Two Decades of Saving Lives on the Battlefield: Tactical Combat Casualty Care Turns 20

Frank K. Butler, MD, FAAO, FUHM

ABSTRACT

Background: Twenty years ago, the original Tactical Combat Casualty Care (TCCC) article was published in this journal. Since TCCC is essentially a set of best-practice prehospital trauma care guidelines customized for use on the battlefield, the presence of a journal with a specific focus on military medicine was a profound benefit to the initial presentation of TCCC to the US Military. **Methods:** In the two ensuing decades, which included the longest continuous period of armed conflict in our nation's history, TCCC steadily evolved as the prehospital trauma care evidence base was augmented and as feedback from user medics, corpsmen, and pararescuemen was obtained. **Findings:** TCCC has taken a leadership role in advocating for battlefield trauma care advances such as the aggressive use of tourniquets and hemostatic dressings to control life-threatening external hemorrhage; improved fluid resuscitation techniques for casualties in hemorrhagic shock; increased emphasis on airway positioning and surgical airways to manage the traumatized airway; faster, safer, and more effective battlefield analgesia; the increased use of intraosseous vascular access when needed; battlefield antibiotics; and combining good medicine with good small-unit tactics. With the continuing assistance of Military Medicine, these advances and the evidence base that supports them have been presented to TCCC stakeholders. **Discussion/Impact:** Now—20 years later—TCCC has been documented to produce unprecedented decreases in preventable combat death in military units that have trained all of their members in TCCC. As a result of this proven success, TCCC has become the standard for battlefield trauma care in the US military and for the militaries of many of our allied nations. Committee on TCCC members and the Joint Trauma System also work closely with civilian trauma colleagues through initiatives such as the Hartford Consensus, the White House Stop the Bleed campaign, and the development of National Association of Emergency Medical Technicians TCCC-based courses to ensure that advances in prehospital trauma care pioneered by the military on the battlefield are translated into civilian practice on the streets of America. Active shooter incidents, terrorist bombings, and the day-to-day trauma that results from motor vehicle accidents and criminal violence create the potential for many additional lives to be saved in the civilian sector. Along with the other components of the Department of Defense's Joint Trauma System, the Committee on TCCC, and the TCCC Working Group have been recognized as a national resource and will continue to advocate

Reprinted with permission from *Military Medicine*, 182, 3/4:e1563, 2017.

Committee on Tactical Combat Casualty Care, Joint Trauma System, US Army Institute of Surgical Research, Joint Base San Antonio, San Antonio, TX 78234.

The opinions or assertions contained herein are the private views of the author and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

This document was reviewed by the Director of the Joint Trauma System and by the Public Affairs Office and the Operational Security Office at the US Army Institute of Surgical Research. Approved for unlimited public release.

doi:10.7205/MILMED-D-16-00214

Military Medicine, Vol. 182, March/April 2017 e1563

for advances in best-practice battlefield trauma care as opportunities to improve are identified.

This article is dedicated to Dr Norman McSwain, one of the central figures in the development of Tactical Combat Casualty Care (TCCC). Dr McSwain was a giant in trauma surgery, a world leader in prehospital trauma care, and a friend to everyone that he met. After the initial connection was made between Dr McSwain and TCCC through VADM Mike Cowan, then the Commander at the Defense Medical Readiness Training Institute in San Antonio, Texas, Dr McSwain subsequently became a powerful contributor to and advocate for the evolving concepts of TCCC. Both the clinical and the organizational advances that TCCC has experienced over the last 20 years are due in large measure to this remarkable surgeon and inspirational leader.

Introduction

Twenty years ago, the original TCCC article was published in this journal. Since TCCC is essentially a set of best practice prehospital trauma care guidelines customized for use on the battlefield, the presence of a journal with a specific focus on military medicine was a profound benefit to the initial presentation of TCCC to the US Military. The novel concepts that the original TCCC article presented were very different from both military and civilian prehospital trauma care practice at the time. Since TCCC was developed specifically for use on the battlefield, the large armed services readership of Military Medicine made it the perfect journal for publication.

