

# BRITISH SURGICAL AID TO JORDAN

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## Summary

THE SURGICAL COMMITMENT of No. 2 Field Hospital, R.A.M.C., during its stay in Jordan is presented. The majority of patients that were admitted had sustained war wounds, many of which were infected due to the delay in treatment. The difficulties encountered in their subsequent management are discussed. Special reference is made to the use of ketamine (Ketalar) and mafenide acetate (Sulphamylon) in the treatment of those burns cases under our care. It is the first time for many years that a British field hospital has been employed in an active rôle.

## Introduction

THE PARTITIONING OF Palestine, the 'Six-Day War' and the repeated fighting between Arab and Israeli has resulted in a movement of the Arab population out of Palestine and Israel into the neighbouring countries. Jordan inherited a problem in the form of over half a million refugees. Some were absorbed into the Jordanian economy, but many could not be, or did not wish to be, part of Jordan, still considering Palestine to be their homeland.

In June 1970 conflict erupted between the Palestine Liberation Army, a collection of irregular troops composed chiefly of young Arab boys from refugee camps, and the regular forces of the Crown—the Jordanian Army. A cease-fire was rapidly negotiated, only for the situation to reach boiling point again on 17th September 1970. Fighting broke out, especially in Jordan's capital, Amman. Casualties rapidly increased and on 19th September King Hussein made an appeal to the British, French and American Governments for medical aid 'to cope with a catastrophe comparable to the after-effects of an earthquake'. The estimated casualties were placed at five thousand. All hospitals were stated to be already crammed and many wounded were said to be lying in the streets.

## Mobilization

At the request of the Jordanian Government a composite medical team, code-named 'Ferrie Force', was despatched from U.K. to Cyprus on 21st September 1970. It consisted of a 50-bedded element of No. 2 Field Hospital, the 50th Field Surgical Team, Hygiene, Field Ambulance and Signals detachments. This force, with all its equipment,

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was air portable and reached Cyprus within 48 hours of the request for help. The element when it moved was to be entirely self-supporting with re-supply from Cyprus. The force was ready to move into Jordan on 22nd September 1970, but attempts to enter the country quickly were frustrated. It had been decided that all international aid would be concentrated under the auspices of the International Red Cross. For various reasons, not the least of which was the presence of hostages taken from three hi-jacked aircraft, the relief force was delayed in Cyprus for one week.

### **Situation in Amman**

The British Field Hospital arrived in Amman on 30th September 1970. All the existing government and private hospitals were crammed full of patients and were working under considerable difficulties due to failure in electricity and water supplies. The main 500-bedded Government Hospital in Amman was badly damaged and virtually untenable. Medical teams came from many European and Middle East countries, but the largest contributions were the hospitals supplied by the military forces of America, Britain and France.

The British Hospital was fortunate in having as their location the structurally complete, but as yet unfinished, King Hussein Hospital in Wadi Sir, some 10 miles from the centre of Amman. Electric light and drinking water were not immediately available, but these commodities were supplied by our own generators and water tanks that we had brought with us.

### **Types of patients admitted**

The British Hospital opened within 24 hours of arrival in Jordan. It would have been possible to begin surgery earlier than this, but the known state of casualties, the lack of sleep and the chaos that would have ensued did not warrant a more premature start. It was noticeable that those hospitals which concentrated on a more rapid start after arrival in Jordan suffered from cluttered corridors, due to packing cases and wood shavings, which further added to already chaotic conditions.

Ninety-four patients were admitted to No. 2 Field Hospital, which included one readmission and one birth. There were 90 surgical cases, 60 of whom had sustained war injuries, inflicted in the majority of cases 5 to 10 days previously. Table I lists the type of injury.

There were 29 multiple injuries including burns. Thirty-two children aged under 14 were admitted. This high number of children was at our own request and did not reflect the incidence of war injury in this section of the population.

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TABLE I

NUMBER AND NATURE OF ADMISSIONS TO NO. 2 FIELD HOSPITAL, R.A.M.C.

