

Committee on Surgical Combat Casualty Care (CoSCCC)



Journal Watch

3rd Quarter

FY 2020

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 Surgery
Injury	Pelvic fracture	Battlefield 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	Poly-trauma
Damage Control Resuscitation	Battlefield injury	Prolonged field care
Tension pneumothorax	Thoracotomy	Military Medicine
Blast Injury	Died of Wounds	Killed in Action
Combat casualty care	Medical treatment facility	Mortality
Surgical skills	Emergency surgery	Infection prevention
Novel Coronavirus	COVID-19	

Life on the Battlefield: Valproic Acid for Combat Applications

Rachel Russo et al. J Trauma Acute Care Surg. 2020.
J Trauma Acute Care Surg

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- DOI: [10.1097/TA.0000000000002721](https://doi.org/10.1097/TA.0000000000002721)

Abstract

The leading causes of death in military conflicts continue to be hemorrhagic shock and traumatic brain injury. Most of the mortality is a result of patients not surviving long enough to obtain surgical care. As a result, there is a significant unmet need for a therapy that stimulates a "pro-survival phenotype" that counteracts the cellular pathophysiology of hemorrhagic shock and traumatic brain injury in order to prolong survival. Valproic acid (VPA), a well-established anti-epileptic therapy for over 50 years, has shown potential as one such pro-survival therapy. This review details how VPA's role as a non-selective histone deacetylase inhibitor induces cellular changes that promote survival and decrease cellular pathways that lead to cell death. The review comprehensively covers over two decades worth of studies ranging from pre-clinical (mice, swine) to recent human clinical trials of the use of VPA in hemorrhagic shock and traumatic brain injury. Furthermore, it details the different mechanisms in which VPA alters gene expression, induces cytoprotective changes, attenuates platelet dysfunction, provides neuroprotection, and enhances survival in hemorrhagic shock and traumatic brain injury. VPA shows real promise as a therapy that can induce the pro-survival phenotype in those injured during military conflict. LEVEL OF EVIDENCE: N/A STUDY TYPE: Basic Science Review.

Mortality Review of US Special Operations Command Battle-Injured Fatalities

Edward L Mazuchowski et al. J Trauma Acute Care Surg. 2020 May.
J Trauma Acute Care Surg

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- PMID: [32039975](#)
- DOI: [10.1097/TA.0000000000002610](#)

Abstract

Background: Comprehensive analyses of battle-injured fatalities, incorporating a multidisciplinary process with a standardized lexicon, is necessary to elucidate opportunities for improvement (OFIs) to increase survivability.

Methods: A mortality review was conducted on United States Special Operations Command battle-injured fatalities who died from September 11, 2001, to September 10, 2018. Fatalities were analyzed by demographics, operational posture, mechanism of injury, cause of death, mechanism of death (MOD), classification of death, and injury severity. Injury survivability was determined by a subject matter expert panel and compared with injury patterns among Department of Defense Trauma Registry survivors. Death preventability and OFI were determined for fatalities with potentially survivable or survivable (PS-S) injuries using tactical data and documented medical interventions.

Results: Of 369 United States Special Operations Command battle-injured fatalities (median age, 29 years; male, 98.6%), most were killed in action (89.4%) and more than half died from injuries sustained during mounted operations (52.3%). The cause of death was blast injury (45.0%), gunshot wound (39.8%), and multiple/blunt force injury (15.2%). The leading MOD was catastrophic tissue destruction (73.7%). Most fatalities sustained nonsurvivable injuries (74.3%). For fatalities with PS-S injuries, most had hemorrhage as a component of MOD (88.4%); however, the MOD was multifactorial in the majority of these fatalities (58.9%). Only 5.4% of all fatalities and 21.1% of fatalities with PS-S injuries had comparable injury patterns among survivors. Accounting for tactical situation, a minority of deaths were potentially preventable (5.7%) and a few preventable (1.1%). Time to surgery (93.7%) and prehospital blood transfusion (89.5%) were the leading OFI for PS-S fatalities. Most fatalities with PS-S injuries requiring blood (83.5%) also had an additional prehospital OFI.

Conclusion: Comprehensive mortality reviews of battlefield fatalities can identify OFI in combat casualty care and prevention. Standardized lexicon is essential for translation to civilian trauma systems.

Level of evidence: Epidemiological, level IV.

A Decade in the Battlefield (2004-2014): A French Military Perspective on the High Mortality Associated With Non-Exclusively Orthopedic or Brain Combat Injuries

Anne de Carbonnières et al. Injury. 2020.

