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Wartime Burn Care in Iraq: 28th Combat Support Hospital, 2003

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Introduction: The U.S. Army 28th Combat Support Hospital (CSH), an echelon III facility, deployed to Iraq at the start of military operations in 2003. Shortly after arrival, it was designated as the hospital primarily responsible for burn care for the U.S. military in Iraq. This report reviews the experience of the CSH with burn care during combat operations. Methods: An after-action review was conducted during a 2-day period after the hospital's redeployment. Results: Between April 11, 2003, and August 21, 2003, the 28th CSH treated a total of 7,920 patients, of whom 103 (1.3%) had burns. Patients included U.S. and allied service members, U.S. contractors, and Iraqi prisoners of war and civilians. Although a CSH is designed to care for patients until they can be stabilized and evacuated, usually within 1 to 3 days, the length of stay for some Iraqi patients was as long as 53 days. Definitive care, including excision and grafting of the burn wound, was thus required for some Iraqi patients. The largest graft completed comprised 40% of the total body surface area. The largest burn survived involved ~65% of the total body surface area. Eighteen (17%) of 103 patients returned to duty after treatment at the 28th CSH. The mortality rate for burn patients at the 28th CSH was 8%. Shortages of burn-experienced personnel and burn-specific supplies were identified during the after-action review. Conclusions: The CSH provided complex definitive care to burn patients in an austere environment. Predeployment identification of military field hospitals for such specialized missions, with early assignment of experienced personnel and materiel to these units, may improve future wartime burn care.

Introduction

Shortly after its establishment outside Baghdad at the beginning of military operations in Iraq in 2003, the U.S. Army 28th Combat Support Hospital (CSH) was designated as the facility primarily responsible for the care of burn patients in support of U.S. forces. Because Iraqi patients could not be evacuated, it became necessary for the 28th CSH to provide specialized long-term care for Iraqi burn patients.

CSHs are echelon III facilities intended to provide short-term care and stabilization of combat casualties before rapid evacuation. The mission of the CSH is to "provide resuscitation, initial wound surgery, postoperative therapy, and RTD [return to duty] those soldiers in the CZ [combat zone] who fall within the corps evacuation policy, or to stabilize patients for further evacuation."[1] The evacuation policy, which determines how long casualties may remain in the combat zone once wounded, is tailored to the situation on the ground. In 2003 in Iraq, this policy called for air evacuation within 72 hours after injury and provided the CSH with a 7-day holding capacity.

When fully deployed, a CSH has eight operating room tables and wards for intensive, intermediate, and minimal nursing care, with beds for up to 296 inpatients.[1] The CSH is staffed with personnel with diverse skills and can treat a wide variety of patients, but it is not designed for definitive care of patients with major thermal injuries.

This report, based on an after-action review conducted at the U.S. Army Burn Center after the unit's redeployment, examines the experience of the 28th CSH with burn patients treated during military conflict under field conditions. We have highlighted areas in which this experience resulted in a change in practice during the current conflict. It should be emphasized that this report represents the personal opinions and experiences of the individuals most directly involved in burn care at the 28th CSH. These perspectives, although unofficial, are offered to assist those responsible for planning for burn care during future combat operations.

Methods

An after-action review was conducted by the authors at the U.S. Army Burn Center, U.S. Army Institute of Surgical Research (Fort Sam Houston, Texas), on May 20–21, 2004. The meeting was sponsored by the U.S. Army Medical Department Center and School. Participants in the meeting included nurses and physicians from the CSH, as well as several external subject matter experts to facilitate the discussion. The latter included a nurse (L.R.S.) and a surgeon (L.C.C.) from the U.S. Army Burn Center, the trauma consultant to the U.S. Army Surgeon General (J.B.H.), and the clinical consultant to the Directorate of Combat Doctrine Development at the U.S. Army Medical Department Center and School (T.E.K.). The meeting addressed burn care during various phases of predeployment, deployment, sustainment, and redeployment. The preliminary report from this meeting was previously acquired by the U.S. Army Center for Army Lessons Learned. The official after-action report prepared by the 28th CSH command and several unpublished memoranda were also consulted. Finally, clinical summaries from the 28th CSH were reviewed to capture burn-care workload data for the most difficult portion of the 28th CSH deployment. This portion of the deployment took place at Logistic Support Area (LSA) Dogwood, during a 132-day period between April 11, 2003, and August 21, 2003.

