Tactical Combat Casualty Care

Journal Article Abstracts

Committee on Tactical Combat Casualty Care
August 2015

References

Aberle S, Dennis A, Landry J, Sztajnkrycer M: Hemorrhage control by law enforcement personnel: a survey of knowledge translation from the military combat experience. Mil Med 2015;180:615-620

Aguilera X, Martinez-Zapata M, Hinarejos P, et al: Topical and intravenous tranexamic acid reduce blood loss compared to routine hemostasis in total knee arthoplasty: a multicenter, randomized, controlled trial. Arch Orthop Trauma Surg 2015;Epub ahead of print

Aldington D, Jagdish S: The fentanyl 'lozenge' story: from books to battlefield. J R Army Med Corps 2014;160:102-104

Altamirano M, Kragh J, Aden J, Dubick M: Role of the windlass in improvised tourniquets use on a manikin hemorrhage model. J Spec Oper Med 2015;15:42-46

Ausset S, Glassberg E, Nadler R, et al: Tranexamic acid as part of remote damage-control resuscitation in the prehospital setting: a critical appraisal of the medical literature and available alternatives. J Trauma Acute Care Surg 2015;78:S70-S75

Bagsby D, Samujh C, Vissing J, et al: Tranexamic acid decreases incidence of blood transfusion in simultaneous bilateral total knee arthroplasty. J Arthroplasty 2015;Epub ahead of print

Beckett A, Callum J, da Luz L, et al: Fresh whole blood transfusion capability for special operations forces. Can J Surg 2015;58:S153-S156

Bridges E, McNeill M: Trauma resuscitation and monitoring: military lessons learned. Crit Care Nurs Clin North Am 2015;27:199-211

Brinck T, Handolin L, Lefering R: The effect of evolving fluid resuscitation on the outcome of severely injured patients: an 8-year experience at a tertiary trauma center. Scand J Surg 2015;Epub ahead of print

Brown JB, Sperry JL, Fombona A, et al: Pre-trauma center red blood cell transfusion is associated with improved early outcomes in air medical trauma patients. J Am Coll Surg 2015 May;220:797-808

Butler F, Smith D, Carmona R: Implementing and preserving the advances in combat casualty care from Iraq and Afghanistan throughout the US military. J Trauma Acute Care Surg 2015;79:321-326

Butler FK: Military history of increasing survival: The U.S. military experience with tourniquets and hemostatic dressings in the Afghanistan and Iraq conflicts. Sept 2015 ACS Bulletin;60-64

Camazine M, Hemmila M, Leonard J, et al: Massive transfusion policies at trauma centers participating in the American College of Surgeons trauma quality improvements program. J Trauma Acute Care Surg 2015;78:S48-S53

Cap A, Pidcoke H, DePasquale M, et al: Blood far forward: time to get moving! J Trauma Acute Care Surg 2015;78:S2-S6

Chaudery M, Clark J, Wilson M, et al: Traumatic intra-abdominal hemorrhage control: has current technology tipped the balance toward a role for prehospital intervention? J Trauma Acute Care Surg 2015 Jan;78:153-163

Chen J, Nadler R, Schwartz D, et al: Needle thoracostomy for tension pneumothorax: the Israeli Defense Forces experience. Can J Surg 2015;58:S118-S124

Cone C, Horowitz B: Convulsions associated with moxifloxacin. Am J Health Syst Pharm 2015;72:910-912

Da Luz T, Nascimento B, Tien H: Current use of live tissue training in trauma: a descriptive systematic review. Can J Surg 2015;58:S125-S134

DeClerck M, Lipman G, Grahn D, et al: A chemical heat pack-based method for consistent heating of intravenous fluids. Wilderness Environ Med 2015;epub ahead of print

Delano M, Rizoli S, Rhind S, et al: Prehospital resuscitation of traumatic hemorrhagic shock with hypertonic solutions worsens hypocoagulation and hyperfibrinolysis. Shock 2015 Jul;44:25-31

Dowling M, MacIntire I, White J, et al: Sprayable foams based on an amphiphilic biopolymer for control hemorrhage without compression. ACS Biomater 2015;1:440-447

Drew J, Chou V, Miller C, et al: Clearing the cervical spine in a war zone: what other injuries matter? Mil Med 2015;180:792-797

Eastin T, Liggin R, Wilbur L: Does a restricted fluid resuscitation strategy decrease mortality in trauma patients? Ann Emerg Med 2015;66:49-50

Ellerton J, Greene M, Paal P: The use of analgesia in mountain rescue casualties with moderate or severe pain. Emerg Med J 2013;30:501-505

Fang R, Markandaya M, DuBose JJ, Cancio LC, Shackelford S, Blackbourne LH: Early in-theater management of combat-related traumatic brain injury: A prospective, observational study to identify opportunities for performance improvement. J Trauma Acute Care Surg; 2015;00

Feix J, Perry C, Gan T, et al: Intra-operative hydroxyethyl starch is not associated with post-craniotomy hemorrhage. Springerplus 2015;4:350

Fisher A, Miles E, Cap A, et al: Tactical damage control resuscitation. Mil Med 2015;180:869-875

Goolsby C, Branting A, Chen E, et al: Just-in-Time to Save Lives: A Pilot Study of Layperson Tourniquet Application. Acad Emerg Med. 2015:Epub ahead of print

Haase N, Perner A: Colloid solutions in the perioperative setting. BMJ 2015;doi;10.1136

Haider A, Piper L, Zogg C, et al: Military-to-civilian translation of battlefield innovations in operative trauma care. Surgery 2015;Epub ahead of print

Heier H, Badloe J, Bohonek M, et al: Use of tranexamic acid in bleeding combat casualties. Mil Med 2015;180:844-846

Heightman AJ: Use of individual first aid kits (IFAKs) credited with saving lives in LA. Journal of Emergency Medical Services News. 26 July 2015

Holcomb JB, Butler FK, Rhee P: Hemorrhage control devices: Tourniquets and hemostatic dressings. Sept 2015 ACS Bulletin Supplement: 66-70

Huff R: ACEP Policies Lead to Evidence-Based Medicine. JEMS 2015

Inaba K, Siboni S, Resnick S, et al: Tourniquet use for civilian extremity trauma. J Trauma Acute Care Surg 2015;79:232-237

Jacobs L: Hartford Consensus III: Implementation of bleeding control. BACS 2015;100:20-26

Jandhyala R, Fullarton J, Bennett M: Efficacy of rapid-onset oral fentanyl formulations vs. oral morphine for cancer-related breakthrough pain: a meta-analysis of comparative trials. J Pain Symptom Manage 2015;Epub ahead of print

Kozek-Langenecker S: Fluids and coagulations. Curr Opin Crit Care 2015;21:285-291

Kragh J, Aden J, Steinbaugh J, et al: Gauze vs XStat in wound packing for hemorrhage control. Am J Emerg Med. 2015 Jul;33:974-976

Kragh JF, Geracci JJ, Parsons DL, et al: Junctional Tourniquet Training Experience. J Spec Op Med 2015;

Lee P, Lee C, Rattner P, et al: Intraosseous versus central venous catheter utilization and performance during inpatient medical emergencies. Crit Care Med 2015;43:1233-1238

Lewis P, Wright C: Saving the critically injured trauma patient: a retrospective analysis of 1000 uses of intraosseous access. Emerg Med J. 2015 Jun;32:463-7

Litwack K: Pain management in military trauma. Crit Care Nurs Clin North Am 2015;27:235-246

Liu J, Khitrov M, Gates J, et: Automated analysis of vital signs to identify patients with substantial bleeding before hospital arrival: a feasibility study. Shock. 2015 May;43:429-436

Mattox K: The ebb and flow of fluid (as in resuscitation). Eur J Trauma Emerg Surg 2015;41:119-127

Meizoso J, Valle E, Allen C, et al: Decreased mortality after prehospital interventions in severely injured trauma patients. J Trauma Acute Care Surg 2015;79:227-231

Mesar T, Martin D, Lawless R, et al: Human dose confirmation for self-expanding intra-abdominal foam: a translation, adaptive, multicenter trial in recently deceased human subjects. J Trauma Acute Care Surg 2015;709:39-47

Mulvaney S, Lynch J, Kotwal R: Clinical Guidelines for Stellate Ganglion Block to Treat Anxiety Associated With Posttraumatic Stress Disorder. J Spec Oper Med. 2015;15:79-85.

Nadler R, Gendler S, Benov A, et al: Intravenous access in the prehospital settings: what can be learned from point-of-injury experience. J Trauma Acute Care Surg 2015;79:221-226

Newgard C, Meier E, Bulger E, et al: Revisiting the “Golden Hour”: an evaluation of out-of-hospital time in shock and traumatic brain injury. Ann Emerg Med 2015;66:30-41

Ohchi F, Komasawa N, Imagawa K, et al: Evaluation of the efficacy of six supraglottic devices for airway management in devices airway management in dark conditions: a crossover randomized simulation trial. J Anesth 2015; Epub ahead of print

Onifer D, Butler F, Gross K, et al: Replacement of promethazine with ondansetron for treatment of opioid and trauma-related nausea and vomiting in Tactical Combat Casualty Care. J Spec Oper Med 2015;15:17-24

Pearse B, Smith I, Faulke D, et al: Protocol guided bleeding management improves cardiac surgery patient outcomes. Vox Sang 2015; Epub ahead of print

Penn-Barwell J, Brown K, Fries C: High velocity gunshot injuries to the extremities: management on and off the battlefield. Curr Rev Musculoskelet Med 2015; Epub ahead of print

Prottengeier J, Albermann M, Heinrich S, et al: The prehospital intravenous access assessment: a prospective study on intravenous access failure and access delay in prehospital emergency medicine. Eur J Emerg Med 2015;Epub ahead of print

Raksakietisak M, Sathitkarnmanee B, Srisaen P, et al: Two dose of tranexamic acid reduce blood transfusion in complex spine surgery: a prospective randomized study. Spine 2015; Epub ahead of print

Roberts I: Tranexamic acid in trauma: how should we use it? J Thromb Haemost 2015;13:S195-S199

Sauer S, Robinson J, Smith M, et al: Saving Lives on the Battlefield (Part II) - One Year Later: A US Central Command and Joint Trauma System Review of Prehospital Trauma Care in Combined Joint Operations Area - Afghanistan (CJOA-A): Final Report, 30 May 2014. J Spec Oper Med 2015 Summer;15:25-41.

Savage L, Tenn C, Vartanian O, et al: A comparison of live tissue training and high-fidelity patient simulator: a pilot study in battlefield trauma training. J Trauma Acute Care Surg 2015;Epub ahead of print

Schroll R, Smith A, McSwain N, et al: A multi-institutional analysis of prehospital tourniquet use. J Trauma Acute Care Surg 2015;79:10-14

Schwab C: Winds of war: enhancing civilian and military partnerships to assure readiness: white paper. J Am Coll Surg 2015;221:235-254

Schwartz D, Weisner Z, Badar J: Immediate lower extremity tourniquet application to delay onset of reperfusion injury after prolonged crush injury. Prehosp Emerg Care 2015;Epub ahead of print

Seaman M, Haut E, Van Arendonk K, et al: An evidence-based approached to patient selection for emergency department thoracotomy: a practice management guideline for the Eastern Association for the Surgery of Trauma. J Trauma Acute Care Surg. 2015 Jul;79(1):159-73

Spinella P, Frazier E, Pidcoke H, et al: All plasma products are not created equal: characterizing differences between plasma products. J Trauma Acute Care Surg 2015;78:S18-S25

St John A, Wang E, et al: Effects of rapid wound sealing of survival and blood loss in a swine model of lethal junctional arterial hemorrhage. J Trauma Acute Care Surg.2015;79:256-262

Strandenes G, Austlid I, Apelseth T, et al: Coagulation function of stored whole blood is preserved for 14 days in austere conditions: a ROTEM feasibility study during a Norwegian antipiracy mission and comparison to equal ratio reconstituted blood. J Trauma Acute Care Surg 2015;78:S31-S38

Stubbs J, Zielinski M. Berns K, et al: How we provide thawed plasma for trauma patients. Transfusion 2015;Epub ahead of print

Sunde G, Vikenes B, Strandenes G, et al: Freeze dried plasma and fresh red blood cells for civilian prehospital hemorrhagic shock resuscitation. J Trauma Acute Care Surg 2015;78:S26-S30

Taddeo J, Devine M, McAlister V: Cervical spine injury in dismounted improvised explosive device trauma. Can J Surg 2015;58:S104-S107

Vlasov A, Ryan D, Ludlow S, et al: Causes of combat ocular trauma-related blindness from Operation Iraqi Freedom and Enduring Freedom. J Trauma Acute Care Surg 2015;Epub ahead of print

Vokoun E: Rationale for use of intravenous acetaminophen in Special Operations medicine. J Spec Oper Med 2015;15:71-73

Wang C, Sun Z, Liu J, et al: Safety and efficacy of intra-articular tranexamic acid injection without drainage on blood loss in total knee arthroplasty: a randomized clinical trial. Int J Surg 2015;20:1-7

Weiskopf R, Michael J: Update of use of hydroxyethyl starches in surgery and trauma. J Trauma Acute Care Surg 2015;78:S54-S59

Wingerter S, Keith A, Schoenecker, et al: Does tranexamic acid reduce blood loss and transfusion requirements associated with periacetabular osteotomy? Clin Orthop Relat Res 2015;Epub ahead of print

Yanartas M, Baysal A, Aydin C, et al: The effects of tranexamic acid and 6% hydroexyethyl starch (HES) solution (130/0.4) on postoperative bleeding in coronary artery bypass graft (CABG) surgery. Int J Clin Exp Med 2015;8:5959-5971

Yue C, Pei F, Yang P, et al: Effect of topical tranexamic acid in reducing bleeding and transfusions in TKA. Orthopedics 2015;38:315-324

Zaidi R, Ahmed A: Comparison of ketorolac and low-dose ketamine in preventing tourniquet-induced increase in arterial pressure. Indian J Anaesth 2015;59:428-432

Zietlow J, Zietlow S, Morris D, et al: Prehospital use of hemostatic bandages and tourniquets: translation from military experience to implementation in civilian trauma center. J Spec Oper Med 2015;15:48-53

Abstracts

Mil Med. 2015 Jun;180(6):615-20. doi: 10.7205/MILMED-D-14-00470.

Hemorrhage control by law enforcement personnel: a survey of knowledge translation from the military combat experience.

Aberle SJ, Dennis AJ, Landry JM, Sztajnkrycer MD

BACKGROUND: Military data demonstrate that exsanguinating hemorrhage is the leading cause of potentially preventable combat death. The purpose of this study was to evaluate attitudes and approaches of civilian law enforcement personnel in the management of acute hemorrhagic trauma.

METHODS: Anonymous survey administered via an online distribution mechanism.

RESULTS: 1,317 U.S. law enforcement personnel began the survey. 370 respondents (30.4%) reported their agencies issued tourniquets, whereas 48.8% indicated their agencies had provided specific training in tourniquet application. Pressure dressings were provided to 43.6% of respondents while hemostatic agents were available to 29.8%. Tourniquets were considered the intervention most likely to save a life, but were also deemed most likely to possibly cause harm or injury if used inappropriately. 43 respondents (0.036%) stated they were aware of circumstances within the past year in which an officer in their agency sustained injuries where a tourniquet could have been used, but was not.

CONCLUSIONS: Hemorrhage control supplies are being issued to less than half of the responding officers. When used, these interventions were generally thought to be effective. Further study is needed to delineate specific medical interventions, and therefore training and equipment, needed by law enforcement personnel.

Arch Orthop Trauma Surg. 2015 Jul;135(7):1017-25. doi: 10.1007/s00402-015-2232-8. Epub 2015 May 7.

Topical and intravenous tranexamic acid reduce blood loss compared to routine hemostasis in total knee arthroplasty: a multicenter, randomized, controlled trial.

Aguilera X, Martínez-Zapata MJ, Hinarejos P, Jordán M, Leal J, González JC, Monllau JC, Celaya F, Rodríguez-Arias A, Fernández JA, Pelfort X, Puig-Verdie LI.

INTRODUCTION: Tranexamic acid (TXA) is becoming widely used in orthopedic surgery to reduce blood loss and transfusion requirements, but consensus is lacking regarding the optimal route and dose of administration. The aim of this study was to compare the efficacy and safety of topical and intravenous routes of TXA with routine hemostasis in patients undergoing primary total knee arthroplasty (TKA).

MATERIALS AND METHODS: We performed a randomized, multicenter, parallel, open-label clinical trial in adult patients undergoing primary TKA. Patients were divided into three groups of 50 patients each: Group 1 received 1 g topical TXA, Group 2 received 2 g intravenous TXA, and Group 3 (control group) had routine hemostasis. The primary outcome was total blood loss. Secondary outcomes were hidden blood loss, blood collected in drains, transfusion rate, number of blood units transfused, adverse events, and mortality.

RESULTS: One hundred and fifty patients were included. Total blood loss was 1021.57 (481.09) mL in Group 1, 817.54 (324.82) mL in Group 2 and 1415.72 (595.11) mL in Group 3 (control group). Differences in total blood loss between the TXA groups and the control group were clinically and statistically significant ($p < 0.001$). In an exploratory analysis differences between the two TXA groups were not statistically significant ($p = 0.073$) Seventeen patients were transfused. Transfusion requirements were significantly higher in Group 3 ($p = 0.005$). No significant differences were found between groups regarding adverse events.

CONCLUSION: We found that 1 g of topical TXA and 2 g of intravenous TXA were both safe strategies and more effective than routine hemostasis to reduce blood loss and transfusion requirements after primary TKA.

LEVEL OF EVIDENCE: I.

J R Army Med Corps. 2014 Jun;160(2):102-4. doi: 10.1136/jramc-2013-000227. Epub 2014 Jan 10.

The fentanyl 'lozenge' story: from books to battlefield.

Aldington D, Jagdish S

ABSTRACT: This article outlines the process that led to the introduction of the fentanyl lozenge for acute pain management. It starts with the historical context before discussing the recognition of an ongoing problem and then identifies the options that were considered. There follows a description of the pharmacology of fentanyl before describing the trial of concept that was conducted. This leads into an outline of the meetings and committees that had to be engaged with before the final acceptance and subsequent ushering in. The final section describes an option that was unsuccessful.

J Spec Oper Med. 2015 Summer;15(2):42-6.

Role of the Windlass in Improvised Tourniquet Use on a Manikin Hemorrhage Model.