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- PMID: 32451146
 - DOI: [10.1016/j.injury.2020.04.035](https://doi.org/10.1016/j.injury.2020.04.035)

Abstract

Background: During the last few decades, French armed forces have regularly deployed in asymmetric conflicts. Surgical support for casualties of these conflicts occurs in NATO role 2 and 3 medical treatment facilities (MTF); definitive surgical care occurs in France following a strategic medical evacuation. The aim of this study was to describe the combat injury profile of these soldiers who presented with either non-exclusively orthopedic and/or brain injuries.

Methods: This descriptive study is a retrospective analysis of the surgical management of French casualties performed in role 2 or 3 MTF in Afghanistan, Mali, Niger, Djibouti and the Central African Republic between January 2004 and December 2014.

Results: One hundred patients were included. Forty had fragment wounds. The most severe lesions were of the head, neck or thorax. The average injury severity score (ISS) was 34.9 (IC 95% 29.8-40). 17 damage control procedures were performed. Thirty patients died with a mean ISS of 61 (IC 95% 56-67); 5 deaths were considered as preventable. The most frequent surgical procedures in the MTF were digestive (n=31) and thoracic surgery (n=19). Thirty patients needed second-look surgery in France; eleven had severe complications. No patient died following medical evacuation to France.

Conclusions: Results from this study indicated that the mortality following non-exclusively brain or orthopedic injuries remains high in modern asymmetric conflicts. Level of Evidence IV.

Keywords: Combat casualty care; Medical treatment facility; Mortality; Surgical skills; Trauma; War.

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Viscoelastic Testing in Combat Resuscitation: Is It Time for a New Standard?

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J Trauma Acute Care Surg

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- DOI: [10.1097/TA.0000000000002634](#)

Abstract

Background: Traumatic hemorrhage and coagulopathy represent major sources of morbidity and mortality on the modern battlefield. Viscoelastic testing (VET) offers a potentially more personalized approach to resuscitation. We sought to evaluate outcomes of combat trauma patients who received VET-guided resuscitation compared with standard balanced blood product resuscitation.

Methods: Retrospective analysis of the Department of Defense Trauma Registry, 2008 to 2016 was performed. Multivariate logistic regression analyses of all adult patients initially presenting to NATO Role III facilities who required blood products were performed to identify factors associated with VET-guided resuscitation and mortality. A propensity score matched comparison of outcomes in patient cohorts treated at VET versus non-VET Role III facilities was performed.

Results: There are 3,320 patients, predominately male (98%), median age ranges from 25 years to 29 years, Injury Severity Score of 18.8, with a penetrating injury (84%) were studied. Overall mortality was 9.7%. Five hundred ninety-four patients had VET during their initial resuscitation. After adjusting for confounders, VET during initial resuscitation was independently associated with decreased mortality (odds ratio, 0.63; $p = 0.04$). Propensity analysis confirmed this survival advantage with a 57% reduction in overall mortality (7.3% vs. 13.1%; $p = 0.001$) for all patients requiring blood products.

Conclusion: Viscoelastic testing offers the possibility of a product-specific resuscitation for critically injured patients requiring transfusion in combat settings. Routine VET may be superior to non-VET-guided resuscitation for combat trauma victims.

Level of evidence: Therapeutic study, level IV.

Forward Surgical Team Procedural Burden and Non-operative Interventions by the U.S. Military Trauma System in Afghanistan, 2008-2014

Amanda M Staudt et al. Mil Med. 2020.
Mil Med

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- PMID: [31863088](#)
- DOI: [10.1093/milmed/usz402](#)

Abstract

Introduction: No published study has reported non-surgical interventions performed by forward surgical teams, and there are no current surgical benchmarks for forward surgical teams. The objective of the study was to describe operative procedures and non-operative interventions received by battlefield casualties and determine the operative procedural burden on the trauma system.

Methods: This was a retrospective analysis of data from the Joint Trauma System Forward Surgical Team Database using battle and non-battle injured casualties treated in Afghanistan from 2008-2014. Overall procedure frequency, mortality outcome, and survivor morbidity outcome were calculated using operating room procedure codes grouped by the Healthcare Cost and Utilization Project classification. Cumulative attributable burden of procedures was calculated by frequency, mortality, and morbidity. Morbidity and mortality burden were used to rank procedures.

