and limb salvage for service members injured by explosive and gunshot mechanisms.

Emerg Med Australas. 2019 Apr 9. doi: 10.1111/1742-6723.13290.

Heterogeneous emergency department management of published recommendation defined hypotension in patients with acute traumatic spinal cord injury: A multi-centre overview.

Sharwood L, Joseph A, Guo C, Flower O, Ball J, Middleton J

OBJECTIVE: Evidence-based management for patients with acute traumatic spinal cord injury (TSCI) in the ED has a critical impact on long-term outcomes. Acute hypotension post-injury may compromise spinal cord perfusion and extend neurological damage. Published guidelines recommend mean arterial blood pressure (BP) maintenance between 85 and 90 mmHg for 7 days post-injury; the extent to which this is followed in Australia is unknown.

METHODS: Prospective observational study of patients ≥16 years with TSCI, treated at 48 hospitals across two Australian states. Mean arterial BPs were recorded in the Ambulance, and ED arrival and discharge. Patients' medical records documented treatment provided (intravenous fluids, vasopressors or both) for BP augmentation. Hypotension was defined as mean arterial BP <85 mmHg, per the American Association of Neurological Surgeons guidelines.

RESULTS: The 208 patients with TSCI in the present study were more likely to receive BP augmentation if they experienced direct transport to a Spinal Cord Service hospital (OR 5.57, 95% CI 2.32-10.11), had a cervical level injury (OR 2.32, 95% CI 1.01-5.5) or were hypotensive on ED arrival (OR 2.42, 95% CI 1.34-4.39). Of the 112 patients who were hypotensive, 71 (63.4%) received treatment for this; however, the majority (76%) remained hypotensive on discharge.

CONCLUSION: Hypotensive patients' post-TSCI experienced heterogeneous ED care discordant with published guidelines; varying by hospital type. Specialist care and more severe injury increased likelihood of guideline adherence. Lack of adherence may influence patient outcomes. Level 1 evidence is needed along with consistent guideline implementation and clinician training to likely improve TSCI management and outcomes.

Transfusion. 2019 Apr 3;Epub ahead of print

Prehospital whole blood resuscitation prevents coagulopathy and improves acid-base status at hospital arrival in a nonhuman primate hemorrhagic shock model.

Sheppard F, Mitchell T, Cap A, Schaub L, Macko A, Glaser J

BACKGROUND: Hemorrhage remains the primary cause of preventable death in civilian and military trauma. The Committee on Tactical Combat Casualty Care recommends prehospital (PH) resuscitation with whole blood (WB). However, 6% hetastarch in lactated electrolyte (HEX) and crystalloids are more commonly available and used for PH resuscitation in military and civilian environments, respectively. The mechanistic benefits of PH WB resuscitation have not been well studied and remain to be elucidated.

STUDY DESIGN AND METHODS: The aim of this study was to evaluate the differences in simulated PH WB and HEX resuscitation, specifically with regards to coagulation, physiologic, and metabolic outcomes to better elucidate the mechanistic benefits of WB. In a randomized study, the physiologic, coagulation, and metabolic responses to simulated PH WB (n = 12) or HEX (n = 12) were evaluated in a nonhuman primate model of severe polytraumatic hemorrhagic shock.

RESULTS: Notable findings included 1) equivalence of shock reversal between simulated PH WB and HEX treatment groups as determined by hemodynamics and base deficit and 2) prevention of coagulopathy at simulated hospital arrival with initial WB resuscitation as determined by viscoelastic and plasmatic coagulation assays.

CONCLUSION: The major benefit of WB, as compared to HEX, in simulated PH resuscitation appears to be prevention of coagulopathy at hospital arrival. Both fluids effectively reversed shock in this model, implying that efficacious provision preload (cardiac output support and hence oxygen delivery) and coagulation proteins (prevention of coagulopathy) are mechanisms underlying WB's effectiveness in early resuscitation of hemorrhagic shock.

J Trauma Acute Care Surg. 2019 May;86(5):902-908

Comparison of the efficacy of a bougie and stylet in patients with endotracheal intubation: A meta-analysis of randomized controlled trials.

Sheu Y, Yu S, Huang T, Liu F, Lin Y, Tam K

BACKGROUND: Endotracheal intubation (ETI) is a procedure widely performed for several clinical indications. In typical ETI, an endotracheal tube is placed into a patient's trachea with the help of a malleable metal rod covered with a clear plastic sheath (called a stylet). However, another intubation aid, a bougie (also named a gum elastic bougie or endotracheal tube introducer), was also introduced in the clinical setting to improve the efficacy of conventional ETI.

METHODS: This study performed a systematic review and meta-analysis of randomized controlled trials to compare the efficacy of bougie and stylet approaches in ETI. PubMed, Embase, and Cochrane Library databases were searched for studies published before November 2018. Randomized controlled trials comparing the clinical outcomes of bougie and stylet approaches in patients who underwent orotracheal intubation were included. Meta-analyses were conducted by using a random effects model, and treatment efficacy was measured by evaluating the first-attempt success rate and intubation duration.

RESULTS: A total of 5 randomized controlled trials and 1,038 patients were included. Although a bougie resulted in a better first-attempt success rate, no significant difference was observed between the approaches (risk ratios, 1.03; 95% confidence interval, 0.85-1.24). Moreover, no significant differences were observed in the intubation duration and esophageal intubation rate between the bougie and stylet approaches.

CONCLUSION: Endotracheal intubation performed with a bougie was not superior over ETI performed with a stylet. Therefore, intubation approaches should be selected by considering personal preference and clinician expertise.

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

Radiol Case Rep. 2019 Mar 15;14(5):623-626

The utility of resuscitative endovascular balloon occlusion of the aorta for temporary hemostasis after extensive bilateral lower extremity injuries: A case report.