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

BACKGROUND: In emergencies when commercially designed tourniquets are unavailable, hemorrhage may need to be controlled with improvised tourniquets. In the aftermath of the Boston Marathon bombing, no improvised strap-and-windlass tourniquets were used to treat casualties; tourniquets without windlasses were used. The purpose of the present study is to determine the effectiveness of improvised tourniquets with and without a windlass to better understand the role of the windlass in tightening the tourniquet strap.

METHODS: An experiment was designed to test the effectiveness of improvisedstrap-and-windlass tourniquets fashioned out of a tee shirt on a manikin thigh. Two users conducted 40 tests each with and without the use of a windlass.

RESULTS: Without a windlass, improvised tourniquets failed to stop bleeding in 99% of tests (79 of 80 tests). With a windlass, improvised tourniquets failed to stop bleeding in 32% of tests ($p < .0001$). In tests with no windlass, attempts to stop the pulse completely failed (100%, 80 of 80 tests). With a windlass, however, attempts to stop the pulse failed 31% of the time (25 of 80 tests); the difference in proportions was significant ($p < .0001$).

CONCLUSIONS: Improvised strap-and-windlass tourniquets were more effective than those with no windlass, as a windlass allowed the user to gain mechanical advantage. However, improvised strap-and-windlass tourniquets failed to control hemorrhage in 32% of tests.

J Trauma Acute Care Surg. 2015 Jun;78(6 Suppl 1):S70-5. doi: 0.1097/TA.0000000000000640.

Tranexamic acid as part of remote damage-control resuscitation in the prehospital setting: A critical appraisal of the medical literature and available alternatives.

Ausset S(1), Glassberg E, Nadler R, Sunde G, Cap AP, Hoffmann C, Plang S, Sailliol A.

BACKGROUND: Hemorrhage remains the leading cause of preventable trauma-associated mortality. Interventions that improve prehospital hemorrhage control and resuscitation are needed. Tranexamic acid (TXA) has recently been shown to reduce mortality in trauma patients when administered upon hospital admission, and available data suggest that early dosing confers maximum benefit. Data regarding TXA implementation in prehospital trauma care and analyses of alternatives are lacking. This review examines the available evidence that would inform selection of hemostatic interventions to improve outcomes in prehospital trauma management as part of a broader strategy of "remote damage-control resuscitation" (RDCR).

METHODS: The medical literature available concerning both the safety and the efficacy of TXA and other hemostatic agents was reviewed.

RESULTS: TXA use in surgery was studied in 129 randomized controlled trials, and a meta-analysis was identified. More than 800,000 patients were followed up in large cohort study. In trauma, a large randomized controlled trial, the CRASH-2 study, recruited more than 20,000 patients, and two cohort studies studied more than 1,000 war casualties. In the prehospital setting, the US, French, British, and Israeli militaries as well as the British, Norwegian, and Israeli civilian ambulance services have implemented TXA use as part of RDCR policies.

CONCLUSION: Available data support the efficacy and the safety of TXA. High-level evidence supports its use in trauma and strongly suggests that its implementation in the prehospital setting offers a survival advantage to many patients, particularly when evacuation to surgical care may be delayed. TXA plays a central role in the development of RDCR strategies.

J Arthroplasty. 2015 Jun 22. pii: S0883-5403(15)00552-5. doi:10.1016/j.arth.2015.06.040. [Epub ahead of print]

Tranexamic Acid Decreases Incidence of Blood Transfusion in Simultaneous Bilateral Total Knee Arthroplasty.

Bagsby DT, Samujh CA, Vissing JL, Empson JA, Pomeroy DL, Malkani AL

ABSTRACT: Blood management for simultaneous bilateral total knee arthroplasty (TKA) patients is more challenging than in unilateral arthroplasty. We examined if administration of tranexamic acid (TXA) to patients undergoing simultaneous bilateral TKA would reduce blood loss and decrease allogeneic blood transfusion requirements. A retrospective review of 103 patients, 57 in the control and 46 in the TXA group, was performed. There was higher postoperative day 1 hemoglobin in patients receiving TXA (2.95 ± 1.33 versus 4.33 ±1 .19, P<0.0001). There was also a decrease in the transfusion incidence with administration of TXA (17.4% versus 57.9%, P<0.0001). In conclusion, we have shown that TXA is an effective tool in reducing the transfusion rates by almost 70% in simultaneous bilateral total knee arthroplasty.

Can J Surg. 2015 Jun;58(3 Suppl 3):S153-6.

Fresh whole blood transfusion capability for Special Operations Forces.

Beckett A, Callum J, da Luz LT, Schmid J, Funk C, Glassberg E, Tien H

SUMMARY: Fresh whole blood (FWB) transfusion is an option for providing volume and oxygen carrying capacity to bleeding Special Operations soldiers who are injured in an austere environment and who are far from a regular blood bank. Retrospective data from recent conflicts in Iraq and Afghanistan show an association between the use of FWB and survival. We reviewed the literature to document the issues surrounding FWB transfusion to Special Operations soldiers in the austere environment and surveyed the literature regarding best practice guidelines for and patient outcomes after FWB transfusions. Most literature regarding FWB transfusion is retrospective or historical. There is limited prospective evidence currently to change transfusion practice in tertiary care facilities, but FWB remains an option in the austere setting.

Crit Care Nurs Clin North Am. 2015 Jun;27(2):199-211. doi: 10.1016/j.cnc.2015.02.003. Epub 2015 Mar 20.

Trauma resuscitation and monitoring: military lessons learned.

Bridges EJ, McNeill MM

SUMMARY: Over the past 13 years, the military health care system has made improvements that are associated with an unprecedented survival rate for severely injured casualties. Monitoring for indications of deterioration as the critically injured patient moves across the continuum of care is difficult, given the limitations of routinely used vital signs. Research by both military and civilian researchers is revolutionizing monitoring, with an increased focus on noninvasive, continuous, dynamic measurements to provide earlier, more sensitive indications of the patient's perfusion status.

Scand J Surg. 2015 May 19. pii: 1457496915586650. [Epub ahead of print]

The Effect of Evolving Fluid Resuscitation on the Outcome of Severely Injured Patients: an 8-year Experience at a Tertiary Trauma Center.

Brinck T, Handolin L, Lefering R

BACKGROUND AND AIMS: Fluid resuscitation of severely injured patients has shifted over the last decade toward less crystalloids and more blood products. Helsinki University trauma center implemented the massive transfusion protocol in the end of 2009. The aim of the study was to review the changes in fluid resuscitation and its influence on outcome of severely injured patients with hemodynamic compromise treated at the single tertiary trauma center.

MATERIAL AND METHODS: Data on severely injured patients (New Injury Severity Score > 15) from Helsinki University Hospital trauma center's trauma registry was reviewed over 2006-2013. The isolated head-injury patients, patients without hemodynamic compromise on admission (systolic blood pressure > 90 or base excess > -5.0), and those transferred in from another hospital were excluded. The primary outcome measure was 30-day in-hospital mortality. The study period was divided into three phases: 2006-2008 (pre-protocol, 146 patients), 2009-2010 (the implementation of massive transfusion protocol, 85 patients), and 2011-2013 (post massive transfusion protocol, 121 patients). Expected mortality was calculated using the Revised Injury Severity Classification score II. The Standardized Mortality Ratio, as well as the amounts of crystalloids, colloids, and blood products (red blood cells, fresh frozen plasma, platelets) administered prehospital and in the emergency room were compared.

RESULTS: Of the 354 patients that were included, Standardized Mortality Ratio values decreased (indicating better survival) during the study period from 0.97 (pre-protocol), 0.87 (the implementation of massive transfusion protocol), to 0.79 (post massive transfusion protocol). The amount of crystalloids used in the emergency room decreased from 3870 mL (pre-protocol), 2390 mL (the implementation of massive transfusion protocol), to 2340 mL (post massive transfusion protocol). In these patients, the blood products' (red blood cells, fresh frozen plasma, and platelets together) relation to crystalloids increased from 0.36, 0.70, to 0.74, respectively, in three phases.

CONCLUSION: During the study period, no other major changes in the protocols on treatment of severely injured patients were implemented. The overall awareness of damage control fluid resuscitation and introduction of massive transfusion protocol in a trauma center has a significant positive effect on the outcome of severely injured patients.

J Am Coll Surg. 2015 May;220(5):797-808. doi: 10.1016/j.jamcollsurg.2015.01.006. Epub 2015 Jan 24.

Pre-trauma center red blood cell transfusion is associated with improved early outcomes in air medical trauma patients.

Brown JB, Sperry JL, Fombona A, Billiar TR, Peitzman AB, Guyette FX

BACKGROUND: Hemorrhage is the leading cause of survivable death in trauma and resuscitation strategies including early RBC transfusion have reduced this. Pre-trauma center (PTC) RBC transfusion is growing and preliminary evidence suggests improved outcomes. The study objective was to evaluate the association of PTC RBC transfusion with outcomes in air medical trauma patients.

STUDY DESIGN: We conducted a retrospective cohort study of trauma patients transported by helicopter to a Level I trauma center from 2007 to 2012. Patients receiving PTC RBC transfusion were matched to control patients (receiving no PTC RBC transfusion during transport) in a 1:2 ratio using a propensity score based on prehospital variables. Conditional logistic regression and mixed-effects linear regression were used to determine the association of PTC RBC transfusion with outcomes. Subgroup analysis was performed for scene transport patients.

RESULTS: Two-hundred and forty treatment patients were matched to 480 control patients receiving no PTC RBC transfusion. Pre-trauma center RBC transfusion was associated with increased odds of 24-hour survival (adjusted odds ratio [AOR] = 4.92; 95% CI, 1.51-16.04; p = 0.01), lower odds of shock (AOR = 0.28; 95% CI, 0.09-0.85; p = 0.03), and lower 24-hour RBC requirement (Coefficient -3.6 RBC units; 95% CI, -7.0 to -0.2; p = 0.04). Among matched scene patients, PTC RBC was also associated with increased odds of 24-hour survival (AOR = 6.31; 95% CI, 1.88-21.14; p < 0.01), lower odds of shock (AOR = 0.24; 95% CI, 0.07-0.80; p = 0.02), and lower 24-hour RBC requirement (Coefficient -4.5 RBC units; 95% CI, -8.3 to -0.7; p = 0.02).

CONCLUSIONS: Pre-trauma center RBC was associated with an increased probability of 24-hour survival, decreased risk of shock, and lower 24-hour RBC requirement. Pre-trauma center RBC appears beneficial in severely injured air medical trauma patients and prospective study is warranted as PTC RBC transfusion becomes more readily available.

J Trauma Acute Care Surg. 2015 Aug;79(2):321-6. doi: 10.1097/TA.0000000000000745.

Implementing and preserving the advances in combat casualty care from Iraq and Afghanistan throughout the US Military.

Butler FK, Smith DJ, Carmona RH.

ABSTRACT: Thirteen years of continuous combat operations have enabled the US Military and its coalition partners to make a number of major advances in casualty care. The coalition nations have developed a superb combat trauma system and achieve unprecedented casualty survival rates. There remains, however, a need to accelerate the translation of new battlefield trauma care information, training, and equipment to units and individuals deploying in support of combat operations. In addition, the US Military needs to ensure that these advances are sustained during peace intervals and that we continue to build upon our successes as we prepare for future conflicts. This article contains recommendations designed to accomplish those goals. For the proposed actions to benefit all branches of our armed services, the direction will need to come from the Office of the Secretary of Defense in partnership with the Joint Staff. Effective translation of military advances in prehospital trauma care may also increase survival for law enforcement officers wounded in the line of duty and for civilian victims of Active Shooter or terrorist-related mass-casualty incidents.

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Military history of increasing survival: The U.S. military experience with tourniquets and hemostatic dressings in the Afghanistan and Iraq conflicts

Butler FK

Quotes:

"Tourniquets are at least half a millennium old, and yet they were not routinely fielded and used by the U.S. military at the onset of the conflict in Afghanistan in 2001. By 2014, however, an article in the Journal of Trauma discussing tourniquets stated, "Tourniquets have been the signature success in battlefield trauma care in Afghanistan and Iraq. Based on the work of U.S. Army Colonel John Kragh and colleagues, the number of lives saved from this intervention has been estimated to be between 1,000 and 2,000." How did the U.S. military come to make this remarkable journey?"

"The resurgence of tourniquet use in the U.S. military originated with the Tactical Combat Casualty Care (TCCC) program. TCCC was the result of a military medical research effort conducted jointly by the U.S. Special Operations Command (USSOCOM) and the Uniformed Services University of the Health Sciences."

"The expanded use of tourniquets in the military did not occur as a gradual evolutionary process but rather as the result of a series of discrete events in 2004 and 2005. As awareness of the success of the TCCC Transition Initiative and the U.S. Central Command directive spread throughout the military, conventional units began to adopt TCCC, including tourniquets. In 2005 and 2006, tourniquet use expanded rapidly throughout the U.S. military. The beneficial impact of the battlefield use of commercially manufactured tourniquets was very well documented by an Army orthopaedic surgeon, Colonel John Kragh, during his time at a combat support hospital in Baghdad in 2006. By the end of 2011, Colonel Brian Eastridge's landmark study "Death on the Battlefield" found that potentially preventable deaths from extremity hemorrhage had dropped from the 7.8 percent noted in the previously mentioned Kelly study to 2.6 percent, a decrease of 67 percent."

"At this time, the U.S. military has more experience with combat tourniquets than any military force in history, and U.S. servicemen and servicewomen no longer step onto the battlefield without an individual first aid kit that contains one or more tourniquets."

"Because most combat fatalities occur in the prehospital phase of care, our nation's combat medical providers play an especially important role in ensuring the highest casualty survival rate possible. TCCC has given these individuals a vastly improved set of tools and skills to better accomplish their heroic and lifesaving deeds on the battlefield, and tourniquets and hemostatic dressings are now a permanent fixture in their aid bags."

J Trauma Acute Care Surg. 2015 Jun;78(6 Suppl 1):S48-53. doi: 10.1097/TA.0000000000000641.

Massive transfusion policies at trauma centers participating in the American College of Surgeons Trauma Quality Improvement Program.

Camazine MN, Hemmila MR, Leonard JC, Jacobs RA, Horst JA, Kozar RA, Bochicchio GV, Nathens AB, Cryer HM, Spinella PC.

BACKGROUND: Massive transfusion protocols (MTPs) have been developed to implement damage control resuscitation (DCR) principles. A survey of MTP policies from American College of Surgeons Trauma Quality Improvement Program (ACS-TQIP) participants was performed to establish which MTP activation, hemostatic resuscitation, and monitoring aspects of DCR are included in the MTP guidelines.

METHODS: On October 10, 2013, ACS-TQIP administration administered a cross-sectional electronic survey to 187 ACS-TQIP participants.

RESULTS: Seventy-one percent (132 of 187) of responses were analyzed, with 62% designated as Level I and 38% designated as Level II ACS-TQIP trauma centers. Sixty-nine percent of sites indicated that they have plasma immediately available for MTP activation. By policy, in the first group of blood products administered, 88% of sites target high (≥1:2) plasma-to-red blood cell (RBC) ratios and 10% target low ratios. Likewise, 79% of sites target high platelet-to-RBC ratios and 16% target low ratios. Eighteen percent of sites reported incorporating point-of-care thromboelastogram into MTP policies. The most common intravenous hemostatic adjunct incorporated into MTPs was tranexamic acid (49%). Thirty-four percent of sites reported that some or all of their emergency medical service agencies have the ability to administer blood products or hemostatic agents during prehospital transport. There were minimal differences in MTP policies or capabilities between Level I and II sites.

CONCLUSION: The majority of ACS-TQIP participants reported having MTPs that support the use of DCR principles including high plasma-to-RBC and platelet-to-RBC ratios. Immediate availability of plasma and product use by emergency medical services are becoming increasingly common, whereas the incorporation of point-of-care thromboelastogram into MTP policies remains low.

J Trauma Acute Care Surg. 2015 Jun;78(6 Suppl 1):S2-6. doi: 10.1097/TA.0000000000000626.

Blood far forward: Time to get moving!

Cap AP, Pidcoke HF, DePasquale M, Rappold JF, Glassberg E, Eliassen HS, Bjerkvig CK, Fosse TK, Kane S, Thompson P, Sikorski R, Miles E, Fisher A, Ward KR, Spinella PC, Strandenes G.

ABSTRACT: In planning for future contingencies, current problems often crowd out historical perspective and planners often turn to technological solutions to bridge gaps between desired outcomes and the reality of recent experience. The US Military, North Atlantic Treaty Organization, and other allies are collectively taking stock of 10-plus years of medical discovery and rediscovery of combat casualty care after the wars in Iraq and Afghanistan. There has been undeniable progress in the treatment of combat wounded during the course of the conflicts in Southwest Asia, but continued efforts are required to improve hemorrhage control and provide effective prehospital resuscitation that treats both coagulopathy and shock. This article presents an appraisal of the recent evolution in medical practice in historical context and suggests how further gains in far forward resuscitation might be achieved using existing technology and methods based on whole-blood transfusion while research on new approaches continues.

J Trauma Acute Care Surg. 2015 Jan;78(1):153-63. doi: 10.1097/TA.0000000000000472.

Traumatic intra-abdominal hemorrhage control: has current technology tipped the balance toward a role for prehospital intervention?

Chaudery M, Clark J, Wilson MH, Bew D, Yang GZ, Darzi A.

BACKGROUND: The identification and control of traumatic hemorrhage from the torso remains a major challenge and carries a significant mortality despite the reduction of transfer times. This review examines the current technologies that are available for abdominal hemorrhage control within the prehospital setting and evaluates their effectiveness.

METHODS: A systematic search of online databases was undertaken. Where appropriate, evidence was highlighted using the Oxford levels of clinical evidence. The primary outcome assessed was mortality, and secondary outcomes included blood loss and complications associated with each technique.

RESULTS: Of 89 studies, 34 met the inclusion criteria, of which 29 were preclinical in vivo trials and 5 were clinical. Techniques were subdivided into mechanical compression, endovascular control, and energy-based hemostatic devices. Gas insufflation and manual pressure techniques had no associated mortalities. There was one mortality with high intensity focused ultrasound. The intra-abdominal infiltration of foam treatment had 64% and the resuscitative endovascular balloon occlusion of the aorta had 74% mortality risk reduction. In the majority of cases, morbidity and blood loss associated with each interventional procedure were less than their respective controls.

CONCLUSION: Mortality from traumatic intra-abdominal hemorrhage could be reduced through early intervention at the scene by emerging technology. Manual pressure or the resuscitative endovascular balloon occlusion of the aorta techniques have demonstrated clinical effectiveness for the control of major vessel bleeding, although complications need to be carefully considered before advocating clinical use. At present, fast transfer to the trauma center remains paramount.