Tourniquets Reconsidered and the Need for TCCC

The need for TCCC was first brought to light by the recognition of a striking paradox in military prehospital trauma care in the early 1990s. Extremity hemorrhage had been documented to be a leading cause of preventable death among combat casualties in Vietnam.[1] If the 7.4% incidence of death from extremity hemorrhage as a percentage of total combat fatalities in Maughon's study (193 out of a cohort of 2,600) is extrapolated to the total number of US military deaths in Vietnam (46,233), then the estimated number of preventable deaths resulting from extremity hemorrhage in that conflict would be 3,421, a staggering figure. The US Military had neither a Department of Defense (DoD) Trauma Registry nor a functioning trauma system during the Vietnam conflict, so no one was tracking the number of preventable deaths from extremity hemorrhage during that war and, therefore, no one was undertaking corrective action. Even after the conclusion of hostilities in Vietnam, there continued to be no corrective action in the military, despite the writings of Maughon and COL Ron Bellamy that documented this large number of potentially preventable deaths.

Well-designed tourniquets can unquestionably stop extremity hemorrhage and prevent loss of life from this cause, as long as the tourniquet is applied quickly and the source of the hemorrhage is not so proximal on the limb so as to preclude the use of extremity tourniquets. Despite this fact, tourniquet use was strongly discouraged in both military and civilian prehospital trauma care courses in 1992 because of the fear that tourniquets would cause ischemic damage to limbs. Completely ignored in this contention was the fact that tourniquets are used routinely during orthopedic surgical procedures and ischemic damage is not sustained in that setting as long as the tourniquet application time is limited to acceptable norms. The aversion to tourniquet use in 1992 was therefore neither evidence-based nor logic-based—but it was nearly universal and over 3,000 US soldiers likely paid for this mistake with their lives in Vietnam.

After the 1992 realization by the Naval Special Warfare (NSW) Biomedical Research Program that this aspect of prehospital trauma care was in error and needed to be revisited, a subsequent review of the pertinent literature revealed that there were many other elements of prehospital trauma care as it was practiced at that time that were not well supported by the available evidence—fluid resuscitation, spinal precautions in penetrating trauma, battlefield analgesia, prehospital cardiopulmonary resuscitation, and management of the traumatized airway, to list a few. Additionally, most Special Operations medics at the time were being taught to do procedures such as venous cutdowns, pericardiocentesis, and tube thoracostomy at the point of injury despite a lack of evidence for the benefit of these procedures when performed by combat medical providers on the battlefield.

A research effort was therefore undertaken to systematically review the elements of battlefield trauma care as it was being practiced at the time and to make recommendations for improvements as indicated. This project was initiated as a combined effort of the Naval Special Warfare Command and the Uniformed Services University of the Health Sciences; it was later expanded to include all of the components of the US Special Operations Command.

In addition to an exhaustive relook at the evidence base for prehospital trauma care recommendations, all of the newly proposed interventions were considered in the context of the lethal chaos of the battlefield. In this setting, preventing additional casualties and successful completion of the combat mission at hand must also be given weight.

Factors specific to the battlefield include (1) the fact that the enemy may be actively shooting at you while care is being rendered—which requires that care be rendered selectively and expeditiously; (2) interventions should be strongly focused on the leading causes of preventable death in combat—hemorrhage, airway obstruction, and tension pneumothorax; (3) evacuation times may be much longer than those seen in urban Emergency Medical Services systems; (4) combat medics are well trained, but those serving in ground units often have much less trauma care experience than civilian Emergency Medical Services personnel; (5) there are often multiple casualties sustained in a single incident; and (6) combat medics may be required to care for their casualties in challenging environments—deserts, mountains, water, night operations—and must have a plan of care that accounts for those conditions.[2]

Also, since battlefield trauma care will be provided by combat medical personnel, the input of military medics, corpsmen, and Air Force pararescuemen (PJs) was essential to this re-evaluation of battlefield trauma care standards and extensive input from these communities was obtained.[2] At the end of this process, the draft of the original TCCC guidelines was sent out to 26 volunteer reviewers from the surgical, emergency medicine, and critical care communities and their feedback considered and incorporated as appropriate. The article as published in Military Medicine in 1996 thus contained a unique set of prehospital trauma care guidelines that combined good clinical medicine with good small-unit tactics to the greatest extent possible.

