Integrating Prolonged Field Care Into Rough Terrain and Mountain Warfare Training

The Mountain Critical Care Course

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ABSTRACT

Current prolonged field care (PFC) training routinely occurs in simulated physical locations that force providers to continue care until evacuation to definitive care, as based on the staged Ruck-Truck-House-Plane model. As PFC-capable teams move further forward into austere environments in support of the fight, they are in physical locations that do not fit this staged model and may require teams to execute their own casualty evacuation through rough terrain. The physical constraints that come specifically with austere, mountainous terrain can challenge PFC providers to initiate resuscitative interventions and challenge their ability to sustain these interventions during lengthy, dismounted movement over unimproved terrain. In this brief report, we describe our experience with a novel training course designed for PFC-capable medical teams to integrate their level of advanced resuscitative care within a mountainous, rough terrain evacuation-training program. Our goals were to identify training gaps for Special Operations Forces medical units tasked to operate in a cold-weather, mountain environment with limited evacuation resources and the challenges related to maintaining PFC interventions during dismounted casualty movement.

KEYWORDS: prolonged field care; evacuation; rough terrain; austere; mountain warfare

Introduction

Prolonged field care (PFC) has been identified as a growing need for Special Operations Forces (SOF) providers to deliver medical care beyond expected operational timelines with the goal being evacuation to higher-level medical treatment facilities. PFC focuses on 10 clinical capabilities within an operational context and is based on the ruck-truck-house-plane (RTHP) model.1–3 The challenge with this model arises when an operational environment does not allow care to fit into one of these stages. An example of this would be mountainous terrain in which an SOF medical unit is operating in an extended ruck stage before reaching truck or house. Military operations in mountainous environments pose a challenge for health-service support planners. With greater than 30% of reported PFC cases already occurring in mountainous locations, the harsh environment, restricted movement, and limited logistical supply chains result in smaller unit operations while increasing casualty evacuation times through the terrain.4,5 This presents a challenge that overlaps with those encountered in traditional wilderness medicine.6,7

Although SOF medical units supporting PFC missions have an array of advanced equipment designed for care of patients in austere settings, most wilderness medicine experts focus on the foundational principle of having few (if any) of these items. Most civilian, wilderness medical care limits advanced medical interventions while focusing efforts on basic care and effective patient evacuation. This requires teams to reevaluate their load and determine what is truly essential without degrading capabilities to a degree that teams can no longer provide the forward resuscitative care they were designed for.

SOF medical units whose future operations include PFC missions in cold and mountainous areas need an opportunity to exercise their resuscitative capabilities in this environment. PFC medical skills training typically conducted in a static physical location based on the RTHP model does not offer adequate training that can be simply adapted to evacuating patients from a mountainous area. New training models require basic mountain warfare fundamentals, improvised patient movement techniques, and testing PFC capabilities that can be realistically sustained during the evacuation process. Medical equipment and monitoring systems that will be exposed to extreme cold conditions must also be tested in this environment. The purpose of this report is to describe the experience using a newly developed training program designed to integrate PFC resuscitative trauma care with a rough terrain evacuation course through mountainous terrain. Our intent is to share lessons learned with the SOF medical community and further develop similar training based on the unit’s needs.

Concept of Operations: The Mountain Critical Care Course

The Army Mountain Warfare School (AMWS) offers primary instruction in the US Army’s basic and advanced military mountaineering courses. It also offers specialty instruction,
The Special Operations Resuscitation Team (SORT) is an eight-person team within the US Army Special Operations Command designed to provide Role II medical support to SOF Operators in austere or remote environments. A training program based on the Rough Terrain Evacuation Course curriculum was used to develop a 5-day Mountain Critical Care Course to exercise the SORT’s medical capabilities in mountainous terrain and cold weather, and to identify operational gaps. Training focused on point-of-injury care followed by medical management during long-range, rough-terrain casualty evacuation adhering to PFC principles. Team members trained to provide medical care and evacuation using standard and nonstandard equipment to safely move patients from point of injury to the next echelon of care. A high-fidelity trauma patient simulator (Trauma F/X®, https://www.trauma fx.net/home/) was used for the medical care components of training.

The Mountain Critical Care Course focused on dismounted operations in an extended ruck stage and progressed through training in the following manner: (1) Crawl: day 1 covered basic mountaineering, route planning, and reconnaissance; basics of high- and low-angle rescue; patient packaging; equipment familiarization; cold weather operations; and hypothermia management and other basic techniques taught in a controlled environment. (2) Walk: days 2–4 focused on situational training exercises incorporating autonomous decision-making, skills learned in the classroom, and the physicality of movement in cold weather and mountainous terrain in a highly supervised fashion with guidance as seen fit for safety and increased proficiency. Situational training exercises were specifically designed to exercise a specific PFC capability appropriate to that day’s scenario, allowing for review and adjustments before the final exercise. (3) Run: day 5 training culminated in a final, 8-hour night exercise testing the SORT’s medical capabilities while evacuating patients through mountainous terrain in cold weather without guidance by instructors.