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Results

Chronology

Table I presents the sequence of events for the 28th CSH deployment. It can be appreciated that the time elapsed between the unit's arrival in Kuwait and its entry into combat in Iraq was short. The 28th CSH was established as a single medical facility in deployable medical systems (DEPMEDS) tents at LSA Dogwood in Iraq from April 11, 2003, to August 21, 2003. With the maturing theater of operations, the CSH conducted split operations to provide medical support to both the Baghdad and Tikrit regions. In Baghdad, the CSH occupied Ibn Sina Hospital in the International Zone (Green Zone). The 28th CSH redeployed to the United States in February 2004, turning over operations at Ibn Sina Hospital to the 31st CSH. At the time of this writing, Ibn Sina Hospital has been continuously operated by a U.S. Army CSH, providing care to U.S., coalition, and Iraqi military and civilian casualties. It has also remained a focus for burn care in the region.

Patient Care

During its 132-day deployment at LSA Dogwood, the hospital treated 7,920 injured patients in the emergency medical treatment section, of whom 1,867 were admitted. Of the 7,920 patients treated in the emergency medical treatment section, 103 had the primary diagnosis of burns. Eighty-six of the 103 burn patients were hospitalized. Therefore, burn patients constituted 1.3% of emergency medical treatment visits and 4.6% of inpatients. These inpatients included 42 U.S. and coalition personnel and 44 Iraqis, with the latter including both civilians and enemy prisoners of war. Seven of the Iraqi civilian burn inpatients were children.

TABLE I

CHRONOLOGY OF 28TH CSH IN OPERATION IRAQI FREEDOM

May 2002	Field training exercise, Operation Purple Dragon
October 2002	Training at Joint Readiness Training Center, Fort Polk, Louisiana
January 2003	Training of five personnel at U.S. Army Burn Center, Fort Sam Houston, Texas
March 10–12, 2003	28th CSH arrives at Camp Doha, Kuwait
March 29, 2003	28th CSH enters Iraq
April 7, 2003	28th CSH establishes operations at LSA Dogwood
April 10, 2003	28th CSH begins to receive patients at LSA Dogwood, including burn patients
August 23, 2003	28th CSH establishes 96-bed unit at Ibn Sina Hospital, International Zone, Baghdad, moving out of LSA Dogwood
January 31, 2004	28th CSH turns over operations to 31st CSH in Baghdad
February 15, 2004	Main body of 28th CSH arrives at Pope Air Force Base, North Carolina

Seriously injured U.S. patients were evacuated, most often to Landstuhl Regional Medical Center (LRMC) in Germany and then to the U.S. Army Burn Center in Texas when indicated. The clinical care of patients admitted to that center has been reported elsewhere.[2-5] There were few transfer options for Iraqi nationals; therefore, most were cared for at the 28th CSH until discharge.

During the 132-day period, surgeons performed a total of 877 operations, including 319 for U.S. and coalition personnel, 290 for civilians, and 268 for enemy prisoners of war. Of these, 32 burn patients underwent 59 operations, including the following procedures: 49 debridements, 5 split-thickness skin graftings, 4 escharotomies, 1 exploratory laparotomy, and 4 tracheostomies. The largest area grafted (sequentially) was 40% of the total body surface area (this was successful).

The mean length of stay in the 28th CSH for U.S. and coalition burn patients was 2 days (range, 1–4 days). For Iraqi patients, the mean length of stay was 10 days (range, 1–53 days). Of the 42 U.S. and coalition patients, 35 were evacuated to LRMC, 6 were discharged to duty, and 1 died of wounds at the 28th CSH. Of the 44 Iraqi patients, 5 were evacuated to other hospitals in the region for humanitarian reasons, 18 were transferred to Iraqi facilities, 10 were discharged to home or to an enemy prisoner of war camp, and 7 died of wounds. (This position was not recorded for four.)

