Review of 54 Cases of Prolonged Field Care

Erik DeSoucy, DO; Stacy Shackelford, MD; Joseph Dubose, MD; Seth Zweben, NREMT-P; Stephen C. Rush, MD; Russ S. Kotwal, MD, MPH; Harold R. Montgomery, SO-ATP; Sean Keenan, MD

ABSTRACT

Background: Prolonged field care (PFC) is field medical care applied beyond doctrinal planning time-lines. As current and future medical operations must include deliberate and contingency planning for such events, data are lacking to support efforts. A case review was conducted to define the epidemiology, environment, and operational factors that affect PFC outcomes. **Methods:** A survey distributed to US military medical providers solicited details of PFC encounters lasting more than 4 hours and included patient demographics, environmental descriptors, provider training, modes of transportation, injuries, mechanism of injury, vital signs, treatments, equipment and resources used, duration of PFC, and morbidity and mortality status on delivery to the next level of care. Descriptive statistics were used to analyze survey responses. **Results:** Surveys from 54 patients treated during 41 missions were analyzed. The PFC provider was on scene at time of injury or illness for 40.7% (22/54) of cases. The environment was described as remote or austere for 96.3% (52/54) of cases. Enemy activity or weather also contributed to need for PFC in 37.0% (20/54) of cases. Care was provided primarily outdoors (37.0%; 20/54) and in hardened nonmedical structures (37.0%; 20/54) with 42.6% (23/54) of cases managed in two or more locations or transport platforms. Teleconsultation was obtained in 14.8% (8/54) of cases. The prehospital time of care ranged from 4 to 120 hours (median 10 hours), and five (9.3%) patients died prior to transport to next level of care. **Conclusion:** PFC in the prehospital setting is a vital area of military medicine about which data are sparse. This review was a novel initial analysis of recent US military PFC experiences, with descriptive findings that should prove helpful for future efforts to include defining unique skillsets and capabilities needed to effectively respond to a variety of PFC contingencies.

Keywords: *prolonged field care; after action review; military medicine; prehospital; medical evacuation*

Introduction

Ongoing worldwide military operations have revived and heightened the awareness of medical challenges faced by tactical medical providers who must hold and manage patients when transport to higher levels of care is not immediately possible. Much of the first responder medical training over the past decade has focused primarily on the initial stabilization of traumatically wounded casualties in preparation for rapid transport to surgical care.[1,2] As our military forces continue to encounter novel and challenging casualty care scenarios in undeveloped countries and immature theaters of operation, it has become apparent that there is currently a strategic and tactical gap in training, planning, and providing for prolonged care in situations where evacuation may be delayed.

The United States Special Operations Command has recognized the challenge of PFC as innate to Special Operations missions and as such has sponsored the establishment of the PFC Working Group. This group has worked to advance training and knowledge in this complex area of care.[3–5] As efforts evolve, this group remains cognizant of the fact that PFC situations may arise on any mission, in any environment, within developed and undeveloped countries, mature and immature theaters of operation, on land and at sea.

PFC has been described as "field medical care, applied beyond doctrinal planning time-lines" culminating in evacuation to a higher level of care.[6] For trauma, PFC may be thought of as an extension or follow-on treatment to Tactical Combat Casualty Care (TCCC)[7] when evacuation is delayed and providers are forced to address the patient's needs beyond the initial resuscitation and preparation for transport. In addition to traumatic battle and nonbattle injuries, PFC also includes treatment of medical and surgical illnesses.

In anticipation of requirements for training, planning, and equipment and supplies tailored to support PFC, we sought to further describe the recent US military experience through a series of PFC cases. The goal of this review of worldwide PFC cases is to define the epidemiology, environment, and operational factors that affect PFC outcomes. This collective experience will prove helpful in guiding training and planning efforts needed to optimize management of casualties beyond initial stabilization.

Methods

This study was approved as a performance improvement project by the Department of Defense Joint Trauma System.

