Tactical Combat Casualty Care

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En Route Combat Casualty Care

2023 Journal Watch

Journal Article Abstracts

Jul 2023- Sept 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.

Comparing the Scalpel-Bougie-Tube Emergency Front-of-Neck Airway (eFONA) Technique on Conventional Manikins and Ovine Larynges: Evaluating Cost, Realism, and Performance in Anaesthetic Trainees

Cureus. 2023 Jun 6;15(6):e40040

Ahmed Abdelhamid, Sadhana Sapra

Abstract

Background Emergency front-of-neck airway (eFONA) is a crucial life-saving procedure in "cannot intubate, cannot oxygenate" (CICO) situations. It is essential to teach and maintain eFONA skills for healthcare providers, especially anesthesiologists. This study aims to assess the effectiveness of cost-effective ovine larynx models compared to conventional manikins in teaching eFONA using the scalpel-bougie-tube technique to a group of anaesthesia novices and newly appointed anaesthetic Fellows. Methods and study design The study was conducted at Walsall Manor Hospital, a district general hospital in the Midlands, UK. Participants underwent a pre-survey to assess familiarity with FONA and the ability to perform a laryngeal handshake. After a lecture and demonstration, participants performed two consecutive emergency cricothyrotomies on both ovine models and conventional manikins, followed by a post-survey to assess their confidence in performing eFONA and rate their experience using sheep larynges. Results The training session significantly improved the participants' ability to perform a laryngeal handshake and their confidence in performing eFONA. The majority of participants rated the ovine model higher in terms of realism, difficulty with penetration, difficulty in recognising landmarks, and difficulty in performing the procedure. Additionally, the ovine model was more cost-effective compared to conventional manikins. Conclusion Ovine models provide a more realistic and cost-effective alternative to conventional manikins for teaching eFONA using the scalpel-bougie-tube technique. The use of these models in routine airway teaching enhances the practical skill set of anaesthesia novices and newly appointed anaesthetists, better preparing them for CICO situations. However, further training with objective assessment methods and larger samples is needed to corroborate these findings.

A kaolin/calcium incorporated shape memory and antimicrobial chitosan-dextran based cryogel as an efficient haemostatic dressing for uncontrolled hemorrhagic wounds

Biomater Adv. 2023 Jul:150:213424.

Syed Muntazir Andrabi, Ashok Kumar

Abstract

Increased mortalities associated with uncontrolled and excessive bleeding is still of paramount concern in the clinics, caregivers and military medics. Herein, we designed a shape memory cryogel based on chitosan (C) and functionalized-dextran (D), incorporated with Kaolin (K) and calcium (Ca2+) as haemostatic agents. The developed cryogel (CDKCa) exhibits a uniform interconnected porous architecture with profound fluid absorption ability, rapid blood clotting, stable clot formation and good antibacterial activity. The CDKCa elucidates significantly less clotting time (~30 s; in-vitro) and increased aggregation and activation of platelets/red blood cells in comparison to the control groups and commercial dressings (Axiostat and QuikClot). The developed CDKCa also significantly reduced the aPTT and PT values by ~58 % and 31 % respectively, leading to the activation of intrinsic and extrinsic coagulation cascades. The CDKCa cryogel displays enhanced mechanical stability, flexibility and a good shape memory, a property quintessential to cease uncontrolled bleeding in irregular and non-compressible wounds. Further, the Kaolin and Ca2+ incorporated shape memory CDKCa cryogel demonstrates a rapid blood coagulation and stable clot formation in different compressible and non-compressible rat liver and femur hemorrhagic models. In summary, the endorsed results of CDKCa suggest that the design, fabrication and excellent clotting ability may attribute to high haemostatic efficiency of CDKCa dressing and have a great potential to prevent uncontrollable hemorrhages.

Testing and Evaluation of a Novel Hemostatic Matrix in a Swine Junctional Hemorrhage Model

J Surg Res. 2023 Nov:291:452-458

Andrew A Angus, Lindsey N July, Patrick M McCarthy, Nola D Shepard, Jason M Rall, Jason S Radowsky

Introduction: In an ongoing effort to improve survival and reduce blood loss from hemorrhagic injuries on the battlefield, new hemostatic dressings continue to be developed. This study aimed to determine the efficacy of a novel silicon dioxide-based hemostatic matrix (HM) and compare it with the current military standard Quikclot Combat Gauze (QCG) utilizing a lethal femoral artery injury model.

Materials and methods: The femoral arteries of 20 anesthetized swine were isolated, and an arteriotomy was performed. After a 45 s free bleed, the wound was treated with either HM or QCG (n = 10 per group). Following a 60-min observation period, ipsilateral leg manipulations and angiography were performed. Animal survival, hemostasis, blood loss, exothermic reaction, and femoral artery patency were analyzed.

Results: Despite a volumetric size discrepancy between the two products tested, the survival rate was similar between the two groups (80% HM, 90% QCG, n = 10, P = 0.588). Immediate hemostasis was obtained in 50% of HM animals and 40% of QCG animals. There was no difference in total blood loss recorded between the two groups (P = 0.472). Femoral artery patency rates following ipsilateral leg manipulations were similar between the two groups (50% HM, 33% QCG, P = 0.637), with no contrast extravasation in HM-treated wounds (0% HM, 33% QCG, P = 0.206). There was no significant difference in either pretreatment or posttreatment laboratory values, and there were no exothermic reactions in either group.

Conclusions: The SiOxMed HM demonstrated comparable hemostatic efficacy to QCG. The tested form of HM may be appropriate for surgical or topical hemostasis applications, and with further product development, it could be used for battlefield trauma implementation.

Extraglottic device use is rare during emergency airway management: A National Emergency Airway Registry (NEAR) study

Am J Emerg Med. 2023 Oct:72:95-100

Michael D April, Brian Driver, Steven G Schauer, Jestin N Carlson, Rachel E Bridwell, Brit Long, Jamie Stang, Subrina Farah, Robert A De Lorenzo, Calvin A Brown 3rd

Introduction: Airway management is a critical component of the management of emergency department (ED) patients. The ED airway literature primarily focuses upon endotracheal intubation; relatively less is known about the ED use of extraglottic devices (EGDs). The goal of this study was to describe the frequency of use, success, and complications for EGDs among ED patients.

Methods: The National Emergency Airway Registry (NEAR) is a prospective, multi-center, observational registry. It captures data on all ED patients at participating sites requiring airway management. Intubating clinicians entered all data into an online system as soon as practical after each encounter. We conducted a secondary analysis of these data for all ED encounters in which EGD placement occurred. We used descriptive statistics to characterize these encounters.

Results: Of 19,071 patients undergoing intubation attempts, 56 (0.3%) underwent EGD placement. Of 25 participating sites, 13 reported no cases undergoing EGD placement; the median number of EGDs placed per site was 2 (interquartile range 1-2.5, range 1-31). Twenty-nine (54%) patients had either hypotension or hypoxia prior to the start of airway management. Clinicians reported anticipation of a difficult airway in 55% and at least one difficult airway characteristic in 93% of these patients. Forty-one encounters entailed placement of a laryngeal mask airway (LMA®) Fastrach™, 33 of whom underwent subsequent successful intubation through the EGD and 7 of whom underwent intubation by alternative methods. An additional 10 encounters utilized a standard LMA® device. Providers placed 34 (61%) EGDs during the first intubation attempt. Seventeen EGD patients (30%) experienced peri-procedure adverse events, including 14 (25%) experiencing hypoxemia. None of these patients expired due to failed airways.

Conclusions: EGD use was rare in this multi-center ED registry. EGD occurred predominantly in patients with difficult airway characteristics with favorable airway management outcomes. Clinicians should consider this emergency airway device for patients with a suspected difficult airway.

Military Standard Testing of Commercially Available Supraglottic Airway Devices for Use in a Military Combat Setting

J Spec Oper Med. 2023 Jun 23;23(2):19-32

Carlos Bedolla, Danielius Zilevicius, Grant Copeland, Marisa Guerra, Sophia Salazar, Michael D April, Brit Long, Jason F Naylor, Robert A De Lorenzo, Steven G Schauer, R Lyle Hood

Introduction: Airway obstruction is the second leading cause of death on the battlefield. The harsh conditions of the military combat setting require that devices be able to withstand extreme circumstances. Military standards (MIL-STD) testing is necessary before devices are fielded. We sought to determine the ability of supraglottic airway (SGA) devices to withstand MIL-STD testing.

Methods: We tested 10 SGA models according to nine MIL-STD-810H test methods. We selected these tests by polling five military and civilian emergency-medicine subject matter experts (SMEs), who weighed the relevance of each test. We performed tests on three devices for each model, with operational and visual examinations, to assign a score (1 to 10) for each device after each test. We calculated the final score of each SGA model by averaging the score of each device and multiplying that by the weight for each test, for a possible final score of 2.6 to 26.3.

Results: The scores for the SGA models were LMA Classic Airway, 25.9; AuraGain Disposable Laryngeal Mask, 25.5; i-gel Supraglottic Airway, 25.2; Solus Laryngeal Mask Airway, 24.4; LMA Fastrach Airway, 24.4; AuraStraight Disposable Laryngeal Mask, 24.1; King LTS-D Disposable Laryngeal Tube, 22.1; LMA Supreme Airway, 21.0; air-Q Disposable Intubating Laryngeal Airway, 20.1; and Baska Mask Supraglottic Airway, 18.1. The limited (one to three) samples available for testing provide adequate preliminary information but restrict the range of failures that could be discovered.

Conclusions: Lower scoring SGA models may not be optimal for military field use. Models scoring sufficiently close to the top performers (LMA Classic, AuraGain, i-gel, Solus, LMA Fastrach, AuraStraight) may be viable for use in the military setting. The findings of our testing should help guide device procurement appropriate for different battlefield conditions.