LEVEL OF EVIDENCE: Systematic review, level IV.

Can J Surg. 2015 Jun;58(3 Suppl 3):S118-24.

Needle thoracostomy for tension pneumothorax: the Israeli Defense Forces experience.

Chen J, Nadler R, Schwartz D, Tien H, Cap AP, Glassberg E

BACKGROUND: Point of injury needle thoracostomy (NT) for tension pneumothorax is potentially lifesaving. Recent data raised concerns regarding the efficacy of conventional NT devices. Owing to these considerations, the Israeli Defense Forces Medical Corps (IDF-MC) recently introduced a longer, wider, more durable catheter for the performance of rapid chest decompression. The present series represents the IDF-MC experience with chest decompression by NT.

METHODS: We reviewed the IDF trauma registry from January 1997 to October 2012 to identify all cases in which NT was attempted.

RESULTS: During the study period a total of 111 patients underwent chest decompression by NT. Most casualties (54%) were wounded as a result of gunshot wounds (GSW); motor vehicle accidents (MVAs) were the second leading cause (16%). Most (79%) NTs were performed at the point of injury, while the rest were performed during evacuation by ambulance or helicopter (13% and 4%, respectively). Decreased breath sounds on the affected side were one of the most frequent clinical indications for NT, recorded in 28% of cases. Decreased breath sounds were more common in surviving than in nonsurviving patients. (37% v. 19%, $p < 0.001$). A chest tube was installed on the field in 35 patients (32%), all after NT.

CONCLUSION: Standard NT has a high failure rate on the battlefield. Alternative measures for chest decompression, such as the Vygon catheter, appear to be a feasible alternative to conventional NT.

Am J Health Syst Pharm. 2015 Jun 1;72(11):910, 912. doi: 10.2146/ajhp130685.

Convulsions associated with moxifloxacin.

Cone C, Horowitz B

Quotes:

" Fluoroquinolones are generally well tolerated but can cause central nervous system (CNS) toxicities. We are unaware of published case reports of moxifloxacin causing new-onset convulsions, though one case associating the drug with seizures in a patient with a history of epilepsy has been reported. We report a case of new-onset convulsions associated with the use of moxifloxacin."

"Moxifloxacin 400 mg orally once daily was prescribed. The patient returned to the same clinic the next day after taking one dose of moxifloxacin. She reported that within one hour of taking the dose, she felt nauseated, nervous, anxious, and agitated. She described feeling her heart racing and pounding. She also described pain and cramps in her legs, beginning two hours after the dose, followed by shaking tremors and an inability to control body movements, which lasted for 10 minutes."

: To our knowledge, this is the first published case of new-onset convulsions associated with moxifloxacin use. It cannot be proven unequivocally that moxifloxacin caused this very unusual reaction. The details of the episode were provided by the patient, as the incident was not directly observed by a healthcare provider. Further, the score on the Naranjo et al. scale was not definitive for an adverse drug reaction, but moxifloxacin was not readministered for obvious reasons. However, given the temporal relationship of the reaction, quick resolution, and lack of recurrence, it seems that moxifloxacin was the likely cause."

Can J Surg. 2015 Jun;58(3 Suppl 3):S125-34.

Current use of live tissue training in trauma: a descriptive systematic review.

da Luz LT, Nascimento B, Tien H, Kim MJ, Nathens AB, Vlachos S, Glassberg E

BACKGROUND: Growing public concern for animal welfare, advances in computerized simulation and economic barriers have drawn a critical eye to the use of live tissue training (LTT) in trauma skills acquisition. As a consequence, other simulation methods have replaced LTT, for example, in the Advanced Trauma Life Support (ATLS) course. Owing to the lack of clear conclusions in the literature, we conducted a systematic review to determine the value of LTT alone and in comparison to other simulation methods in trauma.

METHODS: We performed a systematic review of the literature considering observational studies and randomized controlled trials (RCTs) that examined LTT in trauma exclusively or compared with other simulation methods. Independently and in duplicate, we adjudicated studies for inclusion and data abstraction. We assessed the quality and risk of bias.

RESULTS: Twelve studies met our inclusion criteria: 2 RCTs and 10 prospective cohort studies. Eight and 4 studies were performed in the military and in the civilian settings, respectively. Anesthetized swine were used in 8 studies and goats in 1. The cohort studies involved LTT alone. Different adjunctive training modalities were included: mannequins in 6 studies, cadavers in 2, computer simulation in 1, video presentations in 2 and wound moulage scenarios in 1. The overall methodological quality was moderate as per the Newcastle-Ottawa score (mean 6.0 ± 0, possible range 1-9). The 2 RCTs did not demonstrate adequate random sequence generation and allocation concealment.

CONCLUSION: There is limited evidence that other types of simulation are better than LTT. Data on training effects of LTT versus other simulations on outcomes are lacking.

Wilderness Environ Med. 2015 Sep;26(3):412-416. doi: 10.1016/j.wem.2015.02.004. Epub 2015 Jun 19.

A Chemical Heat Pack-Based Method For Consistent Heating of Intravenous Fluids.

DeClerck MP, Lipman GS, Grahn DA, Cao V, Wieland M, Troxel T, Craig Heller H

BACKGROUND: Transfusion of cold intravenous fluids (IVF) can exacerbate hypothermia. Civilian and military guidelines recommend heated IVF for hypothermic patients; however, there is currently no ideal IVF heating system for use in resource-limited settings.

OBJECTIVE: Development of a system that uses flameless ration heaters (FRH) and an insulated sleeve for the consistent delivery of IVF at physiologically appropriate temperatures (40°-42°C) over the range of ambient conditions typical of the prehospital and wilderness environments.

METHODS: The temperatures of 0.9% normal saline (NS) 1-L bags were measured under 3 ambient conditions: 3°C, 10°C, and 20°C. The IVF was placed in an insulated pouch along with a predetermined number of activated FRH (5 FRH for 3°C, 4 FRH for 10°C, and 3 FRH for 20°C) for 10 minutes before removing the FRHs. The insulated IVF bag was drained through 280 cm of intravenous tubing at a flow rate of 77 mL/min. Raw temperature data for internal and delivery temperatures were collected and analyzed.

RESULTS: The temperature of the IVF throughout the delivery of 1 L of NS under the 3 ambient conditions was as follows (mean ± SD): at 3°C ambient, 47° ± 2.1°C internal and 42.6°C ± 1.4°C at delivery; at 10°C ambient, 52.3° ± 2.7°C and 45.2° ± 1.6°C; and at 20°C ambient, 45.5° ± 1°C and 39.7° ± 0.7°C.

CONCLUSIONS: The IVF heating system described here reliably delivered physiologically appropriate temperature intravenous fluids in 2 of the 3 ambient treatment conditions. With the appropriate number of FRH for the ambient conditions, this system enables the delivery of warmed IVF to provide active warming, which may be clinically beneficial in the prevention and treatment of hypothermia.

Shock. 2015 Jul;44(1):25-31. doi: 10.1097/SHK.0000000000000368.

Prehospital Resuscitation of Traumatic Hemorrhagic Shock with Hypertonic Solutions Worsens Hypocoagulation and Hyperfibrinolysis.

Delano MJ, Rizoli SB, Rhind SG, Cuschieri J, Junger W, Baker AJ, Dubick MA, Hoyt DB, Bulger EM

ABSTRACT: Impaired hemostasis frequently occurs after traumatic shock and resuscitation. The prehospital fluid administered can exacerbate subsequent bleeding and coagulopathy. Hypertonic solutions are recommended as first-line treatment of traumatic shock; however, their effects on coagulation are unclear. This study explores the impact of resuscitation with various hypertonic solutions on early coagulopathy after trauma. We conducted a prospective observational subgroup analysis of large clinical trial on out-of-hospital single-bolus (250 mL) hypertonic fluid resuscitation of hemorrhagic shock trauma patients (systolic blood pressure, ≤70 mmHg). Patients received 7.5% NaCl (HS), 7.5% NaCl/6% Dextran 70 (HSD), or 0.9% NaCl (normal saline [NS]) in the prehospital setting. Thirty-four patients were included: 9 HS, 8 HSD, 17 NS. Treatment with HS/HSD led to higher admission systolic blood pressure, sodium, chloride, and osmolarity, whereas lactate, base deficit, fluid requirement, and hemoglobin levels were similar in all groups. The HSD-resuscitated patients had higher admission international normalized ratio values and more hypocoagulable patients, 62% (vs. 55% HS, 47% NS; $P < 0.05$). Prothrombotic tissue factor was elevated in shock treated with NS but depressed in both HS and HSD groups. Fibrinolytic tissue plasminogen activator and anti-fibrinolytic plasminogen activator inhibitor type 1 were increased by shock but not thrombin-activatable fibrinolysis inhibitor. The HSD patients had the worst imbalance between procoagulation/anticoagulation and profibrinolysis/antifibrinolysis, resulting in more hypocoagulability and hyperfibrinolysis. We concluded that resuscitation with hypertonic solutions, particularly HSD, worsens hypocoagulability and hyperfibrinolysis after hemorrhagic shock in trauma through imbalances in both procoagulants and anticoagulants and both profibrinolytic and antifibrinolytic activities.

ACS Biomater 2015;1:440-447

Sprayable foams based on an amphiphilic biopolymer for control hemorrhage withour compression.

Dowling M, MacIntire I, White J, et al

ABSTRACT: Hemorrhage (severe blood loss) from traumatic injury is a leading cause of death for soldiers in combat and for young civilians. In some cases, hemorrhage can be stopped by applying compression of a tourniquet or bandage at the injury site. However, the majority of hemorrhages that prove fatal are “non-compressible”, such as those due to an internal injury in the truncal region. Currently, there is no effective way to treat such injuries. In this initial study, we demonstrate that a sprayable polymer-based foam can be effective at treating bleeding from soft tissue without the need for compression. When the foam is sprayed into an open cavity created by injury, it expands and forms a self-supporting barrier that counteracts the expulsion of blood from the cavity. The active material in this foam is the amphiphilic biopolymer, hydrophobically modified chitosan (hmC), which physically connects blood cells into clusters via hydrophobic interactions (the hemostatic mechanism of hmC is thus distinct from the natural clotting cascade, and it works even with heparinized or citrated blood). The amphiphilic nature of hmC also allows it to serve as a stabilizer for the bubbles in the foam. We tested the hmC-based hemostatic foam for its ability to arrest bleeding from an injury to the liver in pigs. Hemostasis was achieved within minutes after application of the hmC foams (without the need for external compression). The total blood loss was 90% lower with the hmC foam relative to controls.

Mil Med. 2015 Jul;180(7):792-7. doi: 10.7205/MILMED-D-14-00635.

Clearing the Cervical Spine in a War Zone: What Other Injuries Matter?

Drew J, Chou VB, Miller C, Borg B, Ingalls N, Shackelford S

BACKGROUND: Cervical spine clearance requires clinicians to assess the reliability of physical examination based on a patient's mental status and distracting injuries. Distracting injuries have never been clearly defined in military casualties.

METHODS: Retrospective review was conducted of patients entered into Department of Defense Trauma Registry January 2008 to August 2013, identifying blunt trauma patients with cervical spine injury and Glasgow Coma Score ≥ 14. Physical examination and radiology results were abstracted from medical records and injury diagnoses were obtained from Department of Defense Trauma Registry. Groups were compared, p-value of < 0.05 was considered significant.

RESULTS: A total of 149 patients met study criteria; 20 patients (13%) had a negative clinical examination of the cervical spine. Coexisting injuries identified in patients with negative physical examination included injuries in proximity to the neck (head, thoracic spine, chest, or humerus) in 17 (85%) patients. In 3 patients (15%), coexisting injuries were not in proximity to the neck and included pelvic, femur, and tibia fractures. All patients without coexisting injury (n = 37) had a positive physical examination.

CONCLUSION: Physical examination of multi-trauma casualties with neck injury may be unreliable when distracting injuries are present. When no distracting injuries were present, the physical examination was accurate in all patients.

Ann Emerg Med. 2015 Jul;66(1):49-50. doi: 10.1016/j.annemergmed.2014.12.001. Epub 2014 Dec 24.

Does a Restricted Fluid Resuscitation Strategy Decrease Mortality in Trauma Patients?

Eastin TR, Liggin RL, Wilbur LG

Quote:

"Traditional teaching and textbook recommendations promote aggressive volume resuscitation of patients with suspected hemorrhagic shock; however, this is based largely on controlled hemorrhage animal models. Uncontrolled hemorrhage models suggest that aggressive resuscitation may lead to increased mortality, presumably by dislodging clots and precipitating hypothermia and coagulopathy. However, clinical studies investigating restricted fluid resuscitation have produced inconsistent results, and a recent Cochrane review found no evidence for or against the use of early or larger-volume fluid administration in uncontrolled hemorrhage.

One European guideline advocated targeting a systolic blood pressure of 80 to 100 mm Hg until definitive hemostasis is achieved; however, the authors noted that this approach is contraindicated in patients with concomitant brain or spinal cord injuries. In addition to volume of fluid resuscitation, both the timing of resuscitation and the type of fluid used (isotonic, hypertonic, or colloid) are topics of ongoing debate. To date, studies examining these issues have yielded mixed results."

Emerg Med J. 2013 Jun;30(6):501-5. doi: 10.1136/emermed-2012-202291. Epub 2013 Feb 12.

The use of analgesia in mountain rescue casualties with moderate or severe pain.

Ellerton JA, Greene M, Paal P.

OBJECTIVES: To assess the effectiveness of analgesia used in mountain rescue (MR) in casualties with moderate or severe pain. To determine if a verbal numeric pain score is practical in this environment. To describe the analgesic strategies used by MR.

DESIGN: Prospective, descriptive study.

SETTING: Fifty-one MR teams in England and Wales. The study period was 1 September 2008 to 31 August 2010.

PARTICIPANTS: 92 MR casualties with a pain scoreof 4/10 or greater.

MAIN OUTCOME: 38% of casualties achieved a pain reduction of 50% or greater in their initial score at 15 min and 60.2% had achieved this at handover.

RESULTS: The initial pain score was 8 (median), reducing to 5 at 15 min and 3 at handover. The mean pain reduction was 2.5 ± 2.4 at 15 min and 3.9 ± 2.5 at handover. 80 casualties (87%) were treated with an opioid and seven had two different opioids administered. Seven main strategies were identified in which the principal agent was entonox, intramuscular opioid, oral analgesia, fentanyl lozenge, intranasal or intravenous opioid. The choice of strategy varied with the skills of the casualty carer.

CONCLUSIONS: Pain should be assessed using a pain score. When possible, intravenous opioid is the gold standard to achieve early and continuing pain control in patients with moderate or severe pain. Entonox and oral analgesics, as sole agents, have limited use in moderate or severe pain. Intranasal opioid and fentanyl lozenge are effective, and appropriate in MR. Research priorities include bioavailability in different environmental conditions and patient's satisfaction with their pain management.

J Trauma Acute Care Surg. 2015;00:

Early in-theater management of combat-related traumatic brain injury: A prospective, observational study to identify opportunities for performance improvement

Fang R, Markandaya M, DuBose JJ, Cancio LC, Shackelford S, Blackbourne LH

BACKGROUND: Combat-related moderate-to-severe traumatic brain injury (CRTBI) is a significant cause of wartime morbidity and mortality. As of August 2014, moderate-to-severe traumatic brain injuries sustained by members of the Department of Defense worldwide since 2000 totaled 32,996 cases. Previously published epidemiologic reviews describe CRTBI management at a ‘‘strategic’’ level, but they lack ‘‘tactical’’ patient-specific data required for performance improvement. In addition, scarce data exist regarding prehospital CRTBI care.

METHODS: This is a prospective observational study of consecutive CRTBI casualties presenting to US Role 3 medical facilities. Admission variables including demographics, initial clinical findings, and laboratory results were collected. Head computed tomographic scan findings were noted. Interventions in the first 72 postinjury hours were recorded. Early in-theater mortality was noted, but longer-term outcomes were not.

RESULTS: Casualties were predominately injured by explosive blasts (78.6%). Penetrating injuries occurred in 42.9%. On arrival, Glasgow Coma Scale (GCS) score was less than 8 for 47.7%. Hypothermia (temperature G 95.0-F) was present in 4.5%, and hypotension (systolic blood pressure G 90 mm Hg) in 21.1%. Hypoxia (O2 saturation G 90%) was observed in 52.5%. Both hypercarbia (PaCO2 9 45 mm Hg, 50%) and hypocarbia (PaCO2 G 36 mm Hg, 20.3%) were common on presentation. Head computed tomographic scan most commonly found skull fracture (68.9%), subdural hematoma (54.1%), and cerebral contusion (51.4%). Hypertonic saline was administered to 69.7% and factor VIIa to 11.1%. Early in-theater mortality at Role 3 was 19.4%.

CONCLUSION: Avoidance of secondary brain injury by optimizing oxygenation, ventilation, and cerebral perfusion is the primary goal in the contemporary care of moderate-to-severe CRTBI. Ideally, this crucial care must begin as early as possible after injury. Given the frequency of hypotension, hypoxia, and both hypercarbia and hypocarbia upon Role 3 arrival, increased emphasis on prehospital management is indicated.

LEVEL OF EVIDENCE: Epidemiologic study, level IV.

KEY WORDS: Traumatic brain injury; prehospital emergency care; secondary injury; ventilation; military medicine.

Springerplus. 2015 Jul 16;4:350. doi: 10.1186/s40064-015-1126-0. eCollection 2015.

Intra-operative hydroxyethyl starch is not associated with post-craniotomy hemorrhage.

Feix JA, Peery CA, Gan TJ, Warner DS, James ML, Zomorodi A, McDonagh DL

BACKGROUND: Intraoperative intravascular volume expansion with hydroxyethyl starch-based colloids is thought to be associated with an increased risk of post-craniotomy hemorrhage. Evidence for this association is limited. Associations between resuscitation with hydroxyethyl starch and risk of repeat craniotomy for hematoma evacuation were examined.

METHODS: Using a retrospective cohort of neurosurgical patients at Duke University Medical Center between March 2005 and March 2012, patient characteristics were compared between those who developed post-craniotomy hemorrhage and those who did not.