Shinjo T, Izawa Y, Watanabe N, Tominaga K, Yonekawa C, Lefor A, Mato T

ABSTRACT: A 75-year-old pedestrian was struck by a truck and in shock with both lower extremities significantly deformed, with injuries extending proximally to the inguinal region and degloving injuries. Resuscitative endovascular balloon occlusion of the aorta was performed to achieve temporary hemostasis and the patient became hemodynamically stable. Following stabilization, both lower extremities were amputated. Resuscitative endovascular balloon occlusion of the aorta may be effective to achieve temporary hemostasis in patients with extensive injuries of the lower extremities, especially with extension to the inguinal region which precludes use of a tourniquet.

Am J Surg. 2018 Nov 27;Epub ahead of print

Trends in civilian penetrating brain injury: A review of 26,871 patients.

Skarupa D, Khan M, Hsu A, Madbak F, Ebler D, Yorkgitis B, Rahmathulla G, Alcindor D, Joseph B

INTRODUCTION: The aim of our study is to analyze the 5 years' trends, mortality rate, and factors that influence mortality after civilian penetrating traumatic brain injury (pTBI).

METHODS: We performed a 5-year-analysis of all trauma patients diagnosed with pTBI in the TQIP. Our outcome measures were trends of pTBI.

RESULTS: A total of 26,871 had penetrating brain injury over the 5-year period. Mean age was 36.2 ± 18 years. Overall 55% of the patients had severe TBI and mortality rate was 43.8%. There was an increase in the rate of pTBI from 3042/100,000 (2010) to 7578/100,000 trauma admissions (2014) ($p < 0.001$). The mortality rate has increased from 35% (2010) to 48% (2011) ($p < 0.001$) followed by a linear decrease in mortality to 40% (2014). Independent predictors of mortality were age, pre-hospital intubation, suicide attempt, and craniotomy/craniectomy.

CONCLUSIONS: Incidence and mortality for patients who are brought to hospitals following pTBI have gradually increased over the five-year period. Self-inflicted injury and prehospital intubation were the two most significant predictors of mortality.

J Am Coll Surg. 2019;Epub ahead of print

Incidence and Cause of Potentially Preventable Death after Civilian Public Mass Shooting in the US.

Smith E, Sarani B, Shapiro G, Gondek S, Rivas L, Ju T, Robinson B, Estroff J, Fudenberg J, Amdur R, Mitchell R

BACKGROUND: The incidence and severity of civilian public mass shooting (CPMS) events continue to rise. Understanding the wounding pattern and incidence of potentially preventable death (PPD) after CPMS is key to updating prehospital response strategy.

METHODS: A retrospective study of autopsy reports after CPMS events identified via the Federal Bureau of Investigation CPMS database from December 1999 to December 31, 2017 was performed. Sites of injury, fatal injury, and incidence of PPD were determined independently by a multidisciplinary panel composed of trauma surgery, emergency medicine, critical care paramedicine, and forensic pathology.

RESULTS: Nineteen events including 213 victims were reviewed. Mean number of gunshot wounds per victim was 4.1. Sixty-four percent of gunshots were to the head and torso. The most common cause of death was brain injury (52%). Only 12% (26 victims) were transported to the hospital and the PPD rate was 16% (34 victims). The most commonly injured organs in those with PPD were the lung (59%) and spinal cord (24%). Only 1% of PPD victims had a gunshot to a vascular structure in an extremity.

CONCLUSIONS: The PPD rate after CPMS is high and is due mostly to non-hemorrhaging chest wounds. Prehospital care strategy should focus on immediate point of wounding care by both laypersons and medical personnel, as well as rapid extrication of victims to definitive medical care.

JEMS 2019; April 1, 2018

EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas

Smith J, Simpson G, Heightman A

QUOTE:

"Oscar Monterrosa, the paramedic in charge of the medical tent that night, was focused on getting the team to apply tourniquets to stave o severe hemorrhaging, replace uids for internal bleeding and immobilize trampled limbs. (Of the 546 victims, there were surprisingly few trampling injuries.)

Due to the sheer numbers of injured victims, on-scene medical supplies and stores were quickly exhausted.

Although multiple brands of tourniquets where available and used by EMS and police responders, the two found to be most effective were the CAT and SAM XT tourniquets. Makeshift and other types of tourniquets proved difficult in maintaining a grip and had to be replaced by the CAT and SXT tourniquets."

Trauma Surg Acute Care Open. 2019 Feb 18;4(1):e000263

World trauma education: hemorrhage control training for healthcare providers in India.

Smith L, Caughey S, Liu S, Villegas C, Kilaru M, Gupta A, Winchell R, Narayan M

Background: Hemorrhage remains a major cause of death around the world. Eighty percent of trauma patients in India do not receive medical care within the first hour. The etiology of these poor outcomes is multifactorial. We describe findings from the first Stop the Bleed (StB) course recently offered to a group of medical providers in southern India.

Methods: A cross-sectional survey of 101 participants who attended StB trainings in India was performed. Pre-training and post-training questionnaires were collected from each participant. In total, 88 healthcare providers' responses were analyzed. Three bleeding control skills were presented: wound compression, wound packing, and tourniquet application.

Results: Among participants, only 23.9% had received prior bleeding control training. Participants who reported feeling 'extremely confident' responding to an emergency medical situation rose from 68.2% prior to StB training to 94.3% post-training. Regarding hemorrhage control abilities, 37.5% felt extremely confident before the training, compared with 95.5% after the training. For wound packing and tourniquet application, 44.3% and 53.4%, respectively, felt extremely confident pre-training, followed by 97.7% for both skills post-training. Importantly, 90.9% of StB trainees felt comfortable teaching newly acquired hemorrhage control skills. A significant majority of participants said that confidence in their wound packing and tourniquet skills would improve with more realistic mannequins.

Conclusion: To our knowledge, this is the first StB training in India. Disparities in access to care, long transport times, and insufficient numbers of prehospital personnel contribute to its significant trauma burden. Dissemination of these critical life-saving skills into this region and the resulting civilian interventions will increase the number of trauma patients who survive long enough to reach a trauma center. Additionally, considerations should be given to translating the course into local languages to increase program reach.

Level of Evidence: Level IV.

