Tactical Combat Casualty Care

Journal Article Abstracts

Committee on Tactical Combat Casualty Care

August 2017

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The effect of hemostatic dressing prototypes for the uniformed services on selected blood coagulation parameters in pigs.

Adamiak Z, Krystkiewicz W, Pomianowski A, Bukowiecka D, Zubrzycki W, Jałyński M, Holak P, Głodek J, Jastrzębski P

BACKGROUND: Serious injuries accompanied by severe bleeding are life-threatening. Post-traumatic hemorrhage involves the risk of developing coagulopathy. Hemostatic dressings are widely used to minimize bleeding. The application of procoagulants in control of hemorrhage may lead to thrombosis or disseminated intravascular coagulation. The aim of this study was to evaluate the effect of hemostatic dressing prototypes on the porcine coagulation system.

RESULTS: Fibrinogen and D-dimer concentrations were significantly higher in the experimental groups where hemostatic dressings were used in comparison with the control group. Considerable differences in antithrombin III activity and thrombin-antithrombin complex concentrations were also observed between groups.

CONCLUSIONS: The hemostatic dressing comprising modified seton impregnated with 18.0 g/m(2) of procoagulant was most effective in preserving the physiological equilibrium between fibrinogenesis and fibrinolysis.

Emerg Med Australas. 2017 Jun 5. Epub ahead of print

Emergency airway management in Australian and New Zealand emergency departments: A multicentre descriptive study of 3710 emergency intubations.

Alkhouri H, Vassiliadis J, Murray M, Mackenzie J, Tzannes A, McCarthy S, Fogg T

OBJECTIVE: The aim of this study was to describe the practice of endotracheal intubation across a range of Australasian EDs.

METHODS: We established a multicentre airway registry (The Australian and New Zealand Emergency Department Airway Registry [ANZEDAR]) prospectively capturing intubations from 43 Australian and New Zealand EDs over 24 months using the ANZEDAR form. Information recorded included patient demographics, intubation indications, predicted difficulty, rapid sequence induction and endotracheal intubation preparation technique, induction drugs, airway adjuncts and complications. Factors associated with first attempt success were explored.

RESULTS: Of the 3710 intubations captured, 3533 were in adults (95.2%), 2835 (76.4%) for medical and 810 (21.8%) for trauma indications. Overall, 3127 (84.3%) patients were successfully intubated at the first attempt; the majority by ED doctors (2654 [72.1%]). A total of 10 surgical airways were performed, all of which were successful cricothyroidotomies. Propofol, thiopentone or ketamine were used with similar frequency for induction, and suxamethonium was the most often used muscle relaxant. Adverse events were reported in 964 (26%), the majority involving desaturation or hypotension.

CONCLUSION: Australasian ED doctors, predominantly specialist emergency physicians or trainees, perform the majority of ED intubations using rapid sequence induction as their preferred technique mainly for medical indications. First attempt success rate was not different between different types of EDs, and is comparable published international data. Complications are not infrequent, and are comparable to other published series. Monitoring and reporting of ED intubation practice will enable continued improvements in the safety of this high-risk procedure.

J Orthop Trauma. 2017 Jun 12 Epub ahead of print

Efficacy And Safety Of Tranexamic Acid In Orthopedic Fracture Surgery: A Meta Analysis And Systematic Literature Review.

Amer K, Rehman S, Haydel C.

BACKGROUND: Tranexamic acid (TXA) is an anti-fibrinolytic drug that has been shown to be effective in reducing blood loss and the need for transfusions after several orthopedic surgeries. However, the effectiveness of TXA use in orthopedic fracture surgeries still remains unclear. The purpose of this meta-analysis was to review existing literature with interest in the effectiveness and safety of TXA treatment in reducing total blood loss and transfusion rates for patients who underwent surgery for fracture repairs.

METHODS: An electronic literature search of PubMed, Embase, OVID, and the Cochrane Library was conducted to identify studies published before December 2016. All randomized controlled trials and cohort studies evaluating the efficacy of TXA during fracture repair surgeries were identified. Primary outcome measures included the number of patients receiving a blood transfusion and peri-operative total blood loss. Data were analyzed using Comprehensive Meta Analysis (CMA) statistical software.

RESULTS: Seven studies encompassing 559 patients met the inclusion criteria for the meta-analysis. Our meta-analysis indicated that when compared with the placebo control group, the use of TXA in fracture surgeries significantly reduced total blood loss by approximately 330 mL ($p=0.009$), reduced the transfusion rate with a relative risk of 0.54 ($p<0.001$), and decreased the drop of hemoglobin by 0.76 g/dL ($p<0.001$). There was no significant difference between the number of thrombo-embolic events among the study groups ($p=0.24$).

CONCLUSIONS: This study demonstrated that tranexamic acid may be used in orthopedic fracture surgeries to reduce total blood loss, transfusion rates, and the drop in hemoglobin level, without increasing risk of venous thrombo-embolism. A limitation to these findings is the small number of studies available. Further studies need to be conducted to confirm these findings.

LEVEL OF EVIDENCE: Therapeutic Level I. See Instructions for Authors for a complete description of levels of evidence.

J Trauma Acute Care Surg. 2017 Jun 6. Epub ahead of print

Pre Hospital Administration of Freeze Dried Plasma, is it the solution for Trauma Casualties?

Amir S, Maya ST, Irina R, Kobi P, Avi S, Erez BN, Elon G, Avraham Y

BACKGROUND: Hemorrhage, is the leading cause of possible preventable death in the battlefield. There is an increasing evidence for the effectiveness of blood component therapy in general, and plasma infusion in particular but their use is less applicable in the pre-hospital setting due to logistic difficulties. Israeli Defense Force has implemented the use of freeze dried plasma (FDP) at the point of injury (POI), this adoption of FDP use entailed doubts regarding the feasibility and effectiveness of this practice. In this manuscript we present our experience with the use of FDP at the POI and pre-hospital setting regarding the feasibility, safety, adverse reactions and adherence to clinical practice guidelines (CPG).

METHODS: This is a descriptive retrospective cohort study based on all casualties receiving FDP during January 2013 to June 2016. The study describes the injury, treatment and outcome characteristics from POI until hospital discharge.

RESULTS: During the study period 109 casualties received FDP. The majority were male, aged 18-35 years old. Multiple severe injuries, were found in almost half of the casualties, 78% had penetrating injury and more than half were involved in a multi casualty event. 83% were treated with one unit of FDP, 13% with two units and 4% casualties with three units, nine patients (8.2%) were also treated in the prehospital setting with PRBC. 57% fulfilled at least one criteria for the administration of FDP. Lifesaving interventions were required in 64%. In five cases (4.6%) there were difficulties with FDP administration, Side effects were reported in one female patient.

CONCLUSION: This study supports the usage feasibility of FDP at the POI and in the pre-hospital setting. Further adjustment of the CPG is required basing it not only on patho-physiological parameters but also on clinical judgment. Further investigation of the available data is required in order to learn about the effectiveness of FDP at POI.

LEVEL OF EVIDENCE: Level IV retrospective case series study.

Intensive Care Med. 2017 Jul 29. Epub ahead of print

The research agenda for trauma critical care.

Asehnoune K, Balogh Z, Citerio G, Cap A, Billiar T, Stocchetti N, Cohen MJ, Pelosi P, Curry N, Gaarder C, Gruen R, Holcomb J, Hunt BJ, Juffermans NP, Maegele M, Midwinter M, Moore FA, O'Dwyer M, Pittet JF, Schöchl H, Schreiber M, Spinella PC, Stanworth S, Winfield R, Brohi K

ABSTRACT:

In this research agenda on the acute and critical care management of trauma patients, we concentrate on the major factors leading to death, namely haemorrhage and traumatic brain injury (TBI). In haemostasis biology, the results of randomised controlled trials have led to the therapeutic focus moving away from the augmentation of coagulation factors (such as recombinant factor VIIa) and towards fibrinogen supplementation and administration of antifibrinolytics such as tranexamic acid. Novel diagnostic techniques need to be evaluated to determine whether an individualised precision approach is superior to current empirical practice. The timing and efficacy of platelet transfusions remain in question, while new blood products need to be developed and evaluated, including whole blood variants, lyophilised products and novel red cell storage modalities. The current cornerstones of TBI management are intracranial pressure control, maintenance of cerebral perfusion pressure and avoidance of secondary insults (such as hypotension, hypoxaemia, hyperglycaemia and pyrexia). Therapeutic hypothermia and decompressive craniectomy are controversial therapies. Further research into these strategies should focus on identifying which subgroups of patients may benefit from these interventions. Prediction of the long-term outcome early after TBI remains challenging. Early magnetic resonance imaging has recently been evaluated for predicting the long-term outcome in mild and severe TBI. Novel biomarkers may also help in outcome prediction and may predict chronic neurological symptoms. For trauma in general, rehabilitation is complex and multidimensional, and the optimal timing for commencement of rehabilitation needs investigation. We propose priority areas for clinical trials in the next 10 years.

J Trauma Acute Care Surg. 2017 Jun;82:1122-1128.

Surgical support during the terrorist attacks in Paris, November 13, 2015: Experience at Bégin Military Teaching Hospital.

Barbier O, Malgras B, Choufani C, Bouchard A, Ollat D, Versier G.

BACKGROUND: Recent conflicts have allowed the French Army Health Service to improve management quality for wartime-injured people during military operations. On November 13, 2015, it was in Paris that France was directly attacked and Bégin Military Teaching Hospital, like several hospitals in Paris, had to face a large number of gunshot victims. Thanks to our operational experience, injured people hospitalized in military hospitals benefited from a management based on triage and damage control (DC) principles.

METHODS: Forty-five patients were taken care of in our hospital with an average age of 32 years. During triage, eight patients were categorized T1 (with four extreme emergencies) and 10 were classified T2 and 27 as T3. Twenty-two patients underwent emergency surgery, 15 for soft tissue lesions of limbs, 8 for ballistic fractures (one of which was a cervical wound), and 5 for abdominal wounds. Two patients classified T1 died early.

RESULTS: In total, more than 50 operations were performed including iterative debridements, bone fixation, three amputations, and two flaps. After 9 months, all of the patients had healed. One woman with limb stiffness required an arthrolysis.

CONCLUSION: This event showed that terrorist attacks and mass casualties with war wounds can occur in France. Acquired experience regarding war wounds by the French Army Health Service is precious. Everyone must understand the importance of triage and the principles of damage control. Every hospital must be ready to face this type of massive influx of injured people (white plan).

LEVEL OF EVIDENCE: Epidemiological study, level V.

J Trauma Acute Care Surg. 2017 Jul 8. doi: 10.1097/TA.0000000000001639. [Epub ahead of print]

Smartphone-Based Mobile Thermal Imaging Technology to Assess Limb Perfusion and Tourniquet Effectiveness Under Normal and Blackout Conditions.

Barron MR, Kuckelman JP, McClellan JM, Derickson MJ, Phillips CJ, Marko ST, Smith JP, Eckert MJ, Martin MJ.

BACKGROUND: Over the past decade there has been a resurgence of tourniquet use in civilian and military settings. Several key challenges include assessment of limb perfusion and adequacy of tourniquet placement, particularly in the austere or pre-hospital environments. We investigated the utility of thermal imaging to assess adequacy of tourniquet placement.

METHODS: The FLIR ONE™ smartphone-based thermal imager was utilized. Ten swine underwent tourniquet placement with no associated hemorrhage (n=5) or with 40% hemorrhage (n=5). Experiment 1 simulated proper tourniquet application, experiment 2 had one of two tourniquets inadequately tightened, and experiment 3 had one of two tourniquets inadequately tightened while simulating blackout-combat conditions. Static images were taken at multiple time points up to 30 minutes. Thermal images were then presented to blinded evaluators who assessed adequacy of tourniquet placement.

RESULTS: The mean core temperature was 38.3°C in non-hemorrhaged animals versus 38.2°C in hemorrhaged animals. Hemorrhaged animals were more hypotensive ($p=0.001$), anemic ($p<0.001$), vasodilated ($p=0.008$), and had a lower cardiac output ($p = 0.007$) compared to non-hemorrhaged animals. The thermal imaging temperature reading decreased significantly following proper tourniquet placement in all animals, with no difference between hemorrhaged and non-hemorrhaged groups at 30 minutes ($p=0.23$). Qualitative thermal image analysis showed clearly visible perfusion differences in all animals between baseline, adequate tourniquet, and inadequate tourniquet in both hemorrhaged and non-hemorrhaged groups. Ninety-eight percent of blinded evaluators (n=62) correctly identified adequate and inadequate tourniquet placement at 5-minutes. Images in blackout conditions showed no adverse impact on thermal measurements or in the ability to accurately characterize perfusion and tourniquet adequacy.

CONCLUSIONS: A simple handheld smartphone-based FLIR device demonstrated a high degree of accuracy, reliability, and ease of use for assessing limb perfusion. FLIR also allowed for rapid and reliable identification of adequate tourniquet placement that was not affected by major hemorrhage or blackout conditions.

LEVEL OF EVIDENCE: not applicable (animal study)

STUDY DESIGN: Original Article.

Biomed Res Int. 2017; Epub 2017 May 14.

Red Cell Storage Duration Does Not Affect Outcome after Massive Blood Transfusion in Trauma and Nontrauma Patients: A Retrospective Analysis of 305, Patients.

Bautista A, Wright TB, Meany J, Kandadai SK, Brown B, Khalafalla K, Hashem S, Smith JW, Ayyoubi TM, Dalton JE, Wadhwa A, Sessler DI, Obal D.

BACKGROUND: Prolonged storage of packed red blood cells (PRBCs) may increase morbidity and mortality, and patients having massive transfusion might be especially susceptible. We therefore tested the hypothesis that prolonged storage increases mortality in patients receiving massive transfusion after trauma or nontrauma surgery. Secondarily, we considered the extent to which storage effects differ for trauma and nontrauma surgery.

METHODS: We considered surgical patients given more than 10 units of PRBC within 24 hours and evaluated the relationship between mean PRBC storage duration and in-hospital mortality using multivariable logistic regression. Potential nonlinearities in the relationship were assessed via restricted cubic splines. The secondary hypothesis was evaluated by considering whether there was an interaction between the type of surgery (trauma versus nontrauma) and the effect of storage duration on outcomes.

RESULTS: 305 patients were given a total of 8,046 units of PRBCs, with duration ranging from 8 to 36 days (mean ± SD: 22 ± 6 days). The odds ratio [95% confidence interval (CI)] for in-hospital mortality corresponding to a one-day in mean PRBC storage duration was 0.99 (0.95, 1.03, P = 0.77). The relationship did not differ for trauma and nontrauma patients (P = 0.75). Results were similar after adjusting for multiple potential confounders.

CONCLUSIONS: Mortality after massive blood transfusion was no worse in patients transfused with PRBC stored for long periods. Trauma and nontrauma patients did not differ in their susceptibility to prolonged PRBC storage.

Mil Med. 2017 Jul;182(7):e1929-e1932.

Two New Effective Tourniquets for Potential Use in the Military Environment: A Serving Soldier Study.

Beaven A, Briard R, Ballard M, Parker P

BACKGROUND: Limb tourniquets have been used extensively during modern Middle Eastern conflicts. Despite its undeniable successes, the combat applied tourniquet (C-A-T) has some shortfalls, principally its inability to reliably control lower limb bleeding when applied to the mid-thigh. We tested two tourniquets which may represent an improvement to the combat applied tourniquet; the tactical mechanical tourniquet and the tactical pneumatic tourniquet.

METHODS: We recruited 12 healthy service personnel and applied the tactical mechanical tourniquet and tactical pneumatic tourniquet to both lower limbs in a randomly generated sequence. Tourniquets were tightened until popliteal artery occlusion. This was measured via a SonoSite portable ultrasound machine by a single consultant vascular radiologist familiar with its use. A longitudinal view of the popliteal artery was obtained, and Doppler waveform monitored. The tourniquets were tightened around volunteers' mid-thigh by a second researcher accustomed with their use. Time to complete occlusion, number of windlass revolutions, and pain scores were collected by a third researcher. Non-normally distributed data are present as median (interquartile range). Ordinal nonparametric data are analysed by Mann-Whitney U testing.

RESULTS: Participants had a median age of 32.5 (28-35). Both tourniquets demonstrated complete occlusion of the popliteal artery in all limbs (n = 24). The mechanical tourniquet achieved arterial occlusion after a median of 3.8 (3-4) turns, and 16 (12-20) seconds. No participants dropped out of the study because of intolerable pain, or any cause. Median pain scores for the mechanical tourniquets were 4.5 (3-7) (maximum pain) and 4.0 (2-7) (pain when locked). Median pain scores for the pneumatic tourniquet were 5 (2-6) (maximum pain) and 5 (2-6) (pain when fully applied). There was no statistical difference in maximum pain scores between the tactical mechanical tourniquet and the tactical pneumatic tourniquet (p = 0.75). No participant had any tourniquet applied for longer than 80 seconds.

CONCLUSION: Both tourniquets completely occluded the popliteal artery in all participants within an acceptable pain threshold. Further testing is required before the presented tourniquets can be taken to the battlefield; particularly measures of self-application, and use on other anatomical areas.

J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S79-S86.

An evaluation of methods for producing low-titer group O whole blood to support military trauma resuscitation.

Belin TR, Yazer MH, Meledeo MA, Fahie RL, Malloy WW, Stubbs JR, Cap AP

QUOTE:

“The use of "low titer" group O WB (containing low and presumably safe titers, or concentrations, of anti-A and anti-B antibodies) as a universal blood product in trauma scenarios is a concept that is regaining acceptance in the military and civilian literature. Low-titer Group O WB is a particularly attractive option for transfusion in the prehospital setting, close to the point of injury, in order to ensure that a balanced resuscitation strategy that treats both shock and coagulopathy is initiated as early as possible. This was a practice successfully implemented and passed military conflicts as early as World War II..... notably, in more than 750,000 documented transfusions, there have been very few reports of serious adverse reactions.”

Wilderness Environ Med. 2017 Jun;28(2S):S82-S89.

Battlefield Trauma-Induced Hypothermia: Transitioning the Preferred Method of Casualty Rewarming.

Bennett BL, Holcomb JB

ABSTRACT:

For centuries, cold and wet weather has affected military combat operations leading to tremendous loss of manpower caused by cold-weather-related injuries including trench foot, frostbite, and hypothermia. The initial battlefield management of hypothermia in military personnel had not advanced significantly following many wars and conflicts until 2006. The aim of this review is to: 1) provide an overview of trauma-induced hypothermia (TIH); 2) highlight the Department of Defense strategy for the implementation of a hypothermia clinical management program for battlefield (prehospital) casualties; 3) highlight the research and development of the Hypothermia Prevention and Management Kit (HPMK) as the preferred field rewarming system for battlefield TIH; and 4) emphasize how the HPMK can be easily transitioned to the civilian sector for active rewarming of both accidental and TIH patients. The HPMK is ideal for those working in civilian Emergency Medical Services and austere prehospital care environments. This kit is a low cost, lightweight, small dimension commercial product that can provide effective passive management or active rewarming for both accidental (primary) and trauma-induced (secondary) hypothermia patients.

J Trauma Acute Care Surg. 2017;83(Suppl):S150-S155.

Battlefield pain management: A view of 17 years in Israel Defense Forces.

Benov A, Salas MM, Nakar H, Antebi B, Tarif B, Yitzhak A, Glassberg E.

BACKGROUND: Pain control in trauma is an integral part of treatment in combat casualty care (CCC). More soldiers injured on the battlefield will need analgesics for pain than those who will need lifesaving interventions (LSI). It has been shown that early treatment of pain improves outcomes after traumatic injury, whereas inadequate treatment leads to higher rates of PTSD. The purpose of this article is to report the Israel Defense Forces Medical Corps (IDF-MC) experience with point of injury (POI) use of analgesia.

METHODS: All cases documented in the IDF Trauma Registry (ITR) between January 1997 and December 2014 were examined. All cases of POI pain medications were extracted. Data collection included mechanism of injury, wound distribution, pain medication administered, mortality, and provider type.

RESULTS: Of 8,576 patients, 1,056 (12.3%) patients who had at least one documented pain management treatment were included in this study. Demographics of the study population included 94.2% men and 5.8% women with a median age of 21years. Injury mechanisms included 40.3% blast injuries (n = 426) and 29% gunshot injuries (306). Of 1,513 injured body regions reported, 52% (787) were extremity wounds (upper and lower), 23% (353) were truncal wounds, and 17.7% (268) were head and neck injuries. A total of 1,469 episodes of analgesic treatment were reported. The most common types of analgesics were morphine (74.7%, 1,097 episodes), ketamine (9.6%, 141 episodes), and fentanyl (13.6%, 200 episodes). Of the patients, 39% (413) received more than one type of analgesic. In 90.5% of cases, analgesia was administered by a physician or a paramedic. Over the span of the study period (1997-2014), types of analgesics given by providers at POI had changed, as fentanyl was introduced to providers. A total of 801 LSIs were performed on 379 (35.9%) patients receiving analgesia, and no adverse events were found in any of the casualties.

CONCLUSION: Most casualties at POI did not receive any analgesics while on the battlefield. The most common analgesics administered at POI were opioids and the most common route of administration was intravenously. This study provides evidence that over time analgesic administration has gained acceptance and has been more common place on the battlefield. Increasingly, more casualties are receiving pain management treatment early in CCC along with LSIs. We hope that this shift will impact CCC by reducing PTSD and overall morbidity resulting from inadequate management of acute pain.

J Trauma Acute Care Surg. 2017 Jul;83(1 Suppl 1):S71-S76.

The effect of blood transfusion on compensatory reserve: A prospective clinical trial.

Benov A, Yaslowitz O, Hakim T, Amir-Keret R, Nadler R, Brand A, Glassberg E, Yitzhak A, Convertino VA, Paran H.

BACKGROUND: Bleeding activates the body's compensatory mechanisms, causing changes in vital signs to appear late in the course of progressive blood loss. These vital signs are maintained even when up to 30% to 40% of blood volume is lost. Laboratory tests such as hemoglobin, hematocrit, lactate, and base deficit levels do not change during acute phase of bleeding. The compensatory reserve measurement (CRM) represents a new paradigm that measures the total of all physiological compensatory mechanisms, using noninvasive photoplethysmography to read changes in arterial waveforms. This study compared CRM to traditional vital signs and laboratory tests in actively bleeding patients.

METHODS: Study patients had gastrointestinal bleeding and required red blood cell (RBC) transfusion (n = 31). Control group patients had similar demographic and medical backgrounds. They were undergoing minor surgical procedures and not expected to receive RBC transfusion. Vital signs, mean arterial pressure, pulse pressure, hemoglobin and hematocrit levels, and CRM were recorded before and after RBC transfusion or the appropriate time interval for the control group. Receiver operator characteristic curves were plotted and areas under the curves (AUCs) were compared.

RESULTS: CRM increased 10.5% after RBC transfusion, from 0.77 to 0.85 ($p < 0.005$). Hemoglobin level increased 22.4% after RBC transfusion from 7.3 to 8.7 ($p < 0.005$). Systolic and diastolic blood pressure, mean arterial pressure, pulse pressure, and heart rate did change significantly. The AUC for CRM as a single measurement for predicting hemorrhage at admission was 0.79, systolic blood pressure was 0.62, for heart rate was 0.60, and pulse pressure was 0.36.

CONCLUSIONS: This study demonstrated that CRM is more sensitive to changes in blood volume than traditional vital signs are and could be used to monitor and assess resuscitation of actively bleeding patients.

LEVEL OF EVIDENCE: Care management, level II.

Injury. 2017 Sep;48(9):1906-1910

Management of war-related vascular wounds in French role 3 hospital during the Afghan campaign.

Beranger F, Lesquen H, Aoun O, Roqueplo C, Meyrat L, Natale C, Avaro JP

OBJECTIVES: To describe the management of war-related vascular injuries in the Kabul French military hospital.

METHODS: From January 2009 to April 2013, in the Kabul French military hospital, we prospectively included all patients presenting with war-related vascular injuries. We collected the following data: site, type, and mechanism of vascular injury, associated trauma, type of vascular repair, amputation rate and complications.

RESULTS: Out of the 922 soldiers admitted for emergency surgical care, we recorded 45 (5%) patients presenting with vascular injuries: 30 (67%) gunshot-related, 11 (24%) explosive device-related, and 4 (9%) due to road traffic accident. The majority of injuries (93%) involved limbs. Vascular injuries were associated with fractures in 71% of cases. Twelve (26.7%) had an early amputation performed before evacuation. Twenty (44.4%) patients underwent fasciotomy and three (6.6%) sustained a compartment syndrome.

CONCLUSIONS: This was the first French reported series of war-related vascular injuries during the last decade's major conflicts. The majority of injuries occurred in the limbs. Autologous vein graft remains the treatment of choice for arterial repair. Functional severity of these injuries justifies specific training for military surgeons.

J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S91-S95

Effects on the anti-ABO titers of military blood donors from a predeployment vaccination program.

Berséus O

BACKGROUND: The use of blood group O as "universal blood" for emergency whole blood transfusions carries the risk for a hemolytic transfusion reaction mediated by incompatible A/B antibodies. This risk can be minimized by assuring that the donor has a low titer of anti-A and anti-B. The level of these naturally occurring antibodies has been shown to be increased by vaccination with most biologically derived vaccines. This boostering effect has been investigated for the new generation of vaccines.

METHODS: The 120 crew members of a Swedish naval ship deployed for 7 months to the Indian Ocean were tested for anti-A and anti-B before their predeployment vaccination program and after returning to Sweden. The vaccination program contained vaccines against cholera, diphtheria, hepatitis A and B, influenza, measles, meningitis, mumps, pertussis, polio, rubella, TBE virus, tetanus, typhus and yellow fever. Paired antibody titrations were performed for both IgM and IgG using microtube gelcards (Diamed GMBH).

RESULTS: No crew member, including the six belonging to the "high titer" group, showed a sign of a booster effect by any of the used vaccines.

CONCLUSION: The earlier reported boostering effects mediated by different vaccines cannot be replicated with the new vaccines of today. This is probably a result of the new manufacturing techniques resulting in much purer vaccines.

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

Mil Med. 2017 Jul;182(7):e1722-e1725.

A Study on the Tactical Safety of Endotracheal Intubation Under Darkness.

Bilge S, Aydin A, Bilge M, Aydin C, Cevik E, Eryilmaz M

OBJECTIVE: Strict blackout discipline is extremely important for all military units. To be able to effectively determine wound characteristics and perform the necessary interventions at nighttime, vision and light restrictions can be mitigated through the use of tactical night vision goggles (NVGs). The lamp of the classical laryngoscope (CL) can be seen with the naked eye; infrared light, on the other hand, cannot be perceived without the use of NVGs. The aim of the study is to evaluate the safety of endotracheal intubation (ETI) procedures in the dark under tactically safe conditions with modified laryngoscope (ML) model.

METHODS: We developed an ML model by changing the standard lamp on a CL with an infrared light-emitting diode lamp to obtain a tool which can be used to perform ETI under night conditions in combination with NVGs. We first evaluated the safety of ETI procedures in prehospital conditions under darkness by using both the CL and the ML for the study, and then researched the procedures and methods by which ETI procedure could be performed in the dark under tactically safe conditions. In addition, to better ensure light discipline in the field of combat, we also researched the benefits, from a light discipline standpoint, of using the poncho liner (PL) and of taking advantage of the oropharyngeal region during ETIs performed by opening the laryngoscope blades directly in the mouth and using a cover. During the ETI procedures performed on the field, two experienced combatant staff simulated the enemy by determining whether the light from the two different types of laryngoscope could be seen at 100-m intervals up to 1,500 m.

RESULTS: In all scenarios, performing observations with an NVG was more advantageous for the enemy than with the naked eye. The best measure that can be taken against this threat by the paramedic is to ensure tactical safety by having an ML and by opening the ML inside the mouth with the aid of a PL. The findings of the study are likely to shed light on the tactical safety of ETI performed with NVGs under darkness.

CONCLUSION: Considering this finding, we still strongly recommend that it would be relatively safer to open the ML blade inside the mouth and to perform the procedures under a PL. In chaotic environments where it might become necessary to provide civilian health services for humanitarian aid purposes (Red Crescent, Red Cross, etc.) without NVGs, we believe that it would be relatively safer to open the CL blade inside the mouth and to perform the procedures under a PL.

Injury. 2017 May;48(5):1047-1053.

Coagulopathy and transfusion requirements in war related penetrating traumatic brain injury. A single centre study in a French role 3 medical treatment facility in Afghanistan.

Bordes J, Joubert C, Esnault P, Montcriol A, Nguyen C, Meaudre E, Dulou R, Dagain A

INTRODUCTION: Traumatic brain injury associated coagulopathy is frequent, either in isolated traumatic brain injury in civilian practice and in combat traumatic brain injury. In war zone, it is a matter of concern because head and neck are the second most frequent site of wartime casualty burden. Data focusing on transfusion requirements in patients with war related TBI coagulopathy are limited.

MATERIALS AND METHODS: A descriptive analysis was conducted of 77 penetrating traumatic brain injuries referred to a French role 3 medical treatment facility in Kabul, Afghanistan, deployed on the Kabul International Airport (KaIA), over a 30 months period.

RESULTS: On 77 patients, 23 died during the prehospital phase and were not included in the study. Severe traumatic brain injury represented 50% of patients. Explosions were the most common injury mechanism. Extracranial injuries were present in 72% of patients. Traumatic brain injury coagulopathy was diagnosed in 67% of patients at role 3 admission. Red blood cell units (RBCu) were transfused in 39 (72%) patients, French lyophilized plasma (FLYP) in 41 (76%), and fresh whole blood (FWB) in 17 (31%).

CONCLUSION: The results of this study support previous observations of coagulopathy as a frequent complication of traumatic brain injury. The majority of patients with war related penetrating traumatic brain injury presented with extracranial lesions. Most of them required a high level of transfusion capacity.

J Spec Oper Med. Summer 2017;17(2):96-100.

Intubation of the Right Atrium During an Attempted Modified Surgical Airway in a Pig.

Bowman J, Juergens A, McClure M, Spear D

ABSTRACT:

In modern medicine, the surgical cricothyrotomy is an airway procedure of last resort. In austere environments, however, its simplicity may make it a more feasible option than carrying a full complement of laryngoscopes. To create a Transportation Security Agency-compliant compact first-response bag, we attempted to establish a surgical cricothyrotomy in a pig, using trauma shears, basic medical scissors, a pocket bougie, and an endotracheal tube. Bougies can provide tactile feedback via the "tracheal ring sign" and "stop sign" to indicate positive tracheal placement during orotracheal intubation. We report on a previously unknown serious potential complication that questions the use of scissors to establish a surgical airway and the reliability of tactile bougie signs when translated into certain surgical airways.

Wilderness Environ Med. 2017 Jun;28(2S):S74-S81.

Fluid Resuscitation in Tactical Combat Casualty Care: Yesterday and Today.

Butler FK

ABSTRACT:

The prevailing wisdom for the prehospital fluid resuscitation of trauma victims in hemorrhagic shock in 1992 was to administer 2 L of crystalloid solution as rapidly as possible. A review of the fluid resuscitation literature found that this recommendation was not well supported by the evidence at the time. Prehospital fluid resuscitation strategies were re-evaluated in the 1993-1996 Tactical Combat Casualty Care (TCCC) research program. This article reviews the advances in prehospital fluid resuscitation as recommended by the original TCCC Guidelines and modified over the following 2 decades. These advances include hypotensive resuscitation, use of prehospital whole blood or blood components when feasible, and use of Hextend or selected crystalloids when logistical considerations make blood or blood component use not feasible.

J Trauma Acute Care Surg. 2017 Jul;83(1 Suppl 1):S9-S15.

Evaluation of adenosine, lidocaine, and magnesium for enhancement of platelet function during storage.

Bynum JA, Taylor AS, Peltier GC, McIntosh CS, Meledeo MA, Dobson GP, Cap AP

BACKGROUND: The combination of adenosine, lidocaine, and magnesium (Mg2+) (ALM) has demonstrated cardioprotective and resuscitative properties in models of cardiac arrest and hemorrhagic shock that are linked to reduction of metabolic demand. Platelets play a key role in resuscitation strategies for ATC but suffer from loss of function following storage in part owing to mitochondrial exhaustion. This study evaluates whether ALM also demonstrates protective properties in stored platelet preparations.

METHODS: Platelets were tested at (baseline, Day 5, Day 10, and Day 15) at 22°C (room temperature) or 4°C in 100% plasma and platelet additive solution. Adenosine, lidocaine, and magnesium treatment or its individual components (A, L, M, or combinations) were added directly to the minibags at baseline for storage. Measurements consisted of blood gas and chemistry analyses, thromboelastography, impedance aggregometry, and flow cytometry.

RESULTS: Blood gas and cell analysis, as well as flow cytometry measures, demonstrated only differences between temperature groups starting at Day 5 ($p < 0.05$) and no differences between treatment groups. Aggregation response to collagen (A only, M only, and ALM high dose) and thrombin receptor activation peptide (A + M, and ALM high dose) was significantly greater at Day 5 compared to respective 4°C (100% plasma) controls ($p < 0.05$). Thromboelastography analysis revealed significant preservation of all measures (reaction time, maximum amplitude, and angle) at Day 15 for 4°C-stored samples in 100% plasma in both controls (no ALM) and ALM treatment compared to room temperature ($p < 0.05$); no differences were observed between the ALM and control groups.

CONCLUSIONS: The mechanism of ALM's protective effect remains unclear; key cellular functions may be required to provide protection. In this study, improvements in collagen and thrombin receptor activation peptide aggregation were seen when compared to 4°C-stored plasma samples although no improvements were seen when compared to 4°C-stored platelet additive solution platelets.

LEVEL OF EVIDENCE: Therapeutic/care management, level II.

Prehosp Emerg Care. 2017 Jun 28:1-3.

Case Report: Life Saving Application of Commercial Tourniquet in Pediatric Extremity Hemorrhage.

Callaway DW, Puciaty A, Robertson J, Hannon T, Fabiano SE.

