

# Committee on Surgical Combat Casualty Care (CoSCCC)



**Journal Watch**

**2nd Quarter**

**FY 2022**

## 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	Hypocalcemia
Predictions	Vital Signs	Global Surgery
Limb Salvage	Temporary Shunts	

# Hemorrhagic Resuscitation Guided by Viscoelastography in Far-Forward Combat and Austere Civilian Environments: Goal-Directed Whole-Blood and Blood-Component Therapy Far from the Trauma Center

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## Abstract

Modern approaches to resuscitation seek to bring patient interventions as close as possible to the initial trauma. In recent decades, fresh or cold-stored whole blood has gained widespread support in multiple settings as the best first agent in resuscitation after massive blood loss. However, whole blood is not a panacea, and while current guidelines promote continued resuscitation with fixed ratios of blood products, the debate about the optimal resuscitation strategy-especially in austere or challenging environments-is by no means settled. In this narrative review, we give a brief history of military resuscitation and how whole blood became the mainstay of initial resuscitation. We then outline the principles of viscoelastic hemostatic assays as well as their adoption for providing goal-directed blood-component therapy in trauma centers. After summarizing the nascent research on the strengths and limitations of viscoelastic platforms in challenging environmental conditions, we conclude with our vision of how these platforms can be deployed in far-forward combat and austere civilian environments to maximize survival.

**Keywords:** austere environment; blood-component therapy; far forward; goal-directed therapy; resuscitation; viscoelastic testing; whole blood.

# Whole blood at the tip of the spear: A retrospective cohort analysis of warm fresh whole blood resuscitation versus component therapy in severely injured combat casualties

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## Abstract

**Background:** Death from uncontrolled hemorrhage occurs rapidly, particularly among combat casualties. The US military has used warm fresh whole blood during combat operations owing to clinical and operational exigencies, but published outcomes data are limited. We compared early mortality between casualties who received warm fresh whole blood versus no warm fresh whole blood.

**Methods:** Casualties injured in Afghanistan from 2008 to 2014 who received  $\geq 2$  red blood cell containing units were reviewed using records from the Joint Trauma System Role 2 Database. The primary outcome was 6-hour mortality. Patients who received red blood cells solely from component therapy were categorized as the non-warm fresh whole blood group. Non-warm fresh whole blood patients were frequency-matched to warm fresh whole blood patients on identical strata by injury type, patient affiliation, tourniquet use, prehospital transfusion, and average hourly unit red blood cell transfusion rates, creating clinically unique strata. Multilevel mixed effects logistic regression adjusted for the matching, immortal time bias, and other covariates.

**Results:** The 1,105 study patients (221 warm fresh whole blood, 884 non-warm fresh whole blood) were classified into 29 unique clinical strata. The adjusted odds ratio of 6-hour mortality was 0.27 (95% confidence interval 0.13-0.58) for the warm fresh whole blood versus non-warm fresh whole blood group. The reduction in mortality increased in magnitude (odds ratio = 0.15,  $P = .024$ ) among the subgroup of 422 patients with complete data allowing adjustment for seven additional covariates. There was a dose-dependent effect of warm fresh whole blood, with patients receiving higher warm fresh whole blood dose ( $>33\%$  of red blood cell-containing units) having significantly lower mortality versus the non-warm fresh whole blood group.

**Conclusion:** Warm fresh whole blood resuscitation was associated with a significant reduction in 6-hour mortality versus non-warm fresh whole blood in combat casualties, with a dose-dependent effect. These findings support warm fresh whole blood use for hemorrhage control as well as expanded study in military and civilian trauma settings.

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# Use of Dried Plasma in Prehospital and Austere Environments

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***No abstract available***

# Clinical Characteristics and Resistance Patterns of *Pseudomonas aeruginosa* Isolated From Combat Casualties

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## Abstract

**Introduction:** Multidrug-resistant (MDR) Gram-negative infections complicate care of combat casualties. We describe the clinical characteristics, resistance patterns, and outcomes of *Pseudomonas aeruginosa* infections in combat casualties.

**Methods:** Combat casualties included in the Trauma Infectious Disease Outcomes Study with infections with and without *P. aeruginosa* isolation during initial hospitalization were compared. *Pseudomonas aeruginosa* from initial wound, blood, and serial isolates ( $\geq 7$  days from previous isolate) collected from June 2009 through February 2014 was subjected to antimicrobial susceptibility testing, pulsed-field gel electrophoresis, and whole genome sequencing for assessing clonality. Multidrug resistance was determined using the CDC National Healthcare Safety Network definition.

**Results:** Of 829 combat casualties with infections diagnosed during initial hospitalization, 143 (17%) had *P. aeruginosa* isolated. Those with *P. aeruginosa* were more severely injured (median Injury Severity Score 33 [interquartile range (IQR) 27-45] vs 30 [IQR 18.5-42];  $P < .001$ ), had longer hospitalizations (median 58.5 [IQR 43-95] vs 38 [IQR 26-56] days;  $P < .001$ ), and higher mortality (6.9% vs 1.5%;  $P < .001$ ) than those with other organisms. Thirty-nine patients had serial *P. aeruginosa* isolation (median 2 subsequent isolates; IQR: 1-5), with decreasing antimicrobial susceptibility. Ten percent of *P. aeruginosa* isolates were MDR, associated with prior exposure to antipseudomonal antibiotics ( $P = .002$ ), with amikacin and colistin remaining the most effective antimicrobials. Novel antimicrobials targeting MDR Gram-negative organisms were also examined, and 100% of the MDR *P. aeruginosa* isolates were resistant to imipenem/relebactam, while ceftazidime/avibactam and ceftolozane/tazobactam were active against 35% and 56% of the isolates, respectively. We identified two previously unrecognized *P. aeruginosa* outbreaks involving 13 patients.

**Conclusions:** *Pseudomonas aeruginosa* continues to be a major cause of morbidity, affecting severely injured combat casualties, with emergent antimicrobial resistance upon serial isolation. Among MDR *P. aeruginosa*, active antimicrobials remain the oldest and most toxic. Despite ongoing efforts, outbreaks are still noted, reinforcing the crucial role of antimicrobial stewardship and infection control.