RESULTS: A total of 4,109 craniotomy procedures were analyzed with 61 patients having repeat craniotomy for post-operative hemorrhage (1.5%). The rate of reoperation in the group receiving 6% High Molecular Weight Hydroxyethyl Starch (Hextend(®)) was 2.6 vs. 1.3% for patients that did not receive hetastarch (P = 0.13). The reoperation rate for those receiving 6% hydroxyethyl Starch 130/0.4 (Voluven(®)) was 1.4 vs. 1.6% in patients not receiving Voluven (P = 0.85).

CONCLUSIONS: In this retrospective cohort, intra-operative hydroxyethyl starch was not associated with an increased risk of post-craniotomy hemorrhage.

Mil Med. 2015 Aug;180(8):869-75. doi: 10.7205/MILMED-D-14-00721.

Tactical Damage Control Resuscitation.

Fisher AD, Miles EA, Cap AP, Strandenes G, Kane SF

ABSTRACT: Recently the Committee on Tactical Combat Casualty Care changed the guidelines on fluid use in hemorrhagic shock. The current strategy for treating hemorrhagic shock is based on early use of components: Packed Red Blood Cells (PRBCs), Fresh Frozen Plasma (FFP) and platelets in a 1:1:1 ratio. We suggest that lack of components to mimic whole blood functionality favors the use of Fresh Whole Blood in managing hemorrhagic shock on the battlefield. We present a safe and practical approach for its use at the point of injury in the combat environment called Tactical Damage Control Resuscitation. We describe pre-deployment preparation, assessment of hemorrhagic shock, and collection and transfusion of fresh whole blood at the point of injury. By approaching shock with goal-directed therapy, it is possible to extend the period of survivability in combat casualties.

Acad Emerg Med. 2015 Aug 20. doi: 10.1111/acem.12742. [Epub ahead of print]

Just-in-Time to Save Lives: A Pilot Study of Layperson Tourniquet Application.

Goolsby C, Branting A, Chen E, Mack E, Olsen C

OBJECTIVES: The objective was to determine whether just-in-time (JiT)ninstructions increase successful tourniquet application by laypersons.

METHODS: This was a randomized pilot study conducted in August 2014. The study occurred at the Uniformed Services University campus in Bethesda, Maryland. A total of 194 volunteers without prior military service or medical training completed the study. The participant stood in front of a waist-down mannequin that had an exposed leg. An observer read a scenario card aloud that described a mass casualty event. The observer then asked the participant to apply a Combat Application Tourniquet (C-A-T) to the mannequin. Test participants received a 4 × 6-inch card, with JiT instructions, in addition to their C-A-T; controls received no instructions. Participants were randomized in a 3:1 ratio of instructions to no instructions. The study's primary outcome was the proportion of successfully applied tourniquets by participants receiving JiT instructions compared to participants not receiving instructions. Secondary outcomes included the time for successful tourniquet placement, reasons for failed tourniquet application, and participants' self-reported willingness and comfort using tourniquets in real-life settings.

RESULTS: Just-in-time instructions more than doubled successful tourniquet placement. Participants supplied with JiT instructions placed a tourniquet successfully 44.14% of the time, compared to 20.41% of the time for controls without instructions (risk ratio = 2.16; 95% confidence interval = 1.21 to 3.87; p = 0.003).

CONCLUSIONS: Just-in-time instructions increase laypeople's successful application of C-A-T. This pilot study provides evidence that JiT instructions may assist the lay public in providing effective point-of-injury hemorrhage control.

BMJ. 2015 Mar 27;350:h1656. doi: 10.1136/bmj.h1656.

Colloid solutions in the perioperative setting.

Haase N, Perner A

Quote:

"Opperer and colleagues' study is an important contribution, and the biggest observational study of the safety of colloids in the perioperative period. Are their findings reliable? The adverse effects associated with hydroxyethyl starch in this study are fully in line with those seen among critically ill patients and explained by the same pathophysiological mechanisms. Further, the anticoagulant properties of hydroxyethyl starch may explain its lack of association with thromboembolic complications. On the other hand, the observed increased complication rate associated with albumin contrasts with findings from previous clinical trials, which suggested that albumin was safe in most patient populations.

The obvious challenge in all observational evaluations of treatments is that patients are carefully selected for a particular option, not randomly allocated. Associations between colloid use and complications could be due at least in part to sicker patients being selected for treatment with colloids (confounding by indication) or to other baseline differences between the groups that could not be adjusted for in analyses (residual confounding). Despite extensive adjustments (including the Charlson comorbidity index), the authors are well aware of their study's limitations and, like others, must wait for stronger evidence from large scale randomised clinical trials comparing colloids and crystalloids head to head in perioperative settings. Given Opperer and colleagues' findings, these trials are now urgent. Use of hydroxyethyl starch in particular should be suspended in the interests of patient safety while we wait for trial results."

Surgery. 2015 Jul 23. pii: S0039-6060(15)00525-5. doi: 10.1016/j.surg.2015.06.026. [Epub ahead of print]

Military-to-civilian translation of battlefield innovations in operative trauma care.

Haider AH, Piper LC, Zogg CK, Schneider EB, Orman JA, Butler FK, Gerhardt RT, Haut ER, Mather JP, MacKenzie EJ, Schwartz DA, Geyer DW, DuBose JJ, Rasmussen TE, Blackbourne LH

BACKGROUND: Historic improvements in operative trauma care have been driven by war. It is unknown whether recent battlefield innovations stemming from conflicts in Iraq/Afghanistan will follow a similar trend. The objective of this study was to survey trauma medical directors (TMDs) at level 1-3 trauma centers across the United States and gauge the extent to which battlefield innovations have shaped civilian practice in 4 key domains of trauma care.

METHODS: Domains were determined by the use of a modified Delphi method based on multiple consultations with an expert physician/surgeon panel: (1) damage control resuscitation (DCR), (2) tourniquet use, (3) use of hemostatic agents, and (4) prehospital interventions, including intraosseous catheter access and needle thoracostomy. A corresponding 47-item electronic anonymous survey was developed/pilot tested before dissemination to all identifiable TMD at level 1-3 trauma centers across the US.

RESULTS: A total of 245 TMDs, representing nearly 40% of trauma centers in the United States, completed and returned the survey. More than half (n = 127; 51.8%) were verified by the American College of Surgeons. TMDs reported high civilian use of DCR: 95.1% of trauma centers had implemented massive transfusion protocols and the majority (67.7%) tended toward 1:1:1 packed red blood cell/fresh-frozen plasma/platelets ratios. For the other 3, mixed adoption corresponded to expressed concerns regarding the extent of concomitant civilian research to support military research and experience. In centers in which policies reflecting battlefield innovations were in use, previous military experience frequently was acknowledged.

CONCLUSION: This national survey of TMDs suggests that military data supporting DCR has altered civilian practice. Perceived relevance in other domains was less clear. Civilian academic efforts are needed to further research and enhance understandings that foster improved trauma surgeon awareness of military-to-civilian translation.

Mil Med. 2015 Aug;180(8):844-6. doi: 10.7205/MILMED-D-14-00592.

Use of Tranexamic Acid in Bleeding Combat Casualties.

Heier HE, Badloe J, Bohonek M, Cap A, Doughty H, Korsak J, Medby C, Pfaff RM, Rentas FJ, Sailliol A, Schilha M, Söderström T

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Quotes:

"BACKGROUND: The NATO Blood Panel (NBP) has been asked by the Committee of the Chiefs of Military Medical Services in NATO to present a recommendation on the administration of the antifibrinolytic drug tranexamic acid (TXA) to bleeding traumatized military patients. The purpose of giving this drug is to reduce bleeding and death because of hemorrhage by preventing, delaying, and treating trauma-induced coagulopathy."

" A wealth of data from 252 randomized controlled trials, enrolling over 25,000 patients, demonstrate that antifibrinolytics such as TXA are safe and effective in reducing perioperative need for transfusion in nonurgent surgery. Furthermore, data from 3 studies in 260 patients suggest that TXA safely and effectively reduces the need for transfusion in emergency or urgent surgery. TXA, therefore, offers an approach to the supportive treatment of combat casualties that is radically different from the mere improvement in concentrations of hemostatic factors by transfusion."

"In summary, the NBP makes the following recommendations:

— NATO forces should include TXA in the treatment of trauma patients with uncontrolled bleeding.

— TXA must begin within 3 hours of injury, as guided by the CRASH-2 subgroup analysis.

— TXA can be given as 1 gm intravenously over 10 minutes, followed by infusion of 1 gm over 8 hours.

— There seems to be no evident danger of thromboembolism from such application of TXA treatment. However, continuing pharmacovigiliance should be applied.

— TXA should be used as an integrated part of a massive hemorrhage protocol.

— TXA can be administered in prehospital environment by specifically trained medics according to protocol.

— The NBP emphasizes the established importance of high-quality tactical combat casualty care, damage control resuscitation, and damage control surgery, including adequate thromboprophylaxis once hemorrhage is controlled and initial surgery completed."

Journal of Emergency Medical Services News. 26 July 2015

Use of individual first aid kits (IFAKs) credited with saving lives in LA.

Heightman AJ

Quotes:

"Lafayette LA Police Chief Jim Craft and Louisiana Governor Bobby Jindal credit Individual First Aid Kits (IFAK) carried by Lafayette police officers as being instrumental in saving multiple lives at the Lafayette movie theater active shooter incident Thursday night."

"Governor Jindal, echoed the significance of police use of their IFAKs noting that, during his personal walk-through in the involved movie theater, it was apparent where the IFAKs were used and made an impact. He told reporters that he observed the debris and open tourniquet, occlusive and hemostatic dressing packages in multiple areas where the officers treated critically wounded victims before extricating them to a safe area where EMS crews from Acadian Ambulances took over care of the victims."

"The medical requirements faced by LEOs under fire are somewhat analogous to the combat setting. Over generations of military conflict, U.S. forces have experienced incrementally decreased fatality rates as medical care was effectively brought closer to the battlefield (Goldberg, 2010). The case fatality rate for combat casualties in the War on Terror in Afghanistan and Iraq is below 10% for the first time in history, down from more than 15% in Vietnam (Holcomb, 2006). A substantial part of this improvement has been attributed to the concept of Tactical Combat Casualty Care (TCCC), developed by the US Special Operations medical community."

"Aggressive, directed, point-of-wounding TCCC by non-medical troops in the form of self- and buddy-treatment, as well as continuity of TCCC by medical non-combatants represents significant enhancement in the initial echelons of casualty care."

"As such, the InterAgency Board recommends two to four hours of medical training for LEOs, which includes the following:

The concepts of TECC phases of medical care and the appropriate non-medical first responder application of TECC in relation to active threats. The primary objectives of this medical training are hemorrhage control maneuvers, airway and basic respiratory management, and identification and management of shock and hypothermia."

SEPT 2015 ACS BULLETIN Supplement

Hemorrhage control devices: Tourniquets and hemostatic dressings

Holcomb JB, Butler FK, Rhee P:

Quotes:

"Hemorrhage control is the highest priority in caring for for an injured individual. To be maximally effective, hemorrhage control must occur as soon as possible after the wounding event. Unfortunately, uncontrolled hemorrhage remains the single most preventable cause of death after both military and civilian injuries. One of the most important lessons learned in the last 14 years of war is that using tourniquets and hemostatic dressings as soon as possible after injury is absolutely lifesaving."

"In the 26 years between the end of the Vietnam War in 1975 and 2001, little changed in prehospital hemorrhage control. As a result, preventable deaths from extremity hemorrhage also did not change in almost three decades. After the widespread implementation of the tourniquet recommendations from the Committee on Tactical Combat Casualty Care (CoTCCC), a 10-year review of 4,596 U.S. combat fatalities noted a significant decrease in combat fatalities from extremity hemorrhage. The dramatic decrease in deaths from extremity hemorrhage resulted from the now ubiquitous fielding of modern tourniquets and hemostatic dressings on the battlefield and aggressive training of all levels of responders in their effective use."

"Recommendation: External hemorrhage control can be accomplished easily by welltrained and well-equipped people, whether they are professional first responders or civilians. Tourniquets and hemostatic dressings should reduce preventable deaths from external hemorrhage in the civilian sector, just as they have done in the military. The recommendations for early effective hemorrhage control with commercial devices are important and similar to those of the CoTCCC, the U.S. military, the American College of Surgeons Committee on Trauma, the American College of Emergency Physicians, the National Association of Emergency Medical Technicians, and the Hartford Consensus III. The lessons learned in early hemorrhage control have been gained and applied in the crucible of battle. Widespread application of tourniquets and hemostatic dressings for hemorrhage control after civilian injury will save lives."

Journal of Emergency Medical Services; 2015

ACEP Policies Lead to Evidence-Based Medicine. JEMS 2015

Huff R:

Quotes:

"The outline of the policy, which includes the use of tourniquets when sustained direct pressure or a pressure dressing is ineffective, is based on real-world data generated from battlefield situations and in the civilian arena. The new policy also suggests protocols should address the use of a commercially produced tourniquet with demonstrated arterial flow occlusion; that tourniquets not be released until the patient reaches definitive care; that providers consider the use of topical hemostatic gauze pads in combination with direct pressure/dressing for wounds where a tourniquet isn't possible; that tourniquets may be the first-line treatment for extremity arterial hemorrhage; the consideration of the use of tranexamic acid (TXA); and specific training for EMS personnel include hemorrhage control techniques using tourniquets and topical hemostatic gauze agents."

"Consideration should also be given to the use of tourniquets and topical hemostatic gauze agents by other first responders such as law enforcement and firefighters as part of a system-wide out-of-hospital severe hemorrhage control program that also addresses the role civilians can play," the board of the ACEP wrote in drafting the policy."

"The use of tourniquets got a major push during the wars in Iraq and Afghanistan, and, on a domestic level, there were multiple cases of lives saved following the Boston Marathon bombings when passersby used makeshift tourniquets to help those suffering from devastating injuries."

J Trauma Acute Care Surg. 2015 Aug;79(2):232-7. doi: 10.1097/TA.0000000000000747.

Tourniquet use for civilian extremity trauma.

Inaba K, Siboni S, Resnick S, Zhu J, Wong MD, Haltmeier T, Benjamin E, Demetriades D.

BACKGROUND: Unlike in the military setting, where the use of tourniquets has been well established, in the civilian sector their use has been far less uniform. The purpose of this study was to examine the outcomes associated with the use of tourniquets for civilian extremity trauma.

STUDY DESIGN: Adult (≥18 years) patients admitted to our institution with an extremity injury requiring tourniquet application from January 2007 to June 2014 were retrospectively reviewed. The primary outcome analyzed was limb loss. Secondary outcomes included death, hospital length of stay, and complications.

RESULTS: There were 87 patients who met inclusion criteria. Average age was 35.3 years, 90.8% were male, and 66.7% had penetrating injuries, with a median Injury Severity Score (ISS) of 6. Tourniquets were placed in the prehospital setting in 50.6%, in the emergency department in 39.1%, and in the operating room in 10.3% of patients. The windlass type Combat Application Tourniquet was the most commonly used type (67.8%), followed by a pneumatic system (24.1%) and self-made tourniquet (8.0%). The median duration of use was 75 minutes (interquartile range, 91) with no differences between groups ($p = 0.547$). Overall, 80.5% had a vascular injury (70.1% arterial), and a total of 99 limb operations were performed, including 15 amputations. Fourteen amputations (93.3%) occurred at the scene or were directly attributed to the extent of tissue damage with a median Mangled Extremity Severity Score (MESS) of 7 (interquartile range, 2). In the remaining patient, the tourniquet was lifesaving but likely contributed to limb loss. Seven patients sustained 13 other complications; however, none was directly attributed to tourniquet use.

CONCLUSION: Tourniquet use in the civilian sector is associated with a low rate of complications. With the low complication rate and high potential for benefit, aggressive use of this potentially lifesaving intervention is justified.

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

Bulletin of the ACS 2015;100:20-26

Hartford Consensus III: Implementation of bleeding control.

Jacobs L

Quotes:

"Immediate responders need to recognize that applying pressure to a bleeding vessel is the appropriate first action to take and that their hands are a first-line resource. In most cases, control of external hemorrhage can be accomplished by applying direct pressure on the bleeding vessel."

"Hemostatic dressings and tourniquets may be needed to effectively stop bleeding. For this reason, the Hartford Consensus recommends that all police officers and any concerned citizens carry a hemostatic dressing, a tourniquet, and gloves. This guideline should also apply to all EMS/fire/rescue personnel. Ground and air medical transport vehicles should carry multiple dressings and tourniquets based upon local need. In addition, bleeding control bags should be accessible in public places as determined by a local needs assessment. Potential sites for bleeding control bags include shopping malls, museums, hospitals, schools, theaters, sports venues, transportation centers (such as airports, bus depots, and train stations), and facilities with limited or delayed access. All hemostatic dressings and tourniquets must be clinically effective as documented by valid scientific data."

" The Tactical Combat Casualty Care guidelines for the U.S. military contain objective evidence to support the safety and efficacy of the various options for tourniquets and hemostatic dressings."

J Pain Symptom Manage. 2013 Oct;46(4):573-80. doi: 10.1016/j.jpainsymman.2012.09.009. Epub 2013 Feb 4.

Efficacy of rapid-onset oral fentanyl formulations vs. oral morphine for cancer-related breakthrough pain: a meta-analysis of comparative trials.

Jandhyala R, Fullarton JR, Bennett MI

CONTEXT: Breakthrough cancer pain (BTcP) is widely recognized as a clinically significant complication of chronic cancer pain. With most BTcP episodes peaking in intensity within a few minutes and lasting for approximately 30 minutes, speed of onset is crucial for effective pain management. Although the last decade has seen the development of a number of rapid-onset fentanyl preparations, BTcP is still typically managed by supplemental or rescue doses of the patient's around-the-clock medication, such as oral morphine. Importantly, although the fentanyl preparations, such as fentanyl buccal tablet (FBT), sublingual fentanyl citrate orally disintegrating tablet (ODT), and oral transmucosal fentanyl citrate lozenge (OTFC), have all been proven to be efficacious in clinical studies, oral morphine has never been specifically tested in BTcP, other than as a comparator in studies of OTFC and fentanyl pectin nasal spray.

OBJECTIVES: To determine the relative contributions to pain relief from oral morphine and the fentanyl preparations using placebo as a common comparator.

METHODS: Relevant studies were identified by review of the literature and used in a mixed-treatment meta-analysis to indirectly compare fentanyl preparations, morphine, and placebo for the treatment of BTcP.

RESULTS: Analysis incorporating the five relevant studies identified revealed that although the fentanyl preparations provide superior pain relief vs. placebo in the first 30 minutes after dosing (FBT provided an 83% probability of superior pain relief, ODT 66%, and OTFC 73% vs. placebo), oral morphine performed little better than placebo (56% probability).