Burn size was not rigorously calculated during this portion of the hospital's deployment. However, the surviving Iraqi patient with the largest wound sustained a burn involving an estimated 65% of the total body surface area. Four Iraqi patients and one U.S. patient died soon after admission, as a result of massive injuries, whereas three Iraqi patients died in the hospital on days 9, 10, and 15. Two of these late deaths were attributed to infection and one to pulmonary embolism.

Discussion

Lessons Learned

The 28th CSH, under challenging conditions, provided emergency and definitive care to a wide range of coalition and Iraqi, adult and pediatric, burn patients. The largest obstacles to burn care were related to knowledge, materiel, and disposition of Iraqi patients. The following specific lessons emerged.

Recognition of the Burn Mission

The 28th CSH was designated as the U.S. facility primarily responsible for burn care after it began to receive such casualties at LSA Dogwood. The participants thought that this designation (reminiscent of U.S. practice during the Vietnam War[6]) was beneficial but should have been made earlier, during the predeployment phase. This might have permitted earlier recognition and correction of the shortfalls in personnel, training, supplies, and equipment noted below. Whether earlier designation of this CSH as a burn hospital might have improved outcomes cannot be determined from the available data. Others have stated that such designations should be made in a flexible manner, so that specialty augmentation teams can be moved among level III facilities as demanded by the tactical situation. The latter has proved effective during the current conflict (e.g., in the deployment of neurosurgical assets).

During this phase of the war, the United States assumed responsibility for the long-term care of Iraqi patients of all ages. Of these, patients with burns, major soft tissue injuries, and paraplegia/quadriplegia were particularly difficult to treat. War, not only by generating casualties but also by disrupting local medical systems, creates substantial humanitarian needs. In accordance with the Geneva Conventions, U.S. forces are committed to caring impartially for casualties, without regard to national or combatant status.[1] Therefore, care of enemy prisoners of war, local civilians, and even children has been part of U.S. military operations since World War II.[7-17] Simultaneous efforts to reconstruct the host nation medical infrastructure are equally important.[18]

Data Collection and Process Improvement

Data collection at the 28th CSH was considered to be relatively rudimentary. Since then, the creation of the Joint Theater Trauma Registry and deployment of a theater trauma director have improved data collection and process improvement.[19] Another mechanism for process improvement has been weekly videoconferences among the U.S. Army Burn Center (U.S. Army Institute of Surgical Research, Fort Sam Houston, Texas), LRMC, and deployed hospitals. This has facilitated the identification of problems in burn patient care, such as over-resuscitation.[20]

An effective practice instituted by the 28th CSH and continued to the time of this writing is a weekly morbidity and mortality conference, incorporating all physicians and representatives from the various other clinical sections. Reproducing the practice followed at teaching hospitals in the United States, these conferences enable providers to reflect on patient deaths and major complications and to identify areas for individual and systematic improvement.

Personnel

It is now widely accepted that burn patients are ideally treated by multidisciplinary teams with specialized training and experience, at centers focused on such care. This premise is supported by the American College of Surgeons[21] and was reiterated by the National Burn Care Review conducted in the United Kingdom.[22] The strongest argument in favor of this model is the impact of burn center care on mortality rates[23] and morbidity rates.[24] Even patients with minor burns, who can be adequately treated in the emergency department, may experience cost savings when treated in a burn center.[25] In view of this, we think that personnel assigned to burn hospitals in combat zones should include surgeons with experience in excision and grafting techniques, nurses with previous assignments at a burn center, additional nurses to meet the increased staffing requirements, and members of ancillary services with burn care experience (physical, occupational, and respiratory therapists and dieticians). Only one member of the 28th CSH, a registered nurse, had extensive training in burn care during a previous assignment to the U.S. Army Burn Center. Five other members had received 2 days of training at that center several months before deployment.[26] There was one physical therapist who did not have burn training, and the unit had no surgeons with significant burn-specific experience. It is not known whether this lack of experience affected outcomes at the 28th CSH.