ABSTRACT:

Hemorrhage is the leading preventable cause of death in civilian and military trauma. Recent data from the ongoing conflicts in Iraq and Afghanistan suggest that early and aggressive tourniquet utilization is a safe and effective way to dramatically reduce mortality from extremity hemorrhage. As a result, prehospital tourniquet use is now endorsed by a majority of professional emergency medicine, emergency medical service and trauma professional societies. However, there currently exists scant evidence supporting the efficacy of commercially available tourniquets in controlling extremity hemorrhage in pediatric trauma patients.

J Trauma Acute Care Surg. 2017 Aug;83(2):211-217.

High ratio plasma resuscitation does not improve survival in pediatric trauma patients.

Cannon JW, Johnson MA, Caskey RC, Borgman MA, Neff LP

BACKGROUND: Damage control resuscitation including balanced resuscitation with high ratios of plasma (PLAS) and platelets (PLT) to packed red blood cells (PRBC) improves survival in adult patients. We sought to evaluate the effect of a high ratio PLAS to PRBC resuscitation strategy in massively transfused pediatric patients with combat injuries.

METHODS: The Department of Defense Trauma Registry was queried from 2001 to 2013 for pediatric trauma patients (<18 years). Burns, drowning, isolated head trauma, and older teens were excluded. Those who received massive transfusion (≥40 mL/kg total blood products in 24 hours) and early deaths who received any blood products were then evaluated. Primary outcomes were mortality at 24 hours and in-hospital. Secondary outcomes included blood product utilization over 24 hours, ventilator-free days, intensive care unit-free days, and hospital length of stay.

RESULTS: The Department of Defense Trauma Registry yielded 4,980 combat-injured pediatric trauma patients, of whom 364 met inclusion criteria. Analysis of PLAS/PRBC ratios across the entire spectrum of possible ratios in these patients demonstrated no clear inflection point for mortality. Using a division between low (LO) and high (HI) ratios of PLAS/PRBC 1:2, there was no difference in all-cause mortality at 24 hours (LO, 9.2% vs. HI, 8.0%; p = 0.75) and hospital discharge (LO, 21.5% vs. HI, 17.1%; p = 0.39). HI ratio patients received less PRBC but more PLAS and PLT and more total blood products. Those in the HI ratio group also had longer hospital length of stay. Regression analysis demonstrated no associated mortality benefit with a HI ratio (hazards ratio, 2.04; 95% confidence interval, 0.48-8.73; p = 0.34).

CONCLUSION: In combat-injured children undergoing a massive transfusion, a high ratio of PLAS/PRBC was not associated with improved survival. Further prospective studies should be performed to determine the optimal resuscitation strategy in critically injured pediatric patients.

LEVEL OF EVIDENCE: Therapeutic study, level III.

Aerosp Med Hum Perform. 2017 Aug 1;88(8):768-772.

Experiences with Regional Anesthesia for Analgesia During Prolonged Aeromedical Evacuation.

Carness JM, Wilson MA, Lenart MJ, Smith DE, Dukes SF

INTRODUCTION: There is much debate regarding the appropriate analgesic management of patients undergoing medical evacuation following combat trauma. Our primary objective was to review the utility of regional anesthetic techniques in patients undergoing aeromedical evacuation following surgical limb amputation as treatment for combat trauma.

METHODS: This study was conducted as an observational retrospective cohort whereby acutely injured amputee patients were identified via the U.S. Transportation Command's patient movement database. The Theater Medical Data Store was cross-referenced for additional patient care data including opioid consumption, duration of regional technique, pain scores, and rates of intubation.

RESULTS: Eighty-four records were retrieved from the Theater Medical Data Store. All 84 patients were victims of improvised explosive device detonation requiring limb amputation and subsequent transport from Kandahar Airfield or Camp Bastion, Afghanistan, to the United States. The majority of interventions remained in place throughout the evacuation process. A significant decrease in opioid consumption in patients receiving regional anesthesia was identified at each leg of the medical evacuation process. Pain scores were sporadically reported and not statistically different. Higher rates of intubation were identified in the nonregional anesthetic group.

DISCUSSION: Our analysis demonstrates the feasibility and effectiveness of applying regional anesthetic techniques for pain management to our combat wounded trauma patients throughout multiple stages of aeromedical evacuation. Benefits include the potential for less sedation and less opioid consumption while potentially foregoing the requirement for intubation during transport.

Wilderness Environ Med. 2017 Jun;28(2S):S124-S134.

Remote Damage Control Resuscitation in Austere Environments.

Chang R, Eastridge BJ, Holcomb JB

ABSTRACT:

Hemorrhage is the leading cause of preventable military and civilian trauma death. Damage control resuscitation with concomitant mechanical hemorrhage control has become the preferred in-hospital treatment of hemorrhagic shock. In particular, plasma-based resuscitation with decreased volumes of crystalloids and artificial colloids as part of damage control resuscitation has improved outcomes in the military and civilian sectors. However, translation of these principles and techniques to the prehospital, remote, and austere environments, known as remote damage control resuscitation, is challenging given the resource limitations in these settings. Rapid administration of tranexamic acid and reconstituted freeze-dried (lyophilized) plasma as early as the point of injury are feasible and likely beneficial, but comparative studies in the literature are lacking. Whole blood is likely the best fluid therapy for traumatic hemorrhagic shock, but logistical hurdles need to be addressed. Rapid control of external hemorrhage with hemostatic dressings and extremity tourniquets are proven therapies, but control of noncompressible hemorrhage (ie, torso hemorrhage) remains a significant challenge.

J Trauma Acute Care Surg. 2017 Jul;83(1):11-18.

Multicenter retrospective study of noncompressible torso hemorrhage: Anatomic locations of bleeding and comparison of endovascular versus open approach.

Chang R, Fox EE, Greene TJ, Eastridge BJ, Gilani R, Chung KK, DeSantis SM, DuBose JJ, Tomasek JS, Fortuna GR Jr, Sams VG, Todd SR, Podbielski JM, Wade CE, Holcomb JB; NCTH Study Group.

BACKGROUND: Rational development of technology for rapid control of noncompressible torso hemorrhage (NCTH) requires detailed understanding of what is bleeding. Our objectives were to describe the anatomic location of truncal bleeding in patients presenting with NCTH and compare endovascular (ENDO) management versus open (OPEN) management.

METHODS: This is a retrospective study of adult trauma patients with NCTH admitted to four urban Level I trauma centers in the Houston and San Antonio metropolitan areas in 2008 to 2012. Inclusion criteria include named axial torso vessel disruption, Abbreviated Injury Scale chest or abdomen score of 3 or higher with shock (base excess, <-4) or truncal operation in 90 minutes or less, or pelvic fracture with ring disruption. Exclusion criteria include isolated hip fractures, falls from standing, or prehospital cardiopulmonary resuscitation. After dichotomizing into OPEN, ENDO, and resuscitative thoracotomy (RT) groups based on the initial approach to control NCTH, a mixed-effects Poisson regression with robust error variance (controlling for age, mechanism, Injury Severity Score, shock, hypotension, and severe head injury as fixed effects and site as a random effect) was used to test the hypothesis that ENDO was associated with reduced in-hospital mortality in NCTH patients.

RESULTS: Five hundred forty-three patients with NCTH underwent ENDO (n = 166, 31%), OPEN (n = 309, 57%), or RT (n = 68, 12%). Anatomic bleeding locations were 25% chest, 41% abdomen, and 31% pelvis. ENDO was used to treat relatively few types of vascular injuries, whereas OPEN and RT injuries were more diverse. ENDO patients had more blunt trauma (95% vs. 34% vs. 32%); severe injuries (median Injury Severity Score, 34 vs. 27 vs. 21), and increased time to intervention (median, 298 vs. 92 vs. 51 minutes) compared with OPEN and RT. Mortality was 15% versus 20% versus 79%. ENDO was associated with decreased mortality compared to OPEN (relative risk, 0.58; 95% confidence interval, 0.46-0.73).

CONCLUSION: Although ENDO may reduce mortality in NCTH patients, significant group differences limit the generalizability of this finding.

LEVEL OF EVIDENCE: Therapeutic, level V.

Shock. 2017 Jun 6. Epub ahead of print

Plasma Resuscitation Improved Survival in a Cecal Ligation and Puncture Rat Model of Sepsis.

Chang R, Holcomb JB, Johansson PI, Pati S, Schreiber MA, Wade CE.

BACKGROUND: The paradigm shift from crystalloid to plasma resuscitation of traumatic hemorrhagic shock has improved patient outcomes due in part to plasma-mediated reversal of catecholamine and inflammation-induced endothelial injury, decreasing vascular permeability and attenuating organ injury. Since sepsis induces a similar endothelial injury as seen in hemorrhage, we hypothesized that plasma resuscitation would increase 48-hour survival in a rat sepsis model.

METHODS: Adult male Sprague-Dawley rats (375-425g) were subjected to 35% cecal ligation and puncture (CLP) (t=0h). Twenty-two hours post-CLP and prior to resuscitation (t=22h), animals were randomized to resuscitation with normal saline (NS, 10cc/kg/hr) or pooled rat fresh frozen plasma (FFP, 3.33cc/kg/hr). Resuscitation under general anesthesia proceeded for the next six hours (t=22h to t=28h); lactate was checked every 2hours, and fluid volumes were titrated based on lactate clearance. Blood samples were obtained before (t=22h) and after resuscitation (t=28h), and at death or study conclusion. Lung specimens were obtained for calculation of wet-to-dry weight ratio. Fisher's exact test was used to analyze the primary outcome of 48-hour survival. ANOVA with repeated measures was used to analyze the effect of FFP versus NS resuscitation on blood gas, electrolytes, blood urea nitrogen (BUN), creatinine, interleukin (IL)-6, IL-10, catecholamines, and syndecan-1 (marker for endothelial injury). A two-tailed alpha level of <0.05 was used for all statistical tests.

RESULTS: Thirty-three animals were studied: 14 FFP, 14 NS, and 5 sham. Post-CLP but pre-resuscitation (t=22h) variables between FFP and NS animals were similar and significantly deranged compared to sham animals. FFP significantly increased 48-hour survival compared to NS (n=8 [57%] vs n=2 [14%]), attenuated the post-resuscitation (t=28h) levels of epinephrine (mean 2.2 vs 7.0ng/ml), norepinephrine, (3.8 vs 8.9ng/ml), IL-6 (3.8 vs 18.7ng/ml), and syndecan-1 (21.8 vs 31.0ng/ml) (all p<0.05), improved the post-resuscitation PO2 to FiO2 ratio (353 vs 151), and reduced the pulmonary wet-to-dry weight ratio (5.28 vs 5.94) (all p<0.05).

CONCLUSION: Compared to crystalloid, plasma resuscitation increased 48-hour survival in a rat sepsis model, improved pulmonary function and decreased pulmonary edema, and attenuated markers for inflammation, endothelial injury, and catecholamines.

J Appl Physiol (1985). 2017 Jul 27: Epub ahead of print

Wearable Technology for Compensatory Reserve to Sense Hypovolemia.

Convertino VA, Sawka MN

ABSTRACT:

Traditional monitoring technologies fail to provide accurate or early indications of hypovolemia-mediated extremis because physiological systems (as measured by vital signs) effectively compensate until circulatory failure occurs. Hypovolemia is the most life-threatening physiological condition associated with circulatory shock in hemorrhage or sepsis, and it impairs one's ability to sustain physical exertion during heat stress. This review focuses on the physiology underlying the development of a novel non-invasive wearable technology that allows for real-time evaluation of the cardiovascular system's ability to compensate to hypovolemia, or its compensatory reserve, which provides an individualized estimate of impending circulatory collapse. Compensatory reserve is assessed by real-time changes (sampled millions of times per second) in specific features (hundreds of features) of arterial waveform analog signals that can be obtained from photoplethysmography using machine-learning and feature extraction techniques. Extensive experimental evidence employing acute reductions in central blood volume (using lower body negative pressure, blood withdrawal, heat stress, dehydration) demonstrate that compensatory reserve provides the best indicator for early and accurate assessment for compromises in blood pressure, tissue perfusion and oxygenation in resting human subjects. Engineering challenges exist for the development of a ruggedized wearable system that can measure signals from multiple sites, and be customized for use in austere conditions (e.g., battlefield, patient transport) and be worn during strenuous physical activity.

J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S57-S65

Measuring the compensatory reserve to identify shock.

Convertino VA, Schiller AM

CONCLUSION:

Continued execution of clinical trials will prove critical to the continued development and acceptance of the medical community of the measurement of the compensatory reserve as a standard of care in patients. After FDA clearance, perhaps the most significant future application of compensatory reserve monitoringwill be realized with the placement of the technology in military and civilian prehospital settings where the potential exists to reduce preventable deaths with an early diagnosis of impending shock and triage decision support. Such application has been demonstrated by the Israeli Defense Force's current use of real-time compensatory reserve monitoring in a prospective study of patients with hemorrhage admitted to the ED in which a superior capability to detect hemorrhage and accurately assess the effectiveness of RBC transfusion was demonstrated with measures of the compensatory reserve when compared with conventional vital signs.66 Additionally, Israeli Defense Force clinicians are using compensatory reserve monitoring to assist triage decision support during helicopter transports of trauma patients (unpublished). However, waiting for further clinical data does not detract from the compelling evidence that continuous, real-time measurement of arterial waveform features represents the most sensitive and specific metric of patient status during hemorrhage and resuscitation in states of compromised tissue oxygenation. The capability of medical monitoring that provides continuous measures of compensatory reserve for early identification of shock and guidance for accurate resuscitation without requiring a baseline reference while learning the status of each patient is unprecedented in emergency medical care.

J Trauma Nurs. 2017 May/Jun;24(3):203-207.

Tourniquets in Trauma Care: A Review of Application.

Cornelius B, Campbell R, McGauly P

ABSTRACT:

Traumatic hemorrhage has been identified as the leading cause of battlefield death in recent conflicts. Although injury patterns are not directly reproducible to the civilian world, treatment advancements can be used to provide care to patients worldwide. Long-standing dogma regarding the use of tourniquets has been disproved, and there is now recognition of the critical role that tourniquets play in trauma care. The history and evolution of tourniquets, including the identification of previous faults in application, will lead to an examination of the current devices in use along with evidence-based recommendations for use. A review of ongoing programs to reduce hemorrhage as a cause of death in civilian and law enforcement medicine promotes the application analysis. Tourniquets, as simple technology, have the potential to save many lives through appropriate use, but preconceived myths and notions have limited its use to combat medicine. An increase in utilization could have a much greater impact in areas other than combat.

J Spec Oper Med. Summer 2017;17(2):74-81.

The Sole Provider: Preparation for Deployment to a Medically Austere Theater.

Corso P, Mandry C, Reynolds S

ABSTRACT:

The combat focus of the US Military over the past 15 years has primarily centered on the Iraq and Afghanistan areas of operation (AOs). Thus, much human and financial capital has been dedicated to the creation of a robust medical infrastructure to support those operations. However, Special Operation Forces (SOF) are often called upon to deploy in much more medically austere AOs. SOF medical providers operating in such environments face significant challenges due to the diversity of medical threats, extremely limited access to medical resupply, a material shortage of casualty evacuation platforms, lack of medical facilities, and limited access to higher-level care providers. This article highlights the challenges faced during a recent Special Forces deployment to such an austere environment. Many of these challenges can be mitigated with a specific approach to premission training and preparation.

J Trauma Acute Care Surg. 2017 Jun;82(6):1030-1038

Pelvic fracture pattern predicts the need for hemorrhage control intervention- Results of an AAST multi-institutional study.

Costantini TW, Coimbra R, Holcomb JB, Podbielski JM, Catalano RD, Blackburn A, Scalea TM, Stein DM, Williams L, Conflitti J, Keeney S, Hoey C, Zhou T, Sperry J, Skiada D, Inaba K, Williams BH, Minei JP, Privette A, Mackersie RC, Robinson BR, Moore FO; AAST Pelvic Fracture Study Group.

BACKGROUND: Early identification of patients with pelvic fractures at risk of severe bleeding requiring intervention is critical. We performed a multi-institutional study to test our hypothesis that pelvic fracture patterns predict the need for a pelvic hemorrhage control intervention.

METHODS: This prospective, observational, multicenter study enrolled patients with pelvic fracture due to blunt trauma. Inclusion criteria included shock on admission (systolic blood pressure <90 mm Hg or heart rate >120 beats/min and base deficit >5, and the ability to review pelvic imaging). Demographic data, open pelvic fracture, blood transfusion, pelvic hemorrhage control intervention (angioembolization, external fixator, pelvic packing, and/or REBOA [resuscitative balloon occlusion of the aorta]), and mortality were recorded. Pelvic fracture pattern was classified according to Young-Burgess in a blinded fashion. Predictors of pelvic hemorrhage control intervention and mortality were analyzed by univariate and multivariate regression analyses.

RESULTS: A total of 163 patients presenting in shock were enrolled from 11 Level I trauma centers. The most common pelvic fracture pattern was lateral compression I, followed by lateral compression I and vertical shear. Of the 12 patients with an anterior-posterior compression III fracture, 10 (83%) required a pelvic hemorrhage control intervention. Factors associated with the need for pelvic fracture hemorrhage control intervention on univariate analysis included vertical shear pelvic fracture pattern, increasing age, and transfusion of blood products. Anterior-posterior compression III fracture patterns and open pelvic fracture predicted the need for pelvic hemorrhage control intervention on multivariate analysis. Overall in-hospital mortality for patients admitted in shock with pelvic fracture was 30% and did not differ based on pelvic fracture pattern on multivariate analysis.

CONCLUSION: Blunt trauma patients admitted in shock with anterior-posterior compression III fracture patterns or patients with open pelvic fracture are at greatest risk of bleeding requiring pelvic hemorrhage control intervention.

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

J Trauma Acute Care Surg. 2017 Jun;82(6):1138-1146.

Whole blood transfusion closest to the point-of-injury during French remote military operations.

Daniel Y, Sailliol A, Pouget T, Peyrefitte S, Ausset S, Martinaud C.

ABSTRACT:

To improve the survival of combat casualties, interest in the earliest resort to whole blood (WB) transfusion on the battlefield has been emphasized. Providing volume, coagulation factors, plasma, and oxygenation capacity, WB appears actually as an ideal product severe trauma management. Whole blood can be collected in advance and stored for subsequent use, or can be drawn directly on the battlefield, once a soldier is wounded, from an uninjured companion and immediately transfused.Such concepts require a great control of risks at each step, especially regarding ABO mismatches, and transfusion-transmitted diseases. We present here the "warm and fresh" WB field transfusion program implemented among the French armed forces. We focus on the followed strategies to make it applicable on the battlefield, even during special operations and remote settings, and safe for recipients as well as for donors.

Vox Sang. 2017 Aug;112(6):557-566.

Prehospital parameters can help to predict coagulopathy and massive transfusion in trauma patients.

David JS, Voiglio EJ, Cesareo E, Vassal O, Decullier E, Gueugniaud PY, Peyrefitte S, Tazarourte K

BACKGROUND: This study aimed to evaluate the accuracy of prehospital parameters, including vital signs and resuscitation (fluids, vasopressor), to predict trauma-induced coagulopathy (TIC, fibrinogen <1·5 g/l or PTratio > 1·5 or platelet count <100 × 10(9) /l), and a massive transfusion (MT, ≥10 RBC units within the first 24 h).

METHODS: From a trauma registry (2011-2015), in which patients are prospectively included, we retrospectively retrieved the heart rate (HR), systolic bloodpressure (SBP), volume of prehospital fluids and administration of noradrenaline. We calculated the shock index (SI: HR/SBP), the MGAP prehospital triage score and the Injury Severity Score (ISS). We also identified patients who had positive criteria from the Resuscitation Outcome Consortium (ROC, SBP < 70 mmHg or SBP 70-90 and HR > 107 pulse/min). For these parameters, we drew a ROC curve and defined a cut-off value to predict TIC or MT. The strength of association between prehospital parameters and TIC as well as MT was assessed using logistic regression, and cut-off values were determined using ROC curves.

RESULTS: Among the 485 patients included in the study, TIC was observed in 112 patients (23%) and MT in 22 patients (5%). For the prediction of TIC, ISS had good accuracy (AUC: 0·844, 95% confidence interval, CI: 0·799-0·879), as did the volume of fluids (>1000 ml) given during prehospital care (AUC: 0·801, 95% CI: 0·752-0·842). For the prediction of MT, ISS had excellent accuracy (AUC: 0·932, 95% CI: 0·866-0·966), whereas good accuracy was found for SI (> 0·9; AUC: 0·859, 95% CI: 0·705-0·936), vasopressor administration (AUC: 0·828, 95% CI: 0·736-0·890) and fluids (>1000 ml; AUC: 0·811, 95% CI: 0·737-0·867). Vasopressor administration, ISS and SI were independent predictors of TIC and MT, whereas fluid volume and ROC criteria were independent predictor of TIC but not MT. No independent relationship was found between MGAP and TIC or MT.

CONCLUSIONS: Prehospital parameters including the SI and resuscitation may help to better identify the severity of bleeding in trauma patients and the need for blood product administration at admission.

J Trauma Acute Care Surg. 2017 Jul;83(1):139-143.

Incremental balloon deflation following complete resuscitative endovascular balloon occlusion of the aorta results in steep inflection of flow and rapid reperfusion in a large animal model of hemorrhagic shock.

Davidson AJ, Russo RM, Ferencz SE, Cannon JW, Rasmussen TE, Neff LP, Johnson MA, Williams TK.

INTRODUCTION: To avoid potential cardiovascular collapse after resuscitative endovascular balloon occlusion of the aorta (REBOA), current guidelines recommend methodically deflating the balloon for 5 minutes to gradually reperfuse distal tissue beds. However, anecdotal evidence suggests that this approach may still result in unpredictable aortic flow rates and hemodynamic instability. We sought to characterize aortic flow dynamics following REBOA as the balloon is deflated in accordance with current practice guidelines.

METHODS: Eight Yorkshire-cross swine were splenectomized, instrumented, and subjected to rapid 25% total blood volume hemorrhage. After 30 minutes of shock, animals received 60 minutes of Zone 1 REBOA with a low-profile REBOA catheter. During subsequent resuscitation with shed blood, the aortic occlusion balloon was gradually deflated in stepwise fashion at the rate of 0.5 mL every 30 seconds until completely deflated. Aortic flow rate and proximal mean arterial pressure (MAP) were measured continuously over the period of balloon deflation.

RESULTS: Graded balloon deflation resulted in variable initial return of aortic flow (median, 78 seconds; interquartile range [IQR], 68-105 seconds). A rapid increase in aortic flow during a single-balloon deflation step was observed in all animals (median, 819 mL/min; IQR, 664-1241 mL/min) and corresponded with an immediate decrease in proximal MAP (median, 30 mm Hg; IQR, 14.5-37 mm Hg). Total balloon volume and time to return of flow demonstrated no correlation ($r = 0.016$).

CONCLUSION: This study is the first to characterize aortic flow during balloon deflation following REBOA. A steep inflection point occurs during balloon deflation that results in an abrupt increase in aortic flow and a concomitant decrease in MAP. Furthermore, the onset of distal aortic flow was inconsistent across study animals and did not correlate with initial balloon volume or relative deflation volume. Future studies to define the factors that affect aortic flow during balloon deflation are needed to facilitate controlled reperfusion following REBOA.

J Neurosci Res. 2017 Jul 25. Epub ahead of print

Different resuscitation strategies and novel pharmacologic treatment with valproic acid in traumatic brain injury.

Dekker SE, Nikolian VC, Sillesen M, Bambakidis T, Schober P, Alam HB

ABSTRACT:

Traumatic brain injury (TBI) is a leading cause of death in young adults, and effective treatment strategies have the potential to save many lives. TBI results in coagulopathy, endothelial dysfunction, inflammation, cell death, and impaired epigenetic homeostasis, ultimately leading to morbidity and/or mortality. Commonly used resuscitation fluids such as crystalloids or colloids have several disadvantages and might even be harmful when administered in large quantities. There is a need for next-generation treatment strategies (especially in the prehospital setting) that minimize cellular damage, improve survival, and enhance neurological recovery. Pharmacologic treatment with histone deacetylase inhibitors, such as valproic acid, has shown promising results in animal studies of TBI and may therefore be an excellent example of next-generation therapy. This review briefly describes traditional resuscitation strategies for TBI combined with hemorrhagic shock and describes preclinical studies on valproic acid as a new pharmacologic agent in the treatment of TBI. It finally discusses limitations and future directions on the use of histone deacetylase inhibitors for the treatment of TBI.

Prehosp Emerg Care. 2017 Sep-Oct;21(5):539-544.

Prehospital Intubation is Associated with Favorable Outcomes and Lower Mortality in ProTECT III.

Denninghoff KR, Nuño T, Pauls Q, Yeatts SD, Silbergleit R, Palesch YY, Merck LH, Manley GT, Wright DW.

OBJECTIVE: Traumatic brain injury (TBI) causes more than 2.5 million emergency department visits, hospitalizations, or deaths annually. Prehospital endotracheal intubation has been associated with poor outcomes in patients with TBI in several retrospective observational studies. We evaluated the relationship between prehospital intubation, functional outcomes, and mortality using high quality data on clinical practice collected prospectively during a randomized multicenter clinical trial.

METHODS: ProTECT III was a multicenter randomized, double-blind, placebo-controlled trial of early administration of progesterone in 882 patients with acute moderate to severe nonpenetrating TBI. Patients were excluded if they had an index GCS of 3 and nonreactive pupils, those with withdrawal of life support on arrival, and if they had documented prolonged hypotension and/or hypoxia. Prehospital intubation was performed as per local clinical protocol in each participating EMS system. Models for favorable outcome and mortality included prehospital intubation, method of transport, index GCS, age, race, and ethnicity as independent variables. Significance was set at $\alpha = 0.05$. Favorable outcome was defined by a stratified dichotomy of the GOS-E scores in which the definition of favorable outcome depended on the severity of the initial injury.

RESULTS: Favorable outcome was more frequent in the 349 subjects with prehospital intubation (57.3%) than in the other 533 patients (46.0%, $p = 0.003$). Mortality was also lower in the prehospital intubation group (13.8% v. 19.5%, $p = 0.03$). Logistic regression analysis of prehospital intubation and mortality, adjusted for index GCS, showed that odds of dying for those with prehospital intubation were 47% lower than for those that were not intubated (OR = 0.53, 95% CI = 0.36-0.78). 279 patients with prehospital intubation were transported by air. Modeling transport method and mortality, adjusted for index GCS, showed increased odds of dying in those transported by ground compared to those transported by air (OR = 2.10, 95% CI = 1.40-3.15). Decreased odds of dying trended among those with prehospital intubation adjusted for transport method, index GCS score at randomization, age, and race/ethnicity (OR = 0.70, 95% CI = 0.37-1.31).

CONCLUSIONS: In this study that excluded moribund patients, prehospital intubation was performed primarily in patients transported by air. Prehospital intubation and air medical transport together were associated with favorable outcomes and lower mortality. Prehospital intubation was not associated with increased morbidity or mortality regardless of transport method or severity of injury.

J Trauma Acute Care Surg. 2017 Jun;82(6):1080-1086.

Early tranexamic acid administration ameliorates the endotheliopathy of trauma and shock in an in vitro model.

Diebel LN, Martin JV, Liberati DM

BACKGROUND: Systemic vascular endothelial injury is a consequence of trauma (T)/hemorrhagic shock (HS) which results in disturbances of coagulation, inflammation, and endothelial barrier integrity. The effect of T/HS on the endothelium (endotheliopathy of trauma [EoT]) is of intense research interest and may lead to EoT-directed therapies. Administration of tranexamic acid (TXA) in trauma patients is associated with a survival benefit and fewer complications if given early after injury. Mechanisms for this protective effect include the antifibrinolytic and anti-inflammatory effects of TXA. We hypothesized that "early" administration of TXA would abrogate vascular endothelial cell activation and injury after T/HS. This was studied in vitro.

METHODS: Confluent human umbilical vein endothelial cells were exposed to hydrogen peroxide and/or epinephrine to stimulate post-T/HS oxidant exposure and/or sympathoadrenal activation. TXA was added 15 minutes, 60 minutes, or 120 minutes after H2O2 and/or epinephrine challenge. Endothelial cell injury was indexed by cell monolayer permeability, intracellular adhesion molecule expression, soluble thrombomodulin, syndecan release (marker for glycocalyx injury), tissue type plasminogen activator (tPA), plasminogen activator inhibitor-1 (PAI-1) and angiopoietin-2/angiopoietin-1 ratio (APO-2/APO-1).

RESULTS: Endothelial activation and injury as indexed by permeability, ICAM expression, soluble thrombomodulin were increased by H2O2 and/or epinephrine exposure. Biomarkers of endothelial coagulation profile (tPA/PAI-1) demonstrated a profibrinolytic profile (increased tPA and tPA/PAI-1 ratio) after challenge by H2O2 and/or epinephrine. Vascular "leakiness" as indexed by APO-2/APO-1 ratio was also evident. The most profound effects were noted with H2O2/epinephrine exposure. TXA administration within 60 minutes of H2O2/epinephrine challenge abolished the adverse effects noted on the endothelial-glycocalyx "double barrier." TXA administration after 60 minutes was not protective.

CONCLUSION: Antifibrinolytic and other protective effects of TXA administration on endothelial injury are time-dependent. This study supports the concept that the clinical efficacy of TXA administration requires "early administration."

Ulus Travma Acil Cerrahi Derg. 2017 Jul;23(4):287-293.

Comparison of warm fluid and cold fluid resuscitation during uncontrolled hemorrhagic shock model in rats.

Dilmen S, Eryılmaz M, Balkan SM, Serdar M, Durusu M, Yıldırım AO, Dilmen SA.

BACKGROUND: This study was designed to compare the effects of resuscitation with cold and warm fluid on survival time, rate and volume of hemorrhage, hemodynamics, hypothermia, coagulopathy, acid-base balance, hematocrit, lactate, and base deficit during uncontrolled hemorrhagic shock (HS) model in rats.

METHODS: HS model was created with splenic vascular and parenchymal injury in 29 rats under ketamine and xylazine anesthesia. Thirty minutes after the hemorrhage, the rats were randomized to receive 14.5 mL/kg 0.9% sodium chloride solution at either 24ºC (Group 1; n=9) or 4ºC (Group 2; n=10) for 20 minutes. Groups 1 and 2 were compared with group that did not receive fluid (Group 3; n=10). Statistical data were represented as mean±SD. SPSS for Windows, Version 15.0 (SPSS, Inc., Chicago, IL, USA) software, Bonferroni-adjusted Mann-Whitney U test and Kaplan-Meier procedure were used to perform statistical data analysis. P value of ≤0.05 was considered statistically significant.

RESULTS: Cold fluid resuscitation decreased survival time due to increased rate and volume of hemorrhage, acidosis, hypothermia, lactate, and base deficit and decreased blood pressure and hematocrit.

CONCLUSION: There is a great need for further experimental and clinical trials on fluid resuscitation in trauma in order to define which fluid should be administered, temperature of the fluid, quantity to be delivered, and duration.

J Trauma Acute Care Surg. 2017 Jul;83(1):197-199.

How I do it: Partial resuscitative endovascular balloon occlusion of the aorta (P-REBOA).

DuBose JJ

Quote:

“Complete Total Occlusion vs. Early Partial REBOA

How long balloon occlusion can be obtained is not well known. It is recommended that 30 minutes for Zone 1 and 60 minutes for Zone 3 should be considered the reasonable upper ranges in this regard, but this particular element of use has not been definitively studied. I would suggest that once the balloon is inflated, expedient movement to a location where definitive control of bleeding can be obtained be undertaken—be that the operating room or potentially, the interventional suite for pelvic bleeding. Every effort should be made to move toward addressing hemorrhagic sources expediently so that the aortic occlusion and subsequent ischemic burden can be relieved expeditiously. In my own practice, I use early P-REBOA as a standard approach. 6 (http://links.lww.com/TA/A922). To achieve this goal, I start to come down slightly on the balloon at 10 minutes. This 10-minute period allows resuscitation to be initiated and permits distal clot formation. Slight deflation of the balloon at 10 minutes in a controlled fashion—in patients who tolerate it—then allows me to maintain a normotensive resuscitation above the balloon and a hypotensive resuscitative state below the balloon.

To most effectively achieve P-REBOAmeasuring of distal arterial pressure below the balloon should be used. This can be done in a variety of ways, but I prefer to place the ER-REBOA with a slightly larger 8 Fr sheath to facilitate distal arterial pressure measurement. To achieve the very slight amount of balloon deflation required to introduce distal arterial flow, I use a threeway stopcock and a 3-cm3 or 5-cm3 syringe to more precisely control deflation. I remove the smallest amount of fluid (in my experience, <1 cm3 typically) required to observe a minimal arterial waveform below the balloon. The accompanying video outlines this approach. When the clinical situation affords the use of P-REBOA, the brain and heart remain optimally perfused, and overpressure above the balloon is avoided. Below the balloon, the lower range of pressure and low-grade arterial flow around the balloon minimize total ischemic time, potentially mitigate reperfusion injury, and extend my duration of intervention.”

Can J Anaesth. 2017 Jul 11.

Front-of-neck airway meets front-of-neck simulation: improving cricothyroidotomy skills using a novel open-access three-dimensional model and the Airway App.

Duggan LV, Lockhart SL, Romano KR, Weingart SD, Levitan RM, Brindley PG

QUOTES:

“Although anesthesiologists, intensivists, and emergency physicians rarely perform cricothyroidotomy, these specialists must maintain the knowledge, decisionmaking, and procedural skill sets to perform cricothyroidotomy quickly and safely.”

“Inspired by the lecture given by Dr. Ciaran McKenna, we created a three-dimensional (3D) cricothyroidotomy model based on the original 3D anatomic program from The University of Dundee and BodyParts 3D: The Database Center for Life Science Computer Science departments. To achieve the realism of performing cricothyrotomy on a real person, the authors conceptualized modifications to enable this model to be fitted on the neck of a real person.”

