CHAPTER 1

UROLOGY IN VIETNAM: HISTORICAL, MEDICAL, AND SURGICAL CONSIDERATIONS

INTRODUCTION

The war in Vietnam presented unique problems in the management of casualties. The weapons involved included modern high-velocity automatic rifles, such as the AK-47 used by the Communists and the M16 employed by the US forces. They also included Claymore mines, which, for the most part, inflicted blast injuries and fragment wounds to the lower extremities, pelvis, and abdomen. These contrasted with the crossbows and spears used by the Montagnard tribesmen and the sharp punji sticks, which were contaminated with feces and employed so effectively by the enemy. At one point, punji stick injuries accounted for 22.4% of admissions to the 2nd Surgical Hospital.[1]

a

b

Fig. 1-1. (**a**) UHI (Huey) medical evacuation helicopter. (**b**) Nighttime evacuation, 12th Evacuation Hospital, Cu Chi, Vietnam.

In Vietnam, the concept of rapid helicopter evacuation of wounded service personnel, which had been utilized so effectively in the Korean War, had developed so that casualties were picked up, on average, 35 minutes following injury and were in a military hospital within 1 to 2 hours (Figure 1-1. a,b). An effective medical radio network in addition to the availability of aircraft made this possible, and the terrain and lack of roads in Vietnam helped foster the use of helicopter evacuation. Fixed-wing aircraft were often used for evacuation to larger hospital units (Figure 1-2. a,b). The vast majority of patients who reached medical facilities survived; some of those who did not survive had mortal wounds, and un-

der other circumstances they would not have been evacuated at all.[2–5]

The ability to pack blood in Styrofoam containers permitted it to be stored in forward areas for 2 to 3 days. This, in addition to the availability of advanced surgical techniques and improved medical management, greatly improved patient care in the early postinjury period. Between January 1965 and December 1970, wounded numbering 133,447 were seen at medical treatment facilities (MTFs) in Vietnam, and 97,659 were admitted to hospitals. Hospital mortality was 2.6% during the Vietnam War compared with 2.5% in the Korean War and 4.5% in World War II. The slight increase in mortality during the Vietnam War from the Korean War was probably due to helicopter evacuation of mortally wounded patients. The ratio of deaths to surviving patients who were evacuated after being wounded was 29.3% in the Korean War and 19.0% in Vietnam. The ratio of those killed in action (KIA) to those wounded in action (WIA) in World War II was 1:3.1, in the Korean War, 1:4.1, and in Vietnam, 1:5.6. Of the 194,716 wounded (this figure includes many casualties whose wounds were insignificant and were not admitted to hospitals) in Vietnam between January 1965 and December 1970, 31% were treated and returned to duty immediately. Of those admitted to MTFs, 42.1% returned to duty in Vietnam, 7.6% in the Pacific Command (PACOM), 33.4% in the continental United States (CONUS), and 2.7% were still hospitalized. About 14.2% had died, were transferred to Veterans Administration (VA) hospitals, or had been discharged.[2–5]

Fig. 1-2. (**a**) Patients are being medically evacuated to larger hospitals in the Pacific Command and the continental United States aboard a C-141. (**b**) Patients are being loaded onto a C-141.

INITIAL TREATMENT OF THE WOUNDED CASUALTY: GENERAL MEASURES

A corpsman on the battlefield usually gave first aid to casualties. A patent airway was established, bleeding was controlled, and splints were applied when indicated. Wounds were dressed and medications given for the relief of pain. Medical support was administered during helicopter evacuation from the battlefield to an

MTF in Vietnam, where the initial treatment was supervised by a medical officer. In unusual instances, casualties were not taken to a surgical hospital but directly to a battalion aid station, where intravenous (IV) injections were available, tracheostomies could be done when needed, a thoracentesis could be performed, and plasma expanders were available. At the more forward facilities, blood, oxygen, antibiotics, and tetanus prophylaxis were available. Multiple IVs were usually started with an indwelling plastic tube. The wounded patient was rapidly evaluated, his physiological status determined, and resuscitation begun (Figure 1-3).

Fig. 1-3. Patient care at a forward medical treatment facility.

All clothing was usually removed and the entrance and exit wounds were identified. The wounded patient's entire body was checked for possible wounds. An assessment of potential intraabdominal wounds was made. X-ray films were taken when necessary. Exploratory laparotomy was done if intraabdominal wounds were suspected.[2] Blood transfusions were usually given if the patient's systolic pressure was below 100 mm Hg, and a Foley catheter was inserted. Attempts were made to keep urinary output at 30 to 50 mL per hour. Nasogastric tubes were inserted if necessary. Type O low-titer blood was available. Antibiotics were given. Normal saline and Ringer's lactate were used as crystalloid solutions with sodium bicarbonate and other additives when needed.

Fig. 1-4. The casualty's multiple fragment wounds have been debrided.

Adequate debridement of wounds was emphasized (Figure 1-4). Contaminated wounds were not closed except for certain ones to the head, face, and hand: areas with an excellent blood supply. Debridement included the removal of all dead or devitalized tissue. Wounds were dressed, and delayed closure was done 3 to 5 days later. The wound infection rate was extremely low after delayed primary closure of most body wounds and, when possible, primary closure of wounds involving the face and hands.

WOUND ANALYSIS: CAUSE, BALLISTICS, SITES, AND MORTALITY

Wounds in general were classified as due to gunshot or fragmentation devices and, to a lesser extent, to punji sticks (Exhibit 1-1) and other unique weapons. This

Exhibit 1-1
Punji Sticks In Vietnam

Punji sticks originated several thousand years ago; they were used widely in the central highlands of Vietnam. These small, sharpened wooden sticks were placed in soil with the pointed ends up and contaminated with human fecal material. During the Vietnam War, they were well camouflaged so the soldier would fall into or walk on them. The punji stick was a frequent cause of wounds in members of the allied forces.

At one time, over one fifth of all surgical admissions to the 2nd Surgical Hospital were caused by punji sticks. Of 247 patients studied, each spent an average of 14 hospital days undergoing treatment. This represented an enormous number of hours away from the unit. Following the policy outlined by the USARV Surgeon, all punji stick wounds were debrided and patients were given antibiotics including intramuscular penicillin and streptomycin. Delayed primary closure was done on the 4th or 5th postoperative day. Using this modality, morbidity was low. Punji stick fragments were not detectable on X ray examination. The weapon was simple and cheap, and it disabled its victim for about 3 weeks.

USARV: United States Army in the Republic of Vietnam
Source: Shepard GH. Punji stick wounds. *USARV Medical Bulletin.* 1966;1(5, Jun–Jul):9.

excluded crush injuries and vehicular trauma. High-velocity missiles, with their greater kinetic energy, resulted in larger temporary and permanent cavities and more-severe tissue destruction than did low-velocity projectiles.[6] High-velocity missiles may cause thrombosis of vessels not in the direct path of the bullet or fragments. The Russian AK-47 assault rifle and the M16 rifle used by US troops were fully automatic weapons that fired projectiles with a high muzzle velocity.

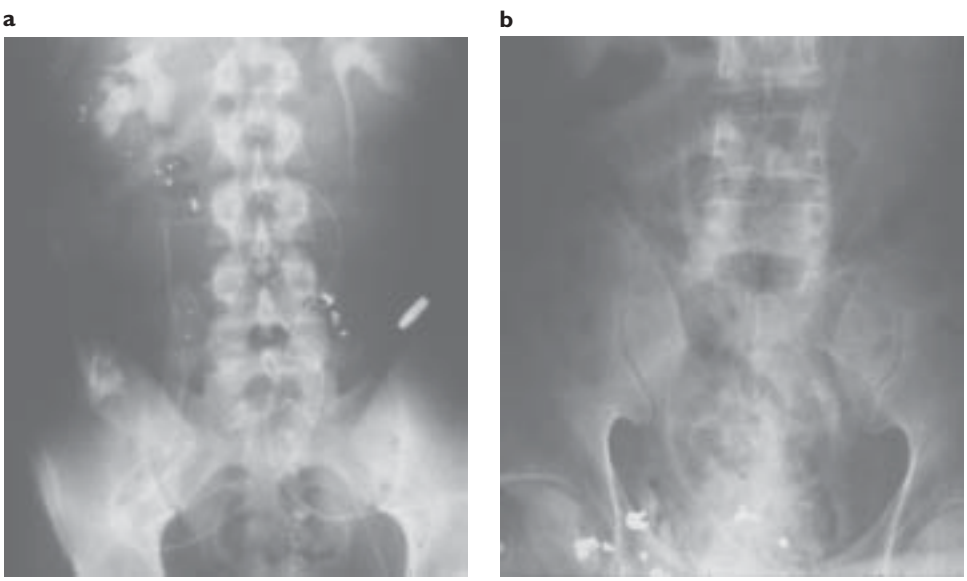

Fig. 1-5. (**a**) The casualty sustained a gunshot wound to the abdomen; this radiograph (**b**) shows multiple fragments and the retained core from an AK-47 round. The casualty's injury to the upper urethra was treated with repair and insertion of a stent.

In two thirds of patients who sustained penetrating missile wounds, either the primary missile or some of the fragments remained after deridement (Figure 1-5. a,b). High-explosive shells create multiple fragments that initially have very high velocities but rapidly lose speed. The fragments spread to cover wide areas.

An evaluation of the wound statistics kept by the 1st Calvary and 25th Infantry Division revealed that most wounds occurred in the extremities. Forty-two percent of casualties had leg wounds. Small-arms fire (gunshot wounds) were the most lethal, resulting in a 31% fatality rate. In this series, casualties were wounded, on average, in 1.71 locations; thus, 1,000 casualties had 1,710 wounds. This series also had 269 fatalities who had, on average, 2.12 wounds each (vs 1.53 in nonfatal cases [this figure includes the fatalities' higher number of wounds]). An analysis of the data on US Army casualties in Vietnam that were collected by the Wound Data and Munitions Effectiveness Team (WDMET)[3–5] noted that mines and booby traps were more apt to injure the lower extremities and pelvis than were the other weapons.[3(p10)] They found that the probability of fatality from a gunshot wound to the upper abdomen was 40%; and to the lower abdomen, hips, pelvis, and buttocks, 21%. The probability of fatality caused by injury from mines, booby traps, and mortars was 12% to 14% in upper abdominal wounds, and 3% to 4% if the lower abdomen, hips, pelvis, or buttocks were involved. Head wounds had the highest fatality,[3(p7)] as they had in other wars. This analyst of WDMET data noted that (1) 50% of all casualties occurred at a range of less than 9.5 m, and (2) fragmentation weapons inflicted casualties at relatively shorter distances than gunshot wounds.[4(p1)]

AEROMEDICAL EVACUATION

Evolution of the Aeromedical Evacuation System

Initially, empty combat aircraft were used to evacuate medical casualties. As the tempo of the war increased, however, regular scheduled airlifts were started, and the Military Aircraft Command began to schedule evacuation flights from Tan San Nhut, Cam Ranh Bay, and Da Nang, Vietnam, to Yokota Air Force Base, Japan, or to CONUS.

