

# Committee on Surgical Combat Casualty Care (CoSCCC)



**Journal Watch**

**4th Quarter**

**FY2019**

## 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	

# An Evaluation of a Novel Medical Device Versus Standard Interventions in the Treatment of Tension Pneumothorax in a Swine Model (*Sus scrofa*).

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## **Abstract**

### **INTRODUCTION:**

Tension pneumothorax is a common cause of preventable death in trauma. Needle decompression is the traditional first-line intervention but has high failure rates. We sought to evaluate the effectiveness and expedience of needle thoracostomy, surgical tube thoracostomy, and Reactor™ thoracostomy - a novel spring-loaded trocar insertion device.

### **MATERIALS AND METHODS:**

Yorkshire swine underwent controlled thoracic insufflation to create tension pneumothorax physiology for device comparison. Additional experiments were performed by increasing insufflation pressures to achieve pulseless electrical activity. Intervention was randomized to needle thoracostomy (14 gauge), tube thoracostomy (32Fr), or Reactor™ thoracostomy (36Fr). Air leak was simulated throughout intervention with 40-80 mL/kg/min insufflation. Intrathoracic pressure monitoring and hemodynamic parameters were obtained at 1 and 5 minutes.

### **RESULTS:**

Tension physiology and tension-induced pulseless electrical activity were created in all iterations. Needle thoracostomy (n = 28) was faster at  $7.04 \pm 3.04$  seconds than both Reactor thoracostomy (n = 32),  $11.63 \pm 5.30$  (p < 0.05) and tube thoracostomy (n = 32),  $27.06 \pm 10.73$  (p < 0.01); however, Reactor™ thoracostomy was faster than tube thoracostomy (p < 0.001). Physiological decompression was achieved in all patients treated with Reactor™ and tube thoracostomy, but only 14% of needle thoracostomy. Cardiac recovery to complete physiologic baseline occurred in only 21% (6/28) of those treated with needle thoracostomy whereas Reactor™ or tube thoracostomy demonstrated 88% (28/32) and 94% (30/32) response rates. When combined, needle thoracostomy successfully treated tension pneumothorax in only 4% (1/28) of subjects as compared to 88% (28/32) with Reactor™ thoracostomy and 94% (30/32) with tube thoracostomy (p < 0.01).

### **CONCLUSIONS:**

Needle thoracostomy provides a rapid intervention for tension pneumothorax, but is associated with unacceptably high failure rates. Reactor™ thoracostomy was effective, expedient, and may provide a useful and technically simpler first-line treatment for tension pneumothorax or tension-induced pulseless electrical activity.

**KEYWORDS:** Battlefield injury; Needle decompression; Prolonged field care; Reactor thoracostomy; Tension pneumothorax

## **Penetrating thoracic injuries: a retrospective analysis from a French military trauma centre.**

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### **Abstract**

#### **BACKGROUND:**

Penetrating thoracic injuries (PTIs) is a medicosurgical challenge for civilian and military trauma teams. In civilian European practice, PTIs are most likely due to stab wounds and mostly require a simple chest tube drainage. On the battlefield, combat casualties suffer severe injuries, caused by high-lethality wounding agents. The aim of this study was to analyse and compare the demographics, injury patterns, surgical management and clinical outcomes of civilian and military patients with PTIs.

#### **METHODS:**

All patients with PTIs admitted to a Level I Trauma Centre in France or to Role-2 facilities in war theatres between 1 January 2004 and 31 May 2016 were included. Combat casualties' data were analysed from Role-2 medical charts. The hospital manages military casualties evacuated from war theatres who had already received primary surgical care, but also civilian patients issued from the Paris area. During the study period, French soldiers were deployed in Afghanistan, in West Africa and in the Sahelo-Saharan band since 2013.

#### **RESULTS:**

52 civilian and 17 military patients were included. Main mechanisms of injury were stab wounds for civilian patients, and gunshot wounds and explosive fragments for military casualties. Military patients suffered more severe injuries and needed more thoracotomies. In total, 29 (33%) patients were unstable or in cardiac arrest on admission. Thoracic surgery was performed in 38 (55%) patients (25 thoracotomies and 13 thoracoscopies). In-hospital mortality was 18.8%.

