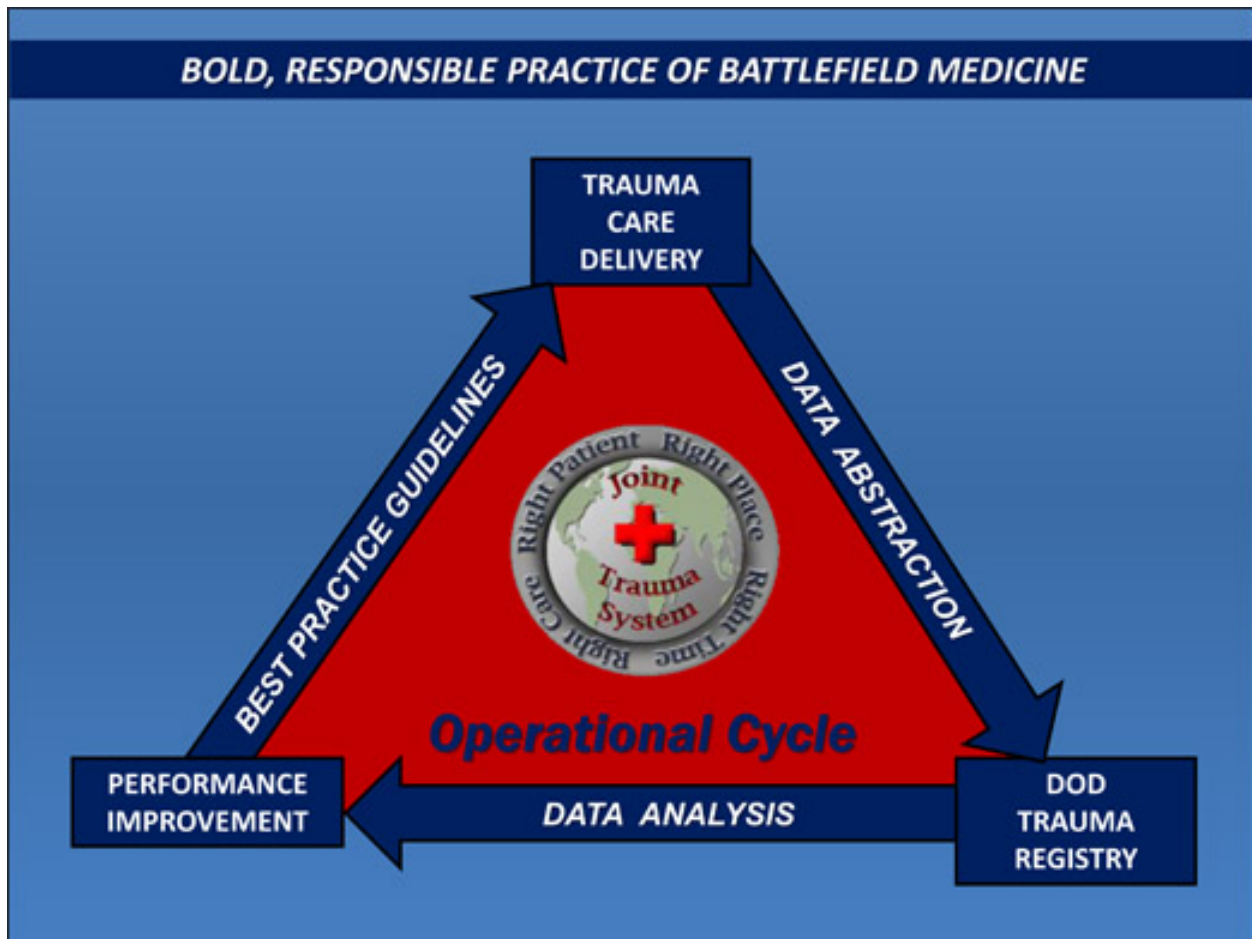


Committee on Surgical Combat Casualty Care  
(CoSCCC)



Journal Watch

4th 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	Pain management
Trauma management	Austere	Austere Surgery

## Combat vascular injury: Influence of mechanism of injury on outcome.

[Sharrock AE](#)<sup>1</sup>, [Remick KN](#)<sup>2</sup>, [Midwinter MJ](#)<sup>3</sup>, [Rickard RF](#)<sup>4</sup>.

