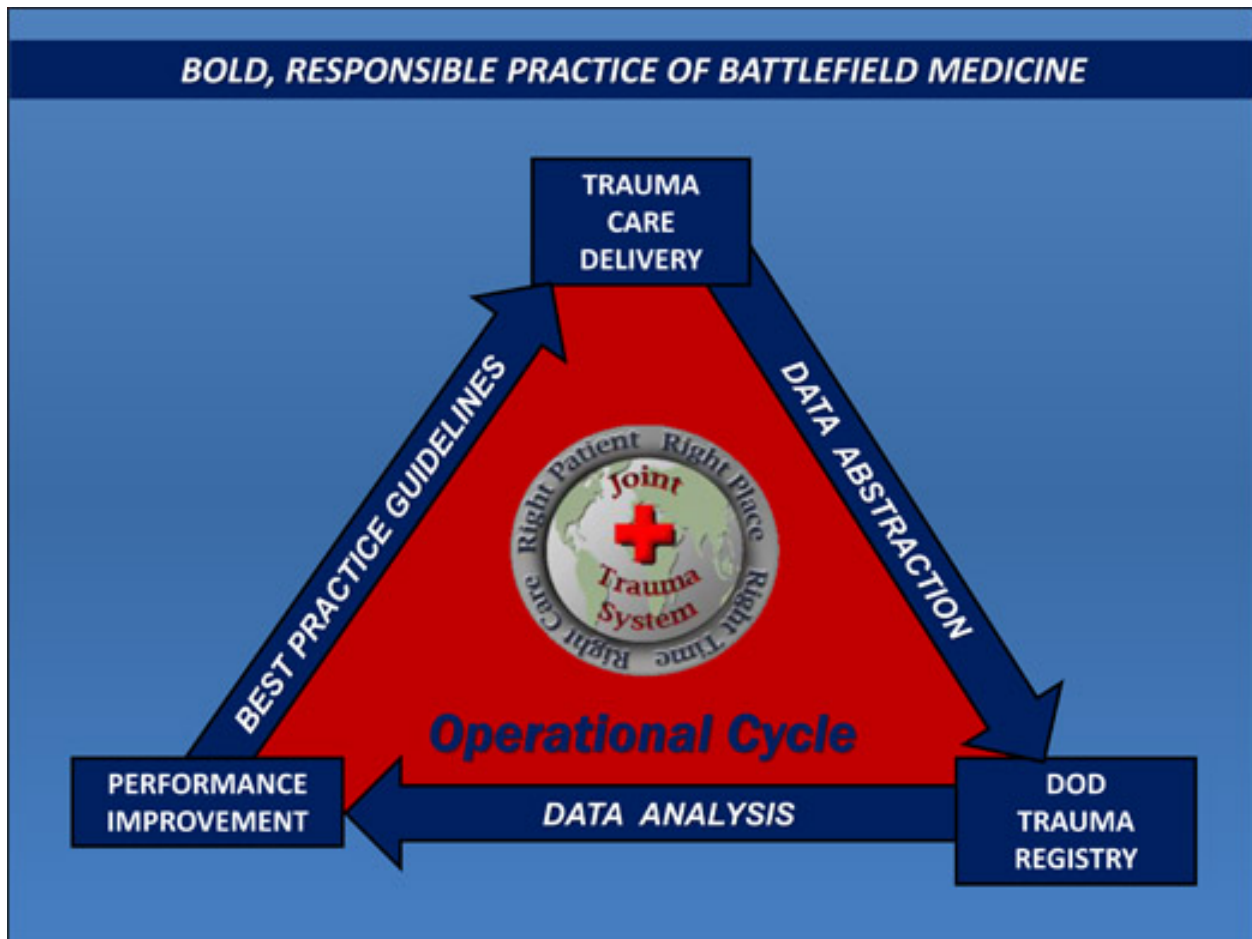


Committee on Surgical Combat Casualty Care
(CoSCCC)



Journal Watch

1st Quarter

2018

Journal Watch Key Terminology Searched:

Microcirculation	Trauma Management	Haemorrhage
Shock	Sublingual	Ethics committees
Human subject research	IDF	Institutional review board
Haemorrhagic shock	Multiple trauma	Shock index
Traumatic brain injury	Coagulopathy	Diagnostic accuracy
Plasma	Pre-hospital	Thrombelastography (TEG)
Transfusion	Trauma	Imaging
RBCs	Resuscitation	Severe trauma
Stability	Ultrasound	Afghanistan
Blast	Facial trauma	War
Amputation	Multiple	Transfusion
Traumatic Clinical outcomes	Clinical parameters	Damage control
Injury	Pelvic fracture	Trauma
Coagulopathy	Cryoprecipitate	Fibrinogen
Fibrinogen concentrate	Massive transfusion	ABO
Viscoelastic haemostatic assays	Angiography	External fixation
Guidelines	Internal fixation	Pelvic ring
fractures	X-ray	Pre-peritoneal pelvic packing
REBOA	Antibiotic prophylaxis	Long bone fractures
Orthopaedic trauma	Perioperative antibiotics	Surgical site infection
Wound ballistics	Faecal diversion	Primary repair
Cause of injury	Head injuries	

[Shock](#). 2017 Dec 26. doi: 10.1097/SHK.0000000000001091. [Epub ahead of print]

Ontemporary Utilization of Resuscitative Thoracotomy: Results from the AAST Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery (AORTA) Multicenter Registry.

[DuBose J¹](#), [Fabian T](#), [Bee T](#), [Moore LJ](#), [Holcomb JB](#), [Brenner M](#), [Skarupa D](#), [Inaba K](#), [Rasmussen TE](#), [Turay D](#), [Scalea TM](#); and the AAST AORTA Study Group.

Author information

1 Travis AFB Medical Center; University of Tennessee - Memphis; University of Texas - Houston; University of Maryland; University of Florida, Jacksonville; University of Southern California; Uniformed Services University of the Health Sciences; Loma Linda University.

Abstract

INTRODUCTION:

Several reviews of Resuscitative thoracotomy (RT) use over the last 5 decades have been conducted, most recently the evidence-based practice management guideline (PMG) of the Eastern Association for the Surgery of Trauma (EAST). The present study was designed to examine contemporary RT utilization and outcomes compared to historical data (n = 10,238) from the EAST PMG review from published series 1974 - 2013.

METHODS: The AAST AORTA registry was utilized to identify patients undergoing RT in the ED from Nov 2013 to Dec 2016. Demographics, injury data, physiologic presentation and outcomes were reviewed and compared to those of the EAST PMG review.

RESULTS: Three-hundred and ten RT patients from 16 contributing AORTA centers were identified. The majority were injured by penetrating mechanisms (197/310, 64% [gunshot (163/197, 83%)]). Signs of life (SOL) (organized electrical activity, pupillary response, spontaneous movement or appreciable pulse/blood pressure) were present on arrival in 47% (147/310). When compared to the EAST PMG results, there was no difference in either hospital survival (5% vs. 8%) or neurologically intact survival between historical controls or AORTA registry patients in any category combination of mechanism / anatomic location / presenting signs of life. Blunt injuries W/O SOL on admission continue to constitute 14% (45/310) of RTs in the Emergency Department, without documented survivors.

CONCLUSION: Comparison of historical RT controls to more contemporary patients from the AORTA registry suggests that practices and outcomes following RT have not changed. Despite a wealth of accumulated data over several decades, RT continues to be performed for patients after blunt mechanisms of injury who present W/O SOL despite lack of demonstrated hope for survival benefit.

PMID: 29280925 DOI:[10.1097/SHK.0000000000001091](https://doi.org/10.1097/SHK.0000000000001091)

A retrospective analysis of the respiratory adjusted shock index (RASI) to determine the presence of occult shock in trauma patients.

[Caputo N¹](#), [Reilly J¹](#), [Kanter M¹](#), [West J¹](#).

Author information

1 Weill Medical College of Cornell University, Department of Emergency Medicine, Lincoln Medical Center, Bronx, NY.

Abstract

BACKGROUND: The shock index (SI), calculated as HR/SBP, is a simple hemodynamic marker that may be used to assess for the presence of occult shock in trauma patients. The normal range for a healthy adult patient is 0.5 to 0.7. Recently, studies have demonstrated that tachypnea is the most important predictor of cardiac arrest in hospital wards and is an important indicator of derangements across multiple organ systems. As such, we have sought to determine whether the inclusion of the patient's respiratory rate to the already existing shock index (called the Respiratory Adjusted Shock Index- RASI), calculated as $HR/SBP \times (RR/10)$, will improve the overall diagnostic accuracy of detecting patients in early occult shock.