“We are pleased to provide our 3Dprintable cricothyrotomy file as a free-of-charge download on our website (www.airwaycollaboration.org). We encourage readers to print their own 3D model. We also encourage readers, should they perform an emergency cricothyrotomy, to share their experiences anonymously on the Airway App 5 (available free of charge from the Apple App Store or Googleplay) so others can learn from their experiences. Of note, we have not yet confirmed that the above approach improves performance or saves lives. The first step, of course, is to receive feedback, with our next steps focused on studying whether this type of training can change proficiency in technical and non-technical cricothyriodotomy skills. Regardless of the eventual technique or teaching model, we believe that something as important as cricothyroidotomy is too important to be left to chance.”

Transfusion. 2017 Aug;57(8):1879-1884.

Safety of the use of group A plasma in trauma: the STAT study.

Dunbar NM, Yazer MH; Biomedical Excellence for Safer Transfusion (BEST) Collaborative and the STAT Study Investigators.

BACKGROUND: Use of universally ABO-compatible group AB plasma for trauma resuscitation can be challenging due to supply limitations. Many centers are now using group A plasma during the initial resuscitation of traumatically injured patients. This study was undertaken to evaluate the impact of this practice on mortality and hospital length of stay (LOS).

STUDY DESIGN AND METHODS: Seventeen trauma centers using group A plasma in trauma patients of unknown ABO group participated in this study. Eligible patients were group A, B, and AB trauma patients who received at least 1 unit of group A plasma. Data collected included patient sex, age, mechanism of injury, Trauma Injury Severity Score (TRISS) probability of survival, and number of blood products transfused. The main outcome of this study was in-hospital mortality differences between group B and AB patients compared to group A patients. Data on early mortality (≤24 hr) and hospital LOS were also collected.

RESULTS: There were 354 B and AB patients and 809 A patients. The two study groups were comparable in terms of age, sex, TRISS probability of survival, and total number of blood products transfused. The use of group A plasma during the initial resuscitation of traumatically injured patients of unknown ABO group was not associated with increased in-hospital mortality, early mortality, or hospital LOS for group B and AB patients compared to group A patients.

CONCLUSION: These results support the practice of issuing thawed group A plasma for the initial resuscitation of trauma patients of unknown ABO group.

J Spec Oper Med. Summer 2017;17(2):65-73.

The Role I Resuscitation Team and Resuscitative Endovascular Balloon Occlusion of the Aorta.

Fisher AD, Teeter WA, Cordova CB, Brenner ML, Szczepanski MP, Miles EA, Galante JM, DuBose JJ, Rasmussen TE.

ABSTRACT:

The medical advancements made during the wars in Iraq and Afghanistan have resulted in an unprecedented survival rate, yet there is still a significant number of deaths that were potentially survivable. Additionally, the ability to deliver casualties to definitive surgical care within the "golden hour" is diminishing in many areas of conflict. Resuscitative endovascular balloon occlusion of the aorta (REBOA) has been implemented successfully in the hospital setting. REBOA may be a possible adjunct for the Role I and point-of-injury (POI) care to provide temporary control of noncompressible torso hemorrhage (NCTH) and junctional hemorrhage. Here the authors advocate for the development of the Role I Resuscitation Team (RT) and a training pathway to meet the challenge of the changing battlefield.

Emerg Med Australas. 2017 Aug;29(4):444-449. Epub 2017 Jun 14.

Pelvic trauma mortality reduced by integrated trauma care.

Fitzgerald M, Esser M, Russ M, Mathew J, Varma D, Wilkinson A, Mannambeth RV, Smit D, Bernard S, Mitra B

OBJECTIVES: A multidisciplinary approach that emphasised improved triage, early pelvic binder application, early administration of blood and blood products, adherence to algorithmic pathways, screening with focused sonography (FAST), early computed tomography scanning with contrast angiography, angio-embolisation and early operative intervention by specialist pelvic surgeons was implemented in the last decade to improve outcomes after pelvic trauma. The manuscript evaluated the effect of this multi-faceted change over a 12-year period.

METHODS: A retrospective cohort study was conducted comparing patients presenting with serious pelvic injury in 2002 to those presenting in 2013. The primary exposure and comparator variables were the year of presentation and the primary outcome variable was mortality at hospital discharge. Potential confounders were evaluated using multivariable logistic regression analysis.

RESULTS: There were 1213 patients with a serious pelvic injury (Abbreviated Injury Scale ≥3), increasing from 51 in 2002 to 156 in 2013. Demographics, injury severity and presenting clinical characteristics were similar between the two time periods. There was a statistically significant difference in mortality from 20% in 2002 to 7.7% in 2013 (P = 0.02). The association between the primary exposure variable of being injured in 2013 and mortality remained statistically significant (adjusted odds ratio 0.10; 95% confidence interval: 0.02-0.60) when adjusted for potential clinically important confounders.

CONCLUSIONS: Multi-faceted interventions directed at the spectrum of trauma resuscitation from pre-hospital care to definitive surgical management were associated with significant reduction in mortality of patients with severe pelvic injury from 2002 to 2013. This demonstrates the effectiveness of an integrated, inclusive trauma system in achieving improved outcomes.

J Trauma Acute Care Surg. 2017 Jul 12.

VENOUS THROMBOEMBOLISM AFTER MAJOR VENOUS INJURIES: COMPETING PRIORITIES.

Frank B, Maher Z, Hazelton JP, Resnick S, Dauer E, Goldenberg A, Lubitz AL, Smith BP, Saillant NN, Reilly PM, Seamon MJ.

BACKGROUND: Venous thromboembolism (VTE) after major vascular injury (MVI) is particularly challenging as the competing risk of thrombosis and embolization after direct vessel injury must be balanced with risk of bleeding after surgical repair. We hypothesized that venous injuries, repair type and intraoperative anticoagulation would influence VTE formation after MVI.

METHODS: A multi-institution, retrospective cohort study of consecutive MVI patients was conducted at 3 urban, level-I centers (2005-2013). Patients with MVI of the neck, torso, or proximal extremities (to elbows/knees) were included. Our primary study endpoint was the development of VTE (DVT or PE).

RESULTS: The 435 MVI patients were primarily young (27 years) males (89%) with penetrating (84%) injuries. When patients with (n=108) and without (n=327) VTE were compared, we observed no difference in age, mechanism, extremity injury, tourniquet use, orthopedic and spine injuries, damage control, local heparinized saline or vascular surgery consultation (all $p>0.05$). VTE patients had greater ISS (17 vs. 12), shock indices (1 vs. 0.9), and more torso (58% vs. 35%) and venous (73% vs. 48%) injuries, but less often received systemic intraoperative anticoagulation (39% vs. 53%) or postoperative enoxaparin (47% vs. 61%) prophylaxis (all $p<0.05$). After controlling for ISS, hemodynamics, injured vessel, intraoperative anticoagulation and postoperative prophylaxis, multivariable analysis revealed venous injury was independently predictive of VTE (OR 2.7, $p=0.002$). Multivariable analysis of the venous injuries subset (n=237) then determined that only delay in starting VTE chemoprophylaxis (OR 1.3/day, $p=0.013$) independently predicted VTE after controlling for ISS, hemodynamics, injured vessel, surgical subspecialty, intraoperative anticoagulation and postoperative prophylaxis. Overall, 3.4% of venous injury patients developed PE, but PE rates were not related to their operative management ($p=0.72$).

CONCLUSIONS: Patients with major venous injuries are at high-risk for VTE, regardless of intraoperative management. Our results support the immediate initiation of postoperative chemoprophylaxis in patients with major venous injuries.

LEVEL OF EVIDENCE: Therapeutic/Care Management, Level III.

Prehosp Emerg Care. 2017 Sep-Oct;21(5):575-582

Body Temperature after EMS Transport: Association with Traumatic Brain Injury Outcomes.

Gaither JB, Chikani V, Stolz U, Viscusi C, Denninghoff K, Barnhart B, Mullins T, Rice AD, Mhayamaguru M, Smith JJ, Keim SM, Bobrow BJ, Spaite DW

INTRODUCTION: Low body temperatures following prehospital transport are associated with poor outcomes in patients with traumatic brain injury (TBI). However, a minimal amount is known about potential associations across a range of temperatures obtained immediately after prehospital transport. Furthermore, a minimal amount is known about the influence of body temperature on non-mortality outcomes. The purpose of this study was to assess the correlation between temperatures obtained immediately following prehospital transport and TBI outcomes across the entire range of temperatures.

METHODS: This retrospective observational study included all moderate/severe TBI cases (CDC Barell Matrix Type 1) in the pre-implementation cohort of the Excellence in Prehospital Injury Care (EPIC) TBI Study (NIH/NINDS: 1R01NS071049). Cases were compared across four cohorts of initial trauma center temperature (ITCT): <35.0°C [Very Low Temperature (VLT)]; 35.0-35.9°C [Low Temperature (LT)]; 36.0-37.9°C [Normal Temperature (NT)]; and ≥38.0°C [Elevated Temperature (ET)]. Multivariable analysis was performed adjusting for injury severity score, age, sex, race, ethnicity, blunt/penetrating trauma, and payment source. Adjusted odds ratios (aORs) with 95% confidence intervals (CI) for mortality were calculated. To evaluate non-mortality outcomes, deaths were excluded and the adjusted median increase in hospital length of stay (LOS), ICU LOS and total hospital charges were calculated for each ITCT group and compared to the NT group.

RESULTS: 22,925 cases were identified and cases with interfacility transfer (7361, 32%), no EMS transport (1213, 5%), missing ITCT (2083, 9%), or missing demographic data (391, 2%) were excluded. Within this study cohort the aORs for death (compared to the NT group) were 2.41 (CI: 1.83-3.17) for VLT, 1.62 (CI: 1.37-1.93) for LT, and 1.86 (CI: 1.52-3.00) for ET. Similarly, trauma center (TC) LOS, ICU LOS, and total TC charges increased in all temperature groups when compared to NT.

CONCLUSION: In this large, statewide study of major TBI, both ETs and LTs immediately following prehospital transport were independently associated with higher mortality and with increased TC LOS, ICU LOS, and total TC charges. Further study is needed to identify the causes of abnormal body temperature during the prehospital interval and if in-field measures to prevent temperature variations might improve outcomes.

J Trauma Acute Care Surg. 2017 Jun 6. Epub ahead of print

Outcomes Following Concomitant Traumatic Brain Injury and Hemorrhagic Shock: A Secondary Analysis from the PROPPR Trial.

Galvagno SM Jr, Fox EE, Appana SN, Baraniuk S, Bosarge PL, Bulger EM, Callcut RA, Cotton BA, Goodman M, Inaba K, O'Keeffe T, Schreiber MA, Wade CE, Scalea TM, Holcomb JB, Stein DM.

BACKGROUND: Often the clinician is faced with a diagnostic and therapeutic dilemma in patients with concomitant traumatic brain injury (TBI) and hemorrhagic shock (HS), as rapid deterioration from either can be fatal. Knowledge about outcomes following concomitant TBI and HS may help prioritize the emergent management of these patients. We hypothesized that patients with concomitant TBI and HS (TBI+HS) had worse outcomes and required more intensive care compared to patients with only one of these injuries.

METHODS: This is a post-hoc analysis of the Pragmatic, Randomized Optimal Platelets and Plasma Ratios (PROPPR) trial. TBI was defined by a head abbreviated injury scale >2. HS was defined as a base excess ≤ -4 and/or shock index ≥ 0.9. The primary outcome for this analysis was mortality at 30 days. Logistic regression, using generalized estimating equations (GEE), was used to model categorical outcomes.

RESULTS: 670 patients were included. Patients with TBI+HS had significantly higher lactate (median 6.3; IQR 4.7,9.2) compared to the TBI group (median 3.3; IQR 2.3,4). TBI+HS patients had higher activated prothrombin times and lower platelet counts. Unadjusted mortality was higher in the TBI+HS (51.6%) and TBI (50%) groups compared to the HS (17.5%) and neither group (7.7%). Adjusted odds of death in the TBI and TBI+HS groups were 8.2 (95% CI, 3.4-19.5) and 10.6 (95% CI, 4.8-23.2) times higher, respectively. Ventilator, ICU- and hospital-free days were lower in the TBI and TBI+HS groups compared to the other groups. Patients with TBI+HS or TBI had significantly greater odds of developing a respiratory complication compared to the neither group.

CONCLUSIONS: The addition of TBI to HS is associated with worse coagulopathy prior to resuscitation, and increased mortality. When conrolling for multiple known confounders, the diagnosis of TBI alone or TBI+HS was associated with significantly greater odds of developing respiratory complications.

STUDY TYPE: prognostic study LEVEL OF EVIDENCE: II.

J Neurotrauma. 2017 Jul 1;34(13):2167-2175.

Resuscitation with Lyophilized Plasma Is Safe and Improves Neurological Recovery in a Long-Term Survival Model of Swine Subjected to Traumatic Brain Injury, Hemorrhagic Shock, and Polytrauma.

Georgoff PE, Nikolian VC, Halaweish I, Chtraklin K, Bruhn PJ, Eidy H, Rasmussen M, Li Y, Srinivasan A, Alam HB

ABSTRACT:

We have shown previously that fresh frozen plasma (FFP) and lyophilized plasma (LP) decrease brain lesion size and improve neurological recovery in a swine model of traumatic brain injury (TBI) and hemorrhagic shock (HS). In this study, we examine whether these findings can be validated in a clinically relevant model of severe TBI, HS, and polytrauma. Female Yorkshire swine were subjected to TBI (controlled cortical impact), hemorrhage (40% volume), grade III liver and splenic injuries, rib fracture, and rectus abdominis crush. The animals were maintained in a state of shock (mean arterial pressure 30-35 mm Hg) for 2 h, and then randomized to resuscitation with normal saline (NS), FFP, or LP (n = 5 swine/group). Animals were recovered and monitored for 30 d, during which time neurological recovery was assessed. Brain lesion sizes were measured via magnetic resonance imaging (MRI) on post-injury days (PID) three and 10. Animals were euthanized on PID 30. The severity of shock and response to resuscitation was similar in all groups. When compared with NS-treated animals, plasma-treated animals (FFP and LP) had significantly lower neurologic severity scores (PID 1-7) and a faster return to baseline neurological function. There was no significant difference in brain lesion sizes between groups. LP treatment was well tolerated and similar to FFP. In this clinically relevant large animal model of severe TBI, HS, and polytrauma, we have shown that plasma-based resuscitation strategies are safe and result in neurocognitive recovery that is faster than recovery after NS-based resuscitation.

Anesthesiology. 2017 Sep;127(3):405-407.

Tranexamic Acid: What Is Known and Unknown, and Where Do We Go From Here?

Goobie SM, Frank SM

QUOTE:

“In summary, the study in this issue of ANESTHESIOLOGY supports the efficacy and safety of tranexamic acid in hip arthroplasty and shows that in short-duration orthopedic procedures, a single bolus of tranexamic acid is adequate, with no additional benefit of a continuous infusion. Further studies, however, need to determine the ideal therapeutic plasma level to reduce bleeding and transfusion while avoiding adverse effects. In addition, for longer surgeries, pharmacokinetic studies are needed to identify the optimum bolus dose and infusion rates to achieve the desired steady-state plasma concentrations. Ongoing well designed tranexamic acid trials including the CRASH-3 trial (head injury) and ClinicalTrials.gov NCT01813058 (scoliosis surgery) will provide answers to these questions. Zufferey *et al.* should be congratulated for adding to our knowledge base for perioperative tranexamic acid use which will benefit our patients by reducing allogeneic transfusions and their associated risks and costs, thus adding value to the care we deliver.”

Curr Trauma Rep 2017;3:144-155

Blood transfusion form the military's standpoint: making last century's standard possible today.

Gurney J, Holcomb J

PURPOSE OF REVIEW: The purpose of this review was to evaluate past, present and emerging concepts in transfusion medicine as it pertains to combat casualty care. Transfusion practices have paramount historical significance in military medicine and battlefield care. An understanding of transfusion history during recent wars have helped inform some current practices and must not be forgotten, especially as we define the future of battlefield transfusion as it pertains to the importance and implementation of whole blood.

RECENT FINDINGS: The implementation of damage control resuscitation during the recent wars in Iraq and Afghanistan has changed the face of modern transfusion practices in both military and civilian trauma. The value of whole blood has been recognized clinically and is considered the best fluid for hemorrhagic shock; however, despite being readily available during walking blood banks, widespread adoption and standardized availability remain a challenge.

SUMMARY: Transfusion is an essential capability and saves lives on the battlefield. Whole blood, followed by component therapy using the proper ratios, is the best fluid for hemorrhagic shock. There is a growing body of evidence regarding the detrimental effects of crystalloid use in hemorrhagic shock. The timing of blood product transfusion is critically important—minutes matter. Lessons learned in previous wars regarding the value of whole blood transfusion have been rediscovered and should be codified into military and civilian surgical practices.

Arch Bone Jt Surg. 2017 Mar;5(2):103-108.

Does Tranexamic Acid Reduce Bleeding during Femoral Fracture Operation?

Haghighi M, Ettehad H, Mardani-Kivi M, Mirbolook A, Nabi BN, Moghaddam R, Sedighinejad A, Khanjanian G

BACKGROUND: Proximal Femoral shaft fractures are commonly associated with marked blood loss which can lead to postoperative acute anemia and some other complications. Tranexamic acid (TA) is an antifibrinolytic medication that reduces intra- and postoperative blood loss and transfusion requirements during some elective surgeries. The aim of this study is to evaluate the effect of intravenous Tranexamic acid (TA) on intraoperative blood loss and a subsequent need for transfusion in patients who were undergoing surgery for femoral shaft fractures in trauma setting.

METHODS: Thirty-eight ASA grade I-II patients undergoing proximal femoral shaft fracture surgery with intra medullary nailing were included in this double blind randomized controlled clinical trial. They were allocated into two groups. Group I, the intervention group with eighteen patients received 15 mg/kg (TA) via intravenous infusion before surgical incision. Patients in the placebo group received an identical volume of normal saline. Hemoglobin level was measured four hours before and after the surgeries. Postoperative blood loss and hemoglobin change as well as transfusion rates and volumes were compared between the two groups.

RESULTS: Mean Percentage fall in hemoglobin after surgery were 1.75±0.84 and 2.04±1.9 in the study and placebo groups, respectively (P=0.570). Hemoglobin loss was higher in the placebo group. Transfusion rates was lower in TA group (5.6%) compared to the placebo group (30%) (P=0.06). No significant difference in The Allowable Blood Loss during the surgery was found between the two groups (P=0.894).

CONCLUSION: Preoperative treatment with TA reduces postoperative blood loss and the need for blood transfusion during traumatic femoral fracture operation**.**

J Trauma Acute Care Surg. 2012 Aug;73(2):452-6

"SCIP"ping antibiotic prophylaxis guidelines in trauma: The consequences of noncompliance.

Smith BP, Fox N, Fakhro A, LaChant M, Pathak AS, Ross SE, Seamon MJ

OBJECTIVE: The Surgical Care Improvement Project (SCIP) established surgical antibiotic prophylaxis guidelines as part of a national patient safety initiative aimed at reducing surgical complications such as surgical site infection (SSI). Although these antibiotic prophylaxis guidelines have become well established in surgical patients, they remain largely unstudied in patients with injury from trauma undergoing operative procedures. We sought to determine the role of these antibiotic prophylaxis guidelines in preventing SSI in patients undergoing trauma laparotomy.

METHODS: A retrospective review of all patients who underwent emergency trauma laparotomy at two Level I trauma centers (2007-2008) revealed 306 patients who survived more than 4 days after injury. Demographics and clinical risk SSI factors were analyzed, and patients were compared on the basis of adherence to the following SCIP guidelines: (1) prophylactic antibiotic given, (2) antibiotic received within 1 hour before incision, (3) correct antibiotic selection, and (4) discontinuation of antibiotic within 24 hours after surgery. The primary study end point was the development of SSI.

RESULTS: The study sample varied by age (mean [SD], 32 [16] years) and injury mechanism (gunshot wound 44%, stab wound 27%, blunt trauma 30%). When patients with perioperative antibiotic management complying with the four SCIP antibiotic guidelines (n = 151) were compared with those who did not comply (n = 155), no difference between age, shock, small bowel or colon resection, damage control procedures, and skin closure was detected ($p > 0.05$). After controlling for injury severity score, hypotension, blood transfusion, enteric injury, operative duration, and other potential confounding variables in a multivariate analysis, complete adherence to these four SCIP antibiotic guidelines independently decreased the risk of SSI (odds ratio, 0.43; 95% confidence interval, 0.20-0.94; $p = 0.035$). Patients adhering to these guidelines less often developed SSI (17% vs. 33%, $p = 0.001$) and had shorter overall hospital duration of antibiotics (4 [6] vs. 9 [11] days, $p < 0.001$) and hospital length of stay (14 [13] vs. 19 [23] days, $p = 0.016$), although no difference in mortality was detected ($p > 0.05$).

CONCLUSIONS: Our results suggest that SCIP antibiotic prophylaxis guidelines effectively reduce the risk of SSI in patients undergoing trauma laparotomy. Despite the emergent nature of operative procedures for trauma, efforts to adhere to these antibiotic guidelines should be maintained.

J Surg Res. 2017 Jun 15;214:154-161.

Impact of blood products on platelet function in patients with traumatic injuries: a translational study.

Henriksen HH, Grand AG, Viggers S, Baer LA, Solbeck S, Cotton BA, Matijevic N, Ostrowski SR, Stensballe J, Fox EE, Chen TA, Holcomb JB, Johansson PI, Cardenas JC, Wade CE

BACKGROUND: Reductions in platelet (PLT) count and function are associated with poor outcomes in trauma patients. We proposed to determine if patients expected to receive blood products have a decrease in PLT function higher than expected based on the reduction in PLT count, and if the reduction in function could be associated with the donor plasma/supernatant received.

METHODS: PLT count and function were measured on admission to the emergency department and intensive care unit in severely injured patients expected to receive a transfusion. PLT function was measured by Multiplate aggregometry in response to five agonists. Function was corrected for alterations in count. In vitro studies were conducted in the blood of normal subjects to assess the effect of dilutions with AB donor plasma on PLT function.

RESULTS: Forty-six patients were enrolled, with 87% requiring a transfusion. Median Injury Severity Score was 23 (13, 29) and mortality 15%. PLT count and function were decreased from emergency department to intensive care unit admission by 25% and 58%, respectively. Decreases in function persisted after adjustment for count. Patients requiring large volumes of blood products had reductions in function that were disproportionately greater. Reductions in PLT function were greatest after transfusion of PLTs. In in vitro studies with a 30% dilution by autologous plasma caused a relational reduction in function, whereas allogenic plasma resulted in greater decreases that were highly variable between donors.

CONCLUSIONS: Within hours of injury a decrease in both PLT count and function occurs, that is aggravated with the administration of blood products, with transfusion of PLTs showing the greatest effect. The effect on PLT function of allogenic transfused plasma appears to be highly donor related.

J Trauma Acute Care Surg. 2017 Sep;83(3):398-405.

Prehospital plasma resuscitation associated with improved neurologic outcomes after traumatic brain injury.

Hernandez MC, Thiels CA, Aho JM, Habermann EB, Zielinski MD, Stubbs JA, Jenkins DH, Zietlow SP.

BACKGROUND: Trauma-related hypotension and coagulopathy worsen secondary brain injury in patients with traumatic brain injuries (TBIs). Early damage control resuscitation with blood products may mitigate hypotension and coagulopathy. Preliminary data suggest resuscitation with plasma in large animals improves neurologic function after TBI; however, data in humans are lacking.

METHODS: We retrospectively identified all patients with multiple injuries age >15 years with head injuries undergoing prehospital resuscitation with blood products at a single Level I trauma center from January 2002 to December 2013. Inclusion criteria were prehospital resuscitation with either packed red blood cells (pRBCs) or thawed plasma as sole colloid resuscitation. Patients who died in hospital and those using anticoagulants were excluded. Primary outcomes were Glasgow Outcomes Score Extended (GOSE) and Disability Rating Score (DRS) at dismissal and during follow-up.

RESULTS: Of 76 patients meeting inclusion criteria, 53% (n = 40) received prehospital pRBCs and 47% (n = 36) received thawed plasma. Age, gender, injury severity or TBI severity, arrival laboratory values, and number of prehospital units were similar (all $p > 0.05$). Patients who received thawed plasma had an improved neurologic outcome compared to those receiving pRBCs (median GOSE 7 [7-8] vs. 5.5 [3-7], $p < 0.001$). Additionally, patients who received thawed plasma had improved functionality compared to pRBCs (median DRS 2 [1-3.5] vs. 9 [3-13], $p < 0.001$). Calculated GOSE and DRS scores during follow-up, median 6 [5-7] months, demonstrated increased function in those resuscitated with thawed plasma compared to pRBCs by both median GOSE (8 [7-8] vs. 6 [6-7], $p < 0.001$) and DRS (0 [0-1] vs. 4 [2-8], $p < 0.001$).

CONCLUSION: In critically injured trauma patients with TBI, early resuscitation with thawed plasma is associated with improved neurologic and functional outcomes at discharge and during follow-up compared to pRBCs alone. These preliminary data support the further investigation and use of plasma in the resuscitation of critically injured TBI patients.

LEVEL OF EVIDENCE: Therapeutic, level V.

PLoS Med. 2017 Jul 5;14(7):e1002339

Major scientific lessons learned in the trauma field over the last two decades.

Holcomb JB

QUOTES:

“Over the last 20 years, care for injured patients has undergone a revolution. As noted by many authors, war's only silver lining is to improve the care of the injured, and this era is no exception. Why do wars always seem to change the existing paradigm? Most experienced military personnel describe a 100% focus on the injured, stemming from the emotional impact of proximity to the battlefield, the close living and working quarters of medical personnel and combatants, and the sense of duty towards those who are injured while serving their country. Whatever the reasons, the results speak for themselves. The present era of conflict, starting on September 11, 2001 and continuing today is no exception. Amazing changes have occurred in care in the combat theater, and some of these have transitioned into the civilian world. This is critically important, as the scope of the civilian injury problem is 300 times that of the military, while military-style injuries are, unfortunately, becoming more common in civilian life.”

“Today, prehospital and hospital team training is commonplace and integrated, simulation centers are widespread and the training and equipment designed for the military environment is commonplace as Tactical Combat Casualty Care (TCCC) spreads across the globe .”

J Spec Oper Med. Summer 2017;17(2):89-95.

Manikin Human-Patient Simulator Training.

Horn GT, Bowling FY, Lowe DE, Parimore JG, Stagliano DR, Studer NM

BACKGROUND: Human-patient simulators (HPSs) may help enhance medical education. Manikin HPS devices respond to common field medical interventions, such as cricothyroidotomy, and have realistic feedback features, such as respirations and pulses. This study surveys Special Operations Medics for evaluations of HPS features.

METHODS: Of 518 subjects, 376 completed testing and surveys with valid responses. A total of 102 variables were divided into three categories-general characteristics, procedures, and injuries-and assessed on a fivepoint Likert scale. The Student t test was used to analyze data together and as separate groups against each other and against an aggregated mean.

RESULTS: Features that received high scores (i.e., higher than 4.5/5) corresponded closely with pillars of the Tactical Combat Casualty Care (TCCC) curriculum, basic life support, and realism.

DISCUSSION: US Army Special Operations Command and US Special Operations Command Medics have overall high confidence in manikin HPS devices and specifically in those that align with TCCC training and lifesaving procedures. The skills most valued coincide with difficult-to-practice measures, such as cricothyroidotomy and wound packing. Features such as prerecorded sounds, sex, automated movements, skin color, defibrillation, bowel sounds, and electrocardiogram are rated lower. These evaluations may guide future development or procurement of manikin HPS devices.

J Trauma Acute Care Surg. 2017 Jun 9 Epub ahead of print

Military use of TXA in combat trauma: Does it matter?

Howard JT, Stockinger ZT, Cap AP, Bailey JA, Gross KR

BACKGROUND: Tranexamic acid (TXA) has been previously reported to have a mortality benefit in civilian and combat-related trauma, and was thus added to the Joint Theater Trauma System Damage Control Resuscitation Clinical Practice Guideline. As part of ongoing system-wide performance improvement, the use of TXA has been closely monitored. The goal was to evaluate the efficacy and safety of TXA use in military casualties and provide additional guidance for continued use.

METHODS: A total of 3,773 casualties were included in this retrospective, observational study of data gathered from a trauma registry. The total sample, along with 3 sub-samples for massive transfusion patients (n=784), propensity-matched sample (n=1,030) and US/NATO military (n=1,262), were assessed for administration of TXA and time from injury to administration of TXA. Outcomes included mortality and occurrence of pulmonary embolism (PE) and deep vein thrombosis (DVT). Multivariable proportional hazards regression models with robust standard error estimates were used to estimate hazard ratios (HR) for assessment of outcomes while controlling for covariates.

RESULTS: Results of univariate and multivariate analyses of the total sample (HR=0.97; 95%CI 0.62-1.53; p=0.86); massive transfusion sample (HR=0.84; 95%CI 0.46-1.56; p=0.51); propensity-matched sample (HR=0.68; 95%CI 0.27-1.73; p=0.34); and US/NATO military sample (HR=0.76; 95%CI 0.30-1.92; p=0.48) indicate no statistically significant association between TXA use and mortality. Use of TXA was associated with increased risk of PE in the total sample (HR=2.82; 95%CI 2.08-3.81; p<0.001); massive transfusion sample (HR=3.64; 95%CI 1.96-6.78; p=0.003); US/NATO military sample (HR=2.55; 95%CI 1.73-3.69; p=0.002); but not the propensity-matched sample (HR=3.36; 95%CI 0.80-14.10; p=0.10). TXA was also associated with increased risk of DVT in the total sample (HR=2.00; 95%CI 1.21-3.30; p=0.02) and US/NATO military sample (HR=2.18; 95%CI 1.20-3.96; p=0.02).

CONCLUSIONS: In the largest study on TXA use in a combat trauma population, TXA was not significantly associated with mortality, due to lack of statistical power. However, our HR estimates for mortality among patients who received TXA are consistent with previous findings from the CRASH2 trial. At the same time, continued scrutiny and surveillance of TXA use in military trauma, specifically for prevention of thromboembolic events, is warranted.

LEVEL OF EVIDENCE: Retrospective/Case-Control, Therapy Level IV.

Int J Burns Trauma. 2017 Apr 15;7(2):17-26

Mortality outcomes in trauma patients undergoing prehospital red blood cell transfusion: a systematic literature review.

Huang GS, Dunham CM

ABSTRACT:

The value of prehospital red blood cell (RBC) transfusion for trauma patients is controversial. The purposes of this literature review were to determine the mortality rate of trauma patients with hemodynamic instability and the benefit of prehospital RBC transfusion. A 30-year systematic literature review was performed in 2016. Eligible studies were combined for meta-analysis when tests for heterogeneity were insignificant. The synthesized mortality was 35.6% for systolic blood pressure ≤ 90 mmHg; 51.1% for ≤ 80 mmHg; and 63.9% for ≤ 70 mmHg. For patients with either hypotension or emergency trauma center transfused RBCs, the synthesized Injury Severity Score (ISS) was 27.0 and mortality was 36.2%; the ISS and mortality correlation was r = 0.766 (P = 0.0096). For civilian patients receiving prehospital RBC transfusions, the synthesized ISS was 27.5 and mortality was 39.5%. One civilian study suggested a decrement in mortality with prehospital RBC transfusion; however, patient recruitment was only one per center per year and mortality was < 10% despite an ISS of 37. The same study created a matched control subset and indicated that mortality decreased using multivariate analysis; however, neither the assessed factors nor raw mortality was presented. Civilian studies with patients undergoing prehospital RBC transfusion and a matched control subset showed that the synthesized mortality was similar for those transfused (37.5%) and not transfused (38.7%; P = 0.8933). A study of civilian helicopter patients demonstrated a similar 30-day mortality for those with and without prehospital blood product availability (22% versus 21%; P = 0.626). Mortality in a study of matched military patients was better for those receiving prehospital blood or plasma (8%) than the controls (20%; P = 0.013). However, transfused patients had a shorter prehospital time, more advanced airway procedures, and higher hospital RBC transfusion (P < 0.05). A subset with an ISS > 16 showed similar mortality with and without prehospital RBC availability (27.6% versus 32.0%; P = 0.343). Trauma patient mortality increases with the magnitude of hemodynamic instability and anatomic injury. Some literature evidence indicates no survival advantage with prehospital RBC availability. However, other data suggesting a potential benefit is confounded or likely to be biased.

Transfusion. 2017 Aug;57(8):2007-2015

Freeze-dried plasma enhances clot formation and inhibits fibrinolysis in the presence of tissue plasminogen activator similar to pooled liquid plasma.

Huebner BR, Moore EE, Moore HB, Sauaia A, Stettler G, Dzieciatkowska M, Hansen K, Banerjee A, Silliman CC

BACKGROUND: Systemic hyperfibrinolysis is an integral part of trauma-induced coagulopathy associated with uncontrolled bleeding. Recent data suggest that plasma-first resuscitation attenuates hyperfibrinolysis; however, the availability, transport, storage, and administration of plasma in austere environments remain challenging and have limited its use. Freeze-dried plasma (FDP) is a potential alternative due to ease of storage, longer shelf life, and efficient reconstitution. FDP potentially enhances clot formation and resistsbreakdown better than normal saline (NS) and albumin and similar to liquid plasma.

STUDY DESIGN AND METHODS: Healthy volunteers underwent citrated blood draw followed by 50% dilution with NS, albumin, pooled plasma (PP), or pooled freeze-dried plasma (pFDP). Citrated native and tissue plasminogen activator (t-PA)-challenge (75 ng/mL) thrombelastography were done. Proteins in PP, pFDP, and albumin were analyzed by mass spectroscopy.

