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Military nursing at the forefront
The Army Forward Surgical Team

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As automatic weapon rounds explode from every direction, a nurse anesthetist is preparing a hemorrhaging soldier for life-saving surgery. In the makeshift recovery room, another nurse is providing postoperative care for a soldier who has undergone a traumatic amputation, his leg shattered by a land mine. Next door, a critical care nurse is assessing a postoperative patient for return of neurologic function. Here you will find no intracranial pressure monitors, no central venous pressure lines or monitors, no arterial lines, not even an IV pump. Here nurses must rely on their finely tuned assessment skills, their trauma knowledge, and each other. This is no ordinary hospital ward — far from it. It is the temporary home of an Army forward surgical team (FST). An FST is a group of military trauma care providers whose mission is to provide emergency surgical stabilization within close proximity of the location of injury [1]. In recent years, most FST deployments centered around peacekeeping, peacemaking, and humanitarian missions. Currently, several Army FSTs are directly supporting Operation Enduring Freedom [2,3], the "War against Terrorism" in Afghanistan. This article provides an overview of the historical background, concept, mission, and capabilities of the Army FST, its personnel and structural organization, and the requirements of its nurses.

Combat care: historical background

A long held principle of combat healthcare has been to evacuate the wounded away from the battle to areas out of immediate danger. For example, in the popular television show *M*A*S*H*, casualties of the Korean Conflict were transported by ground vehicles or helicopters to the mobile army surgical hospital (MASH), which was located in a fairly protected area away from the battlefield. Here soldiers received surgery and recovered enough to either withstand evacuation back to the United States or return to their combat units. In Korea, and more so in Vietnam, Army medical evacuation (MedEvac) helicopters revolutionized the system of evacuation and were credited with saving thousands of lives. But beginning with Vietnam and continuing to our recent conflicts, wars have changed. Clearly defined battle lines are nonexistent; there is no distinct "front." Combat troops move swiftly; they no longer "dig in" and fight for protracted periods in one area. Consequently, there may be no safe haven close to the troops in which to set up a relatively stationary field hospital. In addition, as seen in Operation Desert Shield/Desert Storm, hospitals were separated from their maneuver units by many miles [4]. Although the casualty rate from Operation Desert Shield/Desert Storm was low, the risk of wounded soldiers dying

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during evacuation back to one of the definitive treatment facilities was great.

FST: the concept

The changing nature of the battlefield required that combat health support change also. The current battlefield is characterized by quick military operations, increased mobility and dispersion of the units, flexible and rapid task organization, and geographically extended lines of communication [4].

In the late 1990s, the MASH units were nearly phased out of combat health care because of the inability to relocate them quickly and keep pace with rapidly changing battle lines. The FST, operational as of 1997, represented a significant change, not an addition, to the way combat health support is delivered to soldiers on the battlefield. The FST is in close proximity to the injured, yet retains its mobility and versatility.

FSTs are positioned in what the military calls "far forward" areas, that is, areas as close to the fighting troops as possible. Because hemorrhage is the most common cause of mortality among wounded soldiers, prompt and aggressive resuscitation is required to save lives [4]. The quicker the wounded are stabilized, the lower the mortality, complications, and disability. Battlefield care can best benefit soldiers at the point of injury.

FST members set up their small surgical treatment facility quickly, usually being fully operational within 1 hour. Likewise, they are ready to move at a moment's notice. Depending on the type of mission to be supported, the FST may bring along the team's six "Humvee" trucks; with these the team is 100% mobile on the ground. Both the equipment and personnel can be transported by helicopter or by airplane; they can even be parachuted into a given location. Because personnel and supplies are limited purposefully, the capability for rapid movement of the FST is enhanced.

FSTs are versatile. They can set up their surgical treatment facility using a general purpose tent system (Fig. 1) or a deployable ready assembly surgical shelter (DRASH) (Fig. 2). The DRASH is a lightweight, durable structure that can be set up in minutes with little manpower. The structure actually pops into place with an umbrella-type motion. Both the tentage and the DRASH can be configured differently depending on the nature of the mission. During peacekeeping and humanitarian missions, FSTs have been set up in existing buildings.