CONCLUSION: This mixed-treatment analysis suggests that FBT, ODT, and OTFC might provide more efficacious treatment options than oral morphine for BTcP.

Curr Opin Crit Care. 2015 Aug;21(4):285-91. doi: 10.1097/MCC.0000000000000219.

Fluids and coagulation.

Kozek-Langenecker SA

PURPOSE OF REVIEW: Infusion therapy is essential in intravascular hypovolaemia and extravascular fluid deficits. Crystalloidal fluids and colloidal volume replacement affect blood coagulation when infused intravenously. The question remains if this side-effect of infusion therapy is clinically relevant in patients with and without bleeding manifestations, and if fluid-induced coagulopathy is a risk factor for anaemia, blood transfusion, and mortality, and a driver for resource use and costs.

RECENT FINDINGS: Pathomechanisms of dilutional coagulopathy and evidence for its clinical relevance in perioperative and critically ill patients are reviewed. Furthermore, the article discusses medicolegal aspects.

SUMMARY: The dose-dependent risk of dilutional coagulopathy differs between colloids (dextran > hetastarch > pentastarch > tetrastarch, gelatins > albumin). Risk awareness includes monitoring for early signs of side-effects. With rotational thromboelastometry/thrombelastography, the deterioration not only in clot strength but also in clot formation and in platelet interaction can be assessed. Fibrinogen concentrate administration may be considered in severe bleeding as well as relevant dilutional coagulopathy. Targeted doses of gelatins and tetrastarches seem to have no proven adverse effect on anaemia and allogeneic blood transfusions. Further studies are needed.

Am J Emerg Med. 2015 Jul;33(7):974-6. doi: 10.1016/j.ajem.2015.03.048. Epub 2015 Mar 25.

Gauze vs XSTAT in wound packing for hemorrhage control.

Kragh JF Jr, Aden JK, Steinbaugh J, Bullard M, Dubick MA

Quotes:

"The wound was packed, pressures were measured, flow was restarted, and pressures were remeasured. Measurements included pressures at the wound walls at the side and bottom, weights of the dressings before and after use, time of dressing application, time of dressing removal, bleeding rates (a 10-second sampling), and blood loss (sum of volumes measured including weight changes of dressing)."

"Two dressings were compared. The common gauze dressing was the control intervention (order no. NKG100-E [4.5 in by 4.1 yd, 6 ply], Krinkle Bandage Roll; Rensow, manufactured in China for Miat, Inc, Maspeth, NY); medics routinely call such a dressing "Kerlix," which is a similar product; but many military medical sets, kits, and outfits are stocked with other makes of gauze like the one assessed. The comparison was made of dressing, XSTAT (Revmedx), a 60-mL volume of hemostatic dressing composed of approximately 92 rapidly expanding cellulose mini sponges (unexpanded cylinders, 9-mm diameter; 4.5-mm tall); a prototype version of this dressing was used, which included a 60 cm3 syringe as an injector (Fig. 1). Sponges were small cylinders that expanded when wetted. Analysis was for primary outcome of hemorrhage measured by effectiveness (no bleeding, 0 mL/s), bleeding rate, and blood loss volume; secondary outcomes included pressures, times, and mechanisms of action. Ten tests were made of each dressing type. No other interventions were made; there was no manual pressure or occlusive dressing used."

"XSTAT expanded out evenly and was more balanced in its ratio of bottom-to-side pressures than gauze (P=.0015); XSTAT applied pressure symmetrically,whereas gauze did not (Fig. 2). Mean time of application (a medic task) differed 8-fold favoring XSTAT (P=.0002, Fig. 3),whereas mean time of removal (a surgeon task) differed 22-fold favoring gauze (P=.0001). The mechanisms of action differed, as gauze pistoned up and down repetitively upon each digital push in packing, whereas XSTAT expanded at once randomly and evenly in every direction. Both mechanisms were not digitally controllable as to where the pressure could be reliably applied. Gauze compressed with each digital compression but recoiled and decompressed partially after each release because it expanded upward; shearing between the dressing and the wall of the wound was minimal at the wound bottom butwas maximal at the side. The XSTAT had no digital packing, no compression, no decompression, and no wound-dressing shear."

J Spec Op Med Volume 15, Edition 3/Fall 2015

Junctional Tourniquet Training Experience

Kragh JF, Geracci JJ, Parsons DL; Robinson JB, Biever KA; Rein EB, Glassberg E, StrandenesG, Chen J, Benov A, Marcozzi D, Shackelford S, Cox KM, Mann-Salinas EA

ABSTRACT: Since 2009, out-of-hospital care of junctional hemorrhage bleeding from the trunk–appendage junctions has changed, in part, due to the newly available junctional tourniquets (JTs) that have been cleared by the US Food and Drug Administration. Given four new models of JT available in 2014, several military services have begun to acquire, train, or even use such JTs in care. The ability of users to be trained in JT use has been observed by multiple instructors. The experience of such instructors has been broad as a group, but their experience as individuals has been neither long nor deep. A gathering into one source of the collective experience of trainers of JT users could permit a collation of useful information to include lessons learned, tips in skill performance, identification of pitfalls of use to avoid, and strategies to optimize user learning. The purpose of the present review is to record the experiences of several medical personnel in their JT training of users to provide a guide for future trainers.

Keywords: hemorrhage, resuscitation, medical device, education, skill development, emergency medical services

Crit Care Med. 2015 Jun;43(6):1233-8. doi: 10.1097/CCM.0000000000000942.

Intraosseous versus central venous catheter utilization and performance during inpatient medical emergencies.

Lee PM, Lee C, Rattner P, Wu X, Gershengorn H, Acquah S.

OBJECTIVES: Intraosseous access is a rapid and effective route of fluid and drug administration. Its use has been proven in emergency medicine, pediatrics, and the military. We aimed to assess its performance and utilization against landmark-guided central venous catheter placement during inpatient medical emergencies.

DESIGN: Prospective observational study.

SETTING: Eight hundred fifty-six-bed urban teaching hospital.

PATIENTS: Adult inpatients requiring central venous access during medical emergencies.

INTERVENTIONS: Intraosseous device training was added to standard central venous catheter training beginning in February 2012. Intraosseous were used as primary access in cardiac arrests and secondary access if central venous catheter placement failed during noncardiac arrest emergencies. An online survey was conducted among intraosseous and central venous catheter operators to assess their experience and any barriers to use.

MEASUREMENTS AND MAIN RESULTS: Seventy-nine adults had central access placement from February 2012 to July 2013. Sixty were during medical emergency team calls, and 19 were cardiac arrests. Thirty-one received intraosseous device, and 48 received a central venous catheter. First-pass success was significantly higher for intraosseous than for central venous catheter (90.3 vs 37.5%; 95% CI, 80-101 vs 24-51; $p<0.001$). Mean placement times were significantly shorter for intraosseous than for central venous catheter (1.2 vs 10.7 min; $p<0.001$). There were a total of 33 intraosseous versus 169 central venous catheter attempts with fewer attempts on average per patient during intraosseous placement (1.1 vs 2.8; $p<0.001$). There were three intraosseous-related complications and 22 central venous catheter-related complications. Our survey showed high satisfaction with intraosseous training and operation. Among the barriers cited, timely intraosseous kit acquisition was most common.

CONCLUSIONS: It is feasible to incorporate intraosseous use during medical emergency team calls. Intraosseous had significantly higher first-pass success rates and faster placement compared with central venous catheters. Intraosseous operators reported high satisfaction and confidence in its use. Prospective randomized studies comparing intraosseous and central venous catheter are warranted.

Emerg Med J. 2015 Jun;32(6):463-7. doi: 10.1136/emermed-2014-203588. Epub 2014 Jun 30.

Saving the critically injured trauma patient: a retrospective analysis of 1000 uses of intraosseous access.

Lewis P, Wright C

OBJECTIVE: Intraosseous access (IO) is becoming increasingly accepted in adult populations as an alternative to peripheral vascular access; however, there is still insufficient evidence in large patient groups supporting its use.

METHODS: Retrospective review. This paper reports on the use of IO devices over a 7-year period from August 2006 to August 2013 during combat operations in Afghanistan. A database search of the Joint Theatre Trauma Registry (JTTR) was carried out looking for all the incidences of IO access use during this time. Excel (Microsoft) was used to manage the dataset and perform descriptive statistics on the patient demographics, injuries, treatments and complications that were retrieved.

RESULTS: 1014 IO devices were used in 830 adult patients with no major complications. The rate of minor complications, the majority of which were device failure, was 1.38%. 5124 separate infusions of blood products or fluids occurred via IO access, with 36% being of packed red cells. On average, each casualty received 6.95 different infusions of blood products and fluids, and 3.28 separate infusions of drugs through IO access. 32 different drugs were infused to 367 patients via IO, the most frequent being anaesthetic agents. IO access was used in the prehospital environment, during tactical helicopter evacuation and within hospitals.

CONCLUSIONS: IO access can be used to administer a wide variety of life-saving medications quickly, easily and with low-complication rates. This highlights its valuable role as an alternative method of obtaining vascular access, vital when resuscitating the critically injured trauma patient.

Crit Care Nurs Clin North Am. 2015 Jun;27(2):235-46. doi: 10.1016/j.cnc.2015.02.005. Epub 2015 Mar 18.

Pain management in military trauma.

Litwack K

Quotes:

"Morphine administration has served as the primary method of battlefield pain management since the American Civil War. Although effective and easily administered via intramuscular injection, this therapy is associated with unpredictable results and adverse effects. Intramuscular administration is selected as it is fast, but the vasoconstriction that is often associated with significant trauma makes its absorption unpredictable in terms of onset. Starting an intravenous line when the goal is immediate evacuation results in a delay of care, yet intravenous or interosseous access will be the mainstay for fluid resuscitation. Morphine also causes adverse effects of respiratory depression, sedation, nausea, and vomiting, which may prove fatal to persons wounded in combat. In addition, the need for personnel to manage these complications puts additional personnel at risk."

"Wedmore (2012)11 reported on the use of oral transmucosal fentanyl citrate (OTFC) for prehospital pain control in a battlefield setting, finding a significant reduction in pain intensity at time of administration, sustained at 15 and 30 minutes after the traumatic event. Only 18.2% of patients required other types of analgesics. Nausea was the most significant adverse effect. OTFC was seen as a safe and effective alternative for the prehospital battlefield setting, particularly because of its usefulness in austere environments."

"The administration of intranasal and intramuscular ketamine is another agent considered for battlefield use. Ketamine is classified as a dissociative anesthetic, but one with hallucinogenic and psychoactive properties. It has been used as the sole anesthetic for short painful procedures, such as orthopedic splinting, laceration repair, or fracture resetting. Ketamine offers the advantages of profound pain relief, while maintaining airway reflexes and stimulating cardiac function. It acts as a mild sedative and produces a sense of euphoria. Current Tactical Combat Casualty Care (TCCC) guidelines have incorporated the use of intramuscular ketamine for battlefield trauma, except in patients with traumatic brain injury or open globe injuries. This is out of concern that ketamine has been associated with increased intracranial pressure and increased intraocular pressure. Current research, however, challenges thinking about ketamine's effect on intracranial pressure and intraocular pressure. This is not based on clinical trial or study in a battlefield setting, but initiated after significant interdisciplinary study by the Defense Health Board to the Department of Defense, in recognition that ketamine offers the benefits of significant pain control without opioidinduced hypotension or respiratory depression."

Shock. 2015 May;43(5):429-36. doi: 10.1097/SHK.0000000000000328.

Automated analysis of vital signs to identify patients with substantial bleeding before hospital arrival: a feasibility study.

Liu J, Khitrov MY, Gates JD, Odom SR, Havens JM, de Moya MA, Wilkins K, Wedel SK, Kittell EO, Reifman J, Reisner AT.

ABSTRACT: Trauma outcomes are improved by protocols for substantial bleeding, typically activated after physician evaluation at a hospital. Previous analysis suggested that prehospital vital signs contained patterns indicating the presence or absence of substantial bleeding. In an observational study of adults (aged ≥18 years) transported to level I trauma centers by helicopter, we investigated the diagnostic performance of the Automated Processing of the Physiological Registry for Assessment of Injury Severity (APPRAISE) system, a computational platform for real-time analysis of vital signs, for identification of substantial bleeding in trauma patients with explicitly hemorrhagic injuries. We studied 209 subjects prospectively and 646 retrospectively. In our multivariate analysis, prospective performance was not significantly different from retrospective. The APPRAISE system was 76% sensitive for 24-h packed red blood cells of 9 or more units (95% confidence interval, 59% - 89%) and significantly more sensitive ($P < 0.05$) than any prehospital Shock Index of 1.4 or higher; sensitivity, 59%; initial systolic blood pressure (SBP) less than 110 mmHg, 50%; and any prehospital SBP less than 90 mmHg, 50%. The APPRAISE specificity for 24-h packed red blood cells of 0 units was 87% (88% for any Shock Index ≥1.4, 88% for initial SBP <110 mmHg, and 90% for any prehospital SBP <90 mmHg). Median APPRAISE hemorrhage notification time was 20 min before arrival at the trauma center. In conclusion, APPRAISE identified bleeding before trauma center arrival. En route, this capability could allow medics to focus on direct patient care rather than the monitor and, via advance radio notification, could expedite hospital interventions for patients with substantial blood loss.

Eur J Trauma Emerg Surg. 2015 Apr;41(2):119-27. doi: 10.1007/s00068-014-0437-0. Epub 2014 Aug 20.

The ebb and flow of fluid (as in resuscitation).

Mattox KL

ABSTRACT: Since the early 1960's "resuscitation" following major trauma involved use of replacement crystalloid fluid/estimated blood loss in volumes of 3/1, in the ambulance, emergency room, operating room and surgical intensive care unit. During the past 20 years, MAJOR paradigm shifts have occurred in this concept. As a result hypotensive resuscitation with a view towards restriction of crystalloid, and prevention of complications has occurred. Improved results in both civilian and military environments have been reported. As a result there is new focus on trauma surgical involvement in all aspects of trauma patient management, focus on early aggressive surgical approaches (which may or may not involve an operation), and movement from crystalloid to blood, plasma, and platelet replacement therapy.

J Trauma Acute Care Surg. 2015 Aug;79(2):227-31. doi: 10.1097/TA.0000000000000748.

Decreased mortality after prehospital interventions in severely injured trauma patients.

Meizoso JP, Valle EJ, Allen CJ, Ray JJ, Jouria JM, Teisch LF, Shatz DV, Namias N, Schulman CI, Proctor KG.

BACKGROUND: We test the hypothesis that prehospital interventions (PHIs) performed by skilled emergency medical service providers during ground or air transport adversely affect outcome in severely injured trauma patients.

METHODS: Consecutive trauma activations (March 2012 to June 2013) transported from the scene by air or ground emergency medical service providers were reviewed. PHI was defined as intubation, needle decompression, tourniquet, cricothyroidotomy, or advanced cardiac life support.

RESULTS: In 3,733 consecutive trauma activations (71% blunt, 25% penetrating, 4% burns), age was 39 years, 74% were male, Injury Severity Score (ISS) was 5, and Glasgow Coma Score (GCS) was 15, with 32% traumatic brain injury (TBI) and 7% overall mortality. Those who received PHI (n = 130, 3.5% of the trauma activations) were more severely injured: ISS (26 vs. 5), GCS (3 vs. 15), TBI (57% vs. 31%), Revised Trauma Score (RTS, 5.45 vs. 7.84), Trauma and Injury Severity Score (TRISS, 1.32 vs. 4.89), and mortality (56% vs. 5%) were different (all $p < 0.05$) than those who received no PHI. Air crews transported 22% of the patients; more had TBI, blunt injury, high ISS, and long prehospital times (all $p < 0.05$), but mortality was similar to those transported by ground. In the most severely injured patients with signs of life who received a PHI, the ISS, prehospital times, and proportions of TBI, blunt trauma, and air transport were similar, but mortality was significantly lower (43% vs. 23%, $p= 0.021$).

CONCLUSION: In our urban trauma system, PHIs are associated with a lower incidence of mortality in severely injured trauma patients and do not delay transport to definitive care.

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

J Trauma Acute Care Surg. 2015 Jul;79(1):39-46; discussion 46-7. doi: 10.1097/TA.0000000000000696.

Human dose confirmation for self-expanding intra-abdominal foam: A translational, adaptive, multicenter trial in recently deceased human subjects.

Mesar T(1), Martin D, Lawless R, Podbielski J, Cook M, Underwood S, Larentzakis A, Cotton B, Fagenholz P, Schreiber M, Holcomb JB, Marini J, Sharma U, Rago AP, King DR.

BACKGROUND: Noncompressible abdominal bleeding accounts for significant mortality in both military and civilian populations. There is an emergent need for a temporary hemostatic intervention whenever surgical care is not immediately available. Our team previously described a self-expanding polyurethane foam for the treatment of exsanguinating abdominal hemorrhage. The objective of this study was to translate a safe and effective swine dose into an appropriate human dose through foam administration in recently deceased humans with representative tissue compliance.

METHODS: With institutional review board oversight and informed consent at three centers, terminal patients were identified. Within 3 hours of death, the abdomen was accessed, and fluid was added to simulate hemorrhage. Foam was percutaneously administered using a prototype delivery system at multiple doses (45, 55, 65, 75, and 100 mL). Intra-abdominal pressure was monitored for 15 minutes, and then, foam was removed via laparotomy to assess abdominal tissue contact.

RESULTS: Twenty-one recently deceased patients ranging in age from 20 years to 92 years and body mass index from 18 kg/m to 39 kg/m were enrolled in the study. Foam was administered at a mean (SD) of 146 (34) minutes after death. Three subjects were screen failures, and three subjects were excluded from the analysis because of experimental errors. Change in intra-abdominal pressure and semiquantitative organ contact were used as surrogates to compare findings between humans and swine. Doses of 45, 55, and 65 mL resulted in peak pressures of 37 (20), 28 (8.1), and 33 (20) mmHg, respectively, within the acceptable range established in swine studies. Foam deployments of 75 mL and 100 mL exceeded acceptable pressures defined in swine. Higher foam doses tended to improve contact with the diaphragm, paracolic gutters, and liver.

CONCLUSION: The use of recently deceased humans demonstrates a novel approach to device evaluation in representative human anatomy, particularly when tissue compliance is critical. Sixty-five milliliters was determined to be the clinically appropriate dose for foam treatment in bleeding human patients.

J Spec Oper Med. 2015 Summer;15(2):79-85.