RESULTS: pFDP and PP had superior clot-formation rates (angle) and clot strength (maximum amplitude) compared with NS and albumin in t-PA-challenge thrombelastographies (angle: pFDP, 67.9 degrees; PP, 67.8 degrees; NS, 40.6 degrees; albumin, 35.8 degrees; maximum amplitude: pFDP, 62.4 mm; PP, 63.5 mm; NS, 44.8 mm; albumin, 41.1 mm). NS and albumin dilution increased susceptibility to t-PA-induced hyperfibrinolysis compared with pFDP and PP (NS, 62.4%; albumin, 62.6%; PP, 8.5%; pFDP, 6.7%). pFDP was similar to PP in the attenuation of t-PA-induced fibrinolysis. Most proteins (97%) were conserved during the freeze-dry process, with higher levels in 12% of pFDP proteins compared with PP.

CONCLUSION: pFDP enhances clot formation and attenuates hyperfibrinolysis better than NS and albumin and is a potential alternative to plasma resuscitation in the treatment of hemorrhagic shock.

Ann Emerg Med 2017;69:18A-20A

Nonclinicians get crash course in bleeding control.

Huff C

QUOTES:

“Nonclinicians are learning how to recognize potentially lifethreatening bleeding, pack a wound, and tie a tourniquet to buy time until emergency responders arrive. Enthusiasts describe thetraining approach, called Stop the Bleed, as similar to teaching cardiopulmonary resuscitation (CPR) to the public, but with a Bleeding 101 focus. The concept, which was developed by federal officials working with the American College of Surgeons and other medical groups, stems from the spate of mass fatalities in recent shootings and was specifically spurred by the 2012 Sandy Hook Elementary School shooting in Newtown, CT.”

“The multifaceted collaboration behind this training, called the Hartford Consensus, was initiated by the American College of Surgeons, which quickly joined forces with the Department of Homeland Security, the US Fire Administration, and numerous other groups. Since its formation in 2013, the consensus has published a series of reports with guidance on how to more quickly treat bleeding victims amid a mass casualty shooting. (At Columbine, it took approximately 40 minutes after the first 911 call from the school before any officers entered the building, one consensus report noted. 2) The collaboration developed several key strategies, starting with training police and other law enforcement officers to use a tourniquet and other techniques to ease hemorrhagic bleeding even while working to suppress the shooter, said Lenworth M. Jacobs, MD, MPH, who chairs the Hartford Consensus and is director of the Trauma Institute at Hartford Hospital in Hartford, CT.”

“In Dallas, where police officers started being trained a decade ago,these techniques have already saved lives, said Dr. Eastman, also a deputy medical director of the Dallas Police Department. By early spring, the lives of 15 people had been saved by law enforcement using tourniquets and other bleeding control approaches, he said.”

Am J Emerg Med. 2017 May 8. pii: S0735-6757(17)30366-2.

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

Hyldmo PK, Horodyski M, Conrad BP, Aslaksen S, Røislien J, Prasarn M, Rechtine GR, 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.

Lancet Haematol. 2017 Jun;4(6):e258-e271.

Reversal of trauma-induced coagulopathy using first-line coagulation factor concentrates or fresh frozen plasma (RETIC): a single-centre, parallel-group, open-label, randomised trial.

Innerhofer P, Fries D, Mittermayr M, Innerhofer N, von Langen D, Hell T, Gruber G, Schmid S, Friesenecker B, Lorenz IH, Ströhle M, Rastner V, Trübsbach S, Raab H, Treml B, Wally D, Treichl B, Mayr A, Kranewitter C, Oswald E

BACKGROUND: Effective treatment of trauma-induced coagulopathy is important; however, the optimal therapy is still not known. We aimed to compare the efficacy of first-line therapy using fresh frozen plasma (FFP) or coagulation factor concentrates (CFC) for the reversal of trauma-induced coagulopathy, the arising transfusion requirements, and consequently the development of multiple organ failure.

METHODS: This single-centre, parallel-group, open-label, randomised trial was done at the Level 1 Trauma Center in Innsbruck Medical University Hospital (Innsbruck, Austria). Patients with trauma aged 18-80 years, with an Injury Severity Score (ISS) greater than 15, bleeding signs, and plasmatic coagulopathy identified by abnormal fibrin polymerisation or prolonged coagulation time using rotational thromboelastometry (ROTEM) were eligible. Patients with injuries that were judged incompatible with survival, cardiopulmonary resuscitation on the scene, isolated brain injury, burn injury, avalanche injury, or prehospital coagulation therapy other than tranexamic acid were excluded. We used a computer-generated randomisation list, stratification for brain injury and ISS, and closed opaque envelopes to randomly allocate patients to treatment with FFP (15 mL/kg of bodyweight) or CFC (primarily fibrinogen concentrate [50 mg/kg of bodyweight]). Bleeding management began immediately after randomisation and continued until 24 h after admission to the intensive care unit. The primary clinical endpoint was multiple organ failure in the modified intention-to-treat population (excluding patients who discontinued treatment). Reversal of coagulopathy and need for massive transfusions were important secondary efficacy endpoints that were the reason for deciding the continuation or termination of the trial. This trial is registered with ClinicalTrials.gov, number NCT01545635.

FINDINGS: Between March 3, 2012, and Feb 20, 2016, 100 out of 292 screened patients were included and randomly allocated to FFP (n=48) and CFC (n=52). Six patients (four in the FFP group and two in the CFC group) discontinued treatment because of overlooked exclusion criteria or a major protocol deviation with loss of follow-up. 44 patients in the FFP group and 50 patients in the CFC group were included in the final interim analysis. The study was terminated early for futility and safety reasons because of the high proportion of patients in the FFP group who required rescue therapy compared with those in the CFC group (23 [52%] in the FFP group vs two [4%] in the CFC group; odds ratio [OR] 25·34 [95% CI 5·47-240·03], p<0·0001) and

increased needed for massive transfusion (13 [30%] in the FFP group vs six [12%] in the CFC group; OR 3·04 [0·95-10·87], p=0·042) in the FFP group. Multiple organ failure occurred in 29 (66%) patients in the FFP group and in 25 (50%) patients in the CFC group (OR 1·92 [95% CI 0·78-4·86], p=0·15).

INTERPRETATION: Our results underline the importance of early and effective fibrinogen supplementation for severe clotting failure in multiple trauma. The available sample size in our study appears sufficient to make some conclusions that first-line CFC is superior to FFP.

FUNDING: None.

J Emerg Med. 2017 Jun;52(6):e217-e220.

Ultrasound Findings in Tension Pneumothorax: A Case Report.

Inocencio M, Childs J, Chilstrom ML, Berona K

BACKGROUND: Delayed recognition of tension pneumothorax can lead to a mortality of 31% to 91%. However, the classic physical examination findings of tracheal deviation and distended neck veins are poorly sensitive in the diagnosis of tension pneumothorax. Point-of-care ultrasound is accurate in identifying the presence of pneumothorax, but sonographic findings of tension pneumothorax are less well described.

CASE REPORT: We report the case of a 21-year-old man with sudden-onset left-sided chest pain. He was clinically stable without hypoxia or hypotension, and the initial chest x-ray study showed a large pneumothorax without mediastinal shift. While the patient was awaiting tube thoracostomy, a point-of-care ultrasound demonstrated findings of mediastinal shift and a dilated inferior vena cava (IVC) concerning for tension physiology, even though the patient remained hemodynamically stable.

WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?: This case demonstrates a unique clinical scenario of ultrasound evidence of tension physiology in a clinically stable patient. Although this patient was well appearing without hypotension, respiratory distress, tracheal deviation, or distended neck veins, point-of-care ultrasound revealed mediastinal shift and a plethoric IVC. Given that the classic clinical signs of tension pneumothorax are not uniformly present, this case shows how point-of-care ultrasound may diagnose tension pneumothorax before clinical decompensation.

Shock. 2017 Aug 1. Epub ahead of print

Compensatory Reserve Index: Performance of a Novel Monitoring Technology to Identify the Bleeding Trauma Patient.

Johnson M, Alarhayem A, Convertino V, Carter R 3rd, Chung K, Stewart R, Myers J, Dent D, Liao L, Cestero R, Nicholson S, Muir M, Schwacha M, Wampler D, DeRosa M, Eastridge B.

INTRODUCTION: Hemorrhage is one of the most substantial causes of death after traumatic injury. Standard measures, including systolic blood pressure (SBP), are poor surrogate indicators of physiologic compromise until compensatory mechanisms have been overwhelmed. Compensatory Reserve Index (CRI) is a novel monitoring technology with the ability to assess physiologic reserve. We hypothesized CRI would be a better predictor of physiologic compromise secondary to hemorrhage than traditional vital signs.

METHODS: A prospective observational study of 89 subjects meeting trauma center activation criteria at a single level I trauma center was conducted from October 2015 to February 2016. Data collected included demographics, SBP, HR, and requirement for hemorrhage-associated, life-saving intervention (LSI) (ie: operation or angiography for hemorrhage, local or tourniquet control of external bleeding and transfusion > 2 u PRBC). Receiver-operator characteristic (ROC) curves were formulated and appropriate thresholds were calculated to compare relative value of the metrics for predictive modeling.

RESULTS: For predicting hemorrhage-related LSI, CRI demonstrated a sensitivity of 83% and a negative predictive value (NPV) of 91% as compared to SBP with a sensitivity to detect hemorrhage of 26% ($p<0.05$) and a NPV of 78%. ROC curves generated from admission CRI and SBP measures demonstrated values of 0.83 and 0.62, respectively. CRI identified significant hemorrhage requiring potentially life-saving therapy more reliably than SBP ($p<0.05$).

CONCLUSION: The CRI device demonstrated superior capacity over systolic blood pressure in predicting the need for posttraumatic hemorrhage intervention in the acute resuscitation phase after injury.

J Trauma Acute Care Surg. 2017 Jul;83(1):61-70.

The effect of resuscitative endovascular balloon occlusion of the aorta, partial aortic occlusion and aggressive blood transfusion on traumatic brain injury in a swine multiple injuries model.

Johnson MA, Williams TK, Ferencz SE, Davidson AJ, Russo RM, O'Brien WT Sr, Galante JM, Grayson JK, Neff LP.

BACKGROUND: Despite clinical reports of poor outcomes, the degree to which resuscitative endovascular balloon occlusion of the aorta (REBOA) exacerbates traumatic brain injury (TBI) is not known. We hypothesized that combined effects of increased proximal mean arterial pressure (pMAP), carotid blood flow (Qcarotid), and intracranial pressure (ICP) from REBOA would lead to TBI progression compared with partial aortic occlusion (PAO) or no intervention.

METHODS: Twenty-one swine underwent a standardized TBI via computer Controlled cortical impact followed by 25% total blood volume rapid hemorrhage. After 30 minutes of hypotension, animals were randomized to 60 minutes of continued hypotension (Control), REBOA, or PAO. REBOA and PAO animals were then weaned from occlusion. All animals were resuscitated with shed blood via a rapid blood infuser. Physiologic parameters were recorded continuously and brain computed tomography obtained at specified intervals.

RESULTS: There were no differences in baseline physiology or during the initial 30 minutes of hypotension. During the 60-minute intervention period, REBOA resulted in higher maximal pMAP (REBOA, 105.3 ± 8.8; PAO, 92.7 ± 9.2; Control, 48.9 ± 7.7; $p = 0.02$) and higher Qcarotid (REBOA, 673.1 ± 57.9; PAO, 464.2 ± 53.0; Control, 170.3 ± 29.4; $p < 0.01$). Increases in ICP were greatest during blood resuscitation, with Control animals demonstrating the largest peak ICP (Control, 12.8 ± 1.2; REBOA, 5.1 ± 0.6; PAO, 9.4 ± 1.1; $p < 0.01$). There were no differences in the percentage of animals with hemorrhage progression on CT (Control, 14.3%; 95% confidence interval [CI], 3.6-57.9; REBOA, 28.6%; 95% CI, 3.7-71.0; and PAO, 28.6%; 95% CI, 3.7-71.0).

CONCLUSION: In an animal model of TBI and shock, REBOA increased Qcarotid and pMAP, but did not exacerbate TBI progression. PAO resulted in physiology closer to baseline with smaller increases in ICP and pMAP. Rapid blood resuscitation, not REBOA, resulted in the largest increase in ICP after intervention, which occurred in Control animals. Continued studies of the cerebral hemodynamics of aortic occlusion and blood transfusion are required to determine optimal resuscitation strategies for multi-injured patients.

J Trauma Acute Care Surg. 2017 Jul;83(1):182-189.

Do vented chest seals differ in efficacy? An experimental evaluation using a swine hemopneumothorax model.

Kheirabadi BS, Terrazas IB, Miranda N, Voelker AN, Arnaud F, Klemcke HG, Butler FK, Dubick MA.

OBJECTIVE: Airways compromise was the second leading cause of potentially preventable death among combat casualties. We investigated the ability of five Food and Drug Administration-approved nonocclusive chest seals (CSs) to seal a bleeding chest wound and prevent tension hemopneumothorax (HPTX) in a swine model.

METHODS: Following instrumentation, an open chest wound was created in the left thorax of spontaneously air-breathing anesthetized pigs (n = 26; 43 kg). Autologous fresh blood (226 mL) was then infused into the pleural cavity to produce HPTX. The chest wounds were then sealed with CSs. The sealant strength and venting function of CSs were challenged by infusion of 50 mL more blood directly into the chest wound and incremental air injections into the pleural cavity. Tension HPTX was defined as intrapleural (IP) pressure equal to or more than +1 mm Hg and more than 20% deviation in physiologic measurements.

RESULTS: An open chest wound with HPTX raised IP pressure (~ -0.7 mm Hg) and caused labored breathing and reductions in PaO2 and SvO2 ($p < 0.01$). Sealing the wounds with the CSs restored IP pressure, and improved breathing and oxygenation. Subsequent blood infusion into the wound and IP air injections produced CS-dependent responses. Chest seals with one-way valves (Bolin and SAM) did not evacuate the blood efficiently; pooled blood either detached the CSs from skin and leaked out (75%), or clotted and clogged the valve and led to tension HPTX (25%). Conversely, CSs with laminar venting channels allowed escape of blood and air from the pleural cavity and maintained IP pressure and oxygenation near normal levels. Success rates were 100% for Sentinel and Russell (6/6); 67% for HyFin (4/6); 25% for SAM (1/4); and 0% for Bolin (0/4) CSs ($p = 0.002$).

CONCLUSION: The sealant and valve function of vented CS differed widely in the presence of bleeding chest wounds. Medics should be equipped with more effective CSs for treating HPTX in the field.

Wilderness Environ Med. 2017 Jun;28(2S):S103-S108

The Care of Thermally Injured Patients in Operational, Austere, and Mass Casualty Situations.

King BT, Peterson WC

ABSTRACT:

Burn injury affects a half million people in the United States annually. The severe thermal injury can have long-term debilitating effects. The management of burn patients in austere and operational environments is more complex. Mass casualty incidents can result in a large number of patients with multiple traumatic injuries, which often include burn injury. Appropriate triage of casualties is essential. Severely burned patients should be evacuated to a burn center if possible. Airway management and fluid resuscitation of burn patients present unique challenges. Supplies, resources, and expertise to maintain a definitive airway may not be readily available. Airway adjuncts can be helpful but judicious use of resources is warranted in the austere setting. Traditional resuscitation of severe thermal injury is not practical in the austere environment. Oral resuscitation and in rare cases rectal hydration may be utilized until the patient can be transported to a medical facility. Much has been learned about the management of burn and polytraumatized patients after mass casualty incidents such as the September 11, 2001 terror attacks and the Pope Air Force Base disaster. A well-coordinated emergency preparedness plan is essential. The care of burn patients in austere, operational, and mass casualty situations can tax resources and manpower. The care of these patients will require creativity and ingenuity. Burn patients can be difficult to manage under normal circumstances but the care of these patients under the above situations complicates the management severalfold.

J Trauma Acute Care Surg. 2017 Jul;83(1 Suppl 1):S156-S163.

The Damage Control Surgery in Austere Environments Research Group (DCSAERG): A dynamic program to facilitate real-time telementoring/telediagnosis to address exsanguination in extreme and austere environments.

Kirkpatrick AW, McKee JL, McBeth PB, Ball CG, LaPorta A, Broderick T, Leslie T, King D, Wright Beatty HE, Keillor J, Tien H.

ABSTRACT:

Hemorrhage is the most preventable cause of posttraumatic death. Many cases are potentially anatomically salvageable, yet remain lethal without logistics or trained personnel to deliver diagnosis or resuscitative surgery in austere environments. Revolutions in technology for remote mentoring of ultrasound and surgery may enhance capabilities to utilize the skill sets of non-physicians. Thus, our research collaborative explored remote mentoring to empower non-physicians to address junctional and torso hemorrhage control in austere environments. Major studies involved using remote-telementored ultrasound (RTMUS) to identify torso and junctional exsanguination, remotely mentoring resuscitative surgery for torso hemorrhage control, understanding and mitigating physiological stress during such tasks, and the technical practicalities of conducting damage control surgery (DCS) in austere environments. Iterative projects involved randomized guiding of firefighters to identify torso (RCT) and junctional (pilot) hemorrhage using RTMUS, randomized remote mentoring of MedTechs conducting resuscitative surgery for torso exsanguination in an anatomically realistic surgical trainer ("Cut Suit") including physiological monitoring, and trained surgeons conducting a comparative randomized study for torso hemorrhage control in normal (1g) versus weightlessness (0g). This work demonstrated that firefighters could be remotely mentored to perform just-in-time torso RTMUS on a simulator. Both firefighters and mentors were confident in their abilities, the ultrasounds being 97% accurate. An ultrasound-naive firefighter in Memphis could also be remotely mentored from Hawaii to identify and subsequently tamponade an arterial junctional hemorrhage using RTMUS in a live tissue model. Thereafter, both mentored and unmentored MedTechs and trained surgeons completed resuscitative surgery for hemorrhage control on the Cut-Suit, demonstrating practicality for all involved. While remote mentoring did not decrease blood loss among MedTechs, it increased procedural confidence and decreased physiologic stress. Therefore, remote mentoring may increase the feasibility of non-physicians conducting a psychologically daunting task. Finally, DCS in weightlessness was feasible without fundamental differences from 1g. Overall, the collective evidence suggests that remote mentoring supports diagnosis, noninvasive therapy, and ultimately resuscitative surgery to potentially rescue those exsanguinating in austere environments and should be more rigorously studied.

Prehosp Emerg Care. 2017 Jul 7:1-6. Epub ahead of print

Incidence of Naloxone Redosing in the Age of the New Opioid Epidemic.

Klebacher R, Harris MI, Ariyaprakai N, Tagore A, Robbins V, Dudley LS, Bauter R, Koneru S, Hill RD, Wasserman E, Shanes A, Merlin MA.

STUDY OBJECTIVE: Naloxone, an opioid-antagonist deliverable by an intra-nasal route, has become widely available and utilized by law enforcement officers as well as basic life support (BLS) providers in the prehospital setting. This study aimed to determine the frequency of repeat naloxone dosing in suspected narcotic overdose (OD) patients and identify patient characteristics.

METHODS: A retrospective chart review of patients over 17 years of age with suspected opioid overdose, treated with an initial intranasal (IN) dose of naloxone and subsequently managed by paramedics, was performed from April 2014 to June 2016. Demographic data was analyzed using descriptive statistics to identify those aspects of the history, physical exam findings. Results: A sample size of 2166 patients with suspected opioid OD received naloxone from first responders. No patients who achieved GCS 15 after treatment required redosing; 195 (9%) received two doses and 53 patients received three doses of naloxone by advanced life support. Patients were primarily male (75.4%), Caucasian (88.2%), with a mean age of 36.4 years. A total of 76.7% of patients were found in the home, 23.1% had a suspected mixed ingestion, and 27.2% had a previous OD. Two percent of all patients required a third dose of naloxone.

CONCLUSION: In this prehospital study, we confirmed that intranasal naloxone is effective in reversing suspected opioid toxicity. Nine percent of patients required two or more doses of naloxone to achieve clinical reversal of suspected opioid toxicity. Two percent of patients received a third dose of naloxone.

J Trauma Acute Care Surg. 2017 Jul;83(1):71-76.

Kaolin-based hemostatic dressing improves hemorrhage control from a penetrating inferior vena cava injury in coagulopathic swine.

Koko KR, McCauley BM, Gaughan JP, Nolan RS, Fromer MW, Hagaman ALR, Choron RL, Brown SA, Hazelton JP.

BACKGROUND: Retrohepatic inferior vena cava (RIVC) injuries are often lethal due to challenges in obtaining hemorrhage control. We hypothesized that packing with a new kaolin-based hemostatic dressing (Control+; Z-Medica, Wallingford, CT) would improve hemorrhage control from a penetrating RIVC injury compared with packing with standard laparotomy sponges alone.

METHODS: Twelve male Yorkshire pigs received a 25% exchange transfusion of blood for refrigerated normal saline to induce a hypothermic coagulopathy. A laparotomy was performed and a standardized 1.5 cm injury to the RIVC was created which was followed by temporary abdominal closure and a period of uncontrolled hemorrhage. When the mean arterial pressure reached 70% of baseline, demonstrating hemorrhagic shock, the abdomen was re-entered, and the injury was treated with perihepatic packing using standard laparotomy sponges (L; n = 6) or a new kaolin-based hemostatic dressing (K; n = 6). Animals were then resuscitated for 6 hours with crystalloid solution. The two groups were compared using the Wilcoxon rank sum test and Fisher exact test. A p value of 0.05 or less was considered statistically significant.

RESULTS: There was no difference in the animal's temperature, heart rate, mean arterial pressure, cardiac output, and blood loss at baseline or before packing was performed (all $p > 0.05$). In the laparotomy sponge group, five of six pigs survived the entire study period, whereas all six pigs treated with kaolin-based D2 hemostatic dressings survived. Importantly, there was significantly less blood loss after packing with the new hemostatic kaolin-based dressing compared with packing with laparotomy sponge (651 ± 180 mL vs. 1073 ± 342 mL; $p \leq 0.05$).

CONCLUSION: These results demonstrate that the use of this new hemostatic kaolin-based dressing improved hemorrhage control and significantly decreased blood loss in this penetrating RIVC model.

LEVEL OF EVIDENCE: This is basic science research based on a large animal model, level V.

J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S9-S15

Leadership and a casualty response system for eliminating preventable death.

Kotwal RS, Montgomery HR, Miles EA, Conklin CC, Hall MT, McChrystal SA

ABSTRACT:

Combat casualties who die from their injuries do so primarily in the prehospital setting. Although most of these deaths result from injuries that are nonsurvivable, some are potentially survivable. Of injuries that are potentially survivable, most are from hemorrhage. Thus, military organizations should direct efforts toward prehospital care, particularly through early hemorrhage control and remote damage control resuscitation, to eliminate preventable death on the battlefield. A systems-based approach and priority of effort for institutionalizing such care was developed and maintained by medical personnel and command-directed by nonmedical combatant leaders within the 75th Ranger Regiment, U.S. Army Special Operations Command. The objective of this article is to describe the key components of this prehospital casualty response system, emphasize the importance of leadership, underscore the synergy achieved through collaboration between medical and nonmedical leaders, and provide an example to other organizations and communities striving to achieve success in trauma as measured through improved casualty survival.

J Spec Oper Med. Summer 2017;17(2):39-48.

Assessment of Trainer Skill to Control Groin-Wound Bleeding: Use of Junctional Tourniquet Models on a Manikin.

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

BACKGROUND: The purpose of this study was to assess the skills of trainers using different junctional tourniquet models to control groin bleeding in a manikin.

MATERIALS AND METHODS: In 204 assessments, 17 trainers used four junctional tourniquet models three times each to control simulated hemorrhage. The models included the Combat Ready Clamp (CRoC), Junctional Emergency Treatment Tool (JETT), Abdominal Aortic and Junctional Tourniquet (AAJT), and SAM Junctional Tourniquet (SJT). The criteria of assessment included effectiveness (i.e., control [yes-no]), time to stop bleeding, total blood loss, and bleeding rate.

RESULTS: All uses were effective. By model, the results of mean blood loss and time to stop bleeding were different with varying levels of statistical significance: control was worst with the JETT and AAJT, moderate with the AAJT and SJT, and best with the SJT and CRoC. The means sharing a level were not significantly different, but a mean in more than one level was not different from itself. The composite outcome results were 90% good for CRoC and 67% good for JETT, whereas results for the SJT and AAJT were in between, and only the result of the CROC and JETT comparison was significant. The ease of use varied significantly; JETT was more difficult to use and all others were easier. The analysis attributed to the users 19% of the variance of results for time, 44% for blood loss volume, and 67% for bleeding rate. Most users preferred the SJT (53% before and 70% after assessment).

CONCLUSION: Effectiveness was attained by all users with each of the four models of junctional tourniquet. The analysis demonstrated that up to 67% of the variance of performance results could be attributed to the users.

Wilderness Environ Med. 2017 Jun;28(2S):S25-S32.

Bleeding Control With Limb Tourniquet Use in the Wilderness Setting: Review of Science.

Kragh JF Jr, Dubick MA

ABSTRACT:

The purpose of this review is to summarize tourniquet science for possible translation to wilderness settings. Much combat casualty data has been studied since 2005, and use of tourniquets in the military has changed from a last resort to first aid. The US Government has made use of tourniquets a health policy aimed to improve public access to bleeding control items. International authorities believe that education in first aid should be universal, as all can and should learn first aid. The safety record of tourniquet use is mixed, but users are reliably safe if trained well. Well-designed tourniquets can reliably attain bleeding control, may mitigate risk of shock progression, and may improve survival rates, but conclusive proof of a survival benefit remains unclear in civilian settings. Even a war setting has a bias toward survivorship by sampling mostly survivors in hospitals. Improvised tourniquets are less reliable than well-designed tourniquets but may be better than none. The tourniquet model used most often in 2016 by the US military is the Combat Application Tourniquet (C-A-T), and civilians use an array of various models, including C-A-T. Evidence on tourniquet use to date indicates that most uses are safe and effective in civilian settings. Future directions for study relevant to the wilderness setting include consideration of research priorities, study of the burdens of injury or capability gaps in caregiving for various wilderness settings, determination of the skill needs of outdoor enthusiasts and wilderness caregivers, and survey of wilderness medicine stewards regarding bleeding control.

Int J Infect Dis. 2017 Sep;62:102-111.

Invasive Fungal Infections Secondary to Traumatic Injury.

Kronen R, Liang SY, Bochicchio G, Bochicchio K, Powderly WG, Spec A

ABSTRACT:

Invasive fungal infection (IFI) is a rare but serious complication of traumatic injury. The purpose of this article is to review the epidemiology, natural history, mycology, risk factors, diagnosis, treatment, and outcomes associated with post-traumatic IFI in military and civilian populations. The epidemiology of post-traumatic IFI is poorly characterized, but incidence appears to be rising. Patients often suffer from severe injuries and require extensive medical interventions. Fungi belonging to the order Mucorales are responsible for most post-traumatic IFI in both civilian and military populations. Risk factors differ between these cohorts but include specific injury patterns and comorbidities. Diagnosis of post-traumatic IFI typically follows positive laboratory results in the appropriate clinical context. The gold standard of treatment is surgical debridement in addition to systemic antifungal therapy. Patients with post-traumatic IFI may be at greater risk of amputation, delays in wound healing, hospital complications, and death as compared to trauma patients who do not develop IFI. More research is needed to understand the factors surrounding the development and management of post-traumatic IFI to reduce the significant morbidity and mortality associated with this disease.

J Trauma Acute Care Surg. 2017 Aug;83(2):230-236

Resuscitative endovascular balloon occlusion of the aorta for major abdominal venous injury in a porcine hemorrhagic shock model.

Lallemand MS, Moe DM, McClellan JM, Smith JP, Daab L, Marko S, Tran N, Starnes B, Martin MJ.

BACKGROUND: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a rescue maneuver for unstable patients with noncompressible hemorrhage below the diaphragm. The efficacy of REBOA in the setting a major abdominal venous injury is unknown. Our objective was to examine the use of REBOA in a large animal model of major abdominal venous injury and characterize any impact on the hemodynamics, rate and volume of hemorrhage, and survival.

METHODS: Ten swine (35-55 kg) underwent a controlled and validated hemorrhage and ischemia/reperfusion injury protocol to produce shock physiology. Animals were randomly assigned to a control arm (N = 5) or a treatment (REBOA) arm (N = 5). An injury was then created in the common iliac vein. Bleeding was allowed for 60 seconds and the balloon was then inflated in the REBOA arm. Hemodynamics were recorded for 45 minutes or until death. Blood loss was verified post-mortem and bleeding rate calculated.

RESULTS: All animals demonstrated shock physiology at the time of randomization. There were no differences between control versus REBOA animals in baseline mean arterial pressure (42 vs. 50), pH (7.29 vs. 7.26), lactate (6.19 vs. 6.26), or INR (1.2 vs. 1.3, all p = NS). REBOA animals demonstrated immediate improvements in mean arterial pressure (50.6 vs. 97.2, p = 0.04). The mean survival time was 4.1 minutes for controls (100% died) versus 40.1 minutes for REBOA (p < 0.01). There was no difference in total blood loss (mean 630 mL for both). The rate of bleeding was significantly lower in the REBOA animals (control 197 mL/min vs. REBOA 14 mL/min, p = 0.02).

CONCLUSION: In the setting of an abdominal venous injury, REBOA improved hemodynamics and lengthened survival time. Blood loss was similar between groups but the rate of bleeding was markedly decreased with REBOA. REBOA appears effective for central venous injuries and provides a sustained period of stabilization and window for surgical intervention.

J Trauma Acute Care Surg. 2017 Jul;83(1 Suppl 1):S136-S141

Relative device stability of anterior versus axillary needle decompression for tension pneumothorax during casualty movement: Preliminary analysis of a human cadaver model.

Leatherman ML, Held JM, Fluke LM, McEvoy CS, Inaba K, Grabo D, Martin MJ, Earley AS, Ricca RL, Polk TM.

BACKGROUND: Tension pneumothorax (tPTX) remains a significant cause of potentially preventable death in military and civilian settings. The current prehospital standard of care for tPTX is immediate decompression with a 14-gauge 8-cm angiocatheter; however, failure rates may be as high as 17% to 60%. Alternative devices, such as 10-gauge angiocatheter, modified Veress needle, and laparoscopic trocar, have shown to be potentially more effective in animal models; however, little is known about the relative insertional safety or mechanical stability during casualty movement.

METHODS: Seven soft-embalmed cadavers were intubated and mechanically ventilated. Chest wall thickness was measured at the second intercostal space at the midclavicular line (2MCL) and the fifth intercostal space along the anterior axillary line (5AAL). CO2 insufflation created a PTX, and needle decompression was then performed with a randomized device. Insertional depth was measured between hub and skin before and after simulated casualty transport. Thoracoscopy was used to evaluate for intrapleural placement and/or injury during insertion and after movement. Cadaver demographics, device displacement, device dislodgment, and injuries were recorded. Three decompressions were performed at each site (2MCL/5AAL), totaling 12 events per cadaver.

RESULTS: Eighty-four decompressions were performed. Average cadaver age was 59 years, and body mass index was 24 kg/m. The CWT varied between cadavers because of subcutaneous emphysema, but the average was 39 mm at the 2MCL and 31 mm at the 5AAL. Following movement, the 2MCL site was more likely to become dislodged than the 5AAL (67% vs. 17%, p = 0.001). Median displacement also differed between 2MCL and 5AAL (23 vs. 2 mm, p = 0.001). No significant differences were noted in dislodgement or displacement between devices. Five minor lung injuries were noted at the 5AAL position.

CONCLUSION: Preliminary results from this human cadaver study suggest the 5AAL position is a more stable and reliable location for thoracic decompression of tPTX during combat casualty transport.

LEVEL OF EVIDENCE: Therapeutic study, level III.

PLoS One. 2017 Jul 31;12(7):e0182046.

Risk factors associated with the development of seizures among adult patients treated with ertapenem: A matched case-control study.

Lee YC, Huang YJ, Hung MC, Hung SC, Hsiao CY, Cho HL, Lai LF, Tong SH, Wang JT

OBJECTIVE: The purpose of this study is to compare the characteristics of those ertapenem-treated adult patients with and without development of seizures, and identify the associated factors for the development of seizures.

METHODS: This retrospective study was conducted at Chia-Yi Christian Hospital from January 2012 to December 2014. Patients developing seizures during their ertapenem treatment course were identified as case patients. Those without seizures who had received ertapenem for at least five days were considered as the pool of control patients. For each case patient, four matched patients from the control pool were randomly selected as the final control group, based on age, gender, and the date of ertapenem prescription.

RESULTS: A total of 1706 ertapenem-treated patients were identified, 33 (1.9%) individuals developed seizures with the enrollment of 132 matched control patients. Among these 33 patients, the average age was 79.3 ± 7.5 years, and 20 (60.6%) were male. The mean Charlson co-morbidity score was 4.5 ± 2.4, and the first episode of seizure happened 3.3 ± 2.6 days after receiving ertapenem. In multivariate logistic regression analysis, the independent predictors associated with the development of ertapenem-associated seizures were old stroke (OR, 14.36; 95% CI, 4.38-47.02; $p < 0.0001$), undergoing brain images within one year prior to the admission (OR, 5.73; 95% CI, 1.78-18.43; $p = 0.0034$), low hemoglobin level (OR, 3.88; 95% CI, 1.28-12.75; $p = 0.0165$) and low platelet count (OR, 4,94; 95% CI, 1.56-15.68; $p = 0.0067$) at presentations, and protective factors against the development of seizures were heart failure (OR, 0.04; 95% CI, 0.00-0.63; $p = 0.0222$), concomitant use of steroids (OR, 0.19; 95% CI, 0.05-0.77; $p = 0.0201$), or antiplatelet agents (OR, 0.12; 95% CI, 0.02-0.63, $p = 0.0123$) with ertapenem.

CONCLUSIONS: The development of ertapenem-associated seizures may occur more frequently and much earlier due to its widespread use in treating drug-resistant pathogens, especially when these pathogens emerged worldwide. Our study would help physician to estimate the risk of developing seizure among patients receiving ertapenem.

J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S107-S113

Remote damage control during the attacks on Paris: Lessons learned by the Paris Fire Brigade and evolutions in the rescue system.

