Tactical Combat Casualty Care

Journal Article Abstracts

Committee on Tactical Combat Casualty Care
February 2019

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ACEP Policy Statement: Military Considerations in Emergency Medical Services (EMS). Ann Emerg Med. 2019 Mar;73:e27-e28

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Abstracts

ACEP Policy Statement. Ann Emerg Med. 2019 Mar;73(3):e27-e28

Military Considerations in Emergency Medical Services (EMS).

No authors listed

QUOTE:
“Retiring or end-of-service military members with EMS training and certifications should be afforded a timely, efficient transition method to equivalent civilian EMS certifications if they so desire. With continual needs for highly skilled and experienced clinicians in civilian EMS, use of willing former military EMS personnel helps to fulfill these needs.”

Clin Pract Cases Emerg Med. 2018 Sep 5;2(4):323-325

FascIOtomy: Ultrasound Evaluation of an Intraosseous Needle Causing Compartment Syndrome.

Abramson T, Alreshaid L, Kang T, Mailhot T, Omer T

ABSTRACT:
Intraosseous (IO) needles are used in critically ill patients when it is not possible to quickly obtain venous access. While they allow for immediate access, IO infusions are associated with complications including fractures, infections, and compartment syndrome. We present a case where point-of-care ultrasound was used to quickly identify a malfunctioning IO needle that resulted in compartment syndrome of the lower extremity.

J Trauma Acute Care Surg. 2019 Jan;86(1):155-159

Endovascular control of pelvic hemorrhage: Concomitant use of resuscitative endovascular balloon occlusion of the aorta and endovascular intervention.

Adnan S, Wasicek P, Crawford A, Dubose J, Brenner M, Scalea T, Morrison J

CONCLUSIONS

We describe the technical considerations for endovascular interventions concurrent with REBOA use in patients with pelvic hemorrhage. Determining the access site for angiography and intervention is a major therapeutic consideration in pelvic hemorrhage, with options including upper and lower extremity arteries, each with practical considerations. Lower extremity access affords the use of shorter systems but can be more challenging in terms of vessel access and the maneuvering of wires and catheters. Upper extremity access can be a usefulway of avoiding the groin region altogether but involves specialist equipment and limits some endovascular interventions such as large diameter-covered stent-graft deployment. The use of upper or lower extremity access should be made on the basis of patient factors and clinical capability. Further research is required in this area to optimize the timely care of this critical patient group.

J Emerg Trauma Shock. 2018 Jul-Sep;11(3):205-210

Clinical Profile and Autopsy Findings in Fatal Head Injuries.

Alexis R, Jagdish S, Sukumar S, Pandit V, Palnivel C, Antony M

Aims: This study aims to correlate the autopsy findings with the clinical picture and imaging report in fatal head injury patients.

Settings and Design: A descriptive study conducted at tertiary care hospital in South India from July 2015 to December 2016.

Patients and Methods: All patients with head injuries who were admitted to our Emergency and Trauma Centre and underwent autopsy were included in the study. A structured pro forma was used for collecting information. Autopsy findings were considered as a gold standard to correlate with antemortem findings in fatal head injury. The data were analyzed with EpiData and OpenEpi statistical analyzing software.

Results: Of the 303 fatal head injury patients, a majority were males and age group between 21 and 40 years. Eighty-eight percent (267/303) of fatal head injuries were due to road traffic accidents. Twenty-five of the 303 patients reached our center within 1 h (golden hour) of trauma. Of the 303 fatal head injuries, 153 (50.5%) died within 24 h of reaching our center. The most common autopsy finding in this study was subarachnoid hemorrhage (SAH) (247/303, 81.3%). Diagnostic accuracy of Epi dural hemorrhage (EDH) antemortem had the highest value (98.35%). SAH had least diagnostic accuracy value (45.72). Subdural hemorrhage (SDH) had highest sensitivity (57.02%). EDH had higher specificity (100%). Significant SDH, SAH, and brain contusions were not detected during antemortem evaluation.

Conclusions: Our study revealed that among fatal head injury patients, half of them died within first 24 h after reaching to tertiary care center. Diagnostic accuracy to detect extradural hemorrhage antemortem had the highest value and SAH had least diagnostic accuracy value. Significant subdural hemorrhage, subarachniod hemorrhage, and brain contusion were not detected during antemortem evaluation. Expertise in interpretation of imaging, adequate clinical examination, proper documentation, and early resuscitation may reduce the chances of missed injuries in head injury patients.

J Emerg Med. 2019 Mar;56(3):294-297

Ocular Compartment Syndrome and Lateral Canthotomy Procedure.

Amer E, El-Rahman Abbas A

BACKGROUND: Ocular compartment syndrome (OCS) is a serious ophthalmological emergency that should be diagnosed and treated immediately to prevent permanent loss of vision. It is usually caused by a retro-orbital bleed that will subsequently increase intra-orbital pressure and threaten the patient's vision. Lateral canthotomy and cantholysis is a minor bedside procedure using simple equipment that is readily available in emergency departments, and the aim of such a procedure is to free the eye globe from its lateral attachment to the bony orbital wall and allow more eye protrusion and hence reduce intra-orbital pressure and save the patient's sight. The case we present describes a 42-year-old man who presented with facial injuries following an alleged assault and in whom a computed tomography scan of the head showed a retro-orbital hemorrhage. The patient had subtle signs of increased intra-orbital pressure for which lateral canthotomy and cantholysis was indicated.

DISCUSSION: OCS is an ophthalmological emergency that can present with subtle signs of increased intraocular pressure that can lead to irreversible loss of vision if not treated with a simple bedside operation called lateral canthotomy and cantholysis within a specific time frame. We explore the pathophysiology and presentation of OCS and how to perform the lateral canthotomy with cantholysis procedure.

CONCLUSIONS: The aim of this case presentation is to highlight the importance of diagnosing OCS as an ophthalmological emergency and discuss how to perform the sight-saving procedure.

Ann Emerg Med. 2018 Dec;72(6):645-653

Emergency Department Intubation Success With Succinylcholine Versus Rocuronium: A National Emergency Airway Registry Study.

April M, Arana A, Pallin D, Schauer S, Fantegrossi A, Fernandez J, Maddry J, Summers S, Antonacci A, Brown C; NEAR Investigators.

STUDY OBJECTIVE: Although both succinylcholine and rocuronium are used to facilitate emergency department (ED) rapid sequence intubation, the difference in intubation success rate between them is unknown. We compare first-pass intubation success between ED rapid sequence intubation facilitated by succinylcholine versus rocuronium.

METHODS: We analyzed prospectively collected data from the National Emergency Airway Registry, a multicenter registry collecting data on all intubations performed in 22 EDs. We included intubations of patients older than 14 years who received succinylcholine or rocuronium during 2016. We compared the first-pass intubation success between patients receiving succinylcholine and those receiving rocuronium. We also compared the incidence of adverse events (cardiac arrest, dental trauma, direct airway injury, dysrhythmias, epistaxis, esophageal intubation, hypotension, hypoxia, iatrogenic bleeding, laryngoscope failure, laryngospasm, lip laceration, main-stem bronchus intubation, malignant hyperthermia, medication error, pharyngeal laceration, pneumothorax, endotracheal tube cuff failure, and vomiting). We conducted subgroup analyses stratified by paralytic weight-based dose.

RESULTS: There were 2,275 rapid sequence intubations facilitated by succinylcholine and 1,800 by rocuronium. Patients receiving succinylcholine were younger and more likely to undergo intubation with video laryngoscopy and by more experienced providers. First-pass intubation success rate was 87.0% with succinylcholine versus 87.5% with rocuronium (adjusted odds ratio 0.9; 95% confidence interval 0.6 to 1.3). The incidence of any adverse event was also comparable between these agents: 14.7% for succinylcholine versus 14.8% for rocuronium (adjusted odds ratio 1.1; 95% confidence interval 0.9 to 1.3). We observed similar results when they were stratified by paralytic weight-based dose.

CONCLUSION: In this large observational series, we did not detect an association between paralytic choice and first-pass rapid sequence intubation success or peri-intubation adverse events.

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Nasopharyngeal Airway.

Atanelov Z, Rebstock S

ABSTRACT:
Basic airway management in both the pediatric and adult populations includes assessing and managing airway patency, oxygen delivery, and ventilation. All efforts should be taken to maintain a patient's airway via non-invasive methodology unless indications for invasive airway management are apparent. Non-invasive airway supplementation includes passive oxygenation (nasal cannula, non-rebreather, among others), bag-valve-mask (BVM), non-invasive positive pressure ventilation (BVM with positive-pressure valve, CPAP, BIPAP), and supraglottic airways (King Tube, LMA. among others). Invasive airway management involves establishing a secure airway and placing patients on a ventilator via intubation (nasal or endotracheal), needle jet ventilation (in pediatric patients younger than 8 years old, cricothyroidotomy in pediatric patients older than 8 years old, and adults), and tracheostomy.[1][2][3] Proper airway management begins by looking at the patient visually for trauma, obesity, cervical collar, macroglossia, among other factors to determine the type of airway approach best suited for each patient. Most important is positioning via the head tilt-chin lift maneuver, which involves extending the patient's neck by putting one hand on the forehead and the other hand on the neck to allow for the extension of the head in relation to the neck. This maneuver puts the patient into sniffing position, with the nose pointed upward and forward. Then a chin lift can be performed by taking the hand from underneath the neck to underneath the chin (mandible) and lifting the mandible until the teeth barely touch. Another airway positioning method involves the jaw-thrust maneuver, which is safer in potential cervical spinal cord injury patients. This method involves maintaining the spine in a neutral position and grabbing the sides of the angle of the mandible and lifting it forward to lift the jaw and open the airway. There are some differences between the pediatric and adult populations. For example, the large occiput of the pre-pubescent pediatric patient can lead to too much flexion of the neck and can cause tracheal obstruction. This is addressed by utilizing the head tilt-chin lift maneuver, but care must be taken to avoid overextension in the pediatric population as it can cause airway obstruction due to a weak trachea in the pediatric patient. However, the head tilt-chin lift may not be adequate to maintain a patent airway, and the jaw-thrust maneuver may need to be employed to prevent the pediatric, large, floppy tongue from obstructing the airway. Once properly positioned, the rescuer has the best shot at delivering effective breaths either via mouth to mouth or BVM. If there is continued difficulty at delivering breaths, then airway adjuncts like an oral pharyngeal airway (OPA) device or nasopharyngeal airway (NPA) can be useful for maintaining a patent airway to allow delivery of breaths in an unresponsive patient. NPA devices can be useful at maintaining the airway in an awake patient as well, which is beneficial if intubation is not the goal, the intubation needs to be delayed, or an awake intubation is necessary. NPA devices are plastic hollow or soft rubber tubes that a healthcare provider can utilize to help with patient oxygenation and ventilation when the patient is difficult to oxygenate or ventilate via BVM, for example. NPAs are passed into the nose and pass through to the posterior pharynx. NPAs do not cause patients to gag and are, therefore, the best airway adjunct route in an awake patient and the better choice in a semiconscious patient that may not tolerate an OPA due to the gag reflex. NPAs are also helpful when a patient's mouth is difficult to open, for example, if there are angioedema, trismus, or other factors. While NPAs are airway adjuncts for the difficult patient ventilation and oxygenation, they only act as a bridge to either an eventually stabilized patient that is breathing

without aid or a patient that requires a secure airway via endotracheal or nasotracheal (NT) intubation. The NT route for intubation was the preferred route among critical care and emergency physicians up until several decades ago. However, today, the majority of clinicians prefer the endotracheal route for intubation as it has been shown to have better results and fewer complications. Some of the complications of NT intubation include sinusitis, nasal structure destruction due to localized pressure and decreased perfusion of nasal cartilage, and local abscesses. Furthermore, NT intubation requires narrow tubes making pulmonary toilet very difficult due to the increased airway resistance. However, there are clear advantages to NT intubation. NT intubation can be performed in the sitting position, which is valuable, especially in the pre-hospital setting when needing to intubate a patient in acutely decompensated heart failure that cannot lay flat. Other advantages include the patient's inability to bite or manipulate the tube, better patient tolerance, decrease salivation, and better access to patient oral care. In addition, the NT tube is much more stable as it has the entire nasal tract holding it in place versus the endotracheal tube that flops out the mouth and can easily dislodge or become right main stemmed. NT intubation can be performed blind or with a flexible bronchoscope. Blind NT intubation is difficult and requires expertise and skill. However, when indicated, can be a very useful skill both in the prehospital and hospital setting. Blind NT intubation decreases the need for neck movement and mouth opening, but can only be done in the awake and ventilating patient. NT intubation via a flexible bronchoscope also requires lots of expertise and skill, and it is useless if there is blood, vomitus, or fluid that will obscure the bronchoscopes camera.

A A Pract. 2018 Nov 12 [Epub ahead of print]

A Case Report of an Inadvertent Placement of Tracheostomy Tube Into the Pharynx After Emergency Tracheostomy: Management of a Failed Surgical Airway.

Awad M, Yaghoubian S

ABSTRACT:
Inadvertent placement of a tracheostomy tube through the stoma with the distal tip cephalad in the pharynx is an unusual but potentially devastating complication. Previously reported only once in the literature, its occurrence is not well known. There are several causes of ineffective ventilation after an emergency surgical airway, and an incorrectly placed tracheostomy tube is a differential diagnosis to consider. Prompt identification of this rare complication is essential because the consequences can be fatal. We present a case describing the inadvertent insertion of a tracheostomy tube into the pharynx during emergency tracheostomy and its subsequent management.

Mil Med. 2018 Nov 5;183(11-12):e721-e729

Intravenous Hydroxocobalamin Versus Hextend Versus Control for Class III Hemorrhage Resuscitation in a Prehospital Swine Model.

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

Background: Hydroxyethyl starch (Hextend) has been used for hemorrhagic shock resuscitation, however, hydroxyethyl starch may be associated with adverse outcomes.

Objective: To compare systolic blood pressure (sBP) in animals that had 30% of their blood volume removed and treated with intravenous hydroxocobalamin, hydroxyethyl starch, or no fluid.

Methods: Twenty-eight swine (45-55 kg) were anesthetized and instrumented with continuous femoral and pulmonary artery pressure monitoring. Animals were hemorrhaged 20 mL/kg over 20 minutes and then administered 150 mg/kg IV hydroxocobalamin in 180 mL saline, 500 mL hydroxyethyl starch, or no fluid and monitored for 60 minutes. Data were modeled using repeated measures multivariate analysis of variance.

Results: There were no significant differences before treatment. At 20 minutes after hemorrhage, there was no significant difference in mean sBP between treated groups, however, control animals displayed significantly lower mean sBP ($p < 0.001$). Mean arterial pressure and heart rate improved in the treated groups but not in the control group ($p < 0.02$). Prothrombin time was longer and platelet counts were lower in the Hextend group ($p < 0.05$). Moreover, thromboelastography analysis showed longer clotting (K) times ($p < 0.05$) for the hydroxyethyl starch-treated group.

Conclusion: Hydroxocobalamin restored blood pressure more effectively than no treatment and as effectively as hydroxyethyl starch but did not adversely affect coagulation.

J Anaesthesiol Clin Pharmacol. 2018 Oct-Dec;34(4):450-457

Meloxicam in the management of post-operative pain: Narrative review.

Bekker A, Kloepping C, Collingwood S

ABSTRACT:
Oral formulations of meloxicam, a preferential cyclooxygenase-2 (COX-2) inhibitor, have long been used to treat osteoarthritis, rheumatoid arthritis, ankylosing spondylitis, as well as various pain syndromes of skeletomuscular origin (e.g., low back pain). However, these preparations are rarely indicated for the treatment of acute pain due to a poor dissolution rate and consequently a slow onset of action. The recent introduction of an intravenous (IV) NanoCrystal Colloidal Dispersion formulation opens up the possibility of using this drug during the perioperative period. The present review summarizes the pharmacologic properties of meloxicam, including its pharmacokinetics, adverse effects, and tolerability. In addition, we critically examined a number of recently completed clinical trials that evaluated the efficacy and safety of meloxicam IV in the treatment of post-operative pain. Literature retrieval was performed through PubMed and Medline (through March 2018) using combinations of the terms meloxicam, acute pain, and pharmacology. In addition, bibliographical information, including contributory unpublished data, was requested from the company developing the drug. Clinical trials suggest that single IV doses of 30 mg meloxicam significantly reduce post-operative pain as well as opioid requirements. We conclude that meloxicam IV is an effective and well-tolerated analgesic agent for the management of moderate to severe post-operative pain.

J Spec Oper Med. Winter 2018;18(4):106-110.

Efficacy of the Abdominal Aortic Junctional Tourniquet-Torso Plate in a Lethal Model of Noncompressible Torso Hemorrhage.

Bonanno A, Hoops H, Graham T, Davis B, McCully B, Wilson L, Madtson B, Ross J

BACKGROUND: The Abdominal Aortic Junctional Tourniquet, when modified with an off-label, prototype, accessory pressure distribution plate (AAJT-TP), has the potential to control noncompressible torso hemorrhage in prolonged field care.

METHODS: Using a lethal, noncompressible torso hemorrhage model, 24 male Yorkshire swine (81kg-96kg) were randomly assigned into two groups (control or AAJT-TP). Anesthetized animals were instrumented and an 80% laparoscopic, left-side liver lobe transection was performed. At 10 minutes, the AAJT-TP was applied and inflated to an intraabdominal pressure of 40mmHg. At 20 minutes after application, the AAJT-TP was deflated, but the windlass was left tightened. Animals were observed for a prehospital time of 60 minutes. Animals then underwent damage control surgery at 180 minutes, followed by an intensive care unit-phase of care for an additional 240 minutes. Survival was the primary end point.

RESULTS: Compared with Hextend, survival was not significantly different in the AAJT-TP group ($p = .564$), nor was blood loss (3.3L ± 0.5L and 3.0L ± 0.5L, respectively; $p = .285$). There was also no difference in all physiologic parameters between groups at the end of the study or end of the prehospital phase. Three of 12 AAJT-TP animals had an inferior vena cava thrombus.

CONCLUSION: The AAJT-TP did not provide any survival benefit compared with Hextend alone in this model of noncompressible torso hemorrhage.

J Spec Oper Med. Winter 2018;18(4):70-74.

Feasibility Study Vascular Access and REBOA Placement: From Zero to Hero.

Borger van der Burg B, Maayen R, van Dongen T Gerben C, Eric C, DuBose J, Horer T, Bowyer M, Hoencamp R.

BACKGROUND: Vascular access is a necessary prerequisite for REBOA placement in patients with severe hemorrhagic shock.

METHODS: During an EVTM workshop, 10 Special Forces (SOF) medics, five combat nurses, four military nonsurgeon physicians, and four military surgeons participated in our training program. The military surgeons functioned as the control group. A formalized curriculum was constructed including basic anatomy and training in access materials for resuscitative endovascular balloon occlusion of the aorta (REBOA) placement. Key skills were (1) preparation of endovascular toolkit, (2) achieving vascular access in the model, and (3) bleeding control with REBOA.

RESULTS: The baseline knowledge of anatomy for SOF medics was significantly less than that for nurses and physicians. Medics had a median time of 3:59 minutes to sheath insertion; nurses, 2:47; physicians, 2:34; and surgeons, 1:39. Military surgeons were significantly faster than medics and military nurses ($\rho = .037$ resp. 0.034). Medics had a median total time from start to REBOA inflation of 5:05 minutes; nurses, 4:06; military physicians, 3:36; and surgeons, 2:36.

CONCLUSION: This study showed that a comprehensive theoretical and practical training program using a task training model can be used for percutaneous femoral access and REBOA placement training of military medical personnel without prior ultrasound or endovascular experience. Higher levels of training reduce procedure times.

J Surg Res. 2019 Jan;233:132-138

Prehospital Tranexamic Acid Administration During Aeromedical Transport After Injury.

Boudreau R, Deshpande K, Day G, Hinckley W, Harger N, Pritts T, Makley A, Goodman M

BACKGROUND: Tranexamic acid (TXA) has been shown to reduce mortality in the treatment of traumatic hemorrhage. This effect seems most profound when given early after injury. We hypothesized that extending a protocol for TXA administration into the prehospital aeromedical setting would improve outcomes while maintaining a similar safety profile to TXA dosed in the emergency department (ED).

MATERIALS AND METHODS: We identified all trauma patients who received TXA during prehospital aeromedical transport or in the ED at our urban level I trauma center over an 18-mo period. These patients had been selected prospectively for TXA administration using a protocol that selected adult trauma patients with high-risk mechanism and concern for severe hemorrhage to receive TXA. Patient demographics, vital signs, lab values including thromboelastography, blood administration, mortality, and complications were reviewed retrospectively and analyzed.

RESULTS: One hundred sixteen patients were identified (62 prehospital versus 54 ED). Prehospital TXA patients were more likely to have sustained blunt injury (76% prehospital versus 46% ED, $P = 0.002$). There were no differences between groups in injury severity score or initial vital signs. There were no differences in complication rates or mortality. Patients receiving TXA had higher rates of venous thromboembolic events (8.1% in prehospital and 18.5% in ED) than the overall trauma population (2.1%, $P < 0.001$).

CONCLUSIONS: Prehospital administration of TXA during aeromedical transport did not improve survival compared with ED administration. Treatment with TXA was associated with increased risk of venous thromboembolic events. Prehospital TXA protocols should be refined to identify patients with severe hemorrhagic shock or traumatic brain injury.

Air Med J. 2018 Nov - Dec;37(6):362-366

Critical Care Skill Triad for Tactical Evacuations.

Boutonnet M, Raynaud L, Pasquier P, Vitiello L, Coste S, Ausset S

OBJECTIVE: Providing medical support to French soldiers deployed to war theaters everywhere around the world is the first mission of the French Military Medical Service (FMMS). En-route critical care is critical to maintain the continuum of care and safety during forward and tactical medical evacuation (MEDEVAC). The FMMS has developed specific training programs to ensure optimal en-route critical care air transport. These courses need to be continuously adjusted to the returns of experience and to the operational changes. The aim of our survey was to characterize the critical care skills required for tactical MEDEVAC on fixed wing aircraft.

METHODS: A 10-items survey was sent to 22 flight surgeons previously deployed in the Sahel-Saharan Strip. Eight questions focused on basic critical care skills. The 2 last items assessed the flight surgeons' willingness to follow a pre deployment course in a critical care unit and in a transfusion center.

RESULTS: Fourteen of the 22 flight surgeons responded to the survey. All but one responder had to deal with at least one critical care skill. The most frequent critical care skills required were the management of mechanical ventilation, catecholamine infusion and blood product transfusion. Five of the 14 responders reported on-board blood product transfusion, including red blood cells, lyophilized plasma and fresh whole blood.

CONCLUSION: Our survey highlights the need for the MEDEVAC teams to be skilled in critical care medicine. We defined a triad of critical care skills required for the management of severe casualties, including the management of mechanical ventilation, catecholamine infusion and blood product transfusion.

Br J Anaesth. 2018 Dec;121(6):1215-1217

Venous air embolism: ultrasonographic diagnosis and treatment with hyperbaric oxygen therapy.

Brodbeck A, Bothma P, Pease J

ABSTRACT:
A man with neuromuscular respiratory failure requiring intubation and ventilation suffered a venous air embolism during inadvertent administration of 5 ml of air. Ultrasound (US) imaging confirmed an air embolus in the left subclavian vein, which was only partially treated by US-guided aspiration. The embolus completely resolved on US imaging during hyperbaric oxygen therapy, and the patient recovered with no complications secondary to the embolism. Venous air embolism is under-recognised, and can cause signiificant neurological morbidity and death if untreated. When available, urgent hyperbaric oxygen therapy appears to be an effective approach.

Laryngoscope Investig Otolaryngol. 2018 Oct 31;3(5):356-363

Emergency front-of-neck airway by ENT surgeons and residents: A dutch national survey.

Bruijstens L, Titulaer I, Scheffer G, Steegers M, van den Hoogen F

Objectives: ENT surgeons and anesthesiologists work closely together in managing challenging airway cases. Sharing knowledge, experiences, and expectations interdisciplinary is essential in order to facilitate decision-making and adequate management in emergency front-of-neck airway cases.

Methods: A survey was performed, to analyze level of experience, technique of preference, training, knowledge of material and protocols, and self-efficacy scores of Dutch ENT surgeons and residents in performing an urgent or emergency front-of-neck airway.

Results: Within one year (January 2014-2015), 25.7% of the 257 respondents had performed an urgent or emergency front-of-neck airway. Of all reported emergency front-of-neck airways (N = 30), 80% were managed by tracheotomy. In future emergency front-of-neck airway cases, 74% stated cricothyrotomy would be their technique of preference. The majority would choose an uncuffed large-bore cannula technique. Post-academic hands-on training was attended by 42% of respondents. Self-efficacy scores were highest for surgical tracheotomy, and higher when trained or experienced. In case of an emergency scenario, 8.6% would not perform a front-of-neck airway themselves. The main reasons for reluctance to start in general were lack of experience and lack of training. Reported items for improvement were mainly the development of a protocol and training.

Conclusion: The chance of encountering an airway emergency scenario requiring front-of-neck airway is realistic. There is inconsistency between advised technique, technique of preference and technique actually performed by ENT surgeons. This study shows that there is both a need and desire for improvement in training and organization of care. Interdisciplinary guidelines and education is needed and could eventually safe lives.

J Spec Oper Med. Winter 2018;18(4):37-55.

Advanced Resuscitative Care in Tactical Combat Casualty Care: TCCC Guidelines Change 18-01:14 October 2018.

Butler FK Jr, Holcomb JB, Shackelford S, Barbabella S, Bailey JA, Baker JB, Cap AP, Conklin CC, Cunningham CW, Davis M, DeLellis SM, Dorlac WC, DuBose JJ, Eastridge B, Fisher AD, Glasser JJ, Gurney J, Jenkins DA, Johannigman J, King DR, Kotwal RS, Littlejohn LF, Mabry RL, Martin MJ, Miles EA, Montgomery HR, Northern DM, O'Connor KC, Rasmussen TE, Riesberg JC, Spinella PC, Stockinger Z, Strandenes G, Via DK, Weber MA.

ABSTRACT:
TCCC has previously recommended interventions that can effectively prevent 4 of the top 5 causes of prehospital preventable death in combat casualties-extremity hemorrhage, junctional hemorrhage, airway obstruction, and tension pneumothorax- and deaths from these causes have been markedly reduced in US combat casualties. Noncompressible torso hemorrhage (NCTH) is the last remaining major cause of preventable death on the battlefield and often causes death within 30 minutes of wounding. Increased use of whole blood, including the capability for massive transfusion, if indicated, has the potential to increase survival in casualties with either thoracic and/or abdominopelvic hemorrhage. Additionally, Zone 1 Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) can provide temporary control of bleeding in the abdomen and pelvis and improve hemodynamics in casualties who may be approaching traumatic cardiac arrest as a result of hemorrhagic shock. Together, these two interventions are designated Advanced Resuscitative Care (ARC) and may enable casualties with severe NCTH to survive long enough to reach the care of a surgeon. Although Special Operations units are now using whole blood far-forward, this capability is not routinely present in other US combat units at this point in time. REBOA is not envisioned as care that could be accomplished by a unit medic working out of his or her aid bag. This intervention should be undertaken only by designated teams of advanced combat medical personnel with special training and equipment.

JAMA Surg. 2019 Feb 6. Epub ahead of print

Association Between Emergency Medical Service Response Time and Motor Vehicle Crash Mortality in the United States.

Byrne J, Mann N, Dai M, Mason S, Karanicolas P, Rizoli S, Nathens A

Importance: Motor vehicle crashes (MVCs) are a leading public health concern. Emergency medical service (EMS) response time is a modifiable, system-level factor with the potential to influence trauma patient survival. The relationship between EMS response time and MVC mortality is unknown.

Objectives: To measure the association between EMS response times and MVC mortality at the population level across US counties.

Design, Setting, and Study Population: This population-based study included MVC-related deaths in 2268 US counties, representing an estimated population of 239 464 121 people, from January 1, 2013, through December 31, 2015. Data were analyzed from October 1, 2017, through April 30, 2018.