**BACKGROUND:** Haemorrhage is the leading cause of death on the battlefield. Seventy percent of injuries are due to explosive mechanisms. Anecdotally, these patients have had poorer outcomes when compared to those with penetrating mechanisms of injury (MOI). We wished to test the hypothesis that outcomes following vascular reconstruction were worse in blast-injured than non blast-injured patients.

**METHODS:** Retrospective cohort study. British and American combat casualties with arterial injuries sustained in Iraq or Afghanistan (2003-2014) were identified from the UK Joint Theatre Trauma Registry (JTTR). Eligibility included explosive or penetrating MOI, with follow-up to UK hospital discharge, or death. Outcomes were mortality, amputation, graft thrombosis, haemorrhage, and infection. Statistical analysis was performed using Pearson Chi-Square test, t-tests, ANOVA or non-parametric equivalent, and survival analyses.

**RESULTS:** One hundred and fifteen patients were included, 80 injured by explosive and 35 by penetrating mechanisms. Evacuation time, ISS, number of arterial injuries, age and gender were comparable between groups. Seventy percent of arterial injuries resulted from an explosive MOI. The explosive injuries group received more blood products ( $p = 0.008$ ) and suffered more regions injured ( $p < 0.0001$ ). Early surgical interventions in both were ligation ( $n = 36, 31\%$ ), vein graft ( $n = 33, 29\%$ ) and shunting ( $n = 9, 8\%$ ). Mortality ( $n = 12, 10\%$ ) was similar between groups. Differences in limb salvage rates following explosive ( $n = 17, 53\%$ ) vs penetrating ( $n = 13, 76.47\%$ ) mechanisms approached statistical significance ( $p = 0.056$ ). Nine (28%) vein grafted patients developed complications. No evidence of a difference in the incidence of vein graft thrombosis was found when comparing explosive with non-explosive cohorts ( $p = 0.154$ ).

**CONCLUSIONS:** The recorded numbers of vein grafts following combat arterial trauma in are small in the JTTR. No statistically-significant differences in complications, including vein graft thrombosis, were found between cohorts injured by explosive and non-explosive mechanisms.

PMID: 30219382 DOI: [10.1016/j.injury.2018.06.037](https://doi.org/10.1016/j.injury.2018.06.037)

[Mil Med.](#) 2018 Sep 1;183(suppl\_2):83-91. doi: 10.1093/milmed/usy096.

## **Cervical and Thoracolumbar Spine Injury Evaluation, Transport, and Surgery in the Deployed Setting.**

[Neal CJ](#)<sup>1</sup>, [McCafferty RR](#)<sup>1</sup>, [Freedman B](#)<sup>1</sup>, [Helgeson MD](#)<sup>1</sup>, [Rivet D](#)<sup>1</sup>, [Gwinn DE](#)<sup>1</sup>, [Rosner MK](#)<sup>1</sup>.

### **Author information**

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### **Abstract**

This Cervical and Thoracolumbar Spine Injury Evaluation, Transport, and Surgery Clinical Practice Guideline (CPG) is designed to provide guidance to the deployed provider when they are treating a combat casualty who has sustained a spine or spinal cord injury. The CPG objective for the treatment and the movement of these patients is to maintain spinal stability through transport, perform decompression when urgently needed, achieve definitive stabilization when appropriate, avoid secondary injury, and prevent deterioration of the patient's neurological condition. Thorough and accurate documentation of the patient's neurological examination is crucial to ensure appropriate management decisions are made as the patient transits through the evacuation system. The use of this CPG should be in conjunction with good clinical judgment.