Clinical Guidelines for Stellate Ganglion Block to Treat Anxiety Associated With Posttraumatic Stress Disorder.

Mulvaney SW, Lynch JH, Kotwal RS.

ABSTRACT: Multiple case series published in the peer-reviewed medical literature have demonstrated the safety and efficacy of right-sided stellate ganglion block (SGB) for the treatment of anxiety symptoms associated with posttraumatic stress disorder (PTSD). As this is a new indication for a well-established procedure, there is relatively little information available to assist clinicians in determining the utility of SGB for their patients. Presented are clinical guidelines to assist the provider with patient selection, patient education, and follow-up. Also described is a technique to perform SGB under ultrasound-guidance. Although additional rigorous clinical research is needed to further investigate SGB for the treatment of anxiety symptoms associated with PTSD, these guidelines can also assist clinical investigators in their participant selection, design, and conduct of future research as it pertains tothis important topic.

J Trauma Acute Care Surg. 2015 Aug;79(2):221-6. doi: 10.1097/TA.0000000000000723.

Intravenous access in the prehospital settings: What can be learned from point-of-injury experience.

Nadler R(1), Gendler S, Benov A, Shina A, Baruch E, Twig G, Glassberg E.

BACKGROUND: Intravenous (IV) access has an essential role in the care provided for trauma patients, allowing for transfusion of blood products, fluids, and drugs. Decisions should be made regarding the necessity of IV access while considering cost-benefit of the procedure in terms of delayed evacuation times.

METHODS: A retrospective review of all trauma patients in whom at least one attempt at IV access was performed were reviewed. Data were abstracted from the Israeli Defense Force Trauma Registry.

RESULTS: Of 7,476 patients, 1,082 patients who had at least one documented attempt at IV access between January 1997 and April 2013 were included in this study. Overall cumulative success rate at IV access was 82%. Success rates for IV access were 86%, 68%, 63%, 50%, 20% for the first, second, third, fourth, and fifth attempts, respectively. The first and second attempts accounted for 96% of the successful procedures. Mortality in patients for whom IV access was successful was 13%; mortality in patients for whom IV access was not successful was 35%.

CONCLUSION: The success rate of IV access declined with each subsequent attempt. There was minimal improvement of overall success rate seen after the second attempt. Our findings suggest that the inability to obtain peripheral venous access is associated with severe injuries. These finding support a policy of limiting the number of venous access attempts to two attempts, followed by a reevaluation of need for parenteral access. Improved training of combat medics and paramedics might marginally increase the success rates of IV access. Point-of-injury data, used for ongoing learning and research, form the ground for improving combat casualty care and thus help saving lives.

LEVEL OF EVIDENCE: Therapeutic study, level IV.

Ann Emerg Med. 2015 Jul;66(1):30-41, 41.e1-3. doi: 10.1016/j.annemergmed.2014.12.004. Epub 2015 Jan 14.

Revisiting the "Golden Hour": An Evaluation of Out-of-Hospital Time in Shock and Traumatic Brain Injury.

Newgard CD, Meier EN, Bulger EM, Buick J, Sheehan K, Lin S, Minei JP, Barnes-Mackey RA, Brasel K; ROC Investigators.

STUDY OBJECTIVE: We evaluate patients with shock and traumatic brain injury who were previously enrolled in an out-of-hospital clinical trial to test the association between out-of-hospital time and outcome.

METHODS: This was a secondary analysis of patients with shock and traumatic brain injury who were aged 15 years or older and enrolled in a Resuscitation Outcomes Consortium out-of-hospital clinical trial by 81 emergency medical services agencies transporting to 46 Level I and II trauma centers in 11 sites (May 2006 through May 2009). Inclusion criteria were systolic blood pressure less than or equal to 70 mm Hg or systolic blood pressure 71 to 90 mm Hg with pulse rate greater than or equal to 108 beats/min (shock cohort) and Glasgow Coma Scale score less than or equal to 8 (traumatic brain injury cohort); patients meeting both criteria were placed in the shock cohort. Primary outcomes were 28-day mortality (shock cohort) and 6-month Glasgow Outcome Scale-Extended score less than or equal to 4 (traumatic brain injury cohort).

RESULTS: There were 778 patients in the shock cohort (26% 28-day mortality) and 1,239 patients in the traumatic brain injury cohort (53% 6-month Glasgow Outcome Scale-Extended score ≤4). Out-of-hospital time greater than 60 minutes was not associated with worse outcomes after accounting for important confounders in the shock cohort (adjusted odds ratio [aOR] 1.42; 95% confidence interval [CI] 0.77 to 2.62) or traumatic brain injury cohort (aOR 0.77; 95% CI 0.51 to 1.15). However, shock patients requiring early critical hospital resources and arriving after 60 minutes had higher 28-day mortality (aOR 2.37; 95% CI 1.05 to 5.37); this finding was not observed among a similar traumatic brain injury subgroup.

CONCLUSION: Among out-of-hospital trauma patients meeting physiologic criteria for shock and traumatic brain injury, there was no association between time and outcome. However, the subgroup of shock patients requiring early critical resources and arriving after 60 minutes had higher mortality.

J Anesth. 2015 Jul 24. [Epub ahead of print]

Evaluation of the efficacy of six supraglottic devices for airway management in dark conditions: a crossover randomized simulation trial.

Ohchi F, Komasawa N, Imagawa K, Okamoto K, Minami T.

PURPOSE: During out-of-hospital cardiopulmonary resuscitation, several factors can render tracheal intubation more difficult, such as when rescuers must secure the airway in complete darkness or with limited illumination. The purpose of this study was to evaluate the efficacy of six supraglottic devices (SGDs), ProSeal(®) (ProSeal), Classic(®) (Classic), Supreme(®) (Supreme), Laryngeal Tube(®) (LT), air-Q(®) (air-Q), and i-gel(®) (i-gel), for airway management under light and dark conditions using a manikin.

METHODS: Seventeen novice doctors and 15 experienced doctors performed insertion of six SGDs under light and dark conditions using an adult manikin. Insertion time, successful ventilation rate, and subjective insertion difficulty on a visual analogue scale (VAS) were measured.

RESULTS: Both novice and experienced doctors had a significantly lower ventilation success rate in the dark than in the light when ProSeal and Classic were used, but not with the other four SGDs. Novice doctors required a significantly longer insertion time in the dark than in the light with all SGDs. Experienced doctors required a significantly longer insertion time in the dark than in the light with ProSeal or Classic, but not with the other four SGDs. VAS was significantly higher for both novice and experienced doctors when ProSeal and Classic were used, as compared with the other four SGDs in the dark.

CONCLUSIONS: Compared to ProSeal and Classic, Supreme, i-gel, LT, and air-Q are more effective for airway management in the dark. Our findings suggest that anatomically shaped SGDs may help novice doctors secure the airway under dark conditions.

J Spec Oper Med. 2015 Summer;15(2):17-24.

Replacement of Promethazine With Ondansetron for Treatment of Opioid- and Trauma-Related Nausea and Vomiting in Tactical Combat Casualty Care.

Onifer DJ, Butler FK, Gross KR, Otten EJ, Patton R, Russell RJ, Stockinger Z, Burrell E.

ABSTRACT: The current Tactical Combat Casualty Care (TCCC) Guidelines recommend parenteral promethazine as the single agent for the treatment of opioid-induced nausea and/or vomiting and give a secondary indication of "synergistic analgesic effect." Promethazine, however, has a well-documented history of undesired side effects relating to impairment and dysregulation of the central and autonomic nervous systems, such as sedation, extrapyramidal symptoms, dystonia, impairment of psychomotor function, neuroleptic malignant syndrome, and hypotension. These may be particularly worrisome in the combat casualty. Additionally, since 16 September 2009, there has been a US Food and Drug Administration (FDA) black box warning for the injectable form of promethazine, due to "the risk of serious tissue injury when this drug is administered incorrectly." Conversely, ondansetron, which is now available in generic form, has a well-established favorable safety profile and demonstrated efficacy in undifferentiated nausea and vomiting in the emergency department and prehospital settings. It has none of the central and autonomic nervous system side effects noted with promethazine and carries no FDA black box warning. Ondansetron is available in parenteral form and an orally disintegrating tablet, providing multiple safe and effective routes of administration. Despite the fact that it is an off-label use, ondansetron is being increasingly given for acute, undifferentiated nausea and vomiting and is presently being used in the field on combat casualties by some US and Allied Forces. Considering the risks involved with promethazine use, and the efficacy and safety of ondansetron and ondansetron?s availability in a generic form, we recommend removing promethazine from the TCCC Guidelines and replacing it with ondansetron.

Vox Sang. 2015 Apr 30. doi: 10.1111/vox.12279. [Epub ahead of print]

Protocol guided bleeding management improves cardiac surgery patient outcomes.

Pearse BL, Smith I, Faulke D, Wall D, Fraser JF, Ryan EG, Drake L, Rapchuk IL, Tesar P, Ziegenfuss M, Fung YL.

BACKGROUND AND OBJECTIVES: Excessive bleeding is a risk associated with cardiac surgery. Treatment invariably requires transfusion of blood products; however, the transfusion itself may contribute to postoperative sequelae. Our objective was to analyse a quality initiative designed to provide an evidenced-based approach to bleeding management.

MATERIALS AND METHODS: A retrospective analysis compared blood product transfusion and patient outcomes 15 months before and after implementation of a bleeding management protocol. The protocol incorporated point-of-care coagulation testing (POCCT) with ROTEM and Multiplate to diagnose the cause of bleeding and monitor treatment.

RESULTS: Use of the protocol led to decreases in the incidence of transfusion of PRBCs 47·3% vs. 32·4%; P < 0·0001), FFP (26·9% vs. 7·3%; P < 0·0001) and platelets (36·1% vs. 13·5%; P < 0·0001). During the intra-operative period, the percentage of patients receiving cryoprecipitate increased (2·7% vs. 5·1%; P = 0·002), as did the number of units transfused (248 vs. 692; P < 0·0001). The proportion of patients who received tranexamic acid increased (13·7% to 68·2%; P < 0·0001). There were reductions in re-exploration for bleeding (5·6% vs. 3·4; P = 0·01), superficial chest wound (3·3% vs. 1·4%; P = 0·002), leg wound infection (4·6% vs. 2·0%; P < 0·0001) and a 12% reduction in mean length of stay from operation to discharge (95%: 9-16%, P < 0·0001). Acquisition cost of blood products decreased by $1 029 118 in the 15-month period with the protocol.

CONCLUSIONS: The implementation of a bleeding management protocol supported by POCCT in a cardiac surgery programme was associated with significant reductions in the transfusion of allogeneic blood products, improved outcomes and reduced cost.

Curr Rev Musculoskelet Med. 2015 Sep;8(3):312-7. doi: 10.1007/s12178-015-9289-4.

High velocity gunshot injuries to the extremities: management on and off the battlefield.

Penn-Barwell JG(1), Brown KV, Fries CA.

ABSTRACT: The gunshot wounds sustained on the battlefield caused by military ammunition can be different in nature to those usually encountered in the civilian setting. The main difference is that military ammunition has typically higher velocity with therefore greater kinetic energy and consequently potential to destroy tissue. The surgical priorities in the management of gunshot wounds are hemorrhage control, preventing infection, and reconstruction. The extent to which a gunshot wound needs to be surgically explored can be difficult to determine and depends on the likely amount of tissue destruction and the delay between wounding and initial surgical treatment. Factors associated with greater energy transfer, e.g., bullet fragmentation and bony fractures, are predictors of increased wound severity and therefore a requirement for more surgical exploration and likely debridement. Gunshot wounds should never be closed primarily; the full range of reconstruction from secondary intention to free tissue transfer may be required.

Eur J Emerg Med. 2015 Jun 23. [Epub ahead of print]

The prehospital intravenous access assessment: a prospective study on intravenous access failure and access delay in prehospital emergency medicine.

Prottengeier J, Albermann M, Heinrich S, Birkholz T, Gall C, Schmidt J.

OBJECTIVES: Intravenous access in prehospital emergency care allows for early administration of medication and extended measures such as anaesthesia. Cannulation may, however, be difficult, and failure and resulting delay in treatment and transport may have negative effects on the patient. Therefore, our study aims to perform a concise assessment of the difficulties of prehospital venous cannulation.

METHODS: We analysed 23 candidate predictor variables on peripheral venous cannulations in terms of cannulation failure and exceedance of a 2 min time threshold. Multivariate logistic regression models were fitted for variables of predictive value ($P<0.25$) and evaluated by the area under the curve ($AUC>0.6$) of their respective receiver operating characteristic curve.

RESULTS: A total of 762 intravenous cannulations were enroled. In all, 22% of punctures failed on the first attempt and 13% of punctures exceeded 2 min. Model selection yielded a three-factor model (vein visibility without tourniquet, vein palpability with tourniquet and insufficient ambient lighting) of fair accuracy for the prediction of puncture failure ($AUC=0.76$) and a structurally congruent model of four factors (failure model factors plus vein visibility with tourniquet) for the exceedance of the 2 min threshold ($AUC=0.80$).

CONCLUSION: Our study offers a simple assessment to identify cases of difficult intravenous access in prehospital emergency care. Of the numerous factors subjectively perceived as possibly exerting influences on cannulation, only the universal - not exclusive to emergency care - factors of lighting, vein visibility and palpability proved to be valid predictors of cannulation failure and exceedance of a 2 min threshold.

Spine (Phila Pa 1976). 2015 Jul 22. [Epub ahead of print]

Two doses of tranexamic acid reduce blood transfusion in complex spine surgery: A prospective randomized study.

Raksakietisak M, Sathitkarnmanee B, Srisaen P, Duangrat T, Chinachoti T, Rushatamukayanunt P, Sakulpacharoen N.

STUDY DESIGN: Prospective, double-blinded, randomized controlled study.

OBJECTIVE: To determine whether the use of two doses of tranexamic acid (TXA) can reduce perioperative blood loss and blood transfusions in low-risk adult patients undergoing complex laminectomy.

SUMMARY OF BACKGROUND DATA: Complex laminectomy (multilevel laminectomy or laminectomy and instrumentation) is a procedure with a medium risk of blood loss, which may require allogeneic blood transfusion. Previous studies of TXA showed its inconsistent effectiveness in reducing blood loss during spine surgery. The negative results may stem from ineffective use of a single dose of tranexamic acid during long and complex operations.

METHODS: Eighty adult (18-65 years old) patients in Siriraj Hospital, Mahidol University, Thailand were enrolled and allocated into two groups (40 patients in each group) by computer-generated randomization. Patients with history of thromboembolic diseases were excluded. Anesthesiologists in charge and patients were blinded. Group I received 0.9% NaCl (NSS) or placebo and group II received two doses (15 mg/kg) of TXA. The first dose was administered before anesthesia induction and the second dose, after 3 hours. The assessed outcomes were the amount of perioperative blood loss and the incidence of blood transfusions.

RESULTS: Seventy eight patients were analyzed (one patient in each group was excluded) with 39 patients randomized to each group. There were no differences in patient demographics and pre- and postoperative hematocrit levels. The total blood loss in the control group (NSS) was higher [900 (160, 4150) ml] than in the TXA group [600 (200, 4750) ml]. Patients in the control group received more crystalloid, colloid, and packed red blood cell transfusions. Within 24 hours, we observed a 64.6% reduction of blood transfusions (43.5% vs.15.4%, p = 0.006). No serious thromboembolic complications occurred.

CONCLUSIONS: Two effective doses (15 mg/kg) of tranexamic acid can reduce blood loss and transfusions in low-risk adults undergoing complex spine surgery.

J Thromb Haemost. 2015 Jun;13 Suppl 1:S195-9. doi: 10.1111/jth.12878.

Tranexamic acid in trauma: how should we use it?

Roberts I

SUMMARY: Tranexamic acid (TXA) reduces blood loss by inhibiting the enzymatic breakdown of fibrin. It is often used in surgery to decrease bleeding and the need for blood transfusion. In 2011, results from a multi-center, randomized, and placebo-controlled trial (CRASH-2 trial) showed that TXA (1 g loading dose over 10 min followed by an infusion of 1 g over 8 h) safely reduces mortality in bleeding trauma patients. Initiation of TXA treatment within 3 h of injury reduces the risk of hemorrhage death by about one-third, regardless of baseline risk. Because it does not have any serious adverse effects, TXA can be administered to a wide spectrum of bleeding trauma patients. Limiting its use to the most severely injured or those with a diagnosis of 'hyperfibrinolysis' would result in thousands of avoidable deaths. A clinical trial (CRASH-3 trial) of TXA in patients with traumatic brain injury is now in progress.

J Spec Oper Med. 2015 Summer;15(2):25-41.

Saving Lives on the Battlefield (Part II) - One Year Later A Joint Theater Trauma System and Joint Trauma System Review of Prehospital Trauma Care in Combined Joint Operations Area - Afghanistan (CJOA-A) Final Report, 30 May 2014.

Sauer SW, Robinson JB, Smith MP, Gross KR, Kotwal RS, Mabry RL, Butler FK, Stockinger ZT, Bailey JA, Mavity ME, Gillies DA 2nd.

New Recommendations:

1. DoD establishes TCCC Guidelines as the DoD standard of care for prehospital care.
2. DoD conducts a DOTMLPF-P assessment across Services to assess and implement TCCC Guideline capability.
3. DoD systematically reviews and corrects all prehospital care doctrine across the spectrum to accurately represent TCCC Guidelines with the doctrine specifically stating “in accordance with the current TCCC Guidelines published by the Committee on Tactical Combat Casualty Care” to ensure that the doctrine remains current.
4. Services immediately implement an aggressive transition initiative to update all relevant medical equipment sets and medical logistic policies to ensure units have TCCC Guideline-specified medical materials.
5. DoD establishes a Battlefield Prehospital Trauma Care Program Proponent (or equivalent structure) in the DHA.
6. DoD develops and mandates a TCCC Accreditation, Certification, and Recertification program like Basic Life Support, Advanced Trauma Life Support, and Advanced Cardiac Life Support for all military personnel with a requirement for biannual recertification and as based on level of ability and position (e.g., nonmedical first responder, non-medical leader, medical provider, medical leader).
7. Services require and track TCCC certification for all prehospital medical personnel and integrate tracking into combatant Unit Status Reports.
8. Services incorporate TCCC Champion training into all basic and advanced officer and noncommissioned officer professional military development courses.
9. Services incorporate and mandate casualty management and hands-on practical exercises into all professional military development courses.
10. DoD updates the Joint Capability Requirement for Tactical Enroute Care to include the ability to provide advanced resuscitative care from the point of injury.
11. As military physicians are ultimately responsible for assuming the role of EMS director for prehospital services if assigned to a combatant unit, the military Services should study and develop career, educational, and assignment tracks for operational medical corps officers, with emphasis on prehospital care delivery.