METHODS: A retrospective chart review over a 4-year period (2012-2016) at an urban, level-1 trauma center was performed. All patients admitted to hospital for trauma were included in the study. Exclusion criteria were patients in traumatic arrest or in overt shock. Charts were reviewed for triage vital signs and point of care lactate drawn within thirty minutes of presentation. A lactate > 2 mmol/L was used to determine presence of hypoperfusion. The upper limit of normal for the RASI was calculated multiplying the upper limit of the SI by 1.9 (respiratory rate of 19 divided by 10) and validated internally.

RESULTS: A total of 3093 patients were included in this study. There was no difference in SI for patients discharged vs. patients admitted, 0.6 (95% CI 0.5 to 0.7) vs. 0.7 (95% CI 0.5 to 0.8) and a significant difference between the same groups of patients (discharged vs. admitted) for the RASI, 1.1 (95%CI 1.04 to 1.18) vs. 1.46 (95% CI 1.35 to 1.55), respectively. Area under the curve for SI was 0.58 and for the RASI score was 0.94.

CONCLUSION: The RASI score improves diagnostic accuracy for detecting early occult shock in trauma patients when compared to the SI.

LEVEL OF EVIDENCE: 2 STUDY TYPE: Diagnostic.

PMID:29251715 DOI: [10.1097/TA.0000000000001761](https://doi.org/10.1097/TA.0000000000001761)

[Br J Haematol](#). 2017 Dec;179(5):802-810. doi: 10.1111/bjh.14999. Epub 2017 Nov 22.

Platelets derived from fresh and cold-stored whole blood participate in clot formation in rats with acute traumatic coagulopathy.

[Wu X](#)¹, [Darlington DN](#)¹, [Montgomery RK](#)¹, [Liu B](#)¹, [Keese JD](#)¹, [Scherer MR](#)¹, [Benov A](#)², [Chen J](#)², [Cap AP](#)¹.

Author information

1 Coagulation and Blood Research Program, United States Army Institute of Surgical Research, Fort Sam Houston, TX, USA.

2 Israel Defence Forces, Tel Aviv, Israel.

Abstract

The in vitro haemostatic functions of fresh whole blood (FWB) are well preserved after cold storage. This study aimed to determine whether platelets derived from FWB and stored whole blood (SWB) contribute to clot formation in tissue injury after transfusion into coagulopathic rats with polytrauma/haemorrhage (T/H). The rats were resuscitated 1 h after trauma with FWB or SWB collected from green fluorescence protein (GFP) transgenic rats. After transfusion, a liver incision was made and the tissue was collected 10 min after injury to identify GFP⁺ platelets by immunohistochemistry. In comparison to FWB, platelet aggregation to adenosine diphosphate and protease-activated receptor-4 was reduced by 35% and 20%, and clotting time was shortened by 25% in SWB. After transfusion, SWB led to a significant increase in platelet activation as measured by an elevation of CD62P and phosphatidylserine expression. The platelets from SWB were in a higher activation state, and showed higher clearance rate and formation of platelet-leucocyte aggregates than those from FWB after transfusion. Platelets from both FWB and SWB were equivalently incorporated into the clot at the incisional site, as determined by co-localization of CD61 and GFP. This study suggests that SWB contributes to haemostatic function and is an effective alternative resource to treat trauma patients.

PMID:29168170 DOI:[10.1111/bjh.14999](https://doi.org/10.1111/bjh.14999)

Association of *Enterococcus* spp. with Severe Combat Extremity Injury, Intensive Care, and Polymicrobial Wound Infection.

[Heitkamp RA](#)¹, [Li P](#)^{2,3}, [Mende K](#)^{2,3,4}, [Demons ST](#)¹, [Tribble DR](#)², [Tyner SD](#)¹.