EVALUATION OF TRANEXAMIC ACID AND CALCIUM CHLORIDE IN MAJOR TRAUMAS IN A PREHOSPITAL SETTING: A NARRATIVE REVIEW

Shock. 2023 Sep 1;60(3):325-332

Kameron T Bell, Chase M Salmon, Benjamin A Purdy, Scott G Canfield

Abstract

Excessive blood loss in the prehospital setting poses a significant challenge and is one of the leading causes of death in the United States. In response, emergency medical services (EMS) have increasingly adopted the use of tranexamic acid (TXA) and calcium chloride (CaCl 2) as therapeutic interventions for hemorrhagic traumas. Tranexamic acid functions by inhibiting plasmin formation and restoring hemostatic balance, while calcium plays a pivotal role in the coagulation cascade, facilitating the conversion of factor X to factor Xa and prothrombin to thrombin. Despite the growing utilization of TXA and CaCl 2 in both prehospital and hospital environments, a lack of literature exists regarding the comparative effectiveness of these agents in reducing hemorrhage and improving patient outcomes. Notably, Morgan County Indiana EMS recently integrated the administration of TXA with CaCl 2 into their treatment protocols, offering a valuable opportunity to gather insight and formulate updated guidelines based on patient-centered outcomes. This narrative review aims to comprehensively evaluate the existing evidence concerning the administration of TXA and CaCl 2 in the prehospital management of hemorrhages, while also incorporating and analyzing data derived from the co-administration of these medications within the practices of Morgan County EMS. This represents the inaugural description of the concurrent use of both TXA and CaCl 2 to manage hemorrhages in the scientific literature.

The Use of Hydrogel Dressings in Sulfur Mustard-Induced Skin and Ocular Wound Management

Biomedicines. 2023 Jun 2;11(6):1626

Fanny Caffin, David Boccara, Christophe Piérard

Abstract

Over one century after its first military use on the battlefield, sulfur mustard (SM) remains a threatening agent. Due to the absence of an antidote and specific treatment, the management of SM-induced lesions, particularly on the skin and eyes, still represents a challenge. Current therapeutic management is mainly limited to symptomatic and supportive care, pain relief, and prevention of infectious complications. New strategies are needed to accelerate healing and optimize the repair of the function and appearance of damaged tissues. Hydrogels have been shown to be suitable for healing severe burn wounds. Because the same gravity of lesions is observed in SM victims, hydrogels could be relevant dressings to improve wound healing of SM-induced skin and ocular injuries. In this article, we review how hydrogel dressings may be beneficial for improving the wound healing of SM-induced injuries, with special emphasis placed on their suitability as drug delivery devices on SM-induced skin and ocular lesions.

First-Aid Hydrogel Wound Dressing with Reliable Hemostatic and Antibacterial Capability for Traumatic Injuries

Adv Healthc Mater. 2023 Oct;12(25):e2300312

Junyao Cheng, Hufei Wang, Jianpeng Gao, Xiao Liu, Ming Li, Decheng Wu, Jianheng Liu, Xing Wang, Zheng Wang, Peifu Tang

Abstract

First-aid for severe traumatic injuries in the battlefield or pre-hospital environment, especially for skin defects or visceral rupture, remains a substantial medical challenge even in the context of the rapidly evolving modern medical technology. Hydrogel-based biomaterials are highly anticipated for excellent biocompatibility and bio-functional designability. Yet, inadequate mechanical and bio-adhesion properties limit their clinical application. To address these challenges, a kind of multifunctional hydrogel wound dressing is developed with the collective multi-crosslinking advantages of dynamic covalent bonds, metal-catechol chelation, and hydrogen bonds. The mussel-inspired design and zinc oxide-enhanced cohesion strategy collaboratively reinforce the hydrogel's bio-adhesion in bloody or humoral environments. The pH-sensitive coordinate Zn2+ -catechol bond and dynamic Schiff base with reversible breakage and reformation equip the hydrogel dressing with excellent self-healing and on-demand removal properties. In vivo evaluation in a rat ventricular perforation model and Methicillin-resistant Staphylococcus aureus (MRSA)-infected full-thickness skin defect model reveal excellent hemostatic, antibacterial and pro-healing effectiveness of the hydrogel dressing, demonstrating its great potential in dealing with severe bleeding and infected full-thickness skin wounds.

Haemostatic resuscitation in practice: a descriptive analysis of blood products administered during Operation HERRICK, Afghanistan

BMJ Mil Health. 2023 Jul 2:e002408. Online ahead of print

Rhys L Davies, J Thompson, R McGuire, J E Smith, S Webster, T Woolley

Introduction: Life-threatening haemorrhage is the leading cause of potentially survivable injury in battlefield casualties. During Operation HERRICK (Afghanistan), mortality rates improved year on year due to a number of advances in trauma care, including haemostatic resuscitation. Blood transfusion practice has not previously been reported in detail during this period.

Methods: A retrospective analysis of blood transfusion at the UK role 3 medical treatment facility (MTF) at Camp Bastion between March 2006 and September 2014 was performed. Data were extracted from two sources: the UK Joint Theatre Trauma Registry (JTTR) and the newly established Deployed Blood Transfusion Database (DBTD).

Results: 3840 casualties were transfused 72 138 units of blood and blood products. 2709 adult casualties (71%) were fully linked with JTTR data and were transfused a total of 59 842 units. Casualties received between 1 unit and 264 units of blood product with a median of 13 units per patient. Casualties wounded by explosion required almost twice the volume of blood product transfusion as those wounded by small arms fire or in a motor vehicle collision (18 units, 9 units, and 10 units, respectively). More than half of blood products were transfused within the first 2 hours following arrival at the MTF. There was a trend towards balanced resuscitation with more equal ratios of blood and blood products being used over time.

Conclusion: This study has defined the epidemiology of blood transfusion practice during Operation HERRICK. The DBTD is the largest combined trauma database of its kind. It will ensure that lessons learnt during this period are defined and not forgotten; it should also allow further research questions to be answered in this important area of resuscitation practice.

To Tube or Not to Tube ... That Continues to Be the Question

Air Med J. 2023 Jul-Aug;42(4):276-279

Scott DeBoer, Bruce Hoffman, Lisa DeBoer, Shelton Adkinson, Laurie Romig, Michelle Webb, Michael Seaver, Timothy Tito

Abstract

In the prehospital setting, "to tube, or not to tube" will persist as a probing question - long after this article is published. It is the hope of the authors simply to position a compilation of thoughts to consider in regards to alternate airways vs. endotracheal intubation. Ultimately, it's all about the right care, for the right patient, at the right time!

Performance of portable emergency suction devices in pre-hospital conditions: a pilot study in the fire brigade

Folia Med Cracov. 2023 Apr 30;63(1):79-90

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Aim: Assessment of the effectiveness and efficiency of three mobile (portable) rescue aspirators models in the opinion of state fire service officers. Comparison with the use of the medical simulation element.

Material and methods: The study was conducted in organizational units of the State Fire Service (24-hour officers). The research consisted in carrying out the task with the use of three models of mobile rescue aspirators (manual, hand-foot, battery). Each participating firefighter had the task of sucking up an equal amount of fluid (100 ml, respectively) with each model of an aspirator. The test fluid was water at room temperature in a homogeneous 1:1 mixture with sugar (increased viscosity and density, simulated real conditions). Immediately after three suction attempts (with measured suction time), each officer completed a questionnaire on the three models used. Descriptive statistics were used to characterize the variables. The following measures were calculated for the variables: mean (M) and standard deviation (SD), minimum, maximum. The following measures were calculated for categorical variables: number (n) and frequency (%).

Results: 184 officers (182 M and 2 F) took part in the study, including commanders 18.43%, rescuers 65.22%, drivers 16.30%. In the study area 1,609 officers serve in the combat division as at the end of 2021. The studied group accounts for 11.43%. Age of respondents M 34.04 SD 8.24 Min 21 Max 52, length of service M 8.48, SD 7.20 Min 1, Max 25. The longest mean time of completing the task was recorded for model 2 (hand-foot) and it was 6.77 sec.

Conclusions: SFS officers highly appreciated the usefulness and effectiveness of the battery-operated automatic aspirator. This assessment may contribute to the widespread introduction of such a model to rescue sets in the SFS. Time of performing the task by mode 1 was significantly longer by elderly people. People with experience with the model 1 during rescue and firefighting operations had a significantly shorter time of performing the task with the use of the model 2. According to the subjective assessment of firefighters, the most effective is model 3, which is confirmed by the suction time obtained at the work station.

Moving the needle on time to resuscitation: An EAST prospective multicenter study of vascular access in hypotensive injured patients using trauma video review

J Trauma Acute Care Surg. 2023 Jul 1;95(1):87-93

Ryan P Dumas, Michael A Vella, Amelia W Maiga, Caroline R Erickson, Brad M Dennis, Luis T da Luz, Dylan Pannell, Emily Quigley, Catherine G Velopulos, Peter Hendzlik, Alexander Marinica, Nolan Bruce, Joseph Margolick, Dale F Butler, Jordan Estroff, James A Zebley, Ashley Alexander, Sarah Mitchell, Heather M Grossman Verner, Michael Truitt, Stepheny Berry, Jennifer Middlekauff, Siobhan Luce, David Leshikar, Leandra Krowsoski, Marko Bukur, Nathan M Polite, Ashley H McMann, Ryan Staszak, Scott B Armen, Tiffany Horrigan, Forrest O Moore, Paul Bjordahl, Jenny Guido, Sarah Mathew, Bernardo F Diaz, Jennifer Mooney, Katherine Hebeler, Daniel N Holena

Background: Vascular access in hypotensive trauma patients is challenging. Little evidence exists on the time required and success rates of vascular access types. We hypothesized that intraosseous (IO) access would be faster and more successful than peripheral intravenous (PIV) and central venous catheter (CVC) access in hypotensive patients.

Methods: An EAST prospective multicenter trial was performed; 19 centers provided data. Trauma video review was used to evaluate the resuscitations of hypotensive (systolic blood pressure ≤90 mm Hg) trauma patients. Highly granular data from video recordings were abstracted. Data collected included vascular access attempt type, location, success rate, and procedural time. Demographic and injury-specific variables were obtained from the medical record. Success rates, procedural durations, and time to resuscitation were compared among access strategies (IO vs. PIV vs. CVC).

Results: There were 1,410 access attempts that occurred in 581 patients with a median age of 40 years (27-59 years) and an Injury Severity Score of 22 [10-34]. Nine hundred thirty-two PIV, 204 IO, and 249 CVC were attempted. Seventy percent of access attempts were successful but were significantly less likely to be successful in females (64% vs. 71%, $p = 0.01$). Median time to any access was 5.0 minutes (3.2-8.0 minutes). Intraosseous had higher success rates than PIV or CVC (93% vs. 67% vs. 59%, $p < 0.001$) and remained higher after subsequent failures (second attempt, 85% vs. 59% vs. 69%, $p = 0.08$; third attempt, 100% vs. 33% vs. 67%, $p = 0.002$). Duration varied by access type (IO, 36 [23-60] seconds; PIV, 44 [31-61] seconds; CVC 171 [105-298]seconds) and was significantly different between IO versus CVC ($p < 0.001$) and PIV versus CVC ($p < 0.001$) but not PIV versus IO. Time to resuscitation initiation was shorter in patients whose initial access attempt was IO, 5.8 minutes versus 6.7 minutes ($p = 0.015$). This was more pronounced in patients arriving to the hospital with no established access (5.7 minutes vs. 7.5 minutes, $p = 0.001$).