Lesaffre X, Tourtier JP, Violin Y, Frattini B, Rivet C, Stibbe O, Faure F, Godefroy A, Gallet JC, Ausset S.

ABSTRACT:

On November 13, 2015, in 40 minutes, Paris suffered four suicide bombers attacks; shootings at three different restaurant terraces; and an attack on the Bataclan concert hall, resulting in 130 dead and 495 wounded. How did the Parisian rescue system respond and how did it evolve since? We proved we could deploy quickly wide prehospital and hospital resources and teams' equipment and preparedness is being further developed. To secure a swifter initial response, we need a better integration of the operators of the rescue chain with a simpler and more robust organization as well as improved communications channels. We must continue to anticipate and prepare for possible future attacks.

Wilderness Environ Med. 2017 Jun;28(2S):S69-S73.

Treatment of Thoracic Trauma: Lessons From the Battlefield Adapted to All Austere Environments.

Littlejohn LF

ABSTRACT:

Severe thoracic trauma in the backcountry can be a formidable injury pattern to successfully treat. Traumatic open, pneumo-, and hemothoraces represent some of the most significant patterns for which advanced equipment and procedures may help leverage morbidity and mortality, particularly when evacuation is delayed and environmental conditions are extreme. This paper reviews the development of successful techniques for treating combat casualties with thoracic trauma, including the use of vented chest seals and the technique of needle thoracentesis. Recommendations are then given for applying this knowledge and skill set in the backcountry.

J Trauma Acute Care Surg. 2017 Jul;83(1 Suppl 1):S98-S103.

Inefficacy of standard vital signs for predicting mortality and the need for prehospital life-saving interventions in blunt trauma patients transported via helicopter: A repeated call for new measures.

Liu NT, Holcomb JB, Wade CE, Salinas J.

BACKGROUND: The aim of this study was to investigate the efficacy of traditional vital signs for predicting mortality and the need for prehospital lifesaving interventions (LSIs) in blunt trauma patients requiring helicopter transport to a Level I trauma center. Our hypothesis was that standard vital signs are not sufficient for identifying or determining treatment for those patients most at risk.

METHODS: This study involved prehospital trauma patients suffering from blunt trauma (motor vehicle/cycle collision) and transported from the point of injury via helicopter. Means and standard deviations for vital signs and Glasgow Coma Scale (GCS) scores were obtained for non-LSI versus LSI and survivor versus nonsurvivor patient groups and then compared using Wilcoxon statistical tests. Variables with statistically significant differences between patient groups were then used to develop multivariate logistic regression models for predicting mortality and/or the need for prehospital LSIs. Receiver-operating characteristic (ROC) curves were also obtained to compare these models.

RESULTS: A final cohort of 195 patients was included in the analysis. Thirty (15%) patients received a total of 39 prehospital LSIs. Of these, 12 (40%) died. In total, 33 (17%) patients died. Of these, 21 (74%) did not receive prehospital LSIs. Model variables were field heart rate, lowest systolic blood pressure, shock index, pulse pressure, and GCS components. Using vital signs alone, ROC curves demonstrated poor prediction of LSI needs, mortality, and nonsurvivors who did not receive LSIs (area under the curve [AUC], AUCs: 0.72, 0.65, and 0.61). When using both vital signs and GCS, ROC curves still demonstrated poor prediction of nonsurvivors overall and nonsurvivors who did not receive LSIs (AUCs: 0.67, 0.74).

CONCLUSION: The major implication of this study was that traditional vital signs cannot identify or determine treatment for many prehospital blunt trauma patients who are at great risk. This study reiterated the need for new measures to improve blunt trauma triage and prehospital care.

LEVEL OF EVIDENCE: Therapeutic/care management, level IV.

J Trauma Acute Care Surg. 2017 May 30. Epub ahead of print

Early infectious outcomes following addition of fluoroquinolone or aminoglycoside to post-trauma antibiotic prophylaxis in combat-related open fracture injuries.

Lloyd BA, Murray CK, Shaikh F, Carson ML, Blyth DM, Schnaubelt ER, Whitman TJ, Tribble DR; and the Infectious Disease Clinical Research Program Trauma Infectious Disease Outcomes Study Group.

BACKGROUND: We examined combat-related open extremity fracture infections as a function of whether post-trauma antimicrobial prophylaxis included expanded Gram-negative (EGN) coverage.

METHODS: Military personnel with open extremity fractures sustained in Iraq and Afghanistan (2009-2014) who transferred to participating hospitals in the United States were assessed. The analysis was restricted to patients with a U.S. hospitalization period of ≥7 days. Prophylaxis was classified as narrow (e.g., IV cefazolin, clindamycin, and/or amoxicillin-clavulanate) or EGN, if the prophylactic regimen included fluoroquinolones and/or aminoglycosides.

RESULTS: The study population included 1044 patients, of which 585 (56%) and 459 (44%) received narrow and EGN coverage, respectively ($p<0.001$). Skin and soft-tissue infections (SSTIs) were more common among patients who received narrow prophylaxis compared to EGN coverage (28% versus 22%; $p=0.029$), while osteomyelitis rates were comparable between regimens (8%). Similar findings were noted when endpoints were measured at two and four weeks post-injury. There was no significant difference related to length of hospitalization between narrow and EGN regimens (median: 34 and 32 days, respectively) or operation room visits (median: 5 and 4). A higher proportion of EGN coverage patients had Gram-negative organisms isolated that were not susceptible to fluoroquinolones and/or aminoglycosides (49% versus 40%; $p<0.001$). In a Cox proportional model, narrow prophylaxis was independently associated with an increased risk of extremity SSTIs (Hazard Ratio: 1.41; 95% confidence interval: 1.09-1.83).

DISCUSSION: Despite seeing a small benefit with EGN coverage related to a reduction of SSTIs, it does not decrease the risk of osteomyelitis and there appears to be a cost of increased antibiotic resistance associated with use. Overall, our findings support the current post-combat trauma antibiotic prophylaxis guidelines, which recommend use of cefazolin or clindamycin with open fractures.

LEVEL OF EVIDENCE: Prognostic/Epidemiological Level I.

J Spec Op Med 2017; 1723-27

Combat Trousers as Effective Improvised Pelvic Binders: A Comparative Cadaveric Study

Loftus A, Morris R, Friedmann Y, Pallister I, Parker P

BACKGROUND: Improvised explosive devices and landmines can cause pelvic fractures, which, in turn, can produce catastrophic hemorrhage. This cadaveric study compared the intrapelvic pressure changes that occurred with the application of an improvised pelvic binder adapted from the combat trousers worn by British military personnel with the commercially available trauma pelvic orthotic device (TPOD).

METHODS: Six unembalmed cadavers (three male, three female) were used to simulate an unstable pelvic fracture with complete disruption of the posterior arch (AO/OTA 61-C1) by dividing the pelvic ring anteriorly and posteriorly. A 3-4cm manometric balloon filled with water was placed in the retropubic space and connected to a 50mL syringe and water manometer via a three-way tap. A baseline pressure of 8cm H2O (average central venous pressure) was set. The combat trouser binder (CTB) and TPOD were applied to each cadaver in a random sequence and the steady intrapelvic pressure changes were recorded. Statistical analysis was performed using the Wilcoxon rank-sum test and a paired t test depending on the normality of the data to determine impact on the intrapelvic pressure of each intervention compared with baseline.

RESULTS: The median steady intrapelvic pressure achieved after application of the CTB was 16cm H2O and after application of the TPOD binder was 18cm H2O, both of which were significantly greater than the baseline pressure ($\rho < .01$ and .036, respectively) but not significantly different from each other ($\rho > .05$).

CONCLUSION: Pelvic injuries are increasingly common in modern theaters of war. The CTB is a novel, rapidly deployable, yet effective, method of pelvic binding adapted from the clothes the casualty is already wearing. This technique may be used in austere environments to tamponade and control intrapelvic hemorrhage.

Wilderness Environ Med. 2017 Jun;28(2S):S61-S68

Awake Cricothyrotomy: A Novel Approach to the Surgical Airway in the Tactical Setting.

Mabry RL, Kharod CU, Bennett BL

ABSTRACT:

Airway obstruction on the battlefield is most often due to maxillofacial trauma, which may include bleeding and disrupted airway anatomy. In many of these cases, surgical cricothyrotomy (SC) is the preferred airway management procedure. SC is an emergency airway procedure performed when attempts to open an airway using nasal devices, oral devices, or tracheal intubation have failed, or when the risks from intubation are unacceptably high. The aim of this overview is to describe a novel approach to the inevitably surgical airway in which SC is the first and best procedure to manage the difficult or failed airway. The awake SC technique and supporting algorithm are presented along with the limitations and future directions. Awake SC, using local anesthetic with or without ketamine, will allow the knowledgeable provider to manage patients with a compromised airway across the continuum of emergency care ranging from remote/en route care, austere settings, and prehospital to the emergency department.

J Trauma Acute Care Surg. 2017 May 30 Epub ahead of print

Impact of Critical Care Air Transport Team (CCATT) ventilator management on combat mortality.

Maddry JK, Mora AG, Savell SC, Perez CA, Mason PE, Aden JK, Bebarta VS

BACKGROUND: Aeromedical evacuation platforms such as Critical Care Air Transport Teams (CCATTs) play a vital role in the transport and care of critically injured and ill patients in the combat theater. Mechanical ventilation is used to support patients with failing respiratory function and patients requiring high levels of sedation. Mechanical ventilation, if not managed appropriately, can worsen or cause lung injury, as well as contribute to increased morbidity.The purpose of this study was to evaluate the impact of ARDSNet protocol compliance during aeromedical evacuation of ventilated combat injured patients.

METHODS: We performed a retrospective chart review of combat injured patients transported by CCATTs from Afghanistan to Landstuhl Regional Medical Center (LRMC) in Germany between January 2007 and January 2012. Following univariate analyses, we performed regression analyses to assess compliance and post-flight outcomes. Cox proportional hazard models were used to evaluate associations between the risk factor of non-compliance with increased number of ventilator, ICU, or hospital days. Nominal logistic regression models were performed to evaluate the association between non-compliance and mortality.

RESULTS: Sixty-two percent (n=669) of 1086 patients required mechanical ventilation during transport. A total of 650 patients required volume controlled mechanical ventilation and were included in the analysis. Of the 650 subjects, 62% (n=400) were non-compliant per tidal volume and ARDSNet table recommendations. The groups were similar in all demographic variables, except the Non-compliant group had a higher ISS compared to the Compliant group. Subjects in the Compliant group were less likely to have an incidence of acute respiratory distress, acute respiratory failure, and ventilator associated pneumonia when combing the variables (2% vs 7%, $p<0.0069$).The Non-compliant group had an increased incidence of in-flight respiratory events, required more days on the ventilator and in the ICU, and had a higher mortality rate.

CONCLUSIONS: Compliance with the ARDSNet guidelines was associated with a decrease in ventilator days, ICU days, and 30-day mortality.

LEVEL OF EVIDENCE: Level III: Therapeutic/Care Management.

Trials. 2017 Jul 17;18(1):330

A nested mechanistic sub-study into the effect of tranexamic acid versus placebo on intracranial haemorrhage and cerebral ischaemia in isolated traumatic brain injury: study protocol for a randomised controlled trial (CRASH-3 Trial Intracranial Bleeding Mechanistic Sub-Study [CRASH-3 IBMS]).

Mahmood A, Roberts I, Shakur H

BACKGROUND: Tranexamic acid prevents blood clots from breaking down and reduces bleeding. However, it is uncertain whether tranexamic acid is effective in traumatic brain injury. The CRASH-3 trial is a randomised controlled trial that will examine the effect of tranexamic acid (versus placebo) on death and disability in 13,000 patients with traumatic brain injury. The CRASH-3 trial hypothesizes that tranexamic acid will reduce intracranial haemorrhage, which will reduce the risk of death. Although it is possible that tranexamic acid will reduce intracranial bleeding, there is also a potential for harm. In particular, tranexamic acid may increase the risk of cerebral thrombosis and ischaemia. The protocol detailed here is for a mechanistic sub-study nested within the CRASH-3 trial. This mechanistic sub-study aims to examine the effect of tranexamic acid (versus placebo) on intracranial bleeding and cerebral ischaemia.

METHODS: The CRASH-3 Intracranial Bleeding Mechanistic Sub-Study (CRASH-3 IBMS) is nested within a prospective, double-blind, multi-centre, parallel-arm randomised trial called the CRASH-3 trial. The CRASH-3 IBMS will be conducted in a cohort of approximately 1000 isolated traumatic brain injury patients enrolled in the CRASH-3 trial. In the CRASH-3 IBMS, brain scans acquired before and after randomisation are examined, using validated methods, for evidence of intracranial bleeding and cerebral ischaemia. The primary outcome is the total volume of intracranial bleeding measured on computed tomography after randomisation, adjusting for baseline bleeding volume. Secondary outcomes include progression of intracranial haemorrhage (from pre- to post-randomisation scans), new intracranial haemorrhage (seen on post- but not pre-randomisation scans), intracranial haemorrhage following neurosurgery, and new focal ischaemic lesions (seen on post-but not pre-randomisation scans). A linear regression model will examine whether receipt of the trial treatment can predict haemorrhage volume. Bleeding volumes and new ischaemic lesions will be compared across treatment groups using relative risks and 95% confidence intervals.

DISCUSSION: The CRASH-3 IBMS will provide an insight into the mechanism of action of tranexamic acid in traumatic brain injury, as well as information about the risks and benefits. Evidence from this trial could inform the management of patients with traumatic brain injury.

TRIAL REGISTRATION: The CRASH-3 trial was prospectively registered and the CRASH-3 IBMS is an addition to the original protocol registered at the International Standard Randomised Controlled Trials registry (ISRCTN15088122) 19 July 2011, and ClinicalTrials.gov on 25 July 2011 (NCT01402882).

Eur J Emerg Med. 2017 Jul 19.

Increase in intracranial pressure by application of a rigid cervical collar: a pilot study in healthy volunteers.

Maissan IM, Ketelaars R, Vlottes B, Hoeks SE, den Hartog D, Stolker RJ.

OBJECTIVES: Rigid cervical collars are known to increase intracranial pressure (ICP) in severe traumatic brain injury (TBI). Cerebral blood flow might decrease according to the Kellie Monroe doctrine. For this reason, the use of the collar in patients with severe TBI has been abandoned from several trauma protocols in the Netherlands. There is no evidence on the effect of a rigid collar on ICP in patients with mild or moderate TBI or indeed patients with no TBI. As a first step we tested the effect in healthy volunteers with normal ICPs and intact autoregulation of the brain.

METHODS: In this prospective blinded cross-over study, we evaluated the effect of application of a rigid cervical collar in 45 healthy volunteers by measuring their optical nerve sheath diameter (ONSD) by transocular sonography. Sonographic measurement of the ONSD behind the eye is an indirect noninvasive method to estimate ICP and pressure changes.

RESULTS: We included 22 male and 23 female volunteers. In total 360 ONSD measurements were performed in these 45 volunteers. Application of a collar resulted in a significant increase in ONSD in both the left (β=0.06, 95% confidence interval: 0.05-0.07, P<0.001) and the right eye (β=0.01, 95% confidence interval: 0.00-0.02, P=0.027) CONCLUSION: Application of a rigid cervical collar significantly increases the ONSD in healthy volunteers with intact cerebral autoregulation. This suggests that ICP may increase after application of a collar. In healthy volunteers, this seems to be of minor importance. On the basis of our findings the effect of a collar on ONSD and ICP in patients with mild and moderate TBI needs to be determined.

Malays Orthop J. 2016 Nov;10(3):49-51.

Calf Compartment Syndrome associated with the Use of an Intra-osseous Line in an Adult Patient: A Case Report.

Malhotra R, Chua WL, O'Neill G

ABSTRACT:

We present a case of a lower limb compartment syndrome associated with the use of an intra-osseous line inserted into the proximal tibia in an adult patient. An unconscious 59-year old male with multiple injuries presented to our Emergency Department after a road traffic accident. Bilateral proximal tibial intra osseous-lines were inserted due to poor venous access. After resuscitation his left leg was noted to be tense and swollen with absent pulses. Acute compartment syndrome was diagnosed both clinically and with compartment pressure measurement. Two incision fasciotomy on his left lower leg was performed. Intra osseous-lines in the proximal tibia are increasingly used in adult patients in the pre-hospital setting by paramedics and emergency physicians. Their use, along with the possible complications of these devices, such as the development of compartment syndrome or osteomyelitis leading to amputation, is well reported in the paediatric literature. To the best of our knowledge, there have not been any previous reports of complications in the adult patient. We present a case of lower leg compartment syndrome developing from the use of an intra-osseous line in the proximal tibia in an adult patient. With the increasing use of intra-osseous lines in adult patients, clinicians should be aware of the possibility of developing compartment syndrome which may lead to disability or amputation in severe cases.

Mil Med. 2017 Jul;182(7):e1706-e1711.

Resuscitation of Hypotensive Traumatic Brain Injured Animals With Spray-Dried Plasma Does Not Adversely Alter Physiology and Improves Blood-Brain Barrier Function.

McDaniel S, Golla S, Moore AN, DaCorta J, Bode A, Pati S, Dash PK, Zhao J

INTRODUCTION: According to the Defense and Veterans Brain Injury Center and the Armed Forces Health Surveillance Center, the number of soldiers who have sustained a traumatic brain injury (TBI) has risen dramatically over the past decade. Studies have shown that brain damage can be exacerbated if blood loss occurs (often occurring in polytrauma). As blood supply is critical for brain function and survival, TBI patients must be properly resuscitated to maintain blood volume, blood pressure, and cerebral perfusion. Recent studies have suggested that blood loss can damage the vascular endothelium and enhance blood-brain barrier (BBB) permeability. Brain endothelial cells and the tight junctions between them are key structural components of the BBB. As the BBB is critical for isolating the brain from potential pathogens and for regulating the influx of molecules into the brain, evaluation of resuscitation fluids for their efficacy to improve BBB function has clinical relevance. Although whole blood and fresh frozen plasma (FFP) contain the essential coagulation factors, ions, and other factors, the transport and storage of these products in remote, austere environments can be challenging. The use of spray-dried plasma (SDP) has several advantages including storage at ambient temperature, can be readily reconstituted before use, and infectious materials can be inactivated during the drying process. In this study, we compared FFP and SDP for their effects on blood pressure, cerebral blood flow, BBB integrity, and markers of endothelial cells and tight junction proteins, in TBI animals with blood loss.

MATERIALS AND METHODS: All procedures were reviewed and approved by the UTHealth animal welfare committee. Sprague Dawley rats received controlled cortical impact brain injury followed by removal of 25% blood volume. Animals were resuscitated 40 minutes later with either FFP or concentrated SDP (Resusix) Heart rate and blood pressure were monitored continuously using catheters implanted into the femoral artery. Cerebral perfusion was assessed using a scanning laser Doppler device. Twenty-four hours after the injury and resuscitation with either FFP or SDP, BBB integrity were monitored by measuring the amount of Evans Blue dye in the injured brain following its intravenous administration. As this dye is excluded from the uninjured brain, its presence in the injured brain is an indicator of BBB breakdown. In addition, von Willebrand Factor immunohistochemistry was used to examine endothelial cell loss, whereas claudin-5 immunohistochemistry was used to assess the loss of tight junctions, in FFP- and SDP-resuscitated TBI animals.

RESULTS: Our results show that post-TBI resuscitation with FFP and SDP had similar influences on cardiovascular physiology and cerebral perfusion. Resuscitation with SDP after TBI was found to decrease BBB permeability as indicated by reduced Evans Blue dye extravasation, and increased levels of von Willebrand Factor and claudin-5, as compared to resuscitation with FFP.

CONCLUSIONS: These preclinical results show that resuscitation with SDP may be superior to FFP, and support the further evaluation of this product as a resuscitation fluid for polytrauma patients with TBI.

J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S26-S32.

Volumetric control of whole blood collection in austere environments.

Meledeo MA, Fisher AD, Peltier GC, Miles EA, Muse WB, Kerr WB, Nessen SC, Cap AP

INTRODUCTION: Fresh whole blood transfusions are a powerful tool in prehospital care; however, the lack of equipment such as a scale in field situations frequently leads to collections being under- or overfilled, leading to complications for both patient and physician. This study describes two methods for simple, rapid control of collection bag volume: (1) a length of material to constrict the bag, and (2) folding/clamping the bag.

METHOD: Whole blood collection bags were allowed to fill with saline via gravity. Paracord, zip-tie, beaded cable tie, or tourniquet was placed around the bag at circumferences of 6 to 8.75 inches. A hemostat was used to clamp folds of 1 to 1.5 inches. Several units were drawn during training exercises of the 75th Ranger Regiment with volume controlled by three methods: vision/touch estimation, constriction by paracord, and clamping with hemostat.

RESULTS: Method validation in the Terumo 450-mL bag indicated that paracord, zip-tie, and beaded cable tie lengths of 6.5 inches or clamping 1.25 inches with a hemostat provided accurate filling. The volume variance was significantly lower when using the beaded cable tie. Saline filling time was approximately 2 minutes. With the Fenwal 450-mL bag, the beaded cable tie gave best results; even if incorrectly placed by one/two beads, the volume was still within limits. In training exercises, the use of the cord/clamp greatly reduced the variability; more bags were within limits.

CONCLUSIONS: Both constricting and clamping allow for speed and consistency in blood collection. The use of common cord is appealing, but knot tying induces inevitable variability; a zip/cable tie is easier. Clamping was quicker but susceptible to high variance and bag rupturing. With proper methodological training, appropriate volumes can be obtained in any environment with minimal tools.

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

J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S33-S40.

Acute traumatic coagulopathy: The elephant in a room of blind scientists.

Meledeo MA, Herzig MC, Bynum JA, Wu X, Ramasubramanian AK, Darlington DN, Reddoch KM, Cap AP.

ABSTRACT:

Acute traumatic coagulopathy (ATC) is the failure of coagulation homeostasis that can rapidly arise following traumatic injury, hemorrhage, and shock; it is associated with higher injury severity, coagulation abnormalities, and increased blood transfusions. Acute traumatic coagulopathy has historically been defined by a prolonged prothrombin time, although newer, more informative measurements of hemostatic function have been used to improve diagnosis and support clinical decision making. The underlying biochemical mechanisms of and best practice therapeutics for ATC remain under active investigation because of its significant correlation to poor outcomes. The wide range of hypothesized mechanisms for ATC results from the large number of symptoms, phenotypes, and altered states in these patients as observed by multiple research groups. Much like the ancient fable of blind men describing an elephant from their limited perspectives, the limited nature of clinical and laboratory tools used to diagnose coagulopathy or evaluate hemostatic function has made finding causation difficult. The prolonged prothrombin time, degree of fibrinolysis, depletion of coagulation factors and inhibitors, and general failure of the blood have all been identified as being primary indicators for ATC. Therapeutic interventions including recombinant coagulation factors, antifibrinolytics, and blood products have been used with varying degrees of success as they are used to address specific symptoms. To truly understand the causes of ATC, research efforts must recognize the complexity of the hemostatic system and get to the heart of the matter by answering the question: "Is ATC a pathological condition that develops from the observed deficiencies in coagulation, fibrinolysis, and autoregulation, or is ATC an adaptive response generated as the body attempts to restore perfusion and avoid massive organ failure?" Because patient management must proceed without definitive answers regarding the entire causative chain, the current therapeutic focus should be on using what knowledge has been gained to the patient's advantage: control hemorrhage, maintain appropriate homeostatic balances of coagulation proteins, and restore oxygen perfusion.

Blood Transfus. 2017 Jul;15(4):318-324. doi: 10.2450/2017.0094-17.

The use of fibrinogen concentrate for the management of trauma-related bleeding: a systematic review and meta-analysis.

Mengoli C, Franchini M, Marano G, Pupella S, Vaglio S, Marietta M, Liumbruno GM

ABSTRACT:

Haemorrhage following injury is associated with significant morbidity and mortality. The role of fibrinogen concentrate in trauma-induced coagulopathy has been the object of intense research in the last 10 years and has been systematically analysed in this review. A systematic search of the literature identified six retrospective studies and one prospective one, involving 1,650 trauma patients. There were no randomised trials. Meta-analysis showed that fibrinogen concentrate has no effect on overall mortality (risk ratio: 1.07, 95% confidence interval: 0.83-1.38). Although the meta-analytic pooling of the current literature evidence suggests no beneficial effect of fibrinogen concentrate in the setting of severe trauma, the quality of data retrieved was poor and the final results of ongoing randomised trials will help to further elucidate the role of fibrinogen concentrate in traumatic bleeding.

J Trauma Acute Care Surg. 2017 Jul;83(1):19-24

Every minute counts: Time to delivery of initial massive transfusion cooler and its impact on mortality.

Meyer DE, Vincent LE, Fox EE, O'Keeffe T, Inaba K, Bulger E, Holcomb JB, Cotton BA.

BACKGROUND: American College of Surgeons Trauma Quality Improvement Best Practices recommends initial massive transfusion (MT) cooler delivery within 15 minutes of protocol activation, with a goal of 10 minutes. The current study sought to examine the impact of timing of first cooler delivery on patient outcomes.

METHODS: Patients predicted to receive MT at 12 Level I trauma centers were randomized to two separate transfusion ratios as described in the PROPPR trial. Assessment of Blood Consumption score or clinician gestalt prediction of MT was used to randomize patients and call for initial study cooler. In this planned subanalysis, the time to MT protocol activation and time to delivery of the initial cooler were evaluated. The impact of these times on mortality and time tohemostasis were examined using both Wilcoxon rank sum and linear and logistic regression.

RESULTS: Among 680 patients, the median time from patient arrival to MT protocol activation was 9 minutes with a median time from MT activation call to delivery of first cooler of 8 minutes. An increase in both time to MT activation and time to arrival of first cooler were associated with prolonged time to achieving hemostasis (coefficient, 1.09; $p = 0.001$ and coefficient, 1.16; $p < 0.001$, respectively). Increased time to MT activation and time to arrival of first cooler were associated with increased mortality (odds ratio [OR], 1.02; $p = 0.009$ and OR, 1.02; $p = 0.012$, respectively). Controlling for injury severity, physiology, resuscitation intensity, and treatment arm (1:1:1 vs. 1:1:2), increased time to arrival of first cooler was associated with an increased mortality at 24 hours (OR, 1.05; $p = 0.035$) and 30 days (OR, 1.05, $p = 0.016$).

CONCLUSION: Delays in MT protocol activation and delays in initial cooler arrival were associated with prolonged time to achieve hemostasis and an increase in mortality. Independent of products ratios, every minute from time of MT protocol activation to time of initial cooler arrival increases odds of mortality by 5%.

LEVEL OF EVIDENCE: Prognostic, level II; Therapeutic, level III.

Medicine (Baltimore). 2017 May;96(18):e6801

Effects of 6% hydroxyethyl starch 130/0.4 on postoperative blood loss and kidney injury in off-pump coronary arterial bypass grafting: A retrospective study.

Min JJ, Cho HS, Jeon S, Lee JH, Lee JJ, Lee YT.

ABSTRACT:

We retrospectively evaluated the effects of 6% hydroxyethyl starch (HES) 130/0.4 on postoperative blood loss and acute kidney injury (AKI) in patients undergoing off-pump coronary artery bypass grafting (OPCAB).Electronic medical records of 771 patients who underwent OPCAB in our hospital between July 2012 and July 2014 were reviewed, and 249 patients without intraoperative HES-exposure (group NoHES) were matched 1:N with intraoperative HES-exposed 413 patients (group HES) based on propensity score. The effects of intraoperative HES on postoperative cumulative blood loss within the first 24 hours, need for bleeding-related reoperation, and occurrence of postoperative AKI (determined by KDIGO and RIFLE criteria) were analyzed.In our propensity score matched cohort, there were no significant differences between groups for median postoperative 24 hours blood loss (525 mL in group HES vs. 540 mL in group NoHES, P = .203) or need for bleeding-related reoperation (OR, 2.44; 95% confidence interval [CI], 0.64-9.34, P = .19). However, postoperative AKI (assessed by 2 criteria) occurred more frequently in group HES than in group NoHES (by KDIGO criteria: 10.7% vs. 3.6%; OR 3.43 [95% CI, 1.67-7.04]; P < .001 and by RIFLE criteria: 9.6% vs. 2%; OR 3.32 [95% CI, 1.34-8.24]; P = .01). The median volume of infused HES per patient weight was 16 mL/kg in group HES.In the patients undergoing OPCAB, intraoperative 6% HES 130/0.4 did not increase postoperative bleeding. However, renal safety remains a concern. Intraoperative use of HES should be determined cautiously during OPCAB.

J Spec Oper Med. Summer 2017;17(2):21-38.

TCCC Guidelines Comprehensive Review and Update: TCCC Guidelines Change 16-03.

Montgomery HR, Butler FK, Kerr W, Conklin CC, Morissette DM, Remley MA, Shaw TA, Rich TA

ABSTRACT:

Based on careful review of the Tactical Combat Casualty Care (TCCC) Guidelines, the authors developed a list of proposed changes for inclusion in a comprehensive change proposal. To be included in the proposal, individual changes had to meet at least one of three criteria: (1) The change was primarily tactical rather than clinical; (2) the change was a minor modification to the language of an existing TCCC Guideline; and (3) the change, though clinical, was straightforward and noncontentious. The authors presented their list to the TCCC Working Group for review and approval at the 7 September 2016 meeting of the Committee on Tactical Combat Casualty Care (CoTCCC). Twenty-three items met with general agreement and were retained in this change proposal.

J Surg Res. 2017 May 8. Epub ahead of print

Tranexamic acid is associated with increased mortality in patients with physiological fibrinolysis.

Moore HB, Moore EE, Huebner BR, Stettler GR, Nunns GR, Einersen PM, Silliman CC, Sauaia A

BACKGROUND: Tranexamic acid (TXA) administration after trauma has not been proven to improve survival in the United States. Trauma patients were presented to the hospital with a spectrum of fibrinolytic activity, in which physiological levels of fibrinolysis are associated with the lowest mortality. We hypothesize that trauma patients who present to the hospital with physiological levels of fibrinolysis will have increased mortality if they receive TXA.

MATERIALS AND METHODS: Severely injured trauma patients, followed prospectively from 2014 to 2016, were included in the analysis. The patient's first thrombelastography was used to stratify patients into fibrinolysis phenotypes which included fibrinolysis shutdown, physiological fibrinolysis, and systemic hyperfibrinolysis. The primary outcome was in-hospital mortality.

RESULTS: A total of 232 patients were analyzed (11% received TXA) with an overall mortality rate of 20%. TXA administration was associated with a higher new injury severity score (49 versus 28; P = 0.001), massive transfusion rate (69% versus 12%; P < 0.001), and mortality (52% versus 17%; P < 0.001). Hyperfibrinolysis and shutdown had higher mortality rates than physiological group (24% versus 30% versus 14%; P = 0.050). The effect of TXA within phenotypes was not significant for shutdown (28% versus 38%; P = 0.604) but was significant in the physiological group (11% versus 63%; P < 0.001) and systemic hyperfibrinolysis (19% versus 55%; P = 0.023). After adjusting for new injury severity score, TXA remained a significant predictor of mortality for patients with physiological fibrinolysis (P = 0.018).

CONCLUSIONS: There was no clear benefit of receiving TXA in this study, and patients who present to the hospital with physiologic levels of fibrinolysis, who received TXA, had the highest mortality. The role of TXA in mature trauma systems remains unclear, and emerging data supports it may have adverse effects.

Am J Med. 2017 Aug;130(8):885-892.

Concussion.

Mullally WJ

ABSTRACT:

Concussion has been recognized as a clinical entity for more than 1000 years. Throughout the 20th century it was studied extensively in boxers, but it did not pique the interest of the general population because it is the accepted goal of the boxer to inflict such an injury on their opponent. In 2002, however, the possibility that repetitive concussions could result in chronic brain damage and a progressive neurologic disorder was raised by a postmortem evaluation of a retired player in the most popular sports institution in the United States, the National Football League. Since that time concussion has been a frequent topic of conversation in homes, schools, and on television and has become a major focus of sports programs in communities and schools at all levels. Now all 50 states, the District of Columbia, and the National Collegiate Athletic Association have enacted laws and rules to protect the athlete.

West J Emerg Med. 2017 Jun;18(4):673-683.

Efficacy and Safety of Tranexamic Acid in Prehospital Traumatic Hemorrhagic Shock: Outcomes of the Cal-PAT Study.

Neeki MM, Dong F, Toy J, Vaezazizi R, Powell J, Jabourian N, Jabourian A, Wong D, Vara R, Seiler K, Pennington TW, Powell J, Yoshida-McMath C, Kissel S, Schulz-Costello K, Mistry J, Surrusco MS, O'Bosky KR, Van Stralen D, Ludi D, Sporer K, Benson P, Kwong E, Pitts R, Culhane JT, Borger R

INTRODUCTION: The California Prehospital Antifibrinolytic Therapy (Cal-PAT) study (TXA) administration in cases of trauma-induced hemorrhagic shock. The current study further aimed to assess the feasibility of prehospital TXA administration by paramedics within the framework of North American emergency medicine standards and protocols.

METHODS: This is an ongoing multi-centered, prospective, observational cohort study with a retrospective chart-review comparison. Trauma patients identified in the prehospital setting with signs of hemorrhagic shock by first responders were administered one gram of TXA followed by an optional second one-gram dose upon arrival to the hospital, if the patient still met inclusion criteria. Patients administered TXA make up the prehospital intervention group. Control group patients met the same inclusion criteria as TXA candidates and were matched with the prehospital intervention patients based on mechanism of injury, injury severity score, and age. The primary outcomes were mortality, measured at 24 hours, 48 hours, and 28 days. Secondary outcomes measured included the total blood products transfused and any known adverse events associated with TXA administration.