Author information

1 Bacterial Diseases Branch, Walter Reed Army Institute of Research , Silver Spring, Maryland.

2 Infectious Disease Clinical Research Program, Department of Preventive Medicine and Biostatistics, Uniformed Services University of the Health Sciences , Bethesda, Maryland.

3 Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc. , Bethesda, Maryland.

4 San Antonio Military Medical Center , Joint Base San Antonio, Fort Sam Houston, Texas.

Abstract

BACKGROUND: Combat-related extremity wound infections can complicate the recovery of injured military personnel. The *Enterococcus* genus contains both commensal and pathogenic bacteria found in many combat wounds. We describe the patient population susceptible to *Enterococcus* infection, the characteristics of *Enterococcus* spp. isolated from combat-related wounds, and the microbiological profile of *Enterococcus*-positive wounds.

METHODS: Patient and culture data were obtained from the Trauma Infectious Disease Outcomes Study. Subjects were divided into a case group with enterococcal extremity wound infections and a comparator group with wound infections caused by other micro-organisms.

RESULTS: Case and comparator subjects had similar patterns of injury and infection. Case subjects had higher Injury Severity Scores (33 vs. 30; $p < 0.001$), longer hospitalization at U.S. facilities (55 vs. 40 days; $p = 0.004$), and required more large-volume blood transfusions (>20 units) within 24 h post-injury (53% vs. 30%; $p < 0.001$). Approximately 60% of case subjects had three or more infections, and 91% had one or more polymicrobial infections, compared with 43% and 50%, respectively, in the comparator group. The thigh was the most common site of *Enterococcus* spp. isolation, contributing 50% of isolates. *Enterococcus faecium* was the predominant species isolated from case-group infections overall (66%), as well as in polymicrobial infections (74%). Frequent co-colonizing microbes in polymicrobial wound infections with *Enterococcus* were other ESKAPE pathogens (64%) (*Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae* [and *Escherichia coli*], *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter* spp.) and fungi (35%).

CONCLUSIONS: The specific pathogenicity of *Enterococcus* relative to other pathogens in polymicrobial wounds is unknown. Identifying strain-specific outcomes and investigating the interactions of *Enterococcus* strains with other wound pathogens could provide additional tools and strategies for infection mitigation in combat-related wounds.

PMID:29261091 DOI:[10.1089/sur.2017.157](https://doi.org/10.1089/sur.2017.157)

Early transfusion on battlefield before admission to role 2: A preliminary observational study during "Barkhane" operation in Sahel.

[Vitalis V](#)¹, [Carfantan C](#)², [Montcriol A](#)³, [Peyrefitte S](#)⁴, [Luft A](#)², [Pouget T](#)⁵, [Sailliol A](#)⁵, [Ausset S](#)⁶, [Meaudre E](#)³, [Bordes J](#)⁷. **Author information**

1 French Medical Unit, Medical Centre of Lyon, France.

2 French Military Medical Service, Operational Headquarters, France.

3 Sainte Anne Military Teaching Hospital, Anaesthesia and Intensive Care Unit, Toulon, France.

4 French Medical Unit, Naval Special Operations Commandos Command, Lanester, France.

5 French Military Blood Institute, Clamart, France.

6 Percy Military Teaching Hospital, Anaesthesia and Intensive Care Unit, Clamart, France & Val de Grâce Military Academy, Paris, France.

7 Sainte Anne Military Teaching Hospital, Anaesthesia and Intensive Care Unit, Toulon, France; 7th Paratrooper Forward Surgical Unit, France. Electronic address: bordes.julien@neuf.fr.

Abstract

INTRODUCTION: Haemorrhage is the leading cause of death after combat related injuries and bleeding management is the cornerstone of management of these casualties. French armed forces are deployed in Barkhane operation in the Sahel-Saharan Strip who represents an immense area. Since this constraint implies evacuation times beyond doctrinal timelines, an institutional decision has been made to deploy blood products on the battlefield and transfuse casualties before role 2 admission if indicated. The purpose of this study was to evaluate the transfusion practices on battlefield during the first year following the implementation of this policy.