PMID: 30189075 DOI: [10.1093/milmed/usy096](#)

## **Tube Thoracostomy Management in the Combat Wounded.**

[Bozzay JD](#), [Walker PF](#), [Ronaldi AE](#), [Elster EA](#), [Rodriguez CJ](#), [Bradley MJ](#).

### **Abstract**

The intent of this study was to characterize the management and subsequent complications of combat injury tube thoracostomies and to determine risk factors for the development of pneumonia (PNA) and retained hemothorax (RH). One hundred fifteen patients with 173 tube thoracostomies met the inclusion criteria and were analyzed. The mean injury severity score was  $30.8 \pm 11.6$ , 23.5 per cent had traumatic amputations, 49.7 per cent had a hemothorax, and 50.3 per cent had a pneumothorax as indications for tube thoracostomy (TT) placement. Within 24 hours of injury, 89.6 per cent were intubated, the majority (54%) were injured by improvised explosive devices, 35.6 per cent sustained rib fractures, and 12.2 per cent had a diaphragm injury. A mean of  $1.5 \pm 0.7$  (range 1-4) tube thoracostomies were placed, 18.3 per cent of patients had bilateral tube thoracostomies, and the average TT duration was  $6.7 \pm 3.9$  days. The incidence of PNA was 27 per cent ( $n = 31$ ), RH was 9.6 per cent ( $n = 11$ ), and empyema was 1.7 per cent ( $n = 2$ ). Multivariable analysis identified the duration of ventilation [OR 1.2, 95% confidence interval (CI): 1.097-1.313,  $P < 0.001$ ] as independently associated with the development of PNA. Bilateral TT placement (OR 3.848, 95% CI: 1.219-12.143,  $P = 0.0216$ ) and injury severity score (OR 1.050, 95% CI: 1.001-1.102,  $P = 0.0443$ ) were independently associated with PNA development when a patient was intubated for eight days or less. The number of tube thoracostomies placed (OR 3.08, 95% CI: 1.03-9.18,  $P = 0.0439$ ) was independently associated with the development of RH. Further research is warranted to identify modifiable risk factors to reduce the incidence of PNA and RH in patients with TT placed for traumatic injuries.

PMID: 30185316

## Ostomy Usage for Colorectal Trauma in Combat Casualties.

[Johnston LR](#)<sup>1</sup>, [Bradley MJ](#)<sup>2,3,4</sup>, [Rodriguez CJ](#)<sup>2</sup>, [Mcnally MP](#)<sup>2</sup>, [Elster EA](#)<sup>2,4</sup>, [Duncan JE](#)<sup>2</sup>.

### Abstract

**INTRODUCTION:** The role for diverting ostomy as a method to help reduce morbidity and mortality has been well established in the combat trauma population. However, factors that influence the type of ostomy used and which ostomies become permanent are poorly studied. We examine patterns of ostomy usage and reversal in a large series of combat trauma patients.

**METHODS:** We performed a retrospective review of combat casualties treated at our continental U.S. military treatment facility from 2003 to 2015. All patients who underwent ostomy formation were included. Clinical and demographic factors were collected for all patients including the type of ostomy and whether or not ostomy reversal took place. Patients were grouped and analyzed based on ostomy type and by ostomy reversal.

**RESULTS:** We identified 202 patients who had ostomies created. End colostomies were most common (N = 149) followed by loop colostomies (N = 34) and end ileostomies (N = 19). Casualties that underwent damage control laparotomy (DCL) were less likely to have a loop colostomy created ( $p < 0.001$ ). Ostomy reversal occurred in 89.9% of patients. There was no difference in ostomy reversal rates by ostomy type ( $p = 0.080$ ). Presence of a pelvic fracture was associated with permanent ostomy (OR = 3.28,  $p = 0.019$ ), but no factor independently predicted a permanent ostomy on multivariate analysis.