RESULTS: We included 128 patients in the prehospital intervention group and 125 in the control group. Although not statistically significant, the prehospital intervention group trended toward a lower 24-hour mortality rate (3.9% vs 7.2% for intervention and control, respectively, p=0.25), 48-hour mortality rate (6.3% vs 7.2% for intervention and control, respectively, p=0.76), and 28-day mortality rate (6.3% vs 10.4% for intervention and control, respectively, p=0.23). There was no significant difference observed in known adverse events associated with TXA administration in the prehospital intervention group and control group. A reduction in total blood product usage was observed following the administration of TXA (control: 6.95 units; intervention: 4.09 units; p=0.01).

CONCLUSION: Preliminary evidence from the Cal-PAT study suggests that TXA administration may be safe in the prehospital setting with no significant change in adverse events observed and an associated decreased use of blood products in cases of trauma-induced hemorrhagic shock. Given the current sample size, a statistically significant decrease in mortality was not observed. Additionally, this study demonstrates that it may be feasible for paramedics to identify and safely administer TXA in the prehospital setting.

J Intensive Care. 2017 Jan 20;5:5. doi: 10.1186/s40560-016-0201-0.

Tranexamic acid and trauma-induced coagulopathy.

Nishida T, Kinoshita T, Yamakawa K

ABSTRACT:

Tranexamic acid (TXA) is a synthetic derivative of the amino acid lysine that inhibits fibrinolysis by blocking the interaction of plasminogen with the lysine residues of fibrin. Historically, TXA is commonly used for reduction of blood loss in perioperative situations, while recently it has attracted attention for clinical use in the trauma field. In 2010, the Clinical Randomization of an Antifibrinolytic in Significant Hemorrhage 2 (CRASH-2) trial demonstrated that intravenous administration of TXA improved mortality significantly in trauma patients with significant bleeding. After the launch of its sensational results, the main stream treatment protocol in trauma changed worldwide to include TXA administration. In this review, first we summarize the recent evidence or recommendations in the related guidelines concerning TXA. Also, we next tried to explore in detail not only the benefits but also the harm introduced by TXA in trauma patients, because the main adverse event results for TXA, such as vascular occlusive events in the CRASH-2 trial, are still being discussed in several papers. Thus, we briefly summarized the evidence for the safety of TXA administration by a systematic review method using observational studies. Consequently, the pooled relative risk for venous thromboembolisms was 1.61 (95% CI, 0.86-3.01), indicating a non-significant increase in the venous thromboembolism risk of TXA therapy. Regarding the basic mechanism, TXA potentially possesses the risk of venous thromboembolisms, so it should be used cautiously and selectively. Further investigation is needed to delineate the optimal targeted trauma patients to earn the maximum survival benefits with minimized risk of thrombotic complications.

Anaesthesia. 2017 Aug;72(8):987-992. doi: 10.1111/anae.13905. Epub 2017 May 2.

The height of the cricothyroid membrane on computed tomography scans in trauma patients.

Nutbeam T, Clarke R, Luff T, Enki D, Gay D

ABSTRACT:

Emergency cricothyrotomy is a common feature in all difficult airway algorithms. It is the final step following a 'can't intubate, can't oxygenate' scenario. It is rarely performed and has a significant failure rate. There is variation in the reported size of the cricothyroid membrane, especially across population groups. Procedural failure may result from attempting to pass a device with too large an external diameter through the cricothyroid membrane. We aimed to determine the maximum height of the cricothyroid membrane in a UK trauma population. Electronic callipers were used to measure the maximum height of the cricothyroid membrane on 482 reformatted trauma computed tomography scans, 377 (78.2%) of which were in male patients. The mean (SD) height of the cricothyroid membrane, as independently measured by two radiologists, was 7.89 (2.21) mm and 7.88 (2.22) mm in male patients, and 6.00 (1.76) mm and 5.92 (1.71) mm in female patients. The presence of concurrent tracheal intubation or cervical spine immobilisation was found not to have a significant effect on cricothyroid membrane height. The cricothyroid membrane height in the study population was much smaller than that previously reported. Practitioners encountering patients who may require an emergency surgical airway should be aware of these data. Rescue airway equipment with variety of external diameters should be immediately available.

Anesth Analg. 2017 Jul;125(1):200-209

Factors Influencing Quality of Pain Management in a Physician Staffed Helicopter Emergency Medical Service.

Oberholzer N, Kaserer A, Albrecht R, Seifert B, Tissi M, Spahn DR, Maurer K, Stein P

BACKGROUND: Pain is frequently encountered in the prehospital setting and needs to be treated quickly and sufficiently. However, incidences of insufficient analgesia after prehospital treatment by emergency medical services are reported to be as high as 43%. The purpose of this analysis was to identify modifiable factors in a specific emergency patient cohort that influence the pain suffered by patients when admitted to the hospital.

METHODS: For that purpose, this retrospective observational study included all patients with significant pain treated by a Swiss physician-staffed helicopter emergency service between April and October 2011 with the following characteristics to limit selection bias: Age > 15 years, numerical rating scale (NRS) for pain documented at the scene and at hospital admission, NRS > 3 at the scene, initial Glasgow coma scale > 12, and National Advisory Committee for Aeronautics score < VI. Univariate and multivariable logistic regression analyses were performed to evaluate patient and mission characteristics of helicopter emergency service associated with insufficient pain management.

RESULTS: A total of 778 patients were included in the analysis. Insufficient pain management (NRS > 3 at hospital admission) was identified in 298 patients (38%). Factors associated with insufficient pain management were higher National Advisory Committee for Aeronautics scores, high NRS at the scene, nontrauma patients, no analgesic administration, and treatment by a female physician. In 16% (128 patients), despite ongoing pain, no analgesics were administered. Factors associated with this untreated persisting pain were short time at the scene (below 10 minutes), secondary missions of helicopter emergency service, moderate pain at the scene, and nontrauma patients. Sufficient management of severe pain is significantly better if ketamine is combined with an opioid (65%), compared to a ketamine or opioid monotherapy (46%, P = .007).

CONCLUSIONS: In the studied specific Swiss cohort, nontrauma patients, patients on secondary missions, patients treated only for a short time at the scene before transport, patients who receive no analgesic, and treatment by a female physician may be risk factors for insufficient pain management. Patients suffering pain at the scene (NRS > 3) should receive an analgesic whenever possible. Patients with severe pain at the scene (NRS ≥ 8) may benefit from the combination of ketamine with an opioid. The finding about sex differences concerning analgesic administration is intriguing and possibly worthy of further study.

J Emerg Med. 2017 May;52(5):715-722.

Ultrasound-Guided Resuscitative Endovascular Balloon Occlusion of the Aorta in the Resuscitation Area.

Ogura T, Lefor AK, Nakamura M, Fujizuka K, Shiroto K, Nakano M

BACKGROUND: In trauma resuscitation with resuscitative endovascular balloon occlusion of the aorta (REBOA), urgent and accurate placement of the catheter in the resuscitation area without fluoroscopy can shorten the time from admission to REBOA, allowing rapid, temporary control of bleeding.

DISCUSSION: The experience-based protocol in our center for ultrasound-guided REBOA in the resuscitation area without fluoroscopy is as follows: the femoral artery is punctured and a guidewire inserted; sonography is used to verify that the guidewire is in the abdominal aorta; the position of the balloon is confirmed with ultrasound after estimating the distance to the clavicle, and the pressure in the radial artery and sheath is used to monitor correct positioning; connect the pressure transducer to the catheter sheath for continuous monitoring of the blood pressure in the sheath, and inflate the balloon until the blood pressure tracing at the sheath has disappeared; check the pulse in the left radial artery, and withdraw the catheter slightly if the pulse in the radial artery is not palpable or is decreased (if this pulse is not palpable or decreased, the balloon is in the aortic arch). In this retrospective review of our REBOA protocol, between April 2012 and March 2016, 34 patients were enrolled. Two patients had complications, including dissection of the femoral artery in one and difficult percutaneous vascular access in another. Median time needed to complete the procedure was 8 min. Overall, 24 of 34 patients survived more than 24 h (72%), and overall mortality was 47%. Patients who lived more than 24 h, and then died had severe traumatic brain injury or septic shock.

CONCLUSIONS: Ultrasound-guided REBOA is presented. Monitoring the blood pressure in the left radial artery allows us to determine adequate positioning of the balloon, and the blood pressure in the catheter sheath located in the femoral artery should also be monitored to prevent aortic injuries caused by the overinflation of the balloon.

Transfusion. 2017 Jul;57(7):1808-1817

Blood transfusion in the surgical treatment of adolescent idiopathic scoliosis-a single-center experience of patient blood management in 210 cases.

Ohrt-Nissen S, Bukhari N, Dragsted C, Gehrchen M, Johansson PI, Dirks J, Stensballe J, Dahl B

BACKGROUND: The surgical treatment of adolescent idiopathic scoliosis can be associated with substantial blood loss, requiring allogeneic red blood cell (RBC) transfusion. This study describes the use of RBC and the effect of a standardized perioperative patient blood management program.

STUDY DESIGN AND METHODS: Patients treated with posterior instrumented fusion were consecutively enrolled over a 6-year period. Patient blood management strategies were implemented in 2011, including prophylactic tranexamic acid, intraoperative permissive hypotension, restrictive fluid therapy (including avoidance of synthetic colloids), restrictive RBC trigger according to institutional standardized protocol, the use of cell savage, and goal-directed therapy according to thrombelastography.

RESULTS: In total, 210 patients were included. 64 patients (31%) received RBC transfusions. A decline in the intraoperative rate of RBC transfusion was observed, from 77% in 2011 to 13% in 2016 ($p < 0.001$). Patients in the transfusion group had a significantly larger major curve, lower preoperative hemoglobin, higher estimated blood loss, and an increased use of crystalloid volume resuscitation. Multiple logistic regression showed that significant predictors for RBC transfusion were preoperative hemoglobin level (odds ratio [OR], 0.40; 95% confidence interval [CI], 0.27-0.57), estimated blood loss (OR, 1.26; 95% CI, 1.15-1.42), and year of surgery (indicating the effect of patient blood management) (OR per year, 0.76; 95% CI, 0.58-0.99).

CONCLUSION: A perioperative patient blood management program substantially reduced the need for RBC transfusion. A preoperative evaluation of anemia is essential to further minimize transfusion rates.

J Med Case Rep. 2017 May 1;11(1):121.

"Cannot ventilate, cannot intubate" situation after penetration of the tongue root through to the epipharynx by a surfboard: a case report.

Ono Y, Kunii M, Miura T, Shinohara K

BACKGROUND: Surfing is an increasingly popular activity and surfing-related injuries have increased accordingly. However, to the best of our knowledge, there are no reports of penetrating upper airway injuries in surfers. We present a "cannot ventilate, cannot intubate" situation following penetrating neck injury by a surfboard fin.

CASE PRESENTATION: A previously healthy 29-year-old Japanese man was swept off his board by a large wave and his left mandible, tongue root, and right epipharynx were penetrated by the surfboard fin. He presented with severe hypovolemic shock because of copious bleeding from his mouth. Direct laryngoscopy failed, as did manual ventilation, because of the exacerbated upper airway bleeding and distorted upper airway anatomy. Open cricothyrotomy was immediately performed, followed by surgical exploration, which revealed extensive ablation of his tongue root and laceration of his lingual artery. After definitive hemostasis and intensive care, he returned home with no sequelae.

CONCLUSIONS: The long, semi-sharp surfboard fin created both extensive crushing upper airway lesions and a sharp vascular injury, resulting in a difficult airway. This case illustrates that surfing injuries can prompt a life-threatening airway emergency and serves as a caution for both surfers and health care professionals.

Wilderness Environ Med. 2017 Jun;28(2S):S117-S123

Managing Traumatic Brain Injury: Translating Military Guidelines to the Wilderness.

Otten EJ, Dorlac WC

ABSTRACT:

Traumatic brain injury (TBI) is a common injury on the battlefield. Much of what medics do to manage these injuries on the battlefield can be translated to other austere environments, such as wilderness or disaster settings. The recognition and diagnosis of TBI can be difficult even in the hospital, but basic understanding of how to define a TBI and prevent secondary injuries can be accomplished with relatively few resources and little training. This article outlines what a TBI is and how to manage it in the field.

World Neurosurg. 2017 Sep;105:1-6

Hypertonic Saline for Increased Intracranial Pressure After Aneurysmal Subarachnoid Hemorrhage: A Systematic Review.

Pasarikovski CR, Alotaibi NM, Al-Mufti F, Macdonald RL

BACKGROUND: The use of hyperosmolar agents, such as mannitol or hypertonic saline (HTS), to control high intracranial pressure (ICP) in patients with traumatic brain injury has been well studied. However, the role of HTS in the management of aneurysmal subarachnoid hemorrhage (aSAH)-associated increased ICP is still unclear.

METHODS: We performed a systematic review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. The primary outcome of this review is to quantify ICP reduction produced by HTS and its effect on clinical outcomes defined by any standardized functional score. Secondary outcomes included HTS versus mannitol in ICP reduction, HTS effects on cerebral vasospasm, and HTS dose concentration, infusion rate, infusion volume, frequency of redosing, and serum sodium/osmolality limits for repeat dosing.

RESULTS: Five studies were included in the review encompassing 175 patients. Studies on aSAH included mostly poor grade patients (defined as World Federation of Neurosurgical Societies grade 4 and 5). HTS concentrations ranged from 3%-23.5%. Most studies found that HTS decreased ICP when compared with either baseline or placebo. The mean decrease in ICP from HTS administration was 8.9 mm Hg (range: 3.3-12.1 mm Hg). Only 1 study showed possible improvement in poor grade aSAH outcomes.

CONCLUSIONS: The current evidence suggests that HTS is as effective as mannitol at reducing increased ICP in aSAH. However, there is not enough data to recommend the optimal and safest dose concentration or whether HTS significantly improves outcomes in aSAH.

Simul Healthc. 2017 Apr;12(2):76-82

Cricothyroidotomy In Situ Simulation Curriculum (CRIC Study): Training Residents for Rare Procedures.

Petrosoniak A, Ryzynski A, Lebovic G, Woolfrey K.

INTRODUCTION: Technical skill acquisition for rare procedures can be challenging given the few real-life training opportunities. In situ simulation (ISS), a training technique that takes place in the actual workplace, is a promising method to promote environmental fidelity for rare procedures. This study evaluated a simulation-based technical skill curriculum for cricothyroidotomy using deliberate practice, followed by an ISS evaluation session.

METHODS: Twenty emergency medicine residents participated in a two-part curriculum to improve cricothryoidotomy performance. A pretest established participant baseline technical skill. The training session consisted of two parts, didactic teaching followed by deliberate practice using a task-training manikin. A posttest consisted of an unannounced, high-fidelity ISS, during an emergency department shift. The primary outcome was the mean performance time between the pretest and posttest sessions. Skill performance was also evaluated using a checklist scale and global rating scale.

RESULTS: Cricothyroidotomy performance time improved significantly from pretest to posttest sessions (mean difference, 59 seconds; $P < 0.0001$). Both checklist and global rating scales improved significantly from the pretest to the posttest with a mean difference of 1.82 ($P = 0.002$) and 6.87 ($P = 0.0025$), respectively. Postcourse survey responses were favorable for both the overall curriculum experience and the unannounced ISS.

CONCLUSIONS: This pilot study demonstrated that unannounced ISS is feasible and can be used to effectively measure cricothyroidotomy performance among EM residents. After a two-part training session consisting of didactic learning and deliberate practice, improved cricothyroidotomy skill performance was observed during an unannounced ISS in the emergency department. The integration of ISS in cricothyroidotomy training represents a promising approach; however, further study is needed to establish its role.

Crit Care Nurse. 2017 Aug;37(4):37-47

Hemostatic Management of Trauma-Induced Coagulopathy.

Phillips JB, Mohorn PL, Bookstaver RE, Ezekiel TO, Watson CM

ABSTRACT:

Trauma-induced coagulopathy is a primary factor in many trauma-related fatalities. Management hinges upon rapid diagnosis of coagulation abnormalities and immediate administration of appropriate hemostatic agents. Use of crystalloids and packed red blood cells has traditionally been the core of trauma resuscitation, but current massive transfusion protocols include combination therapy with fresh frozen plasma and predefined ratios of platelets to packed red blood cells, limiting crystalloid administration. Hemostatic agents such as tranexamic acid, prothrombin complex concentrate, fibrinogen concentrate, and, in cases of refractory bleeding, recombinant activated factor VIIa may also be warranted. Goal-directed resuscitation using viscoelastic tools allows specific component-centered therapy based on individual clotting abnormalities that may limit blood product use and thromboembolic risks and may lead to reduced mortality. Because of the complex management of patients with trauma-induced coagulopathy, critical care nurses must be familiar with the pathophysiology, acute diagnostics, and pharmacotherapeutic options used to treat these patients.

J Trauma Acute Care Surg. 2017 Jul;83(1 Suppl 1):S66-S70

Clinical practice guideline adherence during Operation Inherent Resolve.

Plackett TP, Cherry DC, Delk G, Satterly S, Theler J, McVay D, Moore J, Shackelford SA

BACKGROUND: The Joint Trauma System (JTS) clinical practice guidelines (CPGs) contributed to the decrease in battlefield mortality over the past 15 years. However, it is unknown to what degree the guidelines are being followed in current military operations.

METHODS: A retrospective review was performed of all patients treated at three separate US Army Role II facilities during the first 10 months of Operation Inherent Resolve in Iraq. Charts were reviewed for patient demographics, clinical care, and outcomes. Charts were also reviewed for compliance with JTS CPGs and Tactical Combat Casualty Care recommendations.

RESULTS: A total of 114 trauma patients were treated during the time period. The mean age was 26.9 ± 10.1 years, 90% were males, and 96% were host nation patients. The most common mechanisms of injury were blast (49%) and gunshot (42%). Records were compliant with documenting a complete set of vitals in 58% and a pain score in 50% of patients. Recommendations for treatment of hypothermia were followed for 97% of patients. Tranexamic acid was given outside guidelines for 6% of patients, and for 40%, it was not determined if the guidelines were followed. Recommendations for initial resuscitative fluid were followed for 41% of patients. Recommendations for antibiotic prophylaxis were followed for 40% of intra-abdominal and 73% of soft tissue injuries. Recommendations for tetanus prophylaxis were followed for 90% of patients. Deep vein thrombosis prophylaxis was given to 32% of patients and contraindicated in 27%. The recommended transfusion ratio was followed for 56% of massive transfusion patients. Recommendations for calcium administration were followed for 40% of patients. When composite scores were created for individual surgeons, there was significant variability between surgeons with regard to adherence to guidelines.

CONCLUSIONS: There is significant deviation in the adherence to the CPGs.

LEVEL OF EVIDENCE: Epidemiologic study, level IV.

Extrem Physiol Med. 2017 Apr 20;6:1.

Measurements of rates of cooling of a manikin insulated with different mountain rescue casualty bags.

Press C, Duffy C, Williams J, Cooper B, Chapman N

BACKGROUND: Accidental hypothermia is common in those who sustain injuries in remote environments. This is unpleasant and associated with adverse effects on subsequent patient outcomes. To minimise further heat loss, a range of insulating systems are available to mountain rescue teams although the most effective and cost-efficient have yet to be determined.

METHODS: Under ambient, still, dry, air conditions, a thermal manikin was filled with water at a temperature of 42 °C and then placed into a given insulation system. Water temperature was then continuously observed via an in-dwelling temperature sensor linked to a PROPAQ 100 series monitor and recorded every 10 min for 130 min. This method was repeated for each insulating package.

RESULTS: The vacuum mattress/Pertex©/fibrepile blanket system, either on its own or coupled with the Wiggy bag, was the most efficient with water temperatures only decreasing by 3.2 °C over 130 min. This was followed by the heavy-weight casualty bags without the vacuum mattress/Pertex©/fibrepile blanket system, decreasing by 4.2-4.3 °C. With the Blizzard bag, a decline in water temperature of 5.4 °C was seen over the study duration while a decrease of 9.5 °C was noted when the plastic survival bag was employed.

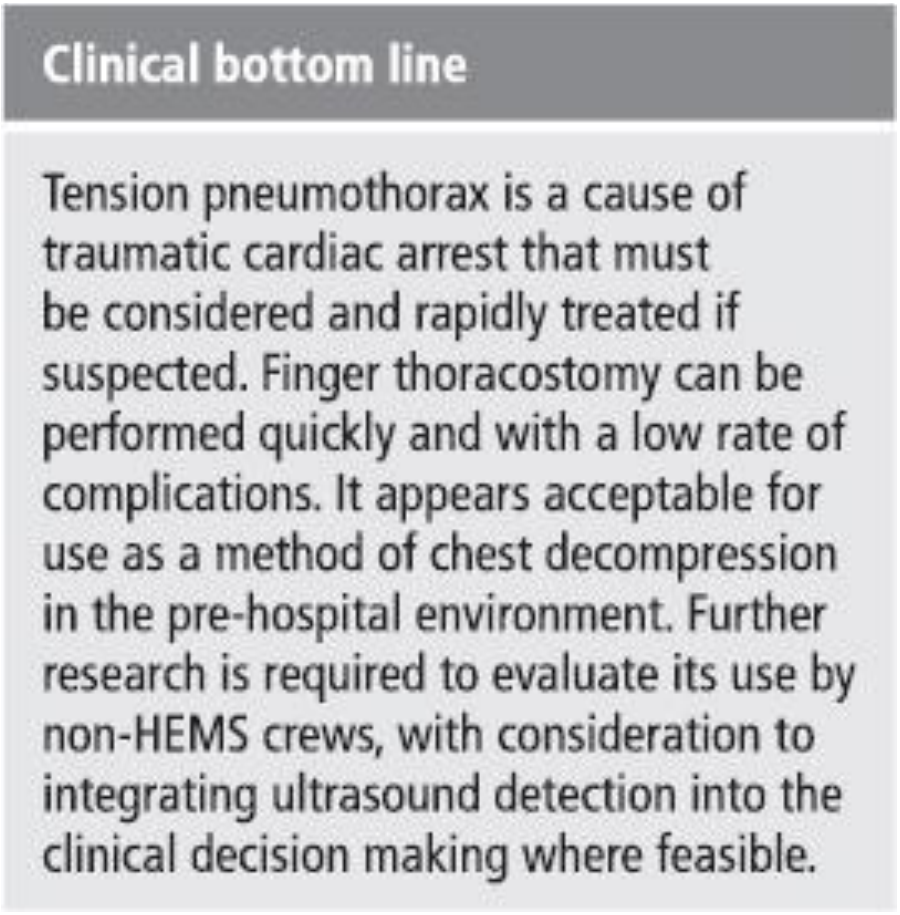
CONCLUSIONS: Under the still-air conditions of the study, the vacuum mattress/Pertex©/fibrepile blanket was seen to offer comparable insulation effectiveness compared to be both heavy-weight casualty bags. In turn, these three systems appeared more efficient at insulating the manikin than the Blizzard bag or plastic survival bag.

Emerg Med J 2017;34:419

Prehospital finger thoracostomy in patients with chest trauma.

Pritchard J, Hogg K:

QUOTE:



Clinical bottom line

Tension pneumothorax is a cause of traumatic cardiac arrest that must be considered and rapidly treated if suspected. Finger thoracostomy can be performed quickly and with a low rate of complications. It appears acceptable for use as a method of chest decompression in the pre-hospital environment. Further research is required to evaluate its use by non-HEMS crews, with consideration to integrating ultrasound detection into the clinical decision making where feasible.

Cochrane Database Syst Rev. 2017 Jul 20;7:CD009026.

ProSeal versus Classic laryngeal mask airway (LMA) for positive pressure ventilation in adults undergoing elective surgery.

Qamarul Hoda M, Samad K, Ullah H

BACKGROUND: The development of supraglottic airway devices has revolutionized airway management during general anaesthesia. Two devices are widely used in clinical practice to facilitate positive pressure ventilation: the ProSeal laryngeal mask airway (pLMA) and the Classic laryngeal mask airway (cLMA). It is not clear whether these devices have important clinical differences in terms of efficacy or complications.

OBJECTIVES: To compare the effectiveness of the ProSeal laryngeal mask airway (pLMA) and the Classic LMA (cLMA) for positive pressure ventilation in adults undergoing elective surgery.

SEARCH METHODS: We searched the Cochrane Central Register of Controlled Trials (CENTRAL; 2017, Issue 3) in the Cochrane Library; MEDLINE (Ovid SP, 1997 to April 2017); Embase (Ovid SP, 1997 to April 2017); the Institute for Scientific Information (ISI) Web of Science (1946 to April 2017); and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) (EBSCO host, 1982 to April 2017).We searched trial registries for ongoing studies to April 2017.We did not impose language restrictions. We restricted our search to the time from 1997 to April 2017 because pLMA was introduced into clinical practice in the year 2000.

SELECTION CRITERIA: We included randomized controlled trials (RCTs) that compared the effectiveness of pLMA and cLMA for positive pressure ventilation in adults undergoing elective surgery. We planned to include only data related to the first phase of cross-over RCTs.

DATA COLLECTION AND ANALYSIS: We used standard methodological procedures expected by the Cochrane Collaboration.

MAIN RESULTS: We included eight RCTs that involved a total of 829 participants (416 and 413 participants in the pLMA and cLMA groups, respectively). We identified six cross-over studies that are awaiting classification; one is completed but has not been published, and data related to the first treatment period for the other five studies were not yet available. Seven included studies provided data related to the primary outcome, and eight studies provided data related to more than one secondary outcome.Our analysis was hampered by the fact that a large proportion of the included studies reported no events in either study arm. No studies reported significant differences between devices in relation to the primary review outcome: failure to adequately mechanically ventilate. We evaluated this outcome by assessing two variables: inadequate oxygenation (risk ratio (RR) 0.75, 95% confidence interval (CI) 0.17 to 3.31; four studies, N = 617) and inadequate ventilation (not estimable; one study, N = 80).More time was required to establish an effective airway using pLMA (mean difference (MD) 10.12 seconds, 95% CI 5.04 to 15.21; P < 0.0001; I^2 = 73%; two studies, N = 434). Peak airway pressure during positive pressure ventilation was lower in cLMA participants (MD 0.84, 95% CI 0.02 to 1.67; P = 0.04; I^2 = 0%; four studies, N = 259). Mean oropharyngeal leak (OPL) pressure was higher in pLMA participants (MD 6.93, 95% CI 4.23 to 9.62; P < 0.00001; I^2 = 87%; six studies, N = 709).The quality of evidence for all outcomes, as assessed by GRADE score, is low mainly

owing to issues related to blinding and imprecision.Data show no important differences between devices with regard to failure to insert the device, use of an alternate device, mucosal injury, sore throat, bronchospasm, gastric insufflation, regurgitation, coughing, and excessive leak. Data were insufficient to allow estimation of differences for obstruction related to the device. None of the studies reported postoperative nausea and vomiting as an outcome.

AUTHORS' CONCLUSIONS: We are uncertain about the effects of either of the airway devices in terms of failure of oxygenation or ventilation because there were very few events. Results were uncertain in terms of differences for several complications. Low-quality evidence suggests that the ProSeal laryngeal mask airway makes a better seal and therefore may be more suitable than the Classic laryngeal mask airway for positive pressure ventilation. The Classic laryngeal mask airway may be quicker to insert, but this is unlikely to be clinically meaningful.

J Trauma Acute Care Surg. 2017 Jul;83(1 Suppl 1):S1-S3.

Combat casualty care research for the multidomain battlefield.

Rasmussen TE, Baer DG, Remick KN, Ludwig GV

QUOTE:

“The 2017 Military Health System Research Symposium (MHSRS) supplement marks a decade of the Journal of Trauma and Acute Care Surgery hosting publications resulting from the military's premier medical research meeting. Among the manuscripts in this 10th consecutive military supplement are projects presented at the 2016MHSRS. Since its origins as Advanced Technology Applications for Combat Casualty Care or ATACCC, a primary aim of the symposium has been to accelerate research and innovation through information sharing among the military and civilian academic and entrepreneurial communities. The MHSRS and the efforts featured in this publication embody the military-civilian partnership, which has now been formalized through a strategic partnership between the Military Health System and the American College of Surgeons (October 2014), publication of a National Academy of Medicine report (June 2016), and language in the 2017 National Defense Authorization Act.1–4

Today, the military is at crossroads where potentially more sophisticated, near-peer adversaries pose a challenge to past successes in casualty care, a projection that requires development of newer life-saving and resuscitative capabilities for military medicine.5 Planners have challenged medical research to innovate for the mid-term and far-term to continue to build a casualty care capability able to sustain the force in more complex and logistically constrained battles with fewer resources, and potentially without direct support for long periods of time.5–7 These scenarios, many of which are encountered by military medics today, are referred to as Tactical Combat Casualty Care, extended and prolonged field care (PFC).”

J Trauma Acute Care Surg. 2017 Jul 19 Epub ahead of print

Military-civilian partnership in device innovation: development, commercialization and application of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA).

Rasmussen TE, Eliason JL.

ABSTRACT:

Noncompressible torso hemorrhage (NCTH) and shock is a leading cause of trauma-related mortality and evidence suggests that survival from this injury pattern has not improved in decades. As such, innovating new approaches and devices, including technologies which can be used by providers within a short of time after severe injury, is a priority for the military. Guided by wartime observations, and through partnerships with civilian academia and private investment, the military has led an effort to define resuscitative endovascular balloon occlusion of the aorta (REBOA) and assess its potential to address this problem. The result of this effort is development and commercialization of new REBOA-specific device referred to as the ER-REBOA™ catheter. This device has been approved by regulatory agencies in the US and abroad and is now being used in civilian trauma centers and by military teams in the deployed setting. Despite excellent device performance and an empiric benefit of its use, there remains skepticism over this disruptive change in practice and an expressed need for more robust data to prove its effectiveness. This commentary reviews of the origins of the REBOA effort and the ER-REBOA™ catheter and outlines key factors influencing its development, commercialization and implementation. This essay also outlines post-market surveillance mechanisms which are tracking use of the ER-REBOA™ catheter as well as plans for prospective, multi-center studies of REBOA in the U.S. and U.K. With this reset on the origins, rationale and progress of REBOA, it's hoped that military-civilian partnerships in this endeavor can be strengthened and that debate of this topic can be evidence-based, balanced and productive.

Spine (Phila Pa 1976). 2017 May 25 Epub ahead of print

Efficacy and Safety of Topical Use of Tranexamic Acid in Reducing Blood Loss During Primary Lumbar Spinal Surgery: A Retrospective Case Control Study.

Ren Z, Li S, Sheng L, Zhuang Q, Li Z, Xu D, Chen X, Jiang P, Zhang X.

STUDY DESIGN: A retrospective case-control study.

OBJECTIVE: To compare postoperative blood loss, amount of allogeneic blood transfusion, removal time of drainage tube, length of hospital stay, and complications associated with tranexamic acid.

SUMMARY OF BACKGROUND DATA: Spinal fusion surgery can be associated with significant blood loss. To the best of our knowledge, very few published studies exist reporting the effect of topical use of tranexamic acid (tTXA) on decreasing the blood loss in patients undergoing posterior lumbar spinal fusions.

METHODS: We conducted a retrospective non-randomized case-control study of 100 adults undergoing posterior lumbar spinal fusion surgery. In the tTXA group (n=50), wound surface was soaked with TXA (1g in 100mL saline solution) for 5 minutes before wound closure. In the control group (n=50), wound surface was soaked with the same volume of normal saline. The postoperative blood loss, removal time of drainage tube, amount of allogeneic blood transfusion and length of hospital stay were compared between the two groups. And the complications of TXA were also collected.

RESULTS: In the tTXA group, the postoperative blood loss, removal time of drainage tube, postoperative length of hospital stay were significantly lower than those in the control group (155.2±104.3mL vs 278.6±124.1mL, 2.0±0.6 d vs 2.4±0.5 d, 4.7±1.4 d vs 5.6±2.3 d, P<0.05, respectively). There was no significant difference in blood transfusion between two groups. No significant changes were noticed in terms of coagulation function, and no complications associated with TXA were observed.

CONCLUSIONS: Topical use of tranexamic acid can significantly reduce postoperative blood loss, accelerate removal of drainage tube, shorten the duration of hospital stay, while not increase the complication incidence in patients undergoing posterior lumbar spinal fusion surgery.

LEVEL OF EVIDENCE: 3

J Trauma Acute Care Surg. 2017 Jul;83(1 Suppl 1):S170-S176.

Field and en route resuscitative endovascular occlusion of the aorta: A feasible military reality?

Reva VA, Hörer TM, Makhnovskiy AI, Sokhranov MV, Samokhvalov IM, DuBose JJ.

BACKGROUND: Severe noncompressible torso hemorrhage remains a leading cause of potentially preventable death in modern military conflicts. Resuscitative endovascular occlusion of the aorta (REBOA) has demonstrated potential as an effective adjunct to the treatment of noncompressible torso hemorrhage in the civilian early hospital and even prehospital settings-but the application of this technology for military prehospital use has not been well described. We aimed to assess the feasibility of both field and en route prehospital REBOA in the military exercise setting, simulating a modern armed conflict.

METHODS: Two adult male Sus Scrofa underwent simulated junctional combat injury in the context of a planned military training exercise. Both underwent zone I REBOA in conjunction with standard tactical combat casualty care interventions-one during point of injury care and the other during en route flight care. Animals were sequentially evacuated to two separate forward surgical teams by rotary wing platform where the balloon position was confirmed by chest x-ray. Animals then underwent different damage control thoracic and abdominal procedures before euthanasia.

RESULTS: The first swine underwent immediate successful REBOA at the point of injury 7 minutes and 30 seconds after the injury. It required 6 minutes total from initiation of procedure to effective aortic occlusion. Total occlusion time was 60 minutes. In the second animal, the REBOA placement procedure was initiated immediately after takeoff (17 minutes and 40 seconds after the injury). Although the movements and vibration of flight were not significant impediments, we only succeeded to put a 6-French (Fr) sheath into a femoral artery during the 14 minutes flight due to lighting and visualization challenges. After the sheath had been upsized in the forward surgical team, the REBOA catheter was primarily placed in zone I followed by its replacement to zone III. Both animals survived to study completion and the termination of training. No complications were observed in either animal.