MATERIALS AND METHODS: Prospective collection of data about combat related casualties categorized alpha evacuated to a role 2. Battlefield transfusion was defined as any transfusion of blood product (red blood cells, plasma, whole blood) performed by role 1 or Medevac team before admission at a role 2. Patients' characteristics, battlefield transfusions' characteristics and complications were analysed.

RESULTS: During the one year study, a total of 29 alpha casualties were included during the period study. Twenty-eight could be analysed, 7/28 (25%) being transfused on battlefield, representing a total of 22 transfusion episodes. The most frequently blood product transfused was French lyophilized plasma (FLYP). Most of transfusion episodes occurred during medevac. Compared to non-battlefield transfused casualties, battlefield transfused casualties suffered more wounded anatomical regions (median number of 3 versus 2, $p = 0.04$), had a higher injury severity score (median ISS of 45 versus 25, $p = 0,01$) and were more often transfused at role 2, received more plasma units and whole blood units. There was no difference in evacuation time to role 2 between patients transfused on battlefield and non-transfused patients. There was no complication related to battlefield transfusions. Blood products transfusion onset on battlefield ranged from 75 min to 192 min after injury.

CONCLUSION: Battlefield transfusion for combat-related casualties is a logistical challenge. Our study showed that such a program is feasible even in an extended area as Sahel-Saharan Strip operation theatre and reduces time to first blood product transfusion for alpha casualties. FLYP is the first line blood product on the battlefield.

[Ear Nose Throat J.](#) 2017 Dec;96(12):E25-E30.

Head and neck surgical reconstruction in Operation Iraqi Freedom and Operation Enduring Freedom-Afghanistan: A systematic review.

[Mikals SJ](#)¹, [Jabaut JM](#), [Ambrosio AA](#).

Author information

1 Department of Otolaryngology-Head and Neck Surgery, Walter Reed National Military Medical Center, 8901 Wisconsin Ave., Bethesda, MD 20889, USA. samantha.mikals@gmail.com.

Abstract

Historically, head and neck injuries constituted 16 to 20% of all nonfatal combat injuries. However, advances in body and vehicle armor in the context of the use of ambushes and improvised explosive devices by enemy combatants have resulted in fewer fatalities from head and neck wounds, and thus the incidence of nonfatal head and neck injuries has risen to as high as 52%. Despite this increase, data regarding specific injury distributions, surgical cases, and approaches to repair are lacking in the current literature. We conducted a study to systematically review the current literature regarding head and neck injuries and reconstructions during Operation Iraqi Freedom and Operation Enduring Freedom-Afghanistan. We found 44 articles that met our inclusion criteria. These articles covered 17,461 head and neck wounds sustained by 12,105 patients. Superficial soft-tissue facial injuries were most common wounds (31.7% of cases), followed by wounds to the neck (25.2%) and midface (17.9%). The 44 articles listed 5,122 discrete surgical reports covering 5,758 procedures. Of these procedures, simple facial laceration repairs (25.2%) and ophthalmologic surgeries (12.1%) were the most common soft-tissue repairs, and mandibular reconstructions (11.3%) were the most common type of bony reconstruction. Major flap reconstructions for coverage were required in only 0.4% of procedures. This information will be valuable for educating those involved in otolaryngology training programs, as well as civilian otolaryngologists regarding the types of injury patterns they should expect to see and treat in the returning veteran population.

PMID:29236278

Association of prehospital intubation with decreased survival among pediatric trauma patients in Iraq and Afghanistan.

[Schauer SG](#)¹, [Naylor JF](#)², [Hill GJ](#)³, [Arana AA](#)⁴, [Roper JL](#)⁵, [April MD](#)⁵.

Author information

1 US Army Institute of Surgical Research, JBSA Fort Sam Houston, TX, United States; 59th Medical Wing, Lackland Air Force Base, TX, United States; Brooke Army Medical Center, JBSA Fort Sam Houston, TX, United States. Electronic address: steven.g.schauer.mil@mail.mil.

2 28th Combat Support Hospital, Fort Bragg, NC, United States.

3 Dell Children's Medical Center, Austin, TX, United States; Madigan Army Medical Center, Joint Base Lewis-McChord, WA, United States.

4 US Army Institute of Surgical Research, JBSA Fort Sam Houston, TX, United States; 59th Medical Wing, Lackland Air Force Base, TX, United States.