In 1965, patients were loaded into C-118 and C-130 aircraft and were flown to Clark Air Force Base, Republic of the Philippines; from there, they were evacuated further. By late 1967, improved hospitalization in Vietnam and the advent of C-141 jets allowed direct evacuation of some patients to off-shore hospitals in Japan, and others to CONUS. White and colleagues[7] analyzed the air-evacuation of Vietnam War casualties (60% from Army; 35% from Navy and Marines; and 1% from Air Force) that occurred over a 2-month period from 8 July 1968 through 7 September 1968. They found that of the 9,000 patients air-evacuated, 4,824 had been wounded. The mean time of departure from Vietnam was 7 days. Most of these patients were sent by C-141s. Fragment wounds of the extremities were the most common problem, but 12% of this group had abdominal injuries and 7% were critically ill. Of the 265 criti-

cally ill patients, only 8 deteriorated while in flight, and 1 died. Three other deaths occurred. There were 20 deaths (0.5%) during the period of observation,[7] certainly a commendable figure. The increase in medically evacuated patients corresponded to (1) the intensity of the war and (2) the increase in US strength from 276,000 in mid 1966 to 549,000 in mid 1969.[8]

The number of patients initially evacuated by helicopter increased from 13,004 in 1965 to 67,910 in 1966, 85,804 in 1967, and peaked at 206,229 in 1969.[2] The Air Force provided all "out of country" aeromedical evacuation. These operations were coordinated through Medical Regulating Offices in Vietnam, Japan, and the Philippines. Evacuation policies varied according to the intensity of the combat. During the Tet and Parrot Beak offensives, large numbers of patients were necessarily evacuated very early to off-shore hospital facilities. Hospitals in Japan were used increasingly as the war escalated.

In general, patients were stabilized as far as possible before medical evacuation. IVs were changed within 24 hours of departure. Patients' hemoglobin levels were brought up to at least 10.5 g/dL. Patency of nasogastric tubes and Foley catheters was determined, and certain types of chest tube drainage with valve attachments were utilized. Once military wounded were stabilized, those with major injuries were transferred to off-shore facilities, providing the physician in charge determined that the patient could withstand the stress and time involved in the evacuation process and the trip. Most patients from 1967 were initially evacuated to Japan (Yokota Air Force Base) and from there transported by helicopter to hospitals in Japan. The minimum transit time from the hospital in Vietnam to PACOM and off-shore hospitals (eg, Long Binh, Vietnam, to US Army Hospital, Camp Zama, Japan [USAHCZ]) was 37–40 hours). The minimum time en route from the hospital in Vietnam to a CONUS hospital (eg, Walter Reed General Army Hospital, Washington, DC) was 73 to 76 hours. These times do not include the time for patient preparation for the flight (4 h) or the time between the end of the flight and delivery to the destination hospital ($\leq$ 3 h).[9]

Medical and Surgical Problems in the Medical Evacuation System

Because of the severe challenges of transporting the severely wounded over lengthy times and distances, multiple medical and surgical problems were encountered in the medical evacuation system. Readers should keep in mind, though, that air evacuation per se was not the *cause* of complications. Rather, complications became apparent during or after evacuation as part of the normal course of the disease state. In 1967, Lieutenant Colonel Gene V. Aaby, Surgical Consultant, US Army in the Republic of Vietnam (USARV) reviewed the records on 69 patients removed from evacuation flights for additional treatment. The largest group (26 cases) was composed of those who required major debridement. These patients frequently manifested fever and at the time of surgery usually were found to have extensive muscle necrosis, infection, and/or loose necrotic fragments of bone. There were 2 deaths: 1 caused by sepsis, and the other, cause unknown.[10]

A second, smaller group (9 cases) who required abdominal surgery had the highest mortality (30%). Of these, 7 had infections as the main component and several had abscesses. Problems with colostomies occurred in some patients. Abdominal abscesses were noted to constitute one of the major complications in patients with extensive abdominal wounds. Massive thoracoabdominal wounds with injury to either (1) the diaphragm, liver, or colon on the right side, or (2) the diaphragm, spleen, or colon on the left side had a 25% to 30% chance of developing a subdiaphragmatic abscess. The incidence of pelvic abscess following severe rectal wounds was about 30%. Most abscesses had common denominators: postoperative oozing, contamination, and poor drainage. Aaby emphasized that drains (usually Penrose drains) needed careful positioning, ample access, and that they should be removed when drainage stops, and recommended that sumps be used more frequently.[10]

Constant evaluation of the management of patients in aeromedical evacuation resulted in continuous ongoing changes and improvement in consensus recommendations,[9] including those for

- guidelines for selection of patients for evacuation,
- type and qualification of nursing and medical personnel,
- in-flight medical equipment, and
- management of specific wounds, drains, tubes, catheters, cranial tongs, and the like.

Better coordination of patient regulation, destination, and hospital evacuation evolved.[9]

HISTORY OF THE ORGANIZATION OF MEDICAL TREATMENT FACILITIES IN JAPAN

In June 1962, an Army dispensary was established at Camp Oji, Japan. In November 1965, the 7th Field Hospital arrived from Fort Knox, Kentucky, and was established at Johnson Air Force Base in Japan. The 1,000-bed 249th General Hospital moved from Denver, Colorado, arrived in Japan, and became operational at Camp Drake in December 1965. The 106th General Hospital, consisting of 1,000 beds, arrived from Fort Bliss, Texas, was located at Kishine Barracks, Yokohama, Japan; it also became operational in December 1965.[11]

What eventually became USAHCZ was a 300-bed hospital that had been built by the Japanese in the 1940s. It was later expanded to 1,000 beds. The 128th Station Hospital, the forerunner of USAHCZ, was activated 20 December 1942 at Camp Beale, California. After numerous locations during World War II, it was scheduled to be a part of a large invasion force but was never needed. Much of it was lost in a typhoon off Okinawa in 1945. The commanding officer (CO) of the 128th arrived at the Japanese Military Hospital, Sagami Ono, and accepted its surrender on 26 September 1945. Only General Kiyoshi Shimozu (Japanese commanding general of the hospital) and his white horse

a

b

Fig. 1-6. (**a**) The headquarters building at US Army Hospital, Camp Zama, Japan. (**b**) Patient transfer, main hospital building, US Army Hospital, Camp Zama, Japan.

waited the arrival of the Americans. He presented his sword and his horse, later named "Duke" by the hospital staff. This horse was an important part of the Physical Therapy Department and was ridden by many patients. Duke was spared from death after breaking its leg and spent its declining years donating blood to the 406th Medical General Laboratory.

The US Army Medical Center, Japan, was established at USAHCZ on 15 January 1958. All specialties were phased from Tokyo to USAHCZ during that year. There was a gradual reduction of beds to a level of 100 in 1965, but this was rapidly increased with military activity in Vietnam. Additional units included headquarters, medical company (ambulance), and many other support units. The hospital was redesignated as USAHCZ, Japan, on 19 January 1966. The 406th Medical Laboratory was attached for logistical support. The hospital was authorized on 7 March 1966 to expand to 1,000 beds[12] (Figure 1-6. a,b).

CONFERENCES ON WAR SURGERY

All concerned knew that better communication was needed among the medical facilities, disciplines, and physicians in Vietnam; the off-shore hospitals; and CONUS. For this purpose, the First Conference on War Surgery was sponsored by the Commander-in-Chief, Pacific (CINCPAC) at John Hay Air Force Base, the Philippines, 20–25 May 1967. Study groups were established for various wound areas, but urology was not yet included.

The Second Conference on War Surgery was again held in the Philippines, 25–28 March 1968. Numerous problems were discussed at length, including medical evacuation, problems with patients requiring massive transfusions, the proper handling of abdominal and chest injuries, and extraperitoneal wounds in general. Sepsis, the management of pelvic fractures involving the urological system, and other areas were also explored. Acute renal failure (ARF) was discussed at some length. Studies were then being carried out by the Trauma Study Section of the US Army Medical Research Team, Walter Reed Army Institute of Research (WRAIR), Washington, DC. The team from WRAIR re-

ported that in patients with war injuries, (1) those with ARF were, in general, dehydrated, and (2) pulmonary insufficiency, sepsis, and upper gastrointestinal (GI) bleeding comprised the 3 most common causes of death in the late (> 5 d) postoperative period. Further investigation of these areas was thought to be indicated.[13]

The Third Conference on War Surgery was held in Hawaii, 20–23 January 1969. This time, urologists were present: T. J. McGeoy, Commander, US Navy, from Oakland Navy Hospital; Ray L. Stutzman, Lieutenant Colonel, US Army, representing the 249th General Hospital in Japan; and David Woodhead, Lieutenant Colonel, US Air Force, from the 12th US Air Force Hospital. A section on the treatment of genitourinary wounds was included in the manual published following this meeting. The meeting also reviewed research reports from WRAIR, which showed pulmonary failure to be the leading cause of death in combat casualties admitted to US Army in the Republic of Vietnam (USARV) hospitals. One hundred patients, excluding burn patients, were included in this study (all these patients had died following treatment). Their mean survival time had been 6.5 days. Forty-one of these patients had abdominal wounds. Stress ulcers were again discussed; this problem was most commonly associated with abdominal sepsis and head injuries.[14]

The Fourth Conference on War Surgery was held in Tokyo, Japan, 16–19 February 1970. This conference produced fairly rigid criteria for medical evacuation, which included[15]

- a stable hematocrit of over 35%,
- stable vital signs,
- no active bleeding, and
- adequate hydration.

This conference, too, stressed the importance of adequate wound debridement. A consensus for treatment guidelines for genitourinary wounds were developed, published, and circulated to all hospitals and MTFs in the Republic of Vietnam and Japan.[15]

The Fifth Conference on War Surgery was held again in Tokyo, 29 March–2 April 1971. Treatment of genitourinary wounds was reviewed, and the section on war surgery recommendations was updated by one of us (JWW) and Major Jeff Deeths, a urologist at the US Air Force Hospital, Taichikawa, Japan. The experience with urological wounds in Vietnam handled at USAHCZ was presented, resulting in the updating and refining of a consensus for managing urological wounds and injuries.[9]

These yearly CINCPAC conferences were instrumental in establishing current, ongoing consensus guidelines for the management of the myriad medical, surgical, logistical, and aeromedical problems encountered in treating sick and wounded soldiers in Vietnam and Japan. The publications were widely disseminated to all MTFs and personnel involved in the care of war-zone casualties; they resulted in improved medical care at all echelons.

THE *USARV MEDICAL BULLETIN*

A medical bulletin was published every other month by Headquarters, United States Army in the Republic of Vietnam (USARV) as a method of disseminating professional material on items of medical interest to all medical personnel of USARV. Much of this material was anecdotal, but it provided an ongoing depiction of events and problems occurring in Vietnam and is the source of much of the information in this chapter. A great deal of credit must go to the various contributors to the *USARV Medical Bulletin*. The initial publication was dated 1 January 1966, and at that time the new journal was planned to be a monthly publication. It was hoped that each issue would feature articles from various medical installations or units. The *Bulletin* welcomed papers submitted from any Army Medical Department organization. Plans called for a surgeon's page, a consultant's page, a nurse's page, and guest editorials to be published, as well as the names of recent arrivals and of course articles concerning various medical specialty problems. Classified information (eg, casualty and mortality figures) was to be excluded. Brief biographical sketches of the contributors were sometimes published. The first publishing editor was Lieutenant Colonel John M. Gorton, MC, Headquarters USARV Surgeons' Office. Colonel Samuel C. Gallup was USARV Surgeon at that time.