A survey instrument was developed in order to afford respondents with the ability to transcribe data from after-action reviews (AARs) in a standardized and uniform manner while also excluding classified or sensitive information. The instrument permitted input of basic patient demographics, patient care environmental descriptors, medical provider training, modes of transportation, patient injuries and mechanism of injury, vital signs, treatments rendered, equipment and resources used, duration of PFC, and morbidity and mortality status upon delivery to the next level of care. Additionally, there were four open-ended questions for reporting equipment failures and shortfalls, lessons learned, and training deficiencies.

For this study, PFC is defined as any Role 1 or prehospital event that lasted longer than 4 hours and required evacuation of the patient to a higher level of medical care, regardless of whether the patient died before or during transport. Patients with traumatic injuries, as well as surgical and medical illnesses, were included in the study. Role 1 events included those that occurred on and off of the battlefield, to include a casualty collection point, aid station, clinic, ship, or any other prehospital environment where surgical care and advanced resuscitation teams were not available.

Surveys were advertised on the PFC website and distributed to members of the PFC working group as well as to US military medical providers from Special Operations, search and rescue, and submarine teams. The Special Operations Combat Medical Skills Sustainment Course website[8] was also reviewed for PFC cases. The survey was voluntary, and responses were collected and deidentified through assignment of a unique serial identification number. Deidentified data were then transcribed into a Microsoft Excel spreadsheet for tabulation and basic analysis.

Descriptive statistics were used to characterize the AAR data. Simple sums and percentages were used to quantify patient demographics (age, sex, military affiliation), care locations, factors influencing PFC duration, mechanisms and injuries, provider skillsets, equipment utilization, and morbidity and mortality.

Results

Patient Demographics

A total of 59 surveys were received describing patients treated during 46 missions from December 2001 to June 2016. Of these surveys, five were excluded from analysis: one for lack of sufficient patient care details, three for medical diagnoses that did not require urgent medical evacuation (MEDEVAC), and one that described a mass casualty incident with hundreds of patients without means to adequately describe individual patient treatment. Remaining were cases describing 54 patients from 41 separate MEDEVAC missions. The majority (96.3%; 52/54) were male with the exception of two female children. Ages ranged from 1 to 60 years with a mean age of 32.5 years and median of 30 years (SD 15 years). Cases were distributed between patient categories to include 50.0% (27/54) US military, 22.2% (12/54) local civilian and non-NATO military members, and 27.8% (15/54) not specified (Table 1).

Table 1 *Patient Demographics*

	No. (%)
Male	52 (96.3)
Age (y); mean (SD)	32.5 (15)
Range (y)	1–60
US military	27 (50.0)
Army	8 (14.8)
Marines	6 (11.1)
Air Force	4 (7.4)
Navy	2 (3.7)
Not specified	7 (13.0)
Non-NATO military	1 (1.9)
Civilian	7 (13.0)
Other/not specified	19 (35.2)
Combatant command	
AFRICOM	20 (37.0)
PACOM	15 (27.8)
CENTCOM	11 (20.4)
USNORTHCOM	3 (5.6)
Not specified	5 (9.3)

PFC Factors

Regions of care were categorized by combatant command. Of 49 cases identifying a combatant command, 40.8% (20/49) were in AFRICOM, 30.6% (15/49) were in PACOM, 22.4% (11/49) were in CENTCOM, and 6.1% (3/49) were in NORTHCOM (Table 1). When further categorizing the environment, 96.3% (52/54) of cases were identified as occurring in remote or austere locations. Of these austere cases, 36.5% (19/52) were in mountainous regions, 28.8% (15/52) were in a desert environment, 19.2% (10/52) were in a maritime setting, 13.5% (7/52) occurred in a jungle environment, and 7.7% (4/52) were in an urban setting. Aside from the austere setting of the majority of these cases, other operational factors contributed to the need for PFC in

23 cases. In these cases, care was primarily extended due to enemy activity (73.9%; 17/23) and weather (13.0%; 3/23), with snow being the contributing element for each weather incident. Additionally, aircraft mechanical problems, lack of night-vision and night-flying capability, and ground force need to complete mission objectives were also mentioned as contributing factors for PFC (Table 2).