**DISCUSSION:** DCL and a severe perineal injury most strongly influence ostomy type selection. Most patients undergo colostomy reversal, and no factor independently predicted an ostomy being permanent. These findings provide a framework for understanding the issue of fecal diversion in the combat trauma population and inform military surgeons about injury patterns and treatment options.

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## Combat-Related Invasive Fungal Infections: Development of a Clinically Applicable Clinical Decision Support System for Early Risk Stratification.

[Potter BK](#)<sup>1,2</sup>, [Forsberg JA](#)<sup>1,2,3</sup>, [Silvius E](#)<sup>2,4</sup>, [Wagner M](#)<sup>1,2</sup>, [Khatri V](#)<sup>1,2</sup>, [Schobel SA](#)<sup>1,2</sup>, [Belard AJ](#)<sup>2</sup>, [Weintrob AC](#)<sup>5,6,7</sup>, [Tribble DR](#)<sup>5</sup>, [Elster EA](#)<sup>1,2</sup>.

### Abstract

**Introduction:** Invasive fungal infections (IFI) are associated with high morbidity and mortality. A better method of risk stratifying trauma patients for combat-related IFI is needed to improve clinical outcomes while minimizing morbidity related to overtreatment. We sought to develop combat-related IFI clinical decision support (CDS) tools to assist providers to make treatment decisions both near the point of injury and subsequently at definitive treatment centers.

**Materials and Methods:** We utilized a training dataset containing information from 227 combat-injured military personnel to build a Bayesian belief network (BBN) to predict the likelihood of developing IFI using information available at the point of initial resuscitation (THEATER model) and in the tertiary care setting (MEDCEN model). After selecting BBN models, external validation used a separate test dataset of 350 wounded warriors. Furthermore, the performance of the BBN models was compared with a "two-rule model" alone (based on physician experience) and combinations of the BBN models plus the two-rule model. The two-rule model contains plausible IFI criteria, but it has not been formally evaluated, and they are not currently actual clinical guidelines.

**Results:** We found receiver operating characteristic areas under the curve (AUC) of 0.70 (95% CI: [0.62, 0.77]) and 0.68 (95% CI: [0.59, 0.76]) for the THEATER and MEDCEN BBN models, respectively, on cross-validation. External validation with the highest AUC BBN models produced THEATER AUC of 0.68 (95% CI: [0.58, 0.78]) and MEDCEN AUC of 0.67 (95% CI: [0.57, 0.78]). With the incorporation of two-rule model in low IFI-prevalence populations, external validation AUC increased to 0.77 (95% CI: [0.69, 0.84]) for the THEATER model and 0.76 (95% CI:[0.68, 0.85]) for the LRMC model. The two-rule model alone has an AUC of 0.72 (95% CI: [0.63, 0.81]).

**Conclusions:** Overall, the IFI tools produced clinically useful, robust models. However, the clinical utility of these models is highly dependent upon the clinician's individual risk tolerance. The threshold probability for optimal clinical use of this CDS tool is currently being evaluated in an ongoing clinical utilization study. CDS tools, such as these, may facilitate early diagnosis of patients with or at risk for IFI, permitting early or prophylactic treatment with the aim of improving outcomes.

PMID: 30124943 DOI: [10.1093/milmed/usy182](https://doi.org/10.1093/milmed/usy182)

## Intraocular Foreign Body Trauma in Operation Iraqi Freedom and Operation Enduring Freedom: 2001 to 2011.

[Justin GA](#)<sup>1</sup>, [Baker KM](#)<sup>2</sup>, [Brooks DI](#)<sup>3</sup>, [Ryan DS](#)<sup>4</sup>, [Weichel ED](#)<sup>5</sup>, [Colyer MH](#)<sup>6</sup>.