Beginnings

Shortly after the publication of the 1996 TCCC article, the concepts of TCCC were presented to MG Les Berger, then the surgeon for the Chairman of the Joint Chiefs of Staff. He subsequently arranged for a summary of these concepts to be presented to both the Senior Military Medical Advisory Committee and the Defense Medical Oversight Committee, two groups of very senior leaders in the DoD. Both groups had a generally favorable response to the information presented, but no specific plan of action emerged from the briefings.

Subsequently, the initial set of TCCC guidelines were presented at a series of both military and civilian medical conferences to introduce these new concepts and to obtain feedback from a variety of medical audiences on the recommendations that they contained.

COL Bob Mabry has outlined the challenges inherent in trying to effect changes in battlefield trauma care in the US Military.[3] Although the initial series of presentations was well received and had not revealed any significant conceptual errors in the TCCC recommendations, there was no DoD-level effort to revamp prehospital combat casualty care practice.

A unit-by-unit introduction program was therefore launched. TCCC was briefed to Rear Admiral Tom Richards, the Commander of the Naval Special Warfare Command, who approved the TCCC Guidelines for use in the NSW community in 1997. TCCC was subsequently presented to the leadership of the 75th Ranger Regiment, the Army Special Missions Unit, and the Air Force Pararescue community. These units and a few other innovative units scattered throughout the military were the only users of TCCC at the start of the war in Afghanistan.[4]

The Committee on TCCC and the TCCC Working Group

The group responsible for the advances made in TCCC beyond the original guidelines published in 1996 has been the Committee on TCCC (CoTCCC).[4] The original TCCC article noted that it was essential to establish a process to update the TCCC guidelines as required by experience, new evidence, and new technology. This need became more pressing with the onset of hostilities in Afghanistan in October 2001. That war, followed in 2003 by the US invasion of Iraq, created a steady flow of casualty information that required collection, evaluation, processing, and corrective action as needed. Further, the recognized presence of preventable deaths among our nation's combat fatalities in the early years of the war[5] imparted additional urgency to this effort.

The CoTCCC was first funded as a medical research effort by the US Special Operations Command (USSOCOM). Through the efforts of CAPT Doug Freer and CAPT Stephen Giebner, the CoTCCC was first established at the Naval Operational Medicine Institute in 2001. The members of the CoTCCC are all volunteers who perform their committee activities in addition to their other duties as military or government employees. The membership includes trauma surgeons, emergency medicine physicians, combatant unit physicians and physician assistants, and combat medical educators. Also—and of critical importance—the group includes combat medical providers. In accordance with both tradition and charter, the CoTCCC must have no less than 30% of its membership comprised of active or former combat medics, corpsmen, and PJs. The 42 members of the CoTCCC include representation from all of the US armed services and, at present, every one of its members has deployed in support of combat operations. Additionally, national leaders in trauma care such as former US Surgeon General Richard Carmona and former Chair of the American College of Surgeons Committee on Trauma David Hoyt have contributed their time and expertise as CoTCCC members.

The CoTCCC was moved in 2007 to the Defense Health Board at the direction of Ms. Ellen Embry, acting Assistant Secretary of Defense for Health Affairs at the time; the CoTCCC was subsequently moved by the Undersecretary of Defense for Personnel and Readiness to the Joint Trauma System (JTS) in 2013. The JTS is located at the US Army Institute of Surgical Research. Despite being located at an Army command, the JTS presently serves as the lead agency for trauma care in the DoD and provides trauma care recommendations to all of the services in the US Military as well as to the Geographic Combat Commands. Experience has shown that the JTS is clearly the right place for the CoTCCC to function optimally. Figure 1 is the CoTCCC logo.

Figure 1 *CoTCCC logo.*

It is through the untiring efforts of the CoTCCC—and its liaison members from allied nations, interagency partners, and various military organizations that collectively comprise the TCCC Working Group—that TCCC has been regularly updated as new medical technologies have become available and combat trauma experience has been gained throughout 14 years of war.