5 Brooke Army Medical Center, JBSA Fort Sam Houston, TX, United States.

Abstract

INTRODUCTION: Airway compromise is the second leading cause of preventable death on the battlefield among US military casualties. Airway management is an important component of pediatric trauma care. Yet, intubation is a challenging skill with which many prehospital providers have limited pediatric experience. We compare mortality among pediatric trauma patients undergoing intubation in the prehospital setting versus a fixed-facility emergency department.

METHODS: We queried the Department of Defense Trauma Registry (DODTR) for all pediatric encounters in Iraq and Afghanistan from January 2007 to January 2016. We compared outcomes of pediatric subjects undergoing intubation in the prehospital setting versus the emergency department (ED) setting.

RESULTS: During this period, there were 3439 pediatric encounters (8.0% of DODTR encounters during this time). Of those, 802 (23.3%) underwent intubation (prehospital=211, ED=591). Compared to patients undergoing ED intubation, patients undergoing prehospital intubation had higher median composite injury severity scores (17 versus 16) and lower survival rates (66.8% versus 79.9%, $p < 0.001$). On univariable logistic regression analysis, prehospital intubation increased mortality odds (OR 1.97, 95% CI 1.39-2.79). After adjusting for confounders, the association between prehospital intubation and death remained significant (OR 2.03, 95% CI 1.35-3.06).

CONCLUSIONS: Pediatric trauma subjects intubated in the prehospital setting had worse outcomes than those intubated in the ED. This finding persisted after controlling for measurable confounders.

Ionised calcium levels in major trauma patients who received blood en route to a military medical treatment facility.

[Kyle T](#)^{1,2}, [Greaves I](#)^{1,3}, [Beynon A](#)^{4,5}, [Whittaker V](#)⁶, [Brewer M](#)⁷, [Smith J](#)^{1,4}.

Author information

1 Academic Department of Military Emergency Medicine, Royal Centre for Defence Medicine (Research and Academia), Birmingham, UK.

2 Institute of Learning Research & Innovation, James Cook University Hospital, Middlesbrough, UK.

3 Emergency Department, James Cook University Hospital, Middlesbrough, UK.

4 Emergency Department, Derriford Hospital, Plymouth, UK.

5 Defence Medical Group South West, Derriford Hospital, Plymouth, UK.

6 Health and Social Care Institute, Teesside University, Middlesbrough, North Yorkshire, UK.

7 Department of Biomedical Science, 16 Medical Regiment, Colchester, UK.

Abstract

BACKGROUND:

Hypocalcaemia is a common metabolic derangement in critically ill patients. Blood transfusion can also contribute to depleted calcium levels. The aims of this study were to identify the incidence of hypocalcaemia in military trauma patients receiving blood products en route to a deployed hospital facility and to determine if intravenous calcium, given during the prehospital phase, has an effect on admission calcium levels.

METHODS: This was a retrospective review of patients transported by the UK Medical Emergency Response Team in Afghanistan between January 2010 and December 2014 who were treated with blood products in the prehospital setting. Total units of blood products administered, basic demographics, Injury Severity Score and trauma type were collected. Ionised serum calcium levels on admission to hospital were compared between those who received blood products without prehospital intravenous calcium supplemental therapy (non-treatment) and patients who were treated with 10 mL of intravenous calcium chloride (10%) concurrently with blood products (treatment).

RESULTS: The study included 297 patients; 237 did not receive calcium and 60 did. The incidence of hypocalcaemia in the non-treatment group was 70.0% (n=166) compared with 28.3% (n=17) in the treatment group. Serum calcium levels were significantly different between the groups (1.03 mmol/L vs 1.25 mmol/L, difference 0.22 mmol/L, 95% CI 0.15 to 0.27). In the non-treatment group, 26.6% (n=63) had calcium levels within the normal range compared with 41.7% (n=25) in those who received calcium. There was a dose response of calcium level to blood products with a significant decrease in calcium levels as the volume of blood products increased.

CONCLUSION: Trauma patients who received blood products were at high risk of hypocalcaemia. Aggressive management of these patients with intravenous calcium during transfusion may be required.

