

Expeditionary Resuscitation Surgical Team

The US Army's Initiative to Provide Damage Control Resuscitation and Surgery to Forces in Austere Settings

Matthew R. D'Angelo, DNP, CRNA^{1*}; John Losch, MPAS, PA-C²; Bret Smith, MPAS, PA-C³; Mark Geslak, MPAS, PA-C⁴; Shon Compton, MPAS, PA-C⁵; Kenneth Wofford, PhD, CRNA⁶; Jason M. Seery, MD⁷; Michael Morrison, DSc, PA-C⁸; Ian Wedmore, MD⁹; James Pairemore, MPAS, PA-C¹⁰; Kirby R. Gross, MD¹¹; Peter Cuenca, MD¹²; Matthew D. Welder, DNP, CRNA¹³

ABSTRACT

Improvements in surgical care on the battlefield have contributed to reduced morbidity and mortality in wounded Servicemembers.¹ Point-of-injury care and early surgical intervention, along with improved personal protective equipment, have produced the lowest casualty statistics in modern warfare, resulting in improved force strength, morale, and social acceptance of conflict. It is undeniable that point-of-care injury, followed by early resuscitation and damage control surgery, saves lives on the battlefield. The US Army's Expeditionary Resuscitation Surgical Team (ERST) is a highly mobile, interprofessional medical team that can perform damage control resuscitation and surgery in austere locations. Its configuration and capabilities vary; however, in general, a typical surgical element can perform one major surgery and one minor surgery without resupply. The critical care element can provide prolonged holding in garrison, but this diminishes in the austere setting with complex and acutely injured patients.

KEYWORDS: *expeditionary, healthcare teams; military, capabilities; austere environment*

Introduction

Improvements in surgical care on the battlefield have contributed to reduced morbidity and mortality in wounded Servicemembers.¹ Point-of-injury care and early surgical intervention, along with improved personal protective equipment, have produced the lowest casualty statistics in modern warfare, resulting in improved force strength, morale, and social acceptance of conflict. It is undeniable that point-of-care injury, followed by early resuscitation and damage control surgery, saves lives on the battlefield.²

Prolonged hypovolemia and ischemia increase morbidity and mortality risks for patients suffering from hemorrhagic shock.^{2,3}

Although most prehospital battlefield deaths are due to non-survivable injuries, data from the Joint Theatre Trauma System suggest that as many as 25% of those who died in Iraq and Afghanistan died of injuries that were potentially survivable if it had been possible to get the injured person to a surgeon.⁴

The purpose of this manuscript is to briefly review casualty movement from the point of injury to surgical care on the battlefield, describe ad hoc methods to improve battlefield access to surgical care, and describe the unit composition and medical capabilities of the ERST.

Surgery on the Battlefield

In the long-standing model of battlefield casualty evacuation, patients are evacuated through echelons of care that are Role dependent and at increasing distances from the battlefield. Typically, injured Servicemembers receive treatment at the point of injury. Based on initial triage and geographic location, injuries that require additional in-theatre care can progress to Role 1 or Role 2 facilities like the battalion aid station, medical company, and forward surgical team (FST), or progress to the technologically more advanced Combat Support Hospital platform (Role 3). Patients with complex injuries or those requiring prolonged rehabilitation are evacuated after initial stabilization to fixed facilities (Role 4) outside the theatre of operations.⁵

Patient evacuation through the continuum of care depends on the phase of war, the maturity of the theatre, and air superiority. The availability of transportation resources (air versus ground), tactical environment (secure versus hostile), geographic location (austere versus well developed), and weather all influence the flow of casualties to Role facilities of increasing levels of care. Although evacuation technologies have evolved from the horse-drawn ambulances of the US Civil War