Exposure: The median EMS response time to MVCs within each county (county response time), derived from data collected by the National Emergency Medical Service Information System. Main Outcomes and Measures: The county rate of MVC-related death, calculated using crash fatality data recorded in the Fatality Analysis Reporting System of the National Highway Traffic Safety Administration.

Results: During the study period, 2 214 480 ambulance responses to MVCs were identified (median, 229 responses per county [interquartile range (IQR), 73-697 responses per county]) in 2268 US counties. The median county response time was 9 minutes (IQR, 7-11) minutes. Longer response times were significantly associated with higher rates of MVC mortality (≥12 vs <7 minutes; mortality rate ratio, 1.46; 95% CI, 1.32-1.61) after adjusting for measures of rurality, on-scene and transport times, access to trauma resources, and traffic safety laws. This finding was consistent in both rural/wilderness and urban/suburban settings, where a significant proportion of MVC fatalities (population attributable fraction: rural/wilderness, 9.9%; urban/suburban, 14.1%) were associated with prolonged response times (defined by the median value, ≥10 minutes and ≥7 minutes, respectively).

Conclusions and Relevance: Among 2268 US counties, longer EMS response times were associated with higher rates of MVC mortality. A significant proportion of MVC-related deaths were associated with prolonged response times in both rural/wilderness and urban/suburban settings. These findings suggest that trauma system-level efforts to address regional disparities in MVC mortality should evaluate EMS response times as a potential contributor.

J Trauma Acute Care Surg. 2019 Feb;86(2):181-188

Ketamine infusion for pain control in adult patients with multiple rib fractures: Results of a randomized control trial.

Carver T, Kugler N, Juul J, Peppard W, Drescher K, Somberg L, Szabo A, Yin Z, Paul J

BACKGROUND: Rib fractures occur in up to 40% of trauma patients and are associated with increased mortality. Opiate-based pain regimens remain the cornerstone of rib fracture management; however, concerns around opioids have fostered interest in alternative analgesics. Ketamine is currently being used in lieu of opioids, but little evidence exists supporting its use within the trauma population.

METHODS: A prospective, randomized, double-blind placebo-controlled trial of adult patients with three or more rib fractures admitted to a Level I trauma center was conducted. Exclusion criteria included age older than 64 years, Glasgow Coma Scale score less than 13, and chronic opiate use. The experimental arm received low-dose ketamine (LDK) at 2.5 μg/kg/min while the placebo cohort received an equivalent rate of 0.9% normal saline. All infusions were continued for 48 hours. The primary outcome was reduction in numeric pain score (NPS) during the first 24 hours. Secondary outcomes studied included oral morphine equivalent (OME) utilization, length of stay, epidural rates, pulmonary complications, and adverse events.

RESULTS: Forty-five (49%) of 91 patients were randomized to the experimental arm. Both groups were similar in makeup. Overall, 74.7% were male, had a median age of 49 years, and an Injury Severity Score (ISS) of 14. Low-dose ketamine was not associated with a significant reduction in 24-hour NPS or OME totals. Subgroup analysis of 45 severely injured patients (ISS, >15) demonstrated that LDK was associated with a significant reduction in OME utilization during the first 24hours (35.7 vs. 68, p = 0.03), 24 hours to 48 hours (64.2 vs. 96, p = 0.03), and overall (152.1 vs. 198, p = 0.048). No difference in other secondary outcomes or adverse events was noted.

CONCLUSION: Low-dose ketamine failed to decrease NPS or OME within the overall cohort, but a decrease in OME was observed among patients with an ISS greater than 15. Confirmatory studies are necessary to determine if LDK is a useful adjunct among severely injured patients.

BMC Infect Dis. 2018 Dec 17;18(1):665

Acute Tibial osteomyelitis caused by intraosseous access during initial resuscitation: a case report and literature review.

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BACKGROUND: Intra-osseous (IO) access is recommended in cases of pre-hospital emergency or resuscitation when intravascular (IV) route is difficult or impossible. Despite recent improvement in IO devices and increasing indications, it remains rarely used in practice. Various complications have been reported but are uncommon.

CASE PRESENTATION: We report a case of massive acute tibial osteomyelitis in an adult male three months after an IO catheter insertion for emergency drug infusion. We review the literature on association between IO access and acute osteomyelitis in children and adults.

CONCLUSIONS: Emergency-care givers and radiologists should be informed about this infrequent complication in order to make early diagnosis and initiate adequate antibiotic therapy.

Eur J Clin Pharmacol. 2019 Apr;75(4):511-517.

Ertapenem for osteoarticular infections in obese patients: a pharmacokinetic study of plasma and bone concentrations.

Chambers J, Page-Sharp M, Salman S, Dyer J, Davis T, Batty K, Manning L

PURPOSE: Ertapenem is used off-label to treat osteoarticular infections but there are few pharmacokinetic (PK) data to guide optimal dosing strategies in patients who may be obese with multiple co-morbidities including diabetes and peripheral vascular disease.

METHODS: Participants undergoing lower limb amputation or elective joint arthroplasty received a dose of intravenous ertapenem prior to surgery. Eight plasma samples were collected over 24 h, together with at least one bone sample per patient. Ertapenem concentrations in plasma and bone were measured using liquid-chromatography/mass-spectroscopy and analysed using non-linear mixed effects PK modelling.

RESULTS: Plasma and bone concentrations were obtained from 10 participants. The final population PK model showed that a fat free body mass was the most appropriate body size adjustment. Ertapenem diffused rapidly into bone but concentrations throughout the 24 h dosing period were on average 40-fold higher in plasma, corresponding to a bone to plasma ratio of 0.025, and highly variable between individuals. Simulations demonstrated a high probability of target attainment (PTA) for free plasma concentrations when the minimum inhibitory concentrations (MIC) were ≤ 0.25 mg/L. By contrast, at MICs of 0.5 mg/L and ≥ 1 mg/L, the fractions of patients attaining this target was ~ 80% and 40%, respectively. In bone, the PTA was ≤ 45% when the MIC was ≥ 0.25 mg/L.

CONCLUSION: Local bone and free plasma concentrations appear adequate for osteoarticular infections where Enterobacteriaceae are the main causative pathogens, but for Staphylococcus aureus and other bacteria, conventional dosing may lead to inadequate PTA.

World Neurosurg. 2019 Feb 2 Epub ahead of print

Improving Survival with Tranexamic Acid in Cerebral Contusions or Traumatic Subarachnoid Hemorrhage: Univariate and Multivariate Analysis of Independent Factors Associated with Lower Mortality.

Chan D, Tsang A, Li L, Cheng K, Tsang F, Taw B, Pu J, Ho W, Lui W, Leung G

BACKGROUND: Fall with head injury is a pervasive challenge, especially in the aging population. Contributing factors for mortality include the development of cerebral contusions and delayed traumatic intracerebral hematoma. Currently, there is no established specific treatment for these conditions.

OBJECT: This study aimed to investigate the impact of independent factors on the mortality rate of traumatic brain injury with contusions or traumatic subarachnoid hemorrhage.

METHODS: Data were collected from consecutive patients admitted for cerebral contusions or traumatic subarachnoid hemorrhage at an academic trauma center from 2010 to 2016. The primary outcome was the 30-day mortality rate. Independent factors for analysis included patient factors and treatment modalities. Univariate and multivariate analyses were conducted to identify independent factors related to mortality. Secondary outcomes included thromboembolic complication rates associated with the use of tranexamic acid.

RESULTS: In total, 651 consecutive patients were identified. For the patient factors, low Glasgow Coma Scale on admission, history of renal impairment, and use of warfarin were identified as independent factors associated with higher mortality from univariate and multivariate analyses. For the treatment modalities, univariate analysis identified tranexamic acid as an independent factor associated with lower mortality ($P = 0.021$). Thromboembolic events were comparable in patients with or without tranexamic acid.

CONCLUSION: Tranexamic acid was identified by univariate analysis as an independent factor associated with lower mortality in cerebral contusions or traumatic subarachnoid hemorrhage. Further prospective studies are needed to validate this finding.

Surgery. 2019 Apr;165(4):795-801

Building community resilience: A scalable model for hemorrhage-control training at a mass gathering site, using the RE-AIM framework.

Chaudhary M, McCarty J, Shah S, Hashmi Z, Caterson E, Goldberg S, Goolsby C, Haider A, Goralnick E

BACKGROUND: In a decade, the US military reduced deaths from uncontrolled bleeding on the battlefield by 67%. This success, coupled with an increased incidence of mass shootings in the US, has led to multiple initiatives intent on translating hemorrhage-control readiness to the civilian sector. However, the best method to achieve widespread population-level hemorrhage-control readiness for civilians has not yet been elucidated. This study evaluates the implementation of American College of Surgeons Bleeding Control training at a National Football League stadium as a prospective model for general mass gathering site implementation.

METHODS: The American College of Surgeons' Bleeding Control Basic layperson hemorrhage-control training was implemented at Gillette Stadium in Massachusetts. The five domains are as follows: reach (demographics of study participants), effectiveness (correct tourniquet application after intervention), adoption (investigator, leadership, and participant efforts for sustainability of intervention), implementation (course details), and maintenance (correct tourniquet application at retention testing at 3 to 9 months).

RESULTS: A total of 562 employees were included in the study. Of those included employees, 58.7% reported having taken first-aid training and 17.3% reported having taken hemorrhage-control training. There was an increased mean likelihood to help (4.39 vs 4.09, $P < .01$) and comfort level to control hemorrhage (4.26 vs 3.60, $P < .01$) after training compared with before training, on a Likert scale (1-5). The stadium operations team located hemorrhage control kits with automatic external defibrillators, integrated layperson immediate-response awareness into its Web site, and developed a public safety announcement. The training, performed by physicians, nurses, and emergency medical technicians, consisted of a 30-minute lecture and a 30-minute hands-on skills-training course, with a class size of 24. The total number of sessions was 24.

CONCLUSION: Achieving initial hemorrhage-control readiness and maintenance at a mass gathering site through American College of Surgeons Bleeding Control training is feasible but requires significant commitment from training staff, site leadership, and financial resources.

Medicine (Baltimore). 2018 Nov;97(46):e13134

Radial artery occlusion with a kaolin-filled pad after transradial cardiac catheterization.

Chiang C, Chang W, Ho C, Hong C, Shih J, Wu W, Chen Z, Chou M

ABSTRACT:
Radial artery occlusion (RAO) occurs in 2% to 18% of patients after transradial access (TRA) cardiac catheterization. Using a kaolin-filled pad (QuikClot) reduces compression time during TRA and might reduce RAO. We examined the RAO risk with the kaolin-filled pad after TRA cardiac catheterization. This was a prospective cross-sectional study of 260 patients who underwent TRA cardiac catheterization in a cardiac ward of a Medical Center from 2012 to 2016. Patients were randomly assigned to 1 of 2 groups: the case group (n=130) was postoperatively treated with a kaolin-filled pad, and the control group (n=130) was treated with conventional hemostasis. Color duplex ultrasound was used to evaluate the 24-hour and 1-month postoperative radial artery flow velocity, diameter, patency, and RAO risk. RAO risk was not significantly different between the case and control groups after 24 hours (4.6% vs 5.4%, P=.776) or after 1 month (5.4% vs 6.1%, P=.789), regardless of whether it was a first TRA cardiac catheterization (after 24 hours [P=.153] or after 1 month [P=.617], respectively) or a repeated TRA cardiac catheterization (after 24 hours [P=.754] or after 1 month [P=.753], respectively). Using a kaolin-filled pad after TRA cardiac catheterization did not significantly reduce RAO risk compared with conventional hemostasis.

Injury. 2019 Jan;50(1):46-53

Massive hemorrhage protocol survey: Marked variability and absent in one-third of hospitals in Ontario, Canada.

Chin V, Cope S, Yeh C, Thompson T, Nascimento B, Pavenski K, Callum J; QUEST Research Group.

BACKGROUND: Massive hemorrhage protocols (MHP) are critical to standardized delivery of timely, safe, and resource-effective coordinated care for patients with life-threatening bleeding.

METHODS: A standardized MHP survey was sent to all hospitals (n = 150) in Ontario with a transfusion service. This study aim was to determine the proportion of hospitals with an MHP and assess for variability.

RESULTS: The overall survey completion rate was 133 of 150 hospitals (89%) (remaining 17 providing negative affirmation that they did not have an MHP). A MHP was in place at 97 of 150 (65%) hospitals (60% of small (<5000 red cell units/year) vs. 91% of medium/large). A total of 10 different names of protocols were reported, with "Massive Transfusion Protocol" (68%) predominating. Activation criteria were present in 82 of 97 (85%); commonly activated based on volume of blood loss (70%). Blood work was drawn at the discretion of the physician (37%) or at predefined intervals (31%; majority every 60 min). Common routine laboratory tests performed were CBC (87%) and INR (84%). Fibrinogen testing was available at 88 (66%) of 133 reporting hospitals and part of the standard testing at 73 of 97 (75%) hospitals with an MHP. Median targets of hemostatic resuscitations, stated in the protocol at 49% of hospitals with an MHP, were: platelets >50 × 109/L, INR < 1.8, fibrinogen >1.5 g/L, and hemoglobin >70 g/L. Protocol required patient temperature monitoring in 65% and specified a reversal plan for patients on anticoagulants in 59%. At 36% of sites all patients are initially managed with O RhD negative blood. Overall, 61% of sites issue blood in predefined packs (vs. on demand). Hemostatic agents in protocols included: tranexamic acid (70%), prothombin complex concentrate (14%), fibrinogen concentrate (13%), and recombinant FVIIa (4%). Quality metrics were tracked in 32% of hospitals.

CONCLUSIONS: A third of hospitals lack formal MHPs, with the majority lacking in smaller hospitals. The survey results indicate that there is marked variability in all key aspects of the reported MHPs. This may be due to differences in hospital resources and personnel, lack of supporting evidence to dictate requirements, and differences in knowledge base of the individuals involved in protocol setting.

J Spec Oper Med. Winter 2018;18:82-86.

Willingness of Emergency Medical Services Professionals to Respond to an Active Shooter Incident.

Chovaz M, Patel RV, March JA, Taylor SE, Brewer KL.

BACKGROUND: Historically, staging of civilian emergency medical services (EMS) during an active shooter incident was in the cold zone while these professionals awaited the scene to be completely secured by multiple waves of law enforcement. This delay in EMS response has led to the development of a more effective method: the Rescue Task Force (RTF). The RTF concept has the second wave of law enforcement escorting civilian EMS into the warm zone, thus decreasing EMS response time. To our knowledge, there are no data regarding the willingness of EMS professionals to enter a warm zone as part of an RTF. In this study, we assessed the willingness of EMS providers to respond to an active shooter incident as part of an RTF.

METHODS: A survey was distributed at an annual, educational EMS conference in North Carolina. The surveys were distributed on the first day of the conference at the beginning of a general session that focused on EMS stress and wellness. Total attendance was measured using identification badges and scanners on exiting the session. Data were assessed using $\chi 2$ analysis, as were associations between demographics of interest and willingness to respond under certain conditions. A p value < .01 indicated statistical significance.

RESULTS: The overall response rate was 76% (n = 391 of 515 session attendees). Most surveys were completed by paramedics (74%; n = 288 of 391). Most EMS professionals (75%; n = 293 of 391) stated they would respond to the given active shooter scenario as part of an RTF (escorted by the second wave of law enforcement) if they were given only ballistic gear. However, most EMS professionals (61%; n = 239 of 391) stated they would not respond if they were provided no ballistic gear and no firearm. Those with tactical or military training were more willing to respond with no ballistic gear and no firearm (49.6%; n = 68 of 137) versus those without such training (31%; n = 79 of 250; odds ratio, 2.2; 95% confidence interval, 1.4-3.3; p < .001).

CONCLUSION: EMS professionals are willing to put themselves in harm's way by entering a warm zone if they are simply provided the proper training and ballistic equipment.

Emerg Med J. 2019 Feb;36(2):78-81

Implementation of tranexamic acid for bleeding trauma patients: a longitudinal and cross-sectional study.

Coats T, Fragoso-Iñiguez M, Roberts I

OBJECTIVE: To describe the use of tranexamic acid (TXA) in trauma care in England and Wales since the Clinical Randomization of an Antifibrinolytic in Significant Hemorrhage (CRASH-2) trial results were published in 2010.

METHODS: A national longitudinal and cross-sectional study using data collected through the Trauma Audit and Research Network (TARN), the clinical audit of major trauma care for England and Wales. All patients in the TARN database injured in England and Wales were included apart from those with an isolated traumatic brain injury, with a primary outcome of the proportion of patients given TXA and the secondary outcome of time to treatment.

RESULTS: Among 228 250 patients, the proportion of trauma patients treated with TXA increased from near zero in 2010 to 10% (4593) in 2016. In 2016, most patients (82%) who received TXA did so within 3 hours of injury, however, only 30% of patients received TXA within an hour of injury. Most (80%) of the patients who had an early blood transfusion were given TXA. Patients treated with TXA by an ambulance paramedic received treatment at a median of 49 min (IQR 33-72) compared with 111 min (IQR 77-162) for patients treated in hospital.

CONCLUSIONS: There is a low proportion of patients treated with TXA across the range of injury severity and the range of physiological indicators of severity of bleeding. Most patients receive treatment within the existing target of 3 hours from injury, however there remains the potential to further improve major trauma outcomes by the earlier treatment of a wider patient group.

Transfusion. 2019 Mar;59(3):927-930

Massive transfusion of low-titer cold-stored O-positive whole blood in a civilian trauma setting.

Condron M, Scanlan M, Schreiber M

BACKGROUND: Based on the improved outcomes achieved with fresh whole blood in cases of military trauma as well as with 1:1:1 transfusion strategies for massive traumatic hemorrhage in civilian settings, there has been resurgent interest in using whole blood for civilian trauma patients. There have been reports of giving up to 4 units of low-titer cold-stored O-positive to these patients. This is the first modern report of a massive transfusion with unrestricted low-titer group O whole blood (LTOWB) use in a civilian trauma patient.

STUDY DESIGN AND METHODS: This is a case report describing the resuscitation and massive transfusion of LTOWB of a 69-year-old man struck by an automobile.

RESULTS: While working to achieve hemorrhage control, the patient received 38 units of LTOWB, 13 units of RBCs, 12 units of fresh frozen plasma, 2 packs of platelets, and 2 units of cryoprecipitate. No evidence of hemolytic reaction was observed. The patient was O positive. Monitoring by thrombelastography revealed adequate clot initiation and propagation, but decreased clot strength (49.6 and 50.2) and a drop in fibrinogen (from 207 to 141) during the resuscitation.

CONCLUSION: This is the first report of a massive transfusion for civilian trauma based on cold-stored whole blood in the recent era. While this patient suffered a tremendous burden of traumatic injury and his recovery is not yet complete, his LTOWB resuscitation was successful. Frequent monitoring of coagulation status with thrombelastography during utilization of LTOWB is indicated because the efficacy of its components (particularly platelets) is not yet fully understood.

Anesthesiol Clin. 2019 Mar;37(1):183-193

Future Trends in Trauma Care: Through the Lens of the Wounded How Lessons from the Battlefield May Be Used at Home.

D'Angelo M, Welder M, Chauhan R, Kearns M

ABSTRACT:
The coordinated terrorist attacks of 2001 thrust the United States and its allies to war. Through an evolving battlefield, the paradigm of large fixed medical facilities advanced to become nimble surgical and resuscitative platforms, able to provide care far forward. Innovations like Tactical Combat Casualty Care, evacuation, fresh whole-blood administration, freeze-dried plasma, and forward surgical care military medicine helped reduce combat mortality to its lowest levels in history. Through the account of a young wounded marine wounded in Iraq, this article examines how innovations on the battlefield saved casualties and explores how these techniques may be applied at home.

World J Emerg Surg. 2018 Nov 21;13:54

Three cases of resuscitative endovascular balloon occlusion of the aorta (REBOA) in austere pre-hospital environment-technical and methodological aspects.

de Schoutheete J, Fourneau I, Waroquier F, De Cupere L, O'Connor M, Van Cleynenbreugel K, Ceccaldi J, Nijs S

Background: The present paper describes three cases where ER-REBOA® was used with partial aorta occlusion (AO), by performing a partial resuscitative endovascular balloon occlusion of the aorta or pREBOA, in an austere pre-hospital military environment. In addition, because no specific REBOA algorithm for pre-hospital environment exists yet, this paper seeks to fill this gap, proposing a new pragmatic REBOA algorithm.

Methods: Belgian Special Operations Surgical Team applied REBOA in three patients according to a decisional algorithm, based on the MIST acronym used for trauma patients. Only 3 ml, in the first instance, was inflated in the balloon to get AO. The balloon was then progressively deflated, and reperfusion was tracked through changes of end-tidal carbon dioxide (EtCO2).

Results: Systolic blood pressure (SBP) before ER-REBOA® placement was not higher than 60 mmHg. However, within the first 5 min after AO, SBP improved in all three cases. Due to the aortic compliance, a self-made pREBOA was progressively achieved while proximal SBP was raising with intravenous fluid infusion. Afterwards, during deflation, a steep inflection point was observed in SBP and EtCO2.

Conclusions: ER-REBOA® is suitable for use in an austere pre-hospital environment. The MIST acronym can be helpful to select the patients for which it could be beneficial. REBOA can also be performed with pREBOA in a dynamic approach, inflating only 3 mL in the balloon and using the aortic compliance. Furthermore, while proximal SBP can be convenient to follow the occlusion, EtCO2 can be seen as an easy and interesting marker to follow the reperfusion.

J Res Med Sci. 2018 Nov 28;23:98. doi: 10.4103/jrms.JRMS_384_18. eCollection 2018.

Post-traumatic endophthalmitis prophylaxis with oral ciprofloxacin in comparison to intravenous cephazolin/gentamicin.

Dehghani A, Rafiemanzelat A, Ghaderi K, Pourazizi M, Feizi A

Background: Although posttraumatic endophthalmitis is an uncommon condition, it causes severe complications, so medical and pharmacological interventions for prevention of endophthalmitis after trauma are a major concern. The aim of this study was to evaluate the efficacy and clinical outcome of oral ciprofloxacin versus intravenous cefazolin/gentamicin for the prevention of endophthalmitis after penetrating ocular trauma.

Materials and Methods: This was a retrospective, descriptive single-center study, including all cases of penetrating ocular trauma seen in the Feiz Hospital, a Tertiary Referral Eye Hospital in Isfahan, Iran, between 2011 and 2017. Data systemically recorded for each patient included clinical, ophthalmological, and demographic findings by a trained medical record abstractor or ophthalmologist reviewing patient records.

Results: Six hundred and forty-five patients in cefazolin/gentamicin and 273 patients in oral ciprofloxacin groups were included in the study. Our study showed that the incidence of endophthalmitis was not significantly different between the two groups (P = 0.463). In patients with either sharp or blunt penetrating ocular trauma.

Conclusion: Oral ciprofloxacin as a prophylactic treatment could prevent posttraumatic endophthalmitis as effective as injectable cefazolin/gentamicin. Due to easier consumption of oral ciprofloxacin and lower systemic complications, in all patients with penetrating eye trauma, oral administration of ciprofloxacin is preferable to intravenous or intramuscular types of antibiotics to reduce the risk of posttraumatic endophthalmitis.

J Trauma Acute Care Surg. 2019 Jan 8 Epub ahead of print

Life Saving Interventions in Blackout Conditions Using Night Vision Technology: Come to the Dark Side.

Derickson M, Kuckelman J, Phillips C, Barron M, Marko S, Eckert M, Martin M, Cuadrado D

INTRODUCTION: During military combat operations and civilian night-time aeromedical transport, medical providers are frequently required to perform life-saving interventions (LSIs) in low-light environments. Because definitive surgical care is often delayed until a white light environment is permissible, we sought to determine if night optical device (NOD) technology could enable surgical capabilities in blackout conditions.

METHODS: Using a cross-over design, 6 surgeons performed 11 different procedures on 6 swine, 3 in normal light conditions (LC) and 3 in blackout conditions (BC) using two-chamber NODs after familiarization with the procedures in both conditions on manikins. Successful completion and procedural times were compared between groups.

RESULTS: Blackout conditions were confirmed with ambient light reading of 0.2llux during BC vs 3962.9lux for LC ($p<0.001$). There were no significant differences in success rates for any procedure. There were no differences in operative times between BC and LC for extremity tourniquet placement, femoral artery cut-down and clamping, resuscitative thoracotomy, or percutaneous REBOA placement. The following procedures took significantly longer in BC vs LC: FAST exam (98s vs 62s), peripheral IV placement (140s vs 35s), intraosseous access (51s vs 26s), jugular vein cut-down and access (237s vs 104s), laparotomy and packing (71s vs 51s), stapled splenectomy (137s vs 74s), REBOA placement via cutdown (1,008s vs 338s), and cricothyroidotomy (177s vs 109s) (all $p<0.05$).

CONCLUSION: LSIs can be safely and effectively performed in blackout conditions using NODS, although increased difficulty with select procedure types were identified. Focused training and technological improvements to currently available devices are needed.

Ann Surg. 2018 Jul 31 Epub ahead of print

Establishing a Regional Trauma Preventable/Potentially Preventable Death Rate.

Drake S, Holcomb J, Yang Y, Thetford C, Myers L, Brock M, Wolf D, Cron S, Persse D, McCarthy J, Kao L, Todd S, Naik-Mathuria B, Cox C, Kitagawa R, Sandberg G, Wade C

OBJECTIVE: To establish a trauma preventable/potentially preventable death rate (PPPDR) within a heavily populated county in Texas.

SUMMARY: The National Academies of Sciences estimated the trauma preventable death rate in the United States to be 20%, issued a call for zero preventable deaths, while acknowledging that an accurate preventable death rate was lacking. In this absence, effective strategies to improve quality of care across trauma systems will remain difficult.

METHODS: A retrospective review of death-related records that occurred during 2014 in Harris County, TX, a diverse population of 4.4 million. Patient demographics, mechanism of injury, cause, timing, and location of deaths were assessed. Deaths were categorized using uniform criteria and recorded as preventable, potentially preventable or non-preventable.

RESULTS: Of 1848 deaths, 85% had an autopsy and 99.7% were assigned a level of preventability, resulting in a trauma PPPDR of 36.2%. Sex, age, and race/ethnicity varied across preventability categories ($P < 0.01$). Of 847 prehospital deaths, 758 (89.5%) were non-preventable. Among 89 prehospital preventable/potentially preventable (P/PP) deaths, hemorrhage accounted for 55.1%. Of the 657 initial acute care setting deaths, 292 (44.4%) were P/PP; of these, hemorrhage, sepsis, and traumatic brain injury accounted for 73.3%. Of 339 deaths occurring after initial hospitalization, 287 (84.7%) were P/PP, of these 117 resulted from sepsis and 31 from pulmonary thromboembolism, accounted for 51.6%.

CONCLUSIONS: The trauma PPPDR was almost double that estimated by the National Academies of Sciences. Data regarding P/PP deaths offers opportunity to target research, prevention, intervention, and treatment corresponding to all phases of the trauma system.

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

Next-level thinking about mass casualty care.

Dutton RP.

QUOTE:
"However, it is clear that hard-won wisdom from previous incidents contributed to the number of lives saved in Las Vegas. Application of direct pressure and effective tourniquets in the field were not perfectly applied, but were far better than in similar events of years past. Transport to hospital, by both public and private mechanisms, and triage to the operating room for those with life-threatening hemorrhage was rapid and effective. Application of damage control resuscitation techniques was widespread, including the early use of dozens of units of uncrossmatched type-O blood and aggressive administration of plasma and platelets. Even patient identification, notification of family members and hospital communication with the public were noticeably influenced – and improved – by prior published experience and previous hospital and trauma system drills."

Br J Anaesth. 2019 Feb;122(2):263-268

Emergency cricothyroidotomy: an observational study to estimate optimal incision position and length.

Fennessy P, Drew T, Husarova V, Duggan M, McCaul C

BACKGROUND: A vertical incision is recommended for cricothyroidotomy when the anatomy is impalpable, but no evidence-based guideline exists regarding optimum site or length. The Difficult Airway Society guidelines, which are based on expert opinion, recommend an 80-100 mm vertical caudad to cephalad incision in the extended neck position. However, the guidelines do not advise the incision commencement point. We sought to determine the minimum incision length and commencement point above the suprasternal notch required to ensure that the cricothyroid membrane would be accessible within its margins.