J Trauma Acute Care Surg. 2015 Jun 30. [Epub ahead of print]

A comparison of live tissue training and high-fidelity patient simulator: A pilot study in battlefield trauma training.

Savage LE, Tenn C, Vartanian O, Blackler K, Sullivan-Kwantes W, Garrett M, Blais AR, Jarmasz J, Peng H, Pannell CD, Tien CH.

BACKGROUND: Trauma procedural and management skills are often learned on live tissue. However, there is increasing pressure to use simulators because their fidelity improves and as ethical concerns increase. We randomized military medical technicians (medics) to training on either simulators or live tissue to learn combat casualty care skills to determine if the choice of modality was associated with differences in skill uptake.

METHODS: Twenty medics were randomized to trauma training using either simulators or live tissue. Medics were trained to perform five combat casualty care tasks (surgical airway, needle decompression, tourniquet application, wound packing, and intraosseous line insertion). We measured skill uptake using a structured assessment tool. The medics also completed exit questionnaires and interviews to determine which modality they preferred.

RESULTS: We found no difference between groups trained with live tissue versus simulators in how they completed each combat casualty care skill. However, we did find that the modality of assessment affected the assessment score. Finally, we found that medics preferred trauma training on live tissue because of the fidelity of tissue handling in live tissue models. However, they also felt that training on simulators also provided additional training value.

CONCLUSION: We found no difference in performance between medics trained on simulators versus live tissue models. Even so, medics preferred live tissue training over simulation. However, more studies are required, and future studies need to address the measurement bias of measuring outcomes in the same model on which the study participants are trained.

LEVEL OF EVIDENCE: Randomized controlled trial, education, level I.

J Trauma Acute Care Surg. 2015 Jul;79(1):10-4; discussion 14. doi: 10.1097/TA.0000000000000689.

A multi-institutional analysis of prehospital tourniquet use.

Schroll R, Smith A, McSwain NE Jr, Myers J, Rocchi K, Inaba K, Siboni S, Vercruysse GA, Ibrahim-Zada I, Sperry JL, Martin-Gill C, Cannon JW, Holland SR, Schreiber MA, Lape D, Eastman AL, Stebbins CS, Ferrada P, Han J, Meade P, Duchesne JC.

BACKGROUND: Recent military studies demonstrated an association between prehospital tourniquet use and increased survival. The benefits of this prehospital intervention in a civilian population remain unclear. The aims of our study were to evaluate tourniquet use in the civilian population and to compare outcomes to previously published military experience. We hypothesized that incorporation of tourniquet use in the civilian population will result in an overall improvement in mortality.

METHODS: This is a preliminary multi-institutional retrospective analysis of prehospital tourniquet (MIA-T) use of patients admitted to nine urban Level 1 trauma centers from January 2010 to December 2013. Patient demographics and mortality from a previous military experience by Kragh et al. (Ann Surg. 2009;249:1-7) were used for comparison. Patients younger than 18 years or with nontraumatic bleeding requiring tourniquet application were excluded. Data were analyzed using a two-tailed unpaired Student's t test with $p < 0.05$ as significant.

RESULTS: A total of 197 patients were included. Tourniquets were applied effectively in 175 (88.8%) of 197 patients. The average Injury Severity Score (ISS) for MIA-T versus military was 11 ± 12.5 versus 14 ± 10.5, respectively ($p = 0.02$). The overall mortality and limb amputation rates for the MIA-T group were significantly lower than previously seen in the military population at 6 (3.0%) of 197 versus 22 (11.3%) of 194 ($p = 0.002$) and 37 (18.8%) of 197 versus 97 (41.8%) of 232 ($p = 0.0001$), respectively.

CONCLUSION: Our study is the largest evaluation of prehospital tourniquet use in a civilian population to date. We found that tourniquets were applied safely and effectively in the civilian population. Adaptation of this prehospital intervention may convey a survival benefit in the civilian population.

LEVEL OF EVIDENCE: Epidemiologic study, level V.

J Am Coll Surg. 2015 Aug;221(2):235-54. doi: 10.1016/j.jamcollsurg.2015.04.014. Epub 2015 Apr 27.

Winds of War: Enhancing Civilian and Military Partnerships to Assure Readiness: White Paper. 2015 ACS Scudder Oration

Schwab CW

ABSTRACT: This White Paper summarizes the state of readiness of combat surgeons and provides action recommendations that address the problems of how to train, sustain, and retain them for future armed conflicts. As the basis for the 2014 Scudder Oration, I explored how to secure an improved partnership between military and civilian surgery, which would optimize learning platforms and embed military trauma personnel at America's academic medical universities for trauma combat casualty care (TCCC). To craft and validate these recommendations, I conducted an integrative and iterative process of literature reviews, interviews of military and civilian leaders, and a survey of military-affiliated surgeons. The recommended action points advance the training of combat surgeons and their trauma teams by creating an expanded network of TCCC training sites and sourcing the cadre of combat-seasoned surgeons currently populating our civilian and military teaching hospitals and universities. The recommendation for the establishment of a TCCC readiness center or command within the Medical Health System of the Department of Defense includes a military and civilian advisory board, with the reformation of a think tank of content experts to address high-level solutions for military medicine, readiness, and TCCC.

Prehosp Emerg Care. 2015 Aug 19:1-4. [Epub ahead of print]

Immediate Lower Extremity Tourniquet Application to Delay Onset of Reperfusion Injury after Prolonged Crush Injury.

Schwartz DS, Weisner Z, Badar J.

ABSTRACT: Reperfusion after severe crush injury is an infrequent, but life-threatening condition. It is a unique aspect of prehospital medicine that occurs in the presence of emergency responders attempting to extricate and treat patients who have suffered a crushing injury. These events are unlikely to occur in the hospital setting and, as a result, remain poorly studied. Some evidence exists regarding prophylaxis, but the efficacy of these treatments has not been clearly established. The use of commercial tourniquets to delay the onset of reperfusion injury has previously been described in theory. Extensive literature now exists supporting the safety of tourniquet use in limb trauma and this potential life-saving measure requires further study in patients with crush injury. We present a case of prehospital tourniquet application to delay reperfusion injury after crush injury that resulted in a reduction in morbidity and complete limb salvage.

Key words: crush injury, prehospital, reperfusion injury, tourniquet.

J Trauma Acute Care Surg. 2015 Jul;79(1):159-73. doi: 10.1097/TA.0000000000000648.

An evidence-based approach to patient selection for emergency department thoracotomy: A practice management guideline from the Eastern Association for the Surgery of Trauma.

Seamon MJ, Haut ER, Van Arendonk K, Barbosa RR, Chiu WC, Dente CJ, Fox N, Jawa RS, Khwaja K, Lee JK, Magnotti LJ, Mayglothling JA, McDonald AA, Rowell S, To KB, Falck-Ytter Y, Rhee P.

BACKGROUND: Within the GRADE (Grading of Recommendations Assessment, Development and Evaluation) framework, we performed a systematic review and developed evidence-based recommendations to answer the following PICO (Population, Intervention, Comparator, Outcomes) question: should patients who present pulseless after critical injuries (with and without signs of life after penetrating thoracic, extrathoracic, or blunt injuries) undergo emergency department thoracotomy (EDT) (vs. resuscitation without EDT) to improve survival and neurologically intact survival?

METHODS: All patients who underwent EDT were included while those involving either prehospital resuscitative thoracotomy or operating room thoracotomy were excluded. Quantitative synthesis via meta-analysis was not possible because no comparison or control group (i.e., survival or neurologically intact survival data for similar patients who did not undergo EDT) was available for the PICO questions of interest.

RESULTS: The 72 included studies provided 10,238 patients who underwent EDT. Patients presenting pulseless after penetrating thoracic injury had the most favorable EDT outcomes both with (survival, 182 [21.3%] of 853; neurologically intact survival, 53 [11.7%] of 454) and without (survival, 76 [8.3%] of 920; neurologically intact survival, 25 [3.9%] of 641) signs of life. In patients presenting pulseless after penetrating extrathoracic injury, EDT outcomes were more favorable with signs of life (survival, 25 [15.6%] of 160; neurologically intact survival, 14 [16.5%] of 85) than without (survival, 4 [2.9%] of 139; neurologically intact survival, 3 [5.0%] of 60). Outcomes after EDT in pulseless blunt injury patients were limited with signs of life (survival, 21 [4.6%] of 454; neurologically intact survival, 7 [2.4%] of 298) and dismal without signs of life (survival, 7 [0.7%] of 995; neurologically intact survival, 1 [0.1%] of 825).

CONCLUSION: We strongly recommend that patients who present pulseless with signs of life after penetrating thoracic injury undergo EDT. We conditionally recommend EDT for patients who present pulseless and have absent signs of life after penetrating thoracic injury, present or absent signs of life after penetrating extrathoracic injury, or present signs of life after blunt injury. Lastly, we conditionally recommend against EDT for pulseless patients without signs of life after blunt injury.

LEVEL OF EVIDENCE: Systematic review/guideline, level III.

J Trauma Acute Care Surg. 2015 Jun;78(6 Suppl 1):S18-25. doi: 10.1097/TA.0000000000000629.

All plasma products are not created equal: Characterizing differences between plasma products.

Spinella PC, Frazier E, Pidcoke HF, Dietzen DJ, Pati S, Gorkun O, Aden JK, Norris PJ, Cap AP.

BACKGROUND: Plasma can be manufactured by multiple methods. Few studies have compared quality parameters between plasma products that may affect efficacy and safety.

METHODS: Four different plasma products were analyzed to include fresh frozen plasma (FFP), liquid plasma (LP), solvent detergent plasma (SDP), and a spray-dried, solvent detergent-treated plasma (SD-SDP) at multiple time points of storage. Parameters measured included red blood cell, platelet, and white blood cell counts; microparticle phenotypes; thrombin generation; and thrombelastography. These parameters were compared in 10 samples of each product.

RESULTS: SDP and SD-SDP contained the smallest number of residual cells compared with FFP and LP. Platelets were the most common residual cell in all products and were highest in LP. FFP contained the greatest number of residual red blood cells. Total microparticle counts were elevated in LP and FFP compared with SDP and SD-SDP. Cell-derived microparticles in both LP and FFP were mostly platelet in origin. Microparticle counts in SDP and SD-SDP were negligible. Thrombelastography results demonstrated similar thrombin, fibrinogen, and platelet function on Day 28 LP compared with Day 5 thawed FFP. Thrombin generation assays revealed that the total, lag time to, and peak thrombin formation were higher in SDP and SD-SDP compared with FFP and LP. All parameters in FFP and LP products were characterized by a large degree of variability.

CONCLUSION: The differences in cellular, microparticle, and functional hemostatic parameters measured between plasma products have the potential to affect efficacy and safety. Further study is needed to elucidate the potential immune effects of the cellular and microparticle differences noted as well as the clinical implications of altered thrombin generation kinetics in SD products.

J Trauma Acute Care Surg. 2015 Aug;79(2):256-62. doi:10.1097/TA.0000000000000746.

Effects of rapid wound sealing on survival and blood loss in a swine model of lethal junctional arterial hemorrhage.

St John AE, Wang X, Lim EB, Chien D, Stern SA, White NJ

BACKGROUND: Hemostatic gauzes, which must be packed into wounds and compressed for several minutes, may be of limited use for noncompressible wounds in junctional anatomic locations. Rapid mechanical wound sealing is an alternative approach that seals the wound at the skin, allowing internal clot formation. We evaluate wound sealing for junctional hemorrhage control using a hemostatic clamp (iTClamp).

METHODS: Severe junctional hemorrhage was induced in anesthetized immature female swine using a 5-mm femoral arteriotomy. After 30 seconds of free bleeding, animals were randomized to one of seven hemostatic interventions: no intervention (control), direct compression for 3 minutes (compression), plain gauze packing (packing), mechanical wound seal (seal), plain gauze packing + wound seal (packing + seal), plain gauze packing + compression (packing + compression), or hemostatic gauze packing (Combat Gauze) + compression (HS-packing + compression). All animals then received one 15-mL/kg bolus of Hextend, followed by lactated Ringer's solution for hypotension up to 100 mL/kg. Animals were monitored for 3 hours.

RESULTS: Survival was similar between control (3-hour survival, 0%) and compression (0%, Kaplan-Meier survival analysis and log-rank test [KM-LR], $p = 1.0$) but marginally improved with packing (12.5%, KM-LR, $p < 0.001$). Survival improved with seal (62.5%) versus control (KM-LR, $p < 0.001$) and with packing + seal (100%) versus packing alone (KM-LR, $p < 0.001$). Survival was similar between packing + compression (87.5%), HS-packing + compression (62.5%), and packing + seal (100%) (KM-LR, $p \geq 0.05$). Total hemorrhage volume was decreased for seal versus control ($p < 0.001$) and for packing + seal versus packing ($p < 0.001$). Hemorrhage was similar among packing + compression, HS-packing + compression, seal, and packing + seal (analysis of variance $p \geq 0.05$). Application times (mean [SD]) were significantly faster with packing + seal (125.8 [56.2] seconds) than packing + compression (236.6 [7.2] seconds) and HS-packing + compression (223.0 [6.8] seconds) (analysis of variance, all $p < 0.001$).

CONCLUSION: In this preclinical junctional hemorrhage model, rapid wound sealing improved survival and decreased hemorrhage in both packed and unpacked wounds and performed comparably with standard-of-care hemostatic bandages. Rapidly sealing junctional wounds may be a viable alternative to wound compression.

J Trauma Acute Care Surg. 2015 Jun;78(6 Suppl 1):S31-8. doi: 10.1097/TA.0000000000000628.

Coagulation function of stored whole blood is preserved for 14 days in austere conditions: A ROTEM feasibility study during a Norwegian antipiracy mission and comparison to equal ratio reconstituted blood.

Strandenes G, Austlid I, Apelseth TO, Hervig TA, Sommerfelt-Pettersen J, Herzig MC, Cap AP, Pidcoke HF, Kristoffersen EK.

BACKGROUND: Formulation of a medical preparedness plan for treating severely bleeding casualties during naval deployment is a significant challenge because of territory covered during most missions. The aim of this study was to evaluate the concept of "walking blood bank" as a supportable plan for supplying safe blood and blood products.

METHODS: In 2013, the Royal Norwegian Navy conducted antipiracy operations from a frigate, beginning in the Gulf of Aden and ending in the Indian Ocean. Crews were on 24-hour emergency alert in preparation for an enemy assault on the frigate. Under an approved command protocol, a "walking blood bank," using crew blood donations, was established for use on board and on missions conducted in rigid-hulled inflatable boats, during which freeze-dried plasma and leukoreduced, group O low anti-A/anti-B titer, cold-stored whole blood were stored in Golden Hour Boxes. Data demonstrating the ability to collect, store, and provide whole blood were collected to establish feasibility of implementing a whole blood-focused remote damage-control resuscitation program aboard a naval vessel. In addition, ROTEM data were collected to demonstrate feasibility of performing this analysis on a large naval vessel and to also measure hemostatic efficacy of cold-stored leukoreduced whole blood (CWB) stored during a period of 14 days. ROTEM data on CWB was compared with reconstituted whole blood.

RESULTS: Drills simulating massive transfusion activation were conducted, in which 2 U of warm fresh whole blood with platelet sparing leukoreduction were produced in 40 minutes, followed by collection of two additional units at 15-minute increments. The ROTEM machine performed well during ship-rolling, as shown by the overlapping calculated and measured mechanical piston movements measured by the ROTEM device. Error messages were recorded in 4 (1.5%) of 267 tests. CWB yielded reproducible ROTEM results demonstrating preserved fibrinogen function and platelet function for at least 3.5 weeks and 2 weeks, respectively. The frequency of ROTEM tests were as follows: EXTEM (n = 88), INTEM (n = 85), FIBTEM (n = 82), and APTEM (n = 12). CWB results were grouped. Compared with Days 0 to 2, EXTEM maximum clot firmness was significantly reduced, beginning on Days 10 to 14; however, results through that date remained within reference ranges and were comparable with the EXTEM maximum clot firmness for the reconstituted whole blood samples containing Day 5 room temperature-stored platelets.

CONCLUSION: A "walking blood bank" can provide a balanced transfusion product to support damage-control resuscitation/remote damage-control resuscitation aboard a frigate in the absence of conventional blood bank products. ROTEM analysis is feasible to monitor damage-control resuscitation and blood product quality. ROTEM analysis was possible in challenging operational conditions.

LEVEL OF EVIDENCE: Therapeutic study, level V.

Transfusion. 2015 Aug;55(8):1830-7. doi: 10.1111/trf.13156. Epub 2015 May 27.

How we provide thawed plasma for trauma patients.

Stubbs JR, Zielinski MD, Berns KS, Badjie KS, Tauscher CD, Hammel SA, Zietlow SP, Jenkins

ABSTRACT: Almost 50% of trauma-related fatalities within the first 24 hours of injury are related to hemorrhage. Improved survival in severely injured patients has been demonstrated when massive transfusion protocols are rapidly invoked as part of a therapeutic approach known as damage control resuscitation (DCR). DCR incorporates the early use of plasma to prevent or correct trauma-induced coagulopathy. DCR often requires the transfusion of plasma before determination of the recipient's ABO group. Historically, group AB plasma has been considered the "universal donor" plasma product. At our facility, the number of AB plasma products produced on an annual basis was found to be inadequate to support the trauma service's DCR program. A joint decision was made by the transfusion medicine and trauma services to provide group A thawed plasma (TP) for in-hospital and prehospital DCR protocols. A description of the implementation of group A TP into the DCR program is provided as well as outcome data pertaining to the use of TP in trauma patients.

J Trauma Acute Care Surg. 2015 Jun;78(6 Suppl 1):S26-30. doi: 10.1097/TA.0000000000000633.

Freeze dried plasma and fresh red blood cells for civilian prehospital hemorrhagic shock resuscitation.

Sunde GA, Vikenes B, Strandenes G, Flo KC, Hervig TA, Kristoffersen EK, Heltne JK.

BACKGROUND: The last decade of military trauma care has emphasized the role of blood products in the resuscitation of hemorrhaging patients. Damage-control resuscitation advocates decreased crystalloid use and reintroduces blood components as primary resuscitative fluids. The systematic use of blood products have been described in military settings, but reports describing the use of freeze dried plasma (FDP) or red blood cells (RBCs) in civilian prehospital care are few. We describe our preliminary results after implementing RBCs and FDP into our Helicopter Emergency Medical Service (HEMS).