There are several potential approaches to providing training to nonburn specialists. Additional improvements in personnel could be implemented through identification of a "CSH burn team" that travels to the U.S. Army Burn Center for ≥1 week of intensive training in burn care before deployment. Training should include the American Burn Association Advanced Burn Life Support course[27] and the Combat Burn Life Support course developed at the U.S. Army Burn Center.[26] An alternative is the Emergency Management of Severe Burns course developed by the Australian and New Zealand Burn Association.[28] Predeployment training should focus largely on hands-on clinical care. Furthermore, identification of burn-experienced providers within the Army personnel database by means of a special skill identifier would be desirable.

Currently, burn training (as distinct from training in trauma and burns as a combined field) is no longer required by the American Board of Surgery for certification in general surgery.[29] However, because burns are a significant component of combat casualty care, it makes sense to ensure that military general and plastic surgeons complete rotations at a burn center during residency training.

Furthermore, U.S. intensive care units (ICUs) are increasingly being managed in a "closed" fashion, such that responsibility for ICU care is limited to physicians with subspecialty training in critical care. This may have the side effect of reducing the exposure of non-critical care-trained general surgeons to ICU care. Although this likely improves the quality of care at home,[30] it potentially limits the ability of military surgeons to function as intensivists in a deployed environment. Therefore, increased emphasis on critical care training for military surgeons is warranted. Alternatively, the value of deploying physicians with additional subspecialty training in critical care has been recognized; the subsequent addition of an intensivist to the CSH staff was accompanied by a reduction in overall mortality rates among trauma patients (K.W. Grathwohl, unpublished data).

The U.S. Army special medical augmentation response teams for burns, based at the U.S. Army Burn Center, provide expertise in burn and trauma triage, resuscitation, treatment, and evacuation in response to both domestic and international contingencies.[31] During the current conflict, these teams have been responsible for the aeromedical evacuation of the most critically ill burn patients from LRMC to the burn center in Texas. During the first Persian Gulf War (Operation Desert Shield, 1990–1991), three such teams were deployed to Saudi Arabia.[32] By regulation, however, these teams cannot be deployed to a combat zone such as Iraq. Also, they are focused on immediate care, rather than definitive care.

Creation of a deployable burn augmentation team, along the model of the extant renal, pathology, head and neck, infectious disease, and special care (i.e., primary care medicine) teams,[33] would be one answer to the need for a definitive burn care capability. Such a team would include personnel with burn-specific expertise in surgery, critical care nursing, operating room nursing, occupational therapy, and physical therapy. This need must be balanced against the significant increase in workload experienced by the home burn center and the costs of long-term deployment. At the present time, the need for expertise in definitive care is being addressed by continued deployment of a surgeon from the U.S. Army Burn Center to the CSH at Ibn Sina Hospital. One individual,

however, does not equate to a burn center; burn care is a quintessentially multidisciplinary team effort.

The labor-intensive nature of burn care has been well documented.[34,35] Furthermore, provider exhaustion ("burnout") is a real problem among burn care professionals working in U.S. burn centers.[36-40] In our experience, the burnout problem may be magnified in the deployed setting. A paucity of studies address burnout among deployed military health care providers, however, and more research in this area is needed.[41-44]

To assist providers with limited burn care experience, deployed hospitals would benefit from deployable medical libraries containing material specific to the care of adult and pediatric burn patients. An electronic format would reduce weight, but the material would need to contain high-resolution digital video clips and still photographs of burn interventions, such as dressing changes, escharotomies, excision and grafting techniques, splinting, and rehabilitation interventions. Such material is now made available to medical units that train at the U.S. Army Burn Center before deployment.

Physical Plant

Chemically protected DEPMEDS provide chemically protected air conditioners, heaters, water distribution systems, latrines, and alarm systems to existing CSH hospital tents and passageways. The chemically protective lining of chemically protected DEPMEDS had the additional benefit of protecting burn patients from the Iraqi fine sand and is thought to have reduced infection rates at the 28th CSH, although objective evidence of this is not available.