METHODS: We measured using ultrasound, in 80 subjects (40 males and 40 females) without airway pathology, the distance between the suprasternal notch and the cricothyroid membrane, in the neutral and extended neck positions. We assessed the inclusion of the cricothyroid membrane within theoretical incisions of 0-100 mm in length made at 10 mm intervals above the suprasternal notch.

RESULTS: In the 80 subjects, the distance ranged from 27 to 105 mm. Movement of the cricothyroid membrane on transition from the neutral to extended neck position varied from 15 mm caudad to 27 mm cephalad. The minimum incision required in the extended position was 70 mm in males and 80 mm in females, commencing 30 mm above the suprasternal notch.

CONCLUSIONS: An 80 mm incision commencing 30 mm above the suprasternal notch would include all cricothyroid membrane locations in the extended position in patients without airway pathology, which is in keeping with the Difficult Airway Society guidelines recommended incision length.

Acta Anaesthesiol Scand. 2019 Jan 15 Epub ahead of print

Does the addition of fentanyl to ketamine improve haemodynamics, intubating conditions or mortality in emergency department intubation: A systematic review.

Ferguson I, Bliss J, Aneman A

BACKGROUND: Ketamine is an induction agent frequently used for general anaesthesia in emergency medicine. Generally regarded as haemodynamically stable, it can cause hypertension and tachycardia and may cause or worsen shock. The effects of ketamine may be improved by the addition of fentanyl to the induction regime. We conducted a systematic review to identify evidence with regard to the effect of adding fentanyl to an induction regime of ketamine and a paralyzing agent on post-induction haemodynamics, intubating conditions and mortality.

METHODS: We conducted a search of the Cochrane library, EMBASE, MEDLINE, PROQUEST, OpenGrey and clinical trial registries. Prominent authors were contacted in order to identify additional literature pertinent to the research question. Studies were included if they pertained to intubation of adult patients in the prehospital or emergency department environments and included an induction regime of ketamine and a paralysing agent, with at least one outcome measure of haemodynamics, intubating conditions or mortality. Search results were reviewed by two investigators independently, adjudicated by a third investigator where disagreement occurred.

RESULTS: One observational study was identified that partially answered the research question.

DISCUSSION: Only one observational study was identified that partially answered the research question. This paper demonstrated that the use of fentanyl as a pretreatment increases the incidence of post-induction hypotension, a phenomenon that was seen with propofol, midazolam and ketamine. The difference in hypotension between these agents was not statistically significant. The impact of this on patient-orientated outcomes is unclear.

JAMA Pediatr. 2019 Feb 1;173(2):140-146

Effect of Intranasal Ketamine vs Fentanyl on Pain Reduction for Extremity Injuries in Children: The PRIME Randomized Clinical Trial.

Frey T, Florin T, Caruso M, Zhang N, Zhang Y, Mittiga M

Importance: Timely analgesia is critical for children with injuries presenting to the emergency department, yet pain control efforts are often inadequate. Intranasal administration of pain medications provides rapid analgesia with minimal discomfort. Opioids are historically used for significant pain from traumatic injuries but have concerning adverse effects. Intranasal ketamine may provide an effective alternative.

Objective: To determine whether intranasal ketamine is noninferior to intranasal fentanyl for pain reduction in children presenting with acute extremity injuries.

Design, Setting, and Participants: The Pain Reduction With Intranasal Medications for Extremity Injuries (PRIME) trial was a double-blind, randomized, active-control, noninferiority trial in a pediatric, tertiary, level 1 trauma center. Participants were children aged 8 to 17 years presenting to the emergency department with moderate to severe pain due to traumatic limb injuries between March 2016 and February 2017. Analyses were intention to treat and began in May 2017.

Interventions: Intranasal ketamine (1.5 mg/kg) or intranasal fentanyl (2 µg/kg).

Main Outcomes and Measures: The primary outcome was reduction in visual analog scale pain score 30 minutes after intervention. The noninferiority margin for this outcome was 10. Results: Of 90 children enrolled, 45 (50%) were allocated to ketamine (mean [SD] age, 11.8 [2.6] years; 26 boys [59%]) and 45 (50%) to fentanyl (mean [SD] age, 12.2 [2.3] years; 31 boys [74%]). Thirty minutes after medication, the mean visual analog scale reduction was 30.6 mm (95% CI, 25.4-35.8) for ketamine and 31.9 mm (95% CI, 26.6-37.2) for fentanyl. Ketamine was noninferior to fentanyl for pain reduction based on a 1-sided test of group difference less than the noninferiority margin, as the CIs crossed 0 but did not cross the prespecified noninferiority margin (difference in mean pain reduction between groups, 1.3; 90% CI, -6.2 to 8.7). The risk of adverse events was higher in the ketamine group (relative risk, 2.5; 95% CI, 1.5-4.0), but all events were minor and transient. Rescue analgesia was similar between groups (relative risk, 0.89; 95% CI, 0.5-1.6).

Conclusions and Relevance: Ketamine provides effective analgesia that is noninferior to fentanyl, although participants who received ketamine had an increase in adverse events that were minor and transient. Intranasal ketamine may be an appropriate alternative to intranasal fentanyl for pain associated with acute extremity injuries. Ketamine should be considered for pediatric pain management in the emergency setting, especially when opioids are associated with increased risk.

Scand J Trauma Resusc Emerg Med. 2019 Feb 7;27(1):11

Prehospital intravenous fentanyl administered by ambulance personnel: a cluster-randomised comparison of two treatment protocols.

Friesgaard K, Kirkegaard H, Rasmussen C, Giebner M,Christensen E, Nikolajsen L

BACKGROUND: Prehospital acute pain is a frequent symptom that is often inadequately managed. The concerns of opioid induced side effects are well-founded. To ensure patient safety, ambulance personnel are therefore provided with treatment protocols with dosing restrictions, however, with the concomitant risk of insufficient pain treatment of the patients. The aim of this study was to investigate the impact of a liberal intravenous fentanyl treatment protocol on efficacy and safety measures.

METHODS: A two-armed, cluster-randomised trial was conducted in the Central Denmark Region over a 1-year period. Ambulance stations (stratified according to size) were randomised to follow either a liberal treatment protocol (3 μg/kg) or a standard treatment protocol (2 μg/kg). The primary outcome was the proportion of patients with sufficient pan relief (numeric rating scale (NRS, 0-10) < 3) at hospital arrival. Secondary outcomes included abnormal vital parameters as proxy measures of safety. A multi-level mixed effect logistic regression model was applied.

RESULTS: In total, 5278 patients were included. Ambulance personnel following the liberal protocol administered higher doses of fentanyl [117.7 μg (95% CI 116.7-118.6)] than ambulance personnel following the standard protocol [111.5 μg (95% CI 110.7-112.4), P = 0.0001]. The number of patient with sufficient pain relief at hospital arrival was higher in the liberal treatment group than the standard treatment group [44.0% (95% CI 41.8-46.1) vs. 37.4% (95% CI 35.2-39.6), adjusted odds ratio 1.47 (95% CI 1.17-1.84)]. The relative decrease in NRS scores during transport was less evident [adjusted odds ratio 1.18 (95% CI 0.95-1.48)]. The occurrences of abnormal vital parameters were similar in both groups.

CONCLUSIONS: Liberalising an intravenous fentanyl treatment protocol applied by ambulance personnel slightly increased the number of patients with sufficient pain relief at hospital arrival without compromising patient safety. Future efforts of training ambulance personnel are needed to further improve protocol adherence and quality of treatment.

Transfus Clin Biol. 2018 Nov;25(4):281-286

Plasma for direct therapeutic use, for today and tomorrow: A short critical overview.

Garraud O, Aubron C, Ozier Y, Coppo P, Tissot J

ABSTRACT:
Plasma for direct therapeutic use is a fast-evolving blood component in terms of its production and presentation. More than a dozen forms are available worldwide, which is often overlooked since most countries apply policies making only one or very few forms available for treating patients in need. It is most often reserved for the same three clinical indications, i.e. overall clotting-factor deficiency, reversal of vitamin K antagonists in the context of active bleeding or prior to urgent surgery, and therapeutic plasma exchange. The level of evidence is often less robust than generally acknowledged for such major indications while novel indications are tending to emerge in medical and trauma settings. This short review explores classical views and new prospects opened up by novel presentations and statuses for therapeutic plasma.

Emerg (Tehran). 2018;6(1):e58. Epub 2018 Oct 2.

Evaluation of Airway Management Proficiency in Pre-Hospital Emergency Setting; a Simulation Study.

Ghiyasvandian S, Khazaei A, Zakerimoghadam M, Salimi R, Afshari A, Mogimbeigi A

Introduction: Infrequency and low exposure to critically ill patients requiring airway management will lead to reduction in the skills and performance of the Emergency Medical Technicians (EMTs) over time. The present study was conducted primarily aiming to evaluate airway management in stationary ambulance simulations and identify the factors affecting Endotracheal Intubation (ETI) success rate.

Method: This is a simulation study. The study population comprised of active EMTs in prehospital emergency bases in Hamadan province. The participants were placed at the back of an ambulance to perform the airway management scenario, which had already been prepared. To investigate the factors affecting the success (≤3 attempts) or failure rate of intubation, both unadjusted and adjusted odds ratios (95% confidence intervals) for univariate and multivariate regressions were reported.

Results: 184 subjects with the mean age of 33.91+6.25 years and the median work experience of 8 years were studied (54.3% with a history of training in the past year). The median number of previous intubations performed by technicians in the last year was 7 times (IQR 4-9). The total success rate at ventilation, intubation and back-up airway were 50.67%, 53.29%, and 50.0%, respectively. Out of the total 552 attempts for ETI placement, 58.2% of the technicians were able to perform ETI within 3 attempts. Univariate analysis showed that age (OR=1.06, P=0.022), previous number of ETIs (OR=2.49, P<0.001), work experience (OR=1.13, P<0.001), and previous ETI training (OR=1.85, P=0.041) were significantly associated with ETI success rate. After adjustment, previous number of ETIs (OR=2.66, P<0.001) was the most effective factor on ETI success rate.

Conclusion: Success rate in airway management, especially ETI, is low. Therefore, improvement in modifiable factors such as increasing the number of ETIs performed and gaining experience in the same conditions as pre-hospital emergency is necessary.

J Trauma Acute Care Surg. 2019 Jan 18 Epub ahead of print

From the Battlefield to Main Street: Tourniquet Acceptance, Use, and Translation from the Military to Civilian Settings.

Goodwin T, Moore K, Pasley J, Troncoso R Jr, Levy M, Goolsby C

ABSTRACT:
Throughout history, battlefield medicine has led to advancements in civilian trauma care. In the most recent conflicts of OEF/OIF, one of the most important advances is increasing use of point-of-injury hemorrhage control with tourniquets. Tourniquets are gradually gaining acceptance in the civilian medical world-in both the prehospital setting and trauma centers. An analysis of EMS data shows an increase of prehospital tourniquet utilization from 0 to nearly 4,000 between 2008 and 2016. Additionally, bystander educational campaigns such as the Stop the Bleed program is expanding, now with over 125,000 trained on tourniquet placement. As the medical community and the population at large has broader acceptance and training on the use of tourniquets, there is greater potential for saving lives from preventable hemorrhagic deaths.

Ann Emerg Med. 2018 Dec;72(6):627-636

Ultrasonography for the Confirmation of Endotracheal Tube Intubation: A Systematic Review and Meta-Analysis.

Gottlieb M, Holladay D, Peksa G

STUDY OBJECTIVE: Intubation is routinely performed in the emergency department, and rapid, accurate confirmation is essential to avoid potentially serious adverse outcomes. The number of studies assessing ultrasonography for the verification of endotracheal tube placement has expanded rapidly in recent years. We performed this systematic review and meta-analysis to determine the sensitivity and specificity of transtracheal ultrasonography for the verification of endotracheal tube location.

METHODS: PubMed, the Cumulative Index of Nursing and Allied Health, Scopus, Latin American and Caribbean Health Sciences Literature database, the Cochrane databases, and bibliographies of selected articles were assessed for all prospective and randomized controlled trials evaluating the accuracy of transtracheal ultrasonography for identifying endotracheal tube location. Data were dual extracted into a predefined worksheet and quality analysis was performed with the Quality Assessment of Diagnostic Accuracy Studies-2 tool. Data were summarized and a meta-analysis was performed with subgroup analyses by location, specialty, experience, transducer type, and technique. Time to confirmation was assessed as a secondary outcome.

RESULTS: This systematic review identified 17 studies (n=1,595 patients). Overall, transtracheal ultrasonography was 98.7% sensitive (95% confidence interval [CI] 97.8% to 99.2%) and 97.1% specific (95% CI 92.4% to 99.0%), with a positive likelihood ratio of 34.4 (95% CI 12.7 to 93.1) and a negative likelihood ratio of 0.01 (95% CI 0.01 to 0.02). Subgroup analyses did not demonstrate a significant difference by location, provider specialty, provider experience, transducer type, or technique. Mean time to confirmation was 13.0 seconds.

CONCLUSION: Transtracheal sonography is rapid to perform, with an acceptable degree of sensitivity and specificity for the confirmation of endotracheal intubation. Ultrasonography is a valuable adjunct and should be considered when quantitative capnography is unavailable or unreliable.

J Spec Oper Med. Winter 2018;18(4):97-102.

A Novel, Perfused-Cadaver Simulation Model for Tourniquet Training in Military Medics.

Grabo DJ Jr, Polk T, Strumwasser A, Inaba K, Foran C, Luther C, Minneti M, Kronstedt S, Wilson A, Demetriades D.

BACKGROUND: Exsanguinating limb injury is a significant cause of preventable death on the battlefield and can be controlled with tourniquets. US Navy corpsmen rotating at the Navy Trauma Training Center receive instruction on tourniquets. We evaluated the effectiveness of traditional tourniquet instruction compared with a novel, perfused-cadaver, simulation model for tourniquet training.

METHODS: Corpsmen volunteering to participate were randomly assigned to one of two tourniquet training arms. Traditional training (TT) consisted of lectures, videos, and practice sessions. Perfused-cadaver training (PCT) included TT plus training using a regionally perfused cadaver. Corpsmen were evaluated on their ability to achieve hemorrhage control with tourniquet(s) using the perfused cadaver. Outcomes included (1) time to control hemorrhage, (2) correct placement of tourniquet(s), and (3) volume of simulated blood loss. Participants were asked about confidence in understanding indications and skills for tourniquets.

RESULTS: The 53 corpsmen enrolled in the study were randomly assigned as follows: 26 to the TT arm and 27 to the PCT arm. Corpsmen in the PCT group controlled bleeding with the first tourniquet more frequently (96% versus 83%; $p < .03$), were quicker to hemorrhage control (39 versus 45 seconds; $p < .01$), and lost less simulated blood (256mL versus 355mL; $p < .01$). There was a trend toward increased confidence in tourniquet application among all corpsmen.

CONCLUSIONS: Using a perfused- cadaver training model, corpsmen placed tourniquets more rapidly and with less simulated-blood loss than their traditional training counterparts. They were more likely to control hemorrhage with first tourniquet placement and gain confidence in this procedure. Additional studies are indicated to identify components of effective simulation training for tourniquets.

Anaesth Crit Care Pain Med. 2019 Feb 23 Epub ahead of print

Effects of modification of trauma bleeding management: A before and after study.

Guth C, Vassal O, Friggeri A, Wey P, Inaba K, Decullier E, Ageron F, David J

OBJECTIVE: We hypothesised that the association of tranexamic acid (TXA) administration and thromboelastometry-guided haemostatic therapy (TGHT) with implementation of Damage Control Resuscitation (DCR) reduced blood products (BP) use and massive transfusion (MT).

METHODS: Retrospective comparison of 2 cohorts of trauma patients admitted in a university hospital, before (Period 1) and after implementation of DCR, TXA (first 3-hours) and TGHT (Period 2). Patients were included if they received at least 1 BP (RBC, FFP or platelet) or coagulation factor concentrates (fibrinogen or prothrombin complex) during the first 24-hours following the admission.

RESULTS: 380 patients were included. Patients in Period 2 (n = 182) received less frequently a MT (8% vs. 33%, P < 0.01), significantly less BP (RBC: 2 units [1-5] vs. 6 [3-11]; FFP: 0 units [0-2] vs. 4 [2-8]) but more fibrinogen concentrates (3.0 g [1.5-4.5] vs. 0.0 g [0.0-3.0], P < 0.01). Multivariate logistic regression analysis identified Period 1 as being associated with an increased risk of receiving MT (OR: 26.1, 95% CI: 9.7-70.2) and decreased survival at 28 days (OR: 2.0, 95% CI: 1.0-3.9). After propensity matching, the same results were observed but there was no difference for survival and a significant decrease for the cost of BP (2370 ± 2126 vs. 3284 ± 3812 €, P: 0.036).

CONCLUSION: Following the implementation of a bundle of care including DCR, TGHT and administration of TXA, we observed a decrease to the use of blood products, need for MT and an improvement of survival.

BMC Emerg Med. 2018 Nov 29;18(1):48

Predictive value of quick surgical airway assessment for trauma (qSAT) score for identifying trauma patients requiring surgical airway in emergency room.

Hayashida K, Matsumoto S, Kitano M, Sasaki J

BACKGROUND: A surgical airway is usually unpredictable in trauma patients. The aim of this study was to develop a predictable scoring system to determine the need for a surgical airway by using a database from a large multicenter trauma registry.

METHODS: We obtained data from the nationwide trauma registry in Japan for adult blunt trauma patients who were intubated in the emergency department. Based on a multivariate logistic regression analysis in the development cohort, the Quick Surgical Airway Assessment for Trauma (qSAT) score was defined to predict the need for a surgical airway. The association of the qSAT with surgical airway was validated in the validation cohort.

RESULTS: Between 2004 and 2014, 17,036 trauma patients were eligible. In the development phase (n = 8129), the qSAT score was defined as the sum of the three binary components, including male sex, presence of a facial injury, and presence of a cervical area injury, for a total score ranging from 0 to 3. In the validation cohort (n = 8907), the proportion of patients with a surgical airway markedly increased with increasing qSAT score (0 points, 0.5%; 1 point, 0.9%; 2 points, 3.5%; 3 points, 25.0%; P < 0.001). Multivariate analysis revealed that qSAT score was an independent predictor of surgical airway (adjusted OR, 3.19 per 1 point increase; 95% CI, 2.47-4.12; P < 0.0001). The qSAT score of ≥1 had a good sensitivity of 86.8% for predicting the requirement for surgical airway; while qSAT score of 3 had a good specificity of 99.9% in ruling out the need for surgical airway.

CONCLUSIONS: The qSAT score could be assessed simply using only information present upon hospital arrival to identify patients who may need a surgical airway. The utilization of qSAT score in combination with repeated evaluations on physical finding could improve outcomes in trauma patients.

Am J Emerg Med. 2018 Oct 22;Epub ahead of print

Prehospital ketamine administration to pediatric trauma patients with head injuries in combat theaters.

Hill G, April M, Maddry J, Schauer S

BACKGROUND: Head injuries frequently occur in combat. Tactical Combat Casualty Care (TCCC) guidelines recommend pre-hospital use of ketamine for analgesia. Yet the use of this medication in patients with head injuries remains controversial, particularly among pediatric patients. We compare survival to hospital discharge rates among pediatric head injury subjects who received prehospital ketamine versus those who did not.

METHODS: We queried the Department of Defense Trauma Registry (DODTR) for all pediatric (<18 years of age) subjects from January 2007 to January 2016. We performed a sub-analysis of subjects with an abbreviated injury severity score for the head of 3 (serious) or higher and at least one documented Glasgow Coma Score (GCS) ≤13.

RESULTS: Of the 3439 pediatric patients within our dataset, 555 subjects met inclusion criteria for head injury - 36 (6.5%) received prehospital ketamine versus 519 (93.5%) who did not. There was no significant difference noted between groups regarding median age (10 versus 8, $p = 0.259$), percent male gender (72.2% versus 76.3%, $p = 0.579$), mechanism of injury ($p = 0.143$), median composite injury scores (22 versus 20, $p = 0.082$), median ventilator-free days (28 versus 27, $p = 0.068$), median ICU-free days (27.5 versus 27, $p = 0.767$), median hospital days (3.5 versus 4, $p = 0.876$) or survival to discharge (66.7% versus 70.7%, $p = 0.607$).

CONCLUSIONS: Within this data set, we were unable to detect any differences in mortality among pediatric head trauma subjects administered ketamine compared to subjects not receiving this medication in the prehospital setting.

J Trauma Acute Care Surg. 2019 Jan;86(1):79-85

Aortic branch vessel flow during resuscitative endovascular balloon occlusion of the aorta.

Hoehn M, Teeter W, Morrison J, Gamble W, Hu P, Stein D, Brenner M, Scalea T

BACKGROUND: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a torso hemorrhage control adjunct. Aortic branch vessel flow (BVF) during REBOA is poorly characterized and has implications for ischemia-reperfusion injury. The aim of this study is to quantify BVF in hypovolemic shock with and without REBOA.

METHODS: Female swine (79-90 kg) underwent anesthesia, 40% controlled hemorrhage and sonographic flow monitoring of the carotid, hepatic, superior mesenteric, renal, and femoral arteries. Animals were randomized to REBOA (n = 5) or no-REBOA (n = 5) for 4 hours, followed by full resuscitation and balloon deflation for 1 hour.

RESULTS: All animals were successfully induced into hemorrhagic shock with a mean decrease of flow in all vessels of 50% from baseline ($p < 0.001$). Deployment of REBOA resulted in a 200% to 400% increase in carotid flow, but near complete abolition of BVF distal to the balloon. The no-REBOA group saw recovery of BVF to 100% of baseline in all measured vessels, except the hepatic at 50% to 75%. two-way analysis of variance confirmed a significant difference between the groups throughout the protocol ($p < 0.001$). During resuscitation, the REBOA group saw BVF restore to between 25% and 50%, but never achieving baseline values. The lactate at 4 hours was significantly higher in the REBOA versus no-REBOA group (17.2 ± 0.1 vs. 4.9 ± 1.4; $p < 0.001$).

CONCLUSION: REBOA not only abolished BVF during occlusion, but appears to have a post-REBOA effect, reducing visceral perfusion. This may be a source of REBOA associated ischemia-reperfusion injury and warrants further investigation in order to mitigate this effect.

J Arthroplasty. 2018 Oct 25;Epub ahead of print

Topical Tranexamic Acid in Revision Total Knee Arthroplasty Reduces Transfusion Rates and May Be Associated With Earlier Recovery.

Huerfano E, Huerfano M, Shanaghan K, Gonzalez Della Valle A

BACKGROUND: The use of tranexamic acid (TXA) has been proved to be effective in reducing blood loss and transfusion requirements after primary total knee arthroplasty (TKA). However, the evidence for its use in revision surgery is scant. We assessed the safety and efficacy of topical TXA in revision TKA.

METHODS: We retrospectively compared 76 revision TKA patients who received topical TXA (3 g before tourniquet deflation) "study group" with a historic control group of 205 revision TKA patients in which TXA was not used. Each group was further stratified into subgroups according to the type of revision. All patients were followed for a minimum of 6 weeks. Blood loss, transfusion requirements, changes in hemoglobin-hematocrit levels, Knee Society Score, and complications were recorded.

RESULTS: The mean estimated blood loss, hemoglobin drop, and transfusion rate were significantly lower in the study group than in the control group ($P = .008$, $P < .001$, $P < .001$, respectively). Hidden blood loss was similar between the 2 groups ($P = .12$). Six weeks postoperatively, the improvement in the knee-specific Knee Society Score was significantly higher in the study group than in the control group ($P < .001$). No significant differences were found in thromboembolic complications between the 2 groups ($P = .92$). In the subgroup analysis, when both components (femur and tibia) were revised, the relative risk of transfusion was significantly lower with the use of TXA (relative risk 0.227, confidence interval 0.0593-0.860, $P = .004$).

CONCLUSION: Topical TXA in revision TKA is safe and effective in reducing blood loss and transfusions. This effect is enhanced when both components are revised. Additionally, the use of TXA may improve early outcomes.

BMC Emerg Med. 2019 Jan 23;19(1):13

Enhanced prehospital volume therapy does not lead to improved outcomes in severely injured patients with severe traumatic brain injury.

Hussmann B, Schoeneberg C, Jungbluth P, Heuer M Lefering R, Maek T, Hildebrand F, Lendemans S, Pape H

BACKGROUND: Whether enhanced prehospital volume therapy leads to outcome improvements in severely injured patients with severe traumatic brain injury (TBI) remains controversial. The aim of this study was to investigate the influence of prehospital volume therapy on the clinical course of severely injured patients with severe TBI.

METHODS: Data for 122,672 patients from TraumaRegister DGU® (TR-DGU) was analyzed. Inclusion criteria were defined as follows: Injury Severety Score (ISS) ≥ 16, primary admission, age ≥ 16 years, Abbreviated Injury Scale (AIS) head ≥3, administration of at least one unit of packed red blood cells (pRBCs), and available volume and blood pressure data. Stratification based on the following matched-pair criteria was performed: group 1: prehospital volumes of 0-1000 ml; group 2: prehospital volumes of ≥1501 ml; AIS head (3, 4, 5 + 6 and higher than for other body regions); age (16-54, 55-69, ≥ 70 years); gender; prehospital intubation (yes/no); emergency treatment time +/- 30 min.; rescue resources (rescue helicopter, emergency ambulance); blood pressure (20-60, 61-90, ≥ 91 mmHg); year of accident (2002-2005, 2006-2009, 2010-2012); AIS thorax, abdomen, and extremities plus pelvis.

RESULTS: A total of 169 patients per group fulfilled the inclusion criteria. Increasing volume administration was associated with reduced coagulation capability and reduced hemoglobin (Hb) levels (prothrombin ratio: group 1: 68%, group 2: 63.7%; $p \leq 0.04$; Hb: group 1: 11.2 mg/dl, group 2: 10.2 mg/dl; $p \leq 0.001$). It was not possible to show a significant reduction in the mortality rate with increasing volumes (group 1: 45.6, group 2: 45.6; $p = 1$).

CONCLUSIONS: The data presented in this study demonstrates that prehospital volume administration of more than 1500 ml does not improve severely injured patients with severe traumatic brain injury (TBI).

Am J Emerg Med. 2017 Nov;35(11):1630-1635

Does the novel lateral trauma position cause more motion in an unstable cervical spine injury than the logroll maneuver?

Hyldmo P, Horodyski M, Conrad B, Aslaksen S, Røislien J, Prasarn M, Rechtine G, Søreide E

OBJECTIVE: Prehospital personnel who lack advanced airway management training must rely on basic techniques when transporting unconscious trauma patients. The supine position is associated with a loss of airway patency when compared to lateral recumbent positions. Thus, an inherent conflict exists between securing an open airway using the recovery position and maintaining spinal immobilization in the supine position. The lateral trauma position is a novel technique that aims to combine airway management with spinal precautions. The objective of this study was to compare the spinal motion allowed by the novel lateral trauma position and the well-established log-roll maneuver.

METHODS: Using a full-body cadaver model with an induced globally unstable cervical spine (C5-C6) lesion, we investigated the mean range of motion (ROM) produced at the site of the injury in six dimensions by performing the two maneuvers using an electromagnetic tracking device.

RESULTS: Compared to the log-roll maneuver, the lateral trauma position caused similar mean ROM in five of the six dimensions. Only medial/lateral linear motion was significantly greater in the lateral trauma position (1.4mm (95% confidence interval [CI] 0.4, 2.4mm)).

CONCLUSIONS: In this cadaver study, the novel lateral trauma position and the well-established log-roll maneuver resulted in comparable amounts of motion in an unstable cervical spine injury model. We suggest that the lateral trauma position may be considered for unconscious non-intubated trauma patients.

J Med Case Rep. 2018 Sep 21;12(1):271

False negative computed tomography scan due to pelvic binder in a patient with pelvic disruption: a case report and review of the literature.