Scand J Trauma Resusc Emerg Med. 2019 Feb 13;27(1):15

Comparison of two different intraosseous access methods in a physician-staffed helicopter emergency medical service - a quality assurance study.

Sørgjerd R, Sunde G, Heltne J

BACKGROUND: Intravenous access in critically ill and injured patients can be difficult or impossible in the field. Intraosseous access is a well-established alternative to achieve access to a noncollapsible vascular network. We wanted to compare the use of a sternal and tibial/humeral intraosseous device in a physician-staffed helicopter emergency medical service.

METHODS: The helicopter emergency medical service in Bergen, Norway, is equipped with two different intraosseous devices, the EZ-IO and FAST-Responder. We compared insertion time, insertion sites, flow, indication for intraosseous access, and complications between the tibial/humeral and sternal techniques.

RESULTS: In 49 patients, 53 intraosseous insertions were made. The overall intraosseous rate was 1.5% (53 insertions in 3600 patients treated). The main patient categories were cardiac arrest and trauma. Overall, 93.9% of the insertions were successful on the first attempt. The median insertion time using EZ-IO was 15 s compared to 20 s using FAST-Responder. Insertion complications registered using the EZ-IO included extravasation, aspiration failure and insertion time > 30 s. Using FAST-Responder, there were reported complications such as user failure (12.5%) and insertion time > 30 s (12.5%). Regarding the flow, we found that 35.1% of the EZ-IO insertions experienced poor flow and needed a pressure bag. With FAST-Responder, the flow was reported as very good or good in 85.7%, and no insertions had poor flow.

CONCLUSION: Intraosseous access seems to be a reliable rescue technique in our helicopter emergency medical service, with high insertion success rates. EZ-IO was a more rapid method in gaining vascular access compared to FAST-Responder. However, FAST-Responder may be a better method when high-flow infusion is needed. Few complications were registered with both techniques in our service.

Mil Med. 2019 Mar 1;184(Suppl 1):335-341

Using Simulation to Address a Training Gap in Battlefield Ocular Trauma: A Lateral Canthotomy and Cantholysis (LCC) Prototype Training System.

Sotomayor T, Bailey M, Dorton S

ABSTRACT: Over the past 15 years of conflict, eye injuries have ocurred at a steady rate of 5-10% of combat casualties, attributed to the enemy's use of improvised explosive devices. Many of these injuries result in a compartment syndrome of the orbit, easily decompressed through the use of a simple procedure called a Lateral Canthotomy and Cantholysis (LCC). Current training curricula at the U.S. Army Center for Pre-Hospital Medicine at Fort Sam Houston, Texas incorporates LCC training presented in lectures and taught using cadavers and goats (resources permitting), but lacks a LCC training device for the development of psychomotor skills. Requirements analysis, iterative design and development, and testing were performed for a simulation-based training system that may be used to practice the LCC procedure. Subject matter experts have conducted numerous reviews of the prototype system, where feedback is used to drive subsequent designs. Further work, including formal analysis of training effectiveness, will be performed to validate the training system. This will benefit will benefit military and civilian training programs by training psychomotor skills to enhance competency in the LCC procedure for preserving eyesight.

JAMA Surg. 2019 May 8:Epub ahead of print

Association of Statewide Implementation of the Prehospital Traumatic Brain Injury Treatment Guidelines With Patient Survival Following Traumatic Brain Injury: The Excellence in Prehospital Injury Care (EPIC) Study.

Spaite D, Bobrow B, Keim S, Barnhart B, Chikani V, Gaither J, Sherrill D, Denninghoff K, Mullins T, Adelson P, Rice A, Viscusi C, Hu C

Importance: Traumatic brain injury (TBI) is a massive public health problem. While evidence-based guidelines directing the prehospital treatment of TBI have been promulgated, to our knowledge, no studies have assessed their association with survival.

Objective: To evaluate the association of implementing the nationally vetted, evidence-based, prehospital treatment guidelines with outcomes in moderate, severe, and critical TBI.

Design, Setting, and Participants: The Excellence in Prehospital Injury Care (EPIC) Study included more than 130 emergency medical services systems/agencies throughout Arizona. This was a statewide, multisystem, intention-to-treat study using a before/after controlled design with patients with moderate to critically severe TBI (US Centers for Disease Control and Prevention Barell Matrix-Type 1 and/or Abbreviated Injury Scale Head region severity ≥3) transported to trauma centers between January 1, 2007, and June 30, 2015. Data were analyzed between October 25, 2017, and February 22, 2019.

Interventions: Implementation of the prehospital TBI guidelines emphasizing avoidance/treatment of hypoxia, prevention/correction of hyperventilation, and avoidance/treatment of hypotension.

Main Outcomes and Measures: Primary: survival to hospital discharge; secondary: survival to hospital admission.

Results: Of the included patients, the median age was 45 years, 14 666 (67.1%) were men, 7181 (32.9%) were women; 16 408 (75.1%) were white, 1400 (6.4%) were Native American, 743 (3.4%) were Black, 237 (1.1%) were Asian, and 2791 (12.8%) were other race/ethnicity. Of the included patients, 21 852 met inclusion criteria for analysis (preimplementation phase [P1]: 15 228; postimplementation [P3]: 6624). The primary analysis (P3 vs P1) revealed an adjusted odds ratio (aOR) of 1.06 (95% CI, 0.93-1.21; P = .40) for survival to hospital discharge. The aOR was 1.70 (95% CI, 1.38-2.09; P < .001) for survival to hospital admission. Among the severe injury cohorts (but not moderate or critical), guideline implementation was significantly associated with survival to discharge (Regional Severity Score-Head 3-4: aOR, 2.03; 95% CI, 1.52-2.72; P < .001; Injury Severity Score 16-24: aOR, 1.61; 95% CI, 1.07-2.48; P = .02). This was also true for survival to discharge among the severe, intubated subgroups (Regional Severity Score-Head 3-4: aOR, 3.14; 95% CI, 1.65-5.98; P < .001; Injury Severity Score 16-24: aOR, 3.28; 95% CI, 1.19-11.34; P = .02).