*Address correspondence to matthew.dangelo@usuhs.edu

¹MAJ D'Angelo, AN USAR, is at the Uniformed Services University of the Health Sciences, Daniel K. Inouye Graduate School of Nursing, Bethesda, MD. ²CPT Losch, SP USA, is at the AMEDD Center and School, Center for Predeployment Medicine, Tactical Combat Medical Care Course, Fort Sam Houston, TX. ³MAJ Smith, SP USA (Ret), is at the AMEDD Center and School, Center for Predeployment Medicine, Tactical Combat Medical Care Course, Fort Sam Houston, TX. ⁴MAJ Geslak, SP USA (Ret), is at the AMEDD Center and School, Center for Predeployment Medicine, Tactical Combat Medical Care Course, Fort Sam Houston, TX. ⁵MAJ Compton, SP USA (Ret), is at the AMEDD Center and School, Center for Predeployment Medicine, Tactical Combat Medical Care Course, Fort Sam Houston, TX. ⁶CDR Wofford, NC USN, is at the Uniformed Services University of the Health Sciences, Bethesda, MD. ⁷LTC(P) Seery, MC USA, is at Martin Army Community Hospital, Surgical Services Service Line, Fort Benning, GA. ⁸MAJ Morrison, SP USA, is at the AMEDD Center and School, Center for Predeployment Medicine, Tactical Combat Medical Care Course, Fort Sam Houston, TX. ⁹COL Wedmore, MC USA, is at the Department of Emergency Medicine, Madigan Army Medical Center, Joint Base Lewis-McChord, WA. ¹⁰LTC Pairemore, SP USA, is at HQDA, Office of the Surgeon General, Falls Church, VA. ¹¹COL Gross, MC USA, is at the Army Trauma Training Department, AMEDD Center and School Health Readiness Center of Excellence, Ryder Trauma Center, Miami, FL. ¹²COL Cuenca, MC USA, is at the AMEDD Center and School, Center for Predeployment Medicine, Tactical Combat Medical Care Course, Fort Sam Houston, TX. ¹³LTC Welder, AN USA (Ret), is at the Uniformed Services University of the Health Sciences, Bethesda, MD.

and World War I to the technologically advanced aeromedical evacuation of modern war, the model of patient movement remains nearly the same.⁶ Injured patients are triaged and cared for at the site of injury, then moved over distances to receive surgical intervention. Patient movement is time and distance dependent and, therefore, may prolong medical intervention.

The military medical community has made several attempts to reduce the time from combat injury to damage control care. The Special Operations Forces (SOF) medical community has pioneered the use of damage control surgery and damage control resuscitation near the point of injury for decades.^{7,8} Role 2 platforms like the Special Operations Resuscitation Teams (SORTs), Special Operations Surgical Teams, and Special Operations Critical Care Evacuation Team provide resuscitative, surgical, and evacuation assets far forward, near, or at the point of injury.⁷

SOF resuscitative and surgical teams have a long history of supporting unconventional warfare units in austere locations; however, the paradigm of embedding or strategically positioning these teams near conventional forces had not been routinely practiced until the war in Afghanistan. The complexity of the Afghan theatre has challenged traditional medical doctrine. Vast mountain ranges, hostile locations, and an immature and inadequate highway infrastructure present several limitations to timely evacuation of those injured on the battlefield.

In response to evacuation barriers, Golden Hour Offset Surgical Teams (GHOSTs) were developed to improve Servicemember access to resuscitation and surgical care. GHOSTs are ad hoc resuscitative and surgical teams developed from conventional FSTs. GHOSTs are split from their organic units and can move to austere locations to provide critical services to units outside the range of rapid medical evacuation. Although GHOSTs have proven effective in bringing damage control care closer to the point of injury, they lack standardized training, use inefficient and less-mobile FST equipment, and require specific transportation assets to deploy. The disadvantages of the GHOST suggest a need to develop a standardized resuscitative and surgical team that can support units serving in austere locations.

Expeditionary Resuscitation Surgical Team

To meet the challenges of the evolving battle space and provide a formalized, discrete medical platform to serve in austere locations, the US Army Medical Command (MEDCOM) has introduced the concept of expeditionary medicine. The ERST is at the forefront of this campaign. A formal request to develop ERST training was made by the Office of the Surgeon General of the Army in January 2016 to the US Army Medical Department Center and School, Center for Predeployment Medicine, division of Tactical Combat Medical Care. Formally, the ERST's mission is to field a rapidly deployable team to provide immediate forward resuscitation, surgery, prolonged field care, and en route critical care in support of SOF missions to include foreign internal defense, counterterrorism, direct action, security force assistance, and counterinsurgency in austere environments.