Jamme S, Poletti A, Gamulin A, Rutschmann O, Andereggen E, Grosgurin O, Marti C

BACKGROUND: Pelvic binders are routinely used in the prehospital setting for stabilization of pelvic injuries in patients with trauma. Emergency department trauma management relies on primary and secondary survey assessment and imaging, most often computed tomography, in hemodynamically stable patients. Maintaining the pelvic binder in situ allows stabilization of pelvic injuries during imaging but may hinder the visualization of some pelvic lesions. We report a very rare case of severe pelvic disruption with an absolutely normal computed tomography scan due to the effective placement of a pelvic binder.

CASE PRESENTATION: We report the case of a 49-year-old Caucasian man referred to our Emergency Department after a high velocity motorcycle accident. Primary assessment revealed a left wrist deformation and pelvic pain, and a pelvic binder was applied by paramedics. A total body computed tomography scan was performed after arrival in our Emergency Department and did not reveal any pelvic injury. The pelvic binder was removed and because of persisting symphyseal pain, pelvic plain radiography was performed revealing a pelvic disruption with an opening of the pubic symphysis and of the left sacroiliac joint ("open book" type pelvic injury) requiring surgical stabilization.

CONCLUSIONS: Pelvic binders may mask pelvic disruption in patients with trauma. Pelvic plain radiography should be repeated after pelvic binder removal in patients with high velocity trauma and pelvic symptoms or neurological alterations limiting the reliability of clinical examination.

Mil Med. 2018 Nov 1;183(11-12):e730-e734

"Guidewire Intravenous Catheter Systems Do Not Improve First-Pass Success Rates for Peripheral Access When Placed By Army Combat Medics (68W) in a Pre-hospital Setting." A Prospective, Randomized Controlled Trial with Crossover Study Design.

Jin L, Medeck S, Ruley J, Riddle M, Aden J

Introduction: This study was completed to determine if guidewire catheters improve first-pass success and time of placement for peripheral intravenous access. In the military, 21% of casualties from the battlefield arrive to a medical facility in hemorrhagic shock. The importance of successful and timely intravenous placement is crucial in the initial steps of preventing this condition. Multiple studies and reviews have shown that initial first-pass success rates for pre-hospital intravenous placement have been as low as 40%, and an average success rate of 81% when completed by paramedics or similarly skilled personnel. In an attempt to replicate or improve these rates, we proposed to study placement success rates by active duty military combat medics. We hypothesized that there would be no difference in first-pass success rates when using either a standard or guidewire catheter.

Materials and Methods: This study was a prospective, randomized, controlled trial with a crossover study design comparing the Accucath 18-gauge guidewire catheter to the standard 18-gauge peripheral intravenous catheter. The study included 93 1st Cavalry Division Army Combat Medics. Participants were voluntarily enrolled and consented on an individual basis. Each participant paired with a partner of their choice and acted as their own control. All supplies were laid out for the participants with the catheters randomly selected for either arm of the patient. The subjects were allowed to choose which catheter they would be tested on first. Times were recorded for only successful attempts.

Results: The guidewire catheter was not proven to have a higher cannulation rate, achieving only a 44% success rate versus 66% in the standard catheter group, as well as averaging 42 seconds longer to obtain successful cannulation versus the standard catheter. Interestingly, it was observed that the greater the time in service, there was an increased success rate with the guidewire catheter that was not noted with the standard catheter.

Conclusions: There was not a statistically significant improvement in the first-pass success rate of intravenous placement with the use of the guidewire catheter when compared with the standard-issue catheter. With these results, we cannot recommend the guidewire catheter to be used in leu of the standard catheter. Further studies might show improvement if subjects are allotted increased practice and familiarity with the new guidewire device.

JAMA Surg. 2019;Epub ahead of print]

Nationwide Analysis of Resuscitative Endovascular Balloon Occlusion of the Aorta in Civilian Trauma.

Joseph B, Zeeshan M, Sakran J, Hamidi M, Kulvatunyou N, Khan M, O'Keeffe T, Rhee P

Importance: The need for improved methods of hemorrhage control and resuscitation has resulted in a reappraisal of resuscitative endovascular balloon occlusion of the aorta (REBOA). However, there is a paucity of data regarding the use of REBOA on a multi-institutional level in the United States.

Objective: To evaluate the outcomes in trauma patients after REBOA placement.

Design, Setting, and Participants: A case-control retrospective analysis was performed of the 2015-2016 American College of Surgeons Trauma Quality Improvement Program data set, a national multi-institutional database of trauma patients in the United States. A total of 593 818 adult trauma patients (aged ≥18 years) were analyzed and 420 patients were matched and included in the study; patients who were dead on arrival or were transferred from other facilities were excluded. Trauma patients who underwent REBOA placement in the ED were identified and matched with a similar cohort of patients (the no-REBOA group). Both groups were matched in a 1:2 ratio using propensity score matching for demographics, vital signs, mechanism of injury, injury severity score, head abbreviated injury scale score, each body region abbreviated injury scale score, pelvic fractures, lower extremity vascular injuries and fractures, and number and grades of intra-abdominal solid organ injuries.

Main Outcomes and Measures: Outcome measures were the rates of complications and mortality.

Results: Of 593 818 trauma patients, 420 patients (the REBOA group, 140 patients; 36 women and 104 men; mean [SD] age, 44 [20] years; the no-REBOA group, 280 patients; 77 women and 203 men; mean [SD] age, 43 [19] years) were matched and included in the analysis. Among the REBOA group, median injury severity score was 29 (interquartile range [IQR], 18-38) and 129 patients (92.1%) had a blunt mechanism of injury. There was no significant difference between groups in median 4-hour blood transfusion (REBOA: packed red blood cells, 6 U [IQR, 3-8 U]; platelets, 4 U [IQR, 3-9 U], and plasma, 3 U [IQR, 2-5 U]; and no-REBOA: packed red blood cells, 7 U [IQR, 3-9 U]; platelets, 4 U [IQR, 3-8 U], and plasma, 3 U [IQR, 2-6 U]) or 24-hour blood transfusion (REBOA: packed red blood cells, 9 U [IQR, 5-20 U]; platelets, 7 U [IQR, 3-13 U], and plasma, 9 U [IQR, 6-20 U]; and no-REBOA: packed red blood cells, 10 U [IQR, 4-21 U]; platelets, 8 U [IQR, 3-12 U], and plasma, 10 U [IQR, 7-20 U]), median hospital length of stay (REBOA, 8 days [IQR, 1-20 days]; and no-REBOA, 10 days [IQR, 5-22 days]), or median intensive care unit length of stay (REBOA, 5 days [IQR, 2-14 days]; and no-REBOA, 6 days [IQR, 3-15 days]). The mortality rate was higher in the REBOA group as compared with the no-REBOA group (50 [35.7%] vs 53 [18.9%]; P = .01). Patients who underwent REBOA placement were also more likely to develop acute kidney injury (15 [10.7%] vs 9 [3.2%]; P = .02) and more likely to undergo lower extremity amputation (5 [3.6%] vs 2 [0.7%]; P = .04).

Conclusions and Relevance: Placement of REBOA in severely injured trauma patients was associated with a higher mortality rate compared with a similar cohort of patients with no placement of REBOA. Patients in the REBOA group also had higher rates of acute kidney injury and lower leg amputations. There is a need for a concerted effort to clearly define when and in which patient population REBOA has benefit.

Cochrane Database Syst Rev. 2018 Dec 31;12:CD004328. doi: 10.1002/14651858.CD004328.pub3.

Tranexamic acid for patients with nasal haemorrhage (epistaxis).

Joseph J, Martinez-Devesa P, Bellorini J, Burton M

BACKGROUND: Epistaxis (nosebleed) most commonly affects children and the elderly. The majority of episodes are managed at home with simple measures. In more severe cases medical intervention is required to either cauterise the bleeding vessel, or to pack the nose with various materials. Tranexamic acid is used in a number of clinical settings to stop bleeding by preventing clot breakdown (fibrinolysis). It may have a role in the management of epistaxis as an adjunct to standard treatments, reducing the need for further intervention.

OBJECTIVES: To determine the effects of tranexamic acid (oral, intravenous or topical) compared with placebo, no additional intervention or any other haemostatic agent in the management of patients with epistaxis.

SEARCH METHODS: The Cochrane ENT Information Specialist searched the Cochrane ENT Register (via CRS Web); Central Register of Controlled Trials (CENTRAL) (via CRS Web); PubMed; Ovid Embase; CINAHL; Web of Science; ClinicalTrials.gov; ICTRP and additional sources for published and unpublished trials. The date of the search was 29 October 2018.

SELECTION CRITERIA: Randomised controlled trials (RCTs) of tranexamic acid (in addition to usual care) compared with usual care plus placebo, usual care alone or usual care plus any other haemostatic agent, to control epistaxis in adults or children.

DATA COLLECTION AND ANALYSIS: We used the standard methodological procedures expected by Cochrane. The primary outcomes were control of epistaxis: re-bleeding (as measured by the proportion of patients re-bleeding within a period of up to 10 days) and significant adverse effects (seizures, thromboembolic events). Secondary outcomes were control of epistaxis as measured by the time to stop initial bleeding (the proportion of patients whose bleeding is controlled within a period of up to 30 minutes); severity of re-bleeding (as measured by (a) the proportion of patients requiring any further intervention and (b) the proportion of patients requiring blood transfusion); length of hospital stay and other adverse effects. We used GRADE to assess the quality of the evidence for each outcome; this is indicated in italics.

MAIN RESULTS: We included six RCTs (692 participants). The overall risk of bias in the studies was low. Two studies assessed oral administration of tranexamic acid, given regularly over several days, and compared it to placebo. In the other four studies, a single application of topical tranexamic acid was compared with placebo (one study) and a combination of epinephrine and lidocaine or phenylephrine (three studies). All participants were adults. For our primary outcome, control of epistaxis: re-bleeding (proportion re-bleeding within 10 days), we were able to pool data from three studies. The pooled result demonstrated a benefit of tranexamic acid compared to placebo, the risk of re-bleeding reducing from 67% to 47% (risk ratio (RR) 0.71, 95% confidence interval (CI) 0.56 to 0.90; three studies; 225 participants; moderate-quality evidence).When we compared the effects of oral and topical tranexamic acid separately the risk of re-bleeding with oral tranexamic acid reduced from 69% to 49%, RR 0.73

(95% CI 0.55 to 0.96; two studies, 157 participants; moderate-quality evidence) and with topical tranexamic acid it reduced from 66% to 43%, RR 0.66 (95% CI 0.41 to 1.05; single study, 68 participants). We rated the quality of evidence provided by the single study as low, therefore it is uncertain whether topical tranexamic acid is effective in stopping bleeding in the 10-day period after a single application. No study specifically sought to identify and report our primary outcome: significant adverse effects (i.e. seizures, thromboembolic events).The secondary outcome time to stop initial bleeding (proportion with bleeding controlled within 30 minutes) was measured in one study using topical tranexamic acid and there was no evidence of a difference at 30 minutes (RR 0.79, 95% CI 0.56 to 1.11; 68 participants; low-quality evidence).No studies reported the proportion of patients requiring any further intervention (e.g. repacking, surgery, embolisation).One study of oral tranexamic acid reported the proportion of patients requiring blood transfusion and found no difference between groups: 5/45 (11%) versus 6/44 (14%) (RR 0.81, 95% CI 0.27 to 2.48; 89 participants; low-quality evidence).Two studies reported hospital length of stay. One study reported a significantly shorter stay in the oral tranexamic acid group (mean difference (MD) -1.60 days, 95% CI -2.49 to -0.71; 68 participants). The other study found no evidence of a difference between the groups. Tranexamic acid versus other haemostatic agents. When we pooled the data from three studies the proportion of patients whose bleeding stopped within 10 minutes was significantly higher in the topical tranexamic acid group compared to the group receiving another haemostatic agent (70% versus 30%: RR 2.35, 95% CI 1.90 to 2.92; 460 participants) (moderate-quality evidence). Adverse effects across all studies Five studies recorded 'adverse effects' in a general way. None found any difference between the groups in the occurrence of minor adverse effects (e.g. mild nausea and diarrhea, 'bad taste' of gel). In one study a patient developed a superficial thrombophlebitis of both legs following discharge, however it is not reported in which group this occurred. No "other serious adverse effect" was reported in any study.

AUTHORS' CONCLUSIONS: We found moderate-quality evidence that there is probably a reduction in the risk of re-bleeding with the use of either oral or topical tranexamic acid in addition to usual care in adult patients with epistaxis, compared to placebo with usual care. However, the quality of evidence relating solely to topical tranexamic acid was low (one study only), so we are uncertain whether or not topical tranexamic acid is effective in stopping bleeding in the 10-day period after a single application. We found moderate-quality evidence that topical tranexamic acid is probably better than other topical agents in stopping bleeding in the first 10 minutes. There have been only three RCTs on this subject since 1995. Since then there have been significant changes in nasal cauterization and packing techniques (for example, techniques including nasal endoscopy and more invasive approaches such as endoscopic sphenopalatine artery ligation). New trials would inform us about the effectiveness of tranexamic acid in light of these developments.

Scand J Trauma Resusc Emerg Med. 2018 Aug 22;26(1):68

Prehospital treatment of patients with acute intracranial pathology: adherence to guidelines and blood pressure recommendations by the Danish Air Ambulance.

Juelsgaard J, Rognås L, Knudsen L, Hansen T, Rasmussen M

BACKGROUND: Hypoxia and hypotension may be associated with secondary brain injury and negative outcomes in patients with traumatic and non-traumatic intracranial pathology. Guidelines exist only for the prehospital management of patients with severe traumatic brain injury (TBI). In patients with non-traumatic intracranial pathology, TBI guideline recommendations may be applied to assess whether hypoxia and hypotension should be avoided during prehospital treatment. The main study objective was to assess the extent to which Danish Helicopter Emergency Medical Service (HEMS) critical care teams adhere to the prehospital TBI guideline recommendations for the management of patients with a clinical diagnosis of non-traumatic intracranial pathology or isolated TBI. Furthermore, in the same two groups of patients, we evaluated the adherence of the Danish HEMS critical care teams to recommendations aiming to maintain systolic blood pressure (SBP) > 110 mmHg and > 120 mmHg.

METHODS: In total, 211 prehospital patient records were studied. All patients were treated for non-traumatic intracranial pathology or isolated TBI by the Danish HEMS critical care teams from October 1, 2014, to January 1, 2017. Adherence to the prehospital TBI guideline recommendations and the SBP recommendations above was assessed in non-TBI and TBI populations.

RESULTS: The adherence rates to TBI guideline recommendations among Danish HEMS critical care teams were 69% (n = 106 [95% CI: 61-77%]) in the non-TBI population and 74% (n = 43 [95% CI: 61-85%]) in the TBI population. SBP > 110 mmHg was observed in 74% (n = 113 [95% CI: 66-81%]) and 69% (n = 40 [95% CI: 56-81%]) of cases in the non-TBI and TBI population, respectively. SBP > 120 mmHg was observed in 55% (n = 84, [95% CI: 47-63%]) of patients in the non-TBI population and 55% (n = 32 [95% CI: 42-68%]) of the patients in the TBI population.

CONCLUSIONS: Due to a lack of comparative data, it is difficult to determine the performance quality of the Danish HEMS critical care teams. Our findings may suggest that adherence to TBI guidelines and SBP recommendations needs to be a continuous focal point for the Danish HEMS to avoid secondary brain damage.

Am J Emerg Med. 2019 Jan;37(1):173.e1-173.e2.

Spontaneous pneumothorax resulting in tension physiology.

Kelly C, Carlberg M, Madsen T

ABSTRACT:
Spontaneous pneumothorax (SP) is a relatively common pathology in emergency medicine; however, scant information is published regarding SPs developing tension physiology in the literature. Risk factors for spontaneous pneumothorax include smoking, family history, and underlying lung disease such as chronic obstructive lung disease (COPD), cystic fibrosis, tuberculosis, among others. Treatment often involves conservative management, needle aspiration, catheter placement, or tube thoracostomy. Tension pneumothorax, however, is a life threatening condition requiring emergent intervention. Case reports have demonstrated large SPs with midline shift but without tension physiology as patients largely remained hemodynamically stable. We report the case of an 18-year-old male presenting to the Emergency Department (ED) with a SP that rapidly developed tension physiology with mediastinal shift and hypotension resolved by needle decompression and CT placement.

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

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

Khan M, Mujahid M

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

BMC Surg. 2018 Nov 16;18(1):101

Factors predicting the need for hemorrhage control intervention in patients with blunt pelvic trauma: a retrospective study.

Kim M, Lee J, Lee S

BACKGROUND: Blunt pelvic injuries are often associated with pelvic fractures and injuries to the rectum and genitourinary tract. Pelvic fractures can lead to life-threatening hemorrhage, which is a common cause of morbidity and mortality in trauma. Thus, early identification of patients with pelvic fractures at risk severe bleeding requiring urgent hemorrhage control is crucial. This study aimed to investigate early factors predicting the need for hemorrhage control in blunt pelvic trauma.

METHODS: The medical records of 1760 trauma patients were reviewed retrospectively between January 2013 and June 2018. We enrolled 187 patients with pelvic fracture due to blunt trauma who were older than 15 years. The pelvic fracture pattern was classified according to the Orthopedic Trauma Association/Arbeitsgemeinschaft fur Osteosynthesefragen (OTA/AO) classification. A multivariate logistic regression model was used to determine independent predictors of the need for pelvic hemorrhage control intervention.

RESULTS: The most common pelvic fracture pattern was type A (54.5%), followed by types B (36.9%) and C (8.6%). Of 187 patients, 48 (25.7%) required pelvic hemorrhage control intervention. Hemorrhage control interventions were most frequently performed in patients with type B fractures (54.2%). Multivariate logistic regression analysis revealed that type B (odds ratio [OR] = 4.024, 95% confidence interval [CI] = 1.666-9.720, p = 0.002) and C (OR = 7.077, 95% CI = 1.781-28.129, p = 0.005) fracture patterns, decreased body temperature (OR = 2.275, 95% CI = 0.134-0.567, p < 0.001), and elevated serum lactate level (OR = 1.234, 95% CI = 1.061-1.435, p = 0.006) were factors predicting the need for hemorrhage control intervention in patients with blunt pelvic trauma.

CONCLUSION: Patients with type B and C fracture patterns on the OTA/AO classification, hypothermia, or an elevated serum lactate level are at risk for bleeding and require pelvic hemorrhage control intervention.

BMC Obes. 2018 Dec 3;5:36. doi: 10.1186/s40608-018-0213-5. eCollection 2018.

Tranexamic acid therapy for postoperative bleeding after bariatric surgery.

Klaassen R, Selles C, van den Berg J, Poelman M, van der Harst E

Background: Tranexamic acid reduces blood loss associated with various surgical procedures. Postoperative bleeding caused by dissection or bleeding of the enteric staple lines is a well-known complication following bariatric surgery. Reoperation in order to restore hemostasis is frequently necessary (up to 2.5% in literature). The effect of conservative therapy using tranexamic acid for postoperative hemorrhage after bariatric surgery is still very much a novel technique. The aim is to present our results (reoperation rate and thrombo-embolic complication rate) of tranexamic acid therapy for postoperative bleeding after bariatric surgery in comparison to those in existing literature.

Methods: We retrospectively reviewed 1388 patients who underwent bariatric surgery (laparoscopic gastric bypass or laparoscopic gastric sleeve). Use of tranexamic acid, reoperation rate, transfusion rate and rate of thrombo-embolic complications were reviewed.

Results: Forty-five of 1388 (3.2%) total patients experienced significant hemorrhage after bariatric surgery. Tranexamic acid was administered in 44 of these patients. A failure of the treatment with tranexamic acid was observed in four patients. The incidence of reoperation was 0.4% for the entire population. No thrombo-embolic complications were registered for patients receiving tranexamic acid.

Conclusion: These findings suggest that the administration of tranexamic acid appears to be safe in reducing the reoperation rate for bleeding after bariatric surgery.

Continuum (Minneap Minn). 2018 Dec;24(6):1588-1602

Cerebral Edema and Elevated Intracranial Pressure.

Koenig M

PURPOSE OF REVIEW: This article reviews the management of cerebral edema, elevated intracranial pressure (ICP), and cerebral herniation syndromes in neurocritical care.

RECENT FINDINGS: While corticosteroids may be effective in reducing vasogenic edema around brain tumors, they are contraindicated in traumatic cerebral edema. Mannitol and hypertonic saline use should be tailored to patient characteristics including intravascular volume status. In patients with traumatic brain injury who are comatose, elevated ICP should be managed with an algorithmic, multitiered treatment protocol to maintain an ICP of 22 mm Hg or less. Third-line ICP treatments include anesthetic agents, induced hypothermia, and decompressive craniectomy. Recent clinical trials have demonstrated that induced hypothermia and decompressive craniectomy are ineffective as early neuroprotective strategies and should be reserved for third-line management of refractory ICP elevation in severe traumatic brain injury. Monitoring for cerebral herniation should include bedside pupillometry in supratentorial space-occupying lesions and recognition of upward herniation in patients with posterior fossa lesions.

SUMMARY: Although elevated ICP, cerebral edema, and cerebral herniation are interrelated, treatments should be based on the distinct pathophysiologic process. Focal lesions resulting in brain compression are primarily managed with surgical decompression, whereas global or multifocal brain injury requires a treatment protocol that includes medical and surgical interventions.

Curr Opin Anaesthesiol. 2019 Apr;32(2):213-226

Resuscitative endovascular balloon occlusion of the aorta: an option for noncompressible torso hemorrhage?

Kulla M, Popp E, Knapp J

PURPOSE OF REVIEW: Hemorrhage is the major cause of early death in severely injured patients. In civilian emergency medical services, the majority of life-threatening bleedings are found in noncompressible body regions (e.g. abdomen and pelvis). Resuscitative endovascular balloon occlusion of the aorta (REBOA) has therefore been discussed in recent years as a possible lifesaving procedure and numerous studies, meta-analyses and guidelines have been published. In this review, the data situation of REBOA in the management of bleeding trauma patients is discussed and practical implementation is depicted.

RECENT FINDINGS: The typical indication for REBOA is a traumatic life-threatening hemorrhage below the diaphragm in patients unresponsive or only transiently responsive to the usual conservative therapeutic measures. REBOA appears to be a safe and effective procedure to reduce blood loss and stabilize the patient's hemodynamic status. However, surgical hemostasis has to be achieved within 30-60 min after occlusion of the aorta. Data on clear advantages of REBOA over resuscitative thoracostomy are inconclusive.

SUMMARY: REBOA could play an important role in the management of the severely bleeding patient in the future. Together with transfusion and therapy of coagulation disorders, REBOA may be an additional tool in the anesthetist's hands for trauma management in interprofessional care concepts.

Resuscitation. 2018 Dec;133:e1-e2

First description of successful use of zone 1 resuscitative endovascular balloon occlusion of the aorta in the prehospital setting.

Lamhaut L, Qasim Z, Hutin A, Dagron C, Orsini J Haegel A, Perkins Z, Pirracchio R, Carli P

QUOTE:

"Early intervention is critical to decrease preventable hemorrhagerelated mortality. Point-of-care hemorrhage control is achieved through appropriate implementation of REBOA into prehospital systems. The Paris SAMU, building on their existing experience with prehospital ECPR, has incorporated REBOA [4].

Civilian data identified 3% of trauma patients per year in Paris have injury patterns potentially amenable to REBOA [5]. REBOA can potentially extend the survival time and resource utilization when multiple exsanguinating casualties from mass casualty incidents are moved to the warm zone, part of a "damage control ground zero" concept.

It is imperative that REBOA is developed within a system that can rapidly transport to definitive care. REBOA should be placed only by those who have undergone appropriate training in patient selection and use. Point-of-care ultrasound can assist in identifying appropriate patients, and in excluding contraindications e.g. pericardial tamponade.

Every case should undergo peer review to ensure quality assurance. This is the first reported case of successful civilian prehospital Zone 1 deployment – a product of extensive training and development within a robust system incorporating an overall "damage control ground zero" concept."

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

The impact of hypothermia on outcomes in massively transfused patients.

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

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

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

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

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

LEVEL OF EVIDENCE: Prognostic, level III.

Transfusion. 2019 Feb;59(2):707-713

Single-donor spray-dried plasma.

Liu Q, Carney R, Sohn J, Sundaram S, Fell M

BACKGROUND: Dried plasma is logistically superior for hemostasis management because it can be transported and stored under nonfrozen conditions and quickly reconstituted at the point of care, enabling prehospital administration. Velico Medical has developed a spray-drying system to be integrated into routine blood center work streams for spray drying single donor plasma units. This study compared the quality of the spray-dried plasma (on-demand plasma [ODP]) with fresh frozen plasma (FFP).

STUDY DESIGN AND METHODS: ODP units (n = 60) were manufactured from never frozen fresh plasma, which was pretreated with glycine-hydrochloric acid and stored at 1to 6°C. Paired aliquots were frozen and stored at -18°C or less. After 31 to 33 days, ODP samples were reconstituted with water for injection and comprehensively characterized in parallel with paired FFP. The quantities of plasma dried and rehydration fluid were predetermined, ensuring comparable total protein concentration in ODP and paired FFP.

RESULTS: ODP is comparable to FFP in global coagulation function as assessed by activated partial thromboplastin time and prothrombin time and in clot formation evaluated by thrombelastography. Compared to FFP, ODP had greater than 80% levels of functional coagulation factors and related proteins and chemistry analytes except for Factor XIII (74%). Pretreatment mitigated cleavage of high-molecular-weight von Willebrand factor multimers by spray drying and resulted in 60% vWF:ristocetin cofactor activity in ODP compared to FFP.

CONCLUSIONS: ODP demonstrates coagulation function comparable to that of FFP. The spray drying system can be implemented in blood centers and is capable of producing units of ODP.

J Craniofac Surg. 2019 Jan;30(1):120-126

Tranexamic Acid Decreases Blood Transfusion Burden in Open Craniosynostosis Surgery Without Operative Compromise.

Lu V, Goyal A, Daniels D

ABSTRACT:
In the surgical management of craniosynostosis, there is a high red blood cell (RBC) transfusion burden due to the small blood volume of the patients combined with significant blood loss that can occur with open surgery (OS). Tranexamic acid (TXA) is an antifibrinolytic which has been shown to decrease such a burden in particular surgeries. The aim of this study was to compare the operative outcomes of craniosynostosis OS which did and did not utilize TXA. Searches of 7 electronic databases from inception to February 2018 were conducted following Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines. There were 206 articles screened against selection criteria for inclusion. Relevant data were extracted and analyzed using meta-analysis of proportions. A total of 9 comparative studies were included for meta-analysis. Compared with the control cohort, craniosynostosis OS utilizing TXA demonstrated significantly lower intraoperative RBC transfusion volumes (mean difference, -8.25 mL/kg; $P<0.001$), blood loss (mean difference, -10.96 mL/kg; $P<0.001$) and postoperative RBC transfusion incidence (odds ratio, OR, 0.12; $P=0.005$). Fresh frozen plasma and crystalloid transfusion, operation time, length of stay, and complications were not significantly different with TXA use. Based on the comparative evidence currently available, TXA significantly decreased RBC transfusion burden during craniosynostosis OS without operative compromise. There is significant heterogeneity in reported TXA regimes in the literature. Future studies that are larger, randomized, and account for these factors will further enhance the authors' understanding.

J Anaesthesiol Clin Pharmacol. 2018 Oct-Dec;34(4):490-495

Assessment of awake i-gel™ insertion for fiberoptic-guided intubation in patients with predicted difficult airway: A prospective, observational study.

Ludeña J, Bellas J, Rementeria R, Muñoz Alameda L

Background and Aims: Orotracheal intubation (OTI) with fiberoptic bronchoscope (FOB) in spontaneous ventilation is one of the main techniques for patients with predicted difficult airway. Latest generation supraglottic airway devices have been designed to allow OTI through them. We assessed the safety and effectiveness of FOB-guided OTI through i-gel™ device which was inserted in spontaneously breathing patients with predicted difficult airway. Material and Methods: Eighty-five patients with difficult airway predictors were included. The i-gel was inserted under oropharyngeal local anaesthesia and sedation. After checking the adequate ventilation through the i-gel with capnography curve, general anaesthesia was induced in order to introduce the endotracheal tube guided by FOB. We recorded the i-gel insertion time (t gel), intubation time (t int), O2 saturation in pulse oximetry (SpO2) at different times: basal (t 0), after 3 min of preoxygenation with a face mask at 100% FiO2 (t 1), after i-gel mask insertion (t 2) and after intubation (t 3). Adverse events during the procedure were also recorded.