The CoTCCC communicates its recommendations on battlefield trauma care in several ways designed to meet a variety of needs. The TCCC Guidelines present the basics of TCCC in an outline form. The TCCC Curriculum is designed to convey the elements of TCCC in a format suitable for training combat medical providers. The TCCC chapters in the Prehospital Trauma Life Support (PHTLS) textbook present a discussion of the evidence base that supports the current TCCC recommendations.[6] The latest addition to the TCCC knowledge products is the publication of a position paper for each new change to the TCCC Guidelines in the Journal of Special Operations Medicine. This series of articles (presently 11 in all) provides an in-depth discussion of each new TCCC recommendation with an expanded review of the evidence base for the change. Since the *Journal of Special Operations Medicine* is included in the Index Medicus, the TCCC change papers published in that journal become a permanent part of the medical literature.

Clinical Advances in TCCC

The evolution of the interventions recommended in TCCC since the original TCCC guidelines has been well documented in the position papers mentioned above and in other publications[4,6,7] and the evidence base for the current TCCC guidelines will not be re-presented in this article. It is noteworthy that current TCCC methodology includes a monthly PUBMED search focused on interventions that are—or potentially could be—used in the prehospital setting. Thus, the evidence base presented in the publications noted above includes studies from the civilian sector as well as from the military. The state of the art in battlefield trauma care in 1992 (before TCCC) is summarized in Table 1. The recommendations in the current TCCC guidelines are shown in Table 2. The reader will note that there is very little overlap between these two sets of recommendations, indicating how far prehospital trauma care has evolved through the TCCC best-practice guideline development methodology.

Changing the Culture in Battlefield Trauma Care

Hundreds of people have played key roles in moving TCCC forward from publications into military medical practice over the past 2 decades. Dr Norman McSwain was one of the first when he established the link between the nascent TCCC effort and PHTLS in 1998. PHTLS works closely with National Association of Emergency Medical Technicians (NAEMT) and the American College of Surgeons Committee on Trauma. Inclusion of TCCC in the 4th Edition of the PHTLS textbook was the first step toward mainstreaming TCCC beyond the few Special Operations units that were the original users. There are now 13 TCCC chapters in the Military 8th Edition of the PHTLS textbook. These chapters are maintained primarily by the CoTCCC Developmental Editor, retired Navy Captain, and first Chairman of the CoTCCC, Dr Stephen Giebner.[6] Dr McSwain's personal participation as a member of the CoTCCC for over a decade and his steadfast support for TCCC in civilian trauma organizations was invaluable to the TCCC effort and resulted in his being honored by both USSOCOM and the CoTCCC for his contributions to improving battlefield trauma care.

COL John Holcomb, at the time the Commander of the US Army Institute of Surgical Research (USAISR) and the Trauma Consultant for the Army Surgeon General, led a team from USSOCOM, USAISR, and the Armed Forces Medical Examiners System that documented in early 2005 that preventable deaths were in fact still occurring at a significant rate, even among elite Special Operations forces.[5] This work and USAISR's subsequent

Table 1 *Battlefield Trauma Care 1992*

Before the development of Tactical Combat Casualty Care, US military medics, corpsmen, and PJs were taught to perform battlefield trauma care in accordance with prehospital trauma courses that were not developed for combat casualty care. Thus their training in 1995 included the following:

- To render care on the battlefield with no structured consideration of the evolving tactical situation
- Not to use tourniquets to control extremity hemorrhage, even when the hemorrhage was severe enough to be life threatening
- To manage external hemorrhage with prolonged direct pressure, thereby precluding the medic from attending to the casualty's other injuries or rendering care to other casualties
- No use of hemostatic dressings (not yet fielded for combat medicine)
- Two large-bore IVs started on all patients with significant trauma, even if there was no immediate need for fluid resuscitation or IV medications
- Treatment of hypovolemic shock with large-volume crystalloid fluid resuscitation (2 liters of Lactated Ringers or normal saline) given as rapidly as possible
- No special consideration of traumatic brain injury with respect to oxygenation and fluid resuscitation, specifically the need to avoid hypotension or hypoxia
- Management of the airway in unconscious or hypoxic casualties with endotracheal intervention, despite the lack of evidence documenting the efficacy of this intervention when performed by medics on the battlefield
- No specific interventions or equipment to prevent hypothermia and the resultant coagulopathy that it causes in combat casualties
- Battlefield analgesia was accomplished with IM morphine—a technique that dates back to the Civil War
- No use of intraosseous access techniques
- No monitoring of oxygenation or heart rate at the point of injury with pulse oximetry; no electronic monitoring capability on Casualty Evacuation platforms
- No use of nonparenteral analgesic medications
- No administration of prehospital antibiotics for open wounds
- No recommendations regarding which casualties might benefit most from supplemental oxygen when it becomes available during evacuation
- Spinal precautions were applied broadly to all casualties with significant trauma, without consideration being given to tactical concerns or the mechanism of injury