ERST Composition

The ERST concept was designed to provide forward care similar to the SORT and blend with the additional capabilities of the US Air Force Mobile FST/Expeditionary Critical

Care Team.⁹ Through this design, the ERST can provide emergency medical care, damage control resuscitation and surgery, critical care patient transport, and patient holding for periods where evacuation is delayed.

ERSTs are composed of eight persons with a standardized equipment set. The team includes a general and orthopedic surgeon, two registered nurses (emergency department and intensive care unit nurses), a surgical technologist, an emergency medicine physician, a critical care physician, and a certified registered nurse anesthetist (CRNA). Through this configuration, the ERST is lightweight, highly mobile, and can provide resuscitation and surgical care in an austere outstation or near the tactical objective with minimal logistical support. The ERST is used to mirror the mobility of the SORTs and tailored to the needs of conventional and unconventional forces located in underdeveloped theatres of operation.

ERST Training

The ERST comprises licensed healthcare providers credentialed to practice in military treatment facilities. ERST members are selected from MEDCOM based on the recommendation of subspecialty branch managers. An ERST completes a total of 21 days of training before deployment. Eight training days—a 5-day Tactical Combat Casualty Care course and a 3-day Emergency War Surgery course—are conducted as prerequisite coursework before ERST-specific training. In addition to these courses, the critical care physician, critical care nurse, and emergency room nurse attend the Joint Enroute Care Course. The entire eight-person team completes the ERST specialty training together, which is a rigorous 13-day program conducted by the Center for Predeployment Medicine, Division of Tactical Combat Casualty Care. ERST training focuses on team development and equipment familiarization using authentic tactical medical scenarios to refine operational skills and prepare the team to function in an austere setting with limited resources.

ERST Resuscitative and Surgical Capabilities

An ERST initially deploys with appropriate medical supplies to perform 10 major surgical cases. The equipment and supplies are packaged and stored in Pelican cases (Pelican Products, <http://www.pelican.com/>) with the intention that these supplies and equipment will be used out of individual backpacks when the team is not in garrison. In addition to ancillary medical supplies (e.g., intravenous catheters, gloves, intravenous fluids, dressings), the team is equipped with surgical sets designed for general, thoracic, and neurologic surgery. The general surgery set includes a diverse selection of staplers for use in a variety of anatomic regions (e.g., gastrointestinal, vascular, lung). The small chest set (thoracic) includes a Lebsche sternal knife, Finochietto rib spreader, and mallet. The craniotomy set includes a hand drill and wire saw for burr holes and craniectomies. In addition to the predesigned sets, the ERST has a variety of vascular tools, clamps, loops, ties, and shunts that can be used for major vessel injuries. The orthopedic surgeon has the equipment and supplies to perform immobilization and external fixation of orthopedic injuries. The ERST is not equipped with orthopedic plates, screws, brackets, or advanced orthopedic imaging technology.

Anesthesia delivery is the primary responsibility of the CRNA. In the event of a mass casualty scenario, or in the absence of the CRNA, the critical care physician is cross-trained to deliver

general anesthesia. Anesthesia is prepared to provide a spectrum of care ranging from limited peripheral regional anesthesia to a full general anesthetic. Total intravenous anesthesia is the primary method of anesthesia; the ERST is not equipped to deliver volatile anesthetics. The anesthetist is equipped with traditional airway management tools and adjuncts, standard monitors, an AutoMedx SAVe ventilator (<http://automedx.com/>), a variety of venous access devices, and traditional medications required for intraoperative and perioperative care.

In addition to its surgical capabilities, the ERST has resuscitative and prolonged holding capabilities. The ERST is supplied with crystalloid solutions (e.g., Ringer's lactate, normal saline), Hextend, and hypertonic saline. The team also has component therapy and a standing issue of 20 units of fresh frozen plasma and 20 units of packed red blood cells, which depend on blood product resupply. The ERST can manage a walking blood bank and initiate fresh whole-blood transfusions as required. Component therapy is distributed among the resuscitation, surgical, and critical care elements as anticipated by a mission.