Unit hospital beds were not adequate for extended use, and the incidence of decubitus ulcers, primarily on the occiput, was high. Burn patients could not be turned and positioned well on the available NATO litters; this was crucial when patients were edematous as a result of fluid resuscitation. The CSH eventually received six beds comparable to those in a fixed medical facility and, although they were difficult to maneuver in a deployed unit, they were superior to standard NATO litters for long-term patient care. Dual "egg-crate" foam pads were placed inside the mattress pads for comfort and pressure reduction for long-term patients (burn patients, amputees, and paralyzed patients). The ideal mattresses and/or beds for long-term patients in combat zones have yet to be designed.

Supplies and Equipment

After designation as the regional burn hospital, the members of the 28th CSH constructed a plan of care for this unique patient population; however, the equipment drawn from the prepositioned stores did not include burn-specific items. Medical materiel came from a cargo ship in the Persian Gulf, docked at a seaport in Kuwait. Some of the supplies were expired and/or environmentally damaged. Acquiring additional burn-specific medical supplies required 8 to 12 weeks. A "push package" of burn supplies was designed by the U.S. Army Burn Center (Table II). However, this package was intended to support the care of patients during the first 72 hours after injury, rather than definitive care. Therefore, it lacked items needed, for example, for excision and grafting of burn wounds.

Available splinting material was adopted. Splints made from aluminum and closed-cell foam, designed for emergency treatment of fractures, were used, but these materials, as well as plaster casting material, seemed to cause increased skin breakdown.

TABLE II

BURN PUSH PACKAGE

Item	Quantity per Day
Albumin, human, 25% (100-mL bottle)	2 (first 2 days)
Burn pads	6
Roller gauze	10
Laparotomy pads (10 per pack)	10
Stapler, disposable	4
Chlorhexidine gluconate, 4% (bottle)	1
Gentamicin, ophthalmic	1
Erythromycin, ophthalmic	1
Silver sulfadiazine cream (400 g)	2
Mafenide acetate cream (400 g)	2

In addition to supplies used in critical care generally, the burn push package contained the listed "burn-specific" items.

Portable, volume-controlled, mechanical ventilators were used. These devices are designed for short-term use and aeromedical evacuation, rather than for long-term ICU use. Pneumonia is the most frequent infectious complication following thermal injury and was indeed common in the CSH.[45] It is possible that inadequate ventilator maintenance and cleaning contributed to this problem. Since then, ventilators with advanced capabilities have been added to the CSH inventory for care of long-term ICU patients and patients with acute respiratory distress syndrome.

A special metal platform was used for securing portable medical equipment to the NATO litter and was invaluable at the 28th CSH. Equipment secured in this manner included a ventilator, suction device, vital signs monitor, infusion pump, power supply, and oxygen cylinder.[46] Because the platform mounts anywhere on a standard litter, medical equipment does not have to be strapped to the patient (which may place the equipment and the patient at risk).

Burn-specific materiel recommended for deployment with the CSH in the future includes the following: (1) surgical equipment for excision and grafting (electrical dermatomes and skin meshers); (2) rehabilitation supplies (such as splinting material for serial casting); (3) biosynthetic wound dressings (bilaminar silicone and nylon); (4) silver-impregnated dressings; (5) vacuum-assisted closure wound-care devices; and (6) γ-irradiated, shelf-stable, cadaver allografts. Many of these items have since been introduced into use at the CSH at Ibn Sina Hospital.

Clinical Care

Prehospital Care

Exposure before evacuation and prolonged transport in helicopters without complete temperature regulation often exacerbates hypothermia even with high environmental temperatures and is a particular threat to burn patients. Hypothermia was in fact the worst arrival problem for burn patients at the 28th CSH. Prevention of hypothermia has been the focus of a major performance improvement effort for the U.S. Army during this con-

flict.[17,47] As a result, hypothermia is much less common now than during the early years of the conflict.

Patients occasionally arrived at the 28th CSH with evidence of over-resuscitation. Such over-resuscitation was manifested by fluid infusion volumes well in excess of the Parkland formula prediction and by high rates of abdominal and extremity compartment syndromes. Introduction of a joint theater resuscitation flow sheet and a renewed emphasis on judicious resuscitation during training have been accompanied by decreases in these complications.[20] Resuscitation at the time of admission was initiated or continued for all patients with burns of <70% of the total body surface area, and decisions to continue burn treatment were based on the patient's response to this initial treatment.

