TACTICAL COMBAT CASUALTY CARE: TRANSITIONING BATTLEFIELD LESSONS LEARNED TO OTHER AUSTERE ENVIRONMENTS

Tactical Combat Casualty Care: Beginnings

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Tactical Combat Casualty Care (TCCC) is a set of evidence-based, best-practice prehospital trauma care guidelines customized for use on the battlefield. The origins of TCCC were nontraditional. The TCCC program began as a Naval Special Warfare biomedical research effort launched after the realization that extremity hemorrhage, a leading cause of preventable death on the battlefield, was not being treated with a readily available and highly effective intervention: the tourniquet. This insight prompted a systematic reevaluation of all aspects of battlefield trauma care that was conducted from 1993 to 1996 as a joint effort by special operations medical personnel and the Uniformed Services University of the Health Sciences. The product of that 3-year research project was TCCC, the first-ever set of battlefield trauma care guidelines designed to combine good medicine with good small-unit tactics.

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Naval Special Warfare Biomedical Research Program

In 1989, the Commander of the Naval Special Warfare Command (NAVSPECWARCOM) established a research program to conduct studies on medical and physiologic issues of particular interest to the NSW community. The charter for the program was broad, and the admiral's primary guidance was to focus on research projects that could be transitioned into use by Navy SEALs in the near term.¹

This program accordingly produced a wide variety of knowledge and technology products, including the Navy SEAL Nutrition Guide; the Navy SEAL Physical Fitness Guide; a prototype tactical athlete program; laser refractive surgery in NSW; a laptop-based medical translator program; expanded closed-circuit oxygen diving limits for SEAL Delivery Vehicle diving operations; and the Cochran Navy—a Navy SEAL decompression computer. Battlefield trauma care was also included in this research portfolio.

Battlefield trauma care in 1992

With even an introductory reading of the prehospital trauma literature, one point stands out as critically important: Most combat fatalities die before they ever reach the care of a surgeon.² This underscores the importance of the care rendered by SEAL corpsmen as well as by Army medics and Air Force pararescuemen (PJs). Another important observation is that, from a prehospital perspective, the number 1 cause of preventable death in Vietnam was extremity hemorrhage. The magnitude of that issue is highlighted in the work of Navy Captain J.S. Maughon, who wrote in 1970 that “the striking feature was to see healthy young Americans with a single injury of the distal extremity arrive at the magnificently equipped field hospital, usually within hours, but dead on arrival. In fact there were 193 deaths due to wounds of the upper and lower extremities. ... of the 2600.”³ The percentage of combat fatalities resulting from extremity hemorrhage was therefore 7.4%. If this percentage is extrapolated to all of the 46,233 US combat fatalities in Vietnam, the estimated number of preventable US deaths from extremity hemorrhage in that conflict is 3421. In the same article, Maughon goes on to say, “All seem uncertain regarding the best method to implement factual knowledge to the man most in need, the front line trooper ... citing our ineptness in the field of self-help and first aid ... little if any

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improvement has been made in this phase of treatment of combat wounds in the past 100 years.”³

The principles of battlefield trauma care in 1992, as taught in the civilian-based trauma courses that were used widely by the US military at the time, included the following:

- Medics, corpsmen, and PJs were taught *not* to use tourniquets because of the widespread belief that even short-duration tourniquet applications would result in ischemic damage to the arm or leg.
- No hemostatic dressings were carried by combat medics.
- Large volume crystalloid fluid resuscitation was used to treat hemorrhagic shock.
- Two large bore intravenous (IV) lines were recommended for *all* casualties with significant trauma.
- A Civil War-era technique (intramuscular morphine) was used for battlefield analgesia.
- There was no focus on the prevention of trauma-related coagulopathy.
- There was no consideration of the tactical context in crafting battlefield trauma care recommendations.
- Special operations medics were taught to perform venous cutdowns if IV access could not be obtained.
- There was a heavy emphasis on endotracheal intubation for prehospital airway management.⁴

Tourniquets reconsidered—the primary driver for TCCC

The observation that tourniquets were widely discouraged by prehospital trauma care courses in 1992 was striking in light of the reports by Maughon and Bellamy^{2,3} that a great many preventable deaths in the Vietnam conflict were the result of extremity hemorrhage. This was especially true considering the fact that tourniquets are routinely used during orthopedic surgical procedures and do not cause loss of limbs in that context. Why then could they not also be used to save lives on the battlefield? No randomized, controlled trials or modern case series were found that reported that prehospital tourniquet use caused preventable loss of extremities. The potential to effectively address a leading cause of preventable death on the battlefield with tourniquets compelled a reexamination of this aspect of battlefield trauma care.