Mission

The FST rapidly deploys to a combat area to support a brigade-sized group, usually 1200 to 1700 soldiers. The primary mission of the FST is to

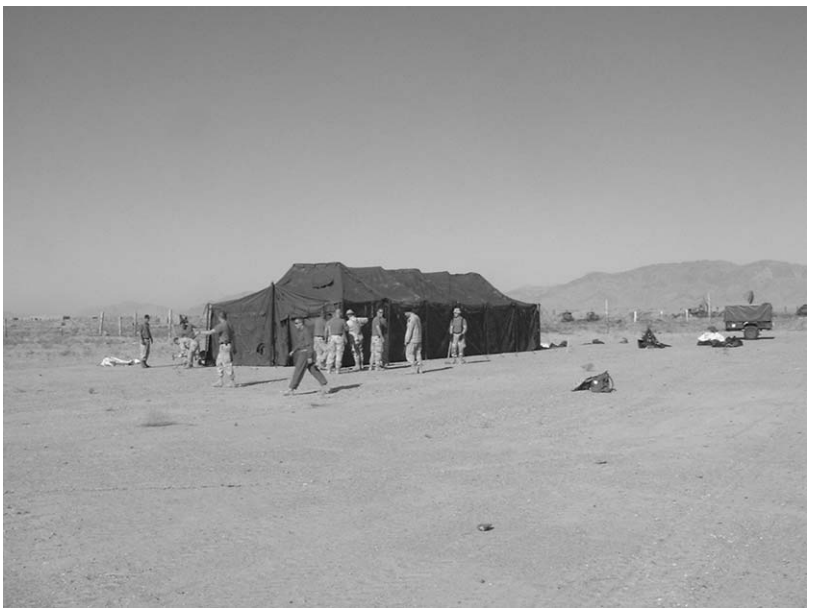

Fig. 1. General purpose tent. (*Courtesy of* Major Michael Sadler.)

Fig. 2. Deployable ready assembly surgical shelter (DRASH). (*Courtesy of* Lieutenant Colonel Charlotte Hough.)

provide initial, immediate life-saving surgery, enabling patients to withstand further evacuation [1,4]. This surgery is considered resuscitative, albeit major surgery, and a typical case lasts less than 2.5 hours. More definitive surgery usually occurs after the soldier is evacuated to a higher level of care.

Capabilities

Initial triage, emergency medical treatment, resuscitative surgery, and intensive care nursing are the primary capabilities of the FST. The team can provide initial surgery and postoperative care for up to 30 critically wounded patients continuously over a period of 72 hours. Within those 72 hours, the FST can perform up to 48 consecutive hours of surgery before personnel fatigue and available on-hand supplies have an impact on performance. Limited storage space makes resupply critical. For example, the FST has the capacity to store only 50 units of group O packed red blood cells [4]. Limited storage space and weight considerations also have implications for the types of treatment modalities used. For example, McHenry et al [1] found external fixation superior to casting of lower extremity fractures not only because of the superior stabilization with external fixation but also because external fixation devices took up less packing space and weighed less when compared to casting supplies.

The FST is designed to receive and manage approximately 10 patients a day. Typical patients cared for in an FST include those with signs and symptoms of airway compromise, difficult breathing, and circulatory shock who do not respond to initial advanced trauma management intervention on the battlefield. As a general rule, patients with major chest or abdominal wounds, continuing hemorrhage, severe shock, airway compromise/distress, and acutely deteriorating levels of consciousness with closed head injury may be surgical candidates for the FST [4]. The FST is not designed for routine or definitive surgery nor is it designed for use when modern facilities are available; however, in the event that evacuation of patients may be delayed because of heavy fire, patients may need to stay longer than anticipated.