Table 2 *Tactical Combat Casualty Care 2016*

A partial list of the elements of battlefield trauma care as contained in the present TCCC guidelines includes the following:

- Phased care in the prehospital tactical environment to ensure that good medicine is combined with good small-unit tactics.
- The aggressive use of CoTCCC-recommended tourniquets for the initial control of life-threatening extremity hemorrhage, followed by removal of the tourniquet when feasible in the Tactical Field Care or Tactical Evacuation phases of care
- The use of CoTCCC-recommended hemostatic dressings to control life-threatening external hemorrhage from sites that are not amenable to tourniquet use.
- The use of junctional tourniquets as an adjunct to external hemorrhage control at junctional bleeding sites (e.g., axilla and groin)
- Initial management of the airway in casualties with maxillofacial trauma through having the casualty sit up and lean forward if he or she is able, thus allowing blood to simply drain out of the oropharynx and thereby clearing the airway
- Surgical airways using the Cric-Key for airway obstruction when the use of the sit-up and lean-forward position is not feasible or not successful
- Aggressive needle thoracostomy with a 14-gauge, 3.25-inch needle for suspected tension pneumothorax Vented chest seals for casualties with open pneumothoraces Intravenous access only when required for medications or fluid resuscitation
- The preferential use of a saline lock for intravenous access instead of having to have intravenous fluids running to keep the vein open
- The use of intraosseous techniques when vascular access is needed but difficult to obtain
- Early use of tranexamic acid in the prehospital phase of care (before fluid resuscitation) for casualties in or at risk of hemorrhagic shock
- Prehospital fluid resuscitation that emphasizes the use of Damage Control Resuscitation with whole blood or blood components in a 1:1 RBCs:plasma ratio as soon as logistically feasible, even in the prehospital environment
- Hypotensive resuscitation with Hextend (Hospira Inc, Lake Forest, Illinois) when blood products are not available
- Safer, faster, and more effective relief of pain from combat wounds through the use of the "Triple-Option" approach to battlefield analgesia that emphasizes the use of ketamine and/or oral transmucosal fentanyl citrate lozenges rather than IM morphine for severe pain
- Ondansetron for trauma or opioid-related nausea and vomiting
- Prevention of hypothermia and secondary coagulopathy with improved technology to prevent heat loss in casualties
- The prehospital use of moxifloxacin or ertapenem to reduce preventable deaths and morbidity from wound infections
- Tactical scenario-based combat trauma training to help combat medical providers grasp that battlefield trauma care must be consistent with good small-unit tactics and the particulars of each combat situation
- The use of the Department of Defense Form 1380 (TCCC casualty card—June 2014) and electronic TCCC Medical After-Action Report to improve the documentation of prehospital care

evaluations of commercial tourniquets and hemostatic dressings were largely responsible for USSOCOM mandating TCCC training and equipment for all Special Operations Forces units and for the US Central Command directing that all US Military members deploying to Afghanistan and Iraq be equipped with a tourniquet and a hemostatic dressing. Subsequently, the USAISR was also instrumental in expediting the equipping and training of deploying USSOCOM units through the conduct of the TCCC Transition Initiative. The project, led by SFC Dom Greydanus, also obtained user feedback from the units after their return from combat operations, which provided early documentation of the success of TCCC interventions.[7] It is often difficult to identify precisely which elements of TCCC save lives. An exception to this general statement is tourniquets. COL John Kragh, an orthopedic surgeon at the Ibn Sina hospital in Baghdad documented that 31 lives were saved with tourniquets at his facility in one 6-month period.[8] Extrapolated to all US casualties in Iraq and Afghanistan, these findings indicated that, as of 2008, well over 1,000 US service members' lives had been saved with tourniquets during the recent conflicts without loss of limbs to tourniquet ischemia. COL Kragh's findings indisputably confirmed the lifesaving benefits of one of the most controversial aspects of TCCC and helped to promote the rapid expansion of TCCC acceptance throughout the US Military.[4]