Results: The study population was comprised of 10,992 casualties, primarily male (97.8%), with a median age interquartile range of 25.0 (22.0-30.0). Affiliations were non-U.S. military (40.0%), U.S. military (35.1%), and others (25.0%). Injuries were penetrating (65.2%), blunt (32.8%), and burns (2.0%). Casualties included 4.4% who died and 14.9% who lived but had notable morbidity findings. After ranking by contribution to trauma system morbidity and mortality burden, the top 10 of 32 procedure groups accounted for 74.4% of operative care, 77.9% of mortality, and 73.1% of unexpected morbidity findings. These procedure groups included laparotomy, vascular procedures, thoracotomy, debridement, lower and upper gastrointestinal procedures, amputation, and therapeutic procedures on muscles and upper and lower extremity bones. Most common non-operative interventions included X-ray, ultrasound, wound care, catheterization, and intubation.

Conclusions: Forward surgical team training and performance improvement metrics should focus on optimizing commonly performed operative procedures and non-operative interventions. Operative procedures that were commonly performed, and those associated with higher rates of morbidity and mortality, can set surgical benchmarks and outline training and skillsets needed by forward surgical teams.

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Survival After Traumatic Brain Injury Improves With Deployment of Neurosurgeons: A Comparison of US and UK Military Treatment Facilities During the Iraq and Afghanistan Conflicts

John Breeze et al. J Neurol Neurosurg Psychiatry. 2020 Apr.
J Neurol Neurosurg Psychiatry

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 - PMCID: [PMC7147183](#)
 - DOI: [10.1136/jnnp-2019-321723](#)

Abstract

Introduction: Traumatic brain injury (TBI) is the most common cause of death on the modern battlefield. In recent conflicts in Iraq and Afghanistan, the US typically deployed neurosurgeons to medical treatment facilities (MTFs), while the UK did not. Our aim was to compare the incidence, TBI and treatment in US and UK-led military MTF to ascertain if differences in deployed trauma systems affected outcomes.

Methods: The US and UK Combat Trauma Registries were scrutinised for patients with HI at deployed MTFs between March 2003 and October 2011. Registry datasets were adapted to stratify TBI using the Mayo Classification System for Traumatic Brain Injury Severity. An adjusted multiple logistic regression model was performed using fatality as the binomial dependent variable and treatment in a US-MTF or UK-MTF, surgical decompression, US military casualty and surgery performed by a neurosurgeon as independent variables.

Results: 15 031 patients arrived alive at military MTF after TBI. Presence of a neurosurgeon was associated with increased odds of survival in casualties with moderate or severe TBI ($p < 0.0001$, OR 2.71, 95% CI 2.34 to 4.73). High injury severity (Injury Severity Scores 25-75) was significantly associated with a lower survival (OR 4×10^4 , 95% CI 1.61×10^4 to 110.6×10^4 , $p < 0.001$); however, having a neurosurgeon present still remained significantly positively associated with survival (OR 3.25, 95% CI 2.71 to 3.91, $p < 0.001$).

Conclusions: Presence of neurosurgeons increased the likelihood of survival after TBI. We therefore recommend that the UK should deploy neurosurgeons to forward military MTF whenever possible in line with their US counterparts.

Practicing Military Medicine in Truly Austere Environments: What to Expect, How to Prepare, When to Improvise

Evangelos Anagnostou et al. Mil Med. 2020.
Mil Med

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- DOI: [10.1093/milmed/usz467](https://doi.org/10.1093/milmed/usz467)

Abstract

Introduction: The majority of the published literature on contemporary military medicine contradicts the concept of austere. Operational medicine is part of every armed conflict around the world, while armed forces of most countries internationally have limited medical resources especially in the front line. The aim of this review is to identify the particularities of a truly austere environment and present a short guide of preparation and action for military medical personnel internationally.

Materials and methods: An exhaustive search of the existing English literature on operational and military medicine in austere environments was carried out in EMBASE and PubMed databases.

Results: This review included seminal and contemporary papers on the subject and synthesized a multiperspective short guide for operational medical personnel.

Discussion: Experience from forward surgical teams of the U.S. Army and humanitarian teams of physicians in war zones who work under precarious and austere circumstances has shown that the management of casualties requires different strategies than in higher levels of combat casualty care and in a civilian setting. A number of factors that must be controlled can be categorized into human, environmental, equipment-related, and socioeconomic. Surgeons and other medical personnel should have knowledge of these aspects beforehand and be adequately trained in peacetime. Physicians must master a number of essential skills and drugs, and be familiar with dosage regimens and side effects.