### Abstract

**PURPOSE:** We update the incidence of intraocular foreign bodies (IOFB) in soldiers admitted to Walter Reed Army Medical Center from 2001 to 2011 after sustaining combat injuries in Operation Iraqi Freedom and Operation Enduring Freedom.

**DESIGN:** This consecutive retrospective case series included 890 eyes of 652 patients.

**METHODS:** Data were collected in the Walter Reed Ocular Trauma Database. Inclusion criteria were any American soldier or Department of Defense civilian with an IOFB injured in Operation Iraqi Freedom/Operation Enduring Freedom. Closed globe injuries with orbital foreign bodies, injury outside of a combat zone, or non-Department of Defense civilian trauma were the exclusion criteria.

**MAIN OUTCOME MEASURES:** Primary outcome measures were final visual outcome and the number, size, and location of IOFBs. Secondary outcome measures included surgical procedures, use of eye protection, associated complications, source of injury and Ocular Trauma Score.

**RESULTS:** There were 890 eye injuries in 652 patients evacuated to Walter Reed Army Medical Center between 2001 and 2011. IOFBs were found in 166 eyes of 149 patients (18.6%; 95% confidence interval [CI], 16.2%-21.3%). Most patients had a single IOFB (80.7%). An IOFB was positively associated with Ocular Trauma Score grade 1 or 2 (0-65) injuries (odds ratio [OR], 1.58; 95% CI, 1.07-2.38; P = 0.01). There were 130 eyes (78.33%) that had recorded time from initial visual acuity to final visual acuity and it ranged from 8 to 2421 days (mean, 433.24 days). Thirty-eight (25.16%; 95% CI, 18.89%-32.67%) eyes had no change in visual acuity, 98 (64.90%; 95% CI, 57.00%-72.07%) had improved visual acuity, and 15 (9.93%; 95% CI, 6.01%-15.84%) had decreased visual acuity. IOFB was not found to predict final visual acuity of <20/200 in multivariate analysis when other injury features were known (P = 0.1). Pars plana vitrectomy was completed on 124 eyes (74.70%). Removal of IOFB was performed in 118 eyes (71.08%; average of 31.67 days after initial injury) with a delayed procedure occurring after primary closure and antibiotics owing to a lack of surgical capacity in Iraq and Afghanistan. Retinal detachment occurred in 48 eyes (28.92%) and proliferative vitreoretinopathy in 44 eyes (26.5%).

### CONCLUSIONS:

IOFBs occur frequently in combat ocular trauma and are significantly associated with more severe injuries. However, IOFBs were not found to be a significant risk factor for visual acuity of <20/200.

PMID: 30037644 DOI: [10.1016/j.ophtha.2018.06.006](https://doi.org/10.1016/j.ophtha.2018.06.006)



## **Surgery at Sea: The Effect of Simulated High Sea States on Surgical Performance.**

[Pierce E](#), [Rapada R](#), [Herder PA](#), [LaPorta AJ](#), [Hoang TN](#), [Pena M](#), [Blankenship J](#), [Kiser J](#), [Catlin SA](#).

### **Abstract**

**BACKGROUND:** The US Navy initiated design concepts for a Medical Mission Module Support Container (M3SC), a mobile operating room capable of rapid installation aboard maneuverable ships within proximity of active combat units. The M3SC provides an alternative echelon of care in the current trauma system by decreasing the time between point of injury, arrival, and surgical intervention. The mobile ships used as M3SC platforms, however, are more susceptible to oceanic conditions that can induce detrimental physiologic motion sickness in medical personnel and patients aboard the vessels. This study investigated the effects of different sea-state motion conditions on the performance of surgical teams.