The second issue, published in February 1966, was entitled the *USARV Medical Newsletter.* But Colonel James E. Weir, MC, who replaced Colonel Gallup as USARV Surgeon on 10 June 1966, believed that the *USARV Medical Bulletin* should be upgraded to a degree comparable to other periodicals published by the US Army Medical Department. This was to be done by having this publication printed in Japan every other month. The *Newsletter* was again renamed the *Bulletin*, thanks to the assurance by USARV Judge Advocate General section that this was in accord with Army regulations.

MEDICAL COMMAND, STAFFING, AND TREATMENT FACILITIES

When USARV was formed on 20 July 1965, it replaced Support Command, and Colonel Ralph E. Coat, MC, became the first surgeon of this new organization. The surgeon's head office was in Tan Son Nhut, Vietnam. Colonel Samuel C. Gallup, referred to above, became USARV Surgeon on arriving in Vietnam on 19 August 1965. In addition to the surgeon, the office of the chief nurse, executive officer, evacuation operation officers, assistant evacuation officer, plans officer, administrative personnel offices, as well as medical records reports officers were located at the headquarters. The USARV dental surgeon, general surgeon, medical internist, neurosurgeon, and neuropsychiatrist consultant offices were located there as well as aviation medical offices, preventive medicine officers, and the supply officer and his staff. Arrangements were made for consultant visits.

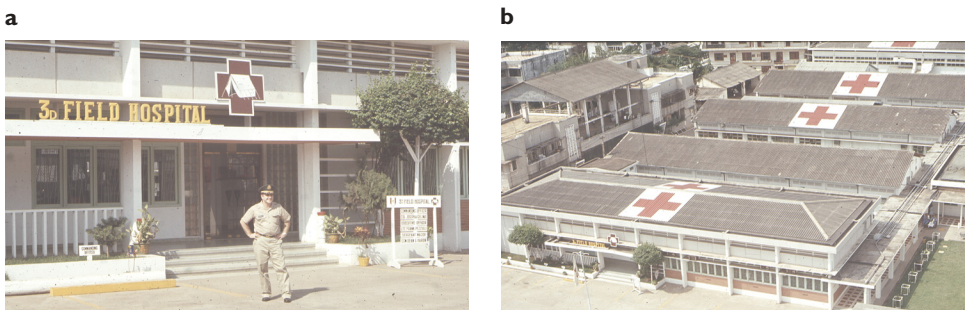

Fig. 1-7. (**a**) The headquarters building of the 3rd Field Hospital, Saigon, Vietnam. (**b**) The headquarters building is in front of other buildings and wards.

The 3rd Field Hospital, Saigon, provided a high level of expertise for in-country evacuations for sophisticated medical care (Figure 1-7. a,b). The 3rd Field Hospital, which had an illustrious history of service in the South Pacific during World War II and the Korean War, was reactivated at Fort Lewis, Washington, on 11 March 1965 to provide medical support for the rapidly expanding US commitment for the Vietnam War. Initially, the 100-bed unit from the 51st Field Hospital supplied the nucleus of the 3rd Field Hospital. The personnel left Fort Lewis, Washington, on 23 April 1965, traveling in 2 sections on MATS C-119 aircraft to Tan Son Nhut. The buildings of the American Community School, Saigon, were to be converted into an indoor hospital. Elevated hospital beds were procured from the Army of the Republic of Vietnam (ARVN) Medical Depot; typewriters from the American Embassy; and desks, bookcases, and other school equipment from the American Community School were used. On 12 May 1965, the 3rd Field Hospital was declared operational by General Norton, the commanding general of the 4th Command.

Electrical power was a major problem, and a large generator was "borrowed" from civilian contractors to supplement the existing power supply. Large casualty loads were present almost from the first operational day. Great tribute was paid to the ingenuity of the supply personnel; at no time were they out of critical supply items in the early phases of this hospital. Following the inception of the 3rd Surgical Hospital as an operational unit on 15 September 1965, the 3rd Field Hospital still functioned (1) to support technical troops and (2) as the only evacuation hospital. On 1 November 1965, the unit was augmented by the headquarters unit into a complete 100-bed hospital unit of the 51st Field Hospital. This expansion was attended by General Leonard Heaton for the ribbon-cutting ceremonies. After that, the hospital grew in size and capability.[16]

The importance of field Army medical installations and clinical laboratories was noted by Major R. W. Van Norman.[17] He emphasized that experiences gained in previous wars frequently required relearning at the start of a new war, because no one had bothered to review what had been written before. There is little time in a mass casualty situation to record data, summarize treatment, and draw generalizations, but the information is lost if this is not done. He noted facts gleaned from the Korean War in this regard. The lower mortality in the Korean War was believed

to flow from improvements in decreasing evacuation time, administration of large amounts of resuscitative fluids preoperatively and during surgery, and routine use of antibiotics. The greatest single difference in management of casualties in Korea appeared to be in the large quantities of blood administered throughout resuscitation.

Wound research was discussed by Colonel B. L. Freund, Chief of the Wound Data and Munitions Effectiveness Team (WDMET), Saigon.[18] This team collected, in Vietnam, the world's first extensive field data on the effectiveness of lightweight body armor. Colonel Freund also noted that in 1968, 85% of all soldiers wounded in Vietnam were being returned to duty, and nearly 50% of the nonfatally wounded casualties did not require hospitalization. These were certainly enviable records.

In 1966, Lieutenant Colonel F. C. Dimond discussed the role of mobile surgical hospitals in Vietnam in relation to air evacuation.[19] The terrain in Vietnam permitted relatively little ground transportation of the wounded, forcing much greater use of air evacuation. This placed the emphasis on bringing the patients to the hospital rather than the hospital to the patient. Operation Crazy Horse was a good example. The 2nd Surgical Hospital, although located a considerable distance from the combat area, was only a few air minutes away; because of the distance, terrain, lack of roads, and vulnerability to ambush, evacuation was impossible other than by air. Administrative personnel at Army mobile hospitals found that with patients coming to them rather than the other way around, they could expand their facilities; the advantages of becoming relatively fixed were quickly apparent. Only fixed facilities could ensure the finest possible medical care at all times. By the end of 1968, 26 fixed hospitals (field, surgical, and evacuation) existed throughout the Republic of South Vietnam (Figure 1-8).

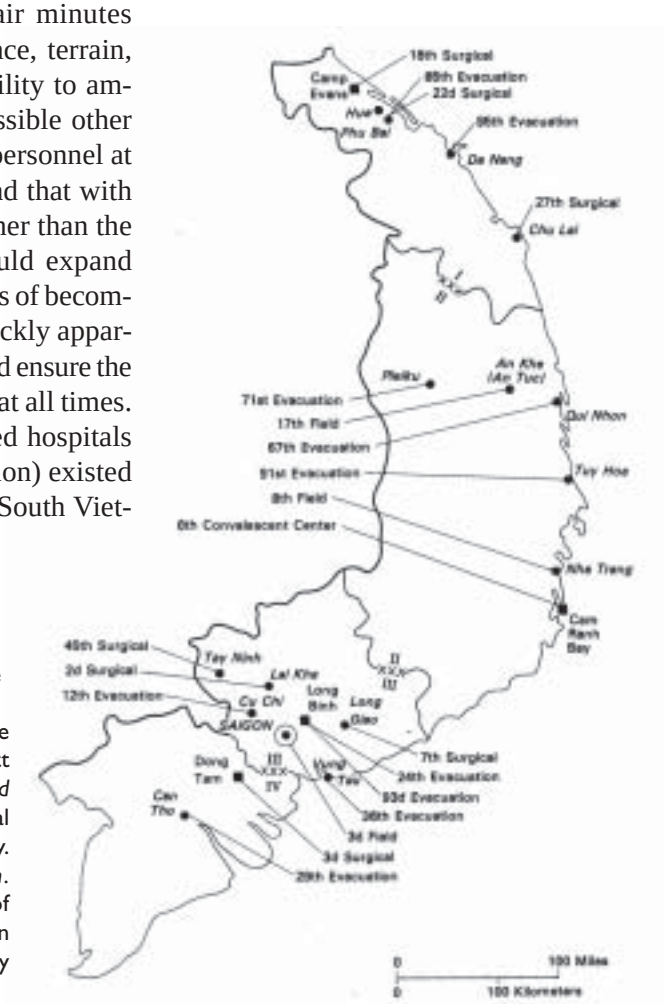

Fig. 1-8. A map of South Vietnam dated 31 December 1968 shows the locations of US Army hospitals. Source: Ognibene AJ. Full-scale operations. In: Ognibene AJ, Barrett O'N Jr, eds. *General Medicine and Infectious Diseases*. Vol 2. In: Medical Department, United States Army. *Internal Medicine in Vietnam*. Washington, DC: Department of the Army, Office of The Surgeon General, and Center of Military History; 1982: 51.

Arrival of specialty units such as the Walter Reed Institute of Research's Renal Dialysis Team at the 3rd Field Hospital in Saigon greatly increased the potential for in-country consultation and specialty care. Air transportation for patients, both within and out of the country, was arranged through the USARV medical regulating officer and through the Armed Forces Joint Medical Regulating Office.

ORGANIZATION AND CONSTRUCTION OF FIXED MILITARY HOSPITALS (FIELD AND EVACUATION) IN THE REPUBLIC OF VIETNAM

The modern military hospital in Vietnam was constructed utilizing a basic form of the World War II cantonment facilities.[20] Hospitals were placed in the combat zone, and then adequate provisions were made to protect them from mortar and rocket attacks. For example, the 24th Evacuation Hospital was placed on a rectangular plot. Quonset-type huts were positioned in parallel on the long sides of the rectangle, leaving a center portion large enough for a potential patient activity area. A similar plan was used at the 12th Evacuation Hospital (Figure 1-9. a,b,c,d). The laboratory, X-ray, preoperative, recovery, and surgery areas; central medical supply; and general surgical wards were all located on one side of the quadrangle. Directly opposite were the neurosurgical, medical, orthopedic, and ambulatory wards. The front of the enclosure was occupied by several administrative Quonset-type huts, which were also placed in parallel lines. The mess hall, general medical

Fig. 1-9. 12th Evacuation Hospital, Cu Chi, Vietnam. (**a**) Headquarters building. (**b**) Corridors between Quonset-type wards and buildings. (**c**) An operating room. (**d**) "Hootches" (living quarters) for physicians, nurses, and other medical personnel.

Exhibit 1-2
Helicopter Pilots And Crews

The increased use of helicopters in all aspects of the Vietnam War was accompanied by a rapidly increasing number of deaths of helicopter crews from enemy action (7 helicopter-related deaths occurred in 1962, 117 in 1965).[1] The enemy frequently used casualties as "bait" to lure helicopters and other support units into an ambush. The highest fatalities were among the pilots and gunners; copilots and crew chiefs fared only slightly better. Passenger fatalities were considerably lower. The "dust off" pilots and crews were truly remarkable individuals.