Conclusions and Relevance: Statewide implementation of the prehospital TBI guidelines was not associated with significant improvement in overall survival to hospital discharge (across the entire, combined moderate to critical injury spectrum). However, adjusted survival doubled among patients with severe TBI and tripled in the severe, intubated cohort. Furthermore, guideline implementation was significantly associated with survival to hospital admission. These findings support the widespread implementation of the prehospital TBI treatment guidelines.

J Orthop Trauma. 2019 Mar 29; Epub ahead of print

Tranexamic Acid Use in Open Reduction and Internal Fixation of Fractures of the Pelvis, Acetabulum, and Proximal Femur: A Randomized Controlled Trial.

Spitler C, Kiner D, Row E, Gardner W, Swafford R, Hankins M, Nowotarski P

OBJECTIVES: Assess the safety and efficacy of tranexamic acid(TXA) use in fractures of the pelvic ring, acetabulum, and proximal femur

DESIGN: Prospective, randomized controlled trial

SETTING: Single Level 1 trauma center

PATIENTS: Fourty-seven patients were randomized to the study group and 46 patients comprised the control group INTERVENTION:: The study group received 15mg/kg IV TXA prior to incision and a second identical dose 3 hours after the initial dose.

MAIN OUTCOME MEASUREMENTS: transfusion rates, total blood loss (via hemoglobin dilutional method, rates of venous thromboembolic events)

RESULTS: Total blood loss was significantly higher in the control group (TXA=952mL, No TXA=1325mL, p=0.028). The total transfusion rates between the TXA and control groups were not significantly different (TXA 1.51, No TXA= 1.17, P=0.41). There were no significant differences between the TXA and control groups in inpatient VTE events (p=0.57) CONCLUSION:: The use of TXA in high-energy fractures of the pelvis, acetabulum and femur significantly decreased calculated total blood loss but did not decrease overall transfusion rates. TXA did not increase the rate of VTE. Further study is warranted prior to making broad recommendations for use of TXA in these fractures.

Mil Med. 2019 Mar 1;184(Suppl 1):83-91

Combat-Related Extremity Wounds: Injury Factors Predicting Early Onset Infections.

Stewart L, Shaikh F, Bradley W, Lu D, Blyth D, Petfield J, Whitman T, Krauss M, Greenberg L, Tribble D

ABSTRACT: We examined risk factors for combat-related extremity wound infections (CEWI) among U.S. military patients injured in Iraq and Afghanistan (2009-2012). Patients with ≥1 combat-related, open extremity wound admitted to a participating U.S. hospital (≤7 days postinjury) were retrospectively assessed. The population was classified based upon most severe injury (amputation, open fracture without amputation, or open soft-tissue injury defined as non-fracture/non-amputation wounds). Among 1271 eligible patients, 395 (31%) patients had ≥1 amputation, 457 (36%) had open fractures, and 419 (33%) had open soft-tissue wounds as their most severe injury, respectively. Among patients with traumatic amputations, 100 (47%) developed a CEWI compared to 66 (14%) and 12 (3%) patients with open fractures and open soft-tissue wounds, respectively. In a Cox proportional hazard analysis restricted to CEWIs ≤30 days postinjury among the traumatic amputation and open fracture groups, sustaining an amputation (hazard ratio: 1.79; 95% confidence interval: 1.25-2.56), blood transfusion ≤24 hours postinjury, improvised explosive device blast, first documented shock index ≥0.80, and >4 injury sites were independently associated with CEWI risk. The presence of a non-extremity infection at least 4 days prior to a CEWI diagnosis was associated with lower CEWI risk, suggesting impact of recent exposure to directed antimicrobial therapy. Further assessment of early clinical management will help to elucidate risk factor contribution. The wound classification system provides a comprehensive approach in assessment of injury and clinical factors for the risk and outcomes of an extremity wound infection.

Mil Med. 2019 Mar 1;184(Suppl 1):367-373

Pilot Study of a Novel Swine Model for Controlling Junctional Hemorrhage Using the iTClamp in Conjunction With Hemostatic Agents.

Stuart S, Zarow G, Walchak A, McLean J, Roszko P

ABSTRACT: Exsanguinating hemorrhage is a primary cause of battlefield death. The iTClamp is a relatively new device (FDA approval in 2013) that takes a different approach to hemorrhage control by applying mechanism wound closure. However, no previous studies have explored the feasibility of utilizing the iTClamp in conjunction with hemostatic packing. To fill this important gap in the literature, a novel swine model was developed, and a total of 12 trials were performed using QuikClot Combat Gauze or XSTAT sponges in conjunction with the iTClamp to treat arterial injuries through 5 cm or 10 cm skin incisions in the groin, axilla, or neck. First-attempt application success rate, application time, and blood loss were recorded. Hemostasis was achieved on all wounds, though reapplication was required in one Combat Gauze and three XSTAT applications. Application averaged ~50% slower for Combat Gauze (M = 41 seconds, 95%CI: 22-32 seconds) than for XSTAT (M = 27 seconds, 95%CI: 35-47 seconds). XSTAT application was faster than Combat Gauze for each wound location and size. The 10 cm wounds took ~10 seconds (36%) longer to close (M = 27 seconds, 95%CI: 35-47 seconds) than the 5 cm wounds (M = 27 seconds, 95%CI: 35-47 seconds). Blood loss was similar for Combat Gauze (M = 51 mL, 95%CI: 25-76 mL) and XSTAT (M = 60 mL, 95%CI: 30-90 mL). Blood loss was roughly twice as great for 10 cm wounds (M = 73 mL, 95%CI: 47-100 mL) than for 5 cm wounds (M = 38 mL, 95%CI: 18-57 mL). This pilot study supports the feasibility of a novel model for testing the iTClamp in conjunction with hemostatic packing towards controlling junctional hemorrhage.

J Spec Oper Med. Spring 2019;19(1):81-87.

Low-Resource Tactical Combat Casualty Care Training for Peshmerga Units in Remote Areas of Kurdistan.

