Tactical Combat Casualty Care

&

En Route Combat Casualty Care

2023 Journal Watch

Journal Article Abstracts

Apr 2023- Jun 2023

A quarterly literature review of topics related to Tactical Combat Casualty Care (TCCC) and En Route Combat Casualty Care (ERCCC) from the months of Dec 2019 through Mar 2020.

Posting of articles does not imply agreement or disagreement with the contents nor constitute a change in TCCC or ERCCC guidelines, practices, or training. Links are provided to respective publications for further reading and research. Additional log-in requirements may be required at various websites. The Joint Trauma System and Deployed Medicine do not provide downloadable articles or free access to journal sites. Access may be acquired through service medical departments/commands or medical agencies/organizations.

The CoTCCC is the branch of the JTS focused on the standard of care for prehospital battlefield medicine. The CoERCCC is the branch of the JTS focused on the standard of care for en route care medicine through the evacuation echelons of care. The JTS is the Department of Defense Center of Excellence for Trauma and division of the Defense Health Agency (DHA) providing clinical practice guidelines and performance improvement for all levels of military trauma care.

Association Between Hemorrhage Control Interventions and Mortality in US Trauma Patients With Hemodynamically Unstable Pelvic Fractures

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JAMA Surg 2023 Jan 1;158(1):63-71

Abstract

Importance: Management of hemodynamically unstable pelvic fractures remains a challenge. Hemostatic interventions are used alone or in combination. There is a paucity of data on the association between the pattern of hemorrhage control interventions and outcomes after a severe pelvic fracture.

Objective: To characterize clinical outcomes and study the patterns of hemorrhage control interventions in hemodynamically unstable pelvic fractures.

Design, setting, and participants: In this cohort study, a retrospective review was performed of data from the 2017 American College of Surgeons Trauma Quality Improvement Program database, a national multi-institutional database of trauma patients in the United States. Adult patients (aged ≥18 years) with pelvic fractures who received early transfusions (≥4 units of packed red blood cells in 4 hours) and underwent intervention for pelvic hemorrhage control were identified. Use and order of preperitoneal pelvic packing (PP), pelvic angioembolization (AE), and resuscitative endovascular balloon occlusion of the aorta (REBOA) in zone 3 were examined and compared against the primary outcome of mortality. The associations between intervention patterns and mortality, complications, and 24-hour transfusions were further examined by backward stepwise regression analyses. Data analyses were performed in September 2021.

Main outcomes and measures: Primary outcomes were rates of 24-hour, emergency department, and in-hospital mortality. Secondary outcomes were major in-hospital complications.

Results: A total of 1396 patients were identified. Mean (SD) age was 47 (19) years, 975 (70%) were male, and the mean (SD) lowest systolic blood pressure was 71 (25) mm Hg. The median (IQR) Injury Severity Score was 24 (14-34), with a 24-hour mortality of 217 patients (15.5%), ED mortality of 10 patients (0.7%), in-hospital mortality of 501 patients (36%), and complication rate of 574 patients (41%). Pelvic AE was the most used intervention (774 [55%]), followed by preperitoneal PP (659 [47%]) and REBOA zone 3 (126 [9%]). Among the cohort, 1236 patients (89%) had 1 intervention, 157 (11%) had 2 interventions, and 3 (0.2%) had 3 interventions. On regression analyses, only pelvic AE was associated with a mortality reduction (odds ratio [OR], 0.62; 95% CI, 0.47 to 0.82; P < .001). Preperitoneal PP was associated with increased odds of complications (OR, 1.39; 95% CI, 1.07 to 1.80; P = .01). Increasing number of interventions was associated with increased 24-hour transfusions (β = +5.4; 95% CI, +3.5 to +7.5; P < .001) and mortality (OR, 1.57; 95% CI, 1.05 to 2.37; P = .03), but not with complications.

Conclusions and relevance: This study found that among patients with pelvic fracture who received early transfusions and at least 1 invasive pelvic hemorrhage control intervention, more than 1 in 3 died, despite the availability of advanced hemorrhage control interventions. Only pelvic AE was associated with a reduction in mortality.

Airway Management during Large-Scale Combat Operations: A Narrative Review of Capability Requirements

Michael D April, Steven G Schauer, Brit Long, Lyle Hood, Robert A De Lorenzo

Med J (Ft Sam Houst Tex). 2023 Jan-Mar:(Per 23-1/2/3):18-27.

Abstract

Large-scale combat and multi-domain operations will pose unprecedented challenges to the military healthcare system. This scoping review examines the specific challenges related to the management of airway compromise, the second leading cause of potentially preventable death on the battlefield. Closing existing capability gaps will require a comprehensive approach across all components of the Joint Capabilities Integration Development System. In this, we present the case for a change in doctrine to selectively provide definitive airway management in prehospital settings to maximize the effectiveness of limited resources. Organizational changes to optimize training and efficiency in delivery of complex airway intervention include centralization of assigned healthcare personnel. Training must vastly increase opportunities for live tissue and patient experiences to obtain repetitions of both non-invasive and definitive airway procedures. Potential materiel solutions include extra-glottic devices, bag-valve masks, video laryngoscopes, and oxygen generators all ruggedized and capable of operations in austere settings. Leadership and education changes must formalize more robust airway skills into the initial training curricula for more healthcare personnel who will potentially need to perform these life-saving interventions. Simultaneously, personnel changes should expand authorizations for clinicians with advanced airway skills to the lowest echelons of care. Finally, existing medical training and treatment facilities must expand as necessary to accommodate the training and skill maintenance of these personnel.

Keywords: airway management; cricothyrotomy; extra-glottic airway device; extraglottic; intubation; military medicine; supraglottic.

Pressure Points Technique for Traumatic Proximal Axillary Artery Hemorrhage: A Case Report

Guy Avital, Chaim Greenberger, Asaf Kedar, Regina Pikman-Gavriely, Maxim Bez, Ofer Almog, Avi Benov

Prehosp Disaster Med. 2022 Dec 16:1-4.

Introduction: While the pressure points technique for proximal hemorrhage control is long known, it is not recommended in standard prehospital guidelines based on a study showing the inability to maintain occlusion for over two minutes.

Main symptom: This report details a gunshot wound to the left axillary area with complete transection of the axillary artery, leading to profuse junctional hemorrhage and profound hemorrhagic shock.

Therapeutic intervention: Proximal pressure of the subclavian artery was applied against the first rib (the pressure points technique) and maintained for 28 minutes.

Outcomes: Cessation of apparent bleeding and excellent, enduring physiologic response to blood transfusion were observed.

Conclusion: The pressure points technique can be life-saving in junctional arterial hemorrhage and should be reconsidered in prehospital guidelines.

Tranexamic Acid Improves Survival in the Setting of Severe Head Injury in Combat Casualties

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Med J (Ft Sam Houst Tex). 2023 Jan-Mar:(Per 23-1/2/3):34-40.

Introduction: Approximately 1.7 million people sustain traumatic brain injuries (TBI) annually in the US. To reduce morbidity and mortality, management strategies aim to control progressive intracranial bleeding. This study analyzes the association between Tranexamic Acid (TXA) administration and mortality among casualties within the Department of Defense Trauma Registry, specifically focusing on subsets of patients with varying degree of head injury severities.

Methods: Besides descriptive statistics, we used inverse probability weighted (for age, military service category, mechanism of injury, total units of blood units administered), and injury severity (ISS) and Abbreviated Injury Scale (AIS) head score adjusted generalized linear models to analyze the association between TXA and mortality. Specific subgroups of interest were increasing severities of head injury and further stratifying these by Glasgow Coma Score of 3-8 and severe overall bodily injuries (ISS>=15).

Results: 25,866 patients were included in the analysis. 2,352 (9.1%) received TXA and 23,514 (90.9%) did not receive TXA. Among those with ISS>=15 (n=6,420), 21.2% received TXA. Among those with any head injury (AIS head injury severity score>=1; n=9,153), 7.2% received TXA. The median ISS scores were greater in the TXA versus no-TXA group (17 versus 6). Weighted and adjusted models showed overall, there was 25% lower mortality risk between those who received TXA at any point and those who did not (OR:0.75, 95% CI: 0.59, 0.95). Further, as the AIS severity score increased from >=1 (1.08; 0.80, 1.47) to >=5 (0.56; 0.33, 0.97), the odds of mortality decreased.

Conclusions: TXA may potentially be beneficial in patients with severe head injuries, especially those with severe overall injury profiles. There is a need of definitive studies to confirm this association.

Are Pelvic Binders an Effective Prehospital Intervention?

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Prehosp Emerg Care. 2023;27(1):24-30

Objective: Widespread adoption of prehospital pelvic circumferential compression devices (PCCDs) by emergency medical services (EMS) systems has been slow and variable across the United States. We sought to determine the frequency of prehospital PCCD use by EMS providers. Secondarily, we hypothesized that prehospital PCCD use would improve early hemorrhagic shock outcomes.

Methods: We conducted a single-center retrospective cohort study of 162 unstable pelvic ring injuries transported directly to our center by EMS from 2011 to 2020. Included patients received a PCCD during their resuscitation (prehospital or emergency department). Prehospital treatment details were obtained from the EMS medical record. The primary outcome was the proportion of patients who received a PCCD by EMS before hospital arrival. Secondarily, we explored factors associated with receiving a prehospital PCCD, and its association with changes in vital signs, blood transfusion, and mortality.

Results: EMS providers documented suspicion of a pelvic ring fracture in 85 (52.8%) patients and 52 patients in the cohort (32.2%) received a prehospital PCCD. Wide variation in prehospital PCCD use was observed based on patient characteristics, geographic location, and EMS provider level. Helicopter flight paramedics applied a prehospital PCCD in 46% of the patients they transported (38/83); in contrast, the EMS organizations geographically closest to our hospital applied a PCCD in ≤5% of cases (2/47). Other predictors associated with receiving a prehospital PCCD included lower body mass index ($p = 0.005$), longer prehospital duration ($p = 0.001$) and lower Injury Severity Score ($p < 0.05$). We were unable to identify any improvements in clinical outcomes associated with prehospital PCCD, including early vital signs, number of blood transfusions within 24 hours, or mortality during admission ($p > 0.05$).

Conclusion: Our results demonstrate wide practice variation in the application of prehospital PCCDs. Although disparate PCCD application across the state is likely explained by differences across EMS organizations and provider levels, our study was unable to identify any clinical benefits to the prehospital use of PCCDs. It is possible that the benefits of a prehospital PCCD can only be observed in the most displaced fracture patterns with the greatest early hemodynamic instability.

Comparison of outcomes between observation and tube thoracostomy for small traumatic pneumothoraces

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Am J Emerg Med. 2023 Apr:66:36-39

Background: Traumatic pneumothorax management has evolved to include the use of smaller caliber tube thoracostomy and even observation alone. Data is limited comparing tube thoracostomy to observation for small traumatic pneumothoraces. We aimed to investigate whether observing patients with a small traumatic pneumothorax on initial chest radiograph (CXR) is associated with improved outcomes compared to tube thoracostomy.

Methods: We retrospectively reviewed trauma patients at our level 1 trauma center from January 1, 2016 through December 31, 2020. We included those with a pneumothorax size <30 mm as measured from apex to cupola on initial CXR. We excluded patients with injury severity score ≥ 25, operative requirements, hemothorax, bilateral pneumothoraces, and intensive care unit admission. Patients were grouped by management strategy (observation vs tube thoracostomy). Our primary outcome was length of stay with secondary outcomes of pulmonary infection, failed trial of observation, readmission, and mortality. Results are listed as mean ± standard error of the mean.

Results: Of patients who met criteria, 39 were in the observation group, and 34 were in the tube thoracostomy group. Baseline characteristics were similar between the groups. Average pneumothorax size on CXR was 18 ± 1.0 mm in the observation group and 18 ± 0.84 mm in the tube thoracostomy group ($p > 0.99$). Average pneumothorax sizes on computed tomography were 25 ± 2.1 and 37 ± 3.9 mm in the observation and tube thoracostomy groups, respectively ($p = 0.01$). Length of stay in the observation group was significantly shorter than the tube thoracostomy group (3.6 ± 0.33 vs 5.8 ± 0.81 days, $p < 0.01$). While pneumothorax size on computed tomography was associated with tube thoracostomy, only tube thoracostomy correlated with length of stay on multivariable analysis; pneumothorax size on CXR and computed tomography did not. There were no deaths or readmissions in either cohort. One patient in the observation group required tube thoracostomy after 18 h for worsening subcutaneous emphysema, and one patient in the tube thoracostomy group developed an empyema.

Conclusions: Select patients with small traumatic pneumothoraces on initial chest radiograph who were treated with observation experienced an average length of stay over two days shorter than those treated with tube thoracostomy. Outcomes were otherwise similar between the two groups suggesting that an observation-first strategy may be a superior treatment approach for these patients.

State of the Union: Timeliness to Antibiotics in Open Fractures

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J Orthop Trauma. 2023 May 1;37(5):e213-e218

Objective: In open fractures, early administration of systemic antibiotics has recently been recognized as a universal recommendation, with the current American College of Surgeons Trauma Center Verification recommendation for administration within 1 hour of facility arrival. We sought to quantify the baseline rate of timely antibiotic administration and the various factors associated with delay.

Methods: Data from the National Trauma Data Bank were obtained for all patients treated for open fractures in 2019. 65,552 patients were included. Univariate and multivariate analyses were performed, first for patient, prehospital, and hospital factors compared with rate of antibiotic administration within 1 hour of hospital arrival, then with a multivariate analysis of factors affecting these times.

Results: The overall rate of antibiotic administration within 1 hour of arrival was 47.6%. Patient factors associated with lower rates of timely antibiotics include increased age, Medicare status, and a higher number of comorbidities. Associated prehospital factors included non-work-related injuries, fixed-wing air or police transport, and walk-in arrival method. Patients with lower extremity open fractures were more likely to receive antibiotics within 1 hour of arrival than those with upper extremity open fractures. Traumatic amputations had a higher rate of timely administration (67.3%). ACS trauma Level II (52.5%) centers performed better than Level III (48.3%), Level I (45.5%), and Level IV (34.5%) centers. Multivariate analysis confirmed the findings of the univariate analysis.

Conclusions: Despite current clinical standards, rates of adherence to rapid antibiotic administration are low. Certain patient, facility, and environmental factors are associated with delays in antibiotic administration and can be a focus for quality improvement processes. We plan to use these data to evaluate how focus on antibiotic administration as this quality standard changes practice over time.

Level of evidence: Prognostic Level III. See Instructions for Authors for a complete description of levels of evidence.

The Ability of Paramedics to Accurately Locate Correct Anatomical Sites for Intraosseous Needle Insertion

Daniel Berger, Alexandra Petrie, Jeffrey S Lubin

Cureus. 2023 Jan 4;15(1):e33355.

Abstract

Introduction Intraosseous (IO) access is an alternative to peripheral intravenous access, in which a needle is inserted through the cortical bone into the medullary space using either a manual driver or an electric drill. Although studies report high success rates of IO access, failures are often attributed to incorrect site placement due to failure to adhere to anatomical landmarks. This study was designed to evaluate the ability of paramedics to locate the correct anatomic location for IO needle insertion. Methods Participants were paramedics who were recruited at Pennsylvania's annual statewide Emergency Medical Services (EMS) conference. After completing a demographics survey which included information about their training and practice environment, they were asked to identify which IO sites were permitted for IO placement using the EZ IO® drill and to place a sticker at those locations on a human volunteer. A transfer sheet was utilized, and the distance between the participants' sticker and the location as marked by a physician board-certified in both Emergency Medicine and Emergency Medical Services was recorded. Descriptive statistics and t-tests were calculated from the records. Results Of 30 paramedics who participated in the study, 25 (83%) had been in practice for more than five years (range: 1-37 years), 13 (46%) reported running more than 20 calls per week, and 23 (79%) reported that they only or mostly provide 9-1-1 EMS response. Ten (36%) participants were currently certified in PHTLS, and 16 (57%) had previously been PHTLS certified. All participants reported having been trained in IO insertion. Seventeen (57%) reported having utilized an IO ≤10 times in the field, and 13 (43%) reported >10 field IO insertions. When asked to identify appropriate IO insertion sites for the EZ IO drill, 26 paramedics (90%) correctly identified both the proximal humerus and proximal tibia. The average distance from the landmark for the humeral insertion site was 5.06 cm, with a statistically significant difference in the means for those who did and did not rotate the arm internally before identifying the humeral IO insertion site ($p < .01$). The average distance from the landmark at the tibial insertion site was 4.13 cm. Conclusion Although a high percentage of paramedics were able to verbally identify the correct location for IO placement, fewer were able to locate the insertion site on a human volunteer. Our results suggest a need for hands-on refresher training to maintain competency at IO insertion, as it is a rarely utilized procedure in the field.

Systemic hemostatic agents initiated in trauma patients in the pre-hospital setting: a systematic review

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Eur J Trauma Emerg Surg. 2023 Jun;49(3):1259-1270.

Purpose: The effect of systemic hemostatic agents initiated during pre-hospital care of severely injured patients with ongoing bleeding or traumatic brain injury (TBI) remains controversial. A systematic review and meta-analysis was therefore conducted to assess the effectiveness and safety of systemic hemostatic agents as an adjunctive therapy in people with major trauma and hemorrhage or TBI in the context of developing the Italian National Institute of Health guidelines on major trauma integrated management.

Methods: PubMed, Embase, and Cochrane Library databases were searched up to October 2021 for studies that investigated pre-hospital initiated treatment with systemic hemostatic agents. The certainty of evidence was evaluated with the Grading of Recommendations Assessment, Development, and Evaluation approach, and the quality of each study was determined with the Cochrane risk-of-bias tool. The primary outcome was overall mortality, and secondary outcomes included cause-specific mortality, health-related quality of life, any adverse effects and blood product use, hemorrhage expansion, and patient-reported outcomes.