Results: All patients were successfully intubated. SpO2 values were: 96.9 ± 1.2 (t 0), 99.0 ± 0.9 (t 1), 96.2 ± 2.4 (t 2), 96.0 ± 2.5 (t 3). t gel and t int were 38.0 ± 7.8 s and 36.5 ± 5.6 s, respectively. No serious adverse events were recorded and no patient suffered airway trauma.

Conclusion: I-gel insertion in spontaneous ventilation secures the airway before achieving fiberoptic intubation without the occurrence of adverse events. More studies might be necessary in order to confirm the results presented, but we consider that the technique described is a safe and effective alternative to classic OTI with FOB in spontaneously breathing patients with predicted difficult airway.

Air Med J. 2019 Jan - Feb;38(1):12-13

Articles That May Change Your Practice: Prehospital Plasma.

MacDonald R

Quote: (With regards to the paper by Sperry et al: Prehospital plasma during air medical transport in trauma patients at risk for hemorrhagic shock. N Engl Med J, 2018

"The use of thawed plasma in the prehospital setting, as was done in this trial, poses several challenges. It requires proper refrigerated storage and has a shelf-life of only 5 to 7 days. The logistics of maintaining a supply without wasting product is a logistical challenge, requiring a good partnership with a blood supply agency and local hospitals. Never-frozen liquid plasma is a potential alternative because it retains the majority of its clotting factors and inhibitors at 26 days.11 Although availability is not widespread and not approved by the Food and Drug Administration (United States) or Health Canada (Canada), freeze-dried plasma can potentially overcome issues with storage and shelf-life. It has shown promise as part of the resuscitation of patients with hemorrhagic shock in military and civilian settings.12,13 If freeze-dried plasma becomes more widely available, it would overcome the storage and shelf life issues present with current forms of plasma.

If the ultimate goal is to restore circulating volume with a comparable fluid, whole blood may be the most effective option. It has the benefit of having oxygen-carrying red blood cells and clotting factors and platelets to enable and promote the formation of a clot. It has a typical shelf life of 21 days and would be an ideal prehospital resuscitation product if it were more widely available. Although theoretically promising, further study would be needed to compare it with existing resuscitation therapies, including those that involve blood components such as PRBCs and plasma."

Mil Med. 2018 Dec 7. Epub ahead of print

En Route Resuscitation - Utilization of CCATT to Transport and Stabilize Critically Injured and Unstable Casualties.

Maddry J, Ball E, Cox D, Flarity K, Bebarta V

Introduction: The U.S. Air Force utilizes specialized Critical Care Air Transport Teams (CCATT) for transporting "stabilized" patients. Given the drawdown of military forces from various areas of operation, recent CCATT operations have increasingly involved the evacuation of unstable and incompletely resuscitated patients from far forward, austere locations. This brief report describes unique cases representative of the evolving CCATT mission and provides future direction for changes in doctrine and educational requirements in preparation for en route combat casualty care.

Methods and Materials: This case series describes three patients who required significant resuscitation during CCATT transport from austere locations between April and November 2017. Approval for this project was received from the US Air Force 59th Medical Wing Institutional Review Board as non-research.

Results: Case 1: CCATT was dispatched to transport patient 1 who was reported to have a head injury after a fall. Upon evaluation of the patient onboard the aircraft, it was discovered that the patient was in cardiac arrest. Cardiopulmonary resuscitation was performed during tactical takeoff with frequent combat maneuvers. The patient developed a palpable pulse after three rounds of CPR, three doses of epinephrine, and one unit of packed red blood cells. Point of care laboratory analysis demonstrated a profoundly elevated lactate level. Cyanide poisoning was a concern but there was no antidote available in the available equipment set. After delivery to a medical facility, blood samples were positive for cyanide. Over the next 2 weeks, the patient improved and was discharged home, neurologically intact. Case 2: Patient 2 sustained complex blast injuries and bilateral lower extremity amputations. He required early transport for continuous renal replacement therapy (CRRT). The patient received 200 units of blood products in the 24 hours prior to transport and developed renal failure, pulmonary edema, and elevated ICP. During the 7 hour flight, Patient 2 received frequent adjustments of vasopressor medications, multiple Dakins solution soaks and flushes, and 1 unit of fresh frozen plasma. He remained alive 2 months later. Case 3: The team was notified to collect an urgent patient with a blast lung injury and bilateral lower extremity amputations. The ground team encountered difficulty ventilating the patient. Patient 3 arrived in the back of a pickup truck accompanied by medics and being bag valve mask ventilated with a pulse oximetry reading of 65%. He was secured to the floor of the aircraft which departed within 5 minutes of arrival. An ultrasound of the lungs showed no pneumothorax. By the end of the flight, the patient's oxygen saturation had risen to 95% and he was delivered to the emergency department in stable condition. He later passed away in the operating room due to severe blast lung and cardiac contusion.

Conclusion: This brief report demonstrates the need of CCATT in the transport of unstable patients from forward deployed locations. The Air Force has adapted and is continuing to adapt CCATT training, equipment, onboard diagnostics and therapies, and team members' clinical skills to meet enroute care combat casualty needs.

Res Pract Thromb Haemost. 2018 Dec 12;3(1):12-14

Prehospital fresh frozen plasma: Universal life saver or treatment in search of a target population?

Makris M, Iorio A

QUOTES:

"Recently within 2 days of each other, two of the leading medical journals published trials on the use of prehospital fresh frozen plasma (FFP) for trauma patients, reaching apparently different conclusions. In the *New England Journal of Medicine* article reporting on the Prehospital Air Medical Plasma (PAMPer) trial, Sperry et al (1) found that two units of prehospital FFP was associated with an almost 10% survival advantage. In the Control of Major Bleeding After Trauma Trial (COMBAT) reported in the Lancet, Moore et al (2) found that the same volume of plasma had no survival advantage."

"An important difference between the trials emerges on looking at the control arms, both receiving standard care. These individuals had identical entry criteria and in theory similar management plans after reaching the hospital facility. However, the 24-hour mortality was 10% in the COMBAT trial and 22% in PAMPer, while the respective 28-to 30-day mortality was 10% and 33%. Such large differences must relate to differences in severity of the injury in the two groups, which unfortunately is not reported with sufficient details to allow a direct comparison. As these data must have been collected, the authors should be encouraged to publish data allowing direct comparison between the two trials, especially detailing the injury severity. It would also be good to see retrospective data from both research networks showing whether the mortality figures observed in the two trials are representative of their previous experience or they happened to select a more (PAMPer) or less (COMBAT) severe population."

"Our conclusion reflecting on these two randomized clinical trials is that the case for universal use of prehospital FFP is not yet made. Until further results from these trials are published to guide interpretation of current evidence and planning of future large pragmatic trials, it would be better for first response teams to concentrate on getting the injured individual to the controlled hospital environment as soon as possible, rather than investing precious time in administering FFP before transfer. Indeed, even assuming plasma can benefit a subgroup of more severely injured patients, it might be difficult to stratify them with the little time and few tools available at the injury site."

J Emerg Med. 2018 Nov;55(5):627-634

Is Peripheral Oxygen Saturation a Reliable Predictor of Upper Airways Air-Flow Limitation?

Malagutti N, Di Laora A, Barbetta C, Groppo E, Tugnoli V, Sette E, Astolfi L, Beswick W, Borin M, Ciorba A, Pelucchi S, Stomeo F, Contoli M

BACKGROUND: Dyspnea secondary to acute upper airways airflow limitation (UAAFL) represents a clinical emergency that can be difficult to recognize without a suitable history; even when etiology is known, parameters to assess the severity are unclear and often improperly used.

OBJECTIVES: The aim of this study was to assess the role of peripheral oxygen saturation (SpO2) as a predictor of severity of upper airway obstruction.

METHODS: The authors propose an experimental model of upper airway obstruction by a progressive increase of UAAFL. Ten healthy volunteers randomly underwent ventilation for 6 min with different degrees of UAAFL. SpO2, heart rate, respiratory rate (RR), tidal volume, accessory respiratory muscle activation, and subjective dyspnea indexes were measured.

RESULTS: In this model, SpO2 was not reliable as the untimely gravity index of UAAFL. Respiratory rate, visual analogue scale (VAS), and Borg dyspnea scale were statistically correlated with UAAFL ($p < 0.0001$ for RR and $p < 0.05$ for VAS and Borg scale). No significant changes were observed on heart rate ($p > 0.05$) and tidal volume ($p > 0.05$); a RR ≤ 7 breaths/min; VAS and Borg scale showed statistically significant parameters changes ($p < 0.05$).

CONCLUSIONS: RR, VAS, and Borg dyspnea scales are sensitive parameters to detect and stage, easily and quickly, the gravity of an upper airways impairment, and should be used in emergency settings for an early diagnosis of a UAAFL. SpO2 is a poorer predictor of the degree of upper airways flow limitation.

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Curr Opin Anaesthesiol. 2019 Apr;32(2):227-233

Thoracic trauma in military settings: a review of current practices and recommendations.

Mansky R, Scher C.

PURPOSE OF REVIEW: To examine current literature on thoracic trauma related to military combat and to explore its relevance to the civilian population.

RECENT FINDINGS: Damage control resuscitation (DCR) has improved the management of hemorrhaging trauma patients. Permissive hypotension below 110 mmHg and antifibrinolytic use during DCR is widely accepted, whereas the use of freeze-dried plasma and whole blood is gaining popularity. The Modified Physiologic Triaging Tool can be used for primary triage and it may have applications in civilian trauma systems. Although Tactical Combat Casualty Care protocol recommends the Cric-Key device for surgical cricothyroidotomies, other devices may offer comparable performance. Recommendations for regional anesthesia after blunt trauma are not well defined. Increasing amounts of evidence favor the use of extracorporeal membrane oxygenation for refractory hypoxemia and resuscitative endovascular balloon occlusion of the aorta (REBOA) for severe hemorrhage. REBOA outcomes are potentially improved by partial occlusion and small 7 Fr catheters.

SUMMARY: The Global War on Terror has provided opportunities to better understand and treat thoracic trauma in military settings. Trauma registries and other data sources have contributed to significant advancements in the management of thoracic trauma in military and civilian populations.

J Trauma Acute Care Surg. 2019 Jan 10; Epub ahead of print

The "Top 10" Research and Development Priorities for Battlefield Surgical Care: Results From the Committee on Surgical Combat Casualty Care Research gap Analysis.

Martin M, Holcomb J, Polk T, Hannon M, Eastridge B, Malik S, Blackman V, Galante J, Grabo D, Schreiber M, Gurney J, Butler F, Shackelford S.

BACKGROUND: The US Military has achieved the highest casualty survival rates in its history. However, there remain multiple areas in combat trauma that present challenges to the delivery of high quality and effective trauma care. Previous work has identified research priorities for pre-hospital care, but there has been no similar analysis for forward surgical care.

METHODS: A list of critical "focus areas" was developed by the Committee on Surgical Combat Casualty Care (CoSCCC). Individual topics were solicited and mapped to appropriate focus areas by group consensus and review of EAST and JTS guidelines. A web-based survey was distributed to the CoSCCC and the military committees of EAST and AAST. Topics were rated on a Likert scale from 1 (low) to 10 (high priority). Descriptives, univariate statistics, and inter-rater correlation analysis was performed.

RESULTS: 13 research focus areas were identified (8 clinical and 5 adjunctive categories). Ninety individual topics were solicited. The survey received 64 responses. The majority of respondents were military (90%) versus civilians (10%). There was moderate to high agreement (inter-rater correlation coefficient=0.93, $p<0.01$) for 10 focus areas. The top 5 focus areas were Personnel/Staffing (mean=8.03), Resuscitation & Hemorrhage Management (7.49), Pain/Sedation/Anxiety Management (6.96), Operative Interventions (6.9), and Initial Evaluation (6.9). The "Top 10" research priorities included 4 in Personnel/Staffing, 4 in Resuscitation/Hemorrhage Management, and 3 in Operative Interventions. A complete list of the topics/scores will be presented.

CONCLUSIONS: This is the first objective ranking of research priorities for combat trauma care. The "Top 10" priorities were all from 3 focus areas, supporting prioritization of personnel/staffing of austere teams, resuscitation/hemorrhage control, and damage control interventions. This data will help guide DOD research programs and new areas for prioritized funding of both military and civilian researchers.

J Trauma Acute Care Surg. 2018 Dec;85(6):1123-1126

Heeding the call: Military-civilian partnerships as a foundation for enhanced mass casualty care in the United States.

Martin M, Rasmussen T, Margaret Knudson M, Elster E

QUOTE:

"**TABLE 2. List of Suggested Action Items for OptimizingMilitary-Civilian Collaboration in Trauma and MASCAL/Disaster Care**

➢All US military medical centers should have a formalized partnership or active participation with the civilian trauma system, including resident training agreements for all teaching programs

➢ Development of military "operational surgeon" training pathway that should include fellowship and board certification in surgical critical care

➢ Establishment of pathway for select civilian trauma surgeons and other key providers to fill deployment slots or other critical positions during periods of active combat operations

➢ Detailed analysis of existing local and regional trauma system to characterize need, potential impact, potential benefits, and cost ofmilitary hospital attaining trauma center verification

➢ Dedicated funding support for select military treatment facilities obtaining trauma center verification if favorable local conditions and positive analysis as described above

➢Dedicated funding support for military-civilian collaborative programs including embedding full-time personnel and establishing training rotations for military personnel/teams at select civilian trauma centers

➢Military representative participates in all local and regional MASCAL and disaster planning/readiness organizations and activities

➢ At least annual MASCAL simulation and rehearsal with combined militarycivilian participation
➢ Development of state-based or national rapid credentials verification and transfer system for use in major disaster/MASCAL events, modeled on the military Interfacility Credentials Transfer Brief (ICTB) system

➢ Legal, regulatory, and policy actions to permit full military participation in homeland trauma care and MASCAL/disaster events, including allowing for outpatient follow-up of civilian patients"

Biomed Res Int. 2018 Nov 18;2018:5202957. doi: 10.1155/2018/5202957. eCollection 2018.

A Comparison between the i-gel® and air-Q® Supraglottic Airway Devices Used for the Patients Undergoing General Anesthesia with Muscle Relaxation.

Massoudi N, Fathi M, Nooraei N, Salehi A

Objectives: The aim of the present study was to compare two supraglottic airway (SGA) devices (i.e., the i-gel® © Intersurgical Ltd and air-Q® (Reusable) Cookgas company) in terms of the insertion time, amount of leak during ventilation with maximum positive pressure, and postoperative complications in patients referring to Modarres Hospital in Tehran.

Method: The present double-blind clinical trial was performed on 60 patients undergoing elective surgeries that required general anesthesia with muscle relaxation. Patients were randomly assigned to either i-gel® (n = 30) or Air-Q® (n = 30) groups.

Results: The mean age, body mass index, duration of surgery, duration of anesthesia, and gender ratio were not significantly different between the two groups. Mean ± SD values of the SGA devices' insertion time (in seconds) in the air-Q® and i-gel® groups were 4.87 ± 1.6 and 6.80 ± 1.2, respectively ($P < 0.001$). The mean OLP in the Air-Q® group was significantly higher than that of the i-gel® group (35.9 ± 9.6 versus 24.8 ± 3.7, $p < 0.001$). The frequency of complications occurred after the supraglottic airway insertion was higher in the i-gel® group. However, only in terms of sore throat, the difference between the two groups was statistically significant: 6 (20%) had sore throat ($P = 0.024$) in the i-gel groups, but in in the Air-Q® groups no one had this side effect after surgery.

Conclusion: It was concluded that the Air-Q® supraglottic airway was placed faster and easier with fewer complications than the i-gel in general anesthesia with muscle relaxation. The frequency of the occurrence of all three complications, cough, sore throat, and blood, on the cuff (6 (20%) was higher in the i-gel group than that in the air-Q® group (cough3 (10%), sore throat 0 (0%), and blood on the cuff 3 (10%) ($P < 0.05$).

Intensive Care Med. 2019 Feb;45(2):257-258

Cerebral fat embolism after intraosseous infusion.

May F, Hodel J, Mekontso Dessap A, Razazi K

QUOTES:

"Antibiotics, analgesic drugs and fluid resuscitation were infused by intraosseous access in the left proximal tibia. The patient developed vasoplegic shock and acute respiratory failure requiring vasopressor therapy and mechanical ventilation."

"Magnetic resonance imaging showed multiple bilateral low-intensity infracentimetric lesions on susceptibility-weighted imaging (SWI), distributed in supra- and subtentorial cerebellar white matter and suggesting cerebral fat embolism (Fig. 1a)."

"Cerebral fat embolism is a classical complication of intraosseous access, and the recent SWI is a key sequence in MRI for its diagnosis."

J Spec Oper Med. Winter 2018;18(4):18-23.

Larger-Caliber Alternative Devices for Decompression of Tension Hemopneumothorax in the Setting of Hemorrhagic Shock.

McEvoy CS, Leatherman ML, Held JM, Fluke LM, Ricca RL, Polk T.

BACKGROUND: The 14-gauge (14G) angiocatheter (AC) has an unacceptably high failure rate in treatment of tension pneumothorax (tPTX). Little is known regarding the interplay among hemorrhage, hemothorax (HTX), and tPTX. We hypothesized that increased hemorrhage predisposes tension physiology and that needle decompression fails more often with increased HTX.

METHODS: This is a planned secondary analysis of data from our recent comparison of 14G AC with 10-gauge (10G) AC, modified 14G Veress needle, and 3mm laparoscopic trocar conducted in a positive pressure ventilation tension hemopneumothorax model using anesthetized swine. Susceptibility to tension physiology was extrapolated from volume of carbon dioxide (CO2) instilled and time required to induce 50% reduction in cardiac output. Failures to rescue and recover were compared between the 10% and 20% estimated blood volume (EBV) HTX groups and across devices.

RESULTS: A total of 196 tension hemopneumothorax events were evaluated. No differences were noted in the volume of CO2 instilled nor time to tension physiology. HTX with 10% EBV had fewer failures compared with 20% HTX (7% versus 23%; p = .002). For larger-caliber devices, there was no difference between HTX groups, whereas smaller-caliber devices had more failures and longer time to rescue with increased HTX volume as well as increased variability in times to rescue in both HTX volume groups.

CONCLUSION: Increased HTX volume did not predispose tension physiology; however, smaller-caliber devices were associated with more failures and longer times to rescue in 20% HTX as compared with 10% HTX. Use of larger devices for decompression has benefit and further study with more profound hemorrhage and HTX and spontaneous breathing models is warranted.

J Inj Violence Res. 2019 Jan;11(1):29-34

The iTClamp in the treatment of prehospital craniomaxillofacial injury: a case series study.

Mckee J, Mckee I, Ball C, Tan E, Moloff A, McBeth P, LaPorta A, Bennett B, Filips D, Teicher C, Kirkpatrick AW.

BACKGROUND: Craniomaxillofacial (CMF) injuries are very common in both civilian and military settings. Nearly half of all civilian trauma incidents include a scalp laceration and historical rates of CMF battle injuries increased from 16%-21% to 42.2%. The scalp is highly vascular tissue and uncontrolled bleeding can lead to hypotension, shock and death. Therefore, enabling on-scene providers, both military and civilian, to immediately manage scalp and face lacerations, in a manner that allows them to still function in a tactical way, offers operational advantages. This case series examines how effectively a wound-clamp (iTClamp) controlled bleeding from CMF injuries pre-hospital environment.

METHODS: The use of the iTClamp for CMF (scalp and face laceration) was extracted from iTrauma Care's post market surveillance database. Data was reviewed and a descriptive analysis was applied.

RESULTS: 216 civilian cases of iTClamp use were reported to iTrauma Care. Of the 216 cases, 37% (n=80) were for control of CMF hemorrhage (94% scalp and 6% face). Falls (n=24) and MVC (n=25) accounted for 61% of the mechanism of injury. Blunt accounted for 66% (n=53), penetrating 16% (n=13) and unknown 18% (n=14). Adequate hemorrhage control was reported in 87.5% (n=70) of cases, three respondents reported inadequate hemorrhage control and in seven cases hemorrhage control was not reported. Direct pressure and packing was bandoned in favor of the iTClamp in 27.5% (n=22) of cases.

CONCLUSIONS: CMF injuries are common in both civilian and military settings. Current options like direct manual pressure (DMP) often do not work well, are formidable to maintain on long transports and Raney clips are a historical suggestion. The iTClamp offers a new option for control of external hemorrhage from open wounds within compressible zones.

**J Emerg Med. 2019 Jan 29. pii: S0736-4679(18)31197-1.
doi:n10.1016/j.jemermed.2018.12.008. [Epub ahead of print]**

A Randomized Controlled Trial using iTClamp, Direct Pressure, and Balloon Catheter Tamponade to Control Neck Hemorrhage in a Perfused Human Cadaver Model.

McKee J, Mckee I, Bouclin M, Filips D, Atkinson I, Ball C, McBeth P, Kirkpatrick M

BACKGROUND: Penetrating neck wounds are common in the civilian and military realms. Whether high or low velocity, they carry a substantial morbidity and mortality rate.

OBJECTIVES: We endeavored to ascertain whether the iTClamp is equivalent to direct manual pressure (DMP) and Foley catheter balloon tamponade (BCT).

METHODS: Using a perfused cadaver, a 4.5-cm wound was made in Zone 2 of the neck with a 1-cm carotid arteriotomy. Each of the hemorrhage control modalities was randomized and then applied to the wound separately. Time to apply the device and fluid loss with and without neck motion was recorded.

RESULTS: There was no significant difference between the fluid loss/no movement ($p > 0.450$) and fluid loss/movement ($p > 0.215$) between BCT and iTClamp. There was significantly more fluid lost with DMP than iTClamp with no movement ($p > 0.000$) and movement ($p > 0.000$). The iTClamp was also significantly faster to apply than the Foley ($p > 0.000$).

CONCLUSIONS: The iTClamp and BCT were associated with significantly less fluid loss than DMP in a perfused cadaver model. The iTClamp required significantly less time to apply than the BCT. Both the iTClamp and the BCT were more effective than simple DMP. The iTClamp offers an additional option for managing hard-to-control bleeding in the neck.

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Trauma Surg Acute Care Open. 2019 Jan 24;4(1):e000267. doi: 10.1136/tsaco-2018-000267. eCollection 2019.

Effect of prehospital tourniquets on resuscitation in extremity arterial trauma.

McNickle A, Fraser D, Chestovich P, Kuhls D, Fildes J

Background: Timely tourniquet placement may limit ongoing hemorrhage and reduce the need for blood products. This study evaluates if prehospital tourniquet application altered the initial transfusion needs in arterial injuries when compared with a non-tourniquet control group.

Methods: Extremity arterial injuries were queried from our level I trauma center registry from 2013 to 2017. The characteristics of the cohort with prehospital tourniquet placement (TQ+) were described in terms of tourniquet use, duration, and frequency over time. These cases were matched 1:1 by the artery injured, demographics, Injury Severity Score, and mechanism of injury to patients arriving without a tourniquet (TQ-). The primary outcome was transfusion within the first 24 hours, with secondary outcomes of morbidity (rhabdomyolysis, renal failure, compartment syndrome), amputation (initial vs. delayed), and length of stay. Statistical tests included t-test and $\chi 2$ for continuous and categorical variables, respectively, with $p<0.05$ considered as significant.

Results: Extremity arterial injuries occurred in 192 patients, with 69 (36%) having prehospital tourniquet placement for an average of 78 minutes. Tourniquet use increased over time from 9% (2013) to 62% (2017). TQ+ patients were predominantly male (81%), with a mean age of 35.0 years. Forty-six (67%) received blood transfusion within the first 24 hours. In the matched comparison (n=69 pairs), TQ+ patients had higher initial heart rate (110 vs. 100, p=0.02), frequency of transfusion (67% vs. 48%, p<0.01), and initial amputations (23% vs. 6%, p<0.01). TQ+ patients had increased frequency of initial amputation regardless of upper (n=43 pairs) versus lower (n=26 pairs) extremity involvement; however, only upper extremity TQ+ patients had increased transfusion frequency and volume. No difference was observed in morbidity, length of stay, and mortality with tourniquet use.

Discussion: Tourniquet use has increased over time in patients with extremity arterial injuries. Patients having prehospital tourniquets required a higher frequency of transfusion and initial amputation, without an increase in complications.

Level of evidence: Therapeutic study, level IV.

Diagn Microbiol Infect Dis. 2018 Dec 29; Epub ahead of print

Microbiology of combat-related extremity wounds: Trauma Infectious Disease Outcomes Study.

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

ABSTRACT:
We present extremity wound microbiology data from 250 combat casualties (2009-2012). Confirmed extremity wound infections (EWIs) were based on clinical and laboratory findings. Suspected EWIs had isolation of organisms from wound cultures with associated signs/symptoms not meeting clinical diagnostic criteria. Colonized wounds had organisms isolated without any infection suspicion. A total of 335 confirmed EWIs (131 monomicrobial and 204 polymicrobial) were assessed. Gram-negative bacteria were predominant (57% and 86% of monomicrobial and polymicrobial infections, respectively). In polymicrobial infections, 61% grew only bacteria, while 30% isolated bacteria and mold. Multidrug resistance was observed in 32% of isolates from first monomicrobial EWIs ±3 days of diagnosis, while it was 44% of isolates from polymicrobial EWIs. Approximately 96% and 52% of the suspected and colonized wounds, respectively, shared ≥1 organism in common with the confirmed EWI on the same patient. Understanding of combat-related EWIs can lead to improvements in combat casualty care.

Crit Care Med. 2019 Feb 5; Epub ahead of print

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

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

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

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

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

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

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

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

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

J Spec Oper Med. Winter 2018;18(4):34-35.

Use of Drone Technology for Delivery of Medical Supplies During Prolonged Field Care.

Mesar T, Lessig A, King DR.

BACKGROUND: Care of trauma casualties in an austere environment presents many challenges, particularly when evacuation is not immediately available. Man-packable medical supplies may be consumed by a single casualty, and resupply may not be possible before evacuation, particularly during prolonged field care scenarios. We hypothesized that unmanned aerial drones could successfully deliver life-sustaining medical supplies to a remote, denied environment where vehicle or foot traffic is impossible or impractical.

METHODS: Using an unmanned, rotary- wing drone, we simulated delivery of a customizable, 4.5kg load of medical equipment, including tourniquets, dressings, analgesics, and blood products. A simulated casualty was positioned in a remote area. The flight was preprogrammed on the basis of grid coordinates and flew on autopilot beyond visual range; data (altitude, flight time, route) were recorded live by high-altitude Shadow drone. Delivery time was compared to the known US military standards for traversing uneven topography by foot or wheeled vehicle.

RESULTS: Four flights were performed. Data are given as mean (± standard deviation). Time from launch to delivery was 20.77 ± 0.05 minutes (cruise speed, 34.03 ± 0.15 km/h; mean range, 12.27 ± 0.07 km). Medical supplies were delivered successfully within 1m of the target. The drone successfully returned to the starting point every flight. Resupply by foot would take 5.1 hours with an average speed of 2.4km/h and 61.35 minutes, with an average speed of 12 km/h for a wheeled vehicle, if a rudimentary road existed.

CONCLUSION: Use of unmanned drones is feasible for delivery of life-saving medical supplies in austere environments. Drones repeatedly and accurately delivered medical supplies faster than other methods without additional risk to personnel or manned airframe. This technology may have benefit for austere care of military and civilian casualties.

Resuscitation. 2019 Jan;134:69-75

Intraosseous versus intravenous access in patients with out-of-hospital cardiac arrest: Insights from the resuscitation outcomes consortium continuous chest compression trial.

Mody P, Brown S, Kudenchuk P, Chan P, Khera R, Ayers C, Pandey A, Kern K, de Lemos J, Link M, Idris A

AIM: To examine outcomes associated with intraosseous access route attempt for delivery of medications during out-of-hospital cardiac arrest (OHCA) resuscitation.