TCCC: The Evidence From 14 Years of War

The first published report of the success of TCCC on the battlefield was presented in the Army Medical Department Journal by the surgeon for an Army unit that had participated on the drive to Baghdad at the start of the Iraq conflict.[9] With respect to tourniquets, the author noted that "Tourniquets played a decisive role in quickly and effectively stopping hemorrhage under fire and keeping a number of Soldiers with serious extremity wounds involving arterial bleeding alive until they could eventually undergo emergent surgery at the Forward Surgical Team (FST)." The author concluded that "The adoption and implementation of the principles of TCCC by the medical platoon of TF 1–15 IN in OIF 1 resulted in overwhelming success."[9]

Six years later, COL Russ Kotwal, MSG Harold Montgomery, and their co-authors documented that the 75th Ranger Regiment had achieved the lowest preventable death rate in the history of modern warfare through the implementation of the Ranger First Responder program, which trained all unit members in TCCC.[10] The Army Special Missions Unit also trains every one of its combat troops in TCCC and noted in an unpublished report in 2008 that they too had suffered no preventable deaths among their unit's casualties up to that point in time.[4] The 2011 article by Savage and her co-authors reported that the Canadian Military had achieved its highest casualty survival rate in history and attributed that in large part to training all of their combatants, not just medics, in TCCC.[11] COL Brian Eastridge and his co-authors, in their landmark 2012 article, examined the causes of death for all 4,596 US Military combat deaths occurring from October 2001 to June 2011.[12] The findings in this paper included: 87% of combat-related deaths occurred in the prehospital setting; 24% of those deaths were potentially preventable; hemorrhage is the predominant cause of preventable death on the battlefield; and that the TCCC-led use of tourniquets in the US Military caused the incidence of death from extremity hemorrhage to drop from the 7.8% incidence noted by Kelly early in the wars[13]—which was essentially the same as in Vietnam—to 2.6% of the total combat fatalities by the end of 2011—a 67% decrease in deaths from this cause.

The accumulated published evidence and battlefield experience has at this point in time resulted in all services in the US Military using TCCC to care for their combat wounded. Many allied nations have also embraced these concepts and several have made significant contributions to advancing and improving TCCC concepts.[4]

Going Forward

Through the collective efforts of military medical and line leaders, unit surgeons, insightful researchers, and the heroic actions of thousands of combat medics, corpsmen, and PJs, the US Military has redefined battlefield trauma care. Further, and very importantly, the CoTCCC and the TCCC Working Group have now established a methodology through which the DoD can ensure that battlefield trauma care practice is a continuous learning process that can adapt quickly to new evidence and combat experience.

The challenge now is to preserve the advances that military medicine has made on behalf of our nation's wounded. Medical advances from past wars have been lost in the ensuing peace intervals and the advances made in our recent conflicts may also not be sustained unless definitive steps are taken to ensure that these advances remain lessons learned and do not become lessons lost.[14]

Active shooter incidents, terrorist bombings, and the day-to-day trauma resulting from motor vehicle accidents and criminal violence create the potential for many additional lives to be saved by the use of TCCC concepts in the civilian sector. CoTCCC members and the Joint Trauma System work closely with civilian trauma colleagues through initiatives such as the Hartford Consensus,[15] the White House Stop the Bleed campaign, and the development of NAEMT TCCC-based courses to ensure that advances in prehospital trauma care

pioneered by the military on the battlefield are translated into civilian practice on the streets of America. Informing civilian leaders and inspiring changes in civilian trauma care where the military experience suggests that that is appropriate will entail new challenges, new interactions, and new processes—and *Military Medicine,* the journal that first introduced TCCC to both US and allied militaries, will continue to play a key role in this effort.