Results: Five trials of tranexamic acid (TXA) met the inclusion criteria for this meta-analysis. With a high certainty of evidence, when compared to placebo TXA reduced mortality at 24 h (relative risk = 0.83, 95% confidence interval = 0.73-0.94) and at 1 month among trauma patients (0.91, 0.85-0.97). These results depend on the subgroup of patients with significant hemorrhage because in the subgroup of TBI there are no difference between TXA and placebo. TXA also reduced bleeding death and multiple organ failure whereas no difference in health-related quality of life.

Conclusion: Balancing benefits and harms, TXA initiated in the pre-hospital setting can be used for patients experiencing major trauma with significant hemorrhage since it reduces the risk of mortality at 24 h and one month with no difference in terms of adverse effects when compared to placebo. Considering the subgroup of severe TBI, no difference in mortality rate was found at 24 h and one month. These results highlight the need to conduct future studies to investigate the role of other systemic hemostatic agents in the pre-hospital settings.

State-by-state estimates of avoidable trauma mortality with early and liberal versus delayed or restricted administration of tranexamic acid

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BMC Emerg Med. 2022 Dec 3;22(1):191.

Objective: Early administration of tranexamic acid (TXA) has been shown to save lives in trauma patients, and some U.S. emergency medical systems (EMS) have begun providing this therapy prehospital. Treatment protocols vary from state to state: Some offer TXA broadly to major trauma patients, others reserve it for patients meeting vital sign criteria, and still others defer TXA entirely pending a hospital evaluation. The purpose of this study is to compare the avoidable mortality achievable under each of these strategies, and to report on the various approaches used by EMS.

Methods: We used the National Center for Health Statistics Underlying Cause of Death data to identify a TXA-naïve population of trauma patients who died from 2007 to 2012 due to hemorrhage. We estimated the proportion of deaths where the patient was hypotensive or tachycardic using the National Trauma Data Bank. We used avoidable mortality risk ratios from the landmark CRASH 2 study to calculate lives saved had TXA been given within one hour of injury based on a clinician's gestalt the patient was at risk for significant hemorrhage; had it been reserved only for hypotensive or tachycardic patients; or had it been given between hours one to three of injury, considered here as a surrogate for deferring the question to the receiving hospital.

Results: Had TXA been given within 1 hour of injury, an average of 3409 deaths per year could have been averted nationally. Had TXA been given between one and three hours after injury, 2236 deaths per year could have been averted. Had TXA only been given to either tachycardic or hypotensive trauma patients, 1371 deaths per year could have been averted. Had TXA only been given to hypotensive trauma patients, 616 deaths per year could have been averted. Similar trends are seen at the individual state level. A review of EMS practices found 15 statewide protocols that allow EMS providers to administer TXA for trauma.

Conclusion: Providing early TXA to persons at risk of significant hemorrhage has the potential to prevent many deaths from trauma, yet most states do not offer it in statewide prehospital treatment protocols.

Prevention of pressure injuries during military aeromedical evacuation or prolonged field care: A randomized trial

Elizabeth Bridges, JoAnne Whitney, Debra Metter, Robert Burr

Nurs Outlook. 2022 Nov-Dec;70(6 Suppl 2):S115-S126

No abstract available

Is Low-Titer Group O Whole Blood Truly a Universal Blood Product?

Jason B Brill, Krislynn M Mueck, Brian Tang, Mariela Sandoval, Madeline E Cotton, C Cameron McCoy, Bryan A Cotton

J Am Coll Surg. 2023 Mar 1;236(3):506-513

Background: Whole blood was historically transfused as a type-specific product. Given recent advocacy for low-titer group O whole blood (LTOWB) as a universal blood product, we examined outcomes after LTOWB transfusion stratified by recipient blood groups.

Study design: Adult trauma patients receiving prehospital or in-hospital transfusion of LTOWB (November 2017 to July 2020) at a single trauma center were prospectively evaluated. The patients were divided into blood type groups (O, A, B, and AB). Major complications and survival to 30 days were compared. Univariate analyses among blood groups were followed by purposeful regression modeling, reflecting 6 variables of significance: male sex, White race, injury severity, arrival lactate, arrival systolic blood pressure, and emergency department blood products.

Results: Of 1,075 patients receiving any LTOWB, 539 (50.1%) were Group O, 340 (31.6%) were Group A, 150 (14.0%) were Group B, and 46 (4.3%) were Group AB. There were no statistically significant differences in demographics, injury severity, hemolysis panels, prehospital vitals, or resuscitation parameters (all $p > 0.05$). However, arrival systolic pressure was lower (91 vs 102, $p = 0.034$) and lactate was worse (5.5 vs 4.1, $p = 0.048$) in Group B patients compared to other groups. While survival and most major complications did not differ across recipient groups, acute kidney injury (AKI) initially appeared higher for Group B. Stepwise regression did not show a difference in AKI rates. This analysis was repeated in patients receiving only component products. Group B again showed no significantly increased risk of AKI (13%) compared to other groups (O 7%, A 7%, AB 5%; $p = 0.091$).

Conclusions: LTOWB appears to be a safe product for universal use across all blood groups. Group B recipients arrived with worse physiologic values associated with hemorrhagic shock whether receiving LTOWB or standard component products.

The effects of timing of prehospital tranexamic acid on outcomes after traumatic brain injury: Subanalysis of a randomized controlled trial

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J Trauma Acute Care Surg. 2023 Jan 1;94(1):86-92.

Background: Tranexamic acid (TXA) is an antifibrinolytic that has shown some promise in improving outcomes in traumatic brain injury (TBI), but only when given early after injury. We examined the association between timing of prehospital TXA administration and outcomes in patients with moderate to severe TBI.

Methods: Patients enrolled in the multi-institutional, double-blind randomized prehospital TXA for TBI trial with blunt or penetrating injury and suspected TBI (Glasgow Coma Scale score ≤ 12, SBP ≥90) who received either a 2-g TXA bolus or a 1-g bolus plus 1 g 8 hour infusion within 2 hours of injury were analyzed. Outcomes were compared between early administration (<45 minutes from injury) and late administration ≥45 minutes from injury) using a χ 2 , Fischer's exact test, t test, or Mann-Whitney U test as indicated. Logistic regression examined time to drug as an independent variable. A p value less than 0.05 was considered significant.

Results: Six hundred forty-nine patients met inclusion criteria (354 early and 259 late). Twenty-eight-day and 6-month mortalities, 6-month Glasgow Outcome Scale-Extended, and disability rating scale scores were not different between early and late administration. Late administration was associated with higher rates of deep venous thrombosis (0.8 vs. 3.4%, $p = 0.02$), cerebral vasospasm (0% vs. 2%, $p = 0.01$), as well as prolonged EMS transport and need for a prehospital airway ($p < 0.01$).

Conclusion: In patients with moderate or severe TBI who received TXA within 2 hours of injury, no mortality benefit was observed in those who received treatment within 45 minutes of injury, although lower rates of select complications were seen. These results support protocols that recommend TXA administration within 45 minutes of injury for patients with suspected TBI.

A CIRCULATION-FIRST APPROACH FOR RESUSCITATION OF TRAUMA PATIENTS WITH HEMORRHAGIC SHOCK

Jonathon Chon Teng Chio, Mark Piehl, Valerie J De Maio, John T Simpson, Chelsea Matzko, Cameron Belding, Jacob M Broome, Juan Duchesne

Shock. 2023 Jan 1;59(1):1-4.

Abstract

The original guidelines of cardiopulmonary resuscitation focused on the establishment of an airway and rescue breathing before restoration of circulation through cardiopulmonary resuscitation. As a result, the airway-breathing-circulation approach became the central guiding principle of resuscitation. Despite new guidelines by the American Heart Association for a circulation-first approach, Advanced Trauma Life Support guidelines continue to advocate for the airway-breathing-circulation sequence. Although definitive airway management is often necessary for severely injured patients, endotracheal intubation (ETI) before resuscitation in patients with hemorrhagic shock may worsen hypotension and precipitate cardiac arrest. In severely injured patients, a paradigm shift should be considered, which prioritizes restoration of circulation before ETI and positive pressure ventilation while maintaining a focus on basic airway assessment and noninvasive airway interventions. For this patient population, the most reasonable current strategy may be to target a simultaneous resuscitation approach, with immediate efforts to control hemorrhage and provide basic airway interventions while prioritizing volume resuscitation with blood products and deferring ETI until adequate systemic perfusion has been attained. We believe that a circulation-first sequence will improve both survival and neurologic outcomes for a traumatically injured patient and will continue to advocate this approach, as additional clinical evidence is generated to inform how to best tailor circulation-first resuscitation for varied injury patterns and patient populations.

Out-of-hospital cardiac arrest due to cervical spine injury by uncertain trauma: A study of two cases

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Ulus Travma Acil Cerrahi Derg. 2023 Feb;29(2):255-258

Abstract

Cervical spinal cord injury is a well-known cause of cardiac arrest in trauma victims. Unless trauma is definitively suspected, emergency medical services teams perform resuscitation in the pre-hospital stage without cervical spine immobilization. During advanced cardiovascular life support (ACLS), intubation with cervical spinal immobilization causes difficulty in accessing the airway, thus, immobilization tends to not be performed, unless the patient is a clear case of trauma. We report two patients with out-of-hospital cardiac arrests (OHCA) due to cervical fractures that have occurred without clear trauma. In these cases, pre-existing cervical spine lesions was additional informed and identification of the cervical spine fractures was delayed. Emergency medical physicians tend to neglect cervical spine injury when the likelihood of trauma is unclear in a patient presenting with OHCA. These cases urge physicians to consider the possibility of cervical spinal injuries, even in cases of minor trauma. If there is a possibility of cervical spinal injury, imaging should not be delayed and should be followed by appropriate treatment.

Prehospital Pharmacotherapy in Moderate and Severe Traumatic Brain Injury: A Systematic Review

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Med J (Ft Sam Houst Tex). 2023 Jan-Mar:(Per 23-1/2/3):47-56.

Background: Traumatic brain injury (TBI) affects civilian and military populations with high morbidity and mortality rates and devastating sequelae. As the US military shifts its operational paradigm to prepare for future large-scale combat operations, the need for prolonged casualty care is expected to intensify. Identifying efficacious prehospital TBI management strategies is therefore vital. Numerous pharmacotherapies are beneficial in the inpatient management of TBI, including beta blockers, calcium channel blockers, statins, and other agents. However, their utility in prehospital management of moderate or severe TBI is not well understood. We performed a systematic review to elucidate agents of potential prehospital benefit in moderate and severe TBI.

Methods: We searched 6 databases from January 2000 through December 2021 without limitations in outcome metrics using a variety of search terms designed to encapsulate all studies pertaining to prehospital TBI management. We identified 2,142 unique articles, which netted 114 studies for full review. Seven studies met stringent inclusion criteria for our aims.

Results: Studies meeting inclusion criteria assessed tranexamic acid (TXA) (n=6) and ethanol (n=1). Of the TXA studies, 3 were randomized controlled trials, 2 were retrospective cohort studies, 1 was a prospective cohort study, and 1 was a meta-analysis. Notably absent were papers investigating therapeutics shown to be beneficial in inpatient hospital treatment of TBI. Overall, data suggest TXA administration is potentially beneficial in moderate or severe TBI with or without intracranial hemorrhage. Severe TBI with or without penetrating trauma was associated with worse overall outcomes, regardless of TXA use.

Conclusion: Effective interventions for treating moderate or severe TBI are lacking. TXA is the most widely studied pharmacologic intervention and appears to offer some benefit without adverse effects in moderate TBI (with or without intracranial hemorrhage) in the pre-hospital setting despite heterogeneous results. Limitations of these studies include heterogeneity in outcome metrics, patient populations, and circumstances of TXA use. We identified a gap in the literature in translating agents with demonstrated inpatient benefit to the prehospital setting. Further investigation into these and other novel therapeutic options in the prehospital arena is crucial to improving clinical outcomes in TBI.

Where Do We Stand on "Buddy Transfusion" During Military Operations?

Yann Daniel, Clement Derkenne, Pierre Mahe, Stephane Travers, Christophe Martinaud

J Spec Oper Med. 2022 Dec 16;22(4):46-49.

Abstract

Warm fresh whole-blood transfusion between comrades on the battlefield, also known as "buddy transfusion," has been thrust back into the limelight for several years now. It means drawing blood on the battlefield, once a bleeding soldier needs a transfusion, from one of their uninjured companions and immediately infusing it. It is a lifesaving procedure, effective and hardy. This work aims to answer the main questions that military caregivers might have about it: interest of this procedure, donor and recipient safety, and hemostatic capacity of the blood collected this way.

Prehospital blood transfusion: Can we agree on a standardised approach?

Ross Davenport, Anne Weaver, Laura Green

Injury. 2023 Jan;54(1):1-2.

No abstract available

Higher Oxygenation Is Associated with Improved Survival in Severe Traumatic Brain Injury but Not Traumatic Shock

Daniel P Davis, Barbara McKnight, Eric Meier, Ian R Drennan, Craig Newgard, Henry E Wang, Eileen Bulger, Martin Schreiber, Michael Austin, Christian Vaillancour

Neurotrauma Rep. 2023 Jan 23;4(1):51-63.

Abstract

Pre-hospital resuscitation of critically injured patients traditionally includes supplemental oxygen therapy to address potential hypoxemia. The objective of this study was to explore the association between pre-hospital hypoxemia, hyperoxemia, and mortality in patients with traumatic brain injury (TBI) and traumatic shock. We hypothesized that both hypoxemia and hyperoxemia would be associated with increased mortality. We used the Resuscitation Outcomes Consortium Prospective Observational Prehospital and Hospital Registry for Trauma (ROC PROPHET) database of critically injured patients to identify a severe TBI cohort (pre-hospital Glasgow Coma Scale [GCS] 3-8) and a traumatic shock cohort (systolic blood pressure ≤90 mm Hg and pre-hospital GCS >8). Arterial blood gas (ABG) obtained within 30 min of hospital arrival was required for inclusion. Patients with hypoxemia (PaO2 <80 mm Hg) and hyperoxemia (PaO2 >400 mm Hg) were compared to those with normoxemia (PaO2 80-400 mm Hg) with regard to the primary outcome measure of in-hospital mortality in both the TBI and traumatic shock cohorts. Multiple logistic regression was used to calculate odds ratios (ORs) after adjustment for multiple covariables. In addition, regression spline curves were generated to estimate the risk of death as a continuous function of PaO2 levels. A total of 1248 TBI patients were included, of whom 396 (32%) died before hospital discharge. Associations between hypoxemia and increased mortality (OR, 1.8; 95% confidence interval [CI], 1.2-2.8; p = 0.008) and between hyperoxemia and decreased mortality (OR, 0.6; 95% CI, 0.4-0.9; p = 0.018) were observed. A total of 582 traumatic shock patients were included, of whom 52 (9%) died before hospital discharge. No statistically significant associations were observed between in-hospital mortality and either hypoxemia (OR, 1.0; 95% CI, 0.4-2.4; p = 0.987) or hyperoxemia (OR, 1.9; 95% CI, 0.6-5.7; p = 0.269). Among patients with severe TBI but not traumatic shock, hypoxemia was associated with an increase of in-hospital mortality and hyperoxemia was associated with a decrease of in-hospital mortality.

Effects of Seawater Immersion on Lethal Triad and Organ Function in Healthy and Hemorrhagic Shock Rats

Haoyue Deng, Yu Zhu, Qinghui Li, Yue Wu, Xiaoyong Peng, Liangming Liu, Tao Li

J Surg Res. 2023 Apr:284:173-185.

Introduction: Marine casualties are increasing, and mortality from trauma associated with immersion in seawater is high. However, the associated pathophysiological characteristics remain unclear, limiting research into the early emergency treatment strategy.

Methods: Healthy and 50% hemorrhagic shock rats were soaked in 15°C and 21°C seawater for 2 h, 4 h and 6 h, respectively, and the effects on vital signs, internal environment, tissue metabolism, lethal triad, vital organ functions and survival were observed.

Results: Immersion in seawater can cause death in healthy rats. Rats with hemorrhagic shock in 15°C seawater showed a lower survival rate than the corresponding groups in 21°C seawater. Moreover, compared with 21°C seawater, 15°C seawater played a more remarkable role in decreasing mean arterial pressure, heart rate, and respiration rate, increasing water content and decreasing Na+/K+-ATPase activity in the brain and lung; increase in plasma osmolality, Na+, K+, Cl-, and the occurrence of the lethal triad manifested by a decrease in core body temperature, pH, lactate, and an increase in coagulation parameters, as well as damage to cardiac, intestinal, hepatic, and renal functions in rats with hemorrhagic shock.

Conclusions: Immersion in seawater at low temperatures could be lethal to healthy rats, causing the occurrence of a lethal triad and damage to vital organs. Furthermore, 15°C-seawater had a more significant effect than 21°C-seawater on aggravating the imbalance of internal environment and tissue metabolism, resulting in a higher incidence of the lethal triad and thus aggravating the dysfunctions of vital organs, which eventually resulted in higher mortality in rats with hemorrhagic shock.

Tranexamic acid in emergency medicine. An overview of reviews

Poshika Dhingra, Matthew Yeung, Eddy Lang

Intern Emerg Med. 2023 Jan;18(1):211-218.

Abstract

Tranexamic acid (TXA) is a common haemorrhage control agent in both emergency department (ED) settings and intra-operatively. While efficacy and potential harms are well-studied, there are no overviews of reviews completed on TXA efficacy in the ED setting. We set out to provide an overview of systematic reviews on TXA efficacy in trauma, gastrointestinal bleeding, and subarachnoid haemorrhage in the ED setting, with outcomes including short and long-term mortality, thromboembolic (TE) events, and whether bleeding continued. Our review is guided by the PRIOR statement. We searched Pubmed, Medline, and EMBASE using broad search terms for systematic reviews, and calculated pooled relative-risk ratios using random and fixed-effects modelling from these studies. A risk-of-bias assessment was also completed for each review. We identified 13 systematic reviews for inclusion, with a variety of different outcomes. We identified improvements in 24-h mortality for trauma (RR 0.88, 95% CI 0.84-0.92) and gastrointestinal bleeds (RR 0.30, 95% CI 0.23-0.39), and decreased long-term gastrointestinal bleed mortality (RR 0.57, 95% CI 0.48-0.69). We also identified an increase in TE risk in gastrointestinal bleeding scenarios (RR 1.45, 95% CI 1.09-1.94), but no other clinical scenarios. TXA is effective in reducing mortality following trauma and gastrointestinal bleeds, however, there is limited evidence at this time to support TXA administration in the context of subarachnoid haemorrhage. TE risk is elevated when used in gastrointestinal bleeds. Selective use in high-risk patients may be warranted. TXA should strongly be considered in management in ED and prehospital settings.