Table 2 *Factors Contributing to PFC*

	No. (%)
Enemy activity	17 (31.5)
Care under fire	13 (24.1)
Weather (snow)	3 (5.6)
Aircraft mechanical issues	1 (1.9)
No night flying capability	1 (1.9)
Remote location	52 (96.3)
Mountainous	19 (35.2)
Desert	15 (27.8)
Maritime	10 (18.5)
Jungle	7 (13.0)
Urban	4 (7.4
Need to complete mission objectives	1 (1.9)

Patient Categories

Patient injury or illness acuity was documented for all 54 cases, with life-threatening injuries or illnesses present in 66.7% (36/54) of cases. Patients identified as having limb- or eyesight-threatening problems accounted for 14.8% (8/54) of cases, and the remaining 18.5% (10/54) of cases were without threat to life, limb, or eyesight. Battle injuries were incurred by 31.5% (17/54) of patients, while nonbattle injuries and medical illnesses accounted for 33.3% (18/54) and 35.2% (19/54) of patients, respectively (Table 3).

Pathologies Encountered

For mechanism, penetrating injuries (37.0%; 20/54) were most prevalent among all cases, with gunshot wounds accounting for the majority (75.0%; 15/20) of these injuries. Burns, motor vehicle crashes, and blast injuries accounted for 11.1% (6/54), 9.3% (5/54), and 5.6% (3/54) of cases, respectively. The remainder of injury mechanisms (18.5%; 10/54) included three bear maulings, two head injuries, one fall, one shrapnel injury, one aircraft crash, one chainsaw laceration, and one unspecified (Table 3).

Traumatic injuries (64.8%; 35/54) were identified as gunshot wounds (42.9%; 15/35), traumatic brain injury (17.1%; 6/35), laceration (17.1%; 6/35), burn (17.1%; 6/35), fracture (11.4%; 4/35), back injury (8.6%; 3/35), blunt abdominal injury (5.7%; 2/35), and blunt thoracic injury (2.9%; 1/35). Active bleeding was present in 42.9% (15/35) of cases and 28.6% (10/35) were identified as being in shock. Of the six burn patients, four had estimated total body surface area burn recorded with a range of 15% to 80% and an average burn area of 53.8% (Table 3).

Table 3 *Patient Injuries and Illnesses*

	No. (%)
Injury classification	
Life-threatening injuries and illnesses	36 (66.7)
Limb or eyesight threatening	8 (14.8)
Non–life/limb/eye threatening	10 (18.5)
Mechanism category	
Battle injury	17 (31.5)
Nonbattle injury	18 (33.3)
Medical illness	19 (35.2)
Mechanism of injury (35 injured patients)	
Penetrating	20 (57.1)
Gunshot wound	15 (42.9)
Other	5 (14.3)
Blunt	9 (25.7)
Motor vehicle crash	5 (14.3)
Other	4 (11.4)
Burn	6 (17.1)
Blast	3 (8.6)
Unspecified	1 (2.9)
Injuries (35 injured patients)	
Gunshot wound	15 (42.9)
Traumatic brain injury	6 (17.1)
Laceration	6 (17.1)
Burn	6 (17.1)
% TBSA, mean (SD)	54 (29)*
Range (% TBSA)	15–80
Fracture	4 (11.4)
Thoracic or lumbar spine injury	3 (8.6)
Blunt abdominal injury	2 (5.7)
Blunt thoracic injury	1 (2.9)
Active bleeding	15 (42.9)
Shock	10 (28.6)

*Four of six had estimates of total body surface area (TBSA).

Of medical illnesses (35.2%; 19/54) encountered, 42.1% (8/19) were abdominal, 42.1% (8/19) were infectious, 5.3% (1/19) was cardiac, and 10.3% (2/19) were other etiologies. The abdominal pathologies consisted of four cases of internal bleeding, two cases of appendicitis and two cases of acute abdomen. The infections etiologies included four cases with acute gastroenteritis, one with meningitis, one with dengue fever, one with Lyme disease, and one with flu-like illness and rash. The cardiac case was acute chest pain with bradycardia. The other etiologies were odynophagia and severe headache.