14 Prediction of massive blood transfusion in battlefield trauma: development and validation of the military acute severe haemorrhage (MASH) score.

[McLennan J](#)¹, [Smith J](#)¹, [Mackway-Jones K](#)².

Author information

1 Academic Department of Military Emergency Medicine, Royal Centre for Defence Medicine, Birmingham.

2 Central Manchester University Hospital NHS Foundation Trust.

Abstract

BACKGROUND: The predominant cause of preventable death from trauma is bleeding. Many patients need resuscitation with massive blood transfusion (MBT). In some theatres of military operation there is limited blood product availability and walking donor panels can be required. This study aimed to produce a tool to predict the need for MBT using information available on patient arrival at the ED for patients sustaining battlefield trauma.

METHODS: A retrospective database analysis was undertaken using the UK Joint Theatre Trauma Registry (JTTR) to provide derivation and validation datasets. Regression analysis of potential predictive factors was performed. MBT was defined either as receiving 6 or more units of red blood cells (RBCs) in 4 hours or 10 units of RBCs in 24 hours. Predictive factors were analysed through multi-logistic regression analysis to build predictive models; sensitivity and specificity of these models was assessed, and the best fit models were analysed in the validation dataset.

RESULTS: The derivation dataset was made up of 1298 casualties with a massive blood transfusion rate of 21.2% (n=275). The validation dataset contained 1186; MBT rate 6.7% (n=79). The majority of patients were young, male and with penetrating injury. Univariate regression analyses showing the predictive value of the variables within the MASH score are shown in table 1. A decision rule was produced using a combination of injury pattern, clinical observations and pre-hospital interventions. The test characteristics for three cut off thresholds for the rule are shown in Table 2 alongside the sensitivity analysis. The proposed rule, using a score of 3 or greater, demonstrated a sensitivity of 82.7% and a specificity of 88.8% for prediction of MBT, with an AUROC of 0.93 (95% CI:0.91 to 0.95).
CONCLUSIONS: This study has produced the first military scoring system that uses clinical observations, injuries sustained and pre-hospital interventions to predict the need for MBT and therefore the requirement for an emergency donor panel in resource-limited environments. The MASH score has higher sensitivity and specificity than previous military prediction tools, and has the advantage of only using information which is rapidly available in the resuscitation bay. This is of importance to civilian practitioners with increasing possibility of major terrorist attacks.

Training and Assessing Critical Airway, Breathing, and Hemorrhage Control Procedures for Trauma Care: Live Tissue Versus Synthetic Models.

[Hart D](#)^{1,2,3}, [Rush R](#)⁴, [Rule G](#)⁵, [Clinton J](#)^{1,2,5}, [Beilman G](#)⁶, [Anders S](#)⁷, [Brown R](#)⁵, [McNeil MA](#)^{1,3}, [Reihsen T](#)⁸, [Chipman J](#)⁶, [Sweet R](#)^{8,9}; on behalf of the University of Minnesota Combat Casualty Training Consortium (UMN CCTC).

Author information

- 1 Emergency Medicine, University of Minnesota Medical School, Minneapolis, MN.
- 2 Hennepin County Medical Center, Minneapolis, MN.
- 3 University of Minnesota Medical School, Minneapolis, MN.
- 4 Department of Surgery, Madigan Army Medical Center, Tacoma, WA.
- 5 Applied Research Associates, San Antonio, TX.
- 6 Department of Surgery, University of Minnesota, Minneapolis, MN.
- 7 Department of Anesthesiology, Vanderbilt University, Nashville, TN.
- 8 SimPORTAL & CREST, University of Minnesota, Minneapolis, MN.
- 9 Department of Urologic Surgery, University of Minnesota, Minneapolis, MN.

Abstract

INTRODUCTION: Optimal teaching and assessment methods and models for emergency airway, breathing, and hemorrhage interventions are not currently known. The University of Minnesota Combat Casualty Training consortium (UMN CCTC) was formed to explore the strengths and weaknesses of synthetic training models (STMs) versus live tissue (LT) models. In this study, we compare the effectiveness of best in class STMs versus an anesthetized caprine (goat) model for training and assessing seven procedures: junctional hemorrhage control, tourniquet (TQ) placement, chest seal, needle thoracostomy (NCD), nasopharyngeal airway (NPA), tube thoracostomy, and cricothyrotomy (Cric).