Comparing a Novel Hand-Held Device for Chest Tube Insertion to the Traditional Open Tube Thoracostomy for Simple Pneumothorax in a Porcine Model

Joshua Dilday, Bethany Heidenreich, Holly Spitzer, Yousef Abuhakmeh, Eric Ahnfeldt, John Watt, Vincent J Mase Jr

J Spec Oper Med. 2022 Dec 16;22(4):41-45.

Background: Tube thoracostomy is the most effective treatment for pneumothorax, and on the battlefield, is lifesaving. In combat, far-forward adoption of open thoracostomy has not been successful. Therefore, the ability to safely and reliably perform chest tube insertion in the far-forward combat theatre would be of significant value. The Reactor is a hand-held device for tube thoracostomy that has been validated for tension pneumothorax compared to needle decompression. Here we investigate whether the Reactor has potential for simple pneumothorax compared to open thoracostomy. Treatment of pneumothorax before tension physiology ensues is critical.

Methods: Simple pneumothoraces were created in 5 in-vivo swine models and confirmed with x-ray. Interventions were randomized to open technique (OT, n = 25) and Reactor (RT, n = 25). Post-procedure radiography was used to confirm tube placement and pneumothorax resolution. Video Assisted Thoracoscopic Surgery (VATS) was used to evaluate for iatrogenic injuries. 50 chest tubes were placed, with 25 per group.

Results: There were no statistical differences between the groups for insertion time, pneumothorax resolution, or estimated blood loss (p = .91 and .83). Injury rates between groups varied, with 28% (n = 7) in the Reactor group and 8% (n = 2) the control group (p = .06). The most common injury was violation of visceral pleura (10%, n = 5, both groups) and violation of the mediastinum (8%, n = 4, both groups).

Conclusion: The Reactor device was equal compared to open thoracostomy for insertion time, pneumothorax resolution, and injury rates. The device required smaller incisions compared to tube thoracostomy and may be useful adjunct in simple pneumothorax management.

Cric in the Dark: Surgical Cricothyrotomy in Low Light Tactical Environments

Chandler W Getz, Sean M Stuart, Brent M Barbour, Jared M Verga, Paul J D Roszko, Emily E Friedrich

J Spec Oper Med. 2022 Dec 16;22(4):50-54.

Background: Surgical cricothyrotomy (SC) is a difficult procedure with high failure rates in the battlefield environment. The difficulty of this procedure is compounded in a low-light tactical environment in which white light cannot be used. This study compared the use of red-green (RG) light and red (R) light in the performance of SC in a low-light environment.

Materials and methods: Tactical Combat Casualty Care-certified navy corpsmen (n = 33) were provided 15 minutes of standardized instruction followed by hands-on practice with the Tactical CricKit and the H&H bougie-assisted Emergency Cricothyrotomy Kit. Participants acclimated to a dark environment for 30 minutes before performing SC on a mannequin with both devices using both R and RG light in a randomized order. Application time, success, participant preference, and participant confidence were analyzed.

Results: There were similarly high levels of successful placement (>87.5%) in all four cohorts. Light choice did not appear to affect placement time with either of the two kits. On Likert-scale surveys, participants reported that RG decreased difficulty ($p < .0001$) and increased confidence ($p < .0001$) in performing the procedure.

Conclusion: RG light increased confidence and decreased perceived difficulty when performing SC, though no differences in placement time or success were observed.

The effect of the Belmont rapid infuser on cold stored whole blood coagulability

Tatiana Hoyos Gomez, S James El Haddi, Sherri L Grimstead-Arnold, Martin A Schreiber

Injury. 2023 Jan;54(1):29-31.

Introduction: With the large-scale use of whole blood in massive transfusion using rapid infusers/fluid warmers such as the Belmont, questions remain as to whether coagulation potency, platelet number and function are preserved. We aimed to study functional coagulation capacity and cell counts in whole blood before and after infusion through the Belmont rapid infuser utilizing TEG analysis and complete blood counts.

Methods: We evaluated 10 whole blood units before and after infusion through a Belmont Fluid Management System at a set rate of 200 mL/min and a temperature of 37.4 °C. Cell counts and thromboelastography function of the specimens were measured. Parameters were compared utilizing paired Student's t-tests and paired Wilcoxon Rank Sign tests.

Results: Platelet count, R time, and Maximum amplitude showed significant decreases (defined as $p<0.05$) after being infused through the Belmont. Hemoglobin, hematocrit, MCV, and alpha angle were not statistically different before and after infusion.

Conclusion: Infusion of cold stored whole blood in a Belmont infuser, appeared to decrease platelet counts and function as well as activate clotting factors as demonstrated by a shorter R time while not affecting red cell counts or fibrin cross-linking as measured by TEG parameters and cell counts. This suggests that while it is possible to transfuse whole blood through a rapid infuser, platelet quantity and function may be negatively impacted.

Unit Collective Medical Training in the 75th Ranger Regiment

Simon Corona Gonzalez, Patricio F Vasquez, Harold R Montgomery, Curtis C Conklin, Zachary A Conaway, David M Pate, James F Lopata, Russ S Kotwal

J Spec Oper Med. 2022 Dec 16;22(4):28-39.

Abstract

The 75th Ranger Regiment's success with eliminating preventable death on the battlefield is innate to the execution of a continuous operational readiness training cycle that integrates individual and unit collective medical training. This is a tactical solution to a tactical problem that is solved by the entire unit, not just by medics. When a casualty occurs, the unit must immediately respond as a team to extract, treat, and evacuate the casualty while simultaneously completing the tactical mission. All in the unit must maintain first responder medical skills and medics must be highly proficient. Leaders must be prepared to integrate casualty management into any phase of the mission. Leaders must understand that (1) the first casualty can be anyone; (2) the first responder to a casualty can be anyone; (3) medical personnel manage casualty care; and (4) leaders have ownership and responsibility for all aspects of the mission. Foundational to training is a command-directed casualty response system which serves as a forcing function to ensure proficiency and mastery of the basics. Four programs have been developed to train individual and collective tasks that sustain the Ranger casualty response system: (1) Ranger First Responder, (2) Advanced Ranger First Responder, (3) Ranger Medic Assessment and Validation, and (4) Casualty Response Training for Ranger Leaders. Unit collective medical training incorporates tactical leader actions to facilitate the principles of casualty care. Tactical leader actions are paramount to execute a casualty response battle drill efficiently and effectively. Successful execution of this battle drill relies on a command-directed casualty response system and mastery of the basics through rehearsals, repetition, and conditioning.

Evaluation of the Impact of a Tourniquet Training Program: A Cross-Sectional Study

Valentín González-Alonso, María Del Carmen Usero-Pérez, Raquel Seguido Chacón, Alicia Gómez de la Fuente, Jonathan Cortés-Martín, Raquel Rodríguez-Blanque, Juan Carlos Sánchez-García

Int J Environ Res Public Health. 2023 Feb 3;20(3):2742.

Abstract

Among the main preventable causes of death in the area of operations is external exsanguinating hemorrhage in the extremities, hence the importance of the tourniquet as a therapeutic tool in this type of injury and, therefore, of the training of personnel participating in international missions. The main objective of this study is to determine the impact of training in the application of this device. This is a quasi-experimental, prospective, cross-sectional study, carried out with 97 healthy volunteers, military personnel who perform their work in the Royal Guard barracks of El Pardo. The study was conducted between June 2019 and July 2021. The correct determination of the device placement site and the times of correct device placement were evaluated by determining whether there was blood flow using Doppler ultrasound measurements. Statistically significant results were obtained for application time (76.68 s to 58.06 s; $p < 0.001$), correct device placement ($p < 0.001$), and achievement of complete ischemia in the upper extremity (23.7% pretest vs. 24.7% post-test; $p < 0.001$). In the lower extremity, after training, longer application duration (43.33 s to 47.30 s) and lower ischemia achievement (59.8% pretest vs. 37.8% post-test) were obtained. Standardized and regulated training improves device application. More intensive training is necessary to obtain better results.

Health and Safety Threats to Ukraine From Nonconventional Weapons: A Clear and Present Danger

Eric Goralnick, Peter R Chai, Timothy B Erickson

JAMA. 2022 Dec 20;328(23):2301-2302.

No abstract available

Differences in Disease Non-battle Injury Between Combatant Commands

Andrew Hall, Anwar E Ahmed, Christopher Cieurzo, Chelsea Payne, Ramey L Wilson

Mil Med. 2022 Dec 30: Online ahead of print.

Introduction: Disease and non-battle injury (DNBI) have historically been a major or primary medical burden in expeditionary military populations. The United States has multiple deployed populations conducting operations across the world. This study aims to determine if DNBI rates are different between military populations by comparing the United States Africa Command (USAFRICOM) and United States Central Command (USCENTCOM) areas of responsibility.

Materials and methods: The study period was from January 1, 2017 to December 31, 2021. Individual evacuation data including date, necessary specialty care, and combatant command (CCMD) were acquired via United States Transportation Command Regulating and Command & Control Evacuation System. Total population data was acquired from USAFRICOM and USCENTCOM headquarters. Total inpatient and outpatient encounters at each CCMD were acquired via Theater Medical Data Store. The proportions and evacuation rates of DNBI types within USAFRICOM and USCENTCOM were compared.

Results: USCENTCOM had significantly higher proportions of outpatient and inpatient services for mental disorders, musculoskeletal diseases, and neurologic conditions compared to USAFRICOM. USCENTCOM had a significantly lower evacuation rate compared to USAFRICOM for every year analyzed: 2017 (P-value < .0001; relative risk [RR] = 0.834; 95% CI = 0.80-0.87), 2018 (P-value < .0001; RR = 0.818; 95% CI = 0.78-0.85), 2019 (P-value < .0001; RR = 0.785; 95% CI = 0.75-0.82), 2020 (P-value < .0001; RR = 0.889; 95% CI = 0.84-0.94), and 2021 (P-value < .0001; RR = 0.868; 95% CI = 0.83-0.91).

Conclusions: The evacuation rates of different categories of DNBI vary between CCMDs. There will be CCMD-specific factors that impact the effectiveness of initiatives to reduce the DNBI burden.

Blood utilization at Abbey Gate

Hall A, King L, Timby J

Trauma. 2022 Dec 25;25(2):1-2

No abstract available

Accidental intrathecal injection of tranexamic acid: a case report

Salama A Harby, Neveen A Kohaf

J Med Case Rep. 2023 Feb 16;17(1):55.

Background: Tranexamic acid is a well-known antifibrinolytic medication frequently prescribed to individuals with bleeding disorders. Following accidental intrathecal injection of tranexamic acid, major morbidities and fatalities have been documented. The aim of this case report is to present a novel method for management of intrathecal injection of tranexamic acid.

Case presentation: In this case report, a 400 mg intrathecal injection of tranexamic acid resulted in significant back and gluteal pain, myoclonus of the lower limbs, agitation, and widespread convulsions in a 31-year-old Egyptian male with history of left arm and right leg fracture. Immediate intravenous sedation with midazolam (5 mg) and fentanyl (50 µg) was delivered with no response in seizure termination. A 1000 mg phenytoin intravenous infusion and subsequently, induction of general anesthesia was performed by thiopental sodium (250 mg) and atracurium (50 mg) infusion, and the trachea of the patient was intubated. Maintenance of anesthesia was achieved by isoflurane 1.2 minimum alveolar concentration and atracurium 10 mg every 20 minutes, and subsequent doses of thiopental sodium (100 mg) to control seizures. The patient developed focal seizures in the hand and leg, so cerebrospinal fluid lavage was done by inserting two spinal 22-gauge Quincke tip needles, one on level L2-L3 (drainage) and the other on L4-L5. Intrathecal normal saline infusion (150 ml) was done over an hour by passive flow. After cerebrospinal fluid lavage and the patient's stabilization was obtained, he was transferred to the intensive care unit.

Conclusions: Early and continuous intrathecal lavage with normal saline, with the airway, breathing, and circulation protocol is highly recommended to decrease morbidity and mortality. The selection of the inhalational drug as a sedative and for brain protection in the intensive care unit provided possible benefits in management of this event with medication errors.

Successful surgical cricothyroidotomy following an obstetric "can't oxygenate" scenario: a narrative of enabling factors

J S Hill, E Robinson

Int J Obstet Anesth. 2023 Feb:53:103611.

Abstract

The airway management of a patient requiring emergency caesarean delivery for fetal distress and pre-eclampsia with severe features is described. A difficult obstetric airway was anticipated prior to induction and managed with the use of decision-support guidelines and cognitive aids. Failed tracheal intubation later progressed to a "can't oxygenate" scenario necessitating front-of-neck-access via surgical cricothyroidotomy. We discuss the factors which facilitated the preparation and implementation of interventions required to successfully execute this high-acuity task.

The efficacy of tranexamic acid treatment with different time and doses for traumatic brain injury: a systematic review and meta-analysis

Honghao Huang, Mei Xin, Xiqiang Wu, Jian Liu, Wenxin Zhang, Ke Yang, Jinbao Zhang

Thromb J. 2022 Dec 19;20(1):79.

Objective: Tranexamic acid (TXA) plays a significant role in the treatment of traumatic diseases. However, its effectiveness in patients with traumatic brain injury (TBI) seems to be contradictory, according to the recent publication of several meta-analyses. We aimed to determine the efficacy of TXA treatment at different times and doses for TBI treatment.

Methods: PubMed, MEDLINE, EMBASE, Cochrane Library, and Google Scholar were searched for randomized controlled trials that compared TXA and a placebo in adults and adolescents (≥ 15 years of age) with TBI up to January 31, 2022. Two authors independently abstracted the data and assessed the quality of evidence.

Results: Of the identified 673 studies, 13 involving 18,675 patients met our inclusion criteria. TXA had no effect on mortality (risk ratio (RR) 0.99; 95% confidence interval (CI) 0.92-1.06), adverse events (RR 0.93, 95% Cl 0.76-1.14), severe TBI (Glasgow Coma Scale score from 3 to 8) (RR 0.99, 95% Cl 0.94-1.05), unfavorable Glasgow Outcome Scale (GOS < 4) (RR 0.96, 95% Cl 0.82-1.11), neurosurgical intervention (RR 1.11, 95% Cl 0.89-1.38), or rebleeding (RR 0.97, 95% Cl 0.82-1.16). TXA might reduce the mean hemorrhage volume on subsequent imaging (standardized mean difference, -0.35; 95% CI [-0.62, -0.08]).

Conclusion: TXA at different times and doses was associated with reduced mean bleeding but not with mortality, adverse events, neurosurgical intervention, and rebleeding. More research data is needed on different detection indexes and levels of TXA in patients with TBI, as compared to those not receiving TXA; although the prognostic outcome for all harm outcomes was not affected, the potential for harm was not ruled out.

Patterns of Palliation: A Review of Casualties That Received Pain Management Before Reaching Role 2 in Afghanistan

Ian L Hudson, Amanda M Staudt, Matthew Burgess, Carmen Hinojosa-Laborde, Steven G Schauer, Ryan K Newberry, Kathy L Ryan, Christopher A VanFosson

Mil Med. 2023 Jan 4;188(1-2):108-116.

Introduction: Battlefield pain management changed markedly during the first 20 years of the Global War on Terror. Morphine, long the mainstay of combat analgesia, diminished in favor of fentanyl and ketamine for military pain control, but the options are not hemodynamically or psychologically equivalent. Understanding patterns of prehospital analgesia may reveal further opportunities for combat casualty care improvement.

Materials and methods: Using Department of Defense Trauma Registry data for the Afghanistan conflict from 2005 to 2018, we examined 2,402 records of prehospital analgesia administration to assess temporal trends in medication choice and proportions receiving analgesia, including subanalysis of a cohort screened for an indication with minimal contraindication for analgesia. We further employed frequency matching to explore the presence of disparities in analgesia by casualty affiliation.

Results: Proportions of documented analgesia increased throughout the study period, from 0% in 2005 to 70.6% in 2018. Afghan casualties had the highest proportion of documented analgesia (53.0%), versus U.S. military (31.9%), civilian/other (23.3%), and non-U.S. military (19.3%). Fentanyl surpassed morphine in the frequency of administration in 2012. The median age of those receiving ketamine was higher (30 years) than those receiving fentanyl (26 years) or nonsteroidal anti-inflammatory drugs (23 years). Among the frequency-matched subanalysis, the odds ratio for ketamine administration with Afghan casualties was 1.84 (95% CI, 1.30-2.61).

Conclusions: We observed heterogeneity of prehospital patient care across patient affiliation groups, suggesting possible opportunities for improvement toward an overall best practice system. General increase in documented prehospital pain management likely reflects efforts toward complete documentation, as well as improved options for analgesia. Current combat casualty care documentation does not include any standardized pain scale.

Impact of time and distance on outcomes following tourniquet use in civilian and military settings: A scoping review

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Injury. 2023 May;54(5):1236-1245.

Background: The last two decades have seen the reintroduction of tourniquets into guidelines for the management of acute limb trauma requiring hemorrhage control. Evidence supporting tourniquet application has demonstrated low complication rates in modern military settings involving rapid evacuation timeframes. It is unclear how these findings translate to patients who have prolonged transport times from injury in rural settings. This scoping review investigates the relationship between time and distance on metabolic complications, limb salvage and mortality following tourniquet use in civilian and military settings.

Methods: A systematic search strategy was conducted using PubMed, Embase, and SafetyLit databases. Study characteristics, setting, mechanism of injury, prehospital time, tourniquet time, distance, limb salvage, metabolic response, mortality, and tourniquet removal details were extracted from eligible studies. Descriptive statistics were recorded, and studies were grouped by ischemia time (< 2 h, 2-4 h, or > 4 h).