Conclusion: Intraosseous is as fast as PIV and more likely to be successful compared with other access strategies in hypotensive trauma patients. Patients whose initial access attempt was IO were resuscitated more expeditiously. Intraosseous access should be considered a first line therapy in hypotensive trauma patients.

Navy En-Route Care in Future Distributed Maritime Operations: A Review of Clinician Capabilities and Roles of Care

Prehosp Emerg Care. 2023;27(4):465-472

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Objective: As the United States Navy transitions from Operation Iraqi Freedom/Operation Enduring Freedom to preparing for a near-peer competition, an increasing focus of wartime strategy relies upon a network of distributed naval assets for total sea control, known as Distributed Maritime Operations (DMO). Historically, embedded medical personnel have provided care at sea in times of war. Recent reviews of shipboard and evacuated mass casualty incidents have alluded to weaknesses in the existing Navy Medicine approach that will require advances in care provision to sustain high-quality care that would benefit from industry and civilian academic collaboration. To gain input from civilian prehospital expertise and insight, the current DMO and Navy En-Route Care (ERC) systems must be plainly described for non-Navy military and civilian leaders, clinicians, and researchers to understand.

Methods: N/A.

Results: In this review, we translate US Navy structure and vernacular into common civilian and non-Navy language, describe the maritime role-tiered ERC system, elucidate the medical assets on each naval warship, and discuss clinician levels and capabilities while deployed to help communicate the inherent challenges of US Navy maritime medical care during routine operations, casualty treatment, stabilization, and evacuation.

Conclusions: We describe the roles of care, clinician levels, and medical assets within the Navy ERC system for researchers and military leaders who aim to mitigate the inherent challenges of future maritime trauma care in the age of Distributed Maritime Operations. This paper lays the framework of the Navy deployed medical system to enable research in maritime en-route care, and prompt inclusion of identified solutions into common use in the US Navy.

Putting Medical Boots on the Ground: Lessons from the War in Ukraine and Applications for Future Conflict with Near-Peer Adversaries

J Am Coll Surg. 2023 Aug 1;237(2):364-373

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Abstract

In the past 20 years of the Global War on Terror, the US has seen substantial improvements in its system of medical delivery in combat. However, throughout that conflict, enemy forces did not have parity with the weaponry, capability, or personnel of the US and allied forces. War against countries like China and Russia, who are considered near-peer adversaries in terms of capabilities, will challenge battlefield medical care in many different ways. This article reviews the experience of a medical team, Global Surgical and Medical Support Group, that has been providing assistance, training, medical support, and surgical support to Ukraine since the Russian invasion began in February 2022. The team has extensive experience in medicine, surgery, austere environments, conflict zones, and building partner nation capacities. This article compares and contrasts the healthcare systems of this war against the systems used during the Global War on Terror. The lessons learned here could help the US anticipate challenges and successfully plan for the provision of medical care in a future conflict against an adversary with capabilities close to its own.

Comparison of the Analgesic Efficacy of Lidocaine Spray versus Tramadol and Fentanyl for Pain Control in Rib Fractures

J Coll Physicians Surg Pak. 2023 May;33(5):491-497

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Objective: To compare the analgesic efficacy of lidocaine spray with tramadol hydrochloride and fentanyl citrate in rib fractures.

Study design: A randomised, controlled open-label study. Place and Duration of the Study: Ministry of Health Ankara City Hospital, Turkiye, from June to November 2021.

Methodology: Patients over the age of 18 years, who applied to the Emergency Department with blunt chest trauma, were divided into three groups. Groups were created from patients who were given lidocaine 10% spray (local), i.v. 100 mg of tramadol, and i.v. fentanyl 50 mcg. A total of 48 patients, each of whom was 16, were included in the study. Numerical rating scale (NRS) pain scores of the patients at baseline, 15th, 30th and 60th minutes were compared. These scores and the number of falls at follow-up were analysed comparatively between the 3 groups.

Results: The age and gender distribution of the patients included in the study were found to be statistically similar between the groups. Although the degrees of decrease in NRS scores in the 0-15, 0-30, and 0-60 minute periods were higher in the tramadol group, these differences were not statistically significant (p=0.465/ 0.256/ 0.678, respectively). While no side effects were observed in the lidocaine group, there were 4 (25.0%) patients in the fentanyl group and 2 (12.5%) patients in the tramadol group.

Conclusion: Lidocaine spray can be used safely in the management of acute pain in rib fractures, as it has fewer side effects and is as effective as opiates.

Effect of Early Equal-Proportional Infusion of Plasma and Red Blood Cells on the Prognosis of Emergency Patients with Traumatic Hemorrhage

Clin Lab. 2023 Jul 1;69(7)

YuanHua Fan, ZhiMei Ye, Yan Tang

Background: The goal was to study the effect of early equal-proportion transfusion on the prognosis of trauma patients with bleeding.

Methods: Emergency hospital trauma patients were randomly divided into two groups, a group based on assessment of blood consumption (ABC) to assess whether need to start the massive blood transfusion patients, such as proportion of blood transfusion (fresh frozen plasma: suspended red blood cells = 1:1), and the other group using traditional methods of blood transfusion, namely according to routine blood and clotting function and hemodynamic parameters, to decide when and what blood constituents should be transfused.

Results: The coagulation got better in the early equal-proportion transfusion group, there were significant differences of PT and APTT ($p < 0.05$). The amount of 24 hours RBC and plasma transfusion was decreased in the early equal-proportion transfusion group, compared to the control group ($p < 0.05$), the length of ICU stay was shortened, the 24-hours SOFA score was improved, and there was no significant difference in 24-hours mortality, in-hospital mortality and total length of in-hospital stay ($p > 0.05$).

Conclusions: Early transfusion can reduce the total amount of blood transfusion and shorten ICU time, but has no significant effect on mortality.

Pain in Trauma Patients: Measurement and Predisposing Factors

J Surg Res. 2023 Nov:291:321-329

Paige Farley, Peter Abraham, Russell L Griffin, Jan O Jansen

Introduction: Acute pain is common after injury. This study intended to evaluate the feasibility of quantifying pain experience over an entire admission using "area under the pain curve" and to identify factors associated with increased pain.

Methods: This retrospective single-center study included all trauma patients admitted from 2013 to 2020. Maximum pain scores were extracted for each day. Pain was defined as area under the curve (AUC) of maximum pain scores/day plotted against time. Injury patterns were analyzed by dichotomizing Abbreviated Injury Scale (AIS) scores (AIS < 3 versus AIS ≥ 3) for each body region. Urinary drug screen results were collected from admission data. A general linear model was used to determine which injury patterns, mechanisms, and age groups were predictive of increased AUC in all patients together and separate by operative and nonoperative groups.

Results: We identified 21,640 patients, of which 70% were male and 83% had suffered blunt injury. Overall injury severity was associated with increased pain experience. Serious head injury, younger age, and older age (compared to 45-49 y) were associated with decreased pain. Spinal injuries, thoraco-abdominal injuries, and combined thoracic and lower extremity injuries were predictive of increased pain. Compared to patients with no positive test for illicit substances or documentation of prehospital narcotic medications, the pain experience was greater for both, those who had been administered a narcotic in the prehospital setting and those who tested positive for illicit substances.

Conclusions: This study extends the concept of total pain experience using AUC methodology. Our results demonstrate associations between increased pain and certain patterns of injury, ages, and presence of drugs on admission. Measuring total pain experience could assist in comparing pain-management strategies. Future research should focus on validating pain experience against quality-of-life measurements.

A brief history of crystalloids: the origin of the controversy

Front Pediatr. 2023 Jul 3:11:1202805. doi: 10.3389/fped.2023.1202805

Jaime Fernández-Sarmiento, Carolina Casas-Certain, Sarah Ferro-Jackaman, Fabian H Solano-Vargas, Jesús Ángel Domínguez-Rojas, Francisco Javier Pilar-Orive

Abstract

Fluid resuscitation with crystalloids has been used in humans for more than 100 years. In patients with trauma, sepsis or shock of any etiology, they can help modify the clinical course of the illness. However, these solutions are medications which are not side-effect free. Recently, they have been questioned in terms of quantity (fluid overload) and their composition. The most frequently used crystalloids, both in high and low-income countries, are 0.9% normal saline (NS) and Ringer's lactate. The first descriptions of the use of sodium and water solutions in humans date from the cholera epidemic which spread throughout Europe in 1831. The composition of the fluids used by medical pioneers at that time differs greatly from the 0.9% NS used routinely today. The term "physiological solution" referred to fluids which did not cause red blood cell hemolysis in amphibians in in vitro studies years later. 0.9% NS has an acid pH, a more than 40% higher chloride concentration than plasma and a strong ion difference of zero, leading many researchers to consider it an unbalanced solution. In many observational studies and clinical trials, this 0.9% NS composition has been associated with multiple microcirculation and immune response complications, acute kidney injury, and worse clinical outcomes. Ringer's lactate has less sodium than plasma, as well as other electrolytes which can cause problems in patients with traumatic brain injury. This review provides a brief summary of the most important historical aspects of the origin of the most frequently used intravenous crystalloids today.

Oxygen saturation targets for adults with acute hypoxemia in low and lower-middle income countries: a scoping review with analysis of contextual factors

Front Med (Lausanne). 2023 Apr 17:10:1148334. doi: 10.3389/fmed.2023.1148334.