Other aspects of battlefield trauma care also lacking in evidence

After the realization that existing prehospital trauma care doctrine might be in error regarding how to effectively address the leading cause of preventable

death in combat, the potential for new insights into other aspects of prehospital trauma care also became obvious. Is spinal immobilization really required for victims of penetrating trauma? What is the evidence that combat medical providers can effectively intubate casualties with traumatized airways? Is 2 L of IV crystalloid solution the best way to treat hemorrhagic shock in the prehospital environment? Was intramuscular morphine really the best technique for battlefield analgesia in 1992? A comprehensive reexamination of battlefield trauma care was obviously needed and was subsequently undertaken.

The TCCC Research Project—a different approach

NSW Biomedical Research Task Statement 3–93 established a flag-officer level requirement for a comprehensive review of battlefield trauma care as practiced by Special Operations corpsmen, medics, and PJs. This was undertaken as a combined effort of Navy SEAL personnel and other Special Operations medical providers in conjunction with the Uniformed Services University of the Health Sciences. The project was 4 years in duration, spanning the years 1993 to 1996. The lethal chaos of the battlefield environment was considered, as were combat medic training, equipment, and experience. Extensive input was obtained from combat medics, corpsmen, and PJs. The recommendations developed were evidence based. Notably, this examination included reviewing the evidence for the prevailing concepts in prehospital trauma care at the time, as well as the evidence for proposed changes to those concepts. Additionally, there was a strong focus on successfully preventing as many prehospital deaths as possible.

Combining good medicine with good tactics

As the project proceeded, it became increasingly obvious that battlefield trauma care had to be combined with an awareness of the tactical environment in developing recommendations. A chief petty officer (CPO) SEAL corpsman involved with the project described a testing scenario that he encountered at a special operations medical training course in 1997. The casualty scenario took place on a hypothetical mountainous terrain battlefield. As the training scenario developed, he was performing the secondary survey (as called for by the Advanced Trauma Life Support course) on his casualty when enemy mortar fire began to land progressively closer to their position. The question presented to him by the course instructor was whether to finish the secondary survey or to move himself and the casualty to a safer location. The correct answer (per the instructor) was for him to finish the secondary survey. This answer was

dramatically wrong, as the SEAL CPO knew and informed the instructor. The SEAL intuitively knew that good medicine can sometimes be bad tactics, and bad tactics can get everyone killed or cause the mission to fail. The emerging Tactical Combat Casualty Care (TCCC) Guidelines, to ensure optimal trauma care in a combat environment, needed to combine good medicine with good small-unit tactics.

The 1996 TCCC Guidelines

Upon completion of the Naval Special Warfare Command research effort just described, the first set of TCCC Guidelines, as well as the underlying evidence base for them, was published in 1996 as a special supplement to the journal *Military Medicine*.⁴ This article presented a set of evidence-based, best practice prehospital trauma care guidelines customized for use on the battlefield. These guidelines were in many respects very different from the prevailing prehospital trauma care doctrine at the time. The original TCCC Guidelines included the following recommendations:

- Battlefield trauma care was divided into 3 phases: Care Under Fire, Tactical Field Care, and Casualty Evacuation Care. Doing the right thing medically at the wrong time tactically can produce catastrophic results, and identifying these phases of TCCC helped to conceptualize the optimal care of the casualty while considering ongoing tactical events.
- Tourniquets were strongly recommended for the initial control of life-threatening extremity hemorrhage.
- Fluid resuscitation was recommended only when the casualty was in shock and when the hemorrhage that caused the shock had been controlled. The recommended resuscitation fluid was the 6% hetastarch solution Hespan.
- Spinal precautions were recommended only for casualties with a blunt trauma mechanism of injury.
- Morphine was recommended to be given intravenously, rather than intramuscularly, both to provide faster relief of pain and to reduce the likelihood of opioid overdose that can result from the delayed onset of analgesia associated with intramuscular morphine administration. Multiple doses of morphine, given in an attempt to hasten pain relief, may result in overdose and death.
- Medications that cause impairment of platelet function (eg, aspirin and the commonly used analgesic ibuprofen) should be avoided in individuals engaged in combat operations. These medications produce a coagulopathy, and the presence of a coagulopathy in severely injured combat casualties increases the likelihood of death.
- Broad-spectrum prehospital antibiotics were recommended for infection-prone wounds such as open fractures or penetrating abdominal injuries or when evacuation to definitive care is delayed.
- The likelihood of survival in casualties with traumatic cardiopulmonary arrest on the battlefield is minimal, and cardiopulmonary resuscitation was not recommended for casualties in the tactical combat environment.
- Every casualty on the battlefield may present unique challenges based on tactical and terrain considerations. Scenario-based training was recommended to help in developing optimized care plans for different types of casualty situations.⁴