METHODS: Using data from the Continuous Chest Compression trial, we examined rates of survival to hospital discharge, sustained return of spontaneous circulation (ROSC), and survival with favorable neurological function among patients with intraosseous and intravenous access attempts after adjusting for age, sex, initial rhythm, bystander cardiopulmonary resuscitation, public location, witnessed status, EMS response and trial randomization cluster.

RESULTS: Among 19,731 patients, intraosseous access was attempted in 3068 patients and intravenous access in 16,663 patients respectively. Patients in whom intraosseous access was attempted were younger, more often female, and had marginally faster times to initial access and to initial drug administration. Unadjusted outcomes were significantly lower in patients with attempted intraosseous access compared with intravenous access: (4.6% vs. 5.7%, $p = 0.01$) for survival to discharge, (17.9% vs. 23.5%, $p < 0.001$) for sustained ROSC and (2.8% vs. 4.2%, $p < 0.001$) for survival with favorable neurological function. After adjustment, there were no differences in hospital survival (OR, 0.88, 95% CI 0.72-1.09, $p = 0.24$) or survival with favorable neurological function (OR, 0.87, 95% CI 0.67-1.12, $p = 0.29$) in patients with intraosseous access attempt (vs. intravenous access). However, intraosseous access continued to associate with lower rates of sustained ROSC (OR, 0.80, 95% CI 0.71 - 0.89, $p < 0.001$).

CONCLUSIONS: Among patients with OHCA, intraosseous access attempt was associated with worse ROSC rates but no difference in survival. Further studies are necessary to elucidate the optimal access route among OHCA patients.

J Trauma Acute Care Surg. 2019 Jan;86(1):20-27. doi: 10.1097/TA.0000000000002061.

Tranexamic acid administration is associated with an increased risk of posttraumatic venous thromboembolism.

Myers S, Kutcher M, Rosengart M, Sperry J, Peitzman A, Brown J, Neal M

BACKGROUND: Tranexamic acid (TXA) is used as a hemostatic adjunct for hemorrhage control in the injured patient and reduces early preventable death. However, the risk of venous thromboembolism (VTE) has been incompletely explored. Previous studies investigating the effect of TXA on VTE vary in their findings. We performed a propensity matched analysis to investigate the association between TXA and VTE following trauma, hypothesizing that TXA is an independent risk factor for VTE.

METHODS: This retrospective study queried trauma patients presenting to a single Level I trauma center from 2012 to 2016. Our primary outcome was composite pulmonary embolism or deep vein thrombosis. Mortality, transfusion, intensive care unit and hospital lengths of stay were secondary outcomes. Propensity matched mixed effects multivariate logistic regression was used to determine adjusted odds ratio (aOR) and 95% confidence intervals (95% CI) of TXA on outcomes of interest, adjusting for pre-specified confounders. Competing risks regression assessed subdistribution hazard ratio of VTE after accounting for mortality.

RESULTS: Of 21,931 patients, 189 pairs were well matched across propensity score variables (standardized differences <0.2). Median Injury Severity Score was 19 (interquartile range, 12-27) and 14 (interquartile range, 8-22) in TXA and non-TXA groups, respectively (p = 0.19). Tranexamic acid was associated with more than threefold increase in the odds of VTE (aOR, 3.3; 95% CI, 1.3-9.1; p = 0.02). Tranexamic acid was not significantly associated with survival (aOR, 0.86; 95% CI, 0.23-3.25; p = 0.83). Risk of VTE remained elevated in the TXA cohort despite accounting for mortality (subdistribution hazard ratio, 2.42; 95% CI, 1.11-5.29; p = 0.03).

CONCLUSION: Tranexamic acid may be an independent risk factor for VTE. Future investigation is needed to identify which patients benefit most from TXA, especially given the risks of this intervention to allow a more individualized treatment approach that maximizes benefits and mitigates potential harms.

LEVEL OF EVIDENCE: Therapeutic, level III.

J Trauma Acute Care Surg. 2019 Jan;86(1):163-166

Future strategies for remote damage control resuscitation after traumatic hemorrhage.

Naumann D, Khan M, Smith J, Rickard R, Woolley T

QUOTES:

“Recently, whole blood (WB) has reemerged as an appealing choice for balanced blood replacement in trauma patients—a strategy used in every military combat operation of the last hundred years.5 Furthermore, the recent availability and clinical delivery of lyophilized plasma3,6 makes the prospect of light-weight, long lasting, refrigeration-free blood products ever closer to realization. But which of these strategies is superior, and which should be the focus of further investigation?”

“At first it seems like WB may be the ultimate solution for RDCR, and that research should be driven toward the advancement and expansion of its delivery, and optimization of the logistical pathways for its provision. But is delivery of WB the ultimate goal for RDCR, or just part of the solution?”

West J Emerg Med. 2018 Nov;19(6):977-986.

Tranexamic Acid in Civilian Trauma Care in the California Prehospital Antifibrinolytic Therapy Study.

Neeki M, Dong F, Toy J, Vaezazizi R, Powell J, Wong D, Mousselli M, Rabiei M, Jabourian A, Niknafs N, Burgett-Moreno M, Vara R, Kissel S, Luo-Owen X, O'Bosky K, Ludi D, Sporer K, Pennington T, Lee T, Borger R, Kwong E

Introduction: Hemorrhage is one of the leading causes of death in trauma victims. Historically, paramedics have not had access to medications that specifically target the reversal of trauma-induced coagulopathies. The California Prehospital Antifibrinolytic Therapy (Cal-PAT) study seeks to evaluate the safety and efficacy of tranexamic acid (TXA) use in the civilian prehospital setting in cases of traumatic hemorrhagic shock.

Methods: The Cal-PAT study is a multi-centered, prospective, observational cohort study with a retrospective comparison. From March 2015 to July 2017, patients ≥ 18 years-old who sustained blunt or penetrating trauma with signs of hemorrhagic shock identified by first responders in the prehospital setting were considered for TXA treatment. A control group was formed of patients seen in the five years prior to data collection cessation (June 2012 to July 2017) at each receiving center who were not administered TXA. Control group patients were selected through propensity score matching based on gender, age, Injury Severity Scores, and mechanism of injury. The primary outcome assessed was mortality recorded at 24 hours, 48 hours, and 28 days. Additional variables assessed included total blood products transfused, the hospital and intensive care unit length of stay, systolic blood pressure taken prior to TXA administration, Glasgow Coma Score observed prior to TXA administration, and the incidence of known adverse events associated with TXA administration.

Results: We included 724 patients in the final analysis, with 362 patients in the TXA group and 362 in the control group. Reduced mortality was noted at 28 days in the TXA group in comparison to the control group (3.6% vs. 8.3% for TXA and control, respectively, odds ratio [OR] =0.41 with 95% confidence interval [CI] [0.21 to 0.8]). This mortality difference was greatest in severely injured patients with ISS >15 (6% vs 14.5% for TXA and control, respectively, OR=0.37 with 95% CI [0.17 to 0.8]). Furthermore, a significant reduction in total blood product transfused was observed after TXA administration in the total cohort as well as in severely injured patients. No significant increase in known adverse events following TXA administration were observed.

Conclusion: Findings from the Cal-PAT study suggest that TXA use in the civilian prehospital setting may safely improve survival outcomes in patients who have sustained traumatic injury with signs of hemorrhagic shock.

Eur J Emerg Med. 2018 Dec 7; Epub ahead of print

Feasibility of prehospital freeze-dried plasma administration in a UK Helicopter Emergency Medical Service.

Oakeshott J, Griggs J, Wareham G, Lyon R; Kent Surrey Sussex Air Ambulance Trust.

BACKGROUND: Early transfusion of patients with major traumatic haemorrhage may improve survival. This study aims to establish the feasibility of freeze-dried plasma transfusion in a Helicopter Emergency Medical Service in the UK.

PATIENTS AND METHODS: A retrospective observational study of major trauma patients attended by Kent, Surrey and Sussex Helicopter Emergency Medical Service and transfused freeze-dried plasma since it was introduced in April 2014.

RESULTS: Of the 1873 patients attended over a 12-month period before its introduction, 79 patients received packed red blood cells (4.2%) with a total of 193 units transfused. Of 1881 patients after the introduction of freeze-dried plasma, 10 patients received packed red blood cells only and 66 received both packed red blood cells and freeze-dried plasma, with a total of 158 units of packed red blood cells transfused, representing an 18% reduction between the two 12-month periods. In the 20 months since its introduction, of 216 patients transfused with at least one unit of freeze-dried plasma, 116 (54.0%) patients received both freeze-dried plasma and packed red blood cells in a 1 : 1 ratio. Earlier transfusion was feasible, transferring the patient to the hospital before transfusion would have incurred a delay of 71 min (interquartile range: 59-90 min).

CONCLUSION: Prehospital freeze-dried plasma and packed red blood cell transfusion is feasible in a 1 : 1 ratio in patients with suspected traumatic haemorrhage. The use of freeze-dried plasma as a first-line fluid bolus reduced the number of prehospital packed red blood cell units required and reduced the time to transfusion.

Aerosp Med Hum Perform. 2018 Dec 1;89(12):1076-1079

Simulation Training for In-Flight Medical Emergencies Improves Provider Knowledge and Confidence.

Padaki A, Redha W, Clark T, Nichols T, Jacoby L, Slivka R, Ranniger C, Lehnhardt K

INTRODUCTION: In-flight medical emergencies require healthcare providers to operate in confined spaces with limited resources and delayed access to definitive care. These emergencies are common, with an estimated frequency of 1 per 100 to 1000 flights. Despite this, training for medical response in these environments is limited. We hypothesize that integrating such education into a pre-existing medical student elective course would improve knowledge and ability to respond appropriately to in-flight medical emergencies.

METHODS: The available literature surrounding in-flight medical emergencies was reviewed. Syncope, respiratory distress, allergic reaction, and cardiac arrest were identified as common and potentially life-threatening complaints. Simulation cases were designed for each of these complaints and a simulation room was modified to mimic an airplane cabin. These simulation cases and accompanying relevant didactic lectures were incorporated into an existing wilderness and extreme environmental medicine course, with multiple-choice tests completed by the students at the beginning and end of the 2-wk course.RESULTS: Participating in this study were 18 students. The pretest average was 76%, which improved to 87% on the posttest. Qualitative feedback regarding this type of training was overwhelmingly positive.

DISCUSSION: Simulation-based training for in-flight medical emergencies can significantly improve medical students' knowledge. This training was very well received by the students. Opportunities for training to manage in-flight medical emergencies remain limited; incorporating such training into existing curricula could provide a means by which to improve provider knowledge. Such a curriculum could be adapted for use by flight crews and other populations.

Scand J Trauma Resusc Emerg Med. 2019 Jan 28;27(1):9.

Prehospital on-scene anaesthetist treating severe traumatic brain injury patients is associated with lower mortality and better neurological outcome.

Pakkanen T, Nurmi J, Huhtala H, Silfvast T

BACKGROUND: Patients with isolated traumatic brain injury (TBI) are likely to benefit from effective prehospital care to prevent secondary brain injury. Only a few studies have focused on the impact of advanced interventions in TBI patients by prehospital physicians. The primary end-point of this study was to assess the possible effect of an on-scene anaesthetist on mortality of TBI patients. A secondary end-point was the neurological outcome of these patients.

METHODS: Patients with severe TBI (defined as a head injury resulting in a Glasgow Coma Score of ≤8) from 2005 to 2010 and 2012-2015 in two study locations were determined. Isolated TBI patients transported directly from the accident scene to the university hospital were included. A modified six-month Glasgow Outcome Score (GOS) was defined as death, unfavourable outcome (GOS 2-3) and favourable outcome (GOS 4-5) and used to assess the neurological outcomes. Binary logistic regression analysis was used to predict mortality and good neurological outcome. The following prognostic variables for TBI were available in the prehospital setting: age, on-scene GCS, hypoxia and hypotension. As per the hypothesis that treatment provided by an on-scene anaesthetist would be beneficial to TBI outcomes, physician was added as a potential predictive factor with regard to the prognosis.

RESULTS: The mortality data for 651 patients and neurological outcome data for 634 patients were available for primary and secondary analysis. In the primary analysis higher age (OR 1.06 CI 1.05-1.07), lower on-scene GCS (OR 0.85 CI 0.79-0.92) and the unavailability of an on-scene anaesthetist (OR 1.89 CI 1.20-2.94) were associated with higher mortality together with hypotension (OR 3.92 CI 1.08-14.23). In the secondary analysis lower age (OR 0.95 CI 0.94-0.96), a higher on-scene GCS (OR 1.21 CI 1.20-1.30) and the presence of an on-scene anaesthetist (OR 1.75 CI 1.09-2.80) were demonstrated to be associated with good patient outcomes while hypotension (OR 0.19 CI 0.04-0.82) was associated with poor outcome.

CONCLUSION: Prehospital on-scene anaesthetist treating severe TBI patients is associated with lower mortality and better neurological outcome.

Mil Med. 2018 Nov 1;183(11-12):e758-e761

Isolated Common Femoral Artery Injury Resulting from Blunt Military Trauma.

Park H, Kim K

ABSTRACT:
The incidence of an isolated femoral vessel injury in the absence of fractures or other organ injury is extremely rare. A 20-yr-old male Korean soldier was taken to the hospital with a common femoral artery (CFA) obstruction. Injured CFA segment was resected and replaced by using 7-mm PTFE (polytetrafluoroethylene) graft. Two months after the surgical treatment, the patient discharged from the hospital without any complaints or postoperative complications. We report an unusual case of isolated femoral artery injury due to blunt trauma during military service with following review of literature.

Bull Emerg Trauma. 2019 Jan;7(1):41-48

Stereological Comparison of Imbibed Fibrinogen Gauze versus Simple Gauze in External Packing of Grade IV Liver Injury in Rats.

Paydar S, Mahmoudi Nezhad G, Karami M, Abdolrahimzadeh H, Samadi M, Makarem A, Noorafshan A

Objective: To evaluate the effect of imbibed fibrinogen gauze on survival, bleeding and healing in liver trauma.

Methods: This animal experimental study was conducted on 20 adult male Sprague-Dawley rats; with a mean weight of 300±50 gram; divided into two groups. Grade IV injury was induced to the subjects' liver. Then, the bleeding site was packed with simple gauze in the control group, and imbibed fibrinogen gauze in the experimental group. All animals were re-evaluated for liver hemostasis 48 hours after the initial injury. Bleeding in the intra peritoneal cavity was measured using Tuberculosis Syringe in the first and second operations. Subjects were followed-up for 14 days. Eventually, the rats were sacrificed and their livers were sent to a lab for stereological assessment. Statistical comparisons were performed via Mann-Whitney U-test using SPSS. P-Values less than 0.05 were considered to be statistically significant.

Results: Half of the rats in the control group died, while all the rats in the imbibed fibrinogen gauze group survived after two weeks ($p= 0.032$). Bleeding in the imbibed fibrinogen gauze was significantly less than control group, 48 hours' post-surgery ($p<0.001$). According to the stereological results, granulation tissue in the imbibed fibrinogen gauze group were more than the control group ($P= 0.032$). Also, fibrosis in the imbibed fibrinogen gauze group were more than the control group ($P= 0.014$).

Conclusion: Our study indicated that imbibed fibrinogen gauze can potentially control liver bleeding and improve survival through increasing granulation tissue and fibrosis in injured liver.

Med Sci (Basel). 2019 Jan 21;7(1)

Prehospital and Emergency Care in Adult Patients with Acute Traumatic Brain Injury.

Pélieu I, Kull C, Walder B

ABSTRACT:
Traumatic brain injury (TBI) is a major healthcare problem and a major burden to society. The identification of a TBI can be challenging in the prehospital setting, particularly in elderly patients with unobserved falls. Errors in triage on scene cannot be ruled out based on limited clinical diagnostics. Potential new mobile diagnostics may decrease these errors. Prehospital care includes decision-making in clinical pathways, means of transport, and the degree of prehospital treatment. Emergency care at hospital admission includes the definitive diagnosis of TBI with, or without extracranial lesions, and triage to the appropriate receiving structure for definitive care. Early risk factors for an unfavorable outcome includes the severity of TBI, pupil reaction and age. These three variables are core variables, included in most predictive models for TBI, to predict short-term mortality. Additional early risk factors of mortality after severe TBI are hypotension and hypothermia. The extent and duration of these two risk factors may be decreased with optimal prehospital and emergency care. Potential new avenues of treatment are the early use of drugs with the capacity to decrease bleeding, and brain edema after TBI. There are still many uncertainties in prehospital and emergency care for TBI patients related to the complexity of TBI patterns.

Curr Opin Anaesthesiol. 2019 Apr;32(2):200-205

The use of new procoagulants in blunt and penetrating trauma.

Peralta M, Chowdary P.

PURPOSE OF REVIEW: Uncontrolled bleeding in trauma secondary to a combination of surgical bleeding and trauma-induced complex coagulopathy is a leading cause of death. Prothrombin complex concentrates (PCCs), recombinant activated factor seven (rFVIIa) and recombinant human prothrombin act as procoagulants by increasing thrombin generation and fibrinogen concentrate aids stable clot formation. This review summarizes the current evidence for procoagulant use in the management of bleeding in trauma, and data and evidence gaps for routine clinical use.

RECENT FINDINGS: Retrospective and prospective studies of PCCs (±fibrinogen concentrate) have demonstrated a decreased time to correction of trauma coagulopathy and decreased red cell transfusion with no obvious effect on mortality or thromboembolic outcomes. PCCs in a porcine model of dilutional coagulopathy demonstrated a sustained increase in thrombin generation, unlike recombinant human prothrombin which showed a transient increase and has been studied only in animals. In other retrospective studies, there is a suggestion that lower doses of PCCs may be effective in the setting of acquired coagulopathy.\

SUMMARY: There is increasing evidence that early correction of coagulopathy has survival benefits, and the use of procoagulants as first-line therapy has the potential benefit of rapid access and timely treatment. This requires confirmation in prospective studies.

Open Access Emerg Med. 2018 Oct 18;10:149-164

The role of inhaled methoxyflurane in acute pain management.

Porter K, Dayan A, Dickerson S, Middleton P

ABSTRACT:
Methoxyflurane is an inhaled analgesic administered via a disposable inhaler which has been used in Australia for over 40 years for the management of pain associated with trauma and for medical procedures in children and adults. Now available in 16 countries worldwide, it is licensed in Europe for moderate to severe pain associated with trauma in conscious adults, although additional applications are being made to widen the range of approved indications. Considering these ongoing developments, we reviewed the available evidence on clinical usage and safety of inhaled analgesic methoxyflurane in trauma pain and in medical procedures in both adults and children. Published data on methoxyflurane in trauma and procedural pain show it to be effective, well tolerated, and highly rated by patients, providing rapid onset of analgesia. Methoxyflurane has a well-established safety profile; adverse events are usually brief and self-limiting, and no clinically significant effects on vital signs or consciousness levels have been reported. Nephrotoxicity previously associated with methoxyflurane at high anesthetic doses is not reported with low analgesic doses. Although two large retrospective comparative studies in the prehospital setting showed inhaled analgesic methoxyflurane to be less effective than intravenous morphine and intranasal fentanyl, this should be balanced against the administration, supervision times, and safety profile of these agents. Given the limitations of currently available analgesic agents in the prehospital and emergency department settings, the ease of use and portability of methoxyflurane combined with its rapid onset of effective pain relief and favorable safety profile make it a useful nonopioid option for pain management. Except for the STOP! study, which formed the basis for approval in trauma pain in Europe, and a few smaller randomized controlled trials (RCTs), much of the available data are observational or retrospective, and further RCTs are currently underway to provide more robust data.

Saudi J Anaesth. 2018 Oct-Dec;12(4):535-539

Comparison of I-gel for general anesthesia in obese and nonobese patients.

Prabha R, Raman R, Khan M, Kaushal D, Siddiqui A, Abbas H

Context: I-gel is a second-generation supraglottic airway device. Despite several studies on i-gel, there are very few studies on the use of i-gel in obese patients.

Aims: The aim of the study was to compare the clinical performance of i-gel between obese and non-obese patients.

Settings and Design: Prospective, controlled, nonrandomized, hospital-based study.

Subjects and Methods: After obtaining informed consent, patients were divide into two groups of 16 patients each: group O consisted of patients with body mass index (BMI) >30 kg/m2 and Group C consisted of patients with BMI 18.5-29.9 kg/m2. I-gel was inserted after induction of anesthesia and muscle relaxation. Oropharyngeal leak pressure (OLP) (primary outcome variable), leak fraction, time taken to insert the device, ease of insertion, fiberoptic view of glottis through i-gel's airway tube, and adverse effects were recorded.

Statistical Analysis Used: Data were analyzed using SPSS 20. Continuous, ordinal, and categorical variables were analyzed using students t-test, Mann-Whitney U-test, and Fischer's exact test, respectively.

Results: OLP was slightly higher in Group O (25.38 ± 4.79 cm H2O) but was not statistically different than Group C (27.38 ± 4.38 cm H2O). Other parameters except weight and BMI (which were higher in Group O) were statistically similar in both groups. There was no statistical difference in side effects.

Conclusions: We concluded that i-gel is as effective in obese patients as in non-obese patients when used for securing the airway for surgical procedures.

J Anaesthesiol Clin Pharmacol. 2018 Oct-Dec;34(4):529-534.

Single intravenous bolus versus perioperative continuous infusion of tranexamic acid to reduce blood loss in abdominal oncosurgical procedures: A prospective randomized double-blind clinical study.

Prasad R, Patki A, Padhy S, Ramchandran G

Background and Aims: Intraoperative use of a single bolus dose of tranexamic acid may not be sufficient to prevent bleeding in the early postoperative period. The present study was carried out to compare the effect of two dose regimens of tranexamic acid in reducing perioperative blood loss and the amount of allogenic blood transfusion in abdominal tumor surgery.

Material and Methods: In this prospective, controlled, and double-blind investigation, 60 patients electively posted for abdominal oncosurgical procedures were randomly assigned to receive a single bolus dose of tranexamic acid (10 mg/kg) (Group A), a bolus dose of tranexamic acid (10 mg/kg) followed by infusion (1 mg/kg/h) till 4 h postoperatively (Group B), and a bolus followed by infusion of normal saline (group C). Total intraoperative blood loss, amount of allogenic blood transfusion, postoperative drain collections, and hemoglobin and hematocrit levels were recorded at different time intervals. Data obtained after comparing three groups were analyzed by analysis of variance test for variables following normal distribution, Kruskal-Wallis test for nonparametric data, and post-hoc Tukey-Kramer test for intergroup analysis. A probability value of less than 5% was considered significant.

Results: There was no significant difference in intraoperative blood loss in all the three groups. Both the tranexamic acid groups showed reduction in postoperative blood collection in drain at 6 h and 24 h in comparison to the control group ($P < 0.001$). There was also a significant difference in the amount of blood in postoperative drain at 24 h within the tranexamic acid groups, where lesser collection was seen in the infusion group ($P = 0.007$). Hemoglobin and hematocrit levels measured at different postoperative time intervals showed a significant reduction from the baseline in the control group compared to the tranexamic acid groups together.

Conclusion: Tranexamic acid causes more effective reduction in post-operative blood loss when used as a bolus followed by an infusion continued in the postoperative period in comparison to its use as a single intravenous bolus in abdominal tumor surgery.

J Intensive Care Med. 2018 Dec 4: Epub ahead of print

Management Strategies for Intracranial Pressure Crises in Subarachnoid Hemorrhage.

Ravishankar N, Nuoman R, Amuluru K, El-Ghanem M, Thulasi V, Dangayach N, Lee K, Al-Mufti F

OBJECTIVES: Standard management strategies for lowering intracranial pressure (ICP) in traumatic brain injury has been well-studied, but the use of lesser known interventions for ICP in subarachnoid hemorrhage (SAH) remains elusive. Searches were performed in PubMed and EBSCO Host to identify best available evidence for evaluation and management of medically refractory ICP in SAH. The role of standard management strategies such as head elevation, hyperventilation, mannitol and hypertonic saline as well as lesser known management such as sodium bicarbonate, indomethacin, tromethamine, decompressive craniectomy, decompressive laparotomy, hypothermia, and barbiturate coma are reviewed. We also included dose concentrations, dose frequency, infusion volume, and infusion rate for these lesser known strategies. Nonetheless, there is still a gap in the evidence to recommend optimal dosing, timing and its role in the improvement of outcomes but early diagnosis and appropriate management reduce adverse outcomes.

Conclusion: In conclusion, the role of all current management interventions to treat high ICP in aSAH is not well studied. Effective treatment involves rigorous avoidance of side effects that can lead to refractory elevated ICP. Accordingly, examining the best available evidence with systematic reviews and consensus methods are urgently needed. This will have important implications for designing future studies and developing standardized management protocols.

Anesth Analg. 2018 Nov 9;Epub ahead of print

Analgesic Efficacy and Safety of Intravenous Meloxicam in Subjects With Moderate-to-Severe Pain After Open Abdominal Hysterectomy: A Phase 2 Randomized Clinical Trial.

Rechberger T, Mack R, McCallum S, Du W Freyer A

BACKGROUND: An intravenous (IV) formulation of meloxicam was developed for moderate-to-severe pain management. This study evaluated the safety and efficacy of meloxicam IV after open abdominal hysterectomy. Meloxicam IV is an investigational product not yet approved by the US Food and Drug Administration.

METHODS: Women (N = 486) with moderate-to-severe pain after open abdominal hysterectomy were enrolled in this multicenter, randomized, double-blind, placebo- and active-controlled trial. Subjects were randomized to receive a single dose of meloxicam IV (5-60 mg), placebo, or morphine (0.15 mg/kg) in ≤6 hours after morphine dosing on postoperative day 1 and were evaluated for 24 hours. Rescue morphine (≈0.15 mg/kg IV) was available if needed for pain not relieved by the study medication. In an open-label extension (N = 295), meloxicam
IV was administered once daily for the remaining hospital stay (or per the investigator's discretion). The coprimary efficacy end points were the summed pain intensity difference (SPID24) and total pain relief (TOTPAR24) from hour 0 to 24 hours after dosing. Effect size, the standardized difference between means reported in standard deviation (SD) units, was calculated to indicate the magnitude of the difference in the mean analgesic effect measured for different intervention groups.

RESULTS: Subjects who received morphine or meloxicam IV had a median time to first perceptible pain relief within 6-8 minutes. Morphine and meloxicam IV 5-60 mg produced statistically significant differences than placebo in SPID24 and TOTPAR24. SPID24 (standard error [SE]) for meloxicam IV 5-60 mg ranged from -56276.8 (3926.46) to -33517.1 (3930.1; P < .001); SPID24 (SE) for morphine and placebo were -29615.8 (3869.2; P < .001) and 4555.9 (3807.1), respectively. SPID24 effect sizes (95% confidence intervals) for the 60, 30, 15, 7.5, and 5 mg meloxicam IV doses and morphine were 1.93 (1.61-2.25), 2.00 (1.65-2.35), 1.70
(1.35-2.05), 1.28 (0.95-1.60), 1.25 (0.90-1.61), and 1.12 (0.77-1.45) SDs, respectively. TOTPAR24 (SE) for meloxicam IV 5-60 mg ranged from 3104.5 (155.28) to 4130.4 (191.17; P < .001); TOTPAR24 (SE) for morphine and placebo were 2723.3 (188.4; P < .001) and 1100.6 (185.4), respectively. TOTPAR24 effect sizes (95% confidence interval) for the 60, 30, 15, 7.5, and 5 mg meloxicam IV doses and morphine were 2.03 (1.70-2.35), 2.05 (1.70-2.40), 1.78 (1.43-2.13), 1.35 (1.03-1.67), 1.37 (1.01-1.72), and 1.10 (0.75-1.45) SDs, respectively. The mean total opioid consumed (SD) during the double-blind phase was 4.6 (8.17), 5.3 (8.85), 5.9 (7.85), 8.5 (9.67), 9.3 (9.47), 9.6 (8.12), and 16.0 (10.15) mg for patients in the 60, 30, 15, 7.5, and 5 mg meloxicam IV, morphine, and placebo groups, respectively. Generally, meloxicam IV was well tolerated, evidenced by the incidence of adverse events compared to placebo and lack of deaths and treatment-related serious adverse events.