Taylor D, Murphy J, Stolley Z

ABSTRACT: The Peshmerga are the official military of the autonomous region of Kurdistan, Iraq. There remains a high level of variability across Peshmerga units in medical equipment and training. Presumably, Peshmerga soldiers are dying from preventable causes of death due to combat-related injuries, just as US troops did before the introduction of Tactical Combat Casualty Care (TCCC) training and supplies. This report outlines the efforts of a small US-based collective to provide TCCC training at the TCCC for all combatants skill level to Peshmerga forces and develop members of the Peshmerga as trainers.

Reg Anesth Pain Med. 2019 Feb 7;Epub ahead of print

Intravenous meloxicam for the treatment of moderate to severe acute pain: a pooled analysis of safety and opioid-reducing effects.

Viscusi E, Gan T, Bergese S, Singla N, Mack R, McCallum S, Du W(7), Hobson S(6).

BACKGROUND AND OBJECTIVES: To describe the safety and tolerability of intravenous meloxicam compared with placebo across all phase II/III clinical trials.

METHODS: Safety data and opioid use from subjects with moderate to severe postoperative pain who received ≥1 dose of intravenous meloxicam (5-60 mg) or placebo in 1 of 7 studies (4 phase II; 3 phase III) were pooled. Data from intravenous meloxicam 5 mg, 7.5 mg and 15 mg groups were combined (low-dose subset).

RESULTS: A total of 1426 adults (86.6% white; mean age: 45.8 years) received ≥1 dose of meloxicam IV; 517 (77.6% white; mean age: 46.7 years) received placebo. The incidence of treatment-emergent adverse events (TEAEs) in intravenous meloxicam and placebo-treated subjects was 47% and 57%, respectively. The most commonly reported TEAEs across treatment groups (intravenous meloxicam 5-15 mg, 30 mg, 60 mg and placebo, respectively) were nausea (4.3%, 20.8%, 5.8% and 25.3%), headache (1.5%, 5.6%, 1.6% and 10.4%), vomiting (2.8%, 4.6%, 1.6% and 7.4%) and dizziness (0%, 3.5%, 1.1% and 4.8%). TEAE incidence was generally similar in subjects aged >65 years with impaired renal function and the general population. Similar rates of cardiovascular events were reported between treatment groups. One death was reported (placebo group; unrelated to study drug). There were 35 serious adverse events (SAEs); intravenous meloxicam 15 mg (n=5), intravenous meloxicam 30 mg (n=15) and placebo (n=15). The SAEs in meloxicam-treated subjects were determined to be unrelated to study medication. Six subjects withdrew due to TEAEs, including three treated with intravenous meloxicam (rash, localized edema and postprocedural pulmonary embolism). In trials where opioid use was monitored, meloxicam reduced postoperative rescue opioid use.

CONCLUSIONS: Intravenous meloxicam was generally well tolerated in subjects with moderate to severe postoperative pain.

Scand J Trauma Resusc Emerg Med. 2019 Feb 26;27(1):23

Changes in anaesthetic use for trauma patients in German HEMS - a retrospective study over a ten-year period.

Wafaisade A, Caspers M, Bouillon B, Helm M, Ruppert M, Gäßler M

BACKGROUND: Airway management and use of intravenous anaesthetics to facilitate tracheal intubation after major trauma remains controversial. Numerous agents are available and used for pre-hospital rapid-sequence induction (RSI). The aim was to investigate usage and potential changes in administration of intravenous anaesthetics for pre-hospital RSI in trauma patients over a ten-year period.

METHODS: Based on a large helicopter emergency medical service (HEMS) database in Germany between 2006 and 2015, a total of 9720 HEMS missions after major trauma leading to RSI on scene were analysed. Administration practice of sedatives and opioids were investigated, while neuromuscular blocking agents were not documented in the database.

RESULTS: With respect to administration of sedatives, independent from trauma mechanism and specific injury patterns the use of Etomidate decreased dramatically (52 to 6%) in favour of a more frequent use of Propofol (3 to 32%) and Ketamine (9 to 24%; all $p < 0.001$) from 2006 to 2015. The use of Benzodiazepines increased slightly, while the utilization rate of Barbiturates remained constant. In patients with Shock Index > 1 at initial contact, the administration rate of Etomidate dropped significantly as well. This decline was mainly substituted by Ketamine and particularly Propofol. In patients with GCS ≤ 8 upon initial contact, a similar distribution compared to the general trauma population could be observed. With respect to opioids, mainly Fentanyl has been administered for RSI in trauma patients (2006: 69, 6% to 2015: 60.2%; $p < 0.001$), while the use of sufentanyl showed a significant increase (0.2 to 8.8%; $p < 0.001$).

CONCLUSIONS: This large study analysed prehospital administration of anaesthetics in trauma patients, showing a substantial change from 2006 to 2015 despite the lack of any high-level evidence. Etomidate has shifted from the main sedative substance to virtual absence, indicating that the recommendation of an established national guideline was transferred into clinical practice, although based on weak evidence as well. The pre-hospital use of Propofol showed a particular increase. Fentanyl has been the main opioid drug for RSI in trauma, however Sufentanyl has become increasingly popular. The mechanisms and advantages of the different substances still have to be elucidated, especially in head injury and bleeding trauma.

Mil Med. 2019 Mar 1;184(3-4):e285-e289

Radiofrequency Identification of the ER-REBOA: Confirmation of Placement Without Fluoroscopy.

Wessels L, Wallace J, Bowie J, Butler W, Spalding C, Krzyzaniak M

INTRODUCTION: Non-compressible torso hemorrhage accounts for 70% of battlefield deaths. Resuscitative endovascular balloon occlusion of the aorta (REBOA) is an emerging technology used to mitigate massive truncal hemorrhage. Use of REBOA on the battlefield is limited by the need for radiographic guided balloon placement. Radiofrequency identification (RFID) is a simple, portable, real-time technology utilized to detect retained sponges during surgery. We investigated the feasibility of RFID to confirm the placement of ER-REBOA.