Organization

To accomplish its mission, the FST personnel are organized into four functional areas: triage-trauma management, surgery, recovery/holding, and administrative/operations. The triage-trauma management is the first stop for injured soldiers. Here they are assessed for severity of wounds and are prioritized, if need be, for surgery. Careful triage is critical to the mission of the FST because of the narrowly defined population served. All four surgeons, the FST chief nurse (a critical care nurse), and three enlisted medical specialists (combat medics) are assigned to this area. While patients are being triaged, the operating room staff prepares the surgery area for the imminent cases. After the initial triage, the surgeons move with the patient to the surgical area and perform the required surgery. The three surgeons, along with the Commander (a general surgeon), work as two-person teams and are able to perform two surgeries simultaneously with the help of three operating room technicians, two certified registered nurse anesthetists, and one operating room nurse. Fig. 3 shows the 250th FST operating room in action in Afghanistan.

Patients are taken to the patient recovery/holding area once surgery is complete. The recovery area has a bed capacity of eight, with four beds equipped for extensive postoperative care, including mechanical ventilation. Fig. 4 displays a portion of the patient recovery area and Fig. 5 shows the co-author tending to a patient in the recovery area. Patients typically stay in this area for 1 to 6 hours until they are fully

Fig. 3. Operating room, 250th FST. (*Courtesy of* Major Michael Sadler.)

recovered and stabilized for further evacuation. The recovery team leader is a medical–surgical nurse who works with three licensed practical nurses (military medics). In addition to providing postoperative recovery and care, the nursing staff from the recovery/holding area also assists with triage and provide preoperative care for incoming patients.

The administrative/operations element helps the commander in planning and executing relocation and arranges for medical resupply, physical security,

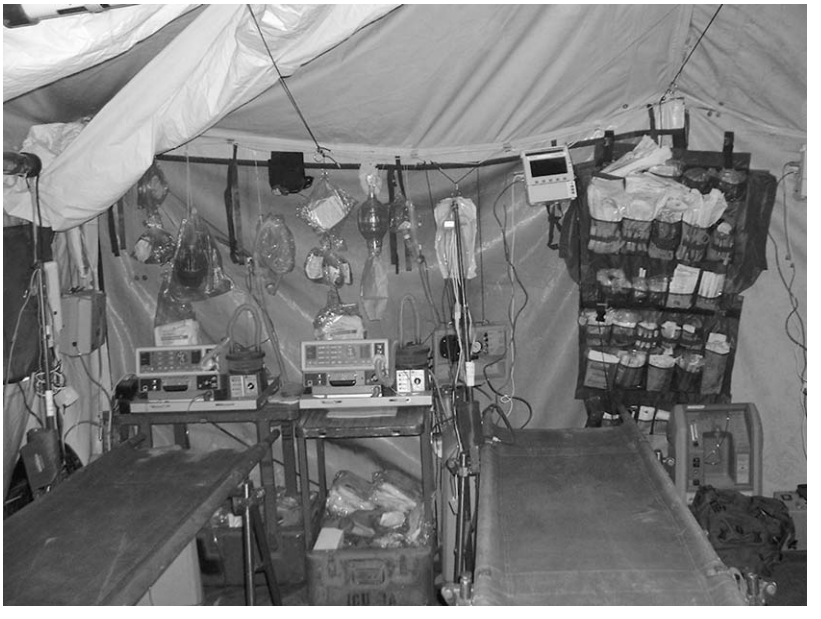

Fig. 4. Postoperative Care Unit / ICU, 250th FST. (*Courtesy of* Major Michael Sadler.)

Fig. 5. Major Michael Sadler with critically injured patient. (*Courtesy of* Lieutenant Colonel Robert M. Rush, Jr.)

vehicle maintenance, food service, and small weapons repair [4]. All this is done by the operations officer and one combat medic. The typical FST team is composed of 20 members.

Challenges

Because of its very nature and mission, the FST faces unique challenges. First, the FST cannot stand alone and is dependent upon the unit to which it is attached or assigned for food service, water distribution, and security. The FST also requires electrical power; maintenance support for vehicles and communications equipment; patient administration, and coordination of medical evacuation; nuclear, biologic, and chemical decontamination support; physical security; and armed escort for security when deploying into and moving through hostile areas [4]. Additionally, the FST has no radiologic capability and limited laboratory service. The FST depends on the attached unit for these services.