Results: The search identified 3103 studies, from which 86 studies were included in this scoping review. Of the 86 studies, 55 studies were primarily in civilian environments and 32 were based in military settings. One study included both settings. Blast injury was the most common mechanism of injury sustained by patients in military settings (72.8% [5968/8200]) followed by penetrating injury (23.5% [1926/8200]). In contrast, in civilian settings penetrating injury was the most common mechanism (47.7% [1633/3426]) followed by blunt injury (36.4% [1246/3426]). Tourniquet time was reported in 66/86 studies. Tourniquet time over four hours was associated with reduced limb salvage rates (57.1%) and higher mortality rates (7.1%) compared with a tourniquet time of less than two hours. The overall limb salvage and mortality rates were 69.6% and 6.7% respectively. Metabolic outcomes were reported in 28/86 studies with smaller sample sizes and inconsistencies in which parameters were reported.

Conclusion: This scoping review presents literature describing comparatively safe tourniquet application when used for less than two hours duration. However, there is limited research describing prolonged tourniquet application or when used for protracted distances, such that the impact of tourniquet release time on metabolic outcomes and complications remains unclear. Prospective studies utilizing the development of an international database to provide this dataset is required.

Prehospital Needle Decompression Should Not Be Compared With Trauma Center Chest Tube Placement

Romain Jouffroy, Benoît Vivien

JAMA Surg. 2023 Jun 1;158(6):670-671.

No abstract available

Efficacy and Safety of Early Anti-inflammatory Drug Therapy for Secondary Injury in Traumatic Brain Injury

Min Soo Kim, Young Hee Kim, Mi Sung Kim, ByungSuk Kwon, Hong Rae Cho

World Neurosurg. 2023 Apr:172:e646-e654.

Background: Brain injury following head trauma occurs in 2 stages, namely an early stage attributable to mechanical damage and a delayed stage resulting primarily from neuroinflammation. In this study, we examined early proinflammatory cytokine upregulation in an animal model of traumatic brain injury (TBI) and examined the effects of early anti-inflammatory therapy on neuroinflammation, neuropathology, and systemic inflammatory activity.

Methods: Seven-week-old C57BL/6 mice (20 g-25 g) were subjected to sham treatment or closed skull impact from a 30-g round weight dropped 15 cm onto the cortical midpoint. Model mice were then randomly assigned to receive intraperitoneal phosphate-buffered saline (control), 20 mg/kg cyclosporine A, 2 mg/kg dexamethasone, or 5 mg/kg cholecalciferol 1 hour post-TBI. Body weight, brain weight, cytokine expression in the brain and draining lymph nodes (DLNs), and histopathological changes were measured at multiple times post-TBI.

Results: Body weight did not significantly differ among the groups, whereas the brain-to-body weight ratio was significantly lower in the control group 7 days post-TBI. The peak expression of tumor necrosis factor-α, interleukin (IL)-1β, and IL-6 in the brain and DLNs 6 hours post-TBI was significantly lower in the dexamethasone and cyclosporine A groups. Conversely, peak IL-10 expression in the brain and DLNs was elevated in the cholecalciferol group. Control mice exhibited earlier and more severe neuroinflammatory damage than those in the experimental groups.

Conclusions: The administration of anti-inflammatory drugs or vitamin D analogs in the early period following TBI might help to reduce secondary injury from neuroinflammation.

Smarter faster just-in-time hemorrhage control: A pilot evaluation of remotely piloted aircraft system delivered STOP-THE-BLEED equipment with just-in-time remote telementored deployment**harcot**

Andrew W Kirkpatrick, Jessica L McKee, John M Conly, Kristin Flemons, Wade Hawkins

Heliyon. 2023 Jan 18;9(1):e12985.

Introduction: Remotely Piloted Aircraft Systems (RPAS) can access patients inaccessible to traditional rescue. Just-in-time remote telementoring (RTM) of naïve users to self-care could potentially address challenges in salvaging exsanguination in remote environments.

Methods: An exsanguination self-application task was established in a wilderness location. Three volunteers-initiated distress calls to prompt RPAS precision delivered STOP-THE-BLEED kits, after which a remote mentor directed the volunteers how to self-care.

Results: Limited connectivity prevented video, however each volunteer delivered images and initiated conversation with the mentor pre-RPAS arrival. Thereafter, all subjects were able to unpack and deploy hemorrhage control adjuncts under verbal direction, and to simulate self-application. All subjects were able to successfully apply wound-clamps, tourniquets, and pack wounds although one had insufficient pressure.

Discussion: RPASs can deliver supplies long before human rescuers, and communication connectivity might allow remote mentoring in device application. Further development of technology and self-care paradigms for exsanguination are encouraged.

Analysis of the primary utilization of videolaryngoscopy in prehospital emergency care in Germany

Daniel Anthony Koch, Paul Hagebusch, Philipp Faul, Thorsten Steinfeldt, Reinhard Hoffmann, Uwe Schweigkofler

Anaesthesiologie. 2023 Apr;72(4):245-252.

Background: In 2019, the German prehospital airway management guidelines were published. One of the recommendations was the primary utilization of videolaryngoscopy (VL) for every prehospital endotracheal intubation (phETI). Guideline compliance is extremely important in emergency medicine as non-compliance in the worst-case scenario leads to death. The study aims to quantify guideline compliance among emergency medical service (EMS) physicians and, subsequently to analyze subgroups influencing compliance.

Material and methods: An online survey was developed and distributed as a hyperlink via email to all medical directors of EMS (n = 155) and the three main operators of helicopter emergency medical services (HEMS) in Germany. The survey was online from August 1st 2021 until October 3rd 2021. The primary outcome measure was the primary VL utilization. Data were evaluated descriptively. A multivariate regression analysis was used to determine associations between the primary VL utilization and age, sex, educational level, specialization, phETI per year, operating field, VL device type, and guideline knowledge.

Results: The analysis included 698 EMS physicians. More than 55% of the EMS physicians do not primarily use a videolaryngoscope for phETI. Multivariate regression analysis showed a significantly higher compliance if the devices C-MAC® or McGrath® were on board, guidelines were known or EMS physicians were female. Age, educational level, specialization or prehospital intubation experience had no significant impact.

Conclusion: The study shows non-compliance with prehospital airway management guidelines in Germany. The guideline recommendation is based on scientific evidence but is not yet generally accepted by all EMS physicians. Videolaryngoscope device type and sex seem to influence the primary VL utilization. Training for EMS physicians must be extended and individual prehospital airway management should be reconsidered by every EMS physician.

United States Military Fatalities During Operation Inherent Resolve and Operation Freedom's Sentinel

Russ S Kotwal, Jud C Janak, Jeffrey T Howard, Andrew J Rohrer, Howard T Harcke, John B Holcomb, Brian J Eastridge, Jennifer M Gurney, Stacy A Shackelford, Edward L Mazuchowski

Mil Med. 2023 Aug 29;188(9-10):3045-3056.

Background: Military operations provide a unified action and strategic approach to achieve national goals and objectives. Mortality reviews from military operations can guide injury prevention and casualty care efforts.

Methods: A retrospective study was conducted on all U.S. military fatalities from Operation Inherent Resolve (OIR) in Iraq (2014-2021) and Operation Freedom's Sentinel (OFS) in Afghanistan (2015-2021). Data were obtained from autopsy reports and other existing records. Fatalities were evaluated for population characteristics; manner, cause, and location of death; and underlying atherosclerosis. Non-suicide trauma fatalities were also evaluated for injury severity, mechanism of death, injury survivability, death preventability, and opportunities for improvement.

Results: Of 213 U.S. military fatalities (median age, 29 years; male, 93.0%; prehospital, 89.2%), 49.8% were from OIR, and 50.2% were from OFS. More OIR fatalities were Reserve and National Guard forces (OIR 22.6%; OFS 5.6%), conventional forces (OIR 82.1%; OFS 65.4%), and support personnel (OIR 61.3%; OFS 33.6%). More OIR fatalities also resulted from disease and non-battle injury (OIR 83.0%; OFS 28.0%). The leading cause of death was injury (OIR 81.1%; OFS 98.1%). Manner of death differed as more homicides (OIR 18.9%; OFS 72.9%) were seen in OFS, and more deaths from natural causes (OIR 18.9%; OFS 1.9%) and suicides (OIR 29.2%; OFS 6.5%) were seen in OIR. The prevalence of underlying atherosclerosis was 14.2% in OIR and 18.7% in OFS. Of 146 non-suicide trauma fatalities, most multiple/blunt force injury deaths (62.2%) occurred in OIR, and most blast injury deaths (77.8%) and gunshot wound deaths (76.6%) occurred in OFS. The leading mechanism of death was catastrophic tissue destruction (80.8%). Most fatalities had non-survivable injuries (80.8%) and non-preventable deaths (97.3%).

Conclusions: Comprehensive mortality reviews should routinely be conducted for all military operation deaths. Understanding death from both injury and disease can guide preemptive and responsive efforts to reduce death among military forces.

Warning: Tourniquets Risk Frostbite in Cold Weather

John F Kragh Jr, Daniel K O'Conor

J Spec Oper Med. 2023 Mar 15;23(1):9-16.

Abstract

We sought to better understand the frostbite risk during first-aid tourniquet use by reviewing information relevant to an association between tourniquet use and frostbite. However, there is little information concerning this subject, which may be of increasing importance because future conflicts against near-peer competitors may involve extreme cold weather environments. Historically, clinical frostbite cases with tourniquet use occurred in low frequency but in high severity when leading to limb amputation. The physiologic response of vasoconstriction to cold exposure leads to limb cooling and causes a reduction of limb blood flow, but cold-induced vasodilation ensues as periodic fluctuations that increase blood flow to hands and feet. In animal experiments, tourniquet use increased the development of frostbite. Evidence from human experiments also supports an association between tourniquet use and frostbite. Clinical guidance for caregiving to casualties at risk for frostbite with tourniquet use had previously been provided but slowly and progressively dropped out of documents. Conclusions: The cause of frostbite was deduced to be a sufficiently negative heat-transfer trend in local tissues, which tourniquet use may worsen because of decreasing tissue perfusion. An association between tourniquet use and frostbite exists but not as cause and effect. Tourniquet use increased the risk of the cold causing frostbite by allowing faster cooling of a limb because of reduced blood flow and lack of cold-induced vasodilation. Care providers above the level of the lay public are warned that first-aid tourniquet use in low-temperature (<0°C [<32°F]) environmental conditions risks frostbite.

Blast Injuries by an Improvised Explosive Device in Japan: A Case Report

Dai Kujirai, Ryo Fujii, Daiki Kaito, Rakuhei Nakama, Yoshimitsu Izawa

Cureus. 2022 Dec 1;14(12):e32118.

Abstract

Blast injuries caused by an improvised explosive device (IED) are becoming more common in civilian settings. However, physicians may not be familiar with the treatment and management of blast-injured victims. To the best of our knowledge, this is the first case report of a blast injury caused by an IED in Japan. A 64-year-old man was admitted to our hospital's emergency department after sustaining a blast injury. His vital signs were stable, but he had multiple small wounds with embedded foreign bodies that were consistent with injuries sustained by IED victims. The patient was treated for his injuries and was moved to another hospital on day 37. Knowledge about blast injuries caused by IEDs and management strategies for mass casualties are both necessary.

A Comparison of Tube Thoracostomy for Chest Trauma Between Prehospital and Inhospital Settings

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Air Med J. 2023 Jan-Feb;42(1):24-27.

Objective: We compared the outcomes of patients with tube thoracostomy for chest trauma between the prehospital and inhospital settings.

Methods: The subjects were then divided into 2 groups: the prehospital group, which included subjects who underwent tube thoracostomy in the prehospital setting, and the inhospital group, which included subjects who underwent tube thoracostomy in the inhospital setting. The variables were compared between the 2 groups.

Results: There were no significant differences between the 2 groups with regard to gender, age, history, mechanism of injury, infusion of antibiotics, white blood cell count, duration of insertion of a chest drain, mechanical ventilation, complication of drain infection, duration of admission, or final outcome. However, the Injury Severity Score, maximum C-reactive protein level, and maximum temperature during hospitalization in the prehospital group (n = 15) were significantly greater than those in the inhospital group (n = 119).

Conclusion: The present study suggested that thoracostomy performed by physicians in the prehospital setting was safe and did not have an increased risk of infection. In addition, thoracostomy for chest injury in the prehospital setting suggested an improvement in the likelihood of a survival outcome.

Factors associated with tracheal intubation-related complications in the prehospital setting: a prospective multicentric cohort study

Quentin Le Bastard, Philippe Pès, Pierre Leroux, Yann Penverne, Joël Jenvrin, Emmanuel Montassier

Eur J Emerg Med. 2023 Jun 1;30(3):163-170.

Abstract

Background Emergency tracheal intubation is routinely performed in the prehospital setting. Airway management in the prehospital setting has substantial challenges. Objective The aim of the present study was to determine risk factors predicting tracheal intubation-related complications on the prehospital field. Setting A prospective, multicentric, cohort study which was conducted in three mobile ICUs (MICUs; service mobile d'urgence et de réanimation).Outcome measures and analysis Tracheal intubation-related complications were defined as the occurrence of at least one of the following events: oxygen desaturation (SpO2 < 90%) during tracheal intubation, aspiration (regurgitation visualized during laryngoscopy), and vomiting. Difficult intubation was defined as more than two failed direct laryngoscopic attempts, or the need for any alternative tracheal intubation method. Multivariate logistic regressions were used. Results During the 5-year study period, 1915 consecutive patients were intubated in the MICUs participating in the study. Overall, 1287 (70%) patients were successfully intubated after the first laryngoscopic attempt, with rates of 90, 74, 42, and 30% for Cormack-Lehane grade 1, 2, 3, and 4, respectively. Tracheal intubation was difficult in 663 cases (36%). Tracheal intubation-related complications occurred in 267 (14%) patients. In the multivariate analysis, we found that the leading risk factors for tracheal intubation-related complications were Cormack and Lehane grade 3 and 4 [odds ratio (OR) = 1.65; 95% confidence interval (CI), 1.05-2.61; and OR = 2.79; 95% CI, 1.56-4.98, respectively], a BMI of more than 30 (OR = 1.61; 95% CI, 1.13-2.28), when intubation was difficult (OR = 1.72; 95% CI, 1.15-2.57), and when tracheal intubation required more than one operator (OR = 2.30; 95% CI, 1.50-3.49).Conclusions In this prospective study, we found that Cormack and Lehane more than grade 2, BMI >30, difficult intubation, and tracheal intubation requiring more than one operator were all independent predictors of tracheal intubation-related complications in the prehospital setting. When these risk factors are identified on scene, adapted algorithms that anticipate the use of a bougie should be generalized to reduce morbidity on the prehospital field.

A Comparison of Injury Patterns and Interventions among US Military Special Operations Versus Conventional Forces Combatants

Casey Lockett, Jason F Naylor, Andrew D Fisher, Brit J Long, Michael D April, Steven G Schauer

Med J (Ft Sam Houst Tex). 2023 Jan-Mar:(Per 23-1/2/3):64-69.

Background: Over the course of the US' Global War on Terrorism, its military has utilized both conventional and special operations forces (SOF). These entities have sustained and treated battlefield casualties in the prehospital, Role 1 setting, while also making efforts to mitigate risks to the force and pursuing improved interventions. The goal of this study is to compare outcomes and prehospital medical interventions between SOF and conventional military combat casualties.

Methods: This is a secondary analysis of previously published data from the Department of Defense Trauma Registry. The casualties were categorized as special operations if they were 18-series, Navy SEAL, Pararescue Jumper, Tactical Air Control Party, Combat Controller, and Marine Corps Force Reconnaissance. The remainder with a documented military occupational specialty (MOS) were classified as conventional forces.

Results: Within our dataset, a MOS was categorizable for 1806 conventional and 130 special operations. Conventional forces were younger age (24 versus 30, p is less than 0.001). Conventional forces had a higher proportion of explosive injuries (61% versus 44%) but a lower proportion of firearm injuries (22% versus 42%, p is less than 0.001). The median injury severity scores were similar between the groups. Conventional forces had lower rates of documentation for all metrics: pulse, respiratory rate, blood pressure, oxygen saturation, Glasgow Coma Scale, and pain score. On adjusted analyses, SOF had higher odds of receiving an extremity splint, packed red blood cells, whole blood, tranexamic acid, ketamine, and fentanyl.

Conclusion: SOF had consistently better medical documentation rates, more use of ketamine and fentanyl, less morphine administration, and lower threshold for use of blood products in both unadjusted and adjusted analyses. Our findings suggest lessons learned from the SOF medics should be extrapolated to the conventional forces for improved medical care.

Paramedic Understanding of Tension Pneumothorax and Needle Thoracostomy (NT) Site Selection

Jeffrey S Lubin, Joshua Knapp, Maude L Kettenmann

Cureus. 2022 Jul 19;14(7):e27013.

Abstract

Introduction Tension pneumothorax is an immediate threat to life. Treatment in the prehospital setting is usually achieved by needle thoracostomy (NT). Prehospital personnel are taught to perform NT, frequently in the second intercostal space (ICS) at the mid-clavicular line (MCL). Previous literature has suggested that emergency physicians have difficulty identifying this anatomic location correctly. We hypothesized that paramedics would also have difficulty accurately identifying the proper location for NT. Methods A prospective, observational study was performed to assess paramedic ability to identify the location for treatment with NT. Participants were recruited during a statewide Emergency Medical Services (EMS) conference. Subjects were asked the anatomic site for NT and asked to mark the site on a shirtless male volunteer. The site was copied onto a transparent sheet lined up against predetermined points on the volunteer's chest. It was then compared against the correct location that had been identified using palpation, measuring tape, and ultrasound. Results 29 paramedics participated, with 24 (83%) in practice for more than five years and 23 (79%) doing mostly or all 9-1-1 response. All subjects (100%) reported training in NT, although six (21%) had never performed a NT in the field. Nine paramedics (31%) recognized the second ICS at the MCL as the desired site for NT, with 12 (41%) specifying only the second ICS, 11 (38%) specifying second or third ICS, and six (21%) naming a different location (third, fourth, or fifth ICS). None (0%) of the 29 paramedics identified the exact second ICS MCL on the volunteer. Mean distance from the second ICS MCL was 1.37 cm (interquartile range (IQR): 0.7-1.90) in the medial-lateral direction and 2.43 cm in the superior-inferior direction (IQR: 1.10-3.70). Overall mean distance was 3.12 cm from the correct location (IQR: 1.90-4.50). Most commonly, the identified location was too inferior (93%). Allowing for a 2 cm radius from the correct position, eight (28%) approximated the correct placement. 25 (86%) were within a 5 cm radius. Conclusion In this study, paramedics had difficulty identifying the correct anatomic site for NT. EMS medical directors may need to rethink training or consider alternative techniques.