MATERIALS AND METHODS: This was a single-arm prospective proof-of-concept experimental study approved by the institutional review board at Naval Medical Center San Diego. The ER-REBOA (Prytime Medical Devices, Inc, Boerne, TX, USA) was modified by placement of a RFID tag. The tagged ER-REBOA was placed in zone I or zone III of the aorta in a previously perfused cadaver. Exact location was documented with X-ray. Five blinded individuals used the RF Assure Detection System (Medtronic, Minneapolis, MN, USA) handheld detection wand to predict catheter tip location from the xiphoid process (zone I) or pubic tubercle (zone III).

RESULTS: In zone I, actual distance (Da) of the catheter tip was 11 cm from the xiphoid process. Mean predicted distance (Dp) from Da was 1.52 cm (95% CI 1.19-1.85). In zone III, Da was 14 cm from the pubic tubercle. Mean Dp from Da was 4.11 cm (95% CI 3.68-4.54). Sensitivity of detection was 100% in both zones. Specificity (Defined as Dp within 2 cm of Da) was 86% in zone I and 16% in zone III.

CONCLUSIONS: Using RFID to confirm the placement of ER-REBOA is feasible with specificity highest in zone I. Future work should focus on refining this technology for the forward-deployed setting.

J Emerg Med. 2019 May;56(5):491-498

Whole Blood in Trauma: A Review for Emergency Clinicians.

Weymouth W, Long B, Koyfman A, Winckler C

BACKGROUND: Blood products are a cornerstone of trauma resuscitation. From the historically distant battlefields of World War II through present-day conflict around the globe, whole blood (WB) has been a potent tool in the treatment of massive hemorrhagic shock. Component therapy with a targeted ratio of packed red blood cells, platelets, and plasma has previously been utilized.

OBJECTIVES: This narrative review describes modern-day WB transfusion, its benefits, potential drawbacks, and implementation.

DISCUSSION: The current form of stored low-titer O WB seems to be the safest and most effective solution. There are many advantages to WB, including the maintenance of coagulation factors, the lack of subsequent thrombocytopenia, and the reduction of infused anticoagulant. Several studies suggest its utility in trauma. Most of the disadvantages of WB stem from a lack of prospective data on the topic, which are likely forthcoming. Logistical issues likely present the greatest barrier to this therapy, but an advanced prehospital protocol developed in San Antonio, Texas, has successfully overcome several of these challenges.

CONCLUSIONS: Although stored WB holds promise, it is not without its distinct challenges, including logistical issues, which this article addresses. There are programs underway currently that demonstrate its feasibility in metropolitan areas. As demonstrated in military settings, WB is likely the ideal resuscitation fluid for civilian trauma in the prehospital and emergency department settings.

Medicine (Baltimore). 2018 Dec;97(50):e13643

The efficacy and safety of tranexamic acid in reducing perioperative blood loss in patients with multilevel thoracic spinal stenosis: A retrospective observational study.

Xue P, Yang J, Xu X, Liu T, Huang Y, Qiao F, Huang X

STUDY DESIGN: A retrospective study.

OBJECTIVE: To investigate the effectiveness and safety of intravenous tranexamic acid for reducing perioperative blood loss in patients with multilevel thoracic spinal stenosis (TSS).

METHODS: This is a retrospective observational study of 42 patients with multilevel TSS admitted from December 2016 to October 2017 to the spine department of Honghui Hospital who underwent posterolateral bone graft fusion with posterior laminectomy and decompression fixation. The patients were divided into 2 groups. All the surgeries were completed by the same surgeon. Group A received an intravenous infusion of 15 mg/kg 15 min prior to surgery. Continuous infuse on of tranexamic acid (TXA) at a dose of 1 mg/kg/h was provided throughout the operation until the skin was closed. Group B received no TXA as a blank control group. Group A comprised 10 males and 10 females with an average age of 53.41±7.93 years; group B comprised 11 males and 11 females with an average age of 55.10±8.43 years. The need for blood transfusion, volume of blood transfusion, blood coagulation function, extubation time, postoperative hospital stay and incidence of postoperative deep venous thrombosis (DVT) were recorded during and after the operation for the 2 groups.

RESULTS: There was no significant difference between the 2 groups in general characteristics, such as age, sex and body mass index (BMI) ($P > .05$). There was no significant difference between the 2 groups in the levels are instrumented and the laminectomy levels in each group. The average postoperative blood loss, need for blood transfusion, time to postoperative extubation and length of postoperative hospital stay in group A were lower than those in group B, and there was a significant difference between the 2 groups ($P < .05$). The preoperative and postoperative coagulation, and postoperative DVT did not occur 48 h after operation.

CONCLUSION: In the treatment of multilevel thoracic spinal canal stenosis using trabeculectomy with posterior laminectomy and posterolateral bone graft fusion, TXA can reduce the amount of blood transfused and the need for blood transfusion and can shorten the extubation time and the length of postoperative hospital stay without increasing the incidence of postoperative coagulation dysfunction or postoperative DVT.

Scand J Trauma Resusc Emerg Med. 2016 Dec 9;24(1):147.

Impact of Cushing's sign in the prehospital setting on predicting the need for immediate neurosurgical intervention in trauma patients: a nationwide retrospective observational study.

Yumoto T, Mitsuhashi T, Yamakawa Y, Iida A, Nosaka N, Tsukahara K, Naito H, Nakao A

BACKGROUND: Cushing's reflex usually results from intracranial hypertension. Although Cushing's sign can implicate severe traumatic brain injury (TBI) in injured patients, no major investigations have been made. The purpose of this study was to assess the predictability of life-threatening brain injury requiring immediate neurosurgical intervention (LT-BI) among trauma patients with Cushing's sign in the prehospital setting.

METHODS: This was a retrospective study using data from the Japan Trauma Data Bank from the period of 2010 to 2014. Patients 16 years old or older with blunt mechanisms of injury who were transported directly from the scene and Glasgow Coma Scale for eye opening of one in the prehospital setting were included. LT-BI was defined as patients requiring burr hole evacuation or craniotomy within 24 h of hospital arrival and patients who were non-survivors due to isolated severe

TBI. Prehospital systolic blood pressure (pSBP) and heart rate (pHR) were assessed using area under the receiver operating characteristic curve (AUROC) and multiple logistic regression analysis to predict LT-BI.