The PFC Environment

The PFC provider was on the scene at the time of injury or illness in 40.7% (22/54) of cases. In the remainder of cases, the PFC provider arrived following onset of the event via one or more of the following conveyances: aircraft (29.6%; 16/54), parachute (24.1%; 13/54), ground vehicle (20.4%; 11/54), by foot (20.4%; 11/54), and by marine surface vehicle (5.6%; 3/54) (Table 4). Care was provided primarily outdoors (37.0%; 20/54) and in hardened nonmedical structures (37.0%; 20/54). Additional locations of care included: ships and boats (18.5%; 10/54), rotary wing aircraft (16.7%; 9/54), fixed wing aircraft (16.7%; 9/54), ground vehicles (14.8%; 8/54), tilt rotor aircraft (7.4%; 4/54), hardened medical structures (7%; 4/54), and tents (1.9%; 1/54). Of note, 42.6% (23/54) of cases were managed in two or more locations or platforms (Table 5). Care was provided during active enemy fire in 24.1% (13/54) of cases, though it must be noted that 12 of these patients were from two incidents of eight and four casualties each. On a per-mission basis, 7.3% (3/41) of missions were performed during active enemy fire (Table 2). The median number of patients cared for on any single mission was one patient and the maximum number of patients was 18. In 9.8% (4/41) of missions, the medic (on-site or PFC provider) was injured or killed.

Provider Skillsets

Patients in this study were cared for by a variety of providers with different training backgrounds. The majority (70%; 38/54) were attended to by either Pararescuemen (PJs), Special Forces Medical Sergeants (SFMS; 18D), or Special Operations Independent Duty Corpsmen (SOIDC). Of 22 providers identified with an emergency medical technician (EMT) training level, all were uniformly trained at the Emergency Medical Technician–Paramedic (EMT-P) level. A physician was present for the management of 24% (15/54) of patients. Teleconsultation was obtained in 14.8% (8/54) of cases, with the most common consultants being surgeons (62.5%; 5/8), flight surgeons (25.0%; 2/8), and emergency physicians (12.5%; 1/8) (Table 6).

Patient Treatment

While treatment documentation was sparse, we did note the following TCCC interventions. Hemorrhage control was attempted or obtained with tourniquets in eight instances, pressure dressings in eight instances, and hemostatic agents in four instances. Airways were obtained through orotracheal intubation in two patients and via

Table 4 *Infil/Exfil Modes, Disposition, Duration and Mortality*

	No. (%)
Mode of PFC provider infiltration*	
Already on the scene at the time of injury or illness	22 (40.7)
Aircraft	16 (29.6)
Fixed wing	13 (24.1)
Rotary wing	3 (5.6)
Parachute	13 (24.1)
Ground vehicle	11 (20.4)
On foot	11 (20.4)
Marine surface vehicle	3 (6.6)
Primary mode of transport to the next level of care	
Rotary wing aircraft	15 (27.8)
Fixed wing aircraft	15 (27.8)
Marine transport	8 (14.8)
Ground transport	3 (5.6)
Not specified	13 (24.1)
Level of care delivered to at end of PFC phase	
Role 2	14 (26.0)
Role 4	8 (14.8)
Host nation hospital	11 (20.4)
CONUS hospital	1 (1.9)
Not specified	20 (37.0)
Death prior to next level of care	5 (9.3)
Duration of prehospital care (h); mean (SD)	17.8 (22.7)
Range (h)	4–120

*Multiple modes possible for a single infiltration.

Table 5 *PFC Location**

	No. (%)
Outdoors	20 (37.0)
Structures	25 (46.3)
Hardened: nonmedical	20 (37.0)
Hardened: medical	4 (7.4)
Tent	1 (1.9)
Aircraft	22 (40.7)
Rotary wing aircraft	9 (16.7)
Fixed wing aircraft	9 (16.7)
Tilt rotor aircraft (CV-22)	4 (7.4)
Ship/boat	10 (18.5)
Ground vehicle	8 (14.8)

*Multiple location types possible for a single patient.