Of the numerous heroes of the dust-off operations, the most famous was probably Major Charles L. Kelly. He was eulogized by General William C. Westmoreland in 1967.[2] Major Kelly was the commanding officer of the 57th Medical Detachment (helicopter ambulances). His drawl, "This is old Dust Off just passing over—is everything okay? Good—take it easy now,"[2] was known to many as he flew by on his mission of mercy. He not only convinced his commanding officer that he and his men should be allowed to fly evacuation missions at night as well as in daytime, but also that the safest way to fly at night was with a single, completely blacked-out helicopter. The Vietnamese soldiers, civilians, and the American advisors loved Major Kelly and his men, who always came when help was needed in the midst of battle—day or night. Major Kelly was killed after he was warned off by ground radio that he was flying into an ambush set up by the enemy. He refused to leave, tried to come in to pick up wounded patients, and was killed by rifle fire. His last words were "I will leave when I have the wounded." There are obviously many other unsung heroes.

Sources: (1) Kiel FW. US Army helicopter deaths in Vietnam. *USARV Medical Bulletin.* 1966;1(1, Jan):13–14. (2). Westmoreland WC. Dustoff. *USARV Medical Bulletin.* 1967;2(1, Jan–Feb):1–3.

supply, and motor pool were up front and near the unoccupied end of the complex. Roads on all sides provided easy access to all wards and administrative facilities. The placement of the helipad away from the billeting area and on one corner of the rectangle helped to alleviate aircraft noise. Combat casualties were brought directly from the helipad (Exhibit 1-2) to the emergency triage area and could pass rapidly through the laboratory, X-ray area, and preoperative wards into the surgical facility—all the while under constant professional observation and with minimal delays. This arrangement, designated the "corridor concept," permitted first-hand visual control of all patients undergoing acute care. It also meant the difference between success and hopeless confusion during mass casualties.

These fixed hospitals took care of all injured combatants and civilians (Figure 1-10. a,b). In some instances, wounded captured enemy troops were treated and hospitalized. Nurses and physicians had constant contact with patients during all phases of their evaluation. The excessive heat, high humidity, torrential rains, and infiltrating dust of Vietnam made stabilization of the wounded soldier very difficult; the corridor concept made this task less formidable. Management of fluid and electrolyte depletion could be undertaken in a clean, dry, and a relatively cool environment. Six-foot sandbag revetments provided significant security for the patients and hospital personnel during enemy attacks.

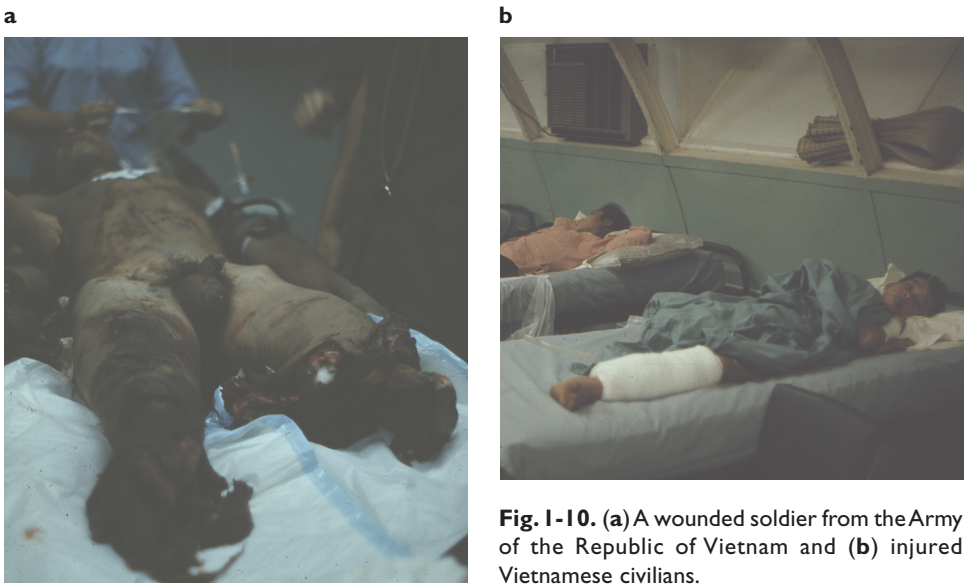

Fig. 1-10. (**a**) A wounded soldier from the Army of the Republic of Vietnam and (**b**) injured Vietnamese civilians.

THE BATTALION SURGEON

Because medical evacuation helicopters transported most sick and wounded patients directly to the medical clearing company or to a hospital rather than to a battalion aid station (BAS), the battalion surgeon usually played only a minor role in combat casualty management during the Vietnam War. He did, however, remain responsible for the health of his battalion and was a special staff officer to the battalion commander, advising the commander concerning the health and welfare of the battalion.[21] The battalion surgeon's role in combating disease was particularly important. More soldiers were evacuated for medical problems than for injuries. In many areas of Vietnam, the most common and serious disease was malaria, and malaria prevention was one of the most common problems of every battalion surgeon.[22–30]

Nevertheless, when their units were under fire, battalion surgeons were called on to treat casualties. In addition to their strictly military duties, battalion surgeons frequently took part in civic action projects in the area of treatment of sick Vietnamese villagers.[21] Many battalion surgeons "adopted" villages to which they would regularly travel to provide medical aid. The battalion surgeon also acted as medical platoon leader and had approximately 30 medical aid men under his command. These individuals often readily and willingly risked their own lives to help the wounded.

Numerous nonmilitary medical problems were also present among the troops. Venereal disease (VD) was quite frequent, mainly consisting of gonorrhea and, to a lesser extent, chancroid. Lymphogranuloma venereum and granuloma inguinale were occasionally seen. Syphilis was rare. Condyloma accuminata was a frequent problem.[31–35] Dermatological problems were extremely common; they included pyoderma, fungal infections, wet injuries, tropical immersion

foot, and rashes secondary to systemic disease. These could be extremely debilitating problems and cause a great deal of loss of manpower. Diarrhea was a common problem for the physician at the troop level; some was caused by parasites. Other parasitic diseases included hookworm infestations, ascariasis, and amoebic dysentery.[36] Insect bites, as well as those from scorpions and centipedes, were seen occasionally. Poisonous snakebites occurred but were rare. Many Vietnamese had malaria, and there also was a high incidence of tuberculosis.[37] Most of the native population had no immunization of any sort. Tetanus was occasionally seen. Hepatitis was a common problem.[36] The more-important medical problems that we and other medical officers treated in Vietnam are discussed in Chapter 12, Nontraumatic Urological Conditions.

RESUSCITATION OF THE SERIOUSLY WOUNDED SOLDIER

For all seriously wounded patients, resuscitation began the moment the casualties were seen by an aid man, buddy, or anyone capable of administrating medical aid. The basic considerations were establishing an airway, controlling bleeding, and administering intravenous fluids as soon as possible. Assessment of the patient as a whole was carried out as soon as feasible. Prompt evacuation by helicopter from the battlefield to a hospital sometimes presented resuscitation teams there with severely or even mortally wounded individuals who would have been classified as KIA or DOA during other conflicts. Many of these patients were in profound hypovolemic shock, and some were actually salvaged from cardiac arrest on admission to the receiving ward. These efforts were successful only in a well-equipped, well-organized receiving ward and with immediate response by the appropriate personnel.

Resuscitation of casualties in profound hypovolemic shock also required adequate available IV fluids and, in many instances, a well-stocked blood bank. Oxygen was given by mask or nasal catheter. The use of large-bore IV plastic catheters was emphasized. Catheters were passed into the vena cava when possible to provide a monitor for venous pressure. The subclavian vein was frequently used and complications including tension pneumothorax occurred in some cases. Initial fluid replacement was accomplished with physiological saline or Ringer's lactate. Type O or type-specific blood was given, depending on the source available. If 4 units of a specific blood type were used, then that blood type was used exclusively thereafter for 2 to 3 weeks, as indicated. The average casualty received 3 to 4 liters of fluid during initial resuscitation and surgery; no effort was made to establish a ratio for blood to electrolyte solutions. Many of these seriously wounded patients were dehydrated from the hot climate and heavy physical effort. The importance of monitoring the central venous pressure was emphasized to permit adequate infusion and to prevent over administration of fluids. The use of vasopressors was discouraged.

A mild increase in respiratory rate from 16 or 18 to 25 breaths per minute might be the earliest evidence of pulmonary problems. Adequate treatment for

retained secretions, atelectasis, pneumonia, contusion, and pulmonary fat emboli was emphasized to prevent the full-blown picture of severe pulmonary insufficiency. It was noted that those surgical patients who died beyond the second or third postoperative day usually had pulmonary pathology. The use of massive doses of cortisone was discussed by Captain A. H. Bennett and colleagues, but cortisone proved ineffective.[38] Many corpsmen and nurses did not have formal training in the area of respiratory or inhalational therapy,[39,40] and mechanical ventilators occasionally malfunctioned.

Blood Type and Transfusions

The availability of whole blood was essential in the treatment of combat casualties. Ideally, blood used in transfusion was as fresh as possible, group- and type-specific, and completely cross-matched. This desirable triad required about 40 minutes to accomplish. Typing blood with the "immediate spin saline" technique for cross-matching took 15 minutes. Low-titer, type O positive (universal donor) blood could be used immediately. It was believed that patients with type AB blood should be transfused with one of the following blood types (in order of decreasing preference): AB, A, O.