RESULTS: Of 6332 eligible patients, 1859 (29%) exhibited LT-BI. AUROC of LT-BI using pSBP and pHR was 0.666 (95% confidence interval (CI); 0.652-0.681, $P < 0.001$), and 0.578 (95% CI; 0.563-0.594, $P < 0.001$), respectively. AUROC of pSBP was the highest among the $60 \leq pHR \leq 99$ subgroup, of which AUROC was 0.680 (95% CI; 0.662-0.699, $P < 0.001$). Multiple logistic regression analysis showed that the higher the pSBP and the lower the pHR, the more likely that the patients had LT-BI. In a group with $pSBP \geq 180$ mmHg and $pHR \leq 59$ beats/min, the odds ratio and 95% CI of LT-BI after adjusting for age, sex, and severity of injuries to other body regions was 4.77 (2.85-7.97), $P < 0.001$ was compared with the reference group, which was defined as patients with normal vital signs.

DISCUSSION: Our study has found that the combination of hypertension and bradycardia, which are the components of Cushing's sign without eye opening in the prehospital setting was a weak but a significant predictor of LT-BI, or death due to possible isolated severe TBI.

CONCLUSIONS: Prehospital Cushing's sign with disturbed level of consciousness in trauma patients was a weak but significant predictor of the need for immediate neurosurgical intervention.

J Trauma Acute Care Surg. 2019 Mar 15;Epub ahead of print

4-Factor Prothrombin Complex Concentrate is associated with Improved Survival in Trauma Related Hemorrhage: A Nationwide Propensity Matched Analysis.

Zeeshan M, Hamidi M, Feinstein A, Gries L, Jehan F, Sakran J, Northcutt A, O'Keeffe T, Kulvatunyou N, Joseph B

INTRODUCTION: Post-traumatic hemorrhage is the most common preventable cause of death in trauma. Numerous small single-center studies have shown the superiority of 4-factor prothrombin complex concentrate (4-PCC) along with fresh frozen plasma (FFP) over FFP-alone in resuscitation of trauma patients. The aim of our study was to evaluate outcomes of severely injured trauma patients who received 4-PCC+FFP compared to FPP-alone.

METHODS: 2-year (2015-2016) analysis of the American College of Surgeons-Trauma Quality Improvement Program database. All adult (age≥18years) trauma patients who received 4-PCC+FFP or FFP-alone were included. We excluded patients who were on preinjury anticoagulants. Patients were stratified into two groups: 4-PCC+FFP vs. FFP-alone and were matched in a 1:1 ratio using propensity-score-matching for demographics, vitals, injury parameters, comorbidities and level of trauma centers. Outcome measures were packed red blood cells (pRBC), plasma & platelets transfused, complications, and mortality.

RESULTS: A total of 468 patients (4-PCC+FFP: 234, FFP-alone: 234) were matched. Mean age was 50±21years; 70% were males, median injury severity score was 27[20-36], and 86% had blunt injuries. 4-PCC+FFP was associated with a decreased requirement for pRBC (6 units vs. 10 units; p=0.02) and FFP (3 units vs. 6 units; p=0.01) transfusion compared to FFP-alone. Patients who received 4-PCC+FFP had a lower mortality (17.5% vs 27.7%, p=0.01) and lower rates of acute respiratory distress syndrome (1.3% vs 4.7%, p=0.04) & acute kidney injury (2.1% vs 7.3%, p=0.01). There was no difference in the rates of deep venous thrombosis (p=0.11) & pulmonary embolism (p=0.33), adverse discharge disposition (p=0.21) and platelets transfusion (p=0.72) between the two groups.

CONCLUSIONS: Our study demonstrates that the use of 4-factor PCC as an adjunct to FFP is associated with improved survival and reduction in transfusion requirements compared to FFP alone in resuscitation of severely injured trauma patients. Further studies are required to evaluate the role of addition of PCC to the massive transfusion protocol.

LEVEL OF EVIDENCE: Level III, Therapeutic studies.

World Neurosurg. 2019 Feb;122:e1312-e1320

The Relationship Between Colloid Transfusion During Surgical Decompression Hemicraniectomy Period and Postoperative Pneumonia or Long-Term Outcome After Space-Occupying Cerebral Infarction: A Retrospective Study.

Zhang L, Li R, Zhao X, Wang M, Fu Y

BACKGROUND: Colloid transfusion during surgical decompressive hemicraniectomy (DHC) to treat space-occupying cerebral infarction induced by middle cerebral artery (MCA) is controversial. A multicenter retrospective study was conducted to determine whether an increased colloid transfusion during surgery is associated with a lower incidence of postoperative pneumonia and better long-term outcomes after space-occupying cerebral infarction.

METHODS: Data from surgical DHC within 48 hours to treat space-occupying cerebral infarction that took place between November 30, 2013, and March 30, 2016, were collected in a multicenter chart. Univariate analysis, Spearman correlation, $\chi 2$ test, and bivariate and multivariate logistic regression were performed to account for the associations between colloid transfusion and postoperative pneumonia or long-term outcomes (indicated by modified Rankin Scale [mRS] scores).

RESULTS: Univariate analysis showed that surgical duration and mRS were significantly different between the subjects older and younger than 60 years who underwent surgical DHC ($P < 0.05$). In the entire population studied, increased National Institutes of Health Stroke Scale was associated with a greater incidence of postoperative pneumonia (odds ratio [OR] 1.255, $P = 0.003$) and increased mRS (OR 1.229, $P = 0.014$). In the population older than 60 years, it was revealed that increased colloid transfusion was associated with a lower incidence of postoperative pneumonia (OR 0.761, $P = 0.030$) or better outcomes, as indicated with lower mRS (OR 0.837, $P = 0.045$).

CONCLUSIONS: Our retrospective study demonstrated that there is a robust association between increased perioperative colloid transfusion and lower incidence of postoperative pneumonia and better outcomes among the patients older than 60 years after space-occupying cerebral infarction.