Table 6 *PFC Provider Qualifications and Teleconsultation*

	No. (%)
Pararescuemen (PJ)	20 (37.0)
Special Operations Independent Duty Corpsmen (SOIDC)	11 (20.4)
Special Forces Medical Sergeant (18D)	7 (13.0)
Independent Duty Medical Technician (IDMT)	2 (3.7)
Paramedic (EMT-P)	22 (40.7)
Physician	15 (27.8)
Teleconsultation	8 (14.8)
Surgeon	5 of 8 (62.5)
Flight surgeon	2 of 8 (25.0)
Emergency medicine physician	1 of 8 (12.5)

cricothyroidotomy in two other patients. These same four airway patients required subsequent mechanical ventilation, while three other patients received bag valve mask ventilation. Supplemental oxygen was used in 16.7% (9/54) of cases. Intravenous access was obtained 61.1% (33/54) of the time and fluids were administered to 48.1% (26/54) of patients, of which 96.1% (25/26) received crystalloids and 26.9% (7/26) received blood products. The most common blood product was whole blood (21 units); however, the majority of this blood (19 units) was used in the care of one patient. Packed red blood cells were transfused in four patients, and two patients received plasma. Medications were administered in 57.4% (31/54) of patients with analgesics being the most common (44.4%; 24/54) followed by antibiotics (22.2%; 12/54). Tranexamic acid was used in 7.4% (4/54) of patients (Table 7). There was no reported administration of vasopressors.

Wound care, splinting, and general nursing care were also identified as important PFC skills assessed in the survey; however, in this retrospective patient series they were infrequently reported.

Delivery, Duration, and Mortality

The primary mode of transport to the next level of care was via air 55.6% (30/54), of which 50.0% (15/30) were by rotary wing aircraft and 50.0% (15/30) were by fixed wing aircraft. The remainder were transported by sea (14.8%; 8/54) and ground (5.6%; 3/54) conveyances, or unspecified 24.1% (13/54). For transport destination, 25.9% (14/54) were delivered to a Role 2 forward surgical team, 14.8% (8/54) were delivered to a Role 4 hospital, 20.4% (11/54) were delivered to a host nation hospital, and the remainder were other continental US hospital (1.9%; 1/54) or unspecified (37.0%; 20/54). The duration of prolonged care was clearly recorded on 92.6% (50/54) of patient care

Table 7 *PFC Treatments*

	No. (%)
Hemorrhage control	
Tourniquet	8 (14.8)
Hemostatic agent	4 (7.4)
Pressure dressing	8 (14.8)
Airway	
NPA	4 (7.4)
Intubation	2 (3.7)
Cricothyroidotomy	2 (3.7)
Breathing	
Supplemental O_2	9 (16.7)
Bag-valve-mask ventilation	3 (5.6)
Mechanical ventilation	4 (7.4)
Circulation	
Peripheral intravenous access	33 (61.1)
Intraosseous access	1 (1.9)
Crystalloid administered	25 (46.3)
Blood products administered	7 (13.0)
Packed red blood cells (8 units)	4 (7.4)
Whole blood (21 units)	2 (3.7)
Plasma (2 units)	2 (3.7)
Medications	
Medication administered	31 (57.4)
Pain medication	24 (44.4)
Antibiotic	12 (22.2)
Tranexamic acid	4 (7.4)

AARs. The prehospital time of care ranged from 4 hours to 120 hours, with a median time of 10 hours, before reaching a higher level of care. While ultimate outcomes were not always available to our respondents, 9.3% (5/54) died prior to transport to the next level of care (Table 4).

Open-Ended Responses

Open-ended questions were included as part of the survey in order to capture points of sustainment and improvement. Responses were received on 72.2% (39/54) of cases, which were divided into equipment issues (17.9%, 7/39), recommendations for pre-mission training (46.2%, 18/39), successful efforts to sustain (35.9%, 14/39), and opportunities to improve (79.5%, 31/39). For equipment issues, the primary failure noted was battery depletion, which occurred in three cases including one that discharged quickly due to cold weather. For pre-mission training, first responder TCCC training was recommended in five cases. Other topics recommended for training included tropical medicine, shipboard operations, telemedicine, advanced wound care, and more training on monitors and ventilators.