**METHODS:** Six four-person surgical teams performed 144 procedures in an M3SC aboard a Stewart motion table that simulated motion profiles of sea states 0, 3, and 4. A modified human-worn partial-task surgical simulator was used as a surgical surrogate to simulate the four most common, wartime, improvised explosive device injuries in the past 10 years. Electroencephalographs and heart rate variability (HRV) data were collected from surgeons and surgical technologists during each procedure to assess real-time physiologic responses to motion. Two postprocedure surveys, a Surgical Task Load Index and a Motion Sickness Assessment Questionnaire, were given to assess subjective responses of workload stress and motion-induced kinetosis. Surgical subject matter experts quantified surgical performance after each procedure by measuring blood loss and orthopedic pin placement to evaluate each intervention.

**RESULTS:** Motion did not significantly influence overall performance ( $p = .002$ ). Surgical procedure was the strongest predictor of performance. HRV was used to measure stress and was increased in surgical technologists; however, HRV was decreased for surgeons and technologists in motion. There was a significant interaction between role and motion ( $p = .002$ ): Surgeons had higher workloads than did surgical technologists and neither demonstrated differences between motion and no motion. Surgeons demonstrated significantly decreased workloads under motion conditions ( $p = 0.002$ ); however, surgeons perceived their workload to be higher. We attribute this to their increased critical thinking and physical execution of procedures. Surgeons and surgical technologists showed a trend toward HRV suppression within the motion conditions. This may indicate a coping response to the increased stress of the motion setting. Procedure and team dynamic were the strongest predictors of overall performance, suggesting a learning curve exists and that added focus on training should be enforced.

**CONCLUSION:** Based on data collected in this study, similar surgical procedures should be implemented aboard these classes of ships. By doing so, injured military personnel would have more timely access to care. Surgical team members were aware of craft motion, used compensatory measures, and exhibited some physiological response.

## Osteomyelitis Risk Factors Related to Combat Trauma Open Tibia Fractures: A Case-Control Analysis.

[Tribble DR](#)<sup>1</sup>, [Lewandowski LR](#)<sup>2</sup>, [Potter BK](#)<sup>2</sup>, [Petfield JL](#)<sup>3</sup>, [Stinner DJ](#)<sup>3</sup>, [Ganesan A](#)<sup>1,4,5</sup>, [Krauss M](#)<sup>6</sup>, [Murray CK](#)<sup>3</sup>; [Trauma Infectious Disease Outcomes Study Group](#).

### [Collaborators \(9\)](#)

[Weintrob AC](#), [Warkentien T](#), [Hsu JR](#), [Fraser J](#), [Bennett D](#), [McClung A](#), [Bradley W](#), [Greenberg L](#), [Xu J](#).

### Abstract

**OBJECTIVES:** We assessed osteomyelitis risk factors in US military personnel with combat-related open tibia fractures (2003-2009).

**METHODS:** Patients with open tibia fractures who met the diagnostic criteria of osteomyelitis were identified as cases using Military Health System data and verified through medical record review. Controls were patients with open tibia fractures who did not meet osteomyelitis criteria. The Gustilo-Andersen fracture classification scheme was modified to include transtibial amputations (TTAs) as the most severe level. Logistic regression multivariable odds ratios [ORs; 95% confidence intervals (CI)] were assessed.

**RESULTS:** A total of 130 tibia osteomyelitis cases and 85 controls were identified. Excluding patients with TTAs, osteomyelitis cases had significantly longer time to radiographic union compared with controls (median: 210 vs. 165 days). Blast injuries, antibiotic bead utilization,  $\geq$  Gustilo-Andersen-IIIb fractures [highest risk with TTA (OR: 15.10; CI: 3.22-71.07)], and foreign body at the fracture site were significantly associated with developing osteomyelitis. In a separate model, the Orthopaedic Trauma Association Open Fracture Classification muscle variable was significant with increasing risk from muscle loss (OR: 5.62; CI: 2.21-14.25) to dead muscle (OR: 8.46; CI: 3.31-21.64). When TTAs were excluded, significant risk factors were similar and included sustaining an injury between 2003 and 2006.