Acknowledgment

The author gratefully acknowledges the leadership, friendship, assistance, and inspiration of the late Dr Norman E. McSwain in turning TCCC from a set of promising concepts into many hundreds of lives saved in both the US and allied militaries as well as in the civilian sector.

References

1. **Maughon JS.** An inquiry into the nature of wounds resulting in killed in action in Vietnam. *Mil Med*. 1970;135:8–13.
2. **Butler FK, Hagmann J, Butler EG.** Tactical combat casualty care in Special Operations. *Mil Med*. 1996;161:3–16.
3. **Mabry RL, DeLorenzo R.** Challenges to improving combat casualty survival on the battlefield. *Mil Med*. 2014;179: 477–482.
4. **Butler FK, Blackbourne LH.** Battlefield trauma care then and now: a decade of tactical combat casualty care. *J Trauma Acute Care Surg*. 2012;73:S395–S402.
5. **Holcomb JB, McMullen NR, Pearse L, et al.** Causes of death in US Special Operations forces in the global war on terror. *Ann Surg*. 2007;245:986–991.
6. **Butler FK, Giebner SD, McSwain N, Pons P (editors).** *Prehospital Trauma Life Support Manual,* Ed 8. Burlington, MA, Jones and Bartlett Learning, 2014.
7. **Butler FK, Holcomb JB, Giebner SG, et al.** Tactical combat casualty care 2007: evolving concepts and battlefield experience. *Mil Med*. 2007;172(Suppl 11):1–19.
8. **Kragh JF, Walters TJ, Baer DJ, et al.** Survival with emergency tourniquet use to stop bleeding in major limb trauma. *Ann Surg*. 2009;249:1–7.
9. **Tarpey MJ.** Tactical combat casualty care in Operation Iraqi Freedom. *US Army Med Dept J*. 2005;38–41.
10. **Kotwal RS, Montgomery HR, Kotwal BM, et al.** Eliminating preventable death on the battlefield. *Arch Surg*. 2011;146: 1350–1358.
11. **Savage E, Forestier C, Withers N, et al.** Tactical Combat Casualty Care in the Canadian Forces: lessons learned from the Afghan War. *Can J Surg*. 2011;59:S118–S123.
12. **Eastridge BJ, Mabry R, 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:S431–S437.
13. **Kelly JF, Ritenhour AE, McLaughlin DF, et al.** Injury severity and causes of death from Operation Iraqi Freedom and Operation Enduring Freedom: 2003-2004 vs 2006. *J Trauma*. 2008;64:S21–S26.
14. **Butler FK, Smith DJ, Carmona RC.** Implementing and preserving advances in combat casualty care from Iraq and Afghanistan throughout the US military. *J Trauma*. 2015;79:3 21–326.
15. **Jacobs L, Wade D, McSwain N, et al.** Hartford Consensus: a call to action for THREAT, a medical disaster preparedness concept. *J Am Coll Surg*. 2014;218:467–475.

The Special Operations Medical Association's Official Journal

JSOM

JOURNAL *of* SPECIAL OPERATIONS MEDICINE™

Summer 2017
Volume 17, Edition 2

THE JOURNAL FOR OPERATIONAL MEDICINE AND TACTICAL CASUALTY CARE

Inside this Issue:

- TCCC Guidelines Change 16-03
- Assessment of Trainer Skill
- Bioelectric Dressing for Blister Management
- Rapid Vision Correction by SOF
- Role 1 Resuscitation Team and REBOA
- Preparing to Deploy to a Medically Austere Theater
- Manikin Human-Patient Simulator Training
- Complication of Attempted Surgical Airway
- Albumin Fluid Resuscitation in TCCC
- QuikClot® Combat Gauze™ Use in Afghanistan
- Ongoing Series: Clinical Corner, Human Performance Optimization, Infectious Diseases, Injury Prevention, Prolonged Field Care, SOFsono Ultrasound Series, Special Talk, Unconventional Medicine, Book Review, TCCC Updates, TacMed 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