Successful efforts to sustain included buddy care and the use of telemedicine, as noted in two cases each. Employment of a "walking blood bank" was found to be effective for one case requiring multiple transfusions of whole blood. Utilization of a nurse-level provider for monitoring vital signs, Foley catheterization, and pain and sedation management was effective and allowed the physician to focus on MEDEVAC coordination. Limb immobilization was noted to be useful in two cases, one using a femoral traction device and the other an air splint.

The most prevalent opportunity to improve was contingency planning for medic incapacitation, which occurred in four cases including one seasick rescuer. Inadequate documentation was noted in three cases including one case in which the tourniquet placement time was not documented. Lack of tourniquet conversion training was identified as a shortfall in two cases. Medical evacuation planning and rehearsals, as well as identification and contingency planning for in-country medical assets, would have been useful in three cases. The need for PFC training, specifically for patient hygiene, was noted. Equipment shortfalls identified were need for oxygen concentrator, monitors, blood products, additional supply of IV crystalloid fluids, field laboratory (e.g., iSTAT), capnography, and ultrasound. Teleconsultation would have been a benefit in two cases. Implementation of pain management protocols was recommended to decrease risk of over medicating patients, and nerve block training was suggested as a means to improve pain control during PFC scenarios.

Discussion

Prolonged field care in the military prehospital setting remains ill-defined. It is an extremely vital area of medical care about which data are sparse. Repositories of PFC data are generally found in AARs at the unit level as well as in the memory of those care providers who were involved in PFC events. Historically, these data have not been collected, consolidated, and analyzed, which adds to the challenges encountered when developing appropriate training courses, guidelines, and mission preparation tools. This review was an initial analysis of recent US military PFC experiences, with descriptive findings that should prove helpful for future efforts to include defining unique skillsets and capabilities needed to effectively respond to a variety of PFC contingencies.

Provider Training

The capabilities of the individual provider can influence patient outcomes during PFC scenarios. Our results demonstrate that PFC constitutes a broad range of patient presentation and clinical care that is not easily addressed with linear or algorithmic patient treatment protocols alone. Although mastery of PFC techniques for all contingencies may prove difficult, providers must at least be familiar or proficient with skills required for common PFC scenarios, and train on such through a variety of different operational settings and evacuation platforms. Prehospital patient care may span the spectrum from initial patient stabilization, to ongoing assessment, resuscitation, and interventions usually reserved for facility-based patient management. This breadth of care presents unique and obvious challenges to remote and austere medical providers, both in and outside of the military.

Skillsets that bridge the gap include both simple and complex interventions. During the PFC phase of care, recording serial vital signs, measuring urine output and interpreting trends over time are invaluable, low cost, and low tech means by which to continuously evaluate the patient and identify early decompensation. More complex skillsets may include subsequent treatment through prolonged mechanical ventilation with commensurate requirements for sedation, balancing pressor and fluid management, and the ability to perform essential acute surgical interventions. Procedures such as tube thoracostomy, cricothyroidotomy, and, in some cases, fasciotomy and escharotomy have the potential to save life and limb, but are not routinely trained and practiced by the prehospital provider.

Particularly where there are knowledge and experience gaps, as there will inevitably be with the various presentations and complex treatment plans sometimes encountered in PFC, telemedicine can be a force multiplier when employed effectively. In 14.8% of the cases reviewed in this study, telemedicine played an integral role in the management of the patient by guiding judgement, differential diagnoses, interventions, or other advanced efforts. When prehospital supplies and equipment are available and robust, electronic monitoring devices (ie. Tempus Pro™, HeartStartMRx™) can allow for the remote transmission of patient vital signs and diagnostics to a distant advanced medical provider (e.g., physician, physician assistant, nurse) or group of such (e.g., joint trauma system, burn center, infectious disease service). In its most basic form, however, simple telephone communication, augmented with low-bandwidth email connections when available, is highly effective and accepted by most to include those within the Special Operations community. This capability, combined with a pool of consultants (trauma, critical care, neurosurgery, burns, pediatrics, cardiology, etc.) allows the PFC provider access to numerous advanced providers with an abundance of expertise. Telemedicine can also support clinical judgment and provide the needed decision-making confidence to commit to a treatment plan, as well as crucial feedback required to manage unanticipated complications. With the recent implementation of a systematic solution for telemedicine by the Telemedicine and Advanced Technology Research Center, we anticipate increased use for PFC cases in the near future.[9] To be proficient, prehospital providers must routinely utilize telemedicine consultation in training as well as during clinical practice.