**Training Scenarios**

Scenario 1 involved a casualty who sustained a lower limb amputation from a blast injury after an explosive breach. Point-of-injury care involved tourniquet placement to a right lower leg amputation with significant blood loss. SORT members reassessed hemorrhage control and rapidly extracted the casualty to a nearby, predetermined location to continue trauma resuscitation. Training focused on patient monitoring and hypothermia management before prolonged evacuation through rough terrain to an ambulance rendezvous. Technical skills were practiced with multiple low- and high-angle rope-rescue systems staged throughout the movement (Figure 1).

Scenario 2 focused on the SORT’s ability to manage an unstable airway due to facial burns and inhalation injury. The scenario required evacuation using a high-angle rope-rescue system to expedite movement to the extraction point. Given the need for a mandatory surgical airway before extraction, the SORT needed to determine (1) how to best provide ventilatory support and sedation through a 20-minute vertical haul using the issued ventilatory equipment and (2) the best approach to managing these interventions despite the complex technical rescue (Figure 2).

Scenario 3 focused on a long-range evacuation for a casualty in neurogenic shock due to high cervical spine injury after falling down a 100-foot cliff during dismounted operations. Although the technical training for this scenario focused on low-slope evacuation haul systems, the extended distance of this evacuation required SORT members to continually monitor and reassess the casualty for adequate resuscitation by providing proper fluid resuscitation, intravenous vasoppressor support, and spinal immobilization while mitigating any hypothermia effects (Figure 3).
Scenario 4 was an 8-hour night exercise that required the SORT to locate a casualty who sustained multiple gunshot wounds to the torso and inguinal junction. After land navigation to the casualty’s position, SORT members initiated resuscitation and had to determine the degree of medical intervention necessary before extended evacuation through mountainous terrain under night vision. Technical guidance from instructors was limited unless safety became a concern. Patient deterioration during evacuation in this scenario incrementally increased the complexity of patient care. Medical providers had to determine points during the evacuation most appropriate for interventions such as administration of fresh whole blood (FWB), endotracheal intubation, and chest tube thoracostomy, as well as planning for maintaining and monitoring these interventions while navigating to the extraction point approximately 4 miles away (Figure 4).

The third (and most important) issue identified from this training was the operational issues encountered when integrating PFC interventions with prolonged casualty evacuations. In a mountainous environment, casualties are at the continual risk of hypothermia. Ruck-stage PFC offered limited rewarming options for the hypothermic trauma patient. Dedicated hypothermia kits beyond a single hypothermia prevention and management kit were frequently needed throughout the week. Providers should plan for carrying additional equipment, including tactical tarps and shelters, blankets, cold weather clothing, sleep system components for insulation, and additional sources of heat, including multiple Ready-Heat™ blankets or water-boiling capabilities to create water-bottle heat packs. SOF providers also need to consider fluid or blood rewarming while in the ruck phase and consider the effects of cold on medication efficacy during mission planning. The ability to use FWB transfusions is appealing in this environment but comes with its own challenges. During scenario 4, a cadre member acting as both FWB transfusion donor and recipient became visibly hypothermic when receiving a unit of his own blood that was exposed to 30°F weather for only a few minutes. No fluid-warming devices were used during the scenario. Currently available fluid warmers are inadequate in the cold PFC setting.

The decision to perform any advanced PFC interventions in the field presented challenges to consider. Although decisions about advanced interventions seemed intuitive in the house stage of PFC, a more deliberate risk-reward analysis occurred during the ruck stage. Interventions considered lifesaving, such as airway management or finger or tube thoracostomy, were needed and could not be deferred even though there were rough-terrain evacuation constraints. Scenario 2 required airway placement upon initial patient contact, forcing team members to consider how best to maintain ventilatory support and sedation during a high-angle extrication. Similarly, scenario 3 required a plan to determine how best to administer vasopressors as part of neurogenic shock treatment without an infusion pump while minimizing movement delays through rough terrain. An obvious strength to the SORT personnel composition is having providers at all levels: a Special Operations Combat Medic, critical care nurse, and emergency physician all drawing on their unique knowledge to be able to work through difficult clinical scenarios.

Conclusion

Advances in PFC capabilities have undoubtedly saved lives on the battlefield. The intent of this training was to determine the operational challenges posed by mountainous terrain on rugged or sloped terrain, and rigging and deploying simple and complex rope systems. The second issue encompasses lessons learned about the education and training process. The instructors provided valuable in-training medical guidance to medics caring for the casualty; however, this guidance was often only available to personnel directly engaged in patient care, because of geographic separation from other team members. The AMWS instructors were an invaluable asset, with their decades of collective mountaineering and wilderness rescue experience. The addition of dedicated emergency and critical care medicine faculty provided immediate knowledge sharing with SORT members and also facilitated realistic patient scenarios as well as feedback on medical decision-making.
a dedicated SOF resuscitation team’s ability to perform and maintain PFC capabilities during rough terrain evacuation. Given the unique SORT mission set, training efforts that teach specific technical skills related to a specific operational environment must be coupled with complex critical care medical scenarios to truly test capabilities and determine limitations. This course highlighted a clear need to integrate concepts taught in other disciplines currently facing similar issues, including wilderness medicine, confined-space medicine, and critical care transport. SOF medical units should never have to degrade their clinical capabilities because of the environment. Instead, they should train to best maintain the standard of care regardless of their environment.

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