METHODS: Army combat medics were randomized to one of four groups: 1) LT trained-LT tested (LT-LT), 2) LT trained-STM tested (LT-STM), 3) STM trained-LT tested (STM-LT), and 4) STM trained-STM tested (STM-STM). Participants trained in small groups for 3 to 4 hours and were evaluated individually. LT-LT was the "control" to which other groups were compared, as this is the current military predeployment standard. The mean procedural scores (PSs) were compared using a pairwise t-test with a Dunnett's correction. Logistic regression was used to compare critical fails (CFs) and skipped tasks.

RESULTS: There were 559 subjects included. Junctional hemorrhage control revealed no difference in CFs, but LT-tested subjects (LT-LT and STM-LT) skipped this task more than STM-tested subjects (LT-STM and STM-STM; $p < 0.05$), and STM-STM had higher PSs than LT-LT ($p < 0.001$). For TQ, both STM-tested groups (LT-STM and STM-STM) had more CFs than LT-LT ($p < 0.001$) and LT-STM had lower PSs than LT-LT ($p < 0.05$). No differences were seen for chest seal. For NCD, LT-STM had more CFs than LT-LT ($p = 0.001$) and lower PSs ($p = 0.001$). There was no difference in CFs for NPA, but all groups had worse PSs versus LT-LT ($p < 0.05$). For Cric, we were underpowered; STM-LT trended toward more CFs ($p = 0.08$), and STM-STM had higher PSs than LT-LT ($p < 0.01$). Tube thoracostomy revealed that STM-LT had higher CFs than LT-LT ($p < 0.05$), but LT-STM had lower PSs ($p < 0.05$). An interaction effect (making the subjects who trained and tested on different models more likely to CF) was

only found for TQ, chest seal, and Cric; however, of these three procedures, only TQ demonstrated any significant difference in CF rates.

CONCLUSION: Training on STM or LT did not demonstrate a difference in subsequent performance for five of seven procedures (junctional hemorrhage, TQ, chest seal, NPA, and NCD). Until STMs are developed with improved anthropomorphic and tissue fidelity, there may still be a role for LT for training tube thoracostomy and potentially Cric. For assessment, our STM appears more challenging for TQ and potentially for NCD than LT. For junctional hemorrhage, the increased "skips" with LT may be explained by the differences in anatomic fidelity. While these results begin to uncover the effects of training and assessing these procedures on various models, further study is needed to ascertain how well performance on an STM or LT model translates to the human model.

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Surgical Instrument Sets for Special Operations Expeditionary Surgical Teams.

[Hale DF](#), [Sexton JC](#), [Benavides LC](#), [Benavides JM](#), [Lundy JB](#).

Abstract

BACKGROUND: The deployment of surgical assets has been driven by mission demands throughout years of military operations in Iraq and Afghanistan. The transition to the highly expeditious Golden Hour Offset Surgical Transport Team (GHOST- T) now offers highly mobile surgical assets in nontraditional operating rooms; the content of the surgical instrument sets has also transformed to accommodate this change.

METHODS: The 102nd Forward Surgical Team (FST) was attached to Special Operations assigned to southern Afghanistan from June 2015 to March 2016. The focus was to decrease overall size and weight of FST instrument sets without decreasing surgical capability of the GHOST-T. Each instrument set was evaluated and modified to include essential instruments to perform damage control surgery.

RESULTS: The overall number of main instrument sets was decreased from eight to four; simplified augmentation sets have been added, which expand the capabilities of any main set. The overall size was decreased by 40% and overall weight decreased by 58%. The cardiothoracic, thoracotomy, and emergency thoracotomy trays were condensed to thoracic set. The orthopedic and amputation sets were replaced with an augmentation set of a prepackaged orthopedic external fixator set). An augmentation set to the major or minor basic sets, specifically for vascular injuries, was created.

CONCLUSION: Through the reorganization of conventional FST surgical instrument sets to maintain damage control capabilities and mobility, the 102nd GHOST-T reduced surgical equipment volume and weight, providing a lesson learned for future surgical teams operating in austere environments.

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