The ERST's patient-holding capabilities are variable and depend on patient acuity. While in garrison, the team has the ability for prolonged holding capacity (i.e., several days), which lessens with higher acuity, multiple casualty scenarios in austere environments. The critical care team members are trained to provide critical care transport over land and for aeromedical evacuation in fixed and rotary wing airframes.

The ERST critical care element is equipped with powered and nonpowered suction devices, an AutoMedx SAVe ventilator, Impact 731 portable ventilators (Zoll Medical, <https://www.zoll.com>), SeQual SAROS oxygen concentrator (3L/min maximum flow; Caire, <https://www.cairemedical.com/>), Philips portable vital signs monitor (Koninklijke Philips, <https://www.usa.philips.com>), North American Rescue Hypothermia Prevention and Management Kit (<https://www.narescue.com/>), Belmont Buddy Lite fluid warmers (Belmont Instrument, <http://www.belmontinstrument.com>), and a variety of critical care pharmaceuticals. The critical care team has limited laboratory capabilities; it is equipped with an i-STAT handheld blood analyzer (Abbott Point of Care, <https://www.pointofcare.abbott>). The critical care element maintains a defibrillator at their static facility and has a portable automated external defibrillator unit for forward movement.

Package Size

The ERST was conceptualized to provide maximum flexibility to support operational forces. Although there is no set package, the most commonly used ERST configuration, thus far, consists of split surgical and critical care elements. Under this model, the surgical element moves forward with the operational element while the critical care element remains at a fixed location. The split ERST surgical element has typically consisted of the two surgeons, the emergency room physician, the CRNA, and either a registered nurse or the surgical technician. The critical care element includes the critical care physician, both nurses, or a nurse and the surgical technician.

ERST equipment is transported using a series of shoulder-carried packs (jump bags) and hanging bags commonly used by the Special Operations community. Based on team configuration and mission weight and volume limitations, the ERST

can go forward with a two-part CTOMS backpack (<http://ctoms.ca>) and one hand-carried hanging bag per team member. This number of bags equates to sufficient medical materials to perform two major surgical cases and enough supplies to resuscitate and/or hold two fewer serious casualties without resupply.

In practice, the ERST has been fielded to forward positions carrying three bags per team member. The bags include two-part CTOMS shoulder packs and personal 36-hour bags. In addition to the three bags, the team must have a way to store component therapy (e.g., a Collins Box, cooler, or refrigerator/freezer) and a Doak table (surgical element; Doak Medical Engineering) or two litter stands (one for the surgical component in place of the Doak table, and one for the critical care element). The team may opt to bring additional equipment (e.g., oxygen concentrator, light sets) as dictated by the mission and limitations on weight and volume.

ERST Limitations

The greatest limitation to the ERST concept is its dependence on the host unit for support. Although the ERST can maintain its class VIII materials, it does not have organic communications, vehicles, supply, administration, or intelligence personnel. ERST members are proficient with individual weapons but unable to provide their own security.

Results

The ERST concept is growing and proving successful in a variety of theatres of operation. In fiscal year 2016, five teams were fielded to support operational units in austere settings. It is projected that an additional nine teams will be fielded in fiscal year 2017. Case data are limited; however, Satterly and colleagues¹⁰ demonstrated a significant reduction in time to emergency care and damage control surgery for SOF with the addition of an ERST. This small analysis demonstrated a nearly 6-hour difference between care for forces with an ERST compared with those without an ERST. The integration of the ERST concept demonstrated a risk reduction for SOF.

Conclusion

The ERST is a highly mobile, interprofessional medical team that can perform damage control resuscitation and surgery in austere locations. Its configuration and capabilities vary; however, in general, a typical surgical element can perform one major surgery and one minor surgery without resupply. The critical care element can provide prolonged holding in garrison, but this diminishes in the austere setting with complex and acutely injured patients. Although the ERST depends on a host unit for administrative, communications, and logistics support, the small unit footprint has been proven effective operationally and is rapidly becoming an asset to operational forces. The ERST was conceptualized to fill a void in emergent battlefield care and is showing promise to care for those in harm's way.