Outcomes after Prehospital Cricothyrotomy

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Med J (Ft Sam Houst Tex). 2023 Jan-Mar:(Per 23-1/2/3):70-73.

Background: Prehospital surgical cricothyrotomies and complications from placement are an important and under-evaluated topic for both the military and civilian prehospital populations. This study uses the Department of Defense Trauma Registry to identify complications and the incidence of complications in prehospital combat surgical cricothyrotomies.

Methods: A secondary analysis of previously described prehospital-based dataset from the Department of Defense Trauma Registry (DODTR) was performed. Casualties who had a prehospital cricothyrotomy performed were isolated and assessed for documented airway injuries and surgical procedures after hospital admission.

Results: There were 25,8976 casualties in the original dataset, of which 251 met inclusion for this analysis. The median age was 25 and most (98%) were male. Explosives were most frequent (55%) followed by firearm (33%) mechanisms. Most were host nation partner forces (35%) and humanitarian (32%) casualties. The median injury severity score was 24. The most frequent seriously injured body region was the head/neck (61%). Most (61%) were discharged alive. Within the 251, 14% had a complication noted, most commonly requiring tracheostomy revision (5%).

Conclusions: Cricothyrotomies are rarely performed, but when they are performed and the casualty survives long enough to reach a military treatment facility with surgical capabilities, the incidence of near-term and long-term complications is high. A better understanding of outcomes associated with this procedure will enable more targeted training and technology development.

Clinical Assessment of Low Calcium In traUMa (CALCIUM)

Jessica Mendez, Rachelle B Jonas, Lauren Barry, Shane Urban, Alex C Cheng, James K Aden, James Bynum, Andrew D Fisher, Stacy A Shackelford, Donald H Jenkins, Jennifer M Gurney, Vikhyat S Bebarta, Andrew P Cap, Julie A Rizzo, Franklin L Wright, Susannah E Nicholson, Steven G Schauer

Med J (Ft Sam Houst Tex). 2023 Jan-Mar:(Per 23-1/2/3):74-80.

Abstract

Major trauma frequently occurs in the deployed, combat setting and is especially applicable in the recent conflicts with explosives dominating the combat wounded. In future near-peer conflicts, we will likely face even more profound weapons including mortars and artillery. As such, the number of severely wounded will likely increase. Hypocalcemia frequently occurs after blood transfusions, secondary to the preservatives in the blood products; however, recent data suggests major trauma in and of itself is a risk factor for hypocalcemia. Calcium is a major ion involved in heart contractility; thus, hypocalcemia can lead to poor contractility. Smaller studies have linked hypocalcemia to worse outcomes, but it remains unclear what causes hypocalcemia and if intervening could potentially save lives. The objective of this study is to determine the incidence of hypocalcemia on hospital arrival and the association with survival. We are seeking to address the following scientific questions, (1) Is hypocalcemia present following traumatic injury prior to transfusion during resuscitation? (2) Does hypocalcemia influence the amount of blood products transfused? (3) To what extent is hypocalcemia further exacerbated by transfusion? (4) What is the relationship between hypocalcemia following traumatic injury and mortality? We will conduct a multicenter, prospective, observational study. We will gather ionized calcium levels at 0, 3, 6, 12, 18, and 24 hours as part of scheduled calcium measurements. This will ensure we have accurate data to assess the early and late effects of hypocalcemia throughout the course of resuscitation and hemorrhage control. These data will be captured by a trained study team at every site. Our findings will inform clinical practice guidelines and optimize the care delivered in the combat and civilian trauma setting. We are seeking 391 patients with complete data to meet our a priori inclusion criteria. Our study will have major immediate short-term findings including risk prediction modeling to assess who is at risk for hypocalcemia, data assessing interventions associated with the incidence of hypocalcemia, and outcome data including mortality and its link to early hypocalcemia.

Safety and efficiency of femoral artery access closure using QuikClot Combat Gauze in patients with severe arterial calcification of access sites

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Quant Imaging Med Surg. 2023 Jan 1;13(1):282-292.

Background: In order to achieve better hemostasis of puncture holes in the femoral artery (FA) after an endovascular procedure, this study evaluated the effect and safety of manual compression (MC) with QuikClot Combat Gauze (QIC) and with mechanical compression (using a C-clamp) of the common access site, the FA, in patients with peripheral arterial occlusive disease (PAOD) combined with anterior femoral artery calcification (AFAC).

Methods: We prospectively reviewed 100 patients receiving either MC with QIC or mechanical compression (control group) after endovascular intervention for PAOD plus AFAC from February 2014 to September 2018 in a single unit, which was assessed using computerized tomography angiography (CTA).

Results: The mean time to completion of hemostasis was 30±0 minutes in the control group and 18±2.20 minutes in the QIC group ($P<0.001$). The time to ambulation of the QIC and control groups was 4.38±0.46 and 4.86±0.30 hours ($P<0.001$), respectively. Eight (16%) patients in the control group had hematoma, as compared with one patient (2%) in the QIC group ($P=0.031$), while sixteen (32%) patients in the control group had ecchymosis, as compared with four (8%) in the QIC group ($P=0.005$). Use of QIC and coronary artery disease (CAD) were identified as independent factors correlated with an increased risk of minor complications.

Conclusions: QIC facilitated effective and safe hemostasis in patients with PAOD and AFAC.

Life-threatening chest drain insertion

Pedro Daniel Martins Mondim, Kate Ward, Emma Townsend

Emerg Med J. 2023 Feb;40(2):119-150.

No abstract available

Success rate of prehospital emergency front-of-neck access (FONA): a systematic review and meta-analysis

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Br J Anaesth. 2023 May;130(5):636-644.

Background: Front-of-neck access (FONA) is an emergency procedure used as a last resort to achieve a patent airway in the prehospital environment. In this systematic review with meta-analysis, we aimed to evaluate the number and success rate of FONA procedures in the prehospital setting, including changes since 2017, when a surgical technique was outlined as the first-line prehospital method.

Methods: A systematic literature search (PROSPERO CRD42022348975) was performed from inception of databases to July 2022 to identify studies in patients of any age undergoing prehospital FONA, followed by data extraction. Meta-analysis was used to derive pooled success rates. Methodological quality of included studies was interpreted using the Cochrane risk of bias tool, and rated using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach.

Results: From 909 studies, 69 studies were included (33 low quality; 36 very low quality) with 3292 prehospital FONA attempts described (1229 available for analysis). The crude median success rate increased from 99.2% before 2017 to 100.0% after 2017. Meta-analysis revealed a pooled overall FONA success rate of 88.0% (95% confidence interval [CI], 85.0-91.0%). Surgical techniques had the highest success rate at a median of 100.0% (pooled rate=92.0%; 95% CI, 88.0-95.0%) vs 50.0% for needle techniques (pooled rate=52.0%; 95% CI, 28.0-76.0%).

Conclusions: Despite being a relatively rare procedure in the prehospital setting, the success rate for FONA is high. A surgical technique for FONA appears more successful than needle techniques, and supports existing UK prehospital guidelines.

Prehospital accuracy of (H)EMS pelvic ring injury assessment and the application of non-invasive pelvic binder devices

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Injury. 2023 Apr;54(4):1163-1168.

Background: Pre-hospital application of a non-invasive pelvic binder device (NIPBD) is essential to increase chances of survival by limiting blood loss in patients with an unstable pelvic ring injury. However, unstable pelvic ring injuries are often not recognized during prehospital assessment. We investigated the prehospital (helicopter) emergency medical services ((H)EMS)' accuracy of the assessment of unstable pelvic ring injuries and NIPBD application rate.

Methods: We performed a retrospective cohort study on all patients with a pelvic injury transported by (H)EMS to our level one trauma centre between 2012 and 2020. Pelvic ring injuries were included and radiographically categorized using the Young & Burgess classification system. Lateral Compression (LC) type II/III -, Anterior-Posterior (AP) type II/III - and Vertical Shear (VS) injuries were considered as unstable pelvic ring injuries. (H)EMS charts and in-hospital patient records were evaluated to determine the sensitivity, specificity and diagnostic accuracy of the prehospital assessment of unstable pelvic ring injuries and prehospital NIPBD application.

Results: A total of 634 patients with pelvic injuries were identified, of whom 392 (61.8%) had pelvic ring injuries and 143 (22.6%) had unstable pelvic ring injuries. (H)EMS personnel suspected a pelvic injury in 30.6% of the pelvic ring injuries and in 46.9% of the unstable pelvic ring injuries. An NIPBD was applied in 108 (27.6%) of the patients with a pelvic ring injury and in 63 (44.1%) of the patients with an unstable pelvic ring injury. (H)EMS prehospital diagnostic accuracy measured in pelvic ring injuries alone was 67.1% for identifying unstable pelvic ring injuries from stable pelvic ring injuries and 68.1% for NIPBD application.

Conclusion: The (H)EMS prehospital sensitivity of unstable pelvic ring injury assessment and NIPBD application rate is low. (H)EMS did not suspect an unstable pelvic injury nor applied an NIPBD in roughly half of all unstable pelvic ring injuries. We advise future research on decision tools to aid the routine use of an NIPBD in any patient with a relevant mechanism of injury.

Association of Prehospital Needle Decompression With Mortality Among Injured Patients Requiring Emergency Chest Decompression

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JAMA Surg. 2022 Oct 1;157(10):934-940.

Importance: Prehospital needle decompression (PHND) is a rare but potentially life-saving procedure. Prior studies on chest decompression in trauma patients have been small, limited to single institutions or emergency medical services (EMS) agencies, and lacked appropriate comparator groups, making the effectiveness of this intervention uncertain.

Objective: To determine the association of PHND with early mortality in patients requiring emergent chest decompression.

Design, setting, and participants: This was a retrospective cohort study conducted from January 1, 2000, to March 18, 2020, using the Pennsylvania Trauma Outcomes Study database. Patients older than 15 years who were transported from the scene of injury were included in the analysis. Data were analyzed between April 28, 2021, and September 18, 2021.

Exposures: Patients without PHND but undergoing tube thoracostomy within 15 minutes of arrival at the trauma center were the comparison group that may have benefited from PHND.

Main outcomes and measures: Mixed-effect logistic regression was used to determine the variability in PHND between patient and EMS agency factors, as well as the association between risk-adjusted 24-hour mortality and PHND, accounting for clustering by center and year. Propensity score matching, instrumental variable analysis using EMS agency-level PHND proportion, and several sensitivity analyses were performed to address potential bias.

Results: A total of 8469 patients were included in this study; 1337 patients (11%) had PHND (median [IQR] age, 37 [25-52] years; 1096 male patients [82.0%]), and 7132 patients (84.2%) had emergent tube thoracostomy (median [IQR] age, 32 [23-48] years; 6083 male patients [85.3%]). PHND rates were stable over the study period between 0.2% and 0.5%. Patient factors accounted for 43% of the variation in PHND rates, whereas EMS agency accounted for 57% of the variation. PHND was associated with a 25% decrease in odds of 24-hour mortality (odds ratio [OR], 0.75; 95% CI, 0.61-0.94; P = .01). Similar results were found in patients who survived their ED stay (OR, 0.68; 95% CI, 0.52-0.89; P < .01), excluding severe traumatic brain injury (OR, 0.65; 95% CI, 0.45-0.95; P = .03), and restricted to patients with severe chest injury (OR, 0.72; 95% CI, 0.55-0.93; P = .01). PHND was also associated with lower odds of 24-hour mortality after propensity matching (OR, 0.79; 95% CI, 0.62-0.98; P = .04) when restricting matches to the same EMS agency (OR, 0.74; 95% CI, 0.56-0.99; P = .04) and in instrumental variable probit regression (coefficient, -0.60; 95% CI, -1.04 to -0.16; P < .01).

Conclusions and relevance: In this cohort study, PHND was associated with lower 24-hour mortality compared with emergent trauma center chest tube placement in trauma patients. Although performed

rarely, PHND can be a life-saving intervention and should be reinforced in EMS education for appropriately selected trauma patients.

Association of antiplatelet or anticoagulant agents with in-hospital mortality among blunt torso trauma patients without severe traumatic brain injury: A retrospective analysis of the Japanese nationwide trauma registry

Keiko Naito, Hiraku Funakoshi, Jin Takahashi

Injury. 2023 Jan;54(1):70-74.

Aim: Patients with head trauma who take antiplatelet or anticoagulant (APAC) agents have a higher rate of mortality. However, the association between these agents and mortality among blunt torso trauma patients without severe traumatic brain injury remains unclear.

Methods: Using the Japanese nationwide trauma registry, we conducted a retrospective cohort study including adult patients with blunt torso trauma without severe head trauma between January 2019 and December 2020. Eligible patients were divided into two groups based on whether or not they took any APAC agents. The primary outcome was in-hospital mortality. To adjust for potential confounding factors, we conducted random effects logistic regression to account for patients clustering within the hospitals. The model was adjusted for potential confounders, including age, mechanism of injury, Charlson comorbidity index, systolic blood pressure, and injury severity scale on arrival as potentially confounding factors.

Results: During the study period, 16,201 patients were eligible for the analysis. A total of 832 patients (5.1%) were taking antiplatelet or anticoagulant agents. Overall in-hospital mortality was 774 patients (4.8%). APAC group had a higher risk of in-hospital mortality compared with the non-APAC group (6.9% vs. 4.7%; unadjusted OR, 1.51; 95% CI, 1.12-2.00; $P < 0.01$). After adjusting for potential confounder, there were no significant intergroup difference in a higher in-hospital mortality compared to with the non-APAC group (OR, 1.07; 95%CI, 0.65-1.77; $P = 0.79$).

Conclusion: The use of APAC agents before the injury was not associated with higher in-hospital mortality among blunt torso trauma patients without severe traumatic brain injury.

Occam's Razor and Prehospital Documentation: When the Simpler Solution Resulted in Better Documentation

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Med J (Ft Sam Houst Tex). 2023 Jan-Mar:(Per 23-1/2/3):81-86.

Introduction: The Tactical Combat Casualty Care (TCCC) card has undergone several changes since its first introduction in 1996. In 2013, updates to the card included more data points to increase prehospital documentation quality and enable performance improvement. This study reviews the proportions of data collected before and after the implementation of the new TCCC card.

Methods: This is a secondary analysis of a previously described dataset from the Department of Defense Trauma Registry (DODTR) focused on prehospital medical care. In this sub-analysis, we defined the pre-implementation period as 2009-2013 followed by a 1-year run-in with the post-implementation period as 2015-2019. Our primary outcome was documentation of a pulse rate and our secondary outcomes included documentation of other vital signs. We used multivariable logistic regression models to adjust for confounders.

Results: There were 18,182 encounters that met inclusion for this analysis-14,711 before and 3,471 after the update. Across all vital signs, there was a peak around 2012-2013 with a drop noted in 2015. Comparing the preimplementation and post-implementation groups, there were higher proportions with documentation of a pulse rate (62% versus 49%), respirations (51% versus 45%), systolic pressure (53% versus 46%), diastolic pressure (49% versus 41%), oxygen saturation (55% versus 46%), and pain score (27% versus 19%, all p is less than 0.001) in the pre-implementation group. When adjusting for injury severity score (ISS), casualty category, and year of injury, the odds ratio of documentation of a pulse after implementation was 0.01 (95% CI: 0.00-0.01). When adjusting for ISS and casualty category, the odds ratio was 0.64 (95% CI: 0.60-0.70). When adjusting for ISS only, the odds ratio was 0.58 (95% CI: 0.54-0.63).

Conclusions: Implementation of the new TCCC card resulted in overall lower documentation proportions which persisted after adjusting for measurable confounders.

Prehospital decompression of tension pneumothorax: Have we moved the needle?

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Am J Surg. 2022 Dec;224(6):1460-1463.

Background: Needle thoracostomy (NT) is the first-line intervention for tension pneumothorax in the prehospital setting. This study examined the effect of ATLS curriculum and EMS protocol changes on patient selection and successful performance of the procedure.

Methods: This is a retrospective chart review of all patients presenting to a Level One Trauma Center from 2015 to 2020 after undergoing prehospital NT.

Results: Lateral NT placement increased significantly from 5.1% to 38.9%. Proper patient selection, defined as presence decompensated shock, respiratory distress, and diminished breath sounds increased from 23.1% to 27.8%. There was no difference in radiographic confirmation of the catheter in the pleural space. Iatrogenic injury rates decreased slightly from 28.2% to 16.7%.

Conclusions: Protocol and curriculum changes have fallen short in yielding improved NT success rates or patient selection. Continued development of EMS education on the performance of NT is indicated.

Lessons from the Fallen: An After-Action Review of Prehospital Casualty Data during the Global War on Terror

Matthew W Paulson, John D Hesling, Steven G Schauer, Robert A De Lorenzo

Med J (Ft Sam Houst Tex). 2023 Jan-Mar:(Per 23-1/2/3):87-91.

Background: The US military's recent involvement in long standing conflict has caused the pioneering of many lifesaving medical advances, often made possible by data-driven research. However, future advances in battlefield medicine will likely require greater data fidelity than is currently attainable. Continuing to improve survival rates will require data which establishes the relative contributions to preventable mortality and guides future interventions. Prehospital data, particularly that from Tactical Combat Casualty Care (TCCC) Cards and TCCC After Action Reports (TCCC AARs), are notoriously inconsistent in reaching searchable databases for formal evaluation. While the military has begun incorporating more modern technology in advanced data capture over the past few years like the Air Force's Battlefield Assisted Trauma Distributed Observation Kit (BATDOK) and the Army's Medical Hands-free Unified Broadcast system (MEDHUB), more analysis weighing the advantages and disadvantages of substituting analog solutions is needed.