Low-titer, type O positive blood was believed to be indicated (1) for patients with acute, severe hemorrhage in mass casualty situations and (2) in small medical units where group- and cross-matching were impractical. Because of its limited supply, type O negative blood was given only in group-specific transfusions. As of February 1969, no complications had been observed in RVN resulting from this practice. Blood 21 days old or less was ordinarily used. "Outdated" blood (22–31 days of age) was retained as a back-up for mass casualty situations.[41]

Coagulopathy

Patients with uncontrollable oozing after massive transfusion were subjected to coagulation workups either prior to or simultaneously with treatment. This included at least an examination of a peripheral blood smear, platelet count, prothrombin time (PT), and a partial thromboplastin time (PTT). Usually, simple dilution of coagulation factors was characterized by a prolonged PT and PTT with normal platelet and fibrinogen levels. Patients usually responded rapidly to 2 or 3 units of fresh frozen plasma (FFP). In some instances, platelets were also depressed, and transfusion with fresh, whole blood (FB) was indicated. Hemorrhage due to disseminated intravascular coagulation was characterized by depressed platelet counts and fibrinogen levels, and lengthened PTs and PTTs. These patients had little or no response to FB or FFP. Heparin was felt to be the treatment of choice. Hemorrhage due to fibrinolysis was associated with a prolonged PT and PTT and a diminished euglobulin lysis time. Hyperfibrinolysis did not respond to FB and FFP and was best treated with aminocaproic acid. Laboratory results were often inconclusive.[42,43]

Soft-tissue destruction acted as a potent stimulus for both coagulation and fibrinolytic problems. Patients in hemorrhagic shock typically passed from a

hypercoagulable to a hypocoagulable state. Many patients with soft-tissue injuries tended to have a pronounced oscillatory curve of hypercoagulability followed by hypocoagulability. Some developed the latter condition in less than 6 hours, in which case it frequently developed into fatal bleeding diathesis. Patients were often difficult to maintain in the state of hemostasis somewhere between disseminated intravascular coagulation—with its resulting excessive depletion of thrombin and fibrin—and the fibrinolytic syndrome. The coagulation mechanism and clinical observations were noted by Major Donald E. Nelson, Commanding Officer, 528th Medical Laboratory, Qui Nhon.[42]

Major Asa Barnes emphasized that FFP contained all the plasma clotting factors in concentrations comparable to those in freshly drawn whole blood. He believed that platelets should be used when available for specific platelet deficiencies. FB drawn in Vietnam was found to have a relatively high risk for the transmission of hepatitis and malaria, especially. Conversely, FFP drawn in PACOM had been shown to result in a remarkably low incidence of transfusion hepatitis.[43] FFP was difficult to process and store, as it required refrigeration at –20°C, and use was limited.[42,43]

ANESTHESIA

General endotracheal anesthesia was employed in most surgical cases in Vietnam. As a rule, thiopentol sodium induction was used for anesthesia; halothane and nitrous oxide plus oxygen were used for maintenance anesthesia. Halothane had many advantages: its nonexplosive quality, the ease of administration, the rapidity of induction, the rapid emergence from anesthesia, and the low incidence of postanesthetic nausea and vomiting. Nitrous oxide is a useful anesthetic agent in preserving cardiovascular stability in the trauma casualty patient. However, because of the propensity of producing gaseous distention of the intestine tract and ileus, its use was limited in the surgical management of casualties with abdominal injuries.[44] Small amounts of curare or succinylcholine were used when necessary as a muscle relaxant. Ether and cyclopropane were *not* used because of their explosive properties; proper physical facilities and equipment were lacking to make them safe to use.

Regional and spinal anesthetics were used but limited to patients with extremity wounds. Local anesthesia was not recommended for debridement when deep penetration from a missile had occurred. Observation at 2nd-echelon hospitals revealed an increased incidence of wound infection when local anesthesia was used for debridement: it frequently compromised adequate wound preparation, cleansing, scrubbing, and tended to cause breaks in surgical techniques. Inadequate debridement often resulted, and wounds tended to be primarily closed rather than debrided when local anesthetic was used.[45]

Urinary output was crucial in monitoring fluid and renal status during operations. Urinary catheters were routine in all major thoracoabdominal procedures. Anesthesia of the combat casualty is the subject of *Anesthesia and Perioperative Care of the Combat Casualty,* a volume in the *Textbooks of Military Medicine* series[46] that interested readers can consult.

ABDOMINAL WOUNDS

Comparative Wound Statistics and Mortality in World Wars I and II and the Korean and Vietnam Wars

Some comparisons are made here with published statistics of abdominal wounds from prior 20th-century wars (both world wars and the Korean and Vietnam wars).[3–5,17,47–51] It became apparent in World War I that early intervention was important in abdominal wounds. The concept of triage was widespread in World War II, first in North Africa and in Sicily and later throughout the Mediterranean and European theaters. The overall mortality of all abdominal wounds admitted to the American Expeditionary Force hospitals in World War I was 66.8%. The frequency of renal wounds was 6.3%. In World War I, only those with less severe abdominal wounds were operated on. The most important prognostic factors were the time lag, the degree of shock, and the multiplicity of abdominal organs injured.

The mortality of 381 abdominal wounds treated by the British Eighth Army during a 3-month period in 1942 was only 12.5%. In World War II, the mortality rate was 7% for those operated on within 8 hours but rose to 22% when surgery was delayed for 48 or more hours. Mortality in World War II ranged from 12% for those with a single organ injury, to 88% for those with 5 or more organs injured. Analysis of 2,918 abdominal wounds included renal injuries in 13.4%, ureteral trauma in 0.8%, and bladder injuries in 4.9%. The overall mortality in this entire group of patients with intraabdominal injuries was 25.5%. Injuries to the colon and small bowel were the most common in this group. The mortality in patients with renal wounds was 35%—slightly higher than the 25% to 30% reported in World War I. However, mortality for bladder wounds was 30% in World War II versus 50% in World War I. Eleven of 27 with associated urethral injuries died, 8 of these of shock.[47]

In the Korean War, mortality for abdominal wounds as recorded at the 46th Surgical Hospital was 12%, and for thoracoabdominal wounds, 10.3%. The mortality of renal wounds was 25.4%, and for bladder wounds, 9.4%.[17]

In Vietnam, a study of 2,600 men KIA showed that 9% succumbed to abdominal trauma. An analysis of 537 wounds in patients arriving in hospital facilities showed renal wounds to be present in 7.45% and bladder injury in 1.68%. As in other conflicts, injuries to the colon, liver, and small bowel composed the largest group of visceral injuries.[51]

Management

After the patient was anesthetized (see above), all penetrating abdominal wounds were usually explored via a midline abdominal incision. In addition, many wounds of the buttocks, extremities, and chest often involved abdominal organs. As far as possible, the course of the projectile was determined and X-ray examinations obtained to rule out clinically unsuspected intraabdominal injury.

Entrance and exit wounds were not used as part of the abdominal exploration, as surgical incisions too close to the wounded area could result in inadequate muscle and fascia for satisfactory closure after appropriate debridement. A midline epigastric wound could be approached through a transverse incision.

Penetrating injuries were discussed in the *USARV Surgery Consultant's Report* in 1968 by Lieutenant Colonel Gene Aaby.[52] He analyzed penetrating abdominal wounds in 514 cases. Of these, 33.4% were due to bullet wounds, 27.4% to mortar fragments, 23.1% from mine explosions, and 15.7% occurred secondary to other causes for a total of 99.8% of injuries that could be evaluated. The small bowel was the most frequently injured organ, composing 22.4% of the distribution of wounds by organ; large bowel, 10.9%; liver, 16.7%; kidney, 12.8%; stomach, 10.4%; spleen, 8.9%; pancreas, 2.5%; bladder, 2.5%; and others, 2.6%. Lieutenant Colonel Aaby noted that the magnitude of trauma in penetrating abdominal wounds was related to the type of wounding agent, its velocity, the effects of secondary missiles, and the amount of gross contamination carried in the missile pathway. Bullets were noted to be more destructive than small fragments. Large fragments could involve large areas, including the full thickness of the abdominal wall, and often caused massive internal damage. In contrast to skeletal muscle, in which extensive adjacent damage occurred with high-velocity wounds, the gastrointestinal tract did not usually experience severe trauma for significant distances beyond the gross evidence of involvement. Solid organs such as the liver, kidney, and spleen, however, have very little supporting fibrous tissue, and the effects of lateral release of energy could be extensive.[52]

In patients undergoing laparotomy for abdominal wounds, it was vital that the entire small bowel be examined to avoid missing possible perforations. Wounds along the mesenteric border were commonly overlooked. Debridement followed by closure using a single layer of interrupted silk sutures was recommended for small-bowel repair. Resection of intestinal segments was done when necessary, and when several wounds were in close proximity or if the bowel had been devascularized.[52]

Postoperative complications were not excessively common after small-bowel injuries (as opposed to large-bowel injuries). Gastric wounds did not usually have major postoperative problems. Duodenal injuries were usually associated with damage to adjacent organs such as the liver, kidney, pancreas, and stomach. These wounds required adequate mobilization to provide careful inspection and appropriate repair.[52]

Duodenal wounds were closed in a manner similar to other small-bowel repairs. Large wounds were evaluated and individually managed according to the extent of the local trauma and involvement of other organs. Thorough drainage and internal decompression of the duodenum were believed to be important. Drains were brought out through large openings in the flank. Sump drains were used when possible. Most of the complications from these injuries were associated with inadequate drainage of secretions, blood, and/or pus. Internal decompression of both the stomach and duodenum was accomplished.[52]

The spleen was usually removed in patients with splenic injuries. About 40% of patients having a wound in the spleen and the adjacent colon developed subdiaphragmatic abscesses. Adequate drainage was imperative.[52]

The liver was the most frequently injured solid intraabdominal organ. The mortality for extensive hepatic injuries was very high. Liver injuries were characterized as mild, moderate, or severe. *Mild* injuries included small perforations, lacerations, or fractures in which neither blood loss, bowel drainage, or sloughed necrotic tissues posed a problem. These injuries were treated minimally with little or no debridement. *Moderate* wounds involved significant deep penetration or destruction of liver tissue. Low-velocity, jagged fragments often caused local destruction and frequently carried dirt, debris, and often clothing into the liver. These injuries required debridement with removal of all devitalized liver tissue and adequate hemostasis. A partial resection was frequently necessary using through-and-through sutures or individual vessel ligation techniques to stop the bleeding. A complete lobectomy was not believed to be required. However, occasional excision of the lateral segment of the left lobe was necessary. Packing these wounds with hemostatic substances and enclosing the capsules invariably led to complications. External drainage was emphasized as being necessary. The most common complication of these wounds was subphrenic abscess. Patients improperly treated by packing and closing the liver often developed intrahepatic abscesses, postoperative hepatic bleeding, hemobilia, biliary fistula, and other complications. Drainage with T tubes of the common bile duct was recommended for *severe* liver injuries. Well-placed drains exiting through the flank were extremely important in managing major hepatic wounds.[52]

Colon wounds occurred in about 1% of all injured patients. About 5% or 6% of all patients injured had intraabdominal injuries of some sort. Of 164 patients with colon wounds that were analyzed, 141 (85.9%) had other organ injuries. Injuries to the small bowel were the most common, followed by injuries to the kidney, liver, bladder, and spleen. The frequency of right colon, left colon, and low sigmoid and rectal injuries was about equal. Transverse colon injuries were somewhat less common. Although a colostomy was usually a fairly simple procedure, some patients had a number of preventable complications (obstruction, infection, retraction, bleeding) that required reexploration. Of the 164 patients, 16 developed pelvic or subphrenic abscesses. Rectal wounds also had a high incidence of postoperative abscesses. A common surgical error was making too-small an exit wound for the drains. It was found that when draining the subdiaphragmatic spaces, the drain should accept 2 fingers without constriction, and the exit site should be located laterally rather than anteriorly.