The TCCC program effort: 1996–2001

The 5-year period between the publication of the 1996 TCCC article and the onset of hostilities in Afghanistan saw 4 parallel efforts undertaken in the nascent TCCC program:

1. Presenting TCCC concepts to senior Department of Defense (DoD) line and medical leaders and advocating for their use.
2. Identifying and developing responses to representative types of TCCC casualty scenarios.
3. Initiating TCCC's first strategic partnership with civilian trauma organizations—the Prehospital Trauma Life Support (PHTLS) Committee, the National Association of Emergency Medical Technicians (NAEMT), and the American College of Surgeons Committee on Trauma (ACS-COT).
4. Expanding TCCC training beyond medical personnel to include SEAL and 75th Ranger Regiment combat leaders and nonmedical unit members.

PRESENTING TCCC CONCEPTS AND ADVOCATING FOR THEIR USE IN THE DOD

With any new best-practice medical care recommendations, acceptance is not assured and decision makers must be informed of the new concepts, become familiar with the evidence that supports them, and be inspired to act on the recommendations. The new TCCC concepts were presented to senior DoD leaders in a series of briefings. A 1996 high-level review of military research and development projects included a TCCC briefing. Major General Les Berger, the joint staff surgeon at the time, attended this briefing and became an early advocate for TCCC. After this review, he arranged for TCCC to be briefed to the Senior Military Medical Advisory Committee (consisting of the Assistant Secretary of

Defense for Health Affairs, the service Surgeons General, and himself). Major General Berger further directed that TCCC take the prehospital lead in the series of conferences that comprised the Joint Staff Vision 2010 Futures Working Group. He also arranged for TCCC to be briefed to the Defense Medical Oversight Committee, a group comprised of the 4-star deputy chiefs of staff of the 4 armed services. Additionally, TCCC was briefed to the Commander of the United States Special Operations Command (USSOCOM). The reception to these briefings was generally favorable, but TCCC was so different from previous battlefield trauma care practice that the recommendations were received by senior leaders with a measure of caution, and no plan of action to implement these recommendations emerged from the briefings.

TCCC was also presented at a series of medical conferences in 1996 and 1997, including the Association of Military Surgeons of the United States conference; the Military Health System annual conference; the Special Operations Medical Association conference; the United States Armed Forces Academy of Family Medicine conference; and the Wilderness Medical Society annual scientific meeting. Presentations at these conferences was an essential component of the transition process in that they afforded the opportunity for a series of medical audiences to identify any potential flaws in the TCCC concepts. The most significant pushback received on TCCC from these conferences was on use of tourniquets because the “no tourniquet” rule was a venerated tenet of prehospital trauma care at the time. No one, however, was able to present evidence that the short-duration application of a tourniquet would result in ischemic damage to an extremity. As with the senior leader briefings, however, these presentations produced no plan of action to incorporate TCCC into medical practice in the military. Despite the large investment in labor and resources over the preceding 4 years, at this point in time, TCCC had made essentially no progress towards being implemented in the US military and saving lives on the battlefield. The presentation to the US Armed Forces Academy of Family Medicine, however, did serve to introduce TCCC concepts to then-Captain Russ Kotwal, who later went on to implement them with historic success in the 75th Ranger Regiment.

The first success in operationalizing the concepts of TCCC came from briefing the leaders of specific combat units, notably the Commander of the Naval Special Warfare Command (Rear Admiral Tom Richards), the leadership of the 75th Ranger Regiment, and the command element of the Army Special Missions Unit. By working in conjunction with unit surgeons and with senior enlisted medical advisers at these commands, line

commanders were convinced that TCCC offered an opportunity to improve survival in their units’ combat casualties, and these leaders subsequently directed that TCCC be implemented within their units.⁵ The PJ Medical Oversight Advisory Board also responded to the recommendations, and TCCC concepts were incorporated into use in the PJ community in the 1997–1998 time frame.

TCCC SCENARIO WORKSHOPS

The success of the NSW Biomedical Research and Development program drew the attention of the leadership at the USSOCOM, and in the late 1990s, the deputy commander directed that this research effort be expanded to address the research needs of all of the components of USSOCOM. The USSOCOM Biomedical Initiatives Steering Committee was established to help oversee the program, which included the continuation of the TCCC effort. The next step in developing TCCC concepts was to evaluate how specific casualty scenarios would affect the optimal actions taken to care for casualties. Special operations missions include a number of challenging environments, and a response to casualty scenarios can be planned at only two times: before the scenario occurs in the real world or after it occurs. A series of workshops was therefore held to look at TCCC as it would apply in SEAL diving operations⁶; in the wilderness environment⁷; in urban environments such as Mogadishu⁸; and in chemical, biological, and radiologic casualty scenarios. The recommendations for the various casualty scenarios that were developed in each of these workshops were not intended to be directive in nature, but to provide operational commanders and combat medical personnel with some considerations on how to approach the casualty response for each type of scenario.