METHODS: We collected data on the use of FDP (LyoPlas N-w (AB)) during a 12-month period from May 31, 2013, to May 30, 2014, before RBC (0Rh (D) negative) introduction in June 2014. FDP and RBCs were indicated in trauma and medical patients presenting with clinical significant hemorrhage on scene. Data were obtained from HEMS registry and patient records.

RESULTS: Our preliminary results show that FDP was used in 16 patients (88% males) during the first year. Main patient categories were blunt trauma (n = 5), penetrating trauma (n = 4), and nontrauma (n = 7). Ten patients (62%) were hypotensive with systolic blood pressures less than 90 mm Hg on scene. The majority (75%) received tranexamic acid. Of 14 patients admitted to the hospital, 11 received emergency surgery and 8 needed additional transfusions within the first 24 hours. No transfusion-related complications were recorded. Two of the FDP patients died on scene, and the remaining 14 patients were alive after 30 days. Early results from the recent introduction of RBC show that RBCs were given to four patients. Two patients (one penetrating trauma and one blunt trauma patient) died on scene because of exsanguination, while additional two patients (one blunt trauma patient and one with ruptured aortic aneurism) survived to hospital discharge.

CONCLUSION: Our small study indicates that introduction of FDP into civilian HEMS seems feasible and may be safe and that logistical and safety issues for the implementation of RBCs are solvable. FDP ensures both coagulation factors and volume replacement, has a potentially favorable safety profile, and may be superior to other types of plasma for prehospital use. Further prospective studies are needed to clarify the role of FDP (and RBCs) in civilian prehospital hemorrhagic shock resuscitation and to aid the development of standardized protocols for prehospital use of blood products.

LEVEL OF EVIDENCE: Therapeutic study, level V.

Can J Surg. 2015 Jun;58(3 Suppl 3):S104-7.

Cervical spine injury in dismounted improvised explosive device trauma.

Taddeo J, Devine M, McAlister VC

BACKGROUND: The injury pattern from improvised explosive device (IED) trauma is different if the target is in a vehicle (mounted) or on foot (dismounted). Combat and civilian first response protocols require the placement of a cervical collar on all victims of a blast injury.

METHODS: We searched the Joint Theatre Trauma Registry (JTTR) and the Role 3 Hospital, Kandahar Airfield (KAF) database from Mar. 1, 2008, to May 31, 2011. We collected data on cervical fracture; head injury; traumatic amputation; initial blood pressure, pulse, injury severity score (ISS), Glasgow Coma Scale (GCS) score and base excess; and patient demographic information.

RESULTS: The concordance rate between JTTR and KAF databases was 98%. Of the 15 693 admissions in JTTR, 326 patients with dismounted IED injuries were located. The rate of cervical collar prehospital placement was 7.6%. Cervical fractures were found in 19 (5.8%) dismounted IED victims, but only 4 (1.2%) were considered radiographically unstable. None of these 19 patients had prehospital placement of a collar. Patients with cervical spine fractures were more severely injured than those without (ISS 18.2 v. 13.4; GCS 10.1 v. 12.5). Patients with head injuries had significantly higher risk of cervical spine injury than those with no head injury recorded (13.6% v. 3.9%). No differences in frequency of cervical spine injury were found between patients who had associated traumatic amputations and those who did not (5.4% v. 6.0%).

CONCLUSION: Dismounted IED is a mechanism of injury associated with a low risk for cervical spine trauma. A selective protocol for cervical collar placement on victims of dismounted IED blasts is possible and may be more amenable to combat situations.

J Trauma Acute Care Surg. 2015 Jun 30. [Epub ahead of print]

Causes of combat ocular trauma-related blindness from Operation Iraqi Freedom and Enduring Freedom.

Vlasov A, Ryan DS, Ludlow S, Weichel ED, Colyer MH.

BACKGROUND: The incidence of eye injuries in military service members is high in the combat setting. This is the first study that identifies the primary reason for poor visual acuity (worse than 20/200).

METHODS: This is a retrospective, noncomparative, interventional case series analyzing US Operation Iraqi and Enduring Freedom members who were evacuated from the theater of operations to Walter Reed Army Medical Center from 2001 through 2011. Primary outcome measures were the length of follow-up, globe survival, and anatomic causes of blindness. Secondary outcome measures included surgical procedures performed, use of eye protection, nonocular injuries, incidence of traumatic brain injury, source of injury, visual outcomes, and predictability of Ocular Trauma Score (OTS) on visual outcome. Univariate analysis was performed using χ and Fisher's exact test. A $p < 0.01$ was considered significant because of the multiple hypotheses tested.

RESULTS: There were 265 eyes of 239 patients who had final best-corrected visual acuity of worse than 20/200. The average age was 27.4 years (range, 19-53 years). Of the patients, 97.5% were male, and 28.9% had documented use of eye protection. The average follow-up was 350.19 days (range, 3-2,421 days). There were 128 right-eye and 133 left-eye injuries, with a total of 26 bilateral injuries. There were 206 open-globe and 56 closed-globe injuries, which were further subdivided into zones. Open-globe Zone III injuries (81.6%) were the number one cause of blindness, and most injuries were caused by improvised explosive devices (64.2%). Enucleation was the most common surgery performed (40.6%) and therefore the leading cause of blindness, followed by a multifactorial cause and direct traumatic optic neuropathy.

CONCLUSION: Ocular trauma is common among combat injuries. Close to a third of service members that experience an ocular trauma become legally blind. Further research is needed to focus on strategies to prevent injury and improve visual outcomes.

LEVEL OF EVIDENCE: Retrospective comparative study without negative criteria, level III.

J Spec Oper Med. 2015 Summer;15(2):71-3.

Rationale for Use of Intravenous Acetaminophen in Special Operations Medicine.

Vokoun ES.

ABSTRACT: Use of intravenous acetaminophen has increased recently as an opioid-sparing strategy for patients undergoing major surgery. Its characteristics and efficacy suggest that it would a useful adjunct in combat trauma medicine. This article reviews those characteristics, which include rapid onset, high peak plasma concentration, and favorable side-effect profile. Also discussed is the hepatotoxicity risk of acetaminophen in a combat trauma patient. It concludes that intravenous acetaminophen should be considered as an addition to the US Special Operations Command Tactical Trauma Protocols and supplied to medics for use in field care.

Int J Surg. 2015 Aug;20:1-7. doi: 10.1016/j.ijsu.2015.05.045. Epub 2015 Jun 3.

Safety and efficacy of intra-articular tranexamic acid injection without drainage on blood loss in total knee arthroplasty: A randomized clinical trial.

Wang CG, Sun ZH, Liu J, Cao JG, Li ZJ

BACKGROUND: Major blood loss is unavoidable after primary total knee arthroplasty (TKA). The aim of this study was to determine if tranexamic acid (TXA) can reduce major blood loss following TKA.

METHODS: In this double-blind, randomized, placebo-control trial, 60 patient treated with unilateral primary cement TKA between August 1st 2013 and September 30th 2013 were randomized into TXA 500 mg intra-articular injection without drainage (test group, 30 knees) and 30 patients with saline intra-articular injection (control group, 30 knees).

RESULTS: There was a significant reduction in mean blood loss (560.55 mL) between the groups at postoperative day (POD) 5 (999.22 mL vs. 1559.77 mL, P = 0.001). The maximum hemoglobin drop was identified at POD 3 (10.51 g/dL vs. 9.10 g/dL, mean difference = 1.41 g/dL). Also, there was a significant reduction in red blood cell and hematocrit loss (P = 0.001). The transfusion rates (0% vs. 23.3%, P = 0.011) and average amount transfused (0.00 ± 0.00 units vs. 0.53 ± 1.04 units, P = 0.009) were significantly lower in the TXA group compared with control group. No significant difference in coagulation marker changes were found between TXA and control groups (P > 0.05), but the D-dimer levels at 3 and 5 days post-TKA were statistically lower in the TXA group (P < 0.05). No significant changes in the rate of symptomatic deep venous thrombosis, pulmonary embolism, or wound healing problems were noted.

CONCLUSIONS: TXA treatment without drainage during TKA reduces the amount of blood transfusions required without increasing the rate of adverse events.

J Trauma Acute Care Surg. 2015 Jun;78(6 Suppl 1):S54-9. doi: 10.1097/TA.0000000000000636.

Update of use of hydroxyethyl starches in surgery and trauma.

Weiskopf RB, James MF.

Summary/Conclusion: Independent of the important methodological and interpretative flaws of two trials of HES in ICU populations (exclusively or with a substantial fraction of septic shock), there are well-established physiologic and pharmacologic principles strongly indicating that it is inappropriate to apply those data to a surgical or trauma population. In addition, there are important therapeutic differences regarding HES use in these populations (multiple doses given over several days or weeks vs. administration only for several hours). Regulatory warnings and prohibitions do not adequately address these issues.The data derived from 59 randomized clinical trials in surgery that enrolled nearly 5,000 patients, with approximately half given a tetrastarch, do not suggest an adverse safety signal (mortality, blood loss, transfusion, renal) in these populations but rather point to lesser blood loss and transfusion in patients given a tetrastarch. Two metaanalyses in these populations confirmed the mortality and renal findings (blood loss and transfusion not evaluated). In hypovolemic volunteers, a tetrastarch restores blood volume better than does a hetastarch. The single randomized trial evaluating an HES (a tetrastarch) in trauma found greater lactate clearance and lesser renal injury in those with penetrating trauma whowere given a tetrastarch rather than crystalloid.We conclude that there is an absence of adverse safety signals for the use of a modern HES in surgery and trauma and a possible indication of benefits in these clinical contexts.

Clin Orthop Relat Res. 2015 Aug;473(8):2639-43. doi: 10.1007/s11999-015-4334-6. Epub 2015 May 20.

Does Tranexamic Acid Reduce Blood Loss and Transfusion Requirements Associated With the Periacetabular Osteotomy?

Wingerter SA, Keith AD, Schoenecker PL, Baca GR, Clohisy JC.

BACKGROUND: Tranexamic acid (TXA) has shown safety and efficacy in reducing blood loss associated with various surgical procedures. However, to our knowledge there are no studies evaluating the effect of TXA on blood loss and transfusion requirements associated with periacetabular osteotomy (PAO).

QUESTIONS/PURPOSES: The main purpose of this study is to determine whether TXA reduces blood loss and transfusion use in patients undergoing PAO for symptomatic acetabular dysplasia. Our secondary purpose was to compare the frequency of symptomatic thromboembolic events between patients undergoing surgery with and without TXA.

METHODS: A consecutive series of 100 periacetabular osteotomies performed by one surgeon was reviewed to compare the groups immediately before and after implementation of routine use of tranexamic acid (two retrospective cohorts). TXA dosing followed an established protocol with a standard dose of 1 g infused intravenously during 10 minutes before skin incision and an additional 1 g intravenously at wound closure. Outcome measures include total estimated blood loss perioperatively and transfusion requirements. Total estimated blood loss was calculated using a formula built from the National Surgical Quality Improvement Program data regarding surgical blood loss.

RESULTS: The mean perioperative total estimated blood loss was less in the patients receiving TXA compared with blood loss in patients who did not receive TXA (706 mL versus 1021 mL; $p < 0.001$; 95% CI, -495 to -134). Twenty-six (52%) of the 50 patients who did not receive TXA had postoperative blood transfusions compared with 15 (30%) of 50 who received TXA (odds ratio, 0.395; 95% CI, 0.174-0.899; $p = 0.0414$). No symptomatic deep vein thromboses or symptomatic pulmonary emboli were identified in either group.

CONCLUSIONS: TXA reduces estimated blood loss and the frequency of transfusions in patients undergoing PAO for treatment of symptomatic acetabular dysplasia. Future prospective studies should confirm our findings to determine whether patients undergoing PAO should receive routine perioperative TXA.

LEVEL OF EVIDENCE: Level III, therapeutic study.

Int J Clin Exp Med. 2015 Apr 15;8(4):5959-71. eCollection 2015.

The effects of tranexamic acid and 6% hydroxyethyl starch (HES) solution (130/0.4) on postoperative bleeding in coronary artery bypass graft (CABG) surgery.

Yanartas M, Baysal A, Aydın C, Ay Y, Kara I, Aydın E, Cevirme D, Köksal C, Sunar H

BACKGROUND: The addition of 6% hydroxyethyl starch (HES) into Ringer lactate priming solution may have adverse effects on hemostasis in patients undergoing coronary artery bypass grafting (CABG) with cardiopulmonary bypass (CPB) with or without the use of tranexamic acid.

METHODS: In a prospective, randomized clinical trial, 132 patients were assigned to receive 20 ml/kg of Ringer priming solution with or without tranexamic acid (TA) (Group RS-TA, n=34 and Group RS-noTA, n=32) or 10 ml/kg of 6% HES plus 10 ml/kg of RS priming solution with or without intravenous tranexamic acid (Group HES-TA, n=35 and Group HES-noTA, n=31). Estimated blood loss, chest tube drainage, amount of blood products, hemoglobin, hematocrit, platelet and coagulation parameters were examined before and 24 hour after surgery.

RESULTS: For Group HES with tranexamic acid, when compared to other groups, estimated blood loss, postoperative 24 hour drainage loss and blood product transfusions were less (P=0.023; P=0.003; P=0.001; respectively) and hemoglobin, hematocrit values at 12 and 24 hours after surgery increased in comparison to other groups (P=0.041, P=0.034, P=0.004, P=0.001; respectively). Platelet concentrations were similar between groups (P>0.05).

CONCLUSIONS: In CABG, the administration of tranexamic acid in HES 130/0.4 prime solution study group decreased estimated blood loss and chest tube drainage in comparison to patients receving Ringer prime solution with or without tranexamic acid postoperatively however, no effects on renal functions or postoperative complications were shown.

Orthopedics. 2015 May;38(5):315-24. doi: 10.3928/01477447-20150504-06.

Effect of Topical Tranexamic Acid in Reducing Bleeding and Transfusions in TKA.

Yue C, Pei F, Yang P, Xie J, Kang P.

ABSTRACT: Intravenous tranexamic acid (TXA) has been identified to be effective in total knee arthroplasty (TKA), but the effect of topical application is still unclear. Therefore, the authors conducted a meta-analysis to assess the effect of topical TXA in TKA. Twelve trials with a total of 1179 knees were included. The results revealed that the application of topical TXA in TKA significantly reduced total blood loss by a mean of 280.65 mL and reduced transfusions without increasing the risks of deep venous thrombosis and pulmonary embolism. Topical TXA also reduced postoperative drain output by a mean of 194.59 mL and lowered postoperative hemoglobin drop by a mean of 0.66 g/dL. In addition, subgroup analysis showed that high-concentration TXA may be better at reducing bleeding and transfusions than low-concentration TXA. Therefore, the authors concluded that topical TXA can effectively reduce bleeding and transfusion rate in TKA without increasing the risk of deep venous thrombosis and pulmonary embolism, and high-concentration (20 mg/mL or more) topical TXA is recommended.

Indian J Anaesth. 2015 Jul;59(7):428-32. doi: 10.4103/0019-5049.160949.

Comparison of ketorolac and low-dose ketamine in preventing tourniquet-induced increase in arterial pressure.

Zaidi R, Ahmed A

BACKGROUND AND AIMS: Application of tourniquet during orthopaedic procedures causes pain and increase in blood pressure despite adequate anaesthesia and analgesia. In this study, we compared ketorolac with ketamine in patients undergoing elective lower limb surgery with tourniquet in order to discover if ketorolac was equally effective or better than ketamine in preventing tourniquet-induced hypertension.

METHODS: Approval was granted by the Institutional Ethics Review Committee and informed consent was obtained from all participants. A randomised double-blinded controlled trial with 38 patients each in the ketamine and ketorolac groups undergoing elective knee surgery for anterior cruciate ligament repair or reconstruction was conducted. Induction and maintenance of anaesthesia were standardised in all patients, and the minimum alveolar concentration of isoflurane was maintained at 1.2 throughout the study period. One group received ketamine in a dose of 0.25 mg/kg and the other group received 30 mg ketorolac 10 min before tourniquet inflation. Blood pressure was recorded before induction of anaesthesia (baseline) and at 0, 10, 20, 30, 40, 50, and 60 min after tourniquet inflation.

RESULTS: The demographic and anaesthetic characteristics were similar in the two groups. At 0 and 10 min, tourniquet-induced rise in blood pressure was not observed in both groups. From 20 min onward, both systolic and diastolic blood pressures were significantly higher in ketorolac group compared to ketamine group.

CONCLUSION: We conclude that ketamine is superior to ketorolac in preventing tourniquet-induced increases in blood pressure.

J Spec Oper Med. 2015 Summer;15(2):48-53.

Prehospital Use of Hemostatic Bandages and Tourniquets: Translation From Military Experience to Implementation in Civilian Trauma Care.

Zietlow JM, Zietlow SP, Morris DS, Berns KS, Jenkins DH.

BACKGROUND: While the military use of tourniquets and hemostatic gauze is well established, few data exist regarding civilian emergency medical services (EMS) systems experience.

METHODS: A retrospective review was performed of consecutive patients with prehospital tourniquet and hemostatic gauze application in a single ground and rotor-wing rural medical transport service. Standard EMS registry data were reviewed for each case.

RESULTS: During the study period, which included 203,301 Gold Cross Ambulance and 8,987 Mayo One Transport records, 125 patients were treated with tourniquets and/or hemostatic gauze in the prehospital setting. Specifically, 77 tourniquets were used for 73 patients and 62 hemostatic dressings were applied to 52 patients. Seven patients required both interventions. Mechanisms of injury (MOIs) for tourniquet use were blunt trauma (50%), penetrating wounds (43%), and uncontrolled hemodialysis fistula bleeding (7%). Tourniquet placement was equitably distributed between upper and lower extremities, as well as proximal and distal locations. Mean tourniquet time was 27 minutes, with 98.7% success. Hemostatic bandage MOIs were blunt trauma (50%), penetrating wounds (35%), and other MOIs (15%). Hemostatic bandage application was head and neck (50%), extremities (36%), and torso (14%), with a 95% success rate. Training for both interventions was computer-based and hands-on, with maintained proficiency of %gt;95% after 2 years.

CONCLUSION: Civilian prehospital use of tourniquets and hemostatic gauze is feasible and effective at achieving hemostasis. Online and practical training programs result in proficiency of skills.