Austin Herbst, Swati Goel, Abi Beane, B Jason Brotherton, Dingase Dula, E Wesley Ely, Stephen B Gordon, Rashan Haniffa, Bethany Hedt-Gauthier, Felix Limbani, Michael S Lipnick, Samuel Lyon, Carolyne Njoki, Peter Oduor, George Otieno, Luigi Pisani, Jamie Rylance, Mark G Shrime, Doris Lorette Uwamahoro, Sky Vanderburg, Wangari Waweru-Siika, Theogene Twagirumugabe, Elisabeth Riviello

Abstract

Knowing the target oxygen saturation (SpO2) range that results in the best outcomes for acutely hypoxemic adults is important for clinical care, training, and research in low-income and lower-middle income countries (collectively LMICs). The evidence we have for SpO2 targets emanates from high-income countries (HICs), and therefore may miss important contextual factors for LMIC settings. Furthermore, the evidence from HICs is mixed, amplifying the importance of specific circumstances. For this literature review and analysis, we considered SpO2 targets used in previous trials, international and national society guidelines, and direct trial evidence comparing outcomes using different SpO2 ranges (all from HICs). We also considered contextual factors, including emerging data on pulse oximetry performance in different skin pigmentation ranges, the risk of depleting oxygen resources in LMIC settings, the lack of access to arterial blood gases that necessitates consideration of the subpopulation of hypoxemic patients who are also hypercapnic, and the impact of altitude on median SpO2 values. This process of integrating prior study protocols, society guidelines, available evidence, and contextual factors is potentially useful for the development of other clinical guidelines for LMIC settings. We suggest that a goal SpO2 range of 90-94% is reasonable, using high-performing pulse oximeters. Answering context-specific research questions, such as an optimal SpO2 target range in LMIC contexts, is critical for advancing equity in clinical outcomes globally.

Occult Pneumothorax in Blunt Thoracic Trauma: Clinical Characteristics and Results of Delayed Tube Thoracostomy in a Level 1 Trauma Center

J Clin Med. 2023 Jun 28;12(13):4333

Chang-Wan Kim, Il-Hwan Park, Young-Jin Youn, Chun-Sung Byun

Abstract

Occult pneumothorax in blunt trauma patients is often diagnosed only after computed tomography because supine chest X-ray (CXR) is preferred as an initial evaluation. However, improperly managed preexisting occult pneumothorax could threaten the vitality of patients. Therefore, this study aimed to evaluate the incidence, characteristics, risk factors, and outcomes of occult pneumothorax in a single trauma center. From 2020 to 2022, patients who were admitted to the level 1 trauma center were retrospectively investigated. Inclusion criteria focused on blunt chest trauma. Variables including demographic factors, image findings, injury-related factors, tube thoracostomy timing, and treatment results were evaluated. Of the 1621 patients, 187 who met the criteria were enrolled in the study: 32 with overt pneumothorax and 81 with occult pneumothorax. Among all of the pneumothorax cases, the proportion of occult pneumothorax was 71.7% (81/113), and its incidence in all admitted trauma victims was 5.0% (81/1621). Subcutaneous emphysema and rib fractures on supine CXR were risk factors for occult pneumothorax. Six patients underwent delayed tube thoracostomy; however, none had serious complications. Given that occult pneumothorax is common in patients with blunt chest trauma, treatment plans should be established that consider the possibility of pneumothorax. However, the prognosis is generally good, and follow-up is an alternative.

Impact of Prehospital Antibiotics on in-Hospital Mortality in Emergency Medical Service Patients with Sepsis

Open Access Emerg Med. 2023 May 26:15:199-206

Rujabhorn Kotnarin, Penpischa Sirinawee, Jirapong Supasaovapak

Background: Sepsis is a life-threatening medical condition that requires early recognition and timely management to improve patient outcomes and reduce mortality rates. Administering antibiotics in the prehospital setting can be effective to reduce the time to antibiotic therapy, which may be crucial for sepsis patients. However, the impact of prehospital antibiotics on mortality in sepsis patients remains uncertain, and the current evidence to support this practice in middle-income countries is particularly limited.

Methods: This was a single-center, retrospective-prospective cohort study aimed at determining the impact of prehospital antibiotics on in-hospital mortality rates among adult patients with sepsis. The study included patients who received care from the advanced level of Emergency Medical Service between June 2020 and October 2022 and compared the mortality rates of patients who received prehospital antibiotics with those of their counterparts who did not.

Results: In this study, 180 patients with a mean age of 71.6 ± 15.7 years were included, of whom 68.9% experienced respiratory infections. The results demonstrated that the prehospital antibiotic group had a significantly lower in-hospital mortality rate (32.2%) than the non-prehospital antibiotic group (47.8%; p=0.034). After adjusting for confounding factors, the odds ratio was 0.304 (95% CI: 0.11, 0.82; p=0.018), indicating a 69.6% lower incidence of in-hospital mortality in the prehospital antibiotic group. Furthermore, the prehospital antibiotic group received antibiotics significantly earlier (16.0 ± 7.4 minutes) than the non-prehospital group (50.9 ± 29.4 minutes; p<0.001).

Conclusion: This study provides evidence to support the administration of antibiotics to sepsis patients in the prehospital setting, as this practice can reduce mortality rates. However, larger, multicenter studies are required to confirm these findings and to further investigate the potential benefits of prehospital antibiotics in improving patient outcomes.

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

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

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

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.

Hemostatics in patients with inhibited coagulation-A viscoelastic in-vitro analysis

Transfusion. 2023 May:63 Suppl 3:S159-S167

Raimund Lechner, Katharina Hanke, Anna Schmid, Benjamin Mayer, Matthias Helm, Martin Kulla, Björn Hossfeld

Background: The military has used topical hemostatic agents to successfully treat life-threatening external bleeding for years. In contrast to the military environment, the general population are increasingly prescribed anticoagulants. There are only few comparative evaluations of topical hemostatic agents with anticoagulated human blood. It is important to understand the impact of these agents on those who take anticoagulants.

Study design and methods: Citrated blood of patients treated with enoxaparin, heparin, and acetylsalicylic acid, apixaban or phenprocoumon was incubated with different hemostatic agents (QuikClot Gauze, Celox Granules, Celox Gauze, Chito SAM 100, WoundClot Trauma Gauze, QuikClot Gauze Moulage Trainer and Kerlix) and rotational thromboelastometry was performed with non-activated thromboelastometry (NATEM reagent).

Results: All tested agents improved the onset of coagulation in all anticoagulants, mostly to a significant degree. Most significant improvements were produced by QuikClot Gauze and QuikClot Gauze Moulage Trainer, followed by the tested chitosans (Celox Granules, Celox Gauze, Chito SAM 100). Of the anticoagulant groups, the most significant improvements were seen in enoxaparin. This was followed in order by apixaban, heparin, and acetylsalicylic acid, and phenprocoumon.

Discussion: All the hemostatic agents tested were able to activate the clotting cascade earlier and initiate faster clot formation in anticoagulated blood. A definitive head-to-head comparison is not feasible, because of the limitations of an in-vitro analysis. However, the sometimes-presented hypothesis that kaolin-based hemostatic agents are ineffective in anticoagulated blood is inaccurate according to our data. Hemostasis with hemostatic agents appears most challenging with phenprocoumon.

Nasopharyngeal Ventilation Compared to Facemask Ventilation: A Prospective, Randomized, Crossover Trial in Two Different Elective Cohorts

Cureus. 2023 May 15;15(5):e39049

Rainer Lenhardt, Ozan Akca, Detlef Obal, Jerrad Businger, Elisabeth Cooke

Background: Facemask ventilation is routinely used to preoxygenate patients before endotracheal intubation during anesthesia induction or to secure ventilation in patients with respiratory insufficiency. Occasionally, facemask ventilation cannot be performed adequately. The placement of a regular endotracheal tube through the nose into the hypopharynx may be a valid alternative to improve ventilation and oxygenation before endotracheal intubation (nasopharyngeal ventilation). We tested the hypothesis that nasopharyngeal ventilation is superior in its efficacy compared to traditional facemask ventilation.

Methods: In this prospective, randomized, crossover trial, we enrolled surgical patients requiring either nasal intubation (cohort #1, n = 20) or patients who met "difficult to mask ventilate" criteria (cohort #2, n = 20). Patients in each cohort were randomly assigned to receive pressure-controlled facemask ventilation followed by nasopharyngeal ventilation or vice versa. The ventilation settings were kept constant. The primary outcome was tidal volume. The secondary outcome was the difficulty of ventilation, measured using the Warters grading scale.

Results: Tidal volume was significantly increased by nasopharyngeal ventilation in cohort #1 (597 ± 156 ml vs.462 ± 220 ml, p = 0.019) and cohort #2 (525 ± 157 ml vs.259 ± 151 ml, p < 0.01). Warters grading scale for mask ventilation was 0.6 ± 1.4 in cohort #1, and 2.6 ± 1.5 in cohort #2.

Conclusion: Patients at risk for difficult facemask ventilation may benefit from nasopharyngeal ventilation to maintain adequate ventilation and oxygenation before endotracheal intubation. This ventilation mode may offer another option for ventilation at induction of anesthesia and during the management of respiratory insufficiency, especially in the setting of "unexpected" ventilation difficulty.

Chest tube thoracostomy: A simple life-saving procedure with potential hazardous risks

Int J Surg Case Rep. 2023 Jul:108:108416. doi: 10.1016

Jay Lodhia, Mujaheed Suleman, Samwel Chugulu, Kondo Chilonga, David Msuya

Introduction and importance: Chest tube thoracostomy is a simple life-saving procedure with many benefits but comes with significant potential morbidity. Potentially all intra-thoracic organs are at risk of possible injury as well as peritoneal.

Case presentation: We present four patients who had chest tube thoracostomy with potential complications fortunately were managed promptly and recovered fully.

Clinical discussion: Complications related to tube thoracostomy is reported up to 25 % especially when done under emergency conditions. While the procedure is reported safe, it's associated morbidity is not well described. Additionally, clinicians are urged to follow standard operating procedures and address the potential complications with consent to their patients.

Conclusion: Chest tube thoracostomy is an invasive life-saving procedure performed across various clinical ranks and sub-specialties. It has potential life-threatening risks and complications therefore clinicians should be well trained to identify such complications and address accordingly.

Decision Support System Proposal for Medical Evacuations in Military Operations

Sensors (Basel). 2023 May 28;23(11):5144

Piotr Lubkowski, Jaroslaw Krygier, Tadeusz Sondej, Andrzej P Dobrowolski, Lukasz Apiecionek, Wojciech Znaniecki, Pawel Oskwarek

Abstract

The area of military operations is a big challenge for medical support. A particularly important factor that allows medical services to react quickly in the case of mass casualties is the ability to rapidly evacuation of wounded soldiers from a battlefield. To meet this requirement, an effective medical evacuation system is essential. The paper presented the architecture of the electronically supported decision support system for medical evacuation during military operations. The system can also be used by other services such as police or fire service. The system meets the requirements for tactical combat casualty care procedures and is composed of following elements: measurement subsystem, data transmission subsystem and analysis and inference subsystem. The system, based on the continuous monitoring of selected soldiers' vital signs and biomedical signals, automatically proposes a medical segregation of wounded soldiers (medical triage). The information on the triage was visualized using the Headquarters Management System for medical personnel (first responders, medical officers, medical evacuation groups) and for commanders, if required. All elements of the architecture were described in the paper.