Second, the mobile nature of the FST poses creature comfort and logistical challenges. Army Nurse Corps Major Michael Sadler, [3] Chief Nurse of the 250th FST at Kandahar Airport, Afghanistan, summed up the issues: "Accommodations are Spartan; [there are] no showers, no hot chow, bottled water when available, no running water, and no toilets . . . electrical power is inconsistent and dust is everywhere." Dr. (Colonel) Cliff Porter summarized the logistical problems as "power surges, equipment maintenance, instrument resterilization and communication" [5]. He goes on to discuss another important issue, that is, keeping the staff motivated and working together in a miserable environment.

Training

To prepare for the FST's combat mission and working under the conditions just described, the FST personnel must maintain both trauma and soldier skills [6]. The Army trains as it expects to fight. Therefore, training must be as realistic as possible. The Army's FSTs receive realistic trauma training during 30-day rotations to civilian trauma centers [7]. These are unique opportunities for the FST members to treat serious trauma injuries before seeing them for the first time in combat. This training began initially at Ben Taub Hospital in Houston, Texas, but currently takes place at Rider Trauma Medical Center in Miami, Florida. These facilities, both Level 1 trauma centers, receive a large number of motor vehicle accident and gunshot wound victims [7]. The FST members follow trauma patients from initial admission to the emergency department, into the operating room, through surgery, and into the postoperative care unit. In the emergency department, triage and initial assessments are performed by the

appropriate FST members, and as the patient moves through the system, such as to the operating room and then to the ICU postoperatively, respective FST members are able to care for the patient while in that area. Training as a cohort team is critically important to the ability to function as a team, especially under the stressors of combat.

Additional opportunities for an FST include rotations through the Army's premiere training sites: the Joint Readiness Training Center at Fort Polk, Louisiana, the National Training Center at Fort Irwin, California, and the Maneuver Training Center at Hohenfels, Germany. At these sites, the FST performs its mission while supporting a large military combat unit during 1 week of the most intense and realistic training the Army provides, complete with live enemy fire and simulated full-scale towns. During these training events, simulated casualties arrive at the FST and serve as the training tool. The FST personnel must also be prepared to provide surgery in a variety of potential combat scenarios, for example, simulated chemical warfare. The FST is evaluated on their response and reaction as well as the care of their patients.

Like all soldiers in the Army, FST medical personnel must be proficient in a number of soldier tasks to include day and night land navigation using a map and compass; competency in firing an M-16 machine gun and a hand gun; and nuclear, chemical, and biologic agent detection, decontamination, and treatment. Certain FST members are required to be airborne qualified, which means they completed a rigorous training program and are certified to parachute into a destination. Some of these skills and competencies are quite different than those required of civilian trauma teams!

Nursing care

Saving lives through resuscitative surgery is the mission of the FST. The FST nursing staff contributes to this mission by focusing their efforts on the safe provision of patient care in an environment with limited resources and rapid patient turnover [4]. The nurses prepare patients for surgery, assist in surgery, treat patients in recovery, and prepare them for medical evacuation. To this end the FST nurses balance the following responsibilities: direct patient care, support services, administrative duties, and staff management.

Nurses are the patient care experts on the FST. The surgeons work magic on the operating table, but it is the nursing staff that keeps the magic spark of life glowing. Nurses in the FST use the nursing process to guide care but must focus their efforts on the traumatized areas of the body. For example, hygiene is limited to the bodily areas surrounding the injury; patients will receive more complete bathing once they arrive at their medical evacuation destination. Principles of sterile and aseptic technique are followed as appropriate. Patent care is guided by standard operating procedures (SOPs); standardization of processes such as weaning from mechanical ventilation postoperatively, extubation, and autotransfusion of chest tube drainage helps to ensure safe and proper care when physicians may not be immediately available.

Vigilant patient surveillance is paramount in all care areas to rapidly detect life-threatening conditions such as hemorrhage and increasing intracranial pressure. One example of vigilance comes from the 250th FST. One night, a ventilated, sedated, and paralyzed patient who was on a continuous oxygen saturation monitor began to desaturate. The alarm on the ventilator and oxygen concentrator (the oxygen source for the ventilator) did not sound, and the machine appeared be working properly. Manually ventilating the patient failed to increase his oxygen saturation. Next, the oxygen concentrator was replaced, resulting in an immediate increase in oxygen saturation. An investigation determined that the oxygen concentrator malfunction was caused by power surges from the generator. Furthermore, the nine-volt battery that powered the alarm was dead.