#### **CONCLUSION:**

War PTIs are associated with extrathoracic injuries and higher mortality than PTIs in the French civilian area. In order to reduce the mortality of PTIs in combat, our study highlights the need to improve tactical en route care with transfusion capabilities and the deployment of forward surgical units closer to the combatants. In the civilian area, our results indicated that video-assisted thoracoscopic surgery is a reliable diagnostic and therapeutic technique for haemodynamically stable patients.

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**KEYWORDS:** military medicine; penetrating thoracic injury; thoracotomy; video-assisted thoracoscopic surgery (vats)

# The blast wounded of Raqqa, Syria: observational results from an MSF-supported district hospital.

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## Abstract

### BACKGROUND:

In June 2017, the U.S.-backed Syrian Democratic Forces (SDF) launched a military operation to retake the city of Raqqa, Syria, from the so-called Islamic State. The city population incurred mass numbers of wounded. In the post-offensive period, the population returned to a city (Raqqa) contaminated with improvised explosive devices (IEDs) and explosive remnants of war (ERWs), resulting in a second wave of wounded patients. Médecins Sans Frontières (MSF) supported a hospital in Tal-Abyad (north of Raqqa) and scaled up operations in response to this crisis. We describe the cohort of blast-wounded cases admitted to this hospital in order help prepare future humanitarian responses.

### METHODS:

We retrospectively extracted data from clinical charts in the MSF-supported hospital. We included all new admissions for blast-wounded patients with key data elements documented. We performed comparative analyses from the offensive period (June 6, 2017 to October 17, 2017) and the post-offensive period (October 18, 2017 to March 17, 2018).

### RESULTS:

We included 322 blast related injuries. There were more than twice the number of cases with blast injuries in the post-offensive period as the offensive period (225 vs. 97,  $p < .001$ ). The offensive period saw a significantly higher proportion of female patients (32.0%,  $n = 31$  vs. 11.1%,  $n = 25$ ,  $p < 0.001$ ) and paediatric patients (42.3%,  $n = 41$  vs 24.9%,  $n = 56$ ,  $p = 0.002$ ). Blast-injured patients in the post-offensive period included more cases with multiple traumatic injuries (65.8%,  $n = 148$  vs. 39.2%,  $n = 38$ ,  $p < 0.001$ ). The treatment of the blast-injured cases in the post-offensive period was more labor intensive with those patients having a higher median number of interventions (2 vs 1,  $p = <0.001$ ) and higher median number of days in hospital (7 vs 4,  $p = < 0.001$ ).

### CONCLUSIONS:

In the wake of the Raqqa offensive, the MSF-supported district hospital received an unpredicted second, larger and more complex wave of blast-wounded cases as the population returned to a city strewn with IEDs and ERWs. These findings indicate the high risk of traumatic injury to the population even after warring factions have vacated conflict zones. Medical humanitarian actors should be prepared for a continued and scaled up response in areas known to be highly contaminated with explosive ordnance.

**KEYWORDS:** Blast; Conflict settings; Surgery; Syria; Trauma; Wound care

## Predictors and timing of amputations in military lower extremity trauma with arterial injury.

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### Abstract

#### **INTRODUCTION:**

Military lower extremity arterial injuries present threats to life and limb. These injuries are common and limb salvage is a trauma system priority. Understanding the timing and predictors of amputation through the phases of casualty evacuation can help inform future limb salvage efforts. This study characterizes limbs undergoing amputation at different operationally relevant time points.

#### **METHODS:**

A retrospective cohort study of casualties with lower extremity arterial injuries undergoing initial vascular limb salvage in Iraq and Afghanistan was undertaken. Amputations were grouped as having been performed early (in theater at Role 2 or 3) or late (after evacuation to Role 4 or 5). Further distinction was made between late and delayed (after discharge from initial hospitalization) amputations.

#### **RESULTS:**

Four hundred fifty-five casualties met inclusion criteria with 103 amputations (23%). Twenty-one (20%) were performed in theater and 82 (80%) were performed following overseas evacuation. Twenty-one (26% of late amputations) were delayed, a median of 359 days from injury (interquartile range, 176-582). Most amputations were performed in the first 4 days following injury. Amputation incidence was highest in popliteal injuries (28%). Overall, amputation was predicted by higher incidence of blast mechanism and fracture and greater limb and casualty injury severity. Early amputations had higher limb injury severity than late amputations. Delayed amputations had greater incidence of motor and sensory loss and contracture than early amputations.