Large wounds of the right colon were best treated by an ileotransverse colostomy. If massive soft-tissue damage occurred on the right, and widespread fecal contamination and/or wounds of the liver and/or kidney existed, then a right colectomy with ileostomy plus creation of a distant mucous fistula was favored over ileotransverse colostomy, because breakdown of the anastomosis had occurred in the presence of some of these injuries. Wounds distal to the

mid transverse colon were thought to be best treated by exteriorization, or, if repaired, a proximal colostomy. Primary repair of left-colon wounds without a proximal colostomy should not be done in the combat zone. Antibiotic coverage was no substitute for adequate drainage.[52]

Treatment of Rectal Wounds

Major Donald Sebesta, Medical Corps, and Chief, Department of Surgery at the 66th Evacuation Hospital, detailed the important fundamentals in treating rectal wounds.[53] We (JWW and JNW) were frequently involved in the management of these wounds, as many patients with rectal wounds had coexisting bladder, prostatic, urethral, and genital wounds. Dr. Sebesta believed that penetrating wounds of the rectum were among the most frequently mismanaged of all Vietnam wounds. He observed that (1) these injuries were uncommon in civilian practice, and (2) most surgeons coming to Vietnam had little experience in evaluating and managing them. There was always a potential for a fatal pelvic sepsis. The importance of rectal examination, bidirectional X-ray examination, and sigmoidoscopy was stressed. Negative rigid sigmoidoscopic examination alone was of little value because small wounds were not easily distinguished by this method.[53]

Because of these difficulties in diagnosis, even a strong suspicion of rectal injury should be sufficient to call for definitive treatment—even when the injury could not be demonstrated on the operating table. Small, often imperceptible perforating wounds in the rectum had the potential of being a death-causing lesion. To allow a combined abdominal-perineal approach, the patient should be placed in the lithotomy position. After opening the perineum, the surgeon should separate the rectum from the surrounding pelvic soft-tissue by gentle, blunt dissection to the level of the coccyx posteriorly, and that of the prostate gland anteriorly. All identifiable wounds of the rectum should be closed preferably in 2 layers.[53]

Next, complete diversion should be done preferably by dividing the colon and bringing the severed ends out through separate incisions away from the midline incision. Careful cleansing of the colon distal to the colostomy was found to be necessary to ensure removal of all residual stool. This is best done by copious irrigation with saline through both the anus and the mucous fistula. If this important step was overlooked, a colostomy would be of little value.

Proper drainage was of great importance in the successful treatment of rectal injuries. Dr. Sebesta believed that a coccygectomy was necessary in nearly all cases to provide adequate drainage, because experience had shown that coccygectomy would eventually be required to allow adequate drainage of the secondary wound closure.[53] Lieutenant Colonel Aaby believed that double-barreled defunctionalized colostomies and drainage of the presacral space were imperative. Generous incisions, coccygectomy, and development of the presacral or pararectal space had to be considered to provide adequate drainage.[52]

Abdominal Organ Wounds and the Urologist

Abdominal wounds presented complex problems for the urologist, as there were nearly always injuries involving other organ systems. In many cases the urological injury was the least life-threatening.[54] In general, all penetrating abdominal wounds were surgically explored through a midline abdominal incision. Many of these surgeries were performed by a team involving the general surgeon, the urologist, and other specialists.[54] In addition, many wounds of the buttocks, other extremity wounds, and chest also involved the abdominal contents. Insofar as possible, the course of the projectile was determined and X-ray examinations were obtained to rule out unsuspected intraabdominal injury. Midline abdominal incisions were generally used for exploration. Entrance or exit wounds were not used as part of an incision anywhere in the body, as is discussed above.

If renal injuries were suspected, an intravenous pyelogram (IVP) was done. Severe renal injuries, particularly if associated with other organ injuries, were usually treated with a nephrectomy. Determination of the status of the other kidney was made prior to nephrectomy. There was some reluctance on the part of general surgeons to do IVPs when the patient was in shock, as it was thought that the kidneys would not adequately visualize. This examination could be done on the way to the operating room or in the surgical suite after resuscitation and usually revealed some key information as to the extent of renal injury and the status "normalcy" of the contralateral kidney. In general, large retroperitoneal hematomas were explored. Ureteral injuries were repaired over an indwelling ureteral catheter using absorbable suture with adequate drainage. Bladder injuries were closed with absorbable suture and were usually treated with a suprapubic tube and a Foley catheter.[54] Antibiotics were given to most patients, usually penicillin and either chloramphenicol or streptomycin.

During mass casualty situations, the urologist often screened incoming patients independent of the triage officer in the evacuation hospital and did not function as a regular member of the general surgical team. Instead, he moved freely among the operating room, the preoperative ward, and the X-ray examination area to offer assistance, advice, technical guidance, or personally repair urological injuries. It was important that a urinalysis be done on all patients with intraabdominal injuries and a Foley catheter inserted when hematuria was present.

POSTOPERATIVE COMPLICATIONS OF ABDOMINAL WOUNDS

Bleeding

Postoperative bleeding occurred in some patients. This was often due to stress ulcer, bleeding from the colostomy, problems with nephrostomy, and breakdown of rectal repairs. Infection was present in nearly all patients who developed bleeding. Several patients developed fistulae after colonic injuries.

Intraabdominal Sepsis

The management of intraabdominal sepsis was a constant problem for urologists as well as general surgeons and others who dealt with abdominal wounds and wound complications. This problem was addressed thoroughly in April 1970 by Major Frederick G. Winegarner, Medical Corps, Chief of Surgery, US Army Hospital, Camp Zama, Japan.[55] He studied 75 patients with intraabdominal sepsis who required 116 procedures for surgical drainage for just over 2 years, from 1 January 1967 through 30 January 1969. This group included 56 patients wounded in Vietnam and 19 patients with intraabdominal sepsis from other diseases, all of whom were treated at USAHCZ. Twenty of the 75 patients required more than 1 surgical procedure. Twenty-nine of these had received gunshot wounds and 27 had fragment wounds. Colon injuries were present in 48% of patients, hepatic injuries in 41%, and small-intestine injuries in 37%. Seventy percent had more than 1 vascular injury. Several patients also had urological injuries. He found the pelvis to be the most common place for development of intraabdominal abscess, and this occurred in 14 cases. Thirteen patients had a subphrenic abscess on the left side and 11 on the right. Eight patients had multiple abscesses. Less-common locations included the right lower quadrant and intrahepatic involvement following liver injuries.[55]

Culture results were available in only 39 of the 75 patients. In many cases, detailed records had been passed on with the patient to the next MTF. Culture reports showed more than 1 organism in two thirds of patients. Two thirds had *Klebsiella* (formerly called *Aerobacter*) organisms; 50%, *Escherichia coli*; and 33%, *Proteus* or *Pseudomonas*. Cultures were usually not done for anaerobes. The patients who required reoperation averaged 3 procedures, reflecting the complexity of these complications.

Acalculus cholecystitis occurred in 3 patients. Repeated disruption of gastrointestinal suture lines occurred in 4; 2 of these patients died. There were 3 deaths in the entire group.[55]

Plain X-ray examinations of the chest and abdomen were often quite helpful in finding and locating intraabdominal abscesses. The visualization techniques of sonography, computed tomography, and magnetic resonance imaging had not yet been developed. Injection of draining sinuses with radiopaque material was often helpful; unsuspected communications with abdominal viscera were frequently found.[55]

Pathogenic organisms could be resistant to antibiotics, as patients with intraabdominal sepsis had had antibacterial therapy before they were medically evacuated to Japan. Aggressive surgical treatment was indicated. Many pelvic abscesses were drained through the rectum or by removal of the coccyx with wide presacral drainage as noted above in this chapter and as discussed more extensively in Chapter 7, Wounds of the Posterior Urethra and Prostate. Leaking anastomoses were exteriorized at the time of abdominal drainage. Exceptions were leaks in the stomach or proximal small bowel. It was very important to examine the liver carefully for possible intrahepatic abscesses.

Dependent drainage was established, and sump drains were used frequently in deep pockets and for genitourinary wounds. The correct postoperative management of drains *could not* be overemphasized. Patients who continued to have fever past the first few postoperative days had to be suspected of having another abscess. Of patients who had abscesses, 27% required further drainage. Continuing weight loss and abdominal pain were symptoms of ongoing infection. Patients with colon wounds were the most likely group to have recurring abscesses. Four patients in this group developed gastric stress ulcers.[55]

Bacteremic Shock

Postoperative bacteremic or septic shock presented certain unusual problems. The problem was a common one because of the severity of the wounds and the relatively high rate of infections from abscesses and other causes. The large number of penetrating wounds of the colon with extensive peritonitis contributed to this, as did the sometimes unavoidable delay in the administration of antibiotics and the presence of protracted hypovolemic shock. Bacteremic shock was discussed by Captain Charles E. Fitzgerald, Jr, Medical Corps, in July 1966.[56] Recommended treatment at that time included blood cultures, antibiotics, and restoration and maintenance of adequate vascular volume. Antibiotics used included penicillin, streptomycin, and either a tetracycline or chloramphenicol. Adequate fluid replacement was facilitated by monitoring the central venous pressure. Steroids and adrenergic blocking drugs were sometimes employed.[56]

The use of high-dose steroids was controversial. Vasopressors have been shown to impair the peripheral and splanchnic contraction in bacteremic shock. Prevention of shock was obviously the most important aspect. Often, physicians did not appreciate (1) the importance of adequate drainage of pus and (2) that removal of infected material is paramount in the prevention and treatment of bacteremic shock.[56]

Intestinal Obstruction

In one series of 514 patients with abdominal wounds, 20 developed postoperative intestinal obstruction requiring operative correction.[52] Of these obstructions, 8 were caused by intraabdominal abscesses and 6 were secondary to adhesions. There were 4 instances of obstruction at the colostomy site from incorrect operative technique used in treating small wounds of the cecum. In another series of 75 patients with intraabdominal wounds and infection, 20% developed small-bowel obstruction.[55]

CONTROL OF PELVIC BLEEDING

The control of massive pelvic hemorrhage was extremely difficult. Ligation of the hypogastric vessels did not always stop the bleeding. Later in the Viet-

nam War, application of a G-suit (based on the aviators' antigravity suit, which compressed the legs and abdomen) was used with some success. Occasionally, the pelvis had to be packed in an effort to control bleeding. It was found that this packing could be removed several days later, usually with a fairly bloodless field. These problems were discussed by Captain David P. Pilcher, MC; and Captain Lawrence S. Bizer, MC; from the 2nd Surgical Hospital, Lai Khe, Vietnam.[57] The management of severe pelvic bleeding is discussed extensively in Chapter 7, Wounds of the Posterior Urethra and Prostate.

PENETRATING CHEST WOUNDS

Urologists frequently managed casualties with concomitant chest injuries. Most patients with penetrating chest wounds having pneumothorax were treated with a closed-chest thoracotomy. The majority of these simply required a properly positioned chest tube with blood replacement. In general, those injuries responding to this treatment were peripheral in location. The lung would usually reexpand rapidly after insertion of a chest tube. Blood and air were quickly evacuated, and the chest tube emptied completely and remained clear. Chest tubes were usually placed low and in the midaxillary line. Extra holes were cut to facilitate drainage. Occasionally, drainage of the upper chest was necessary. Nonfunctioning tubes were irrigated with saline to promote drainage. Patients with chest tubes required close, frequent supervision by the physician.

Central chest wounds—particularly those involving the bronchi, hilar vessels, heart, or internal mammary arteries—required surgery on many occasions.[58] Coexisting vascular injuries were present in many patients with urological trauma; their true instance is not accurately recorded. The management of vascular wounds was discussed in the *USARV Medical Bulletin*.[58,59] Many arteriovenous fistulae and false aneurysms went unrecognized (Figure 1-11. a,b).

