

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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The 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.

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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

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

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