Our study showed that a PFC provider was present at the point of injury in only 40.7% of cases, reinforcing the importance of training both medical and non-medical first responders in both TCCC and PFC. Adaptability between various modes of transport is also important since 42.6% of patients required transition between two or more locations or platforms. Patient transport has often occurred on non-standard evacuation platforms where the ground prehospital provider is needed to accompany and provide en route care to the patient until transferred to a higher level of care. True designated and dedicated medical evacuation platforms, robust with medical personnel and equipment capabilities, are limited in the current operational environment as global efforts have widely dispersed military forces in numerous locations, most of which are austere in nature.

Equipment

Each of the equipment and supply shortfalls identified by the open-ended questions are also detailed in the PFC capabilities position paper as they are common areas of focus during recommended unit-level PFC exercises.[5] Additionally, the PFC definition incorporates limited resources into its definition and denotes that any medical planning and training should anticipate critical shortfalls and develop contingency plans for continued patient care in light of limited resources.

Unique and often hostile environments present multiple challenges when determining appropriate medical personnel, equipment, and supply needs for supporting the mission. These challenges are compounded when the medical component of the mission is unknown. Weight and space, and their effect on mobility, are often an issue with respect to small, specialized response teams. Even the most basic of resuscitative therapies (e.g., IV fluids to include blood products) require additional equipment (needles, tubing, coolers, fluid warmers, etc.) beyond the products themselves. To remain tactically feasible, equipment must be lightweight and compact yet durable enough to perform effectively in extremes of environment with notable variations in temperature, pressure, vibration, shock, dust, and moisture. Additionally, battery depletion, which was identified in three cases, is a common observation in medical operational reviews and should be noted as an assumption when planning for PFC situations.

In addition to being rugged, other ideal characteristics of PFC equipment must be considered. As weight is often a limiting factor, the ability for a single piece of equipment to perform multiple tasks is an exceptional advantage. An example of such a flexible and multipurpose device, already available to some PFC providers, is the Tempus Pro™ manufactured by Remote Diagnostic Technologies Limited. The development and evolution of this device was guided by parallel input from prehospital and Special Operations providers. The current product incorporates numerous monitoring capabilities, ultrasound diagnostics, video laryngoscopy, and teleconsultation suitable for extended operations. End-user input and operational scenarios that include PFC should be considered during the development of future novel products. Although technology may enhance the provision of medical care, it is not a suitable alternative to provider knowledge and experience in these complex and varied patient scenarios.

Future Research

Retrospective reviews of data such as the one presented here, as well as future prospective analysis, will prove invaluable for identifying and developing training, education, and equipment needs that evolve with the PFC provider. Studying the factors that contribute to PFC will help to identify the outcomes that may be improved with better training and equipment. Post hoc surveys are a valuable tool to identify general epidemiologic trends, injuries, and treatment of PFC patients; however, recall of events will be incomplete. Initial and subsequent patient evaluations (vital signs, Glasgow Coma Scale scores, etc.) were requested, but seldom returned with the surveys.

Similar to that previously described for TCCC care,[10] a PFC solution to documentation and data collection would be the combination of both a prospective PFC card along with a retrospective PFC AAR form that can ultimately be used to collect, consolidate, and analyze data and other information through a central repository or registry dedicated to PFC. Field care cards like the one developed by the Special Operations Medical Association Prolonged Field Care Working Group[11] should be complemented by detailed AARs which comment on the progression of the PFC event including notes on environmental factors, utilization of equipment and supplies, and any deficiencies in training or education. The combination of these two instruments, deployed with US military prehospital providers, would lend more clarity to problems encountered by PFC providers. Additionally, similar to reintegration procedures, post action provider interviews may yield valuable information that could improve PFC training.