Discussion: We propose 3 changes which may aid prehospital data capture and facilitate analysis: reexamine the current format of TCCC Cards and consider reducing the number of available datapoints to streamline completion, implement a military-wide mandate for all Role 1 providers to complete a TCCC AAR within 24 hours of a casualty event, and formalize the process of requesting de-identified data from the Armed Forces Medical Examiner System (AFMES) database.

Conclusion: Reflecting on the state of US military medicine after 20 years of war, an important focus is improving the way prehospital data is gathered and analyzed by the military. There are steps we can take now to enhance our capabilities.

Oral transmucosal fentanyl citrate analgesia in prehospital trauma care: an observational cohort study

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Scand J Trauma Resusc Emerg Med. 2023 Jan 7;31(1):2.

Background: Pain is one of the major prehospital symptoms in trauma patients and requires prompt management. Recent studies have reported insufficient analgesia after prehospital treatment in up to 43% of trauma patients, leaving significant room for improvement. Good evidence exists for prehospital use of oral transmucosal fentanyl citrate (OTFC) in the military setting. We hypothesized that the use of OTFC for trauma patients in remote and challenging environment is feasible, efficient, safe, and might be an alternative to nasal and intravenous applications.

Methods: This observational cohort study examined 177 patients who were treated with oral transmucosal fentanyl citrate by EMS providers in three ski and bike resorts in Switzerland. All EMS providers had previously been trained in administration of the drug and handling of potential adverse events.

Results: OTFC caused a statistically significant and clinically relevant decrease in the level of pain by a median of 3 (IQR 2 to 4) in NRS units ($P < 0.0001$). Multiple linear regression analysis showed a significant absolute reduction in pain, with no differences in all age groups and between genders. No major adverse events were observed.

Conclusions: Prehospital administration of OTFC is safe, easy, and efficient for extrication and transport across all age groups, gender, and types of injuries in alpine environments. Side effects were few and mild. This could provide a valuable alternative in trauma patients with severe pain, without the delay of inserting an intravenous line, especially in remote areas, where fast action and easy administration are important.

Retrospective analysis of tranexamic acid administration in French war-wounded between October 2016 and September 2020

BMJ Mil Health. 2023 Jan 30:e002321.

Thibault Pinna, N Py, L Aigle, S Travers, P Pasquier, N Cazes

Introduction: Since 2013, the French Army Health Service, in agreement with international experts, has recommended the administration of 1 g of tranexamic acid (TXA) in trauma patients in haemorrhagic shock or at risk of bleeding within 3 hours of the trauma.

Methods: The aim of this analysis was to describe the administration of TXA in French military personnel wounded during military operations in the Sahelo-Sahelian band between October 2016 and September 2020. Data were collected from forward health records and hospital data from the French hospital where the casualty was finally evacuated. Underuse of TXA was defined as the lack of administration in casualties who had received a blood transfusion with one or more of red blood cells, low-titre whole blood or French lyophilised plasma within the first 24 hours of injury and overuse as its administration in the non-transfused casualty.

Results: Of the 76 patients included, 75 were men with an average age of 28 years. Five patients died during their management. 19 patients received TXA (25%) and 16 patients were transfused (21%). Underuse of TXA occurred in 3 of the 16 patients (18.8%) transfused. Overuse occurred in 6 of 60 (10%) non-transfused patients.

Conclusion: The analysis found an important underuse of TXA (almost 20%) and highlighted the need for optimising the prehospital clinical practice guidelines to aid prehospital medical practitioners more accurately in administering TXA to casualties that will require blood products.

Prediction of pre-hospital blood transfusion in trauma patients based on scoring systems

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BMC Emerg Med. 2023 Jan 12;23(1):2.

Background: Pre-hospital blood transfusion (PHBT) is a safe and gradually expanding procedure applied to trauma patients. A proper decision to activate PHBT with the presently limited diagnostic options at the site of an incident poses a challenge for pre-hospital crews. The purpose of this study was to compare the selected scoring systems and to determine whether they can be used as valid tools in identifying patients with PHBT requirements.

Methods: A retrospective single-center study was conducted between June 2018 and December 2020. Overall, 385 patients (aged [median; IQR]: 44; 24-60; 73% males) were included in this study. The values of five selected scoring systems were calculated in all patients. To determine the accuracy of each score for the prediction of PHBT, the Receiver Operating Characteristic (ROC) analysis was used and to measure the association, the odds ratio with 95% confidence intervals was counted (Fig. 1).

Results: Regarding the proper indication of PHBT, shock index (SI) and pulse pressure (PP) revealed the highest value of AUC and sensitivity/specificity ratio (SI: AUC 0.88; 95% CI 0.82-0.93; PP: AUC 0.85 with 95% CI 0.79-0.91).

Efficacy of Video Laryngoscopy versus Direct Laryngoscopy in the Prehospital Setting: A Systematic Review and Meta-Analysis

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Prehosp Disaster Med. 2022 Dec 14:1-11.

Introduction: Placing an endotracheal tube is a life-saving measure. Direct laryngoscopy (DL) is traditionally the default method. Video laryngoscopy (VL) has been shown to improve efficiency, but there is insufficient evidence comparing VL versus DL in the prehospital settings. This study, comprising a systematic review and random-effects meta-analysis, assesses current literature for the efficacy of VL in prehospital settings.

Methods: PubMed and Scopus databases were searched from their beginnings through March 1, 2022 for eligible studies. Outcomes were the first successful intubation, overall success rate, and number of total DL versus VL attempts in real-life clinical situations. Cochrane's Risk of Bias (RoB) tool and the Newcastle-Ottawa Scale (NOS) were applied to assess risk of bias and study quality; Q-statistics and I2 values were used to assess heterogeneity.

Results: The search yielded seven studies involving 23,953 patients, 6,674 (28%) of whom underwent intubation via VL. Compared to DL, VL was associated with a statistically higher risk ratio for first-pass success (Risk Ratio [RR] = 1.116; 95% CI, 1.005-1.239; P = .041; I2 = 87%). The I2 value for the subgroup of prospective studies was 0% compared to 89% for retrospective studies. In addition, VL was associated with higher likelihood of overall success rate (RR = 1.097; 95% CI, 1.01-1.18; P = .021; I2 = 85%) and lower mean number of attempts (Mean Difference = -0.529; 95% CI, -0.922 to -0.137; P = .008).

Conclusion: The meta-analysis suggested that VL was associated with higher likelihood of achieving first-pass success, greater overall success rate, and lower number of intubation attempts for adults in the prehospital settings. This study had high heterogeneity, likely presenced by the inclusion of retrospective observational studies. Further studies with more rigorous methodology are needed to confirm these results.

An observational study of the blood use in combat casualties of the French Armed Forces, 2013-2021

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Transfusion. 2023 Jan;63(1):69-82.

Background: The French Armed Forces conduct asymmetric warfare in the Sahara-Sahel Strip. Casualties are treated with damage control resuscitation to the extent possible. Questions remain about the feasibility and sustainability of using blood for wider use in austere environments.

Methods: We performed a retrospective analysis of all French military trauma patients transfused after injury in overseas military operations in Sahel-Saharan Strip, from the point of injury, until day 7, between January 11, 2013 to December 31, 2021.

Results: Forty-five patients were transfused. Twenty-three (51%) of them required four red blood cells units (RBC) or more in the first 24H defining a severe hemorrhage. The median blood product consumption within the first 48 h, was 8 (IQR [3; 18]) units of blood products (BP) for all study population but up to 17 units (IQR [10; 27.5]) for the trauma patients with severe hemorrhage. Transfusion started at prehospital stage for 20 patients (45%) and included several blood products: French lyophilized plasma, RBCs, and whole blood. Patients with severe hemorrhage required a median of 2 [IQR 0; 34] further units of BP from day 3 to day 7 after injury. Eight patients died in theater, 4 with severe hemorrhage and these 4 used an average of 12 products at Role 1 and 2.

Conclusion: The transfusion needs were predominant in the first 48 h after the injury but also continued throughout the first week for the most severe trauma patients. Importantly, our study involved a low-intensity conflict, with a small number of injured combatants.

Correlation between prehospital and in-hospital hypotension and outcomes after traumatic brain injury

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Am J Emerg Med. 2023 Mar:65:95-103.

Background and objective: Hypotension has a powerful effect on patient outcome after traumatic brain injury (TBI). The relative impact of hypotension occurring in the field versus during early hospital resuscitation is unknown. We evaluated the association between hypotension and mortality and non-mortality outcomes in four cohorts defined by where the hypotension occurred [neither prehospital nor hospital, prehospital only, hospital only, both prehospital and hospital].

Methods: Subjects ≥10 years with major TBI were included. Standard statistics were used for unadjusted analyses. We used logistic regression, controlling for significant confounders, to determine the adjusted odds (aOR) for outcomes in each of the three cohorts.

Results: Included were 12,582 subjects (69.8% male; median age 44 (IQR 26-61). Mortality by hypotension status: No hypotension: 9.2% (95%CI: 8.7-9.8%); EMS hypotension only: 27.8% (24.6-31.2%); hospital hypotension only: 45.6% (39.1-52.1%); combined EMS/hospital hypotension 57.6% (50.0-65.0%); ($p < 0.0001$). The aOR for death reflected the same progression: 1.0 (reference-no hypotension), 1.8 (1.39-2.33), 2.61 (1.73-3.94), and 4.36 (2.78-6.84), respectively. The proportion of subjects having hospital hypotension was 19.0% (16.5-21.7%) in those with EMS hypotension compared to 2.0% (1.8-2.3%) for those without ($p < 0.0001$). Additionally, the proportion of patients with TC hypotension was increased even with EMS "near hypotension" up to an SBP of 120 mmHg [(aOR 3.78 (2.97, 4.82)].

Conclusion: While patients with hypotension in the field or on arrival at the trauma center had markedly increased risk of death compared to those with no hypotension, those with prehospital hypotension that was not resolved before hospital arrival had, by far, the highest odds of death. Furthermore, TBI patients who had prehospital hypotension were five times more likely to arrive hypotensive at the trauma center than those who did not. Finally, even "near-hypotension" in the field was strongly and independently associated the risk of a hypotensive hospital arrival (<90 mmHg). These findings are supportive of the prehospital guidelines that recommend aggressive prevention and treatment of hypotension in major TBI.

Intraosseous administration of freeze-dried plasma in the prehospital setting

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Isr Med Assoc J. 2022 Sep;24(9):591-595.

Background: Freeze dried plasma (FDP) is a commonly used replacement fluid in the prehospital setting when blood products are unavailable. It is normally administered via a peripheral intravenous (PIV) line. However, in severe casualties, when establishing a PIV is difficult, administration via intraosseous vascular access is a practical alternative, particularly under field conditions.

Objectives: To evaluate the indications and success rate of intraosseous administration of FDP in casualties treated by the Israel Defense Forces (IDF).

Methods: A retrospective analysis of data from the IDF-Trauma Registry was conducted. It included all casualties treated with FDP via intraosseous from 2013 to 2019 with additional data on the technical aspects of deployment collected from the caregivers of each case.

Results: Of 7223 casualties treated during the study period, intravascular access was attempted in 1744; intraosseous in 87 of those. FDP via intraosseous was attempted in 15 (0.86% of all casualties requiring intravascular access). The complication rate was 73% (11/15 of casualties). Complications were more frequent when the event included multiple casualties or when the injury included multiple organs. Of the 11 failed attempts, 5 were reported as due to slow flow of the FDP through the intraosseous apparatus. Complications in the remaining six were associated with deployment of the intraosseous device.

A Systematic Review of Tranexamic Acid-Associated Venous Thromboembolic Events in Combat Casualties and Considerations for Prolonged Field Care

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Mil Med. 2023 Aug 29;188(9-10):e2932-e2940.

Introduction: Tranexamic acid (TXA) is a standard component of Tactical Combat Casualty Care. Recent retrospective studies have shown that TXA use is associated with a higher rate of venous thromboembolic (VTE) events in combat-injured patients. We aim to determine if selective administration should be considered in the prolonged field care environment.

Materials and methods: We performed a systematic review using the 2020 Preferred Reporting Items for Systematic Review and Meta-Analysis guidelines. Clinical trials and observational studies of combat casualties published between January 1, 1960, and June 20, 2022, were included. We analyzed survival and VTE outcomes in TXA recipients and non-recipients. We discussed the findings of each paper in the context of current and future combat environments.

Results: Six articles met criteria for inclusion. Only one study was powered to report mortality data, and it demonstrated a 7-fold increase in survival in severely injured TXA recipients. All studies reported an increased risk of VTE in TXA recipients, which exceeded rates in civilian literature. However, five of the six studies used overlapping data from the same registry and were limited by a high rate of missingness in pertinent variables. No VTE-related deaths were identified.

Conclusions: There may be an increased risk of VTE in combat casualties that receive TXA; however, this risk must be considered in the context of improved survival and an absence of VTE-associated deaths. To optimize combat casualty care during prolonged field care, it will be essential to ensure the timely administration of VTE chemoprophylaxis as soon as the risk of significant hemorrhage permits.

Neurotrauma Update

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Emerg Med Clin North Am. 2023 Feb;41(1):19-33.

Abstract

Traumatic brain injury (TBI) continues to be a leading cause of morbidity and mortality worldwide with older adults having the highest rate of hospitalizations and deaths. Management in the acute phase is focused on preventing secondary neurologic injury from hypoxia, hypocapnia, hypotension, and elevated intracranial pressure. Recent studies on tranexamic acid and continuous hypertonic saline infusion have not found any difference in neurologic outcomes. Care must be taken in prognosticating TBI outcomes, as recovery of consciousness and orientation has been observed up to 12 months after injury.

Compelling Evidence for Effectiveness of Cricoid Pressure in Occluding the Esophageal Entrance: Where Do We Go From Here?

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Anesth Analg. 2023 Feb 1;136(2):e7.

No abstract available

Prehospital Use of Ketamine versus Benzodiazepines for Sedation among Pediatric Patients with Behavioral Emergencies

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Prehosp Emerg Care. 2023;27(7):908-914.

Introduction: Ketamine is an emerging alternative sedation agent for prehospital management of agitation, yet research is limited regarding its use for children. Our objective was to compare the effectiveness and safety of ketamine and benzodiazepines when used for emergent prehospital sedation of pediatric patients with behavioral emergencies.

Methods: We performed a retrospective review of 9-1-1 EMS records from the 2019-2020 ESO Data Collaborative research datasets. We included patients ≤18 years of age who received ketamine or benzodiazepines for EMS primary and secondary impressions indicating behavioral conditions. We excluded patients with first Glasgow Coma Scale (GCS) scores ≤8, those receiving ketamine or benzodiazepines prior to EMS arrival, those receiving both ketamine and benzodiazepines, and interfacility transfers. Effectiveness outcomes included general clinician assessment of improvement, decrease in GCS, and administration of a subsequent sedative. Safety outcomes included mortality; advanced airway placement; ventilatory assistance without advanced airway placement; or marked sedation (GCS ≤8). Chi-square and t-tests were used to compare the ketamine and benzodiazepines groups.

Results: Of 57,970 pediatric patients with behavioral complaints and GCS scores >8, 1,539 received ketamine (13.3%, n = 205) or a benzodiazepine (86.7%, n = 1,334). Most patients were ≥12 years old (89.2%, n = 1,372), predominantly Caucasian (48.3%, n = 744), and were equally distributed by sex (49.7% male, n = 765). First treatment with ketamine was associated with a greater likelihood of improvement (88.8% vs 70.5%, $p < 0.001$) and a greater average GCS reduction compared to treatment with benzodiazepines (-2.5 [SD:4.0] vs -0.3 [SD:1.7], $p < 0.001$). Fewer patients who received ketamine received subsequent medication compared to those who received benzodiazepines (12.2% vs 27.0%, $p < 0.001$). Marked sedation was more frequent with ketamine than benzodiazepines (28.8% vs 2.9%, $p < 0.001$). Provision of ventilatory support (1.5% vs 0.5%, $p = 0.14$) and advanced airway placement (1.0% vs 0.2%, $p = 0.09$) were similar between ketamine and benzodiazepine groups. No prehospital deaths were reported.

Conclusion: In this pediatric cohort, prehospital sedation with ketamine was associated with greater patient improvement, less subsequent sedative administration, and greater sedation compared to benzodiazepines. Though we identified low rates of adverse events in both groups, ketamine was associated with more instances of marked sedation, which bears further study.

Trauma care during times of conflict: Strategic targeting of medical resources & operational logistics to save more lives

Matthew Sauder, Lucy Kornblith, Jennifer Gurney, Adel Elkbuli

Injury. 2023 Feb;54(2):271-273.

No abstract available

Incidence of Airway Interventions in the Setting of Serious Facial Trauma

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J Spec Oper Med. 2022 Dec 16;22(4):18-21.

Background: Airway obstruction is the second leading cause of preventable death on the battlefield. Most airway obstruction occurs secondary to traumatic disruptions of the airway anatomical structures. Facial trauma is frequently cited as rationale for maintaining cricothyrotomy in the medics' skill set over the supraglottic airways more commonly used in the civilian setting.

Methods: We used a series of emergency department procedure codes to identify patients within the Department of Defense Trauma Registry (DoDTR) from January 2007 to August 2016. This is a sub-group analysis of casualties with documented serious facial trauma based on an abbreviated injury scale of 3 or greater for the facial body region.

Results: Our predefined search codes captured 28,222 DoDTR casualties, of which we identified 136 (0.5%) casualties with serious facial trauma, of which 19 of the 136 had documentation of an airway intervention (13.9%). No casualties with serious facial trauma underwent nasopharyngeal airway (NPA) placement, 0.04% underwent cricothyrotomy (n = 10), 0.03% underwent intubation (n = 9), and a single subject underwent supraglottic airway (SGA) placement (<0.01%). We only identified four casualties (0.01% of total dataset) with an isolated injury to the face.