CONCLUSION: Our study demonstrates the potential feasibility of REBOA for use during tactical field and en route (flight) care of combat casualties. Further study is needed to determine the optimal training and utilization protocols required to facilitate the effective incorporation of REBOA into military prehospital care capabilities.

Medicine (Baltimore). 2017 Jun;96(25):e7195

The EasyTube during general anesthesia for minor surgery: A randomized, controlled trial.

Robak O, Vaida S, Gaitini L, Thierbach A, Urtubia R, Krafft P, Frass M.

BACKGROUND: The EasyTube (EzT) is a supraglottic airway device that is used for emergency airway situations. Ventilation during general anesthesia should also be feasible, but literature on the EzT is scarce. We evaluated the EzT in comparison with the endotracheal tube (ETT) in its use during general anesthesia in a comparative study.

METHODS: A total of 400 patients with American Society of Anesthesiologists (ASA) physical status I to II scheduled for minor surgery in 4 centers were randomized for ventilation via the ETT or EzT.

RESULTS: In all patients, the EzT and the ETT could be inserted within 3 attempts. In all EzT patients, the inspiratory and expiratory minute volumes (6.64±0.71 and 6.34±0.69L/min) were sufficient to reach target oxygenation values, similar to ETT patients (P = .59). Mean peak pressure, mean plateau pressure, and mean dynamic compliance did not differ between the groups. Sore throat and blood on the cuff after removal were the most frequent complications in both groups.

CONCLUSION: Ventilation for up to 1 hour during general anesthesia in patients with ASA physical status I to II with the EzT is feasible and safe.

PLoS One. 2017 Jun 2;12(6):e0178756.

Inter-center comparison of EasyTube and endotracheal tube during general anesthesia in minor elective surgery.

Robak O, Vaida S, Somri M, Gaitini L, Füreder L, Frass M, Szarpak L

BACKGROUND: The EasyTube® (EzT) is a supraglottic airway device (SAD) enabling ventilation irrespective of its placement into the esophagus or trachea. Data obtained on SADs from multicenter studies, performed in highly specialized centers cannot always be transferred to other sites. However, data on comparability of different sites are scarce. This study focused on inter-site variability of ventilatory and safety parameters during general anesthesia with the EzT.

METHODS: 400 patients with ASA physical status I-II undergoing general anesthesia for elective surgery in four medical centers (EzT group (n = 200), ETT group (n = 200)). Mallampati classification, success of insertion, insertion time, duration of ventilation, number of insertion attempts, ease of insertion, tidal volumes, leakage, hemodynamic parameters, oxygenation, and complications rates with the EasyTube (EzT) or endotracheal tube (ETT) in comparison within the sites and in between the sites were recorded.

RESULTS: Intra-site and inter-site comparison of insertion success as primary outcome did not differ significantly. The inter-site comparison of expiratory minute volumes showed that the volumes achieved over the course of anesthesia did not differ significantly, however, mean leakage at one site was significantly higher with the EzT (0.63 l/min, p = 0.02). No significant inter-site differences in heart rate, blood pressure, or oxygenation were observed. Sore throat and blood on the cuff after removal of the device were the most frequent complications with significantly more complications at one site with the EzT (p = 0.01) where insertion was also reported significantly more difficult (p = 0.02).

CONCLUSION: Performance of the EzT but not the ETT varied between sites with regard to insertion difficulty, leakage, and complications but not insertion success, ventilation, hemodynamics, and oxygenation parameters in patients with ASA physical status 1-2 during general anesthesia undergoing minor elective surgery.

Arq Neuropsiquiatr. 2017 Jun;75(6):387-393

Traumatic spinal cord injury: current concepts and treatment update.

Rouanet C, Reges D, Rocha E, Gagliardi V, Silva GS

ABSTRACT:

Spinal cord injury (SCI) affects 1.3 million North Americans, with more than half occurring after trauma. In Brazil, few studies have evaluated the epidemiology of SCI with an estimated incidence of 16 to 26 per million per year. The final extent of the spinal cord damage results from primary and secondary mechanisms that start at the moment of the injury and go on for days, and even weeks, after the event. There is convincing evidence that hypotension contributes to secondary injury after acute SCI. Surgical decompression aims at relieving mechanical pressure on the microvascular circulation, therefore reducing hypoxia and ischemia. The role of methylprednisolone as a therapeutic option is still a matter of debate, however most guidelines do not recommend its regular use. Neuroprotective therapies aiming to reduce further injury have been studied and many others are underway. Neuroregenerative therapies are being extensively investigated, with cell based therapy being very promising.

Emerg Med J. 2017 Sep;34(9):568-572

Detection of pneumothoraces in patients with multiple blunt trauma: use and limitations of eFAST.

Sauter TC, Hoess S, Lehmann B, Exadaktylos AK, Haider DG

BACKGROUND: Extended focused assessment with sonography for trauma (eFAST) has been shown to have moderate sensitivity for detection of pneumothorax in trauma. Little is known about the location or size of missed pneumothoraces or clinical predictors of pneumothoraces in patients with false-negative eFAST.

METHODS: This retrospective cross-sectional study includes all patients with multiple blunt trauma diagnosed with pneumothorax who underwent both eFAST and CT performed in the ED of a level 1 trauma centre in Switzerland between 1 June 2012 and 30 September 2014. Sensitivity of eFAST for pneumothorax was determined using CT as the gold standard. Demographic and clinical characteristics of those who had a pneumothorax detected by eFAST and those who did not were compared using the Mann-Whitney U or Pearson's $\chi(2)$ tests. Univariate binary logistic regression models were used to identify predictors for pneumothoraces in patients with negative eFAST examination.

RESULTS: The study included 109 patients. Overall sensitivity for pneumothorax on eFAST was 0.59 and 0.81 for pneumothoraces requiring treatment. Compared with those detected by eFAST, missed pneumothoraces were less likely to be ventral (30 (47.6%) vs 4 (9.3%), $p < 0.001$) and more likely to be apical and basal (7 (11.1%) vs 15 (34.9%), $p=0.003$; 11 (17.5%) vs 18 (41.9%), $p=0.008$, respectively). The missed pneumothoraces were smaller than the detected pneumothoraces (left side: 30.7±17.4 vs 12.1±13.9 mm; right side: 30.2±10.1 vs 6.9±10.2 mm, both $p < 0.001$). No clinical variables were identified which predicted pneumothoraces in falsely negative eFAST. Among those pneumothoraces missed by eFAST, 30% required tube thoracostomy compared with 88.9% of those detected with eFAST.

CONCLUSION: In our study, pneumothoraces missed by eFAST were smaller and in atypical locations compared with those detected by eFAST and needed thoracic drainage less often.

J Spec Oper Med. 2017 Fall;17(3):85-89.

Chest Seal Placement for Penetrating Chest Wounds by Prehospital Ground Forces in Afghanistan.

Schauer SG, April MD, Naylor JF, Simon EM, Fisher AD, Cunningham CW, Morissette DM, Fernandez JRD, Ryan KL.

BACKGROUND: Thoracic trauma represents 5% of all battlefield injuries. Communicating pneumothoraces resulting in tension physiology remain an important etiology of prehospital mortality. In addressing penetrating chest trauma, current Tactical Combat Casualty Care (TCCC) guidelines advocate the immediate placement of a vented chest seal device. Although the Committee on TCCC (CoTCCC) has approved numerous chest seal devices for battlefield use, few data exist regarding their use in a combat zone setting.

OBJECTIVE: To evaluate adherence to TCCC guidelines for chest seal placement among personnel deployed to Afghanistan.

METHODS: We obtained data from the Prehospital Trauma Registry (PHTR). Joint Trauma System personnel linked patients to the Department of Defense Trauma Registry, when available, for outcome data upon reaching a fixed facility.

RESULTS: In the PHTR, we identified 62 patients with documented gunshot wound (GSW) or puncture wound trauma to the chest. The majority (74.2%; n = 46) of these were due to GSW, with the remainder either explosive-based puncture wounds (22.6%; n = 14) or a combination of GSW and explosive (3.2%; n = 2). Of the 62 casualties with documented GSW or puncture wounds, 46 (74.2%) underwent chest seal placement. Higher proportions of patients with medical officers in their chain of care underwent chest seal placement than those that did not (63.0% versus 37.0%). The majority of chest seals placed were not vented.

CONCLUSION: Of patients with a GSW or puncture wound to the chest, 74.2% underwent chest seal placement. Most of the chest seals placed were not vented in accordance with guidelines, despite the guideline update midway through the study period. These data suggest the need to improve predeployment training on TCCC guidelines and matching of the Army logistical supply chain to the devices recommended by the CoTCCC.

Int J Obstet Anesth. 2017 Apr 1 Epub ahead of print

An algorithm for the management of coagulopathy from postpartum hemorrhage, using fibrinogen concentrate as first-line therapy.

Seto S(1), Itakura A(2), Okagaki R(1), Suzuki M(1), Ishihara O(1).

BACKGROUND: We constructed an algorithm for the management of coagulopathy from massive postpartum hemorrhage. Fibrinogen concentrate was administered preferentially, and the dose of both fibrinogen concentrate and fresh frozen plasma given was determined by the plasma fibrinogen concentration and prothrombin time. The efficacy of the algorithm and the amount of fibrinogen concentrate and fresh frozen plasma transfused were determined.

METHODS: The study was conducted in a single teaching perinatal center. Nineteen patients were included between April 2011 and March 2014 (patient group). For a historical comparison group, we retrospectively analyzed the records of 19 patients who had been treated for coagulopathy from massive postpartum hemorrhage between April 2006 and March 2011 (control group).

RESULTS: Blood loss was significantly lower in the patient group. No adverse events were associated with this management in either group. The dose of fibrinogen concentrate administered was significantly higher and that of fresh frozen plasma administered was significantly lower in the patient group.

CONCLUSION: This algorithm appeared to help reduce blood loss and the total amount of fresh frozen plasma transfused when treating coagulopathy from postpartum hemorrhage, and may represent another strategy for achieving hemostasis in this setting.

Eur J Emerg Med. 2017 Jun 27 Epub ahead of print

Laryngeal mask airway as a rescue device for failed endotracheal intubation during scene-to-hospital air transport of combat casualties.

Shavit I, Aviram E, Hoffmann Y, Biton O, Glassberg E.

BACKGROUND: Advanced airway management of combat casualties during scene-to-hospital air transport is challenging. Because of the short transport time, flight physicians of the Israeli military airborne combat evacuation unit are approved for the use of a laryngeal mask airway (LMA) in the event of failed endotracheal intubation (ETI). The aim of this study was to assess the effectiveness of LMA use during scene-to-hospital transport of combat casualties in Israel.

PATIENTS AND METHODS: A retrospective cohort analysis of all combat casualties treated with ETI during scene-to-hospital transport over a 3-year period was carried out. Successful LMA insertion was defined as satisfactory placement of the device on the basis of adequate chest expansion with bag-mask ventilation.

RESULTS: The median flight time from scene to hospital was 13 min [interquartile range (IQR): 9-15 min]. Sixty-five casualties underwent ETI attempts, 47 successful and 18 failed. All 18 casualties who had failed ETI underwent LMA insertion as a rescue treatment. Six casualties suffered from traumatic brain injury, six had firearm injuries, two had blast injuries, and two had inhalational injuries. LMA insertion was successful in 16/18 (88.9%) casualties, 14 survived to hospital discharge, whereas two were declared dead upon hospital arrival. Two cases of LMA insertion were unsuccessful, but patients survived to hospital discharge. Among the 16 successful cases, the median oxygen saturation on scene-pickup before LMA insertion and on hospital-handover with LMA in place were 90% (IQR: 84-96%) and 98% (IQR: 96-99%), respectively ($P<0.0001$, the 95% confidence interval for difference between medians was 4-11).

CONCLUSION: The findings of this study suggest that in the event of failed ETI, combat casualties can be treated effectively with LMA during a short scene-to-hospital transport time.

World J Pediatr Congenit Heart Surg. 2017 Jul;8(4):475-479

Experience Using Kaolin-Impregnated Sponge to Minimize Perioperative Bleeding in Norwood Operation.

Shinkawa T, Holloway J, Tang X, Gossett JM, Imamura M

PURPOSE: A kaolin-impregnated hemostatic sponge (QuikClot) is reported to reduce intraoperative blood loss in trauma and noncardiac surgery. The purpose of this study was to assess if this sponge was effective for hemostasis during Norwood operation.

DESCRIPTION: We conducted a retrospective review of patients undergoing Norwood operation in infancy between 2011 and 2016 at our institution.

EVALUATION: Of 31 identified Norwood operations, a kaolin-impregnated sponge was used intraoperatively in 15 (48%) patients. The preoperative profiles and cardiopulmonary bypass status were similar between the operations with or without kaolin-impregnated sponge. The comparison on each operative outcome between operations with or without kaolin-impregnated sponge showed that the intraoperative platelets, cryoprecipitate, and factor VII dosage were significantly less in the operations with kaolin-impregnated sponge (55 mL, 10 mL, 0 µg/kg vs 72 mL, 15 mL, 45 µg/kg; P = .03, .021, .019), as well as the incidence of perioperative bleeding complications (second cardiopulmonary bypass for hemostasis or postoperative mediastinal exploration, 0% vs 31%, P = .043). A logistic regression model showed that the nonuse of kaolin-impregnated sponge and longer aortic cross clamp time were associated with perioperative bleeding complication in univariable model (P = .02 and .005).

CONCLUSIONS: Use of kaolin-impregnated hemostatic sponge was associated with reduced blood product use and perioperative bleeding complications in Norwood operation at a single institution**.**

J Trauma Acute Care Surg. 2017 Aug;83(2):278-283

Point of injury tourniquet application during Operation Protective Edge-What do we learn?

Shlaifer A, Yitzhak A, Baruch EN, Shina A, Satanovsky A, Shovali A, Almog O, Glassberg E.

BACKGROUND: Hemorrhage is a leading cause of preventable death on the battlefield. Timely tourniquet application to massively bleeding extremity wounds is critical for casualty survival albeit with reported adverse effects to extremity integrity. The aim of this study was to describe the immediate- and short-term outcomes of point of injury (POI) tourniquet applications during "Operation Protective Edge" (OPE).

METHODS: A case series study regarding tourniquet application at the POI during OPE was collected. The data gathered included reports by medical providers at the POI, aerial and land evacuation vehicles, and receiving hospitals. Variables collected included, the number of tourniquet applications, caregiver level, tourniquet type, limb characters, tourniquet effectiveness, in-hospital procedures, complications, and short-term limb outcome.

RESULTS: During OPE, the Israeli Defense Forces Medical Corps treated 704 casualties. Of these, 90 casualties were treated with 119 tourniquets of which 79 survived. Penetrating trauma was the mechanism of injury in 97.8% (88 of 90) of the casualties. Injuries sustained from improvised explosive devices and shrapnel were related to the use of more than one tourniquet per casualty and per limb ($p = 0.034$). The success rate of the first tourniquet was reported to be 70% (84 of 119), regardless of caregiver level ($p = 0.56$), tourniquet type ($p = 0.16$), or limb characters ($p = 0.48$). Twenty-seven (25.7%) of 105 of the tourniquets were converted to direct pressure dressings enroute to receiving hospitals two of the conversions failed and thus a new tourniquet was applied. Fasciotomy was performed on eight casualties (a single limb in each). Vascular injury was presumed to be the indication for fasciotomy in three of these cases, in the other five limbs (6%, 5 of 85), no vascular involvement was discovered during surgery, and the fasciotomy is suspected as tourniquet related. 7%) 6 of 85) suffered from neurological sequela that could not be explained by their primary injury. Total complication rate was 11.7% (10 of 85) (one patient had both fasciotomy and neural complication without vascular injury).

CONCLUSION: Tourniquet use on the battlefield is a simple method of eliminating preventable death, we believe that clinical practice guidelines should promote liberal use of tourniquets by trained combatants and medical personnel with abilities to convert to direct pressure hemorrhage control when possible since an unjustified tourniquet application risks low rates minor morbidity, whereas a justifiable tourniquet not applied may be lethal.

LEVEL OF EVIDENCE: Epidemiologic study, level III; Therapeutic study, level IV.

Open Access Emerg Med. 2017 Jul 6;9:47-52.

Availability and use of hemostatic agents in prehospital trauma patients in Pennsylvania translation from the military to the civilian setting.

Sigal A, Martin A, Ong A

OBJECTIVE: To understand the translation of one innovation in trauma care from the military to the civilian setting, the adoption of topical hemostatic agents in the Emergency Medical Services (EMS) community and in Trauma Centers in Pennsylvania.

METHOD: We utilized an anonymous electronic survey of EMS Agency Administrative Officers and Trauma Center Coordinators.

RESULTS: We received responses from 23% (93/402) Advanced Life Support and Air Medical agencies in the State. Of the EMS agencies that responded, 46.6% (61/131) stock hemostatic products, with 55.5% (44/79) carrying QuickClot(®) Combat Gauze(®). Of the agencies that carried hemostatic products, 50% utilized them at least once in the prior 6 months and 59% over the past 12 months. Despite the infrequent number of applications, prehospital providers ranked themselves as somewhat skilled and comfortable both with the application of the products and the indications for their use.

CONCLUSION: Our survey found that 46.6% of the respondents indicated they carry hemostatic products, a much greater number than found on prior surveys of EMS agencies. There is a steady acceptance by EMS of new innovations in trauma care although more work is needed in translating the exact role of hemostatic agents in the civilian setting.

J Emerg Med. 2017 May;52(5):601-608. doi: 10.1016/j.jemermed.2016.12.039. Epub 2017 Mar 6.

The Use of Ketamine for Acute Treatment of Pain: A Randomized, Double-Blind, Placebo-Controlled Trial.

Sin B, Tatunchak T, Paryavi M, Olivo M, Mian U, Ruiz J, Shah B, de Souza S

BACKGROUND: Pain is one of the most common reasons for emergency department (ED) visits in the United States. Ketamine is a sedative with N-methyl-D-aspartate (NMDA) receptor antagonism. Recent literature has suggested that the use of subdissociative dose ketamine (SDDK) may be safe and effective for acute pain.

OBJECTIVE: The objective of our study was to evaluate ketamine in subdissociative doses as an adjunct for acute pain in the ED.

METHODS: This was a single-center, prospective, randomized, double-blind, placebo-controlled trial that evaluated the use of SDDK in adult patients who presented to the ED with acute pain. Patients received ketamine 0.3 mg/kg via intravenous piggyback over 15 min or placebo. Morphine 0.1 mg/kg intravenous push was administered with the study interventions. The primary outcome was the patient's pain score 15 min after initiation of the intervention. Secondary outcomes included adverse events, consumption of rescue analgesia, patient's length of stay, and patient satisfaction with treatment.

RESULTS: Thirty patients were enrolled in each group. Median pain scores in patients who received ketamine were lower than in controls at 15 min (3.5 [interquartile range {IQR} 1.0-7.3 vs. 6.0 [IQR 4.0-9.0], respectively;p = 0.018). No serious adverse events occurred. No difference was detected in the amount of rescue analgesia used or in length of stay. Patients who received ketamine reported a higher mean satisfaction score with their pain management (8.57 [standard deviation {SD} 2.1]) than patients who received placebo (6.05 [SD2.6]; p = 0.01).

CONCLUSION: When used as an adjunct, SDDK administered at 0.3 mg/kg over 15 min resulted in safe and effective analgesia for ≤30 min in patients who presented with acute pain in the ED.

Indian J Anaesth. 2017 Jun;61(6):469-474

Comparative evaluation of Ambu AuraGain™ with ProSeal™ laryngeal mask airway in patients undergoing laparoscopic cholecystectomy.

Singh K, Gurha P

BACKGROUND AND AIMS: Second generation supraglottic airways are increasingly being used in surgical patients undergoing laparoscopic surgery. Preventing aspiration at higher airway pressures may be at the expense of a higher cuff pressure which can impair mucosal perfusion. We attempted to elucidate whether Ambu AuraGain™ (AAU) would provide a higher oropharyngeal leak pressure (OLP) with a lower mucosal pressure in comparison to ProSeal™ laryngeal mask airway (PLMA).

METHODS: This was a prospective randomised study involving sixty patients undergoing laparoscopic cholecystectomy under general anaesthesia, using either AAU (Group AAU [n = 30]) or PLMA (Group PLMA [n = 30]) for elective ventilation. Primary outcome measure was the OLP. Number of insertion attempts, ease of insertion, time required for placement and calculated pharyngeal mucosal pressure were the secondary outcome measures. Data were analysed using Student's t-test and Chi-square test.

RESULTS: No significant difference in the OLP was noted in both groups. The ease of insertion and success rate at first attempt was similar between the groups.Time taken for insertion in Group AAU was longer than Group PLMA (13.57 ± 1.94 vs. 11.60 ± 2.22 s). The calculated pharyngeal mucosal pressures were lower with Group AAU than Group PLMA for all 3 sizes. The minimum cuff pressure and minimum cuff volume required to prevent leak were found similar in both groups.

CONCLUSION: AAU provides adequate sealing pressures and effective ventilation with lower calculated pharyngeal mucosal pressure, compared to PLMA.

Air Med J. 2017 May - Jun;36(3):127-130

An Analysis of the Temperature Change in Warmed Intravenous Fluids During Administration in Cold Environments.

Singleton W, McLean M, Smale M, Alkhalifah M, Kosahk A, Ragina N, Cheng CI, Figg BJ

ABSTRACT:

This nonhuman simulation study was conducted to determine the decrease in temperature that occurred to 1-L bags of normal saline in a cold environment. The bags were warmed to 39°C and administered through intravenous (IV) tubing at a set flow rate while in a cold environment. The goal was to determine if there was a significant decrease in fluid temperature from the bag to the catheter site. Three trials were completed at temperatures of 0°C, -7°C, -12°C, and 22°C (control). Each bag of normal saline was warmed to 39°C using the SoftSack IV Fluid Warmer (Smithworks Med Inc, Lindale, TX). Fluid was collected and temperatures recorded at 5-minute intervals. The results showed a statistically significant (P = .003) change in temperature between the IV bag and the administration site. The most rapid change occurred within the first 5 minutes. The temperature change was more significant with colder ambient temperatures, with an average of a 28.7°C difference at -7°C and -12°C after 30 minutes. It appears that the most significant heat loss occurs through the IV tubing itself. Therefore, it may be beneficial to insulate the tubing on a trauma patient receiving warmed IV fluids in a cold environment to help prevent hypothermia.

Wilderness Environ Med. 2017 Jun;28(2S):S146-S153.

Integration of Tactical EMS in the National Park Service.

Smith WWR

ABSTRACT:

The National Park Service (NPS) has domestic responsibility for emergency medical services (EMS) in remote and sometimes tactical situations in 417 units covering over 34 million hectares (84 million acres). The crossover between conflicting patient care priorities and complex medical decision making in the tactical, technical, and wilderness/remote environments often has many similarities. Patient care in these diverse locations, when compared with military settings, has slightly different variables but often similar corresponding risks to the patients and providers. The NPS developed a Tactical EMS (TEMS) program that closely integrated many principles from: 1) Tactical Combat Casualty Care (TCCC); 2) Tactical Emergency Casualty Care (TECC); 3) and other established federal and civilian TEMS programs. Combining these best practices into the NPS TEMS Program allowed for standardized training and implementation across not only the NPS, but also paralleled other military/federal/civilian TEMS programs. This synchronization is critical when an injury occurs in a joint tactical operation, either planned (drug interdiction) or unplanned (active shooter response), so that patient care can be uniform and efficient. The components identified for a sustainable TEMS program began with strong medical oversight, protocol development with defined phases of care, identifying specialized equipment, and organized implementation with trained TEMS instructors. Ongoing TEMS program management is continuously improving situationally appropriate training and integrating current best practices as new research, equipment, and tactics are developed. The NPS TEMS Program continues to provide ongoing training to ensure optimal patient care in tactical and other NPS settings.

Pol J Vet Sci. 2017 Mar 28;20(1):45-49

Thromboelastographic profile of goat blood after the experimental injury of the femoral artery and use of QuikClot gauze and Celox gauze dressings.

Sobiech P, Adamiak Z, Holak P, Jastrzębski P, Rogowski J, Brzeziński M, Bury K, Jałyński M, Baumgartner W

ABSTRACT:

The aim of this study was to evaluate the suitability of thromboelastometry for the analysis of blood test results in goats after the use of hemostatic dressings to control massive bleeding. The study was carried out on 12 goats, 6 animals in each of two subgroups. In all experimental animals incision of the femoral artery was performed, and bleeding was controlled with QuikClot gauze in the first group and Celox gauze in the second group. Dressings were applied for 60 minutes. Blood samples for thromboelastometry were collected from the jugular vein before the incision and 60 min after the application of a dressing. Clotting time (CT), clot formation time (CFT), maximum clot firmness (MCF) and α angle (°) were measured in three standard ROTEM assays (system with generation of reaction curve, numerical parameters and size of the blood clot): intrinsic coagulation pathway (INTEM), extrinsic coagulation pathway (EXTEM) and functional fibrinogen (FIBTEM). Complete hemostasis of the injured femoral artery was found in all goats. No significant differences between pre- and post-incision thromboelastometric parameters were found in any tests in any of the groups, which indicates that the use of dressings was not associated with blood coagulation disorders. This study is the first to describe the use of thromboelastometry in goats for the assessment of clot formation and hemostatic disorders.

Scand J Surg. 2017 Sep;106(3):255-260

Bleeding Pelvic Fracture Patients: Evolution of Resuscitation Protocols.

Söderlund T, Ketonen T, Handolin L

BACKGROUND AND AIMS: Massive transfusion protocol seems to improve outcome in massively bleeding trauma patients, but not pelvic fracture patients. The aim of this study was to evaluate the effect of massive transfusion protocol on the mortality and fluid resuscitation of shocked pelvic fracture patients.

MATERIAL AND METHODS: This is a trauma register study from a single hospital. From the trauma registry patients with pelvic fracture, injury severity score >15, admission base excess below -5, age >15 years, blunt trauma, and primary admission from the scene were identified. Patients were divided into two groups: Group 1-pre-massive transfusion protocol (2006-2009) and Group 2-post-massive transfusion protocol (2010-2013). Basic characteristics and intensive care unit length of stay, mortality, and fluid resuscitation data were retrieved from the registry. Standardized mortality ratio was assessed using revised injury severity classification, version II methodology.

RESULTS: Altogether, 102 patients were identified. Group 1 (n = 56) and Group 2 (n = 46) were comparable in their basic characteristics. The observed mortality was 35.7% and 26.1% in Groups 1 and 2, respectively. The standardized mortality ratio failed to reveal any difference between observed and expected mortality in either group. In the emergency room, the use of crystalloids decreased from 5.3 ± 3.4 to 3.3 ± 1.8 L (p = 0.002) with increased use of fresh frozen plasma (2.9 ± 4.4 vs 5.1 ± 5.3, p = 0.007).

CONCLUSION: No improvement in the adjusted survival of shocked pelvic fracture patients is apparent after implementation of massive transfusion protocol. Implementation of massive transfusion protocol is associated with a higher use of fresh frozen plasma and improved ratio of fresh frozen plasma:red blood cell toward the targeted 1:1 and decreased use of crystalloids.

Ann Emerg Med. 2017 May 27. pii: S0196-0644(17)30323-2

Association of Out-of-Hospital Hypotension Depth and Duration With Traumatic Brain Injury Mortality.

Spaite DW, Hu C, Bobrow BJ, Chikani V, Barnhart B, Gaither JB, Denninghoff KR, Adelson PD, Keim SM, Viscusi C, Mullins T, Rice AD, Sherrill D

STUDY OBJECTIVE: Out-of-hospital hypotension has been associated with increased mortality in traumatic brain injury. The association of traumatic brain injury mortality with the depth or duration of out-of-hospital hypotension is unknown. We evaluated the relationship between the depth and duration of out-of-hospital hypotension and mortality in major traumatic brain injury.

METHODS: We evaluated adults and older children with moderate or severe traumatic brain injury in the preimplementation cohort of Arizona's statewide Excellence in Prehospital Injury Care study. We used logistic regression to determine the association between the depth-duration dose of hypotension (depth of systolic blood pressure <90 mm Hg integrated over duration [minutes] of hypotension) and odds of inhospital death, controlling for significant confounders.

RESULTS: There were 7,521 traumatic brain injury cases included (70.6% male patients; median age 40 years [interquartile range 24 to 58]). Mortality was 7.8% (95% confidence interval [CI] 7.2% to 8.5%) among the 6,982 patients without hypotension (systolic blood pressure ≥90 mm Hg) and 33.4% (95% CI 29.4% to 37.6%) among the 539 hypotensive patients (systolic blood pressure <90 mm Hg). Mortality was higher with increased hypotension dose: 0.01 to 14.99 mm Hg-minutes 16.3%; 15 to 49.99 mm Hg-minutes 28.1%; 50 to 141.99 mm Hg-minutes 38.8%; and greater than or equal to 142 mm Hg-minutes 50.4%. Log2 (the logarithm in base 2) of hypotension dose was associated with traumatic brain injury mortality (adjusted odds ratio 1.19 [95% CI 1.14 to 1.25] per 2-fold increase of dose).

CONCLUSION: In this study, the depth and duration of out-of-hospital hypotension were associated with increased traumatic brain injury mortality. Assessments linking out-of-hospital blood pressure with traumatic brain injury outcomes should consider both depth and duration of hypotension.

J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S2-S8.

Zero preventable deaths after traumatic injury: An achievable goal.

Spinella PC

QUOTE:

Civilian and military trauma systems have been developing and contributing simultaneously to the improvement of trauma systems over time, and it will take continued collaboration to achieve additional advancements in the future. The goal of improving outcomes for patients with traumatic injury and reducing unnecessary death and disability has always been a high priority. In the early 1990s after an analysis of outcomes from combat operations in Mogdishu, Somalia,[1] two US military-led efforts have significantly guided the current goal of zero-preventable deaths after traumatic injury. First the US Tactical Combat Casualty Care Committee was developed with a goal of constructing a robust set of presurgical care guidelines that could be implemented by all military providers.[2] Soon thereafter, the US Army Ranger's implemented Tactical Combat Casualty Care Committee guidelines for presurgical care, with a goal of zero preventable deaths after traumatic injury.[3] These goals were met due to a strong leadership culture, accountability, shared responsibility, extensive training, and maintenance of medical skills.[4]

These accomplishments have raised expectations and set an example for how to develop and implement best practice guidelines.[2,3] Many excellent trauma systems are operational around the United States and the world, but what is still lacking is a highly organized approach to how these systems learn from their experiences and how it adapts with increasing knowledge.

J Trauma Acute Care Surg. 2017 Jul;83(1):25-29

Incompatible type A plasma transfusion in patients requiring massive transfusion protocol: Outcomes of an Eastern Association for the Surgery of Trauma multicenter study.

Stevens WT, Morse BC, Bernard A, Davenport DL, Sams VG, Goodman MD, Dumire R, Carrick MM, McCarthy P, Stubbs JR, Pritts TA, Dente CJ, Luo-Owen X, Gregory JA, Turay D, Gomaa D, Quispe JC, Fitzgerald CA, Haddad NN, Choudhry A, Quesada JF, Zielinski MD.

BACKGROUND: With a relative shortage of type AB plasma, many centers have converted to type A plasma for resuscitation of patients whose blood type is unknown. The goal of this study is to determine outcomes for trauma patients who received incompatible plasma transfusions as part of a massive transfusion protocol (MTP).

METHODS: As part of an Eastern Association for the Surgery of Trauma multi-institutional trial, registry and blood bank data were collected from eight trauma centers for trauma patients (age, ≥ 15 years) receiving emergency release plasma transfusions as part of MTPs from January 2012 to August 2016. Incompatible type A plasma was defined as transfusion to patient blood type B or type AB.

RESULTS: Of the 1,536 patients identified, 92% received compatible plasma transfusions and 8% received incompatible type A plasma. Patient characteristics were similar except for greater penetrating injuries (48% vs 36%; $p = 0.01$) in the incompatible group. In the incompatible group, patients were transfused more plasma units at 4 hours (median, 9 vs. 5; $p < 0.001$) and overall for stay (11 vs. 9; $p = 0.03$). No hemolytic transfusion reactions were reported. Two transfusion-related acute lung injury events were reported in the compatible group. Between incompatible and compatible groups, there was no difference in the rates of acute respiratory distress syndrome (6% vs. 8%; $p = 0.589$), thromboembolic events (9% vs. 7%; $p = 0.464$), sepsis (6% vs. 8%; $p = 0.589$), or acute renal failure (8% vs. 8%, $p = 0.860$). Mortality at 6 (17% vs. 15%, $p = 0.775$) and 24 hours (25% vs. 23%, $p = 0.544$) and at 28 days or discharge (38% vs. 35%, $p = 0.486$) were similar between groups. Multivariate regression demonstrated that Injury Severity Score, older age and more red blood cell transfusion at 4 hours were independently associated with death at 28 days or discharge; Injury Severity Score and more red blood cell transfusion at 4 hours were predictors for morbidity. Incompatible transfusion was not an independent determinant of mortality or morbidity.

CONCLUSION: Transfusion of type A plasma to patients with blood groups B and AB as part of a MTP does not appear to be associated with significant increases in morbidity or mortality.

LEVEL OF EVIDENCE: Therapeutic study, level IV.

J Spec Oper Med. Summer 2017;17(2):82-88.

Albumin for Prehospital Fluid Resuscitation of Hemorrhagic Shock in Tactical Combat Casualty Care.

Studer NM, April MD, Bowling F, Danielson PD, Cap AP.

ABSTRACT:

Optimal fluid resuscitation on the battlefield in the absence of blood products remains unclear. Contemporary Combat medics are generally limited to hydroxyethyl starch or crystalloid solutions, both of which present significant drawbacks. Obtaining US Food and Drug Administration (FDA)-approved freeze-dried plasma (FDP) is a top casualty care research priority for the US Military. Interest in this agent reflects a desire to simultaneously expand intravascular volume and address coagulopathy. The history of FDP dates to the Second World War, when American expeditionary forces used this agent frequently. Also fielded was 25%albumin, an agent that lacks coagulation factors but offers impressive volume expansion with minimal weight to carry and requires no reconstitution in the field. The current potential value of 25% albumin is largely overlooked. Although FDP presents an attractive future option for battlefield prehospital fluid resuscitation once FDA approved, this article argues that in the interim, 25% albumin, augmented with fibrinogen concentrate and tranexamic acid to mitigate hemodilution effects on coagulation capacity, offers an effective volume resuscitation alternative that could save lives on the battlefield immediately.