Limitations

Our present study has several limitations. Most of the surveys received were not accompanied by a formal AAR or patient care card. Surveys based on recorded data were not differentiated from those completed from the provider's memory of events. Specific details (initial and subsequent assessment of vital signs, Glasgow Coma Scale, volumes of fluid, number of blood products, and dosage of medications) were often missing or incomplete from surveys. Even when performing a retrospective review of a formal AAR, the interpretation may not be commensurate to what actually transpired during the PFC event. Post action interviews and patient care cards obtained on future PFC casualties should decrease uncertainty in the data and the data collection process.

There have been over 59,000 casualties treated in recent operations[12]; however, it has proven difficult to ascertain the incidence of PFC encounters and the extent to which our study is reflective of the total of PFC cases. We do not know what percentage of providers were surveyed, and if any cases were withheld due to security, personal, or other reasons. Only through an exhaustive review of all medical AARs from all US military units would we come close to identifying a true incidence of PFC, and even then we would be missing numerous cases and data where prehospital documentation did not occur as historically this deficiency has already been noted.[10,13,14]

While the focus of this study is analysis of PFC events, it is important to note that avoidance of these scenarios is preferable. The survey instrument did not identify which events could have been avoided with improved mission support and prepositioned assets. Potential for PFC should be considered during mission planning and appropriate steps taken to mitigate the risk.

Conclusion

PFC, with its unique environmental challenges and often unpredictable casualty burden, remains as an underdeveloped frontier of military medicine. Success in this arena will rely on expanding provider knowledge and skillsets that incorporate detailed emergency evaluation, critical care treatment and resuscitation, and advanced nursing care concepts. Carefully selected and adaptable equipment should enhance care provided by prehospital personnel without hindering mobility and mission completion. Further research and active collection of PFC event data will help clarify the demands of treating casualties beyond the parameters of TCCC.

Disclosures

The authors have nothing to disclose.

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Maj DeSoucy, USAF, is a general surgery resident, currently serving at David Grant Medical Center, Travis AFB, California. He has deployed twice as flight surgeon and medical director for the 48th Rescue Squadron, Davis-Monthan AFB, Arizona. E-mail: esdesoucy@ucdavis.edu, erik.desoucy.2@us.af.mil.

Col Shackelford, USAF, is a trauma surgeon, currently serving as the chief of performance improvement, Joint Trauma System, San Antonio, Texas. She is a member of the Committee on TCCC and has previously deployed as the director of the Joint Theater Trauma System.

Lt Col DuBose, USAF, is a trauma and vascular surgeon currently serving at David Grant Medical Center, Travis Air Force Base, California. He is a member of the Committee on TCCC and has deployed four times in support of OEF, OIF and Operation Inherent Resolve.

SMSgt Zweben, USAF, is a Pararescueman currently serving as the Operations superintendent at the 131st RQS, Moffett Field, Mountain View, California. He has deployed six times in support of OEF and OIF.

Lt Col Rush, USAF, is a pararescue flight surgeon for the 103rd Rescue Squadron in NY, and is the USAF pararescue medical director. He is a member of the Committee on TCCC.

COL (Ret) Kotwal, USA, is a family medicine and aerospace medicine physician currently serving as the director for strategic projects for the Joint Trauma System, Fort Sam Houston, Texas. He previously served with USASOC, 75th Ranger Regiment, and 3d Battalion, 75th Ranger Regiment. He is a prior member and current senior consultant to the Committee on TCCC.

MSG (Ret) Montgomery, USA, is a retired Ranger Medic/Special Operations Combat Medic, having served as the Senior Enlisted Medical Advisor at USSOCOM and the Regimental Senior Medic of the 75th Ranger Regiment for a combined 25 years. He is currently the operational medicine liaison for the Joint Trauma System and a member of the Committee on TCCC.

COL Keenan, USA, is a board-certified emergency physician and is currently serving as command surgeon, Special Operations Command, Europe. He has previously served as battalion surgeon in both 1st and 3rd SFG(A) and as group surgeon, 10th SFG(A). He is the coordinator for the SOMA Prolonged Field Care Working Group.
E-mail: sean.keenan1.mil@mail.mil.

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