Acknowledgments

We thank the many subject matter experts who gave their time and energy toward the development of the ERST. The team's accomplishments and the development of this manuscript would have been impossible without their support.

Disclaimer

The views expressed are those of the authors and do not reflect the official policy or position of the US Army, the Uniformed Services University of the Health Sciences, the Department of the Defense, or the US Government.

Disclosure

The authors have nothing to disclose.

Author Contributions

M.D. served as the lead author of this manuscript. J.L., B.S., M.G., S.C., M.M., J.P., K.G., P.C. and M.W. conceived and developed the ERST platform. K.W. I.W. and J.S. provided subject matter expertise for the development of this manuscript. All authors provided substantive input to the final manuscript.

References

1. Goldberg M. *Updated Death and Injury Rates of U.S. Military Personnel During the Conflicts in Iraq and Afghanistan*. Washington, DC: Congressional Budget Office; 2014.
2. Kotwal RS, Howard JT, Orman JA, et al. The effect of a golden hour policy on the morbidity and mortality of combat casualties. *JAMA Surg*. 2016;151(1):15–24.
3. Eisele C. The golden hour. 2008. <http://www.jems.com/articles/supplements/special-topics/perfect-view/golden-hour.html>. Accessed 15 October 2017.
4. Eastridge BJ, Mabry RL, Seguin P, et al. Death on the battlefield (2001-2011): implications for the future of combat casualty care. *J Trauma Acute Care Surg*. 2012;73(6 suppl 5):S431–437.
5. Borden Institute; Office of the Surgeon General. *Emergency War Surgery*. 4th ed. Fort Sam Houston, TX; Office of the Surgeon General, Borden Institute; 2013.
6. Blaisdell FW. Medical advances during the Civil War. *Arch Surg*. 1988;123(9):1045–1050.
7. Riesberg J. The Special Operations Resuscitation Team: robust Role II medical support for today's SOF environment. *J Spec Oper Med*. 2009;9(1):27–32.
8. Remick KN. The Surgical Resuscitation Team: surgical trauma support for U.S. Army Special Operations Forces. *J Spec Oper Med*. 2009;9(4):20–25.
9. Delmonaco BL, Baker A, Clay J, et al. Experience of a US Air Force surgical and critical care team deployed in support of Special Operations Command Africa. *J Spec Oper Med*. 2016;16(1): 103–108.
10. Satterly S, Reilly S, Verwiebe E, et al. Special Operations Forces risk reduction: integration of expeditionary surgical and resuscitation teams. https://prolongedfieldcare.org/20170619_192244/.



Winter 2017
Volume 17, Edition 4

JSOM

JOURNAL of SPECIAL OPERATIONS MEDICINE™



THE JOURNAL FOR OPERATIONAL MEDICINE AND TACTICAL CASUALTY CARE



Inside this Issue:

- › In Brief: Female Genital Mutilation
- › Extraglottic Airways in Tactical Combat Casualty Care
- › User, Glove, and Device Effects on Tourniquet Use
- › Tourniquet Distance Effects
- › Use of PTs to Evaluate Musculoskeletal Injuries
- › Therapy Dogs and Military Behavioral Health Patients
- › SOF Truths for ARSOF Surgical Teams
- › Anesthesia Support for Surgical Missions
- › Medical Skills Course for Partner Forces
- › SRT Prehospital Damage Control
- › Emergency US to Detect Wooden Foreign Bodies
- › "MARCH PAWS" as a Checklist for Pararescuemen
- › Ongoing Series: Canine Medicine, Clinical Corner, Human Performance Optimization, Infectious Diseases, Injury Prevention, Preventive Medicine, Prolonged Field Care, SOFsono Ultrasound Series, Special Talk: An Interview, Unconventional Medicine, The World of Special Operations Medicine, Book Review, TCCC Updates, and more!

*Dedicated to the
Indomitable Spirit
and Sacrifices of
the SOF Medic*

A Peer-Reviewed Journal That Brings Together the Global Interests of Special Operations' First Responders