J Trauma Acute Care Surg. 2019 Apr 25;Epub ahead of print

Shock Index and Pulse Pressure as Triggers for Massive Transfusion.

Zhu C, Cobb D, Jonas R, Pokorny D, Rani M, Cotner-Pouncy T, Oliver J, Cap A, Cestero R, Nicholson S, Eastridge B, Jenkins D

BACKGROUND: Hemorrhage is the most common cause of preventable death in trauma patients. These mortalities might be prevented with prehospital transfusion. We sought to characterize injured patients requiring massive transfusion to determine the potential impact of a prehospital whole blood transfusion program.The primary goal of this analysis was to determine a method to identify patients at risk for massive transfusion in the prehospital environment. Many of the existing predictive models require laboratory values and/or sonographic evaluation of the patient after arrival at the hospital. Development of an algorithm to predict massive transfusion protocol (MTP) activation could lead to an easy-to-use tool for prehospital personnel to determine when a patient needs blood transfusion.

METHODS: Using our Level I trauma center's registry, we retrospectively identified all adult trauma patients from January 2015 to August 2017 requiring activation of the massive transfusion protocol (MTP). Patients who were <18 years old, >89 years old, prisoners, pregnant women, and/or with non-traumatic hemorrhage were excluded from the study. We retrospectively collected data including: demographics, blood utilization, variable outcome data (survival, length of stay, ICU days, ventilator days), prehospital vital signs, prehospital transport times, and injury severity scores. The independent samples t-test and chi square test was used to compare the group that died to the group that survived. P values less than 0.05 were considered significant. Based upon age and mechanism of injury, relative risk of death was calculated. Graphs were generated using Microsoft Excel software to plot patient variables.

RESULTS: Our study population of 102 MTP patients had an average age of 42 years, average injury severity score (ISS) of 29, consisted of 80% males (82/102), and was 66% blunt trauma (67/102). The all-cause mortality was 67% (68/102). The positive predictive value of death for patients with pulse pressure (PP)<45 and shock index (SI)>1 was 0.78 for all patients, but was 0.79 and 0.92 for blunt injury and elderly patients, respectively.

CONCLUSIONS: Our data demonstrate a high mortality rate in trauma patients who require MTP despite short transport times, indicating the need for early intervention in the prehospitalss environment. Given our understanding that the most severely injured patients in hemorrhagic shock require blood resuscitation, this study demonstrates that this subset of trauma patients requiring massive transfusion can be identified in the prehospital setting. We recommend using EMS pulse pressure in combination with shock index to serve as a trigger for initiation of prehospital whole blood transfusion.

LEVELS OF EVIDENCE AND STUDY TYPE: Therapeutic/Care Management, Level V.

Mil Med. 2019 Mar 1;184(Suppl 1):542-544

Prehospital Use of Ketamine: Effectiveness in Critically Ill and Injured Patients.

Zietlow J, Berns K, Jenkins D, Zietlow S

BACKGROUND: The military use of ketamine is well established. The benefits of prehospital civilian use have not been extensively reported.

METHODS: A retrospective review was performed of patients with prehospital ketamine use in Mayo One's air and critical care ground transport.

RESULTS: The medical records were reviewed from 2014 to 2016 to assess the efficacy of Ketamine. During this time frame, 158 (167 instances) patients were treated with ketamine for analgesia (38%), sedation (44%), or procedural (18%) use. The patient population had a mean age of 49 (range: 1-100), with 105 (67%) male patients. Indications included trauma (69%), which was further broken down into blunt (57%), penetrating (4%), and miscellaneous (8%), and medical illness (31%). The mean ketamine dose was 52.6 mg (range: 5-200 mg) via intravenous route. Ketamine was utilized in 61% of patients after other medications were ineffective. Overall success rate was 98%. Mean pain scale before and after ketamine use was 9/10 and 3/10, respectively. Ketamine use increased yearly from 21 (13%) in 2014, 56 (36%) in 2015, and 81 (51%) in 2016.

CONCLUSION: Prehospital ketamine use is effective alone or in conjunction with other medications for analgesia, sedation, and procedural use in trauma and critically ill patients with minimal hemodynamic and respiratory consequences.

Injury. 2019 Apr;50(4):864-868

Practice makes perfect: The impact of Stop the Bleed training on hemorrhage control knowledge, wound packing, and tourniquet application in the workplace.

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INTRODUCTION: The national Stop the Bleed (STB) campaign was implemented in 2015 to provide hemorrhage control education to non-medical providers to reduce the number of deaths due to uncontrolled hemorrhage. Hands on training limits the availability of this program, and its importance is not known amongst lay providers. This study aimed to evaluate the efficacy of STB training for laypersons on knowledge and skill-based abilities in the workplace setting. We hypothesized such hands on and in-person training would improve performance.

METHODS: Non-medical potential first responders (PFR; N = 298) participated in STB training comprised of a lecture and hands-on component. PFRs completed a bleeding control knowledge-based pre-and post-assessment. Following the lecture, participants were divided into experimental and control groups during which hands-on practice was manipulated to determine the impact of guided practice on wound packing and tourniquet application. Wound packing and tourniquet application assessments were performed and scores compared between the experimental and control groups.

RESULTS: PFRs scored higher on the bleeding control bleeding control knowledge-based post-test (M = 4.63, SD = 1.32) than on the pre-test (M = 3.21, SD = 1.14). Employees in the experimental group (M = 2.93, SD = .26) also scored significantly higher than the control group (M = 1.97, SD = .77) that attempted wound packing without any hands-on training. PFRs in the experimental group scored significantly higher (M = 7.41, SD = .91) than PFRs in the control group (M = 5.99, SD = 1.81) for tourniquet application.

CONCLUSION: Knowledge related to hemorrhage control increased following the STB course. Participants who engaged in hands-on practice for tourniquet and wound packing were more proficient than those who only saw the lecture. We confirm that in person, hands on training is key to the success of lay STB training.