**CONCLUSIONS:** Patients with severe blast trauma resulting in significant muscle damage are at the highest risk for osteomyelitis. The period association coincides with a time frame when several trauma system practice changes were initiated (eg, increased negative pressure wound therapy, decreased high-pressure irrigation, and reduced crystalloid use).

**LEVEL OF EVIDENCE:** Prognostic Level III. See Instructions for Authors for a complete description of levels of evidence. PMID: 29878946 PMCID: [PMC6103838](#) [Available on 2019-09-01] DOI: [10.1097/BOT.0000000000001225](#)

## A US military Role 2 forward surgical team database study of combat mortality in Afghanistan.

[Kotwal RS<sup>1</sup>](#), [Staudt AM](#), [Mazuchowski EL](#), [Gurney JM](#), [Shackelford SA](#), [Butler FK](#), [Stockinger ZT](#), [Holcomb JB](#), [Nessen SC](#), [Mann-Salinas EA](#).

### Abstract

**BACKGROUND:** Timely and optimal care can reduce mortality among critically injured combat casualties. US military Role 2 surgical teams were deployed to forward positions in Afghanistan on behalf of the battlefield trauma system. They received prehospital casualties, provided early damage control resuscitation and surgery, and rapidly transferred casualties to Role 3 hospitals for definitive care. A database was developed to capture Role 2 data.

**METHODS:** A retrospective review and descriptive analysis were conducted of battle-injured casualties transported to US Role 2 surgical facilities in Afghanistan from February 2008 to September 2014. Casualties were analyzed by mortality status and location of death (pretransport, intratransport, or posttransport), military affiliation, transport time, injury type and mechanism, combat mortality index-prehospital (CMI-PH), and documented prehospital treatment.

**RESULTS:** Of 9,557 casualties (median age, 25.0 years; male, 97.4%), most (95.1%) survived to transfer from Role 2 facility care. Military affiliation included US coalition forces (37.4%), Afghanistan National Security Forces (23.8%), civilian/other forces (21.3%), Afghanistan National Police (13.5%), and non-US coalition forces (4.0%). Mortality differed by military affiliation ( $p < 0.001$ ). Among fatalities, most were Afghanistan National Security Forces (30.5%) civilian/other forces (26.0%), or US coalition forces (25.2%). Of those categorized by CMI-PH, 40.0% of critical, 11.2% of severe, 0.8% of moderate, and less than 0.1% of mild casualties died. Most fatalities with CMI-PH were categorized as critical (66.3%) or severe (25.9%), whereas most who lived were mild (56.9%) or moderate (25.4%). Of all fatalities, 14.0% died prehospital (pretransport, 5.8%; intratransport, 8.2%), and 86.0% died at a Role 2 facility (posttransport). Of fatalities with documented transport times (median, 53.0 minutes), most (61.7%) were evacuated within 60 minutes.

**CONCLUSIONS:** Role 2 surgical team care has been an important early component of the battlefield trauma system in Afghanistan. Combat casualty care must be documented, collected, and analyzed for outcomes and trends to improve performance.

**LEVEL OF EVIDENCE:** Therapeutic/Care Management, level IV.

PMID: 29851907 DOI: [10.1097/TA.0000000000001997](https://doi.org/10.1097/TA.0000000000001997)

## **Recent advances in austere combat surgery: Use of aortic balloon occlusion as well as blood challenges by special operations medical forces in recent combat operations.**

[Northern DM](#)<sup>1</sup>, [Manley JD](#), [Lyon R](#), [Farber D](#), [Mitchell BJ](#), [Filak KJ](#), [Lundy J](#), [DuBose JJ](#), [Rasmussen TE](#), [Holcomb JB](#).