J Surg Res. 2017 May 1;211:223-227

Validation of a field spinal motion restriction protocol in a level I trauma center.

Tatum JM, Melo N, Ko A, Dhillon NK, Smith EJT, Yim DA, Barmparas G, Ley EJ

BACKGROUND: Spinal motion restriction (SMR) after traumatic injury has been a mainstay of prehospital trauma care for more than 3 decades. Recent guidelines recommend a selective approach with cervical spine clearance in the field when criteria are met.

MATERIALS AND METHODS: In January 2014, the Department of Health Services of the City of Los Angeles, California, implemented revised guidelines for cervical SMR after blunt mechanism trauma. Adult patients (aged ≥18 y) with an initial Glasgow Coma Scale (GCS) score of ≥13 presented to a single level I trauma center after blunt mechanism trauma over the following 1-y period were retrospectively reviewed. Demographics, injury data, and prehospital data were collected. Cervical spine injury (CSI) was identified by International Classification of Disease, Ninth Revision, codes.

RESULTS: Emergency medical services transported 1111 patients to the emergency department who sustained blunt trauma. Patients were excluded if they refused c-collar placement or if documentation was incomplete. A total of 997 patients were included in our analysis with 172 (17.2%) who were selective cleared of SMR per protocol. The rate of Spinal Cord Injury was 2.2% (22/997) overall and 1.2% (2/172) in patients without SMR. The sensitivity and specificity of the protocol are 90.9% (95% confidence interval: 69.4-98.4) and 17.4% (95% confidence interval: 15.1-20.0), respectively, for CSI. Patients with CSI who arrived without immobilization having met field clearance guidelines, were managed without intervention, and had no neurologic compromise.

CONCLUSIONS: Guidelines for cervical SMR have high sensitivity and low specificity to identify CSI. When patients with injuries were not placed on motion restrictions, there were no negative clinical outcomes.

J Trauma Acute Care Surg. 2017 Jul;83(1 Suppl 1):S120-S123.

Vascular complications from resuscitative endovascular balloon occlusion of the aorta: Life over limb?

Taylor JR 3rd, Harvin JA, Martin C, Holcomb JB, Moore LJ

BACKGROUND: Vascular complications from resuscitative endovascular balloon occlusion of the aorta (REBOA) have been reported in as high as 13% with some patients requiring lower-extremity amputation. We sought to review our institution series of REBOA and assess our vascular complications.

METHODS: Retrospective review of all patients undergoing REBOA from October 2011 through July 2016. Data were gathered from the Memorial Hermann Trauma Registry and the hospital electronic medical records. Operative details and vascular injuries from arterial access for REBOA insertion were recorded.

RESULTS: Forty-eight patients underwent REBOA during our study period. Thirty-eight had the 14 Fr. system placed and 10 had the 7 Fr. system placed. Of the 24 surviving the removal of the 14 Fr. sheath, 19 had primary repair of the arteriotomy without vascular complication. The other five required additional vascular procedures to repair arteriotomy with no lower-extremity amputations. There were no vascular complications of sheath removal with the 7 Fr. system, with no amputations.

CONCLUSION: Implementation of REBOA can be done safely without increased risk of vascular access complications or limb loss. The 14 Fr. system will more likely require further vascular procedures to address the access site, whereas the 7 Fr. system will not.

LEVEL OF EVIDENCE: Therapeutic/care management, level II.

Injury. 2016 May;47(5):1007-11.

Prehospital use of hemostatic dressings in emergency medical services in the Netherlands: A prospective study of 66 cases.

te Grotenhuis R, van Grunsven PM, Heutz WM, Tan EC

BACKGROUND: Uncontrolled haemorrhage is the leading cause of potentially preventable death in both civilian and military trauma patients. Animal studies and several case series have shown that hemostatic dressings reduce haemorrhage and might improve survival. One of these products is HemCon ChitoGauze(®). The objective of this study was to determine the effectiveness and safety of ChitoGauze in achieving hemostasis in massive traumatic bleeding in civilian emergency medical services.

METHODS: From June 2012 to December 2014, all ambulances of two emergency medical services in the Netherlands were equipped with ChitoGauze. The dressing was used according to protocol; if conventional treatment (gauze dressing with manual pressure) failed to control external traumatic bleeding or if conventional treatment was unlikely to achieve hemostasis. The ambulance personnel filled in an evaluation form after each use.

RESULTS: A total of 66 patients were treated with ChitoGauze during the study period. Twenty-one patients were taking anticoagulants or suffered from a clotting disorder. The injuries were located in the extremities (n=29), the head and face (n=29), or the neck, thorax and groin (n=8). In 46/66 patients, the use of ChitoGauze resulted in cessation of haemorrhage. In 13/66 patients, Chitogauze application reduced haemorrhage. ChitoGauze failed to control haemorrhage in 7/66 patients, whereby user error was a contributing factor in 3 of these failures. No side effects have been observed during treatment or transport of the patients and no adverse effects have been reported in discharge letters.

CONCLUSION: This is the largest prospective study in civilian healthcare and the second largest case series with prehospital use of hemostatic dressings. It demonstrated that ChitoGauze is an effective and safe adjunct in the prehospital treatment of massive external traumatic haemorrhage.

Can J Surg. 2017 Jun;60(3):152-154.

The University of Toronto's lasting contribution to war surgery: how Maj. L. Bruce Robertson fundamentally transformed thinking toward blood transfusion during the First World War.

Tien A, Beckett A, Pannell D

SUMMARY: During the Great War, Canadian military surgeons produced some of the greatest innovations to improve survival on the battlefield. Arguably, the most important was bringing blood transfusion practice close to the edge of the battlefield to resuscitate the many casualties dying of hemorrhagic shock. Dr. L. Bruce Robertson of the Canadian Army Medical Corps was the pioneering surgeon from the University of Toronto who was able to demonstrate the benefit of blood transfusions near the front line and counter the belief that saline was the resuscitation fluid of choice in military medicine. Robertson would go on to survive the Great War, but would be taken early in life by influenza. Despite his life and career being cut short, Robertson's work is still carried on today by many military medical organizations who strive to bring blood to the wounded in austere and dangerous settings. This article has an Appendix, available at canjsurg.ca.

J Trauma Acute Care Surg. 2017 Jul;83(1):77-83

Combat surgical workload in Operation Iraqi Freedom and Operation Enduring Freedom: The definitive analysis.

Turner CA, Stockinger ZT, Gurney JM.

BACKGROUND: Relatively few publications exist on surgical workload in the deployed military setting. This study analyzes US military combat surgical workload in Iraq and Afghanistan to gain a more thorough understanding of surgical training gaps and personnel requirements.

METHODS: A retrospective analysis of the Department of Defense Trauma Registry was performed for all Role 2 (R2) and Role 3 (R3) military treatment facilities from January 2001 to May 2016. International Classification of Diseases, Ninth Revision, Clinical Modification procedure codes were grouped into 18 categories based on functional surgical skill sets. The 189,167 surgical procedures identified were stratified by role of care, month, and year. Percentiles were calculated for the number of procedures for each skill set. A literature search was performed for publications documenting combat surgical workload during the same period.

RESULTS: A total of 23,548 surgical procedures were performed at R2 facilities, while 165,619 surgical procedures were performed at R3 facilities. The most common surgical procedures performed overall were soft tissue (37.5%), orthopedic (13.84%), abdominal (13.01%), and vascular (6.53%). The least common surgical procedures performed overall were cardiac (0.23%), peripheral nervous system (0.53%), and spine (0.34%).Mean surgical workload at any point in time clearly underrepresented those units in highly kinetic areas, at times by an order of magnitude or more. The published literature always demonstrated workloads well in excess of the 50th percentile for the relevant time period.

CONCLUSIONS: The published literature on combat surgical workload represents the high end of the spectrum of deployed surgical experience. These trends in surgical workload provide vital information that can be used to determine the manpower needs of future conflicts in ever-changing operational tempo environments. Our findings provide surgical types and surgical workload requirements that will be useful in surgical training and placement of medical assets in future conflicts.

LEVEL OF EVIDENCE: Epidemiologic study, level III; Care management, level III.

World J Surg. 2017 Jul 26. Epub ahead of print

Can We Train Military Surgeons in a Civilian Trauma Center?

Uchino H, Kong VY, Oosthuizen GV, Bruce JL, Bekker W, Laing GL, Clarke DL

INTRODUCTION: The objective of this study was to review the trauma workload and operative exposure in a major South African trauma center and provide a comparison with contemporary experience from major military conflict.

MATERIALS AND METHODS: All patients admitted to the PMTS following trauma were identified from the HEMR. Basic demographic data including mechanism of injury and body region injured were reviewed. All operative procedures were categorized. The total operative volume was compared with those available from contemporary literature documenting experience from military conflict in Afghanistan. Operative volume was converted to number of cases per year for comparison.

RESULTS: During the 4-year study period, 11,548 patients were admitted to our trauma center. Eighty-four percent were male and the mean age was 29 years. There were 4974 cases of penetrating trauma, of which 3820 (77%) were stab wounds (SWs), 1006 (20%) gunshot wounds (GSWs) and the remaining 148 (3%) were animal injuries. There were 6574 cases of blunt trauma. The mechanism of injuries was as follows: assaults 2956, road traffic accidents 2674, falls 664, hangings 67, animal injuries 42, sports injury 29 and other injuries 142. A total of 4207 operations were performed. The volumes per year were equivalent to those reported from the military surgical literature.

CONCLUSION: South Africa has sufficient burden of trauma to train combat surgeons. Each index case as identified from the military surgery literature has a sufficient volume in our center. Based on our work load, a 6-month rotation should be sufficient to provide exposure to almost all the major traumatic conditions likely to be encountered on the modern battlefield.

J Trauma Acute Care Surg. 2017 Aug;83(2):328-339

Accuracy of prehospital triage protocols in selecting severely injured patients: A systematic review.

van Rein EAJ, Houwert RM, Gunning AC, Lichtveld RA, Leenen LPH, van Heijl M.

BACKGROUND: Prehospital trauma triage ensures proper transport of patients at risk of severe injury to hospitals with an appropriate corresponding level of trauma care. Incorrect triage results in undertriage and overtriage. The American College of Surgeons Committee on Trauma recommends an undertriage rate below 5% and an overtriage rate below 50% for prehospital trauma triage protocols. To find the most accurate prehospital trauma triage protocol, a clear overview of all currently available protocols and corresponding outcomes is necessary.

OBJECTIVES: The aim of this systematic review was to evaluate the current literature on all available prehospital trauma triage protocols and determine accuracy of protocol-based triage quality in terms of sensitivity and specificity.

METHODS: A search of Pubmed, Embase, and Cochrane Library databases was performed to identify all studies describing prehospital trauma triage protocols before November 2016. The search terms included "trauma," "trauma center," or "trauma system" combined with "triage," "undertriage," or "overtriage." All studies describing protocol-based triage quality were reviewed. To assess the quality of these type of studies, a new critical appraisal tool was developed.

RESULTS: In this review, 21 articles were included with numbers of patients ranging from 130 to over 1 million. Significant predictors for severe injury were: vital signs, suspicion of certain anatomic injuries, mechanism of injury, and age. Sensitivity ranged from 10% to 100%; specificity from 9% to 100%. Nearly all protocols had a low sensitivity, thereby failing to identify severely injured patients. Additionally, the critical appraisal showed poor quality of the majority of included studies.

CONCLUSION: This systematic review shows that nearly all protocols are incapable of identifying severely injured patients. Future studies of high methodological quality should be performed to improve prehospital trauma triage protocols.

LEVEL OF EVIDENCE: Systematic review, level III.

Br J Anaesth. 2017 May 1;118(5):645-649

'Failed supraglottic airway': an algorithm for suboptimally placed supraglottic airway devices based on videolaryngoscopy.

Van Zundert AAJ, Gatt SP, Kumar CM, Van Zundert TCRV, Pandit JJ

Conclusions

Anaesthetists should aspire to improving the quality of SAD insertions; it is unacceptable to have patients breathing noisily, partly obstructed via a misplaced SAD, or SAD cuff inflation pressures that are dangerously high (or unmeasured). Poor fits should not be accepted. Blind insertion results in a poor fit, whereas direct vision improves placement with videolaryngoscopy, facilitating functional and anatomical optimization. Any placement Grade of II or III should be regarded as a misplaced or 'failed' SAD. As the way forward is direct viewing, manufacturers are encouraged to develop SAD-specific viewing tools to facilitate correct insertion. Until such a time, videolaryngoscopy is the tool of choice. More than 40 yr ago, Brain[22] suggested the use of a laryngoscope to view and adjust the position of his then newly invented laryngeal mask airway. However, using a Macintosh laryngoscope has historically been regarded as defeating part of the purpose of using a SAD, which is to avoid the adverse haemodynamic effects of laryngoscopy. Videolaryngoscopes offer a fresh alternative,[20] and the time is ripe to follow Brain's early advice to check and correct malpositioned SADs by direct viewing.

J Trauma Acute Care Surg. 2017 Jul 19. Epub ahead of print

Buddy-aid battlefield pain management.

Vertu N, Nacimento M, Pasquier P

QUOTE:

"More surprisingly, physicians and/or a paramedic provided the administration of 90.5% of analgesics given to casualties at POI. In the discussion section, the authors justified this high ratio of pain interventions performed by physicians and paramedics, by the rapid availability of these front-line providers. We would like to go further into the debate since the French Army has a long experience of buddy-aid battlefield pain management, using a 10mg morphine auto-injector, also known as the *Syrette* of morphine. The *Syrette* is a device for injecting liquid through a needle, almost similar to a syringe, except that it has a closed flexible tube, instead of a rigid tube and piston. During military operations, not only front-line providers including, physicians, paramedics, and medics can provide an adequate battlefield pain management.

Actually, all soldiers carry a combat first aid kit including a *Syrette* of morphine. At POI, this individual auto-injector containing 10 mg of morphine is well designed for intramuscular administration of drugs for self-aid or buddy-aid, even before the arrival of front-line providers. Before deployment in a combat zone, every French soldier undergoes the Forward Combat Casualty Care Level 1-courses, including the virtual simulation of morphine administration in 3D-SC1. 3D-SC1 is a serious game designed for training of soldiers to life-saving interventions on the battlefield. Soldiers are trained to use their combat first aid kit, including the *Syrette* of morphine.[2,3] In the French Military Medical Service policy for combat analgesia, and also discussed by the authors, other techniques are encouraged, including titration of intravenous morphine, use of ketamine and fascia-iliaca compartment block for lower limb injuries.[4] Finally, we would like to know if the authors could provide more details about the IDF experience in buddy-aid battlefield pain management, and if it was employed in the 1,056 casualties who were treated with an analgesic at the prehospital settings."

Resuscitation. 2017 Oct;119:1-4. Epub 2017 Jul 24

Unrecognized failed airway management using a supraglottic airway device.

Vithalani VD, Vlk S, Davis SQ, Richmond NJ

BACKGROUND: 911 Emergency Medical Services (EMS) systems utilize supraglottic devices for either primary advanced airway management, or for airway rescue following failed attempts at direct laryngoscopy endotracheal intubation. There is, however, limited data on objective confirmation of supraglottic airway placement in the prehospital environment. Furthermore, the ability of EMS field providers to recognize a misplaced airway is unknown.

METHODS: Retrospective review of patients who underwent airway management using the King LTS-D supraglottic airway in a large urban EMS system, between 3/1/15-9/30/2015. Subjective success was defined as documentation of successful airway placement by the EMS provider. Objective success was confirmed by review of waveform capnography, with the presence of a 4-phase waveform greater than 5mmHg. Sensitivity and specificity of the field provider's assessment of success were then calculated.

RESULTS: A total of 344 supraglottic airway attempts were reviewed. No patients met obvious death criteria. 269 attempts (85.1%) met criteria for both subjective and objective success. 19 attempts (5.6%) were recognized failures by the EMS provider. 47 (13.8%) airways were misplaced but unrecognized by the EMS provider. 4 attempts (1.2%) were correctly placed but misidentified as failures, leading to the unnecessary removal and replacement of the airway. Sensitivity of the provider's assessment was 98.5%; specificity was 28.7%.

CONCLUSION: The use of supraglottic airway devices results in unrecognized failed placement. Appropriate utilization and review of waveform capnography may remedy a potential blind-spot in patient safety, and systemic monitoring/feedback processes may therefore be used to prevent unrecognized misplaced airways.

Mil Med Res. 2017 Jun 14;4:20

Comparison of five video-assisted intubation devices by novice and expert laryngoscopists for use in the aeromedical evacuation environment.

Wallace MC, Britton ST, Meek R, Walsh-Hart S, Carter CTE, Lisco SJ

BACKGROUND: The critically ill or injured patient undergoing military medical evacuation may require emergent intubation. Intubation may be life-saving, but it carries risks. The novice or infrequent laryngoscopist has a distinct disadvantage because experience is critical for the rapid and safe establishment of a secured airway. This challenge is compounded by the austere environment of the back of an aircraft under blackout conditions. This study determined which of five different video-assisted intubation devices (VAIDs) was best suited for in-flight use by U.S. Air Force Critical Care Air Transport Teams by comparing time to successful intubation between novice and expert laryngoscopists under three conditions, Normal Airway Lights on (NAL), Difficult Airway Lights on (DAL) and Difficult Airway Blackout (DAB), using manikins on a standard military transport stanchion and the floor with a minimal amount of setup time and extraneous light emission.

METHODS: A convenience sample size of 40 participants (24 novices and 16 experts) attempted intubation with each of the 5 different video laryngoscopic devices on high-fidelity airway manikins. Time to tracheal intubation and number of optimization maneuvers used were recorded. Kruskal-Wallis testing determined significant differences between the VAIDs in time to intubation for each particular scenario. Devices with significant differences underwent pair-wise comparison testing using rank-sum analysis to further clarify the difference. Device assembly times, startup times and the amount of light emitted were recorded. Perceived ease of use was surveyed.

RESULTS: Novices were fastest with the Pentax AWS in all difficult airway scenarios. Experts recorded the shortest median times consistently using 3 of the 5 devices. The AWS was superior overall in 4 of the 6 scenarios tested. Experts and novices subjectively judged the GlideScope Ranger as easiest to use. The light emitted by all the devices was less than the USAF-issued headlamp.

CONCLUSIONS: Novices intubated fastest with the Pentax AWS in all difficult airway scenarios. The GlideScope required the shortest setup time, and participants judged this device as the easiest to use. The GlideScope and AWS exhibited the two fastest total setup times. Both devices are suitable for in-flight use by infrequent and seasoned laryngoscopists.

Wilderness Environ Med. 2017 Jun;28(2S):S109-S116

Battlefield Analgesia in Tactical Combat Casualty Care.

Wedmore IS, Butler FK Jr

ABSTRACT:

At the start of the Afghanistan conflict, battlefield analgesia for US military casualties was achieved primarily through the use of intramuscular (IM) morphine. This is a suboptimal choice, since IM morphine is slow-acting, leading to delays in effective pain relief and the risk of overdose and death when dosing is repeated in order to hasten the onset of analgesia. Advances in battlefield analgesia, pioneered initially by Tactical Combat Casualty Care (TCCC), and the Army's 75th Ranger Regiment, have now been incorporated into the Triple-Option Analgesia approach. This novel strategy has gained wide acceptance in the US military. It calls for battlefield analgesia to be achieved using 1 or more of 3 options depending on the casualty's status: 1) the meloxicam and acetaminophen in the combat wound medication pack (CWMP) for casualties with relatively minor pain that are still able to function effectively as combatants if their sensorium is not altered by analgesic medications; 2) oral transmucosal fentanyl citrate (OTFC) for casualties who have moderate to severe pain, but who are not in hemorrhagic shock or respiratory distress, and are not at significant risk for developing either condition; or 3) ketamine for casualties who have moderate to severe pain, but who are in hemorrhagic shock or respiratory distress or are at significant risk for developing either condition. Ketamine may also be used to increase analgesic effect for casualties who have previously been given opioid medication. The present paper outlines the evolution and evidence base for battlefield analgesia as currently recommended by TCCC. It is not intended to be a comprehensive review of all prehospital analgesic options.

J Trauma Acute Care Surg. 2017 Jun 6. Epub ahead of print

Does prehospital management by doctors affect outcome in major trauma? A systematic review.

Wilson S, Gangathimmaiah V.

BACKGROUND: There is substantial variation worldwide in prehospital management of trauma and the role of doctors is controversial. The objective of this review was to determine whether prehospital management by doctors affects outcomes in major trauma, including the pre-specified subgroup of severe traumatic brain injuries (TBI) when compared to management by other advanced life support providers.

METHODS: EMBASE, MEDLINE(R), PubMed, SciELO, Trip, Web of Science and Zetoc were searched for published articles. HSRProj, OpenGrey and the WHO International Clinical Trials Registry Platform were searched for unpublished data. Relevant reference lists were hand-searched. There were no limits on publication year, but articles were limited to the English language. Authors were contacted for further information as required. Quality was assessed using the Downs and Black criteria. Mortality was the primary outcome and disability was the secondary outcome of interest. Studies were subjected to a descriptive analysis alone without a meta-analysis was due to significant study heterogeneity. All searches, quality assessment, data abstraction and data analysis was performed by two reviewers independently.

RESULTS: 2037 articles were identified, 49 full-text articles assessed and eight studies included. The included studies consisted of one randomised controlled trial with 375 participants and seven observational studies with over 4451participants. All included studies were at a moderate to high risk of bias. Six of the eight included studies showed an improved outcome with prehospital management by doctors, five in terms of mortality and one in terms of disability. Two studies found no significant difference.

CONCLUSION: There appears to be an association between prehospital management by doctors and improved survival in major trauma. There may also be an association with improved survival and better functional outcomes in severe TBI. Further high quality evidence is needed to confirm these findings.

LEVEL OF EVIDENCE: level III TYPE OF STUDY: therapeutic study.

Clin Appl Thromb Hemost. 2017 Jan 1: Epub ahead of print

Experimental Evaluation of Tranexamic Acid-Loaded Porous Starch as a Hemostatic Powder.

Xi C, Zhu L, Zhuang Y, Wang S, Sun G, Liu Y, Wang D

ABSTRACT:

We evaluated the effectiveness of a novel hemostatic powder called Tranexamic Acid-loaded Porous Starch (TAPS) developed recently on blood clotting activity and hemostasis. The effectiveness of TAPS was evaluated by comparing hemostatic properties with those of Quick-acting Styptic Powder (QSP) and Compound Microporous Polysaccharide Haemostatic powder (CMPHP). The blood clotting activities of human blood were analyzed by thromboela-stogram (TEG) assays in vitro. The hemostatic effectiveness in vivo was evaluated using a rat model with hepatic traumatic hemorrhage. The blood loss and standardized bleeding score, which reflects the degree of bleeding after treatment with styptic powder, were used to evaluate hemostatic efficacy. In vitro, the values of TEG parameters in TAPS group were significantly different, compared with untreated controls or CMPHP group ($p < 0.05$). In vivo, the application of QSP, CMPHP and TAPS led to significantly decreased post-treatment blood loss than in the control group ($p < 0.01$). The scores of the groups treated with QSP, CMPHP and TAPS (0, 0.2±0.422, 0.3±0.483, respectively) were significant lower than with gauze control (1.6±0.516) which success hemostatic was achieved at 5 minutes ($p < 0.01$). Hemostasis was achieved successfully within approximately 4 minutes after the application of TAPS. TAPS could help blood to form an artificial scab on a wound and to seal injuries for hemostasis to reduce blood loss in rats with hepatic trauma and hemorrhage. It was safe to use with no impact on blood clotting function or other apparent side effects.

Anesth Analg. 2017 Sep;125(3):958-966

Comparison Between the Cobra Perilaryngeal Airway and Laryngeal Mask Airways Under General Anesthesia: A Systematic Review and Meta-analysis.

Xu R, Zhu Y, Fan Q, Shen X, Li WX.

ABSTRACT:

The complication rate and efficacy of the Cobra Perilaryngeal Airway (CobraPLA) and laryngeal mask airways (LMAs®) have been evaluated in the published literature, but the conclusions have been inconsistent. The aim of this systematic review and meta-analysis was thus to assess the performance of the CobraPLA and LMAs under general anesthesia. We searched PubMed, Embase, and the Cochrane Library for randomized controlled trials comparing the CobraPLA with LMAs under general anesthesia. The LMAs used for comparison were the classic LMA (CLMA) and the unique LMA (ULMA). The random effect model was used if heterogeneity was observed, otherwise the fixed effect model was used. Seventeen randomized controlled trials were included; number of studies analyzed for each result are different and were up to 10. The current result suggests that no significant difference between the devices in the insertion success rate at the first attempt. The success rate of first insertion of the CobraPLA was not different from the rates for the CLMA and the ULMA (relative risk: 0.95, 95% confidence interval [CI], 0.91-1.00). CobraPLA insertion was not different from CLMA and ULMA insertion. The CobraPLA provided an oropharyngeal leak pressure higher than that provided by the CLMA (weight mean difference: 3.90, 95% CI, [1.59-6.21] cmH2O) and ULMA (weight mean difference: 6.57, 95% CI, [4.30-8.84] cmH2O). We also found a higher likelihood of blood staining in the airway with the CobraPLA than with the CLMA. In our research, the principal finding of our meta-analysis is that the success rate of first insertion of the CobraPLA was not different from the rate for each of the CLMA and the ULMA, which featured a short learning curve implying its ease of insertion. There was also no significant difference in the incidence of the best view (with a score of 4) obtained with the CobraPLA compared with the other 2 devices. The CobraPLA does seem to be superior to the CLMA and ULMA in providing a higher oropharyngeal leak pressure. The data were insufficient to establish differences in airway adverse even between the groups except for blood staining in the devices, although mucosal trauma occurred more frequently with the Cobra PLA device than with the CLMA and the ULMA.

J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S66-S69.

The need for optimized crystalloid-based resuscitation.

Yitzhak A, Glick Y, Benov A, Nadler R, Rappold JF, Glassberg E

QUOTE:

"The Present Is What Is Happening While We Talk About the Future"

As the quest for the optimized fluid resuscitation strategies and protocols continues, providers around the world treat millions of trauma casualties a year using what they got, that is, water and salt solutions (crystalloids). These cheap, readily available, and common solutions have been in use for some 150 years, and their use is so indoctrinated, that even providers who have access to more advanced treatments still use crystalloids to resuscitate trauma patients. It is up to the scientific, professional community not only to come up with improved treatment options, whether "new" or "old,"[32–36] but at the same time to develop the much needed optimized, scientific proven and practical crystalloids based fluid resuscitation protocols. This should involve an international effort based on research, data collection and evidence-based adjustments to the current clinical practice guidelines. Furthermore, leadership will be required to promote and fund such efforts, since the financial incentive to improve these products will not suffice. It is our hope that such adjustments and their practical implementation will translate to improved survival rates.

Blood Transfus. 2017 Jul;15(4):357-364.

Improving the safety of whole blood-derived transfusion products with a riboflavin-based pathogen reduction technology.

Yonemura S, Doane S, Keil S, Goodrich R, Pidcoke H, Cardoso M

ABSTRACT:

Worldwide safety of blood has been positively impacted by technological, economic and social improvements; nevertheless, growing socio-political changes of contemporary society together with environmental changes challenge the practice of blood transfusion with a continuous source of unforeseeable threats with the emergence and re-emergence of blood-borne pathogens. Pathogen reduction (PR) is a proactive strategy to mitigate the risk of transfusion-transmitted infections. PR technologies for the treatment of single plasma units and platelet concentrates are commercially available and have been successfully implemented in more than 2 dozen countries worldwide. Ideally, all labile blood components should be PR treated to ensure a safe and sustainable blood supply in accordance with regional transfusion best practices. Recently, a device (Mirasol(®) Pathogen Reduction Technology System) for PR treatment of whole blood using riboflavin and UV light has received CE marking, a significant step forward in realising blood safety where WB transfusion is the norm, such as in sub-Saharan Africa and in far-forward combat situations. There is also keen interest in the ability to derive components from Mirasol(®)-treated whole blood, as it is seen as a more efficient and economical means to implement universal PR in the blood centre environment than treatment of components with different PR systems.

Medicine (Baltimore). 2017 May;96(21):e6916

Is combined topical and intravenous tranexamic acid superior to intravenous tranexamic acid alone for controlling blood loss after total hip arthroplasty?: A meta-analysis.

Zhang H, He G, Zhang C, Xu B, Wang X, Zhang C.

BACKGROUND: We performed a meta-analysis of randomized controlled trials (RCTs) to compare the efficacy and safety of combined intravenous (IV) and topical tranexamic acid (TXA) with IV-TXA alone for controlling blood loss in patients following primary total hip arthroplasty (THA).

METHODS: PubMed, EMBASE, the Cochrane Central Register of Controlled Trials, the Google database, the Chinese Wanfang database, and the China National Knowledge Infrastructure database were searched to identify studies comparing combined IV and topical TXA with IV-TXA alone in patients who were prepared for THA. The weighed mean differences for total blood loss, hemoglobin drop, intraoperative blood loss, and the length of hospital stay were calculated. We calculated risk ratios for the need for transfusion and the occurrence of deep venous thrombosis (DVT) in the combined TXA and IV-TXA alone groups. Relevant data were analyzed using Reviewer Manager 5.3.0. RESULTS: Eight RCTs with a total of 850 patients (combined TXA: n=471; IV-TXA: n=479) were included in this meta-analysis. Pooled results indicated that compared with the IV-TXA alone group, the combined TXA group was associated with a lesser need for transfusion, total blood loss, intraoperative blood loss, and hemoglobin drop ($P<.05$). There was no significant difference between the 2 groups for the length of hospital stay and the occurrence of DVT ($P>.05$).

CONCLUSIONS: The current meta-analysis indicated that combined topical and IV-TXA was a relatively effective hemostasis method compared with IV-TXA alone. The number of studies included in this meta-analysis is limited, and more studies are needed to verify the effects of combined IV and topical TXA in THA patients.

J Trauma Acute Care Surg. 2017 Jun;82(6S Suppl 1):S70-S78

Prehospital blood transfusion programs: Capabilities and lessons learned.

Zielinski MD, Stubbs JR, Berns KS, Glassberg E, Murdock AD, Shinar E, Sunde GA, Williams S, Yazer MH, Zietlow S, Jenkins DH

QUOTES:

PREHOSPITAL ADMINISTRATION OF BLOOD: THE MAYO CLINIC PLAN OF CARE

An institutional decision has been made to start carrying CWB and cold stored platelets (CSP) on our helicopters for prehospital transfusion therapy in trauma victims. Administration of blood products in our prehospital practice is based on criteria in the Mayo Clinic Trauma Center guidelines. These prehospital criteria mirror those used once in the Trauma Center with some additional criteria (Fig. 2).

Component therapy has been used for years, but following recent military experiences, there has been renewed interest in using whole blood for patients suffering from trauma-related hemorrhage.[8–11] Having the ability to bring CWB and CSP to the prehospital transport environment would enable patients to receive potentially lifesaving products sooner. Although our transfusion colleagues worked on the feasibility of taking these products on the helicopter or critical care ground transports, our task was to decide which product should be given first.

CONCLUSION

THOR is a rapidly growing society which promotes best practices in hemorrage resuscitation with an emphasis on RDCR for military and civilian practice. The current state of the art in RDCR focuses on providing the novel blood products, including CWB, to the field. In addition, novel storage methods, such as cold platelets and FDP, are becoming increasingly available as data emerges to their efficacy. As the THOR group has grown, each meeting has matured in content and fellowship. We antcipate the upcoming meeting in 2017 will continue this trend.

Anesthesiology. 2017 Sep;127(3):413-422

Intravenous Tranexamic Acid Bolus plus Infusion Is Not More Effective than a Single Bolus in Primary Hip Arthroplasty: A Randomized Controlled Trial.

Zufferey PJ(1), Lanoiselée J, Chapelle C, Borisov DB, Bien JY, Lambert P, Philippot R, Molliex S, Delavenne X; investigators of the PeriOpeRative Tranexamic acid in hip arthrOplasty (PORTO) Study.

BACKGROUND: Preoperative administration of the antifibrinolytic agent tranexamic acid reduces bleeding in patients undergoing hip arthroplasty. Increased fibrinolytic activity is maintained throughout the first day postoperation. The objective of the study was to determine whether additional perioperative administration of tranexamic acid would further reduce blood loss.

METHODS: This prospective, double-blind, parallel-arm, randomized, superiority study was conducted in 168 patients undergoing unilateral primary hip arthroplasty. Patients received a preoperative intravenous bolus of 1 g of tranexamic acid followed by a continuous infusion of either tranexamic acid 1 g (bolus-plus-infusion group) or placebo (bolus group) for 8 h. The primary outcome was calculated perioperative blood loss up to day 5. Erythrocyte transfusion was implemented according to a restrictive transfusion trigger strategy.

RESULTS: The mean perioperative blood loss was 919 ± 338 ml in the bolus-plus-infusion group (84 patients analyzed) and 888 ± 366 ml in the bolus group (83 patients analyzed); mean difference, 30 ml (95% CI, -77 to 137; P = 0.58). Within 6 weeks postsurgery, three patients in each group (3.6%) underwent erythrocyte transfusion and two patients in the bolus group experienced distal deep-vein thrombosis. A meta-analysis combining data from this study with those of five other trials showed no incremental efficacy of additional perioperative administration of tranexamic acid.

CONCLUSIONS: A preoperative bolus of tranexamic acid, associated with a restrictive transfusion trigger strategy, resulted in low erythrocyte transfusion rates in patients undergoing hip arthroplasty. Supplementary perioperative administration of tranexamic acid did not achieve any further reduction in blood loss.