CONCLUSIONS: A meloxicam IV dose of 5-60 mg was generally well tolerated and appeared to reduce opioid consumption in subjects with moderate-to-severe pain after open abdominal hysterectomy. Once-daily administration of meloxicam IV produced analgesic effect within 6-8 minutes postdose that was maintained over a 24-hour dosing interval.

Injury. 2019 Feb;50(2):358-364

Specific stretchers enhance rapid extraction by tactical medical support teams in mass casualty incidents.

Reuter P, Baker C, Loeb T

OBJECTIVE: In mass casualty incidents where the threat is on-going, victim evacuation remains a challenge: fast extraction while respecting spinal immobilisation and haemorrhage control. Different devices can be used but their suitability has not been compared.

METHODS: We conducted a simulation study comparing eight extraction devices with a randomisation of the order of testing. Five teams, consisting of four officers, evacuated a single victim in five steps: device's deployment, loading the victim, carrying the victim along a corridor, negotiating a corner passage and a descent by staircase. Primary outcome was the emergency extraction time, from deployment to the first obstacle. Secondary outcomes included ease of transport and victim's stability, rated from 1 (worst) to 10 (best).

RESULTS: One hundred and sixty simulations were carried out. The median emergency extraction time was 16.7 [IQR: 11.6-24.9] seconds. The three speediest devices were the "firefighters' worn", "snogg" and "flexible tarp", taking 9.7 [8.1-11.0], 11.7 [10.9-15.4] and 12.2 [11.2-17.9] seconds respectively ($p < 0.0001$). Regarding the ease of transport, the three best-evaluated devices were the "firefighters' worn", "strap" and "flexible tarp" with 10 [9-10], 9 [8-9] and 8 [8-9] respectively ($p < 0.0001$). Considering stability reported by simulated victims, the three best-evaluated devices were the "inflated stretcher", "flexible tarp" and "firefighters' worn" with 8.0 [7.8-9.0], 8.0[7.0-8.0] and 6.5 [6.0-7.0] respectively.

CONCLUSION: Devices were not equivalent in terms of extraction time and suitability criteria. For rapid extraction of victims from danger zones, the "firefighter's worn" and "flexible tarp", as very simple stretchers, seem to be the most appropriate devices.

Adv Anesth. 2018 Dec;36(1):1-22

Care of the Severely Injured Orthopedic Trauma Patient: Considerations for Initial Management, Operative Timing, and Ongoing Resuscitation.

Richards J, Conti B, Grissom T

Key points:

- Perioperative management of the orthopedic polytrauma patient requiring operative intervention can be extremely challenging.
- An understanding of prehospital and initial management of hemorrhage control, includingthe increasinguseof tourniquetsandREBOA,willaffectoperativeplanning.
- Decisions regarding operative timing for non–life-saving orthopedic surgical intervention requires consultation among anesthesiologists, surgeons, and other specialists to determine whether a definitive repair is appropriate given the overall patient condition. Most patients, however, will be appropriate for early definitive care and likely to benefit from this approach.
- Intraoperative resuscitation of these patients starts at the point of initial contact and will frequently continue into the operative setting. Use of antifibrinolytic therapy has a role in the management of orthopedic trauma, although additional study is required to assess the impact on the subpopulation with fibrinolytic shutdown on arrival to the hospital.

Trauma Surg Acute Care Open. 2019 Jan 24;4(1):e000207

The focused assessment with sonography in trauma (FAST) in hypotensive injured patients frequently fails to identify the need for laparotomy: a multi-institutional pragmatic study.

Rowell S, Barbosa R, Holcomb J, Fox E, Barton C, Schreiber M

Background: The ability of focused assessment with sonography for trauma (FAST) to detect clinically significant hemorrhage in hypotensive injured patients remains unclear. We sought to describe the sensitivity and specificity of FAST using findings at laparotomy as the confirmatory test.

Methods: Patients from the Prospective Observational Multicenter Major Trauma Transfusion (PROMMTT) study that had a systolic blood pressure < 90mm Hg and underwent FAST were analysed. Results were compared with findings at laparotomy. A therapeutic laparotomy (T-LAP) was defined as an abdominal operation within 6 hours in which a definitive procedure was performed. The sensitivity and specificity of FAST were calculated.

Results: The cohort included 317 patients that underwent FAST (108 positive, 209 negative). T-LAP was performed in 69% (n=75) of FAST(+) patients and 22% (n=48) of FAST(-) patients. FAST had a sensitivity of 62% and specificity of 83%.

Conclusions: In our multicenter cohort, 22% of FAST(-) patients underwent T-LAP within 6 hours of admission. In hypotensive patients with a negative FAST, clinicians should still maintain a high index of suspicion for significant abdominal hemorrhage.

Level of evidence: Level IV.

Indian J Pharmacol. 2018 Nov-Dec;50(6):332-335

Efficacy ratio: A tool to enhance optimal antimicrobial use for intra-abdominal infections.

Sabu P, Elangovan D, Pragasam A, Bakthavatchalam Y, Rodrigues C, Chitnis D, Chaudhuri B, Veeraraghavan B

BACKGROUND: Antimicrobial resistance and inappropriate antibiotic regimen hamper a favorable outcome in intra-abdominal infections. Clinicians rely on the minimum inhibitory concentration (MIC) value to choose from the susceptible antimicrobials. However, the MIC values cannot be directly compared between the different antibiotics because their breakpoints are different. For that reason, efficacy ratio (ER), a ratio of susceptible MIC breakpoint and MIC of isolate, can be used to choose the most appropriate antimicrobial.

MATERIALS AND METHODS: A prospective, observational study conducted during 2015 and 2016 included 356 Escherichia coli and 158 Klebsiella spp. isolates obtained from the intra-abdominal specimens. MIC was determined by microbroth dilution method, and ER of each antibiotic was calculated for all the isolates.

RESULTS: For both E. coli and Klebsiella spp., ertapenem, amikacin, and piperacillin/tazobactam had the best activities among their respective antibiotic classes.

DISCUSSION: This is the first study calculating ER for deciding empiric treatment choices. ER also has a potential additional value in choosing the use of susceptible drugs as monotherapy or combination therapy. A shift in ERs over a period of time tracks rising MIC values and predicts antimicrobial resistance development.

CONCLUSION: Estimation of ER could be a meaningful addition for the interpretation of an antimicrobial susceptibility report, thus helping the physician to choose the best among susceptible antimicrobials for patient management.

BMC Anesthesiol. 2019 Jan 31;19(1):18

Differences in pain treatment between surgeons and anaesthesiologists in a physician staffed prehospital emergency medical service: a retrospective cohort analysis.

Schaller S, Kappler F, Hofberger C, Sattler J, Wagner R, Schneider G, Blobner M, Kanz K

BACKGROUND: Although pain treatment is an important objective in prehospital emergency medicine the incidence of oligoanalgesia is still high in prehospital patients. Given that prehospital emergency medicine in Germany is open for physicians of any speciality, the prehospital pain treatment may differ depending on the primary medical education. Aim of this study was to explore the difference in pain treatment between surgeons and anaesthesiologists in a physician staffed emergency medical service.

METHODS: Retrospective single centre cohort analysis in a physician staffed ground based emergency medical service from January 2014 until December 2016. A total of 8882 consecutive emergency missions were screened. Primary outcome measure was the difference in application frequency of prehospital analgesics by anaesthesiologist or surgeon. Univariate and multivariate logistic regression analysis was used for statistical analysis including subgroup analysis for trauma and acute coronary syndrome.

RESULTS: A total of 8238 patients were included in the analysis. There was a significant difference in the application frequency of analgesics between surgeons and anaesthesiologists especially for opioids ($p < 0.001$, OR 0.68 [0.56-0.82]). Fentanyl was the most common administered analgesic in the trauma subgroup, but significantly less common used by surgeons ($p = 0.005$, OR 0.63 [0.46-0.87]). In acute coronary syndrome cases there was no significant difference in morphine administration between anaesthesiologists and surgeons ($p = 0.49$, OR 0.88 [0.61-1.27]).

CONCLUSIONS: Increased training for prehospital pain treatment should be implemented, since opioids were administered notably less frequent by surgeons than by anaesthesiologists.

Mil Med. 2018 Nov 5;Epub ahead of print

The First 30 Months Experience in the Non-Doctrinal Operation Inherent Resolve Medical Theater.

Schauer S, Naylor J, April M, Thronson E, Maddry J, Becker T, Gross K

Introduction: U.S. military forces were redeployed in 2014 in support of Operation Inherent Resolve (OIR), operating in an austere theater without the benefit of an established medical system. We seek to describe the prehospital and hospital-based care delivered in this medically immature, non-doctrinal theater.

Materials and Methods: We queried the Department of Defense Trauma Registry (DODTR) for all encounters associated with OIR from August 2014 through June 2017. We sought all available prehospital and hospital-based data.

Results: There were a total of 826 adults that met inclusion; 816 were from Iraq and the remaining 10 were from Syria. The median age was 21 years and the most frequent mechanism of injury was explosives (47.7%). Median composite injury severity scores were low (9, IQR 2.75-14) and the most frequent seriously injured body region was the extremities (23.0%). Most subjects (94.9%) survived to hospital discharge. Open fractures were the most frequent major injury (26.0%). In the prehospital setting, opioids were the most frequently administered medication (9.3%) and warming blanket application (48.7%) and intravenous line placement (24.8%) were the most frequent interventions. In the emergency department, Focused Assessment with Sonography in Trauma exams (64.3%) was the most frequently performed study and endotracheal intubations were the most frequent (29.9%) procedure. In the operating room, the most frequently performed procedure was exploratory laparotomy (12.3%).

Conclusions: Host nation military males injured by explosion comprised the majority of casualties. Open fracture was the most common major injury. Hence, future research should focus upon the unique challenges of delivering care to members of partner forces with particular focus upon interventions to optimize outcomes among patients sustaining open fractures.

Prehosp Emerg Care. 2018 Dec 27:1-8.

Analysis of Injuries and Prehospital Interventions Sustained by Females in the Iraq and Afghanistan Combat Zones.

Schauer S, Naylor J, Long A, Mora A, Le T, Maddry J, April M

BACKGROUND: Women served in both combat and non-combat units in the recent conflicts in Iraq and Afghanistan. Moreover, the recent conflicts lacked traditional separation of civilians from combatants carrying additional risk for injury to local civilians. There is a relative paucity of data specific to this topic. We compare injury patterns and interventions performed in the prehospital, combat setting among females versus males.

METHODS: This is a secondary analysis of previously published data from the Department of Defense Trauma Registry. We included all subjects that had at least one prehospital intervention documented. We compared variables between females and males.

RESULTS: From January 2007 to August 2016, our inclusion criteria captured 19,485 males and 533 females. Female casualties were older (median age 29 vs. 25), less likely to have sustained injuries from explosives (48.0% vs. 56.8%), and more severely injured as measured by median composite injury scores (10 vs. 9). Most subjects were in Afghanistan for both females and males (52.9% vs. 73.9%). Among United States (US) service members, findings were similar to the overall study population, except female service members had lower median composite injury scores than males (5 vs. 9). In unadjusted analyses, females were less likely to survive to hospital discharge (OR 0.68, 95% CI 0.48-0.97). There was no difference in survival (OR 0.73, 95% CI 0.50-1.07), when controlling for confounders. In both unadjusted and adjusted analyses specific to US forces, we were unable to detect any differences in survival or for select analgesic administration. In both unadjusted and adjusted analyses specific to host nation civilians, we were unable to detect any differences in survival; however, even when controlling for confounders females were less likely to receive ketamine and IV morphine (OR 0.31, 95% CI 0.15-0.63; 0.69, 95% CI 0.49-0.98, respectively).

CONCLUSIONS: Females accounted for a small proportion of total casualties within our dataset. After controlling for confounders, survival was comparable between males and females, but host nation females were less likely to receive ketamine and intravenous morphine. Future studies should seek to elucidate the reasons for these subtle differences between males and females in prehospital combat casualty care.

BMC Emerg Med. 2019 Jan 23;19(1):12

Prehospital cricothyrotomies in a helicopter emergency medical service: analysis of 19,382 dispatches.

Schober P, Biesheuvel T, de Leeuw M, Loer S, Schwarte L.

BACKGROUND: Creating a patent airway by cricothyrotomy is the ultimate maneuver to allow oxygenation (and ventilation) of the patient. Given the rarity of airway management catastrophes necessitating cricothyrotomy, sufficiently sized prospective randomized trials are difficult to perform. Our Helicopter Emergency Medical Service (HEMS) documents all cases electronically, allowing a retrospective analysis of a larger database for all cases of prehospital cricothyrotomy.

METHODS: We analyzed all 19,382 dispatches of our HEMS 'Lifeliner 1', since set-up of a searchable digital database. This HEMS operates 24/7, covering ~ 4.5 million inhabitants of The Netherlands. The potential cases were searched and cross-checked in two independent databases.

RESULTS: We recorded n = 18 cases of prehospital cricothyrotomy. In all 18 cases, less invasive airway techniques, e.g., supraglottic devices, were attempted before cricothyrotomy. With exception of 2 cases, at least one attempt of orotracheal intubation had been performed before cricothyrotomy. Out of the 18 cases, 4 were performed by puncture-based technique (Melker), the remaining 14 cases by surgical technique. Indications for cricothyrotomy were diverse, dividable into 9 trauma cases and 9 medical cases. The procedure was successful in all but one case (17/18, i.e., 94%; with a 95% confidence interval of 72.7-99.9%). Outcome was such that 6/18 patients arrived at the hospital alive. Long term outcome was poor, with only 2/18 patients discharged from hospital alive.

CONCLUSIONS: Cricothyrotomy remains, although rare, a regularly occurring requirement in (H)EMS. Our finding of a convincingly high success rate of 94% in trained hands encourages training and a timely performance of cricothyrotomy.

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

Hypobaria during long-range flight resulted in significantly increased histopathological evidence of lung and brain damage in a swine model.

Scultetus A, Jefferson M, Haque A, Ho L, Hazzard B, Saha B, Chun S, Auker C, Moon-Massat P, McCarron R, Malone D

BACKGROUND: Aeromedical evacuation to definitive care is standard in current military conflicts. However, there is minimal knowledge on the effects of hypobaria (HYPO) on either the flight crew or patients. The effects of HYPO were investigated using healthy swine.

METHODS: Anesthetized Yorkshire swine underwent a simulated 4 h "transport" to an altitude of 2,441 m (8,000 feet. HYPO, N = 6) or at normobaric conditions (NORMO, N = 6). Physiologic and biochemical data were collected. Organ damage was assessed for hemorrhage, inflammation, edema, necrosis, and for lungs only, microatelectasis.

RESULTS: All parameters were similar prior to and after "transport" with no significant effects of HYPO on hemodynamic, neurologic, or oxygen transport parameters, nor on blood gas, chemistry, or complete blood count data. However, the overall Lung Injury Score was significantly worse in the HYPO than the NORMO group (10.78 ± 1.22 vs. 2.31 ± 0.71, respectively) with more edema/fibrin/hemorrhage in the subpleural, interlobular and alveolar space, more congestion in alveolar septa, and evidence of microatelectasis (vs. no microatelectasis in the NORMO group). There was also increased severity of pulmonary neutrophilic (1.69 ± 0.20 vs. 0.19 ± 0.13) and histiocytic inflammation (1.83 ± 0.23 vs. 0.47 ± 0.17) for HYPO versus NORMO, respectively. On the other hand, there was increased renal inflammation in NORMO compared with HYPO (1.00 ± 0.13 vs. 0.33 ± 0.17, respectively). There were no histopathological differences in brain (whole or individual regions), liver, pancreas, or adrenals.

CONCLUSION: Hypobaria, itself, may have an adverse effect on the respiratory system, even in healthy individuals, and this may be superimposed on combat casualties where there may be preexisting lung injury. The additional effects of anesthesia and controlled ventilation on these results are unknown, and further studies are indicated using awake models to better characterize the mechanisms for this pathology and the factors that influence its severity.

Am J Emerg Med. 2018 Dec 20;Epub ahead of print

Effect of hypoxia on mortality and disability in traumatic brain injury according to shock status: A cross-sectional analysis.

Seo D, Shin S, Song K, Ro Y, Hong K, Park J

OBJECTIVES: This study aimed to test the association between hypoxia level and outcomes according to shock status in traumatic brain injury (TBI) patients.

METHODS: Adult TBI patients transported by emergency medical services in 10 provinces were enrolled. Hypoxia was a main exposure; three groups by oxygen saturation (SaO2, non-hypoxia (≥94%), mild hypoxia (90 ≤ SaO2 < 94%)), and severe hypoxia (<90%). Shock status (<systolic blood pressure 90 mmHg) was an interactive exposure. The outcomes were hospital mortality and worsened disability (a 2-point increase of Glasgow Outcome Scale). Multivariable logistic regression was used to calculate the adjusted odds (AORs) with 95% Confidence intervals (CIs).

RESULTS: Of the 6125 patients, the mortality/disability rates were 49.4%/69.0% in severe hypoxia, 30.7%/46.9% in mild hypoxia, and 18.5%/27.5% in normoxia ($p < 0.0001$). Mortality/disability rates were 47.1%/57.1% in shock status and 20.5%/31.4% in non-shock status ($p < 0.0001$). AORs (95% CIs) for worsened disability/mortality compared with normoxia (reference) were 3.23 (2.47-4.21)/2.24 (1.70-2.96) in patients with severe hypoxia and 2.11 (1.63-2.74)/1.84 (1.39-2.45) in those with mild hypoxia. AORs (95% CIs) for worsened disability/mortality was 1.58 (1.20-2.09)/1.33 (1.01-1.76) by severe hypoxia than normoxia in patient with only non-shock status in the interaction analysis.

CONCLUSIONS: There was a trend toward worsened outcomes with mild and severe hypoxia in patient with and without shock, however, the only met statistical significance for patients with both severe hypoxia and non-shock status.

Injury. 2019 Feb;50:226-234

What is the impact of prehospital blood product administration for patients with catastrophic haemorrhage: an integrative review.

Shand S, Curtis K, Dinh M, Burns B

INTRODUCTION: Catastrophic haemorrhage is recognised as the leading cause of preventable death in trauma and is also prevalent in medical and other surgical aetiology. Prehospital blood product transfusion is increasingly available for both military and civilian emergency teams. Hospitals have well-established massive transfusion protocols for the resuscitation of this patient group, however the use and impact in the prehospital field is less understood.

AIM: To identify and evaluate the current knowledge surrounding prehospital blood product administration for patients with catastrophic haemorrhage.

METHODS: The integrative review method included systematic searching of online databases Medline, EMBASE, SCOPUS and CINAHL alongside hand-searching for primary research articles published prior to 19 November 2018. Papers were included if the population studied patients with catastrophic haemorrhage who received prehospital transfusion of blood products. The level of evidence and quality was evaluated using the NHMRC hierarchy of evidence. All identified full text articles were reviewed by all authors.

RESULTS: Twenty-two papers were included in the final analysis, including both civilian (16) and military (6) practice. The earliest publication for prehospital transfusion was 1999, with increasing prevalence in recent years. Findings were extracted and into two main categories; (1) transfusion processes included team staffing, product selection, and criteria for transfusion and (2) transfusion outcomes; transfusion safety, haemoglobin, hospital intervention and mortality.

DISCUSSION: The level of evidence specific to prehospital blood product transfusion is low, with predominantly retrospective methods and rarely sufficient sample sizes to reach statistical significance. Prehospital research is challenged by clinical and logistical variability preventing accurate cohort matching, sample sizes and inconsistent data collection. Evaluation of prehospital transfusion in isolation is also particularly problematic as multiple factors and developments in clinical practice affect patient outcomes and all samples were subject to survival bias. Conclusion The volume and strength of the available evidence prevents accurate evaluation of the intervention and definitive practice recommendations however prehospital transfusion is shown to be logistically achievable and without serious incident. The reviewed evidence broadly supports the translation of recent in-hospital studies, such as PROMTT and PROPPR. Further research specific to prehospital practice is required to guide the development of evidence-based protocols.

BMC Emerg Med. 2018 Dec 20;18(1):57

Emergency and acute care management of traumatic spinal cord injury: a survey of current practice among senior clinicians across Australia.

Sharwood L, Dhaliwal S, Ball J, Burns B, Flower O, Joseph A, Stanford R, Middleton J

BACKGROUND: To describe pre-hospital, emergency department and acute care assessment and management practices of senior clinicians for patients with acute traumatic spinal cord injury (TSCI) across Australia; and to describe clinical practice variation.

METHODS: We used a descriptive, cross-sectional study design to survey senior clinicians (greater than 10 years practice in this field) caring for patients with acute TSCI. The assessment, management and referral practices of prehospital, emergency department/trauma and surgical expert clinicians, across prehospital, early hospital care, diagnostic imaging and haemodynamic management were surveyed.

RESULTS: We invited 95 eligible senior clinicians; the response rate was 75%. Survey findings demonstrated overall lack of awareness or consistent use of evidence based published guidelines; many clinicians following 'locally written' or 'no particular' guideline. Practitioners were conflicted across multiple areas including patient assessment and diagnosis, treatment and transport decisions. Reported spinal immobilisation practices differed substantially, as did target setting for blood pressure; the majority of clinicians actively monitored risk of respiratory deterioration. Specialist care consult and specialist service bed availability was reported as problematic by more than one third of clinicians.

CONCLUSIONS: Unwarranted clinical practice variation is known to contribute to different health outcomes for patients with similar etiologies. Clinical practice guidelines offer evidence based, best practice standards, however are only effective if adopted throughout the healthcare system. Wide variability in acute care practices, pathways and timing to specialist centres for TSCI was evidenced by this survey despite seniority among clinicians. This devastating injury requires prompt, consistent, evidence based care from the moment of first responder. Improved outcomes for patients with TSCI would be more likely with standardised care across pre-hospital, emergency and acute care phases of care.

J Trauma Acute Care Surg. 2018 Dec;85(6):1055-1062

Whole blood mitigates the acute coagulopathy of trauma and avoids the coagulopathy of crystalloid resuscitation.

Sheppard F, Schaub L, Cap A, Macko A, Moore H, Moore E, Glaser C

INTRODUCTION: The contributions of type and timing of fluid resuscitation to coagulopathy in trauma remain controversial. As part of a multifunctional resuscitation fluid research effort, we sought to further characterize the coagulation responses to resuscitation, specifically as compared to whole blood. We hypothesized that early whole blood administration mitigates the acute coagulopathy of trauma by avoiding the coagulopathy of CR resuscitation.

METHODS: Anesthetized rhesus macaques underwent polytraumatic, hemorrhagic shock, then a crossover study design resuscitation (n = 6 each) with either whole blood first (WB-1st) followed by crystalloid (CR); or CR-1st followed by WB. Resuscitation strategies were the following: WB-1st received 50% shed blood in 30minutes, followed by twice the shed blood volume (SBV) of CR over 30minutes and one times the SBV CR over 60minutes, where CR-1st received twice the SBV of CR over 30minutes, followed by 50% of shed blood in 30minutes, and one times the SBV CR over 60minutes. Blood samples were collected at baseline, end-of-shock, end-of-first and end-of-second resuscitation stages, and end-of-resuscitation for assessment (thromboelastometry, platelet aggregation, and plasmatic coagulation factors). Statistical analyses were conducted using two-way analysis of variance ANOVA with Bonferroni correction and t-tests; significance was at $p < 0.05$.

RESULTS: Survival, blood loss, hemodynamics, and shock duration were equivalent between the groups. Compared to baseline, parameters measured at first and second resuscitation stage time points directly following CR infusion revealed abnormalities in thromboelastometry (clot formation time, α angle, and maximumclot firmness), platelet aggregation response (to collagen, arachidonic acid, and adenosine diphosphate), and plasmatic coagulation (prothrombin time, anti-thrombin 3, and fibrinogen), while whole blood infusion resulted in stabilization or correction of these parameters following its administration.

CONCLUSIONS: These data suggest that in the setting of trauma and hemorrhagic shock, the coagulation alterations begin before intervention/resuscitation; however, these are significantly aggravated by CR resuscitation and could perhaps be best termed acute coagulopathy of resuscitation.

STUDY TYPE: Translational animal model.

Am J Emerg Med. 2019 Feb;37(2):377.e5-377.e6

Left ventricular perforation with catheter decompression.

Shin-Kim J, Zapolsky N, Wan E, Steinberg E, Heller M, Jacoby J

ABSTRACT:
Thoracostomy tube placement is one of the more common procedures performed in the Emergency Department, most commonly for treatment of pneumothorax or hemothorax but occasionally for drainage of empyema or pleural effusion. Thoracostomy may be a life-saving procedure with a wide range of complication rates reported, ranging from 19.4-37%, most commonly extrathoracic placement. Most recent meta-analyses showed a relatively stable complication rate of 19% over the past three decades with the vast majority being benign in nature. We present a case with the rare complication of thoracostomy in which of a small-caliber thoracostomy tube was placed in the left ventricle. Although thoracotomy was performed to remove the catheter, the patient remained virtually asymptomatic and had an uneventful course.

J Trauma Acute Care Surg. 2019 Jan;86(1):108-115

The impact of prehospital administration of freeze-dried plasma on casualty outcome.

Shlaifer A, Siman-Tov M, Radomislensky I, Peleg K, Klein Y, Glassberg E, Yitzhak A.

BACKGROUND: Hemorrhage is the most common preventable cause of death in both civilian and military trauma. There is no consensus regarding the appropriate fluid resuscitation protocol. Plasma, as a resuscitative fluid, has substantial benefits as a volume expander, owing to its relatively high oncotic pressure and its positive effect on trauma-induced coagulopathy by replenishing the lostcoagulation factors, rather than diluting the casualty's remaining factors. The Israel Defense Force Medical Corps decided to use freeze-dried plasma (FDP) as the fluid of choice for casualties in hemorrhagic shock in the prehospital setting. The aim of our study is to compare the differences of coagulation, perfusion measurements, resource utilization, and outcome between casualties receiving FDP to casualties who did not receive FDP in the prehospital setting.

METHODS: This is a retrospective matched cohort study based on two groups of casualties (those treated with FDP vs. those without FDP treatment). The control group was compiled in three steps of precision for age, sex, mechanism of injury and maximum level of severity for each nine injured body regions. Data were collected from the IDF Trauma Registry and The National Israel Trauma Registry.

RESULTS: The study group comprised 48 casualties receiving FDP and 48 controls with no differences in demographic, evacuation time, and injury characteristics. The FDP group demonstrated a lower level of hemoglobin (12.7 gr/dzl) (odds ratio [OR], 3.11; 95% confidence interval [CI], 1.10-8.80), lower level of international normalized ratio (1.1) (OR, 3.09; 95% CI, 1.04-9.14), and lower level of platelets (230 × 109/L) (OR, 3.06; 95% CI, 1.16-8.06). No other differences were found between the two groups.

CONCLUSION: The use of FDP in the prehospital setting has logistic benefits and a positive effect on coagulation profile, with no other significant effects. Future studies need to be performed on larger groups to verify trends or nullify our hypotheses.

J Trauma Acute Care Surg. 2019 Jan;86(1):43-51

Prehospital tourniquet use in penetrating extremity trauma: Decreased blood transfusions and limb complications.

Smith A, Ochoa J, Wong S, Beatty S, Elder J, Guidry C, McGrew P, McGinness C, Duchesne J, Schroll R.

BACKGROUND: Despite increasing popularity of prehospital tourniquet use in civilians, few studies have evaluated the efficacy and safety of tourniquet use. Furthermore, previous studies in civilian populations have focused on blunt trauma patients. The objective of this study was to determine if prehospital tourniquet use in patients with major penetrating trauma is associated with differences in outcomes compared to a matched control group.

METHODS: An 8-year retrospective analysis of adult patients with penetrating major extremity trauma amenable to tourniquet use (major vascular trauma, traumatic amputation and near-amputation) was performed at a Level I trauma center. Patients with prehospital tourniquet placement (TQ) were identified and compared to a matched group of patients without tourniquets (N-TQ). Univariate analysis was used to compare outcomes in the groups.