Endotracheal Intubation of Difficult Airways in Emergency Settings: A Guide for Innovators

Med Devices (Auckl). 2023 Jul 18:16:183-199

Samantha Maguire, Phillip R Schmitt, Eliza Sternlicht, Celinda M Kofron

Abstract

Over 400,000 Americans are intubated in emergency settings annually, with indications ranging from respiratory failure to airway obstructions to anaphylaxis. About 12.7% of emergency intubations are unsuccessful on the first attempt. Failure to intubate on the first attempt is associated with a higher likelihood of adverse events, including oxygen desaturation, aspiration, trauma to soft tissue, dysrhythmia, hypotension, and cardiac arrest. Difficult airways, as classified on an established clinical scale, are found in up to 30% of emergency department (ED) patients and are a significant contributor to failure to intubate. Difficult intubations have been associated with longer lengths of stay and significantly greater costs than standard intubations. There exists a wide range of airway management devices, both invasive and noninvasive, which are available in the emergency setting to accommodate difficult airways. Yet, first-pass success rates remain variable and leave room for improvement. In this article, we review the disease states most correlated with intubation, the current landscape of emergency airway management technologies, and the market potential for innovation. The aim of this review is to inspire new technologies to assist difficult airway management, given the substantial opportunity for translation due to two key-value signposts of medical innovation: the potential to decrease cost and the potential to improve clinical outcomes.

Tourniquet Use in the Prehospital Setting

Prehosp Emerg Care. 2023 Aug 17:1-5. Online ahead of print.

Elizabeth M McCarthy, Kevin Burns, Kevin M Schuster, David C Cone

Purpose: Tourniquets are a mainstay of life-saving hemorrhage control. The US military has documented the safety and effectiveness of tourniquet use in combat settings. In civilian settings, events such as the Boston Marathon bombing and mass shootings show that tourniquets are necessary and life-saving entities that must be used correctly and whenever indicated. Much less research has been done on tourniquet use in civilian settings compared to military settings. The purpose of this study is to describe the prehospital use of tourniquets in a regional EMS system served by a single trauma center.

Methods: All documented cases of prehospital tourniquet use from 2015 to 2020 were identified via a search of EMS, emergency department, and inpatient records, and reviewed by the lead investigator. The primary outcomes were duration of tourniquet placement, success of hemorrhage control, and complications; secondary outcomes included time of day (by EMS arrival time), transport interval, extremity involved, who placed/removed the tourniquet, and mechanism of injury.

Results: Of 182 patients with 185 tourniquets applied, duration of application was available for 52, with a median (IQR) of 43 (56) minutes. Hemorrhage control was achieved in all but two cases (96%). Three cases (5.8%) required more than one tourniquet. Complications included five cases of temporary paresthesia, one case of ecchymosis, two cases of fasciotomy, and two cases of compression nerve injury. The serious complication rate was 7.7% (4/52). Time of day was daytime (08:01-16:00) = 15 (31.9%), evening (16:01-00:00) = 27 (57.4%), and night (00:01- 08:00) = 5 (10.6%). The median transport interval was 22 (IQR 5] minutes. The limbs most often injured were the left and right upper extremities (15 each). EMS clinicians and police officers were most often the tourniquet placers. Common mechanisms of injury included gunshot wounds, motorcycle accidents, and glass injuries.

Conclusion: Tourniquets used in the prehospital setting have a high rate of hemorrhage control and a low rate of complications.

Prehospital Active and Passive Warming in Trauma Patients

Air Med J. 2023 Jul-Aug;42(4):252-258

Heather McLellan, Tim W H Rijnhout, L Michael Peterson, David F E Stuhlmiller, Jerry Edwards, Aous Jarrouj, Damayanti Samanta, Alfred Tager, Edward C T H Tan

Objective: Hypothermia is common among trauma patients and can lead to a serious rise in morbidity and mortality. This study was performed to investigate the effect of active and passive warming measures implemented in the prehospital phase on the body temperature of trauma patients.

Methods: In a multicenter, multinational prospective observational design, the effect of active and passive warming measures on the incidence of hypothermia was investigated. Adult trauma patients who were transported by helicopter emergency medical services (HEMS) or ground emergency medical services with an HEMS physician directly from the scene of injury were included. Four HEMS/ground emergency medical services programs from Canada, the United States, and the Netherlands participated.

Results: A total of 80 patients (n = 20 per site) were included. Eleven percent had hypothermia on presentation, and the initial evaluation occurred predominantly within 60 minutes after injury. In-line fluid warmers and blankets were the most frequently used active and passive warming measures, respectively. Independent risk factors for a negative change in body temperature were transportation by ground ambulance (odds ratio = 3.20; 95% confidence interval, 1.06-11.49; P = .03) and being wet on initial presentation (odds ratio = 3.64; 95% confidence interval, 0.99-13.36; P = .05).

Conclusion: For adult patients transported from the scene of injury to a trauma center, active and passive warming measures, most notably the removal of wet clothing, were associated with a favorable outcome, whereas wet patients and ground ambulance transport were associated with an unfavorable outcome with respect to temperature.

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

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

Fan-Chieh Meng, Chiu-Yang Lee

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.

Pre-hospital freeze-dried plasma for critical bleeding after trauma: A pilot randomized controlled trial

Acad Emerg Med. 2023 Oct;30(10):1013-1019

Biswadev Mitra, Ben Meadley, Stephen Bernard, Marc Maegele, Russell L Gruen, Olivia Bradley, Erica M Wood, Zoe K McQuilten, Mark Fitzgerald, Toby St Clair, Andrew Webb, David Anderson, Michael C Reade

Objectives: Transfusion of a high ratio of plasma to packed red blood cells (PRBCs), to treat or prevent acute traumatic coagulopathy, has been associated with survival after major trauma. However, the effect of prehospital plasma on patient outcomes has been inconsistent. The aim of this pilot trial was to assess the feasibility of transfusing freeze-dried plasma with red blood cells (RBCs) using a randomized controlled design in an Australian aeromedical prehospital setting.

Methods: Patients attended by helicopter emergency medical service (HEMS) paramedics with suspected critical bleeding after trauma managed with prehospital RBCs were randomized to receive 2 units of freeze-dried plasma (Lyoplas N-w) or standard care (no plasma). The primary outcome was the proportion of eligible patients enrolled and provided the intervention. Secondary outcomes included preliminary data on effectiveness, including mortality censored at 24 h and at hospital discharge, and adverse events.

Results: During the study period of June 1 to October 31, 2022, there were 25 eligible patients, of whom 20 (80%) were enrolled in the trial and 19 (76%) received the allocated intervention. Median time from randomization to hospital arrival was 92.5 min (IQR 68-101.5 min). Mortality may have been lower in the freeze-dried plasma group at 24 h (RR 0.24, 95% CI 0.03-1.73) and at hospital discharge (RR 0.73, 95% CI 0.24-2.27). No serious adverse events related to the trial interventions were reported.

Conclusions: This first reported experience of freeze-dried plasma use in Australia suggests prehospital administration is feasible. Given longer prehospital times typically associated with HEMS attendance, there is potential clinical benefit from this intervention and rationale for a definitive trial.

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

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

Sarah Morton, Pascale Avery, Justin Kua, Matt O'Meara

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

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

Daniel Muchnok, Francis X Guyette, Joshua B Brown

No abstract available

Safety and efficacy of a kaolin-impregnated hemostatic gauze in cardiac surgery: A randomized trial

JTCVS Open. 2023 May 4:14:134-144

Mubashir Mumtaz, Richard B Thompson, Marc R Moon, Ibrahim Sultan, T Brett Reece, William B Keeling, Jacob DeLaRosa

Objective: A kaolin-based nonresorbable hemostatic gauze, QuikClot Control+, has demonstrated effective hemostasis and safety when used for severe/life-threatening (grade 3/4) internal organ space bleeding. We evaluated the efficacy and safety of this gauze for mild to moderate (grade 1-2) bleeding in cardiac surgery compared with control gauze.

Methods: This was a randomized, controlled, single-blinded study of patients who underwent cardiac surgery between June 2020 and September 2021 across 7 sites with 231 subjects randomized 2:1 to QuikClot Control+ or control. The primary efficacy end point was hemostasis rate (ie, subjects achieving grade 0 bleed) through up to 10 minutes of bleeding site application, assessed using a semiquantitative validated bleeding severity scale tool. The secondary efficacy end point was the proportion of subjects achieving hemostasis at 5 and 10 minutes. Adverse events, assessed up to 30 days postsurgery, were compared between arms.

Results: The predominant procedure was coronary artery bypass grafting, and 69.7% and 29.4% were sternal edge and surgical site (suture line)/other bleeds, respectively. Of the QuikClot Control+ subjects, 121 of 153 (79.1%) achieved hemostasis within 5 minutes, compared with 45 of 78 (58.4%) controls ($P < .001$). At 10 minutes, 137 of 153 patients (89.8%) achieved hemostasis compared with 52 of 78 controls (68.4%) ($P < .001$). At 5 and 10 minutes, hemostasis was achieved in 20.7% and 21.4% more QuikClot Control+ subjects, respectively, compared with controls ($P < .001$). There were no significant differences in safety or adverse events between treatment arms.

Conclusions: QuikClot Control+ demonstrated superior performance in achieving hemostasis for mild to moderate cardiac surgery bleeding compared with control gauze. The proportion of subjects achieving hemostasis was more than 20% higher in QuikClot Control+ subjects at both timepoints compared with controls, with no significant difference in safety outcomes.

Advanced Non-compressible Torso Hemorrhage Management is Combat Casualty Care's Moon Shot

Mil Med. 2023 Jun 3: Online ahead of print

Asad Naveed, David Gomez, Joao Rezende-Neto, Najma Ahmed, Andrew Beckett

Abstract

Non-compressible torso hemorrhage continues to cause considerable preventable mortality on the battlefield. In this editorial, we highlight the burden of deaths, the most at-risk torso structures, current interventions, and their limitations and recommendations for future research and device development.