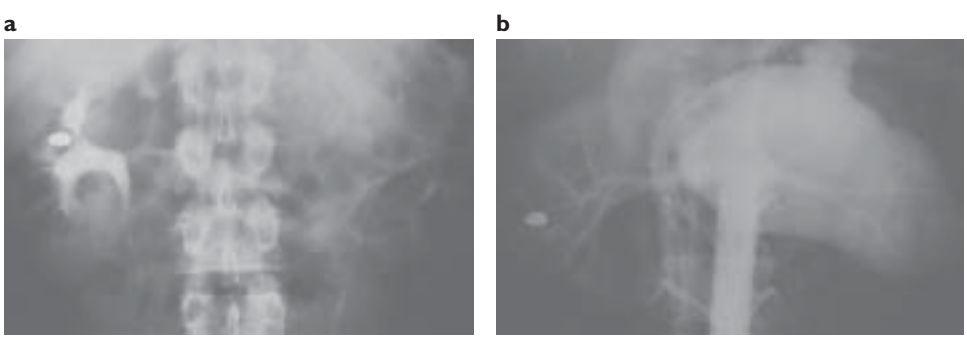

Fig. 1-11. (**a**) The casualty sustained a gunshot wound to the left side of the abdomen; the bullet crossed the midline and lodged in the cortex of the right kidney, as shown on the intravenous pyelogram. The casualty was hemodynamically stable and subsequently was transferred to Japan. (**b**) Persistent hematuria was investigated by performing an aortogram, which revealed a large, hitherto-unrecognized pseudoaneurism and an arteriovenous fistula. The casualty was evacuated from Japan to the continental United States for further treatment; details of his condition after evacuation have been lost to history.

WOUND DEBRIDEMENT

The necessity and technique for adequate debridement of high-velocity missile wounds had to be emphasized to all incoming surgeons; they also had to be taught the basic principles that were involved. These included

- wide skin incisions, longitudinal on the extremities and curved in flexion areas, with excision of only a 2- to 3-mm rim of skin;
- fasciotomy, extending the full length of the skin incision;
- debridement of all devitalized muscle; and
- removal of completely detached pieces of bone.

Badly contaminated, dirty, or potentially infected wounds were always best treated by secondary closure 3 to 5 or more days after the initial surgery. Most wounds treated in Vietnam were caused by fragments from mortars, Claymore mines, and grenades. Each of the possibly hundreds of fragment wounds required incision and curettage. If a fragment had penetrated the fascia, the latter had to be opened and irrigated. No specific effort was made to locate the metal fragment. Success was usually ensured by irrigating out the organic foreign matter and allowing for drainage. Packing the wound defeated this important principle. Proper debridement demanded adequate anesthesia, and preference was given to regional or general anesthesia (see above). Amputation was a difficult professional decision demanding wise judgment and sometimes bold actions. Procrastination could often result in a debilitated, septic patient who died, or a late amputation at an even higher level.

Meticulous postoperative wound care and dressing changes were essential. Proper debridement of extremity wounds was reviewed by Lieutenant Colonel Gene Aaby in the *Surgery Consultant's Report* in1968.[52] He believed strongly that the correct technique of debridement in initial wound management was the key to reducing morbidity and mortality in patients with soft-tissue wounds. It was vital that each new combat surgeon learn these methods in the operating room; simply reading about the experience of predecessors was not sufficient:

> [H]is eyes must learn to recognize the difference between viable and nonviable tissue, and his fingers must be educated to sense the feel of soft, devitalized muscle.[52(p21)]

The elasticity of the skin allows stretching to occur during penetration of a missile with the result that the skin sustains rather mild effects when compared with muscle. Often, fascia has an innocuous appearance with only a small perforation. However, deep to the fascia, extensive cavitation may exist. Skeletal muscles are usually severely traumatized as lateral energy is transmitted. Devitalized muscle can be recognized by its dark color, soft consistency, noncontractility, and decreased bleeding. Tendons and nerves are usually less severely damaged and require limited debridement. To perform a good debridement in Vietnam, the surgeon had

to understand the pathology, execute a stepwise plan, have detailed knowledge of the anatomy, and use careful technique. The operation had to proceed in an orderly manner; each type of tissue had to be treated properly as it was encountered. Paradoxically, the 2 most common errors in the debridement of skin were (1) failure to open widely and (2) excision of too much skin. Like the cover of a book, the skin had to be opened to discover the contents. Longitudinal incisions were used so that extension for needed exposure might be possible. Ragged, contaminated, and traumatized edges were removed surgically, but excising excessive skin was unnecessary and hampered subsequent skin closure. The fascia was opened widely, and frayed and soiled edges were trimmed away. On opening the fascia, tense, bulging hematomas were often found. These could be evacuated by sponging, suction, and irrigation. Copious irrigation was useful in flushing out clots, debris, and foreign matter. By sharp dissection, devitalized muscle could be removed using the aforementioned criteria for viability. Wounds caused by mine fragments were a challenge because of massive soilage, and often a choice had to be made between excessive debridement and leaving behind a source of infection. These wounds frequently required redebridement. Viable skin and muscle flaps were retained in traumatic amputation for use in subsequent revision of the stump.[52]

POSTTRAUMATIC CONDITIONS

Tetanus

Adequate immunization prevented tetanus in US military personnel, but a number of cases were seen in the Vietnamese. These included several neonates. Mortality remained high. Antitoxin was of value. Human tetanus immune globulin was preferable and was given in doses of 50 to 150 units per kilogram of body weight.[21]

Clostridial Infections

Gangrene caused by clostridia was rarely seen.[60] Sound surgical judgment was the best preventive. The antitoxin for gangrene was probably without value. Penicillin was the systemic antibiotic of choice and was given in massive doses, often 20 g or more daily (32 million units). Topical Sulfamylon solution was used to control local progression. Hyperbaric oxygen did not prove to be of much value.

Acute Respiratory Failure

Postoperative pulmonary failure was increasingly recognized as the war went on. This was due not only to causes such as postoperative pneumonia and pulmonary embolization (Figure 1-12) but, even more so, to an initially ill-defined condition that was fully described by civilians in the 1970s and 1980s—adult respiratory distress syndrome (ARDS). Two conditions that were recognized during the Vietnam War may have been manifestations of ARDS: “wet lung” syndrome and fat embolism.

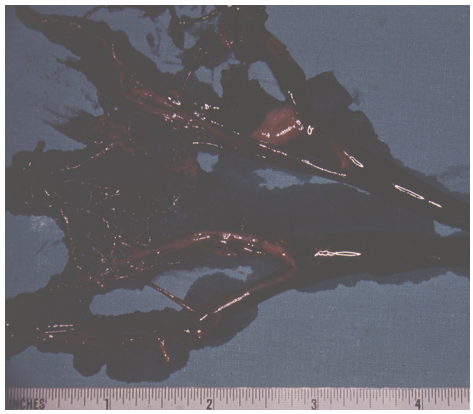

Fig. 1-12. Autopsy findings: multiple fatal pulmonary emboli.

Wet Lung Syndrome

"Wet lung" syndrome following trauma, which had been widely recognized during World War II, was described again by Captain Richard K. Ricks, Medical Corps, of the 155th Medical Detachment (Thoracic Surgical Team) in March 1966.[61] He noted that this syndrome—then a relatively new concept—was one of the most serious and frequently overlooked problems in the management of the traumatic casualty. "Wet lung" could occur in comatose patients after chest or abdominal wounds, and if untreated, these patients frequently[61]

- responded poorly to emergency resuscitation,
- did not tolerate surgery well, and
- had increased postoperative pulmonary complications with increased morbidity and mortality.

"Wet lung" was the term used to refer to retention of secretions and the inability to evacuate tracheobronchial fluids due to direct or indirect trauma to the chest. Other factors, such as overhydration and ARDS, almost certainly played a role but were not well understood at the time. The filling of the bronchioles and alveoli with blood and the inadequate evacuation of secretions led to a decrease in ventilatory capacity and reduced oxygenation of the blood. Progression to the plugging of larger bronchi with lobular atelectasis caused further reduction in oxygenation. Increased capillary permeability and pulmonary edema were severe complications that frequently led to death. Captain Ricks noticed that "wet lung" most frequently occurred within hours after injuries but could appear up to 3 to 5 days following trauma. Chest X-ray films often appeared fairly normal and were frequently of little help in the early stages of what became known as ARDS. Later, patchy areas of infiltration and atelectasis were usually present and could be seen on chest X-ray films. The initial diagnosis could best be made by clinical examination and a high index of suspicion. The best management of the condition was prevention, with vigorous use of endotracheal suction and adequate oxygenation—possibly including positive pressure respiration.

Fat Embolism

Fat embolism occasionally occurred in patients with severe trauma, and when it did, it was a problem for urologists and general surgeons as well as orthopedic surgeons. Fat embolism was a poorly understood entity and ordinarily occurred in

patients with fractures of the long bones and crush injuries of cancellous bones. The condition was thought to occur—at least in a subclinical form—in most patients with these injuries (Figure 1-13). Treatment included adequate oxygenation, often a tracheostomy, and intravenous administration of both 5% ethanol and heparin.[62] Today, there is some question as to the true nature of this disorder.

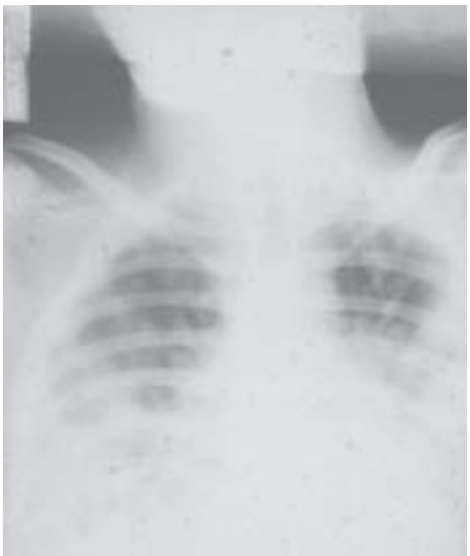

Fig. 1-13. A radiograph of the chest showing the effect of fat embolization in a patient with multiple fractures.

Acute Renal Failure and Acute Renal Insufficiency

Physicians at all levels of medical care were involved in the treatment of the condition known as ARF. Urologists were intimately involved in many of these problems.[63–67] ARF was usually manifested by (1) a steady daily rise in the blood urea nitrogen (BUN), (2) increase in serum creatinine in the absence of glomerulonephritis, and (3) urinary volume depletion; and was usually (4) without urinary tract obstruction. This condition frequently followed an acute illness in a patient with previously normal renal function. Oliguria with a urinary output of less than 500 mL for 24 hours was usually present. Intravenous pyelography rarely visualized the kidneys. The potential for renal toxicity from contrast material was not adequately recognized at that time. Cystoscopy and retrograde pyelography were rarely performed to rule out ureteral obstruction.

Renal arteriography was done only occasionally when there was a suggestion of a renovascular problem. Renal scans were not commonly used in Vietnam. It was obvious that prevention was the most important factor concerning ARF. Prevention required normal circulating blood or fluid volumes, hydration, adequate monitoring of blood pressure in wounded and severely ill patients, and careful blood bank techniques to avoid transfusion reactions. In addition, many of the drugs used were nephrotoxic, and the doses of these needed to be carefully supervised. Mannitol was frequently used in patients with oliguria. Physicians probably did not adequately emphasize the importance of adequate hydration prior to using these diuretics.