#### **CONCLUSION:**

Casualty and limb injury severity predict predictors and timing of amputation in military lower extremity arterial injury. Amputation following overseas evacuation was more common than in-theater amputation, and functional loss is associated with delayed amputation. Future limb salvage efforts should focus on postevacuation and rehabilitative care.

**LEVEL OF EVIDENCE:** Epidemiologic study, level III. PMID: 31246923 DOI: [10.1097/TA.0000000000002185](#)

## Essentials of emergency transfusion-The complement to stop the bleed.

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### Abstract

Over the past decade, the shift toward damage control surgery for bleeding trauma patients has come with an increased emphasis on optimal resuscitation. Two lifesaving priorities predominate: to quickly stop the bleed and effectively resuscitate the hemorrhagic shock. Blood is separated into components for efficient storage and distribution; however, bleeding patients require all components in a balanced ratio. A variety of blood products are available to surgeons, and these products have evolved over time. This review article describes the current standards for resuscitation of bleeding patients, including characteristics of all available products. The relevant details of blood donation and collection, blood banking, blood components, and future therapies are discussed, with the goal of guiding surgeons in their emergency transfusion practice.

PMID: 31348403 DOI: [10.1097/TA.0000000000002298](#)

# Damage control resuscitation and surgery for indigenous combat casualties: a prospective observational study.

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## **Abstract**

### **INTRODUCTION:**

Specialist units that assist indigenous forces (IF) in their strategic aims are supported by medical teams providing point of injury emergency care for casualties, including IF and civilians (Civ). We investigated the activities of a Coalition Forces far-forward medical facility, in order to inform medical providers about the facilities and resources required for medical support to IF and Civ during such operations.

### **METHODS:**

A prospective observational study (June to August 2017) undertaken at a far-forward Coalition Forces medical support unit (12 rotating personnel) recorded patient details (IF or Civ), mechanism of injury (MOI), number of blood products used, damage control resuscitation (DCR) and damage control surgery (DCS), number of mass casualty (MASCAL) scenarios, resuscitative thoracotomy, resuscitative endovascular balloon occlusion of the aorta (REBOA) and whole blood emergency donor panels (EDP).

### **RESULTS:**

680 casualties included 478 IF and 202 Civ (45.5% of the Civ were paediatric). Most common MOIs were blast (n=425; 62.5%) and gunshot wound (n=200; 29.4%). Fifteen (2.2%) casualties died; 627 (92.2%) were transferred to local hospitals. DCR was used for 203 (29.9%), and DCS for 182 (26.8%) casualties. There were 23 MASCAL scenarios, 1220 transfusions and 32 EDPs. REBOA was performed eight times, and thoracotomy was performed 27 times.

### **CONCLUSIONS:**

A small medical team provided high-tempo emergency resuscitative care for hundreds of IF and Civ casualties within a short space of time using state-of-the-art resuscitative modalities. DCR and DCS were undertaken with a large number of EDPs, and a high survival-to-transfer rate.

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### **KEYWORDS:**

accident and emergency medicine; adult intensive and critical care; organisation of health services; surgery; trauma management



## Early identification of trauma patients in need for emergent transfusion: results of a single-center retrospective study evaluating three scoring systems.

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### Abstract

#### BACKGROUND:

The Trauma-Induced Coagulopathy Clinical Score (TICCS) was developed to be calculable on the site of injury to discriminate between trauma patients with or without the need for damage control resuscitation and thus transfusion. This early alert could then be translated to in-hospital parameters at patient arrival. Base excess (BE) and ultrasound (FAST) are known to be predictive parameters for emergent transfusion. We emphasize that adding these two parameters to the TICCS could improve the scoring system predictability.

#### METHODS:

A retrospective study was conducted in the University Hospital of Liège. TICCS was calculated for every patient. BE and FAST results were recorded and points were added to the TICCS according to the TICCS.BE definition (+ 3 points if BE < - 5 and + 3 points in case of a positive FAST). Emergent transfusion was defined as the use of at least one blood product in the resuscitation room. The capacity of the TICCS, the TICCS.BE and the Trauma-Associated Severe Hemorrhage (TASH) to predict emergent transfusion was assessed.