Retention of emergency cricothyroidotomy skills: A multicenter randomized controlled trial

AEM Educ Train. 2023 Jul 30;7(4):e10900

Martine Siw Nielsen, Felix Nicolai Raben-Levetzau, Steven Arild Wuyts Andersen, Kasper Wennervaldt, Lars Konge, Anders Bo Nielsen

Objectives: Emergency cricothyroidotomy is the final approach to establishing a secure airway. The procedure is acute and highly infrequent, making it difficult to achieve and maintain competence in the clinic. Simulation-based training in emergency cricothyroidotomy is effective but it is unknown how often training should be repeated to maintain skills. This study aimed to assess novices' retention of technical skills in emergency cricothyroidotomy after completing SBT.

Methods: Novices in emergency cricothyroidotomy completed a structured, simulation-based training program and were randomized to retention tests after 1, 3, or 6 months. Participants completed two emergency cricothyroidotomy tests at end-of-training and follow-up retention testing. Test performances were video recorded and evaluated by two experienced blinded raters using a structured assessment tool. Differences in the performances and the pass/fail rates were analyzed.

Results: Eighty-two medical students from two different Danish universities were included from April 2021 to February 2022. Paired t-tests showed skills decay significantly after 1 month (mean loss 6.7 points, $p < 0.001$). The mean loss of points, representing the difference in global score points, from the end-of-training to retention test was 6.7 points (95% confidence interval [CI] 4.5-8.8) for the 1-month group, 8.2 points (95% CI 5.8-10.0) for the 3-months group, and 9.9 points (95% CI 8.1-11.7) for the 6-months group. Six participants in both the 1-month group (23.1%) and the 3-month group (24%) passed the first retention test, but no one in the 6-months group had a passing performance.

Conclusions: Novices' technical skills performance in emergency cricothyroidotomy decay significantly already after 1 month. This initial loss of skill seems to be stable until 3 months, after which there is a further significant loss of skills. Recurring training should be implemented for the benefit of patient safety and outcomes.

Incidence of rescue surgical airways after attempted orotracheal intubation in the emergency department: A National Emergency Airway Registry (NEAR) Study

Am J Emerg Med. 2023 Jun:68:22-27

Joseph Offenbacher, Dhimitri A Nikolla, Jestin N Carlson, Silas W Smith, Nicholas Genes, Dowin H Boatright, Calvin A Brown 3rd

Background: Cricothyrotomy is a critical technique for rescue of the failed airway in the emergency department (ED). Since the adoption of video laryngoscopy, the incidence of rescue surgical airways (those performed after at least one unsuccessful orotracheal or nasotracheal intubation attempt), and the circumstances where they are attempted, has not been characterized.

Objective: We report the incidence and indications for rescue surgical airways using a multicenter observational registry.

Methods: We performed a retrospective analysis of rescue surgical airways in subjects ≥14 years of age. We describe patient, clinician, airway management, and outcome variables.

Results: Of 19,071 subjects in NEAR, 17,720 (92.9%) were ≥14 years old with at least one initial orotracheal or nasotracheal intubation attempt, 49 received a rescue surgical airway attempt, an incidence of 2.8 cases per 1000 (0.28% [95% confidence interval 0.21 to 0.37]). The median number of airway attempts prior to rescue surgical airways was 2 (interquartile range 1, 2). Twenty-five were in trauma victims (51.0% [36.5 to 65.4]), with neck trauma being the most common traumatic indication (n = 7, 14.3% [6.4 to 27.9]).

Conclusion: Rescue surgical airways occurred infrequently in the ED (0.28% [0.21 to 0.37]), with approximately half performed due to a trauma indication. These results may have implications for surgical airway skill acquisition, maintenance, and experience.

Clinical outcomes of traumatic pneumothoraces undergoing conservative management following detection by prehospital physicians

Injury. 2023 Sep;54(9):110886. Epub 2023 Jun 15.

Christopher Partyka, Kimberley Lawrie, Jimmy Bliss 2

Objective: To describe the clinical and transport characteristics of patients diagnosed with a suspected traumatic pneumothorax and managed conservatively by prehospital medical teams including secondary deterioration during transfer and the subsequent rate of in-hospital tube thoracostomy.

Methods: Retrospective observational study of all adult trauma patients diagnosed with a suspected pneumothorax on ultrasound and managed conservatively by their treating prehospital medical team between 2018 and 2020. Descriptive analysis was performed comparing patients who did and did not receive in-hospital tube thoracostomy.

Results: In total, 181 patients were diagnosed with suspected traumatic pneumothoraces on prehospital ultrasound of which 75 (41.4%) were managed conservatively by their treating medical team whilst 106 (58.6%) underwent pleural decompression. There were no recorded cases of emergent pleural decompression required in transit. Of the 75 conservatively managed patients, 42 (56%) had an intercostal catheter (ICC) placed within four hours of hospital arrival and another nine (17.6%) had an ICC placed between four- and 24-hours post-hospital arrival. There was no significant difference in prehospital clinical characteristics between patients who did and did not receive an in-hospital ICC. The detection of a pneumothorax on the initial chest x-ray and larger pneumothorax volume visualised on computed tomography imaging were significantly more common in patients receiving in-hospital ICCs. Aviation factors including flight altitude and duration of flight were not associated with subsequent in-hospital tube thoracostomy.

Conclusion: Prehospital medical teams can safely identify patients who have a traumatic pneumothorax and can be transported to hospital without pleural decompression. Patient characteristics at the time of hospital arrival combined with the size of pneumothorax identified on imaging appear most likely to influence subsequent urgent in-hospital tube thoracostomy placement.

Prehospital Tranexamic Acid for Severe Trauma

N Engl J Med. 2023 Jul 13;389(2):127-136.

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Background: Whether prehospital administration of tranexamic acid increases the likelihood of survival with a favorable functional outcome among patients with major trauma and suspected trauma-induced coagulopathy who are being treated in advanced trauma systems is uncertain.

Methods: We randomly assigned adults with major trauma who were at risk for trauma-induced coagulopathy to receive tranexamic acid (administered intravenously as a bolus dose of 1 g before hospital admission, followed by a 1-g infusion over a period of 8 hours after arrival at the hospital) or matched placebo. The primary outcome was survival with a favorable functional outcome at 6 months after injury, as assessed with the use of the Glasgow Outcome Scale-Extended (GOS-E). Levels on the GOS-E range from 1 (death) to 8 ("upper good recovery" [no injury-related problems]). We defined survival with a favorable functional outcome as a GOS-E level of 5 ("lower moderate disability") or higher. Secondary outcomes included death from any cause within 28 days and within 6 months after injury.

Results: A total of 1310 patients were recruited by 15 emergency medical services in Australia, New Zealand, and Germany. Of these patients, 661 were assigned to receive tranexamic acid, and 646 were assigned to receive placebo; the trial-group assignment was unknown for 3 patients. Survival with a favorable functional outcome at 6 months occurred in 307 of 572 patients (53.7%) in the tranexamic acid group and in 299 of 559 (53.5%) in the placebo group (risk ratio, 1.00; 95% confidence interval [CI], 0.90 to 1.12; P = 0.95). At 28 days after injury, 113 of 653 patients (17.3%) in the tranexamic acid group and 139 of 637 (21.8%) in the placebo group had died (risk ratio, 0.79; 95% CI, 0.63 to 0.99). By 6 months, 123 of 648 patients (19.0%) in the tranexamic acid group and 144 of 629 (22.9%) in the placebo group had died (risk ratio, 0.83; 95% CI, 0.67 to 1.03). The number of serious adverse events, including vascular occlusive events, did not differ meaningfully between the groups.

Conclusions: Among adults with major trauma and suspected trauma-induced coagulopathy who were being treated in advanced trauma systems, prehospital administration of tranexamic acid followed by an infusion over 8 hours did not result in a greater number of patients surviving with a favorable functional outcome at 6 months than placebo. (Funded by the Australian National Health and Medical Research Council and others; PATCH-Trauma ClinicalTrials.gov number, NCT02187120.).

Casualty care implications of large-scale combat operations

J Trauma Acute Care Surg. 2023 Aug 1;95(2S Suppl 1):S180-S184

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Abstract

Analysis and review of combat casualty care challenges in future large-scale and medical multi-domain operations from the perspective of past, present, and potential future conflicts.

Phosphorus Burn Management with Multimodal Analgesia

J Spec Oper Med. 2023 Oct 5;23(3):82-84

Luc Saint-Jean, Simon-Pierre Corcostegui, Julien Galant, Clement Derkenne

We report the case of a patient suffering from a chemical burn caused by white phosphorus, for whom initial management required decontamination using multimodal analgesia. This case report should be familiar to other military emergency physicians and Tactical Emergency Medical Support for two reasons: 1) A phosphorus burn occurs from a chemical agent rarely encountered, with minimal research available in the medical literature, despite the use of this weapon in the recent Ukrainian conflict, and 2) We discuss the use of multimodal analgesia, combining loco-regional anesthesia (LRA) and an intranasal pathway, which can be used in a remote and austere environment.

Association of Ketamine Dosing with Intubation and Other Adverse Events in Patients with Behavioral Emergencies

Prehosp Emerg Care. 2023 Jul 17:1-6. Online ahead of print.

Paulina B Sergot, Loren B Mead, Elizabeth B Jones, Remle P Crowe, Ryan M Huebinger

Objective: Varying rates of complications have been reported for prehospital sedation with ketamine, and the relationship to dosing has not been studied on a large scale. We evaluated the association between prehospital ketamine dosing and rates of intubations and other adverse events in patients with behavioral emergencies.

Methods: Using the 2018/2019 ESO public-use research datasets, we included all non-traumatic, adult behavioral and drug-related EMS encounters with ketamine administration. Based on consensus guidelines, we stratified patients into "above" and "at/below" the maximum dosing for sedation (2 mg/kg IV/IO or 5 mg/kg IM) using the highest single dose of ketamine given. We created propensity scores for matched subjects using 1:1 propensity score matching. Using logistic regression, we compared rates of intubation and other airway interventions, antipsychotic coadministration, improvement reported by EMS, hypoxia, hypotension, and cardiac arrest between the two groups.

Results: We included 2383 patients: 478 in the above and 1905 in the at/below dose group. Above-dose ketamine was associated with a higher rate of intubation or supraglottic airway placement (6.4% v 3.3%, OR 2.0, 95% CI 1.00-3.90). Other airway interventions were similar (40.0% v 40.0%, OR 1, 95% CI 0.80-1.30). The above-dose group also showed a higher rate of improvement noted by EMS clinicians (92.5% v 88.7%, OR 1.6, 95% CI 1.01-2.40). The rates of antipsychotic coadministration, hypoxia, hypotension, and cardiac arrest were similar between the cohorts.