Emotional support is another critical aspect of patient care in a FST and is heightened by the bond that exists between Army nurses and their soldier–patients. Although Army FSTs typically support US ground units, FST nurses also provide care for coalition forces of both the North Atlantic Treaty Organization (NATO) and host countries.

Specialized support services, such as laboratory and radiology, may not be available. For this reason and for immediate results to guide medical decision making, nurses use point-of-care testing devices for determining levels of hematocrit, electrolytes, and blood gases and for performing urinalyses. In the absence of an attached radiology unit, nursing staff of the 250th FST at Khandahar Airport in Afghanistan used an explosive ordinance detection imaging device for patient radiographs. This attests to the ingenuity of FST nurses!

Administrative tasks handled by the nursing staff include completing required documentation and tracking and inventorying patients' personal effects, which accompany the patient when evacuated. Staff management includes redistribution of nursing assets

during periods of expansion or contraction of the patient care areas based on patient demand and combat conditions.

The nursing staff of an FST must be flexible and ready to do what they must for the good of the patients and the team. For example, some nurses from the 250th FST provided inner perimeter security during a firefight while their nursing colleagues inside the tent provided patient care wearing bullet proof flak jackets, helmets, and loaded 9-mm handguns at their hips to protect their patients and themselves from any enemy that might break through the perimeter.

FST nurses must also be creative in their approach to patient care, especially given the logistical constraints, such as lack of proper heating, air conditioning, potable water, and supplies.

Recent missions

Since their inception, FSTs have participated in almost all US wartime and peacekeeping missions, including Operation Just Cause in Panama, Operation Desert Shield/Desert Storm in Saudi Arabia, Operation Uphold Democracy in Haiti, various missions in the Balkans, and most recently, Operation Enduring Freedom in Afghanistan. During Operation Uphold Democracy, the 274th FST from Fort Bragg, North Carolina, was part of a medical task force that provided humanitarian primary care services to the local populace and healthcare to the US troops. There, the team set up on a runway in Guantanamo Bay, Cuba, and cared for troops that were deployed as part of that operation and performed surgeries on three of the soldiers. Most recently, two FSTs were deployed to Operation Enduring Freedom in Afghanistan, where they supported seriously wounded troops from the land battle, Operation Anaconda. The 274th FST located at Bagram Airbase cared for 500 patients, including more than 200 combat casualties [8]. Types of surgical cases encountered by this team included multiple trauma, amputations, external fixations, and a craniotomy. Most noncombat injuries were caused by acute mountain sickness from the high altitude of Afghanistan. The commander of this FST reported no patient deaths among the seriously wounded patients for whom care was provided [2].

Summary

From World War II to current conflicts, history has validated the need for early surgical intervention to save lives and established the need for FSTs. Historically 10% to 15% of soldiers wounded in action require surgery to control hemorrhage and to provide stabilization sufficient for evacuation to a medical treatment facility where definitive care can be provided [4]. Undoubtedly, many lives were saved in past conflicts because resuscitative surgery and care were available a short time after being wounded. The need for surgical stabilization for patients to survive a long evacuation was well-established during military operations such as Operation Desert Storm.

Resuscitative surgery capability must be present on the battlefield, and this capability must be able to move with the units the FST is supporting. These two imperatives were the driving force of the creation of the US Army's FSTs: they are light, easily transportable, and able to keep pace with the supported units.

FSTs are an integral and essential element in providing surgical care to save soldiers' lives on the modern battlefield. The US military has been involved in more operations and deployments since the end of the Cold War than in the preceding years. FSTs participated in many of these operations and have performed superbly. FSTs will continue to have a critical role in providing combat health service support to soldiers on the battlefield of the twenty-first century, and FST nurses will continue to be an indispensable asset.

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