#### RESULTS:

A total of 328 patients were included. Among them, 14% needed emergent transfusion. The probability for emergent transfusion grows with the TICCS and the TICCS.BE values. We did not find a significant difference between the TICCS (AUC 0.73) and the TICCS.BE (AUC 0.76). The TASH proved to be more predictive (AUC 0.89). 66.6% of the patients with a TICCS ≥ 10 and 81.5% with a TICCS.BE ≥ 14 required emergent transfusion.

#### CONCLUSION:

Adding BE and FAST to the original TICCS does not significantly improve the scoring system predictability. A prehospital TICCS > 10 could be used as a trigger for emergent transfusion activation. TASH could then be used at hospital arrival. Prehospital TASH calculation may be possible but should be further investigated.

**LEVEL OF EVIDENCE:** Diagnostic test, level III.

**KEYWORDS:** Blood products transfusion; Coagulopathy; Prehospital care; Trauma

## Use of Combat Casualty Care Data to Assess the US Military Trauma System During the Afghanistan and Iraq Conflicts, 2001-2017.

[Howard JT](#)<sup>1,2</sup>, [Kotwal RS](#)<sup>2,3,4</sup>, [Stern CA](#)<sup>2</sup>, [Janak JC](#)<sup>2</sup>, [Mazuchowski EL](#)<sup>2,5</sup>, [Butler FK](#)<sup>2</sup>, [Stockinger ZT](#)<sup>2,6</sup>, [Holcomb BR](#)<sup>7</sup>, [Bono RC](#)<sup>8</sup>, [Smith DJ](#)<sup>8</sup>.

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### Abstract

#### IMPORTANCE:

Although the Afghanistan and Iraq conflicts have the lowest US case-fatality rates in history, no comprehensive assessment of combat casualty care statistics, major interventions, or risk factors has been reported to date after 16 years of conflict.

#### OBJECTIVES:

To analyze trends in overall combat casualty statistics, to assess aggregate measures of injury and interventions, and to simulate how mortality rates would have changed had the interventions not occurred.

#### DESIGN, SETTING, AND PARTICIPANTS:

Retrospective analysis of all available aggregate and weighted individual administrative data compiled from Department of Defense databases on all 56 763 US military casualties injured in battle in Afghanistan and Iraq from October 1, 2001, through December 31, 2017. Casualty outcomes were compared with period-specific ratios of the use of tourniquets, blood transfusions, and transport to a surgical facility within 60 minutes.

#### MAIN OUTCOMES AND MEASURES:

Main outcomes were casualty status (alive, killed in action [KIA], or died of wounds [DOW]) and the case-fatality rate (CFR). Regression, simulation, and decomposition analyses were used to assess associations between covariates, interventions, and individual casualty status; estimate casualty transitions (KIA to DOW, KIA to alive, and DOW to alive); and estimate the contribution of interventions to changes in CFR.

#### RESULTS:

In aggregate data for 56 763 casualties, CFR decreased in Afghanistan (20.0% to 8.6%) and Iraq (20.4% to 10.1%) from early stages to later stages of the conflicts. Survival for critically injured casualties (Injury Severity Score, 25-75 [critical]) increased from 2.2% to 39.9% in Afghanistan and from 8.9% to 32.9% in Iraq. Simulations using data from 23 699 individual casualties showed that without interventions assessed, CFR would likely have been higher in Afghanistan (15.6% estimated vs 8.6% observed) and Iraq (16.3% estimated vs 10.1% observed), equating to 3672 additional deaths (95% CI, 3209-4244 deaths), of which 1623 (44.2%) were associated with the interventions studied: 474 deaths (12.9%) (95% CI, 439-510) associated with the use of tourniquets, 873 (23.8%) (95% CI, 840-910) with blood transfusion, and 275 (7.5%) (95% CI, 259-292) with prehospital transport times.

#### CONCLUSIONS AND RELEVANCE:

Our analysis suggests that increased use of tourniquets, blood transfusions, and more rapid prehospital transport were associated with 44.2% of total mortality reduction. More critically injured casualties reached surgical care, with increased survival, implying improvements in prehospital and hospital care.

[J Trauma Acute Care Surg](#). 2019 Jul;87(1S Suppl 1):S22-S27. doi: 10.1097/TA.0000000000002301.

## **A contemporary report on US military guidelines for the use of whole blood and resuscitative endovascular balloon occlusion of the aorta.**

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