Conclusions: Patients given ketamine doses above consensus recommendations for sedation appeared more likely to receive prehospital intubation but not more likely to experience other adverse events.

Intranasal Fentanyl for Acute Pain Management in Children, Adults and Elderly Patients in the Prehospital Emergency Service and in the Emergency Department: A Systematic Review

J Clin Med. 2023 Mar 30;12(7):2609. doi: 10.3390/jcm12072609.

Sossio Serra, Michele Domenico Spampinato, Alessandro Riccardi, Mario Guarino, Rita Pavasini, Andrea Fabbri, Fabio De Iaco

Abstract

This systematic review examined the efficacy and safety of intranasal fentanyl (INF) for acute pain treatment in children, adults, and the elderly in prehospital emergency services (PHES) and emergency departments (ED). ClinicalTrials.gov, LILACS, PubMed, SCOPUS, EMBASE, Google Scholar and Cochrane databases were consulted until 31 December 2022. A total of 23 studies were included: 18 in children (1 PHES, 17 ED), 5 in adults (1 PHES, 4 ED) and 1 in older people (1 PHES subgroup analysis). In children, INF was effective in both settings and as effective as the comparator drugs, with no differences in adverse events (AEs); one randomised controlled trial (RCT) showed that INF was more effective than the comparator drugs. In adults, one study demonstrated the efficacy of INF in the PHES setting, one study demonstrated the efficacy of INF in the ED setting, two RCTs showed INF to be less effective than the comparator drugs and one RCT showed INF to be as effective as the comparator, with no difference in AEs reported. In older people, one study showed effective pain relief and no AEs. In summary, INF appears to be effective and safe in children and adults in PHES and ED. More high-quality studies are needed, especially in PHES and older people.

Association between Blood Pressure Recording in Prehospital Setting and Patient Outcome in Pediatric Trauma Patients: A Propensity Score Matching Study

J Trauma Acute Care Surg. 2023 Jul 21. Online ahead of print.

Mafumi Shinohara, Takeru Abe, Ichiro Takeuchi

Abstract

Background: Rapid identification of the severity of injuries in the field is important to ensure appropriate hospital care for better outcomes. Vital signs are used as a field triage tool for critically ill or injured patients in prehospital settings. Several studies have shown that recording vital signs, especially blood pressure, in pediatric patients is sometimes omitted in prehospital settings compared with that in adults. However, little is known about the association between the lack of measurement of prehospital vital signs and patient outcomes. In this study, we examined the association between the rate of vital sign measurements in the field and patient outcomes in injured children.

Methods: This study analyzed secondary data from the Japan Trauma Data Bank. We included pediatric patients (0-17 years) with injuries who were transported by emergency medical services. Hospital survival was the primary outcome. We performed a propensity-matched analysis with nearest-neighbor matching without replacement by adjusting for demographic and clinical variables to evaluate the effect of recording vital signs.

Results: During the study period, 13,413 pediatric patients were included. There were 9,187 and 1,798 patients with and without prehospital blood pressure records, respectively. After matching, there were no differences in the patient characteristics or disease severity. Hospital mortality was significantly higher in the non-recorded group than in the recorded group (4.3% vs. 1.1%; $P < .001$). The multiple logistic regression analysis results showed no prehospital record of blood pressure being associated with death (odds ratio [OR], 6.82; 95% confidence interval [CI], 2.40-19.33). Glasgow Coma Scale score and Injury Severity Score were also associated with death (OR, 0.71; 95% CI, 0.63- 0.81 and OR, 1.10; 95% CI, 1.06-11.14, respectively).

Conclusions: Pediatric patients without any blood pressure records in prehospital settings had higher mortality rates than those with prehospital blood pressure records.

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

Prehosp Emerg Care. 2023 Feb 13:1-7 Online ahead of print.

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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.

Anatomical morphometry for Cricothyrotomy puncture and incision

BMC Surg. 2023 Jul 12;23(1):198.

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Purpose: Emergency surgical airway securing techniques include cricothyrotomy, puncture, and incision. While the instruments used for these methods vary in size, no index of laryngeal morphology exists to guide instrument selection. Therefore, we measured the morphology of the cricothyroid ligament in Japanese individuals and assessed its correlations with height.

Methods: This retrospective study used 61 anatomical practice specimens. The cricothyroid ligament of the laryngeal area was dissected, and a frontal image was recorded. Next, images of the midsagittal sections of the larynx and trachea were recorded. The width and height of the cricothyroid ligament were measured from the frontal images, and the depth of the larynx and the angle to the lower edge of the cricothyroid plate were measured from the mid-sagittal cross-sectional images. The height was estimated from the tibial lengths of the specimens and statistically analyzed for correlations. RESULTS: The width and depth were significantly greater in males. Overall, there was a slight correlation between the results of each laryngeal measurement and estimated height for all items.

Conclusion: The morphology of cricothyrotomy revealed that the width and depth of the laryngeal area varied according to sex. Moreover, the results also showed a correlation with the estimated height. Thus, it is important to predict the morphology of the laryngeal area and cricothyroid ligament by considering factors such as patient sex, weight, and height.

Safety and Performance of Hemostatic Powders

Med Devices (Auckl). 2023 Jun 8:16:133-144

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Background: Hemorrhage, a sudden and severe leakage of blood due to the disruption of blood vessels, is one of the most common causes of death from injuries worldwide. Severe bleeding accounts for more than 35% of pre-hospital deaths and about 40% of deaths recorded within 24 hours of injury. One of the methods for achieving homeostasis is the use of hemostatic powders. This study compares the basic safety and performance of the most popular hemostatic powders.

Methods: Basic safety of commercially available products were evaluated using MTT, MEM elution assay, and endotoxin testing. The in vitro performance was evaluated using water absorption capacity, water absorption rate, and adhesion strength assays.

Results: 4Seal, Starsil, and 4DryField extracts did not cause cytotoxicity in MTT and MEM elution assays. PerClot and SuperClot extracts demonstrated cytotoxic potential in MTT assay, while Arista extract was cytotoxic in both MEM elution and MTT assays. 4Seal has the lowest endotoxin contamination, followed by PerClot, 4DryField, SuperClot, Arista, and Starsil. 4Seal and Starsil showed significantly highest WAR among the tested samples, followed by 4DryField, Arista, PerClot, and SuperClot. Adhesion force is highest for 4Seal, followed by Starsil, PerClot, 4DryField Arista, and SuperClot.

Conclusion: 4Seal is the most versatile in terms of safety and functional properties compared to 4DryField, Arista, PerClot, Starsil, and SuperClot.

Tick-tock: Prehospital intubation is associated with longer field time without any survival benefit

Surgery. 2023 Oct;174(4):1034-1040

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Background: Prehospital endotracheal intubation is a debated topic, and few studies have found it beneficial after trauma. A growing body of evidence suggests that prehospital endotracheal intubation is associated with increased morbidity and mortality. Our study was designed to compare patients with attempted prehospital endotracheal intubation to those intubated promptly upon emergency department arrival.

Methods: A retrospective review of a single-center trauma research data repository was utilized. Inclusion criteria included age ≥15 years, transport from the scene by ground ambulance, and undergoing prehospital endotracheal intubation attempts or intubation within 10 minutes of emergency department arrival without prior prehospital endotracheal intubation attempt. Propensity score matching was used to minimize differences in baseline characteristics between groups. Standard mean differences are also presented for pre- and post-matching datasets to evaluate for covariate balance.

Results: In total, 208 patients met the inclusion criteria. Of these, 95 patients (46%) underwent prehospital endotracheal intubation, which was successful in 47% of cases. A control group of 113 patients (54%) were intubated within 10 minutes of emergency department arrival. We performed propensity score matching between cohorts based on observed differences after univariate analysis and used standard mean differences to estimate covariate balance. After propensity score matching, patients who underwent prehospital endotracheal intubation experienced a longer time on scene as compared with those intubated in the emergency department (9 minutes [interquartile range 6-12] vs 6 minutes [interquartile range 5-9], P < .01) without difference in overall mortality (67% vs 65%, P = 1.00). Rapid sequence intubation was not used in the field; however, it was used for 58% of patients intubated within 10 minutes of emergency department arrival. After matched analysis, patients with a failed prehospital intubation attempt were equally likely to receive rapid sequence intubation during re-intubation in the emergency department as compared with those undergoing a first attempt (n = 13/28, 46% vs n = 28/63, 44%, P = 1.00, standard mean differences 0.04). Among patients with prehospital arrest (n = 98), prehospital endotracheal intubation was associated with shorter time to death (8 minutes [interquartile range 3-17] vs 14 minutes [interquartile range 8-45], P = .008) and longer total transport time (23 minutes [interquartile range 19-31] vs 19 minutes [interquartile range 16-24], P = .006), but there was no difference in observed mortality (n = 29/31, 94% vs n = 30/31, 97%, P = 1.00, standard mean differences = 0.15) after propensity score matching.

Conclusion: Prehospital providers should prioritize expeditious transport over attempting prehospital endotracheal intubation, as prehospital endotracheal intubation is inconsistently successful, may delay definitive care, and appears to have no survival benefit.

Frostbite: a systematic review on freezing cold injuries in a military environment

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Background: Military practice or deployment in extreme conditions includes risks, dangers and rare disorders. One of the challenges is frostbite; however, current literature does not provide an overview of this condition in a military context. This review aims to map the incidence, risk factors and outcome of frostbite in military casualties in the armed forces.

Methods: A systematic literature search on frostbite (freezing cold injuries) in military settings from 1995 to the present was performed. A critical appraisal of the included articles was conducted. Data on incidence, risk factors, treatment and outcome were extracted.

Results: Fourteen studies were included in our systematic review. Most studies of frostbite in a military setting were published nearly half a century ago. Frostbite incidence has declined from 7% to around 1% in armed forces in arctic regions but could be as high as 20% in small-scale arctic manoeuvres. Overall and military-specific risk factors for contracting frostbite were identified.

Conclusion: During inevitable arctic manoeuvres, frostbite is a frequently diagnosed injury in service members. Postfreezing symptoms often persist after severe frostbite injury, which decreases employability within the service. Over time, military practice has changed considerably, and modern protective materials have been introduced; therefore, re-evaluation and future study in the military field are appropriate, preferably with other North Atlantic Treaty Organization partners.