### **Abstract**

**BACKGROUND:** Resuscitative endovascular balloon occlusion of the aorta (REBOA) for control of noncompressible torso hemorrhage is a technology that is increasingly being utilized in the combat casualty setting. Its use in the resource restricted environment holds potential to improve hemorrhage control, decrease blood product utilization, decrease morbidity, and improve combat mortality. The objective of this report is to present the single largest series of REBOA use on severely injured combat casualties.

**METHODS:** Over an 18-month period, austere surgical teams comprised of coalition partners provided initial damage control resuscitation (DCR) and surgical stabilization for over 2,300 combat casualties prior to transferring patients to the next level of trauma care.

**RESULTS:** Twenty patients presented with injuries from explosion and gunshot wounds with mean initial heart rate of 129 bpm and mean initial systolic blood pressure of 71 mm Hg. Femoral cutdowns were used in six patients. Aortic occlusion was achieved with REBOA catheter placement in Zone 1 (n = 17) and Zone 3 (n = 2). Systolic blood pressure increased an average of 56 mm Hg with aortic occlusion. There were no access related site complications. All patients survived transport to the next level of care. The majority of blood products transfused in this cohort were whole blood, largely supported by emergent blood drives.

**CONCLUSION:** This series demonstrates the potential for REBOA as a lifesaving technique for the patient who presents with hemodynamic instability and noncompressible torso hemorrhage. Resuscitative endovascular balloon occlusion of the aorta allows austere surgical teams to rapidly stabilize severely injured combat casualties, expand capability, and provide enhanced DCR while minimizing personnel, resources, and blood product utilization. The use of "whole blood only" strategy for DCR shows potential to be superior to traditional component therapy, and when combined with "proactive" REBOA utilization, provides significant improvements in hemodynamics and hemorrhage control.

**LEVEL OF EVIDENCE:** Case series, level V. PMID: 29787545 DOI: [10.1097/TA.0000000000001966](#)

## **Vascular surgery during U.S. combat operations from 2002 to 2016: Analysis of vascular procedures performed to inform military training.**

[Turner CA](#)<sup>1</sup>, [Stockinger ZT](#), [Gurney JM](#).

### **Author information**

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### **Abstract**

**BACKGROUND:** Vascular surgery constitutes approximately 6.5% of surgical procedures performed for combat injuries, yet general surgeons are increasingly unfamiliar with vascular surgery. This study examines the frequency and type of vascular surgical procedures performed during recent US Military operations from 2002 to 2016.

**METHODS:** A retrospective analysis of the Department of Defense Trauma Registry was performed for all Role (R)2 and R3 medical treatment facilities (MTFs), from January 2002 to May 2016. A total of 106 International Classification of Diseases-9th Rev.-Clinical Modification (ICD-9-CM) procedure codes were categorized as vascular and were included in the present analysis. Procedure codes were separated by anatomic location and procedure type. Ligation as part of an amputation was excluded. Grafts were further subdivided by type: synthetic, autologous, and unknown. Procedure grouping and categorization were determined by subject matter experts. Data analysis used Stata Version 14 (College Station, TX).

**RESULTS:** A total of 25,816 vascular surgical procedures were identified at R2 and R3 MTFs. Role 3 MTFs reported more than four times the number of procedures compared to R2 MTFs. The most common anatomic locations documented were extremity (64.96%) and not otherwise specified (28.1%). The most common procedures overall were amputation (33.36%) and fasciotomy (18.83%). The most common graft type was autologous (68.87%), and the least common was synthetic (5.69%).

**CONCLUSION:** While amputation, fasciotomy, and ligation were the most common vascular procedures performed for combat trauma, the need for definitive repair including grafting is common at both R2 and R3 MTFs. Vascular surgery therefore remains a necessary skill set for the deployed US Military surgeon; military general surgeons need to train and sustain their vascular skills, including proficiency at amputation and fasciotomy.

**LEVEL OF EVIDENCE:** Epidemiologic study, level III.

PMID: 29462088 DOI: [10.1097/TA.0000000000001849](https://doi.org/10.1097/TA.0000000000001849)