The problem of ARF was recognized early in the Vietnam War. In April 1966, a medical team initially designated as a K team and later as a KF (Kidney Failure) team, was deployed to Vietnam for the purpose of establishing a renal center. That team, the 629th Medical Renal Detachment, was located at the 3rd Field Hospital in Saigon. Its objectives were to prevent and treat ARF. After 1 year, in October 1967, the results of the unit's performance were reviewed by Captain James V. Donadio, Medical Corps, and Captain Andrew Whelton, Medical Corps, members

of the detachment.[63] At that time, 27 patients with posttraumatic renal failure had been referred to the unit. Of these, 16 were treated and 7 (43.7%) survived, For patients with medical causes of renal failure, 13 (67%) of 17 survived. This latter group of patients included those with medical problems secondary to malaria, glucose-6-phosphate dehydrogenase deficiency, and various other entities. Patients thought to be candidates for hemodialysis included those[64]

- with uremic manifestations,
- whose hyperkalemia was uncontrolled by simple measures,
- with dangerous fluid overloads, and
- who were taken off drugs that were believed to have accumulated in excess in the presence of renal failure.

Prophylactic hemodialysis programs appeared to be of benefit. Peritoneal dialysis was rarely used by the Renal Unit in Saigon.[64]

Posttraumatic acute renal insufficiency (ARI) in 62 cases was reviewed in October 1969, by Major James H. Knepshield, Medical Corps, and Major William J. Stone, Medical Corps, from the 3rd Field Hospital in Saigon.[65] They noted the unresolved high mortality rate of (50%–90%) in patients with ARI secondary to hemorrhagic shock in association with excessive tissue trauma. Other causes of ARI were septic shock, transfusion reactions, nephrotoxic antibiotics in excessive doses, and a small miscellaneous group. Forty-three deaths occurred for a fatality of 69%. The cause of death was septic shock in 65%, respiratory insufficiency in 23%, hemorrhagic shock in 7%, head injuries in 2%, and hyperkalemia in 2%. Thirty-six (83%) of the 43 fatalities had a clinical picture of septicemia.[65]

A common sequence of fatal events occurred following 24 to 48 hours of septic shock. Signs of pulmonary consolidation and cyanosis refractory to volume control and ventilation developed. Death *always* ensued within 24 hours. Autopsy demonstrated severe bilateral pulmonary hemorrhage. Supportive measures consisted of hemodialysis or peritoneal dialysis, assisted ventilation, the use of modern blood bank and laboratory facilities, and a wide range of drugs. Despite this armamentarium, uncontrolled sepsis resulted in an inordinate mortality. Avoidable contributing factors were inadequate drainage of contaminated wound areas, failure to explore when intraabdominal infection was suspected, placement of colostomy sites near the incisions and drains, prolonged use and poor local care of venous plastic cannulae, and the improper use and management of indwelling urethral catheters. Drs Knepshield and Stone believed that meticulous attention to the prevention of infection would have undoubtedly resulted in a reduction of mortality. In general, patients with adequate hydration with a creatinine level over 4.0 mg/dL were thought to be in probable renal failure. It was emphasized that a common pitfall was the failure to recognize patients who were in high-output renal failure if those patients had urine volumes over 1,000 mL/24 h. This nonoliguric form of renal failure was most frequently observed after trauma, was invariably associated with areas of tissue necrosis and infection, and was often due to an unrecognized or inadequately drained abscess.[65]

NONTRAUMATIC CONDITIONS

Hepatitis

The forms of hepatitis recognized during the Vietnam War were Type A, Type B, and an evolving category sometimes called Type C or Type D.[68(p420)] Hepatitis—in the broad sense of the word—ranked next to malaria as a cause of noneffectiveness requiring hospitalization for medical disease in Vietnam in 1970. The average length of hospital stay was approximately 20 days for these patients. Many cases could be traced to the consumption of nonpotable water and ice. The possibility of hepatitis was always present in patients treated by urologists and other surgeons, particularly when the patients had fever and jaundice. Sepsis was certainly a common cause of these 2 symptoms and signs, and many patients seen in the evacuation hospitals in Japan and elsewhere had this clinical picture. Many had had numerous transfusions, and the possibility of transfusion-acquired hepatitis was always present.

PT was useful as a screening test in the early course of hepatitis and in an effort to separate out those patients who might have a fulminant course. Amoebic and hemolytic diseases had to be ruled out. Gamma globulin prophylaxis was not used routinely by 1970 except in certain high-risk groups including Special Forces personnel, as gamma globulin was not readily available. Gamma globulin was not given routinely to patients receiving multiple transfusions.[69]

Parasitic Infections

Parasitic infections were extremely common in Southeast Asia. Careful examination of warm stool specimens in individuals suspected of these problems usually resulted in a high yield of positive findings. The genus *Ascaris*, or roundworm, is worldwide in distribution and is capable of producing intestinal obstruction and digestive disorders. Most of the Vietnamese that one of us (JWW) operated on in whom intestinal injury had occurred were found to have large numbers of these parasites (Figure 1-14). Ascariasis was treated with a single dose of Antipar (a piperazine salt), 150 mg/kg.[70]

Fig. 1-14. Roundworms of the genus *Ascaris* that were removed from a Vietnamese patient with intestinal and renal wounds.

Nonoliguric Renal Failure

Medical causes of nonoliguric renal failure included hemoglobinuria as in blackwater fever, glucose-6-phosphate dehydrogenase deficiency, and nephrotoxic drugs such as Coly-Mycin (colystimethate sodium; Parke-Davis, Morris Plains, NJ), neomycin, kanamycin sulfate, gentamicin; and C-4 plas-

tic explosives. A dilemma in the evaluation of oliguria was that of distinguishing prerenal from renal failure. Postrenal failure was very unusual in the young population of US troops and could ordinarily be excluded unless there was a question of trauma with inadvertent surgical ligation of both ureters. It was noted that prerenal causes could ordinarily be diagnosed with a therapeutic trial of fluids and mannitol. Patients in prerenal failure usually had urine sodium concentrations lower than 10 mg/dL, very concentrated urine with a high urine urea:plasma urea ratio of over 20:1, and a high concentration of creatinine—a ratio of urinary to plasma urea higher than 70:1. In the normal patient, urine osmolality was high, usually over 600 mg/dL. In true renal failure, the kidney was noted to have tubular damage and the tubular cells could not conserve sodium or concentrate urine. The urine sodium was usually high, over 20 mg/dL, and the urine urea:plasma urea ratio low, less than 10. The ratio of urinary to plasma creatinine was low, less than 30. Urine osmolality was also low, in the range of 300 to 400 mg/dL.[66,67]

The importance of fluid and protein restriction in the treatment of acute renal failure was noted, as was the fact that hyperkalemia was the most immediate threat to life in these patients. Sources of potassium toxicity included dietary protein, salt substitutes, hemolysis of banked blood, rhabdomyolysis associated with injured muscle, and potassium penicillin (1.5 mEq/10^6 U). Hyperkalemia was treated by the immediate infusion of 2 ampules of sodium bicarbonate (88 mEq), 2 ampules of calcium gluconate 10% (20 mL), 50 g of 50% glucose (100 mL), and a 50-g Kayexalate (sodium polystyrene sulfonate; Sanofi Winthrop Pharmaceuticals, New York, NY) enema (200 mL), if available. Hyperkalemia was the most common cause of death in patients who died en route to the Renal Unit in Saigon. It was thought that the above regimen should be been given to all patients transferred to that unit regardless of their serum potassium values. If renal failure was severe enough to alter drug dosage, the patient was transferred to the Renal Unit.[66,67]

Digitalis was ineffective in improving the pulmonary edema fluid overload in patients who were oliguric and could result in arrhythmias if the electrolytes were altered during dialysis. Early referral of patients in renal failure to the artificial kidney team was a vital factor in their survival (Figure 1-15).[66,67]

Other Medical Problems

Urinary tract calculi were a common problem in Vietnam. This was discussed by Captain Neel R. Scott, Medical Corps, Captain Gary Ardison, Medical Corps, and Lieutenant Colonel Ralph F. Well, Medical Corps, from the

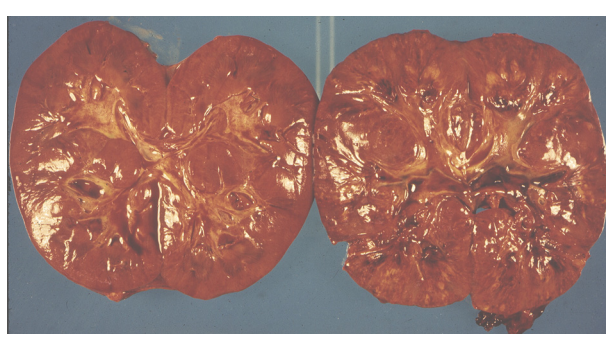

Fig. 1-15. Fatal acute papillary necrosis in a patient with sepsis.

568th Medical Company, December 1967.[71] Urinary tract calculi are further discussed in detail in Chapter 12, Nontraumatic Urological Conditions.

Urologists were often faced with the management of febrile patients who had coexistent medical diseases and other nonurological problems. It was often a difficult decision to determine whether fever was due to a possible abscess for which surgical exploration should be done, or whether it was due to diseases such as malaria or scrub typhus. The problem of malaria, which was a leading cause of troop ineffectiveness in Vietnam,[22–30] was addressed by Lieutenant Colonel Raymond W. Blohm, Jr,[25] and is discussed later in this textbook (Chapter 12, Nontraumatic Urological Conditions).

Urologists managed patients with amoebic problems, which manifested as liver abscesses and/or amoebic dysentery. This problem was addressed by Lieutenant Colonel Thomas W. Sheehy, Medical Corps, Medical Consultant, in March 1966, and was also discussed by Captain John E. Rosenblatt, Medical Corps, in October 1968. Amoebic infection of the liver could produce a spectrum of pathology ranging from diffuse hepatitis to localized abscess formation. Isotope scanning and needle aspiration were not commonly done in these patients. Drs Sheehy and Rosenblatt also discussed treatment.[72–74]

CONCLUSION

The succeeding chapters in this volume are devoted to separate analyses of the 692 wounds and injuries of each different organ system of the genitourinary tract. The injuries were inflicted and received their initial treatment in RVN; subsequently, they were managed by us (JNW and JWW), primarily at USAHCZ. Urologists in Japan were concerned with treating the early and intermediate phases of these wounds and injuries, and accordingly had the opportunity to assess the efficacy of the initial treatment in RVN (presence or absence of complications) and to gain valuable experience in the management of these injuries and complications. This experience permitted us to make specific recommendations with confidence regarding initial therapy of certain types of wounds. In general, each chapter includes genitourinary organ wound statistics from RVN compared with those from with past wars; specific wound analysis from RVN; the initial treatment in RVN; our Japan experience with complications, management, and outcomes; illustrative case studies; recommended evaluation and management of genitourinary organ-specific traumatic injury; and a contemporary review of current preferred diagnoses and management in relation to battlefield injuries.

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