Keywords: altitude medicine; musculoskeletal disorders; primary care; trauma management; wound management.

Characteristics of Medical Evacuation by Train in Ukraine, 2022

JAMA Netw Open. 2023 Jun 1;6(6):e2319726.

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Affiliations expand

Importance: The 2022 war in Ukraine severely affected access to health care for patients in the conflict-affected regions and limited options for medical evacuation. Air transport, a common method of medical evacuation in war zones, was unsafe due to the conflict of 2 modernized military forces that were in possession of aircraft and surface-to-air weapons; therefore, Médecins Sans Frontières, in collaboration with the Ukrainian railway company and Ukrainian health agencies, addressed this by initiating medical evacuation via medically customized trains.

Objective: To describe the implementation of medical evacuation trains aimed at improving the access to health care for war-affected patients.

Design, setting, and participants: This case series describes the remodeling of 2 trains used for medical evacuation in a conflict zone during the war in Ukraine. The study was conducted from March 30 to November 30, 2022. One train had minimal adjustments and could be rapidly deployed to address the most pressing humanitarian needs, while the other underwent major structural modifications to provide intensive care capacity. The report details the medical capabilities of the trains, the organization of referrals, and operational challenges encountered. Additionally, it includes a case series on the characteristics of patients transported in the initial 8 months, based on routinely collected programmatic descriptive data of all patients transported by the medical trains.

Results: In 8 months, 2481 patients (male-female ratio, 1.07; male, 1136 [46%]; female 1058 [43%]; missing data, 287 [12%]; median age, 63 years [range, 0-98 years]) were evacuated from 11 cities near the Ukrainian conflict frontline to safer areas. Initially, the trains predominantly evacuated trauma patients, but over the course of the war, the patient characteristics changed with more medical and nonacute conditions, and fewer trauma patients. The main reason for entry into the intensive care unit train carriage was for close monitoring and observation, and the main interventions performed were primarily for respiratory failure.

Conclusions and relevance: The findings of this study suggest that medical evacuation in a war zone by converted trains is possible and can improve access to health care for war-affected patients. The presence of intensive care capacity on board allows for transport of more severely ill or injured individuals. However, the target population should not be limited to trauma patients, as health care institutions affected host a much broader population whose needs and urgency for evacuation may change over time.

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

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

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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.

Abdominal aortic junctional tourniquet (AAJT-S): a systematic review of utility in military practice

BMJ Mil Health. 2023 Jul 2:Online ahead of print.

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Introduction: Haemorrhage is the leading cause of potentially survivable death on the battlefield. Despite overall improvement in battlefield mortality, there has been no improvement in survival following non-compressible torso haemorrhage (NCTH). The abdominal aortic junctional tourniquet-stabilised (AAJT-S) is a potential solution that may address this gap in improving combat mortality. This systematic review examines the evidence base for the safety and utility of the AAJT-S for prehospital haemorrhage control in the combat setting.

Methods: A systematic search of MEDLINE, Cumulated Index to Nursing and Allied Health Literature and Embase (inception to February 2022) was performed using exhaustive terms, in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guideline. The search was limited to English-language publications in peer-reviewed journals; grey literature was not included. Human, animal and experimental studies were included. Papers were reviewed by all authors to determine inclusion. Each study was assessed for level of evidence and bias.

Results: 14 studies met the inclusion criteria: 7 controlled swine studies (total n=166), 5 healthy human volunteer cases series (total n=251), 1 human case report and 1 mannikin study. The AAJT-S was demonstrated to be effective at cessation of blood flow when tolerated in healthy human and animal studies. It was easy to apply by minimally trained individuals. Complications were observed in animal studies, most frequently ischaemia-reperfusion injury, which was dependent on application duration. There were no randomised controlled trials, and the overall evidence base supporting the AAJT-S was low.

Conclusions: There are limited data of safety and effectiveness of the AAJT-S. However, there is a requirement for a far-forward solution to improve NCTH outcomes, the AAJT-S is an attractive option and high-quality evidence is unlikely to be reported in the near future. Therefore, if this is implemented into clinical practice without a solid evidence base it will need a robust governance and surveillance process, similar to resuscitative endovascular balloon occlusion of the aorta, with regular audit of use.

Cadaveric emergency cricothyrotomy training for non-surgeons using a bronchoscopy-enhanced curriculum

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Background: Emergency cricothyrotomy training for non-surgeons is important as rare "cannot intubate or oxygenate events" may occur multiple times in a provider's career when surgical expertise is not immediately available. However, such training is highly variable and often infrequent, therefore, enhancing these experiences is important.

Research question: Is bronchoscopy-enhanced cricothyrotomy training in cadavers feasible, and what are the potential benefits provided by this innovation for trainees?

Methods: This study was performed during implementation of a new program to train non-surgeon providers on cadaveric donors on our campus. Standard training with an instructional video and live coaching was enhanced by bronchoscopic visualization of the trachea allowing participants to review their technique after performing scalpel and Seldinger-technique procedures, and to review their colleagues' technique on live video. Feasibility was measured through assessing helpfulness for trainees, cost, setup time, quality of images, and operator needs. Footage from the bronchoscopy recordings was analyzed to assess puncture-to-tube time, safety errors, and evidence for a training effect within groups. Participants submitted pre- and post-session surveys assessing their levels of experience and gauging their confidence and anxiety with cricothyrotomies.

Results: The training program met feasibility criteria for low costs (<200 USD/donor), setup time (<30 minutes/donor), and operator needs (1/donor). Furthermore, all participants rated the cadaveric session as helpful. Participants demonstrated efficient technique, with a median puncture-to-tube time of 48.5 seconds. Bronchoscopy recordings from 24 analyzed videos revealed eight instances of sharp instruments puncturing the posterior tracheal wall (33% rate), and two instances of improper tube placement (8% rate). Sharp instruments reached potentially dangerous insertion depths beyond the midpoint of the anterior-posterior diameter of the trachea in 58.3% of videos. Bronchoscopic enhancement was rated as quite or extremely helpful for visualizing the trachea (83.3%) and to assess depth of instrumentation (91.7%). There was a significant average increase in confidence (64.4%, $P<0.001$) and average decrease in performance anxiety (-11.6%, $P = 0.0328$) after the session. A training effect was seem wherein the last trainee in each group had no posterior tracheal wall injuries.

Interpretation: Supplementing cadaveric emergent cricothyrotomy training programs with tracheal bronchoscopy is feasible, helpful to trainees, and meets prior documented times for efficient technique. Furthermore, it was successful in detecting technical errors that would have been missed in a standard training program. Bronchoscopic enhancement is a valuable addition to cricothyrotomy cadaveric training programs and may help avoid real-life complications.

Effect of SAM junctional tourniquet on respiration when applied in the axilla: A swine model

Chin J Traumatol. 2023 May;26(3):131-138.

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Purpose: SAM junctional tourniquet (SJT) has been applied to control junctional hemorrhage. However, there is limited information about its safety and efficacy when applied in the axilla. This study aims to investigate the effect of SJT on respiration when used in the axilla in a swine model.

Methods: Eighteen male Yorkshire swines, aged 6-month-old and weighing 55 - 72 kg, were randomized into 3 groups, with 6 in each. An axillary hemorrhage model was established by cutting a 2 mm transverse incision in the axillary artery. Hemorrhagic shock was induced by exsanguinating through the left carotid artery to achieve a controlled volume reduction of 30% of total blood volume. Vascular blocking bands were used to temporarily control axillary hemorrhage before SJT was applied. In Group I, the swine spontaneously breathed, while SJT was applied for 2 h with a pressure of 210 mmHg. In Group II, the swine were mechanically ventilated, and SJT was applied for the same duration and pressure as Group I. In Group III, the swine spontaneously breathed, but the axillary hemorrhage was controlled using vascular blocking bands without SJT compression. The amount of free blood loss was calculated in the axillary wound during the 2 h of hemostasis by SJT application or vascular blocking bands. After then, a temporary vascular shunt was performed in the 3 groups to achieve resuscitation. Pathophysiologic state of each swine was monitored for 1 h with an infusion of 400 mL of autologous whole blood and 500 mL of lactated ringer solution. Tb and T0 represent the time points before and immediate after the 30% volume-controlled hemorrhagic shock, respectively. T30, T60, T90 and T120, denote 30, 60, 90, and 120 min after T0 (hemostasis period), while T150, and T180 denote 150 and 180 min after T0 (resuscitation period). The mean arterial pressure and heart rate were monitored through the right carotid artery catheter. Blood samples were collected at each time point for the analysis of blood gas, complete cell count, serum chemistry, standard coagulation tests, etc., and thromboelastography was conducted subsequently. Movement of the left hemidiaphragm was measured by ultrasonography at Tb and T0 to assess respiration. Data were presented as mean ± standard deviation and analyzed using repeated measures of two-way analysis of variance with pairwise comparisons adjusted using the Bonferroni method. All statistical analyses were processed using GraphPad Prism software.

Results: Compared to Tb, a statistically significant increase in the left hemidiaphragm movement at T0 was observed in Groups I and II (both $p < 0.001$). In Group III, the left hemidiaphragm movement remained unchanged ($p = 0.660$). Compared to Group I, mechanical ventilation in Group II significantly alleviated the effect of SJT application on the left hemidiaphragm movement ($p < 0.001$). Blood pressure and heart rate rapidly increased at T0 in all three groups. Respiratory arrest suddenly occurred in Group I after T120, which required immediate manual respiratory assistance. PaO_2 in Group I decreased significantly at T120, accompanied by an increase in $PaCO_2$ (both $p < 0.001$ vs. Groups II and III). Other biochemical metabolic changes were similar among groups. However, in all 3 groups, lactate and potassium increased immediately after 1 min of resuscitation concurrent with a drop in pH. The swine in Group I exhibited the most severe hyperkalemia and metabolic acidosis. The coagulation function test did not show statistically significant differences among three groups at any time point. However, D-dimer levels showed a more than 16-fold increase from T120 to T180 in all groups.

Conclusion: In the swine model, SJT is effective in controlling axillary hemorrhage during both spontaneous breathing and mechanical ventilation. Mechanical ventilation is found to alleviate the restrictive effect of SJT on thoracic movement without affecting hemostatic efficiency. Therefore, mechanical ventilation could be necessary before SJT removal.