Conclusion: The military surgeon must be specially trained and prepared to use a wide range of skills in truly austere environments in contemporary conflicts.

Emergency Trauma Care During the Outbreak of Corona Virus Disease 2019 (COVID-19) in China

Yang Li et al. World J Emerg Surg. 2020.
World J Emerg Surg

Authors

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- PMCID: [PMC7226718](https://pubmed.ncbi.nlm.nih.gov/PMC7226718/)
- DOI: [10.1186/s13017-020-00312-5](https://doi.org/10.1186/s13017-020-00312-5)

Abstract

Background: A novel coronavirus pneumonia outbreak began in Wuhan, Hubei Province, in December 2019; the outbreak was caused by a novel coronavirus previously never observed in humans. China has imposed the strictest quarantine and closed management measures in history to control the spread of the disease. However, a high level of evidence to support the surgical management of potential trauma patients during the novel coronavirus outbreak is still lacking. To regulate the emergency treatment of trauma patients during the outbreak, we drafted this paper from a trauma surgeon perspective according to practical experience in Wuhan.

Main body: The article illustrates the general principles for the triage and evaluation of trauma patients during the outbreak of COVID-19, indications for emergency surgery, and infection prevention and control for medical personnel, providing a practical algorithm for trauma care providers during the outbreak period.

Conclusions: The measures of emergency trauma care that we have provided can protect the medical personnel involved in emergency care and ensure the timeliness of effective interventions during the outbreak of COVID-19.

Keywords: Emergency surgery; Infection prevention; Novel Coronavirus; Trauma.

Procedural Volume Within Military Treatment Facilities- Implications for a Ready Medical Force

Brandon M Carius et al. Mil Med. 2020.
Mil Med

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 - ⁴ US Army Institute of Surgical Research, JBSA Fort Sam Houston, San Antonio, TX The view(s) expressed herein are those of the author(s) and do not reflect the official policy or position of Brooke Army Medical Center, US Army Institute of Surgical Research, Uniformed Services University of the Health Sciences, the U.S. Army Medical Department, 2nd Brigade, 4th Infantry Division, the U.S. Army Office of the Surgeon General, the Department of the Army, the Department of the Air Force, the Department of Defense or the U.S. Government. This work has not been previously presented.
- PMID: [32484224](#)
 - DOI: [10.1093/milmed/usaa001](#)

Abstract

Introduction: Consistent procedural volume is important for emergency physicians (EPs) to maintain opportunities for critical lifesaving skills. While non-EP literature demonstrates improved patient outcomes with higher volumes, few studies examine the optimal number of repetitions needed to maintain procedural competency in EP populations. The largely young, healthy active duty population that constitutes the majority of patients in military treatment facilities (MTFs) decreases the likelihood to utilize emergent procedures. Despite this likelihood, EPs are expected to maintain proficiency and readiness to perform critical procedures in deployed settings.

Materials and methods: A retrospective analysis of de-identified data obtained through the Military Health System Mart was performed for procedural codes involving surgical airway, central venous access, and intubation. Data were sought for 2014-2016 calendar years from seven Army hospitals under the Southwest Region Medical Command. Procedural numbers were obtained for both overall volume and those performed per 1,000 encounters. Additionally, we analyzed for volume differences with the highest volume MTF (Brooke Army Medical Center [BAMC]) removed from the data set.

Results: A total of 1,450 procedures were performed among the MTFs analyzed, including 973 intubations, 473 central venous catheter placements, and 4 surgical airways. MTFs averaged 69.5 intubations and 38.8 venous catheters placed each year, but decreased to 28.1 intubations and 13.0 venous catheters placed annually when BAMC was removed from the data set (a 59.6 and 61.6% decrease, respectively). Monthly averages of 40.5 intubations and 19.7 central venous catheterizations per month among all included MTFs decreased to 14.0 and 6.5 when BAMC was removed. All surgical airways were performed at BAMC. Procedural frequency per 1,000 encounters was highest at BAMC, although ordinal differences were noted in the remaining six MTFs compared with overall procedural volumes.

Conclusions: This retrospective analysis demonstrates a significant variation in procedural volumes across MTFs, illustrating disproportionate opportunities for procedural skill maintenance among Army EPs. Low procedural volume threatens the maintenance of critical EP skills. These numbers could also suggest low skills for other providers (such as physician assistants), further illustrating decreased skill readiness throughout the force. Further research is needed to examine procedural volumes per individual EP, as well as those performed by other providers to evaluate for overall procedural readiness across the military force.