Conclusions: Serious injury to the face rarely occurred among trauma casualties within the DoDTR. In this subgroup analysis of casualties with serious facial trauma, the incidence of airway interventions to include cricothyrotomy was exceedingly low. However, within this small subset the mortality rate is high and thus better methods for airway management need to be developed.

Expert Consensus Panel Recommendations for Selection of the Optimal Supraglottic Airway Device for Inclusion to the Medic's Aid Bag

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Med J (Ft Sam Houst Tex). 2023 Jan-Mar:(Per 23-1/2/3):97-102.

Introduction: Airway obstruction is the second leading cause of potentially survivable death on the battlefield. The Committee on Tactical Combat Casualty Care (CoTCCC) has evolving recommendations for the optimal supraglottic airway (SGA) device for inclusion to the medics' aid bag.

Methods: We convened an expert consensus panel consisting of a mix of 8 prehospital specialists, emergency medicine experts, and experienced combat medics, with the intent to offer recommendations for optimal SGA selection. Prior to meeting, we independently reviewed previously published studies conducted by our study team, conducted a virtual meeting, and summarized the findings to the panel. The studies included an analysis of end-user after action reviews, a market analysis, engineering testing, and prospective feedback from combat medics. The panel members then made recommendations regarding their top 3 choices of devices including the options of military custom design. Simple descriptive statistics were used to analyze panel recommendations.

Results: The preponderance (7/8, 88%) of panel members recommended the gel-cuffed SGA, followed by the self-inflating-cuff SGA (5/8, 62%) and laryngeal tube SGA (5/8, 62%). Panel members expressed concerns primarily related to the (1) devices' tolerance for the military environment, and (2) ability to effectively secure the gel-cuffed SGA and the self-inflating-cuff SGA during transport.

Conclusions: A preponderance of panel members selected the gel-cuff SGA with substantial feedback highlighting the need for military-specific customizations to support the combat environment needs.

Implementation and Evaluation of Tactical Combat Casualty Care for Army Aviators

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Mil Med. 2020 Aug 14;185(7-8):e1271-e1276.

Introduction: The importance of developing military strategies to decrease preventable death by mitigating hemorrhage and reducing time between the point of injury and surgical intervention on the battlefield is highlighted in previous studies. Successful implementation of Tactical Combat Casualty Care (TCCC) throughout elements of the USA and allied militaries begins to address this need. However, TCCC implementation is neither even nor complete in the larger, conventional force. Army Aviators are at risk for preventable death as they do not receive prehospital care training and are challenged to render prehospital care in the austere environment of helicopter operations. Army aviators are at risk for preventable death due to the challenges to render prehospital care in the austere environment of helicopter operations. Helicopters often fly at low altitudes, engage in direct action in support of ground troops, operate at a great distance from medical facilities, typically do not have medical personnel onboard, and can have long wait times for medical evacuation services due to the far forward nature of helicopter operations.

Materials and methods: This is a quality improvement pre-post-intervention design study evaluating the implementation of a combat casualty care training program for Army aviators using well-established evidence-based guidelines for providing care to casualties on the battlefield. The evaluation consisted of participants' self-perceived confidence in providing care to a casualty and change in knowledge level in combat casualty care in a pre/post-intervention design. Clinical skills of tourniquet application, nasopharyngeal airway placement, and needle chest decompression were assessed on a pass/fail grading standard.

Results: A total of 18 participants completed the pre- and post-education surveys. A paired t-test showed a statistically significant increase in total composite scores from pre ($M = 24.67$, $SD = 5.06$) to post-education self-efficacy ($M = 37.94$, $SD = 2.10$), $t(17) = -11.29$, $p < 0.001$. A paired t-test revealed a significant increase in exam scores from pre ($M = 70.22$, $SD = 9.43$) to post ($M = 87.78$, $SD = 7.19$), $t(17) = -7.31$, $p < 0.001$. There was no pre-intervention skills assessment, however, all participants ($n = 18$, 100%) passed the tourniquet application, needle chest compression, and insertion of nasopharyngeal airway.

Conclusion: TCCC for Army Aviators is easily implemented, demonstrates an increase in knowledge and confidence in providing prehospital care, and provides effective scenario-based training of necessary psychomotor skills needed to reduce preventable death on the battlefield. TCCC for Army Aviators effectively takes the TCCC for All Combatants curriculum and modifies it to address the unique considerations in treating wounded aviators and passengers, both in flight and after crashes. This project demonstrates on a small scale how TCCC can be tailored to specific military jobs in order to successfully meet the intent of the upcoming All Service Member TCCC course mandated in DoD 1322.24. Beyond Army aviation, this program is easily modifiable for aviators throughout the military and civilian sector.

Extremity tourniquets raise blood pressure and maintain heart rate

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Am J Emerg Med. 2023 Mar:65:12-15.

Background: Tourniquets have been modified and used for centuries to occlude blood flow to control hemorrhage. More recently, the occlusion of peripheral vessels has been linked to resultant increases in blood pressure, which may provide additional therapeutic potential, particularly during states of low cardiac output.

Objective: The objective of this study was to investigate a causal relationship between tourniquet application and blood pressure in healthy adults.

Methods: Healthy adult volunteers were recruited to participate in this IRB-approved study. Each participant met inclusion criteria and demonstrated baseline normotension. Brachial cuff blood pressure and heart rate were recorded pre- and post-tourniquet application to the bilateral legs.

Results: Twenty-seven adults aged 22 to 35 years participated and were included in analysis. The average systolic blood pressure was 122 ± 7 mmHg, diastolic blood pressure was 72 ± 9 mmHg, and heart rate was 70 ± 13 bpm. Following bilateral tourniquet application over the femoral vasculature, we observed a statistically significant increase in systolic (7 mmHg, $p < 0.001$) and diastolic (4 mmHg, $p = 0.05$) blood pressures with no significant change in heart rate (2 bpm, $p > 0.05$).

Conclusions: The elevations in systolic and diastolic blood pressures establish a dependent relationship between tourniquet application to the lower extremities and blood pressure elevation. These results may support new indications for tourniquet-use or extremity vessel occlusion in settings of hemodynamic instability.

Major haemorrhage: past, present and future

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Anaesthesia. 2023 Jan;78(1):93-104.

Abstract

Major haemorrhage is a leading cause of morbidity and mortality worldwide. Successful treatment requires early recognition, planned responses, readily available resources (such as blood products) and rapid access to surgery or interventional radiology. Major haemorrhage is often accompanied by volume loss, haemodilution, acidaemia, hypothermia and coagulopathy (factor consumption and fibrinolysis). Management of major haemorrhage over the past decade has evolved to now deliver a 'package' of haemostatic resuscitation including: surgical or radiological control of bleeding; regular monitoring of haemostasis; advanced critical care support; and avoidance of the lethal triad of hypothermia, acidaemia and coagulopathy. Recent trial data advocate for a more personalised approach depending on the clinical scenario. Fresh frozen plasma should be given as early as possible in major trauma in a 1:1 ratio with red blood cells until the results of coagulation tests are available. Tranexamic acid is a cheap, life-saving drug and is advocated in major trauma, postpartum haemorrhage and surgery, but not in patients with gastrointestinal bleeding. Fibrinogen levels should be maintained > 2 g.l-1 in postpartum haemorrhage and > 1.5 g.l-1 in other haemorrhage. Improving outcomes after major traumatic haemorrhage is now driving research to include extending blood-product resuscitation into prehospital care.

Efficacy of high dose tranexamic acid (TXA) for hemorrhage: A systematic review and meta-analysis

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Injury. 2023 Mar;54(3):857-870.

Background: Standard dose (≤ 1 g) tranexamic acid (TXA) has established mortality benefit in trauma patients. The role of high dose IV TXA (≥2 g or ≥30 mg/kg as a single bolus) has been evaluated in the surgical setting, however, it has not been studied in trauma. We reviewed the available evidence of high dose IV TXA in any setting with the goal of informing its use in the adult trauma population.

Methods: We searched MEDLINE, EMBASE and unpublished sources from inception until July 27, 2022 for studies that compared standard dose with high dose IV TXA in adults (≥ 16 years of age) with hemorrhage. Screening and data abstraction was done independently and in duplicate. We pooled trial data using a random effects model and considered randomized controlled trials (RCTs) and observational cohort studies separately. We assessed the individual study risk of bias using the Cochrane Risk of Bias for RCTs and the Newcastle-Ottawa Scale for observational cohort studies. The overall certainty of evidence was assessed using the GRADE approach (Grading of Recommendations Assessment, Development and Evaluation).

Results: We included 20 studies with a combined total of 12,523 patients. Based on pooled RCT data, and as compared to standard dose TXA, high dose IV TXA probably decreases transfusion requirements (odds ratio [OR] 0.86, 95% confidence interval [CI] 0.76 to 0.97, moderate certainty) but with possibly no effect on blood loss (mean difference [MD] 43.31 ml less, 95% CI 135.53 to 48.90 ml less, low certainty), and an uncertain effect on thromboembolic events (OR 1.33, 95% CI 0.86 to 2.04, very low certainty) and mortality (OR 0.70, 95% CI 0.37 to 1.32, very low certainty).

Conclusion: When compared to standard dose, high dose IV TXA probably reduces transfusion requirements with an uncertain effect on thromboembolic events and mortality.

A Retrospective Nationwide Comparison of the iGel and King Laryngeal Tube Supraglottic Airways for Out-of-Hospital Cardiac Arrest Resuscitation

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Prehosp Emerg Care. 2023 Feb 13:1-7.

Introduction: While various supraglottic airway devices are available for use during out-of-hospital cardiac arrest (OHCA) resuscitation, comparisons of patient outcomes by device are limited. In this study, we aimed to compare outcomes of OHCA patients who had airway management by emergency medical services (EMS) with the iGel or King-LT.

Methods: We used the 2018-2021 ESO Data Collaborative public use research datasets for this retrospective study. All patients with non-traumatic OHCA who had iGels or King-LTs inserted by EMS were included. Our primary outcome was survival to discharge to home, and secondary outcomes included first-pass success, return of spontaneous circulation (ROSC), and prehospital rearrest. We examined the association between airway device and each outcome using two-level mixed effects logistic regression with EMS agency as the random effect, adjusted for standard Utstein variables and failed intubation prior to supraglottic airway insertion. Average treatment effects were calculated through propensity score matching.

Results: A total of 286,192 OHCA patients were screened, resulting in 93,866 patients eligible for inclusion in this analysis. A total of 9,456 transported patients (59.8% iGel) had associated hospital disposition data. Use of the iGel was associated with greater survival to discharge to home (aOR:1.36 [1.06, 1.76]; ATE: 2.2%[+0.5, +3.8]; n = 7,576), first pass airway success (aOR:1.94 [1.79, 2.09]; n = 73,658), and ROSC (aOR:1.19 [1.13, 1.26]; n = 73,207) in comparison to airway management with the King-LT. iGel use was associated with lower odds of experiencing a rearrest (aOR:0.73 [0.67, 0.79]; n = 20,776).Among patients who received a supraglottic device as a primary airway, use of the iGel was not associated with significantly greater survival to discharge to home (aOR:1.26 [0.95, 1.68]). Among patients who received a supraglottic device as a rescue airway following failed intubation, use of the iGel was associated with greater odds of survival to discharge to home (aOR:2.16 [1.15, 4.04]).

Conclusion: In this dataset, use of the iGel during adult OHCA resuscitation was associated overall with better outcomes compared to use of the King-LT. Subgroup analyses suggested that use of the iGel was associated with greater odds of achieving the primary outcome than the King-LT when used as a rescue device but not when used as the primary airway management device.

Nonfatal Injuries From Falls Among U.S. Military Personnel Deployed for Combat Operations, 2001-2018

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Mil Med. 2022 Dec 28: Online ahead of print.

Introduction: Falls are a leading mechanism of injury. Hospitalization and outpatient clinic visits due to fall injury are frequently reported among both deployed and non-deployed U.S. Military personnel. Falls have been previously identified as a leading injury second only to sports and exercise as a cause for non-battle air evacuations.

Materials and methods: This retrospective study analyzed the Department of Defense Trauma Registry fall injury data from September 11, 2001 to December 31, 2018. Deployed U.S. Military personnel with fall listed as one of their mechanisms of injury were included for analysis.

Results: Of 31,791 injured U.S. Military personnel captured by the Department of Defense Trauma Registry within the study time frame, a total of 3,101 (9.8%) incurred injuries from falls. Those who had fall injuries were primarily 21 to 30 years old (55.4%), male (93.1%), Army (75.6%), and enlisted personnel (56.9%). The proportion of casualties sustaining injuries from falls generally increased through the years of the study. Most fall injuries were classified as non-battle injury (91.9%). Falls accounted for 24.2% of non-battle injury hospital admissions with a median hospital stay of 2 days. More non-battle-related falls were reported in Iraq-centric military operations (62.7%); whereas more battle-related falls were reported in Afghanistan-centric military operations (58.3%).

Conclusions: This study is the largest analysis of deployed U.S. Military personnel injured by falls to date. Highlighted are preventive strategies to mitigate fall injury, reduce workforce attrition, and preserve combat mission capability.

iTClamp-Mediated Wound Closure Speeds Control of Arterial Hemorrhage With or Without Additional Hemostatic Agents

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J Spec Oper Med. 2022 Dec 16;22(4):87-92.

Background: Exsanguination is the leading cause of preventable posttraumatic death, especially in the prehospital arena. Traditional hemorrhage control methods involve packing the wound with hemostatic agents, providing manual pressure, and then applying a pressure dressing to stabilize the treatment. This is a lengthy process that frequently destabilizes upon patient transport. Conversely, the iTClamp, a compact wound closure device, is designed to rapidly seal wound edges mechanically, expediting clot formation at the site of injury.

Objectives: To determine the efficacy of the iTClamp with and without wound packing in the control of a lethal junction hemorrhage.

Methods: Given the limited available information regarding the efficacy of the iTClamp in conjunction with traditional hemostatic agents, this study used a swine model of severe junctional hemorrhage. The goal was to compare a multiagent strategy using the iTClamp in conjunction with XSTAT to the traditional method of Combat Gauze packing with pressure dressing application. Readouts include application time, blood loss, and rebleed occurrence.

Results: Mean application times of the iTClamp treatment alone or in conjunction with other hemostatic agents were at least 75% faster than the application time of Combat Gauze with pressure dressing. Percent blood loss was not significantly different between groups but trended the highest for Combat Gauze treated swine, followed by iTClamp plus XSTAT, iTClamp alone and finally iTClamp plus Combat Gauze.

Conclusion: The results from this study demonstrate that the iTClamp can be effectively utilized in conjunction with hemostatic packing to control junctional hemorrhages.

Cricothyrotomy for an Unexpected Cannot Intubate, Cannot Ventilate Situation for a Patient with Chronic Graft-Versus-Host Disease After Induction of General Anesthesia: A Case Report

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Am J Case Rep. 2023 Feb 20:24:e938992.

BACKGROUND Chronic graft-versus-host disease (GVHD) is a major complication of hematopoietic stem cell transplantations. Due to fibrotic changes, patients with GVHD are at risk for difficult airway management. We encountered a case of chronic GVHD that went into a "cannot intubate, cannot ventilate" (CICV) condition after induction of general anesthesia and was managed using cricothyrotomy.

CASE REPORT A 45-year-old man with uncontrolled chronic GVHD developed pneumothorax of the right lung. Thoracoscopic dissection of the adhesions, closure of the pneumostomy, and drainage under general anesthesia were planned. In the preoperative airway assessment, we concluded that using a video laryngoscope or endotracheal fiber would be sufficient to intubate the patient after sedation and that airway management after the loss of consciousness would not be difficult. Therefore, general anesthesia was induced by rapid induction; however, the patient developed difficult mask ventilation. Intubation was attempted via a video laryngoscope or bronchofiber but failed. Ventilating using a supraglottic instrument was difficult. The patient was evaluated to have a CICV condition. Thereafter, because of a rapid decrease in oxygen saturation (SpO2) and bradycardia, a cricothyrotomy was performed. Subsequently, ventilation became adequate, SpO2 increased immediately and drastically, and respiration and circulatory dynamics recovered.

CONCLUSIONS We believe that anesthesiologists should practice, prepare, and simulate airway emergencies that can be experienced during surgery. In this case, we recognized that skin sclerosis in the neck and chest could lead to CICV. It may be suitable for airway management of scleroderma-like patients to select conscious intubation with a bronchoscope as a first choice.

Effectiveness of "Stop the Bleed" Courses: A Systematic Review and Meta-analysis

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J Surg Educ. 2023 Mar;80(3):407-419.

Objective: Our object was to comprehensively analyze the existing body of evidence to evaluate the Stop the Bleed (STB) course effectiveness and satisfaction and find the direction of improvement for the future.

Study design: A literature search with the term "Stop the Bleed" in the electronic databases PubMed, Web of Science, EMBASE, Cochrane Library was performed, retrieving records from January 1, 2013 to April 13, 2022 based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram. In addition, all selected papers' references were examined for qualified studies that were missed during the first search. Original publications were included that reported on (1) clinical studies of the STB course implementation; and (2) studies comparing students' hemostasis ability and attitude (comfort, confidence, and willingness) before and after the STB course. The literature search and data extraction were done independently by 2 writers. To establish consensus, disagreements will be handled with the help of a third reviewer. For data synthesis, the most inclusive data from studies with repeated data were abstracted. Changes in hemostasis questionnaire scoring and operation evaluation after the STB course were the main outcomes.

Results: This systematic review and meta-analysis includes 36 trials with a total of 11,561 trainees. Thirty-one of them were undertaken in the USA, while the other 5, accounting for 13.9%, were conducted in other regions. Among various evaluation methods, 3 trials with 927 trainees indicated that scores of correct uses of tourniquet significantly increased after the STB course (mean difference of post versus pre groups, 44.28; 95% CI 41.24-47.32; $p < 0.001$). Significant difference was also observed in the willingness to apply a hemostatic dressing in a real-world situation (risk ratio for post versus pre groups, 1.28; 95% CI 1.08-1.52; $p = 0.004$) (7 studies and 2360 participants). The results indicate that hemostasis knowledge and skills after the STB course had improved, but statistics indicated that STB courses implemented in the USA were more effective than other regions.