TCCC AND CIVILIAN TRAUMA ORGANIZATIONS

The TCCC program was fortunate to make a great friend early in its evolution. The first connection between TCCC and the civilian prehospital trauma care community came as a result of one of the leaders of that community, the late Dr. Norman McSwain, suggesting to then-Rear Admiral Mike Cowan that military medicine authors contribute material to the fourth edition of the PHTLS manual in 1998. This initial interaction led to a robust and ongoing dialogue between military and civilian prehospital trauma care providers. TCCC material was included in the PHTLS textbook, as Dr. McSwain had suggested, and has been part of every subsequent edition of the PHTLS textbook. This inclusion represented an important measure of acceptance for TCCC. Dr. McSwain was a world leader in prehospital

trauma care, and the recommendations in the PHTLS textbook are endorsed by the ACS-COT and the NAEMT. The strong partnership between NAEMT, PHTLS, and TCCC has endured and has been of great benefit to TCCC and, one hopes, to the civilian sector as well.

TACTICAL MEDICINE FOR COMBAT COMMANDERS AND NONMEDICAL UNIT MEMBERS

The fourth parallel line of effort in TCCC involved combat commanders. Soon after its inception, it became obvious that it was not just medical personnel who needed to understand TCCC concepts; line commanders as well as every combatant on the battlefield need to know these concepts as well.

In combat, casualties occur in the context of an ongoing mission. In determining the unit response to the casualty situation, one must recognize that executing the mission and providing optimal care for the casualty may be in direct conflict. What is best for the casualty may *not* be what is best for the mission. When there is this sort of conflict, which consideration takes precedence? Both the SEAL community and the 75th Ranger Regiment understood this fact early on and began to incorporate this expanded training into their respective unit TCCC programs.^{9,10}

In 1999, a book was published which eloquently illustrated this conflict. The book was called *Special Operations*, and it was authored by then-Commander William McRaven. The book contained a number of notable special operations missions with commentaries on the relevant tactical considerations. One of the missions in the book was the Israeli Defense Force Raid on Entebbe in 1976, a dramatic rescue of 106 hostages from an airport terminal in Uganda. As the assault phase of the operation commenced, the ground commander, Lieutenant Colonel Yoni Netanyahu (the brother of Israel's current Prime Minister), was shot in the chest. In a nontactical setting, attention would immediately be directed to the injured warrior. In a hostage rescue mission, however, rescuing the hostages before they are executed by the terrorists is the mission's overriding priority. That was precisely what Lieutenant Colonel Netanyahu had briefed to his rescue force before the mission, and that was exactly what his team did when confronted with his injury at the start of the assault phase of the rescue. Netanyahu died of his wounds, but the mission was a dramatic success. There is no question that this was the correct course of action, and it is critical that mission commanders consider casualty scenarios such as this one as part of their mission preparation.

A very similar scenario occurred in 2012, when the point man on a SEAL mission in Afghanistan to rescue a hostage being held by Taliban forces sustained a gunshot wound to the head while going through the door of the building in which the hostage was being held. The second assaulter, rather than stop and render care, proceeded with the mission, removed the threat in the room, and successfully rescued the hostage. Once the room was secured and the hostage safe, the second assaulter, Senior Chief Special Warfare Operator Ed Byers, who was trained as a corpsman, then helped to provide care for his wounded teammate, whose head wound unfortunately proved to be fatal. Senior Chief Byers subsequently won the Medal of Honor for his actions.¹¹

Both the Raid on Entebbe and Senior Chief Byers's hostage rescue mission are dramatic examples of why the tactical aspects of TCCC are just as important as the medical aspects. TCCC is designed to secure mission success as well as to save lives, and both missions were successfully completed by doing the right thing at the right time in response to a casualty situation.

2001 and beyond

In 2001, two things happened that would permanently change the face of TCCC. The first was the founding of the Committee on TCCC at the Navy Operational Medicine Institute, thanks to the leadership of Captain Doug Freer and Captain Steve Giebner at that command. The second event was our nation going to war in Afghanistan as a result of the al Qaeda attacks on the World Trade Center in New York and the Pentagon on September 11, 2001. The progress of TCCC after these events is discussed in a follow-on article by Giebner in this journal.¹²

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