Wound Care

Because of the lack of isolation at the bedside and the ready availability of the operating room, many painful burn-care procedures took place in the latter location. These procedures included initial debridement and cleansing of the burn wound (normally performed in the shower room at the U.S. Army Burn Center in Texas). Routine burn wound care, however, was performed at the bedside. The CSH anesthesiologist gave a course of instruction on the use of intravenously administered ketamine to the nurses and surgeons providing this care.

Standard practice at the U.S. Army Burn Center is to change dressings twice daily but, because this practice further increased staff workload and reduced supplies, a decision was made to change dressings once each day.[48] This did not appear to affect recovery at the 28th CSH.

Because operative burn surgery is labor- and resource-intensive, often requiring heavy consumption of blood products, U.S. doctrine has routinely discouraged burn wound excision and grafting in combat zones.[49] At the 28th CSH, no effort was made to excise burn wounds by a specific day after injury. Eschar often was allowed to separate and was then removed through debridement. Earlier excision was performed when the eschar appeared to compromise the patient. With the movement of the CSH to Ibn Sina Hospital in Baghdad and the deployment of experienced burn surgeons to that location in later months, earlier excision and grafting of the burn wound became standard practice in the care of Iraqis with major burns. This shift in emphasis reflects the importance of early excision in reducing hospital length of stay, as well as morbidity and mortality rates.[50]

Infection Control

At the 28th CSH, one participant observed that "infection control at LSA Dogwood in the desert was a Herculean task." Infection control issues included environmental challenges (extreme heat and dust storms), lack of water, limited plumbing and hand-washing stations, flies, absence of isolation rooms, and limited laboratory capabilities. Traditionally, many burn centers use hydrotherapy "tanks" for daily wound care. These tanks have been replaced in the U.S. Army Burn Center by shower facilities, into which patients can be wheeled on steel gurneys. Regardless of how bathing is performed, facilities to permit daily bathing are essential in burn care. Such facilities were not available at LSA Dogwood. Therefore, most baths were given at the bedside.

The 28th CSH was not able to culture specimens until it was supplemented with a microbiology laboratory during the third month of deployment. In the absence of specific data, an attempt was made to minimize cross-contamination among patients suspected of being infected with multidrug-resistant organisms, by assigning one nurse to each such patient; however, this was described by one as a "monumental challenge." Clearly, a microbiology laboratory team is an essential component of any hospital capable of providing definitive care to wartime burn casualties.[51]

Iraqi Cultural Issues

Iraqi family members stayed with patients, often sleeping beneath the patients' cots. Family members were taught many of the interventions and became "health care extenders." Few Iraqi patients returned to the CSH for follow-up care, however, and their outcomes after leaving the CSH are not known. A CSH chaplain has commented on the need for a ministry program for host-nation casualties.

Research and Development Needs

Ideas for future research that emerged during this after-action review included the following: (1) rapid, accurate, and deployable microbiology capabilities; (2) a temporary covering for burns that can provide antimicrobial coverage for 48 to 72 hours; (3) semiautomated methods for resuscitating unstable patients with burn shock; (4) improved ways to promote anabolism in theater; (5) new methods of drug delivery to facilitate pain control during painful wound care, such as target-controlled, total intravenous anesthesia; and (6) rehabilitative support devices for the field. Several of these concepts are currently under study at the U.S. Army Institute of Surgical Research and elsewhere, including development of a computerized fluid resuscitation system,[52] evaluation of the anabolic effects of oxandrolone and insulin,[53] and use of target-controlled anesthesia.[54]

Conclusions

The 28th CSH experienced the challenges and demonstrated the feasibility of providing definitive burn care to Iraqi patients of all ages in an austere field environment at LSA Dogwood and later in a general hospital at Ibn Sina Hospital. This experience underscores the importance of anticipating the need for such care during medical support planning, particularly with respect to the unique personnel, supply, and equipment requirements of burn care.

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