RESULTS: A total of 204 patients were matched with 127 (62.3%) in the prehospital TQ group. No differences in patient demographics or injury severity existed between the two groups. Average time from tourniquet application to arrival in the emergency department (ED) was 22.5 ± 1.3 minutes. Patients in the TQ group had higher average systolic blood pressure on arrival in the ED (120 ± 2 vs. 112 ± 2, $p = 0.003$). The TQ group required less total PRBCs (2.0 ± 0.1 vs. 9.3 ± 0.6, $p < 0.001$) and FFP (1.4 ± 0.08 vs. 6.2 ± 0.4, $p < 0.001$). Tourniquets were not associated with nerve palsy ($p = 0.330$) or secondary infection ($p = 0.43$). Fasciotomy was significantly higher in the N-TQ group (12.6% vs. 31.4%, $p < 0.0001$) as was limb amputation (0.8% vs. 9.1%, $p = 0.005$).

CONCLUSION: This study demonstrated that prehospital tourniquets could be safely used to control bleeding in major extremity penetrating trauma with no increased risk of major complications. Prehospital tourniquet use was also associated with increased systolic blood pressure on arrival to the ED, decreased blood product utilization and decreased incidence of limb related complications, which may lead to improved long-term outcomes and increased survival in trauma patients.

LEVEL OF EVIDENCE: Therapeutic, level IV.

J Trauma Acute Care Surg. 2019 Mar;86(3):532-539

The effectiveness of junctional tourniquets: A systematic review and meta-analysis.

Smith S, White J, Wanis K, Beckett A, McAlister V, Hilsden R.

BACKGROUND: Junctional tourniquets have been incorporated into tactical combat casualty care for junctional vascular trauma. They apply external compression to stop blood flow in the groin and axilla.

OBJECTIVES: The primary outcome was effectiveness in achieving arterial occlusion. Secondary outcomes included time to application and pain scores.

DATA SOURCES: Medline and EMBASE databases were searched.

STUDY APPRAISAL AND SYNTHESIS METHODS: A random-effects meta-analysis was conducted to estimate the average effectiveness and time to effective application for each device.

RESULTS: Eight studies reported the effectiveness of junctional tourniquets in healthy volunteers. The average effectiveness was 52% (95% confidence interval [CI], 15-87%) for the abdominal application of the abdominal aortic and junctional tourniquet (AAJT), 83% (95% CI, 73-89%; 26%) for the junctional Emergency Treatment Tool, 87% (95% CI, 79-92%; 15%) for the SAM junctional tourniquet (SJT), and 95% (95% CI, 90-98%) for the Combat Ready Clamp. The groin application of the AAJT was studied in two articles with 100% in both studies. The average time to application was 101 seconds for the SAM junctional tourniquet (95% CI, 50-152 seconds) and the Combat Ready Clamp (95% CI, 63-139 seconds), while it was 130 seconds (95% CI, 85-176 seconds) for the Junctional Emergency Treatment Tool. The abdominal application of AAJT had an average time to application of 92 and 171 seconds in two studies.

LIMITATIONS: All studies were conducted in healthy volunteers.

CONCLUSION AND IMPLICATIONS: Junctional tourniquets may meet a medical need in combat, and in the civilian environment, to control hemorrhage from these difficult injuries. All four Food and Drug Administration-approved devices demonstrate the ability to achieve vascular occlusion in healthy volunteers; however, effectiveness in patient transport has not been evaluated, and outcomes of their use in the field need to be captured and reported.

LEVEL OF EVIDENCE: Systematic review, level III.

Eur Spine J. 2018 Dec;27(12):2999-3006

Prehospital care of spinal injuries: a historical quest for reasoning and evidence.

ten Brinke J, Groen S Dehnad M, Saltzherr T, Hogervorst M, Goslings J

PURPOSE: The practice of prehospital immobilization is coming under increasing scrutiny. Unravelling the historical sequence of prehospital immobilization might shed more light on this matter and help resolve the situation. Main purpose of this review is to provide an overview of the development and reasoning behind the implementation of prehospital spine immobilization.

METHODS: An extensive search throughout historical literature and recent evidence based studies was conducted.

RESULTS: The history of treating spinal injuries dates back to prehistoric times. Descriptions of prehospital spinal immobilization are more recent and span two distinct periods. First documentation of its use comes from the early 19th century, when prehospital trauma care was introduced on the battlefields of the Napoleonic wars. The advent of radiology gradually helped to clarify the underlying pathology. In recent decades, adoption of advanced trauma life support has elevated in-hospital trauma-care to an high standard. Practice of in-hospital spine immobilization in case of suspected injury has also been implemented as standard-care in prehospital setting. Evidence for and against prehospital immobilization is equally divided in recent evidence-based studies. In addition, recent studies have shown negative side-effects of immobilisation in penetrating injuries.

CONCLUSION: Although widely implementation of spinal immobilization to prevent spinal cord injury in both penetrating and blunt injury, it cannot be explained historically. Furthermore, there is no high-level scientific evidence to support or reject immobilisation in blunt injury. Since evidence in favour and against prehospital immobilization is equally divided, the present situation appears to have reached something of a deadlock. These slides can be retrieved under Electronic Supplementary Material.

J Trauma Acute Care Surg. 2019 Jan 10;Epub ahead of print

Predictors and Timing of Amputations in Military Lower Extremity Trauma With Arterial Injury.

Thomas S, Schechtman D, Walters T, Kauvar D

INTRODUCTION: Military lower extremity arterial injuries present threats to life and limb. These injuries are common and limb salvage is a trauma system priority. Understanding the timing and predictors of amputation through the phases of casualty evacuation can help inform future limb salvage efforts. This study characterizes limbs undergoing amputation at different operationally relevant time points.

METHODS: A retrospective cohort study of casualties with lower extremity arterial injuries undergoing initial vascular limb salvage in Iraq and Afghanistan was undertaken. Amputations were grouped as having been performed early (in theater at Role 2 or 3) or late (after evacuation to Role 4 or 5). Further distinction was made between late and delayed (after discharge from initial hospitalization) amputations.

RESULTS: 455 casualties met inclusion criteria with 103 (23%) amputations. 21 (20%) were performed in theater and 82 (80%) were performed following overseas evacuation. 21 (26% of late amputations) were delayed, a median of 359 days from injury (IQR 176-582). Most amputations were performed in the first 4 days following injury. Amputation incidence was highest in popliteal injuries (28%). Overall amputation was predicted by higher incidence of blast mechanism and fracture and greater limb and casualty injury severity. Early amputations had higher limb injury severity than late amputations. Delayed amputations had greater incidence of motor and sensory loss and contracture than early amputations.

CONCLUSION: Casualty and limb injury severity predict predictors and timing of amputation in military lower extremity arterial injury. Amputation following overseas evacuation was more common than in-theater amputation and functional loss is associated with delayed amputation. Future limb salvage efforts should focus on post-evacuation and rehabilitative care.

EVIDENCE LEVEL: Level III, epidemiologic.

Transfusion. 2019 Feb 5; [Epub ahead of print]

International assessment of massive transfusion protocol contents and indications for activation.

Thomasson R, Yazer M, Gorham J, Dunbar N MTP Use Study Investigators, on behalf of the Biomedical Excellence for Safer Transfusion (BEST) Collaborative.

BACKGROUND: Massive transfusion protocols (MTPs) provide blood products rapidly and in fixed amounts. MTPs are commonly used in trauma but may also be used in other clinical settings, although evidence to support fixed-ratio resuscitation in nontraumatic hemorrhage is lacking. The goals of this study were to describe the types and contents of available MTPs and the clinical indications for MTP activation.

METHODS: A survey was distributed to 353 transfusion medicine specialists to assess the types and contents of available MTPs. Survey participants were invited to provide the clinical indications for consecutive adult and pediatric MTP activations for at least 6 months during 2015 to 2017.

RESULTS: There were 125 completed surveys (35% response rate) including three from children's specialty hospitals. Most hospitals that treated adult patients (90/122, 74%) utilized only one MTP for all adult bleeding emergencies, while one hospital had no MTP. Of the 31 hospitals that provided more than one adult MTP, 20 provided MTPs specific for obstetric bleeding cases. Of these, 50% (10/20) included at least one pool of cryoprecipitate or fibrinogen concentrate in the first MTP round, compared with 14% (13/90) of the hospitals with one MTP ($p = 0.0012$). Fifty-seven hospitals provided the clinical indication for 4176 adult and 155 pediatric MTP activations. Although trauma was the single most common indication, the majority of adult (58%) and pediatric (65%) activations were for nontrauma indications.

CONCLUSIONS: The majority of hospitals use a single MTP to manage massive hemorrhage. The majority of MTP activations were for nontrauma indications.

JAMA Surg. 2019 Mar 20; Epub ahead of print

The Need to Better Define the Who, What, and Where of Resuscitative Endovascular Balloon Occlusion of the Aorta.

Upchurch G Jr, Smith R

QUOTES: (Invited commentary on the paper by Joseph et al in JAMA Surgery)

"There clearly are some valuable nuggets of knowledge that can be derived from this ACS-TQIP review of REBOA, despite the small sample size. First—and we know this seems obvious—patients do not present to the emergency department following the rules of propensity matching. Patients present with hypotension and bleeding to death. In addition, much important individual patient information is simply not available from the ACS-TQIP. For example, was a protocol used? What were the indications for REBOA placement? Was REBOA used early or late in the course of treatment? Was the balloon deployed in zone 1 or 2?Was REBOA placed by experienced surgeons at high-volume centers? Which REBOA device was used? Clearly, REBOA will not raise the dead, but we should recognize this fact after performing resuscitative thoracotomy for multiple decades. Although we all have heroic stories to tell, mortality remains at or nearly at 100% for resuscitative thoracotomy in the setting of blunt trauma. Therefore, we agree with the authors that every effort should be made to better define which patients would most benefit from REBOA."

"It seems that, similar to the use of EVAR for ruptured AAA, it is imperative for us to better define who should undergo REBOA, who should perform it, and where it should be performed to maximize the survival benefit from this technique for our badly injured trauma patients."

World J Emerg Med. 2019;10(1):27-32

Comparison between intravenous morphine versus fentanyl in acute pain relief in drug abusers with acute limb traumatic injury.

Vahedi H, Hajebi H, Vahidi E, Nejati A, Saeedi M

BACKGROUND: Rapid and effective pain relief in acute traumatic limb injuries (ATLI) is one of the most important roles of emergency physicians. In these situations, opioid addiction is an important concern because of the dependency on opioids. The study aims to compare the effectiveness of intravenous (IV) fentanyl versus morphine in reducing pain in patients with opioid addiction who suffered from ATLI.

METHODS: In this double-blind randomized clinical trial, 307 patients with ATLI, who presented to the emergency department (ED) from February 2016 to April 2016, were randomly divided into two groups. One group (152 patients) received 0.1 mg/kg IV morphine. The other group (155 patients) received 1 mcg/kg IV fentanyl. Patients' demographic data, pain score at specific intervals, vital signs, side effects, satisfaction and the need for rescue analgesia were recorded.

RESULTS: Eight patients in the morphine group and five patients in the fentanyl group were excluded. Pain score in the fentanyl group had a significant decrease at 5-minute follow-up (P value=0.00). However, at 10, 30, and 60-minute follow-ups no significant differences were observed between the two groups in terms of pain score reduction. The rescue analgesia was required in 12 (7.7%) patients in the fentanyl group and in 48 (31.6%) patients in the morphine group (P value=0.00). No significant difference was observed regarding side effects, vital signs and patients' satisfaction between the two groups.

CONCLUSION: Fentanyl might be an effective and safe drug in opioid addicts suffering from ATLI.

Transfusion. 2019 Mar;59:965-970

Transfusion. 2019 Mar;59(3):965-970The use of whole blood in US military operations in Iraq, Syria, and Afghanistan since the introduction of low-titer Type O whole blood: feasibility, acceptability, challenges.

Vanderspurt C, Spinella P, Cap A, Hill R, Matthews S, Corley J, Gurney J

BACKGROUND: Hemorrhage is the leading cause of preventable death in military and civilian traumatic injury. Blood product resuscitation improves survival. Low-titer Type O Whole Blood (LTOWB) was recently re-introduced to the combat theater as a universal resuscitation product for hemorrhagic shock. This study assessed the utilization patterns of LTOWB compared to warm fresh whole blood (WFWB) and blood component therapy (CT) in US Military Operations in Iraq/Syria and Afghanistan known as Operation Inherent Resolve (OIR) and Operation Freedom's Sentinel (OFS) respectively. We hypothesized LTOWB utilization would increase over time given its advantages.

STUDY DESIGN AND METHODS: Using the Theater Medical Data Store, patients receiving blood products between January 2016 and December 2017 were identified. Product utilization ratios (PUR) for LTOWB, WFWB, and CT were compared across Area of Operations (AORs), medical treatment facilities (Role 2 vs. Role 3), and time. PUR was defined as number of blood products transfused/(number of blood products transfused + number of blood products wasted).

RESULTS: The overall PUR for all blood products was 17.4%; the LTOWB PUR was 14.3%. Over the study period, the total number of blood products transfused increased 133%. Although the total whole blood (WB) increased from 2.1% to 6.6% of all products transfused, WFWB use remained at 2% while LTOWB transfusions increased from 0.5% to 4%. Transfusion of LTOWB occurred more in austere Role 2 facilities compared to Role 3 hospitals.

CONCLUSIONS: LTOWB transfusion is feasible in austere, far-forward environments. Further investigation is needed regarding the safety, clinical outcomes, and drivers of LTOWB transfusions.

Neurocrit Care. 2019 Apr;30(2):364-371

Intraosseous Administration of 23.4% NaCl for Treatment of Intracranial Hypertension.

Wang J, Fang Y, Ramesh S, Zakaria A, Putman M, Dinescu D, Paik J, Geocadin R, Tahsili-Fahadan P, Altaweel LR

BACKGROUND/OBJECTIVE: Prompt treatment of acute intracranial hypertension is vital to preserving neurological function and frequently includes administration of 23.4% NaCl. However, 23.4% NaCl administration requires central venous catheterization that can delay treatment. Intraosseous catheterization is an alternative route of venous access that may result in more rapid administration of 23.4% NaCl.

METHODS: Single-center retrospective analysis of 76 consecutive patients, between January 2015 and January 2018, with clinical signs of intracranial hypertension received 23.4% NaCl through either central venous catheter or intraosseous access.

RESULTS: Intraosseous cannulation was successful on the first attempt in 97% of patients. No immediate untoward effects were seen with intraosseous cannulation. Time to treatment with 23.4% NaCl was significantly shorter in patients with intraosseous access compared to central venous catheter ($p < 0.0001$).

CONCLUSIONS: Intraosseous cannulation resulted in more rapid administration of 23.4% NaCl with no immediate serious complications. Further investigations to identify the clinical benefits and safety of hypertonic medication administration via intraosseous cannulation are warranted.

J Trauma Acute Care Surg. 2019 Mar;86(3):424-430

Initial evaluation of the efficacy and safety of in-hospital expandable hemostatic minisponge use in penetrating trauma.

Warriner Z, Lam L, Matsushima K, Benjamin E, Strumwasser A, Demetriades D, Inaba K.

BACKGROUND: Hemorrhage remains the leading cause of preventable death after trauma. The XSTAT expandable minisponge hemostatic device was developed for the control of severe, life-threatening bleeding from junctional wounds not amenable to tourniquet application. This is an initial report of the clinical use of this novel method of hemorrhage control for civilian penetrating injury.

METHODS: A review of trauma admissions at a high-volume Level I trauma center was performed from July 2016 to November 2017. All patients sustaining penetrating trauma with active hemorrhage were evaluated for XSTAT use. Ten device deployments occurred during this time. Each deployment was reviewed in detail, capturing patient and injury data, efficacy of hemorrhage control, and evaluation of any potential device or treatment related complications.

RESULTS: Six thousand three hundred sixty-three trauma admissions were reviewed with 22.1% sustaining a penetrating mechanism of injury. XSTAT was deployed in 10 (0.7%) penetrating trauma admissions with a mean age of 38.3 (range, 16-59) years, systolic blood pressure (SBP) of 126.7 (range, 74-194) mm Hg, Glasgow Coma Scale (GCS) score of 14.5 (range, 13-15), and New Injury Severity Score (NISS) of 9.5 (range, 1-27). Eight patients had an identifiable arterial injury; the remainder had vein or soft tissue bleeding. Overall, half were junctional injuries. XSTAT was able to stop bleeding in nine of ten patients on the first deployment, with the remaining patient requiring one repeat injection. Dwell times ranged from 1 hour to 40 hours (median, 15 hours). There were no technical device failures or embolic complications. Retained sponges were identified in two patients on initial postremoval x-rays following wound exploration for definitive hemorrhage control and sponge removal. No patient died during the study period.

CONCLUSION: XSTAT use appears safe. It is rapid, reliable, and provides a high degree of hemorrhage control on first deployment. Sponge removal should always be followed by radiographic clearance. For patients with hemorrhage from cavitary wounds not amenable to tourniquet placement, this device was effective. Further study is warranted as XSTAT use becomes more widespread.

LEVEL OF EVIDENCE: Therapeutic study, level V.

Int J Exerc Sci. 2019 Jan 1;12(3):136-143

The Effect of Cuff Width for Determining Limb Occlusion Pressure: A Comparison of Blood Flow Restriction Devices.

Weatherholt A, Vanwye W, Lohmann J, Owens J

ABSTRACT:
The purpose of this study was to compare the standing lower extremity limb occlusion pressure (LOP) between two units. It was hypothesized that the Delfi unit, which utilizes a wider cuff (11.5 cm), would require significantly less LOP as compared to the KAASTU unit, which utilizes a narrow cuff (5 cm). Twenty-nine healthy participants (22 men, 7 women) mean age 24 years old (± 1.7 SD) volunteered. The procedure was identical for each cuff, completed with 5 minutes of rest in between. The cuff was placed on the proximal left thigh in the standing position. The initial pressure was set to 50 mmHg and then increased in 50 mmHg increments until complete arterial occlusion was achieved or the unit went to its maximum pressure. Arterial blood flow was determined by a mobile ultrasound measured at the left popliteal artery. Paired samples t-tests were used to determine differences in LOP (mmHg) between the Delfi and KAATSU unit cuffs. Significant differences were observed between the cuffs (wide: 239.4 mmHg vs. narrow: 500 mmHg; $p < 0.001$). We were able to achieve complete arterial occlusion with the wide cuff. The KAATSU unit reached maximum pressure with all participants, therefore we were unable to achieve complete arterial occlusion with the narrow cuff. Although achieving complete arterial occlusion is not indicated or safe for BFR training, relative pressures are used and determined as a percentage of LOP. Our study found that the relative pressure of the wide cuff is lower than the narrow cuff.

World Neurosurg. 2019 Mar;123:128-135

Effect of Tranexamic Acid in Patients with Traumatic Brain Injury: A Systematic Review and Meta-Analysis.

Weng S, Wang W, Wei Q, Lan H, Su J, Xu Y

OBJECTIVE: Tranexamic acid (TXA) reduces hemorrhage volume and consequently the need for operative intervention. However, its effectiveness and safety in patients with traumatic brain injury (TBI) is unclear. We conducted this systematic review and meta-analysis to evaluate the safety and efficacy of TXA in patients with TBI.

METHODS: In July 2018, a systematic search for studies including patients with TBI treated with TXA was conducted using PubMed, Embase, and the Cochrane Library databases. Only related randomized controlled trials were included. Main outcomes included hematoma expansion, surgery rate, death rate, neurologic outcome, and any thrombosis events.

RESULTS: Of the identified 426 studies, 5 randomized controlled trials involving 917 patients met our inclusion criteria. For hematoma expansion, pooled results showed that TXA significantly decreased hemorrhage growth rate and total hemorrhage growth in patients with TBI. Regarding clinical outcomes, pooled results of surgery, mortality, and neurologic outcome showed no significant difference between the groups, and rate of thrombosis events was similar. Following sensitivity analysis, one study was excluded due to low quality. Then, results of TXA effect on mortality and neurologic outcomes became significant. We confirm that the earlier the TXA treatment is performed, the smaller the size of hematoma will be.

CONCLUSIONS: TXA demonstrates significant effect in reducing the risk of hematoma expansion by lowering the mortality rate and improving favorable neurologic outcomes in patients with TBI while not affecting thrombosis event rates. In addition, early TXA treatment is more effective in decreasing hematomas.

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Traumatic brain injury may worsen clinical outcomes after prolonged partial resuscitative endovascular balloon occlusion of the aorta in severe hemorrhagic shock model.

Williams A, Bhatti U, Dennahy S, Graham N, Nikolian V, Chtraklin K, Chang P, Zhou J, Biesterveld B, Eliason J, Alam H

BACKGROUND: The use of partial resuscitative endovascular balloon occlusion of the aorta (pREBOA) in combined hemorrhagic shock (HS) and traumatic brain injury (TBI) has not been well studied. We hypothesized that the use of pREBOA in the setting of TBI would be associated with worse clinical outcomes.

METHODS: Female Yorkshire swine were randomized to the following groups: HS-TBI, HS-TBI-pREBOA, and HS-pREBOA (n = 5/cohort). Animals in the HS-TBI group were left in shock for a total of 2 hours, whereas animals assigned to pREBOA groups were treated with supraceliac pREBOA deployment (60 minutes) 1 hour into the shock period. All animals were then resuscitated, and physiologic parameters were monitored for 6 hours. Further fluid resuscitation and vasopressors were administered as needed. At the end of the observation period, brain hemispheric swelling (%) and lesion size (mm) were assessed.

RESULTS: Mortality was highest in the HS-TBI-pREBOA group (40% [2/5] vs. 0% [0/5] in the other groups, $p = 0.1$). Severity of shock was greatest in the HS-TBI-pREBOA group, as defined by peak lactate levels and pH nadir ($p < 0.05$). Fluid resuscitation and norepinephrine requirements were significantly higher in the HS-TBI-pREBOA group ($p < 0.05$). No significant differences were noted in brain hemispheric swelling and lesion size between the groups.

CONCLUSION: Prolonged application of pREBOA in the setting of TBI does not contribute to early worsening of brain lesion size and edema. However, the addition of TBI to HS-pREBOA may worsen the severity of shock. Providers should be aware of the potential physiologic sequelae induced by TBI.

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To shunt or not to shunt in combined orthopedic and vascular extremity trauma.

Wlodarczyk J, Thomas A, Schroll R, Campion E, Croyle C, Menaker J, Bradley M, Harvin J, Collum M, Cho J, Seamon M, Leonard J, Tiller M, Inaba K, Moore M

BACKGROUND: There exists a long established but not validated practice of placing temporary intravascular shunts (TIVS) in cases of combined vascular and orthopedic extremity trauma. Though logical to prioritize blood flow, large-scale data to support this practice is lacking. We hypothesize that the order of repair yields no difference in outcomes in combined vascular and orthopedic extremity trauma and offer a larger-scale analysis than is previously available.

METHODS: A retrospective chart review was conducted at six Level I trauma centers from 2004 to 2015 comparing patients who received a TIVS during their initial surgery versus those who did not. Nonshunted patients were further divided into initial definitive vascular repair versus initial orthopedic fixation groups. Metrics were used to control for sampling bias while revision rate, amputation, hospital length of stay (HLOS), and development of thrombosis and compartment syndrome were used to assess outcomes.

RESULTS: Of 291 total patients, 72 had TIVS placement, 97 had initial definitive vascular repair, and 122 had initial orthopedic fixation. The shunted group had a higher Abbreviated Injury Scale (3.0 vs. 2.8 p = 0.04) and Mangled Extremity Severity Score (6.1 vs. 5.7 p = 0.006) and a significantly lower rate of compartment syndrome (15% vs. 34% p = 0.002). Among patients who developed compartment syndrome, those who were shunted were younger (23 vs. 35 yrs, p = 0.03) and were more likely sustain a penetrating injury (p = 0.007). Those receiving initial orthopedic fixation had a longer HLOS (HLOS >15 days in 61% vs. 38%, p = 0.049) and a higher amputation rate (20% vs. 7%, p = 0.006) when compared with those undergoing initial definitive vascular repair.

CONCLUSION: Lack of TIVS was associated with a significant increase in the development of compartment syndrome. Though it seems to have become common practice to proceed directly to vascular repair during the initial surgery, morbidity is improved with the placement of a TIVS.

LEVEL OF EVIDENCE: Therapeutic cohort, level III.

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

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

STUDY DESIGN: A retrospective study.

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

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

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

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

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Topical tranexamic acid in spinal surgery: A systematic review and meta-analysis.

Yerneni K, Burke J, Tuchman A, Li X, Metz L, Lehman R, Lenke L, Tan L

ABSTRACT:
Tranexamic acid (TXA) is a commonly used antifibrinolytic agent for perioperative blood conservation in several surgical specialties. Although historically administered intravenously, such systemic administration may be accompanied by severe side effects. Thus, the topical usage of TXA has been established in several fields but remains poorly evaluated in spine surgery. In this study, the authors aimed to review the medical literature on topical TXA usage in spine surgery to evaluate its safety and efficacy. We reviewed manuscripts and clinical trials exploring topical TXA usage in spine surgery published by April 1st, 2018. Postoperative blood loss volumes and hospitalization lengths of stay were evaluated with separate meta-analyses. We identified five articles and one unpublished clinical trial that were placebo-controlled and comprised 218 patients receiving topical TXA in spine surgery. Patients receiving topical TXA demonstrated significantly lower postoperative blood loss as compared to the placebo group (Standardized Mean Difference [SMD] 2.21, 95% CI 0.79-3.62, $p < 0.001$) and had a lower hospitalization duration (MD 0.99, 95% CI 0.49-1.49, $p < 0.001$). Overall, topical TXA favorably reduced postoperative blood loss and hospitalization duration in patients undergoing spinal surgery. However, further randomized controlled trials will be needed to definitively establish the optimal therapeutic doses needed for hemorrhage management, and the pharmacodynamics of tTXA in spinal surgery.

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Intravenous and Oral Tranexamic Acid are Equivalent at Reducing Blood Loss in Thoracolumbar Spinal Fusion: A Prospective Randomized Trial.

Yu C, Kadri O, Kadado A, Buraimoh M, Pawloski J, Bartol S, Graziano G

STUDY DESIGN: A prospective randomized trial of patients enrolled at a university affiliated tertiary medical center between February and December 2017.

OBJECTIVE: To compare perioperative blood loss in patients undergoing elective posterior thoracolumbar fusion who were treated with IV versus PO TXA.

SUMMARY OF BACKGROUND DATA: The use of antifibrinolytic agents such as tranexamic acid (TXA) to decrease operative blood loss and allogenic blood transfusions is well documented in the literature. While evidence supports the use of intravenous (IV) and topical formulations of TXA in spine surgery, the use of oral (PO) TXA has not been studied.

METHODS: 83 patients undergoing thoracolumbar fusion were randomized to receive 1.95g of PO TXA 2hours preoperatively or 2g IV TXA (1g before incision and 1g before wound closure) intraoperatively. The sample was further stratified into 3 categories based on number of levels fused (1-2 level fusions, 3-5, and >5). The primary outcome was the reduction of hemoglobin. Secondary outcomes included calculated blood loss, drain output, postoperative transfusion, complications, and length of hospital stay. Equivalence analysis was performed with a two one-sided test (TOST). A P-value of <0.05 suggested equivalence between treatments.

RESULTS: 43 patients received IV TXA and 40 patients received PO TXA. Patient demographic factors were similar between groups except for BMI. The mean reduction of hemoglobin was similar between IV and PO groups (3.36g/dL vs. 3.43g/dL, respectively; P=0.01, equivalence). Similarly, the calculated blood loss was equivalent (1235mL vs. 1312mL, respectively; P=0.02, equivalence). Eight patients (19%) in IV TXA group received a transfusion compared to five patients in PO TXA group (13%) (P=0.44). One patient (2% and 3% in IV and PO, respectively) in each group experienced a DVT/PE (P=0.96).

CONCLUSION: Patients treated with IV and PO TXA experienced the same perioperative blood loss after spinal fusions. Given its lower cost, PO TXA represents an excellent alternative to IV TXA in patients undergoing elective posterior thoracolumbar fusion and may improve healthcare cost-efficiency in the studied population.

LEVEL OF EVIDENCE: 1