Conclusions and relevance: Meta-analysis showed that comparison before and after the STB course were significantly different. However, the outcome measures in each study were different and could not, therefore, be compiled in all cases. The effectiveness and worth of implementation of STB in different countries should be continuously evaluated in the future.

Tranexamic acid for safer surgery: does the evidence support preventative use? Response to Br J Anaesth 2023; 130: e23-e24

UK Royal Colleges Tranexamic Acid in Surgery Implementation Group; Michael P W Grocott, Mike Murphy, Ian Roberts, Rob Sayers, Cheng-Hock Toh

Br J Anaesth. 2023 Feb;130(2):e195-e196.

No abstract available

Early Hypocalcemia in Severe Trauma: An Independent Risk Factor for Coagulopathy and Massive Transfusion

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J Pers Med. 2022 Dec 28;13(1):63.

Abstract

The rapid identification of patients at risk for massive blood transfusion is of paramount importance as uncontrolled exsanguination may lead to death within 2 to 6 h. The aim of this study was to analyze a cohort of severe trauma patients to identify risk factors associated with massive transfusion requirements and hypocalcemia. All major trauma (ISS > 16) presented directly from the scene to the Niguarda hospital between 1 January 2015 and 31 December 2021 were analyzed. A total of 798 patients were eligible out of 1586 screened. Demographic data showed no significant difference between hypocalcemic (HC) and normocalcemic (NC) patients except for the presence of crush trauma, alcohol intake (27% vs. 15%, $p < 0.01$), and injury severity score (odds ratio 1.03, $p = 0.03$). ISS was higher in the HC group and was an independent, even if weak, predictor of hypocalcemia (odds ratio 1.03, $p = 0.03$). Prehospital data showed a lower mean systolic arterial pressure (SAP) and a higher heart rate (HR) in the HC group (105 vs. 127, $p < 0.01$; 100 vs. 92, $p < 0.001$, respectively), resulting in a higher shock index (SI) (1.1 vs. 0.8, $p < 0.001$). Only retrospective studies such as ours are available, and while hypocalcemia seems to be an independent predictor of mortality and massive transfusion, there is not enough evidence to support causation. Therefore, randomized prospective studies are suggested.

The effect of a multi-faceted quality improvement program on paramedic intubation success in the critical care transport environment: a before-and-after study

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Scand J Trauma Resusc Emerg Med. 2023 Feb 22;31(1):9.

Introduction: Endotracheal intubation (ETI) is an infrequent but key component of prehospital and retrieval medicine. Common measures of quality of ETI are the first pass success rates (FPS) and ETI on the first attempt without occurrence of hypoxia or hypotension (DASH-1A). We present the results of a multi-faceted quality improvement program (QIP) on paramedic FPS and DASH-1A rates in a large regional critical care transport organization.

Methods: We conducted a retrospective database analysis, comparing FPS and DASH-1A rates before and after implementation of the QIP. We included all patients undergoing advanced airway management with a first strategy of ETI during the time period from January 2016 to December 2021.

Results: 484 patients met the inclusion criteria during the study period. Overall, the first pass intubation success (FPS) rate was 72% (350/484). There was an increase in FPS from the pre-intervention period (60%, 86/144) to the post-intervention period (86%, 148/173), $p < 0.001$. DASH-1A success rates improved from 45% (55/122) during the pre-intervention period to 55% (84/153) but this difference did not meet pre-defined statistical significance ($p = 0.1$). On univariate analysis, factors associated with improved FPS rates were the use of video-laryngoscope (VL), neuromuscular blockage, and intubation inside a healthcare facility.

Conclusions: A multi-faceted advanced airway management QIP resulted in increased FPS intubation rates and a non-significant improvement in DASH-1A rates. A combination of modern equipment, targeted training, standardization and ongoing clinical governance is required to achieve and maintain safe intubation by paramedics in the prehospital and retrieval environment.

Effect of Different Early Oxygenation Levels on Clinical Outcomes of Patients Presenting in the Emergency Department With Severe Traumatic Brain Injury

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Ann Emerg Med. 2023 Mar;81(3):273-281.

Study objective: Despite the almost universal administration of supplemental oxygen in patients presenting in the emergency department (ED) with severe traumatic brain injury, optimal early oxygenation levels are unknown. Therefore, we aimed to examine the effect of different early oxygenation levels on the clinical outcomes of patients presenting in the emergency department with severe traumatic brain injury.

Methods: We performed a secondary analysis of the Resuscitation Outcomes Consortium Traumatic Brain Injury Hypertonic Saline randomized controlled trial by including patients with Glasgow Coma Scale ≤8. Early oxygenation levels were assessed by the worst value of arterial partial pressure of oxygen (PaO2) during the first 4 hours of presentation in the emergency department. The primary outcome was 6-month neurologic status, as assessed by the Extended Glasgow Outcome Scale. A binary logistic regression was utilized, and an odds ratio (OR) with 95% (95% confidence intervals) was calculated.

Results: A total of 910 patients were included. In unadjusted (crude) analysis, a PaO2 of 101 to 250 mmHg (OR, 0.59 [0.38 to 0.91]), or 251 to 400 mmHg (OR, 0.53 [0.34 to 0.83]) or ≥401 mmHg (OR, 0.31 [0.20 to 0.49]) was less likely to be associated with poor neurologic status when compared with a PaO2 of ≤100 mmHg. This was also the case for adjusted analyses (including age, pupillary reactivity, and Revised Trauma Score).

Conclusion: High oxygenation levels as early as the first 4 hours of presentation in the emergency department may not be adversely associated with the long-term neurologic status of patients with severe traumatic brain injury. Therefore, during the early phase of trauma, clinicians may focus on stabilizing patients while giving low priority to the titration of oxygenation levels.

The impact of low-dose aspirin in the Brain Injury Guidelines on outcomes in traumatic brain injury: A retrospective cohort study

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J Trauma Acute Care Surg. 2023 Feb 1;94(2):320-327.

Background: Current Brain Injury Guidelines (BIG) characterize patients with intracranial hemorrhage taking antiplatelet or anticoagulant agents as BIG 3 (the most severe category) regardless of trauma severity. This study assessed the risk of in-hospital mortality or need for neurosurgery in patients taking low-dose aspirin who otherwise would be classified as BIG 1.

Methods: This was a retrospective study at an academic level 1 trauma center. Patients were included if they were admitted with traumatic intracerebral hemorrhage and were evaluated by the BIG criteria. Exclusion criteria included indeterminate BIG status or patients with missing primary outcomes documentation. Patients were categorized as BIG 1, BIG 2, BIG 3, or BIG 1 on aspirin (patients with BIG 1 features taking low-dose aspirin). The primary endpoint was a composite of neurosurgical intervention and all-cause in-hospital mortality. Key secondary endpoints include rate of intracranial hemorrhage progression, and intensive care unit- and hospital-free days.

Results: A total of 1,520 patients met the inclusion criteria. Median initial Glasgow Coma Scale was 14 (interquartile range [IQR], 12-15), Injury Severity Scale score was 17 (IQR, 10-25), and Abbreviated Injury Scale subscore head and neck (AIS Head) was 3 (IQR, 3-4). The rate of the primary outcome for BIG 1, BIG 1 on aspirin, BIG 2, and BIG 3 was 1%, 2.2%, 1%, and 27%, respectively; the difference between BIG 1 on aspirin and BIG 3 was significant ($p < 0.001$).

Conclusion: Patients taking low-dose aspirin with otherwise BIG 1-grade injuries experienced mortality and required neurosurgery significantly less often than other patients categorized as BIG 3. Inclusion of low-dose aspirin in the BIG criteria should be reevaluated.

Comparison of Warming Capabilities Between Buddy Lite, enFlow, and Thermal Angel for US Army Medical Personnel in Austere Conditions: A Literature Review

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Abstract

US Army Forward Surgical Elements (FSEs) are highly mobile teams that provide damage control surgery (DCS) and damage control resuscitation (DCR) in austere locations that often lack standard hospital utilities (electricity, heat, food, and water). FSEs rely on portable battery-operated intravenous (IV) fluid warmers to remain light and mobile. However, their ability to warm blood in a massive resuscitation requires additional analysis. The purpose of this literature review is to examine the three most common battery-operated IV fluid warmers as determined by type and quantity listed on the Mission Table of Organization and Equipment (MTOE) of organic mobile medical units. These include the Buddy Lite, enFlow, and Thermal Angel, which are available to deployed US Army FSEs for blood resuscitation therapy. Based on limited available evidence, the enFlow produced higher outlet temperatures, effectively warmed greater volumes, reached the time to peak temperature faster, and produced greatest flow rates, with cool saline (5-10°C), compared to the Thermal Angel and Buddy Lite. However, recently the US Food and Drug Administration (FDA) issued a Class 1 recall on enFlow cartridges. Testing demonstrated aluminum elution from enFlow cartridges into IV solutions, thereby exposing patients to potentially unsafe aluminum levels. The authors recommend FSE units conduct a 100% enFlow cartridge inventory and seek an alternative IV fluid warming system prior to enFlow cartridge disposal. If an alternative does not exist, or the alternative warming system does not fit mission requirements, then medical personnel must carefully weigh the risks and benefits associated with the enFlow delivery system.

Comparing the Effects of Low-Dose Ketamine, Fentanyl, and Morphine on Hemorrhagic Tolerance and Analgesia in Humans

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Prehosp Emerg Care . 2023;27(5):600-612.

Abstract

Hemorrhage is a leading cause of preventable battlefield and civilian trauma deaths. Ketamine, fentanyl, and morphine are recommended analgesics for use in the prehospital (i.e., field) setting to reduce pain. However, it is unknown whether any of these analgesics reduce hemorrhagic tolerance in humans. We tested the hypothesis that fentanyl (75 µg) and morphine (5 mg), but not ketamine (20 mg), would reduce tolerance to simulated hemorrhage in conscious humans. Each of the three analgesics was evaluated independently among different cohorts of healthy adults in a randomized, crossover (within drug/placebo comparison), placebo-controlled fashion using doses derived from the Tactical Combat Casualty Care Guidelines for Medical Personnel. One minute after an intravenous infusion of the analgesic or placebo (saline), we employed a pre-syncopal limited progressive lower-body negative pressure (LBNP) protocol to determine hemorrhagic tolerance. Hemorrhagic tolerance was quantified as a cumulative stress index (CSI), which is the sum of products of the LBNP and the duration (e.g., [40 mmHg x 3 min] + [50 mmHg x 3 min] …). Compared with ketamine ($p = 0.002$ post hoc result) and fentanyl ($p = 0.02$ post hoc result), morphine reduced the CSI (ketamine ($n = 30$): 99 [73-139], fentanyl ($n = 28$): 95 [68-130], morphine ($n = 30$): 62 [35-85]; values expressed as a % of the respective placebo trial's CSI; median [IQR]; Kruskal-Wallis test $p = 0.002$). Morphine-induced reductions in tolerance to central hypovolemia were not well explained by a prediction model including biological sex, body mass, and age ($R2=0.05$, $p = 0.74$). These experimental data demonstrate that morphine reduces tolerance to simulated hemorrhage while fentanyl and ketamine do not affect tolerance. Thus, these laboratory-based data, captured via simulated hemorrhage, suggest that morphine should not be used for a hemorrhaging individual in the prehospital setting.

Intraosseous Tibial Resuscitation After a Total Knee Arthroplasty Leading to Osteonecrosis and Loosening of the Tibial Component

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Arthroplast Today. 2023 Jan 14:19:101088.

Abstract

A 51-year-old woman suffered cardiac arrest requiring emergent intraosseous access that abutted the tibial component of her total knee arthroplasty. She developed a wound at the site and knee pain which was concerning for deep infection. Subsequent imaging was consistent with osteonecrosis developing around the tibial component. The component eventually loosened, requiring a revision surgery. Her deep cultures remained negative throughout. Her findings are most consistent with osteonecrosis and aseptic loosening of her prosthesis. While intraosseous access may be beneficial during resuscitation, it has complications. This is the first reported case of osteonecrosis secondary to intraosseous access leading to prosthetic loosening necessitating a revision surgery.

Ketamine decreased opiate use in US military combat operations from 2010 to 2019

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Background: Ketamine is a dissociative anaesthetic currently used in a variety of healthcare applications. Effects are dose dependent and cause escalating levels of euphoria, analgesia, dissociation and amnesia. Ketamine can be given via intravenous, intramuscular, nasal, oral and aerosolised routes. A 2012 memorandum and the 2014 Tactical Combat Casualty Care (TCCC) guidelines included ketamine as part of the 'Triple Option' for analgesia. This study investigated the effect of ketamine adoption by the US military TCCC guidelines on opioid use between 2010 and 2019.

Methods: This was a retrospective review of deidentified Department of Defense Trauma Registry data. The study was approved by the Institutional Review Board of Naval Medical Center San Diego (NMCSD) and facilitated by a data sharing agreement between NMCSD and the Defense Health Agency. Patient encounters from all US military operations from January 2010 to December 2019 were queried. All administrations of any pain medications via any route were included.

Results: 5965 patients with a total of 8607 pain medication administrations were included. Between 2010 and 2019, the yearly percentage of ketamine administrations rose from 14.2% to 52.6% ($p<0.001$). The percentage of opioid administrations decreased from 85.8% to 47.4% ($p<0.001$). Among the 4104 patients who received a single dose of pain medication, the mean Injury Severity Score for those who received ketamine was higher than for those who received an opioid (mean=13.1 vs 9.8, $p<0.001$).

Conclusion: Military opioid use declined as ketamine use increased over 10 years of combat. Ketamine is generally used first for more severely injured patients and has increasingly been employed by the US military as the primary analgesic for combat casualties.

PREHOSPITAL CRYSTALLOID RESUSCITATION: PRACTICE VARIATION AND ASSOCIATIONS WITH CLINICAL OUTCOMES

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Shock. 2023 Jan 1;59(1):28-33.

Introduction: Although resuscitation guidelines for injured patients favor blood products, crystalloid resuscitation remains a mainstay in prehospital care. Our understanding of contemporary prehospital crystalloid (PHC) practices and their relationship with clinical outcomes is limited. Methods: The Pragmatic, Randomized Optimal Platelet and Plasma Ratios trial data set was used for this investigation. We sought to identify factors associated with PHC volume variation and hypothesized that higher PHC volume is associated with worse coagulopathy and a higher risk of acute respiratory distress syndrome (ARDS) but a lower risk of acute kidney injury (AKI). Subjects were divided into groups that received <1,000 mL PHC (PHC<1,000) and ≥1,000 mL PHC (PHC≥1,000); initial laboratory values and outcomes (ARDS and AKI risk) were summarized with medians and interquartile ranges or percentages and compared using Wilcoxon rank-sum tests and chi-square tests. The primary outcome was ARDS risk. Multivariable regression was used to characterize the association of each 500 mL aliquot of PHC with initial laboratory values and clinical outcomes. Results: PHC volume among study subjects (n = 680) varied (median, 0.3 L; interquartile range, 0-0.9 L) with weak associations demonstrated among prehospital hemodynamics, intubation, Glasgow Coma Score, and Injury Severity Score ($0.008 \leq R2 \leq 0.09$); prehospital time and enrollment site explained more variation in PHC volume with R2 values of 0.2 and 0.54, respectively. Compared with PHC<1,000, PHC≥1,000 had higher INR, PT, PTT, and base deficit and lower hematocrit and platelets. The proportion of ARDS in the PHC≥1,000 group was higher than PHC<1,000 (21% vs. 12%, $P < 0.01$), whereas the rate of AKI was similar between groups (23% vs. 23%, $P = 0.9$). In regression analyses, each 500 mL of PHC was associated with increased INR and PTT, and decreased hematocrit and platelet count ($P < 0.05$). Each 500 mL of PHC was associated with increased ARDS risk and decreased AKI risk ($P < 0.05$). Conclusion: PHC administration correlates poorly with prehospital hemodynamics and injury characteristics. Increased PHC volume is associated with greater anemia, coagulopathy, and increased risk of ARDS, although it may be protective against AKI.

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Beirut massive blast explosion: A unique injury pattern of the wounded population

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Introduction: On August 4, 2020, a massive explosion of a warehouse holding 2,700 metric tons of ammonium nitrate took place in the port of Beirut, Lebanon. This incident, which is considered as one of the largest industrial disasters lead to the death of at least 220 people and more than 6000 injuries. Hospitals near the blast were damaged significantly which made it difficult to treat injured patients. The objective of this study is to report the epidemiology and characteristics of the injuries and their initial management that could be useful for healthcare workers and policymakers in case of a similar massive accident in the future.

Materials and methods: A retrospective study was conducted. All charts of patients admitted to the emergency room and outpatient clinics on the day of the blast and during the following 2 weeks were thoroughly reviewed. Due to initial chaos during triage, direct phone contact with patients was utilized in certain situations to confirm their identity or for further information. All acute injuries were recorded based on the region, severity, degree of emergency, initial and later management, type of injured organs, and surgical procedures.

Results: A total of 159 patients presented to our facility. 153 patients presented to the ER on the same day of the blast. The mean age was 47.07 years and around 60% of the patients were males (n = 93). Most of the patients presented either from zone 1 (n = 67, 42%) or zone 3 (n = 68, 43%). The majority of injuries were secondary injuries due to glass (n = 131, 82.3%), with the head (34%) and upper extremities (31.2%) being most commonly affected. A total of 94 patients (62.6%) underwent a type of imaging and 64 patients (40.2%) had at least one surgery performed during their hospitalization in which 71% of the surgeries being related to the limbs.

Conclusion: This study demonstrated a unique injury pattern due to this type of blast. Injuries were mostly due to glass shrapnel. Contrary to bomb blasts, most injuries were located in the head and upper extremities rather than on the lower extremities.