Combat Thoracic Surgery in Iraq and Afghanistan: 2002-2016

Caryn A Stern et al. J Trauma Acute Care Surg. 2020.
J Trauma Acute Care Surg

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- PMID: [32467471](#)
- DOI: [10.1097/TA.0000000000002800](#)

Abstract

Background: Thoracic surgery constitutes 2.5% of surgical procedures performed in theater, but the skills required are increasingly foreign to military surgeons. This study examines thoracic surgical workload in Iraq and Afghanistan to help define surgical training gaps.

Methods: Retrospective analysis of Department of Defense Trauma Registry (DoDTR) for all Role 2 (forward surgical) and Role 3 (theater) military facilities, from January 2002 to May 2016. The 95 thoracic surgical ICD-9-CM procedure codes were grouped into ten categories based on anatomy or endoscopy. Select groups were further stratified by type of definitive procedure. Procedure groupings were determined and adjudicated by surgeon subject matter experts. Data analysis used Stata Version 15 (College Station, Texas).

Results: Of the total procedures, 5,301 were classified as thoracic surgical procedures and were included in the present study. The majority of thoracic surgical procedures (4,645 (87.6%)) were recorded as being performed at R3 MTFs. The thoracic surgical procedures groups with the largest proportions were: bronchoscopy (39.1%), thoracotomy (16.9%), diaphragm (15.6%), and lung (11.4%). The most common lung procedure subgroup, aside from NOS, was segmentectomy (28.8%). R3 MTFs recorded nearly 5 times the number of lung procedures compared to R2 MTFs; with R3 MTFs recording more than 8 times the number of lobectomies compared to R2 MTFs. Thoracic workload was variable over the 15 year study period.

Conclusions: Thoracic surgical skills are necessary in the deployed environment to manage combat-related injuries. Given the current trends in training and specialization, development and sustainment of thoracic surgical skills is challenging in the deployed US trauma system and likely for other nations, and humanitarian surgical care as well. Current training and practice paradigms pose both training and sustainment challenges for surgeons who deploy to a combat zone.

Level of evidence: Level III, epidemiologic study.

Outcomes Following Penetrating Neck Injury During the Iraq and Afghanistan Conflicts: A Comparison of Treatment at US and United Kingdom Medical Treatment Facilities

John Breeze et al. J Trauma Acute Care Surg. 2020 May.
J Trauma Acute Care Surg

Authors

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- PMCID: [PMC7182242](#)
- DOI: [10.1097/TA.0000000000002625](#)

Abstract

Introduction: The United States and United Kingdom (UK) had differing approaches to the surgical skill mix within deployed medical treatment facilities (MTFs) in support of the military campaigns in Iraq and Afghanistan.

Methods: The US and UK combat trauma registries were scrutinized for patients with penetrating neck injury (PNI) at deployed coalition MTF between March 2003 and October 2011. A multivariate mixed effects logistic regression model (threshold, $p < 0.05$) was used stratified by MTF location and year of injury. The dependent variable was fatality on leaving Role 3, and the independent variables were ISS on arrival, nationality, MTF nationality, and presence of head and neck surgeon.

Results: A total of 3,357 (4.9%) of 67,586 patients who arrived alive at deployed military MTF were recorded to have sustained neck injuries; of which 2,186 (83%) were PNIs and the remainder were blunt injuries. When service members killed in action were included, the incidence of neck injury rose from 4.9% to 10%. Seven hundred nine (32%) of 2,186 patients with PNI underwent neck exploration; 555 patients were recorded to have sustained cervical vascular injury, 230 (41%) of 555 underwent vascular ligation or repair. Where it was recorded, PNI directly contributed to death in 64 (28%) of 228 of patients. Fatality status was positively associated with ISS on arrival (odds ratio, 1.05; 95% confidence interval, 1.04-1.06; $p < 0.001$) and the casualty being a local national (odds ratio, 1.74; 95% confidence interval, 1.28-2.38; $p < 0.001$).

Conclusion: Significant differences in the treatment and survival of casualties with PNI were identified between nations in this study; this may reflect differing cervical protection, management protocols, and surgical capability and is worthy of further study. In an era of increasing specialization within surgery, neck exploration remains a skill that must be retained by military surgeons deploying to Role 2 and Role 3 MTF.

Level of evidence: Retrospective cohort study, level III.