Total admissions	94
No. of children aged 14 and under	32
Readmission	1
Birth	1

Type of injury	No. of patients
War wounds: Gunshot wounds, mine, shrapnel	60*
Burns	10*
Other injuries/disease (medical—3)	22*

\*Of these 92 cases 29 had multiple injuries.

Thirty-two patients were admitted on the first day. Most of these cases came from the Jordanian Army Medical Services Reception Centres, which contained beds and nursing staff but no surgical facilities. During the first week to 10 days we received patients who were transferred from other medical teams and admitted several patients direct from their homes. Emergency admissions to our hospital were largely the result of fresh mine injuries, accidental weapon discharges and patients who had been involved in road traffic accidents.

Three medical cases were admitted: myocardial infarction, bilateral lower limb oedema due to inferior vena cava obstruction, and an undiagnosed gross hepatomegaly in a child. One baby was born.

**Limb injuries**

The majority of patients that were admitted had sustained severe limb injuries. There was a total of 65 such injuries, 55 of which followed war trauma. Forty-six were associated with fractures, nearly all major in type (Table II). This high number of fractures reflected the type of case that was transferred to our hospital.

TABLE II

LIMB INJURIES EXCLUDING BURNS

Site	Total	War trauma
Upper limb—soft tissue only	6	6
Fractures—humerus	7	6
Fractures—radius/ulnar	9	5
Hand injuries	8	8
Traumatic upper limb amputations	2	2
Lower limb—soft tissue only	13	12
Fractures—femur	8	5
Fractures—tibia	7	6
Foot injuries	4	4
Traumatic lower limb amputations	1	1
Total	<u>65</u>	<u>55</u>

Many of these wounds were sustained 5 to 10 days before admission and had had either no or minimal treatment. Because of this delay in treatment many of them were grossly infected. The major problem was therefore the management of a severely infected gunshot wound associated with gross comminution of bone, a situation perhaps not very far removed from that seen in some of the Base Hospitals during the Second World War. Soon after commencing surgery on these wounds it became apparent that there was hidden dead tissue and foreign matter in their depths. A fairly extensive debridement was therefore required. This was not made any the easier in the older wounds as the repair processes of the body were already under way, making identification of the neurovascular bundles that much more difficult. The care of the associated fractures demands special mention. No bone, however comminuted, was removed, with the exception of the smallest completely denuded pieces. The presence of multiple bone fragments and gross infection in no way altered the surgical principle that segments of a long bone should be left in their anatomical position if at all possible.

Wound closure by delayed primary suture was possible in some of the limb wounds that had received early adequate debridement. Owing to the presence of infection, the majority of wounds were only closed after several wound toilets. It was frequently not until two or three weeks after admission to hospital that wound closure could be contemplated. It was usually effected by the application of split skin grafts, as at this late stage closure of the wound by undermining the skin edges was not possible. Wound closure by primary suture was reserved for those hand injuries received within eight hours of injury.

A Field Hospital does not carry the necessary facilities for bacteriological study. Penicillin was the only antibiotic immediately available in any quantity. All patients received this. Following re-supply from Cyprus, streptomycin was added. Resistance was suspected, however, and it was decided empirically to give Ampicillin to all traumatic cases after the completion of a seven-day course of streptomycin and penicillin. Later, culture of the infection and assessment of the antibiotic sensitivity of the organisms isolated was provided by the Jordanian Army Base Hospital Pathology Laboratory. This showed the main organisms involved were *Escherichia coli*, *Bacillus proteus*, coagulase positive Staphylococcus and *Pseudomonas pyocyaneus* which proved to be virtually resistant to all the antibiotics. Pus swabs were later sent to the Bacteriological Dept. at the Queen Alexandra Military Hospital, Millbank, and this showed that, although the organisms isolated were the same, the sensitivity pattern was not quite so bad (Table III).

All cases associated with a fractured femur were treated by skeletal traction. The traction frames were made by the hospital carpenter from spare wood lying about the unfinished part of the hospital.

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TABLE III

SENSITIVITY PATTERN OF ORGANISMS ISOLATED FROM THE WOUND SWABS  
EXAMINED AT THE QUEEN ALEXANDRA MILITARY HOSPITAL, MILLBANK

<i>Organisms isolated</i>	<i>No. of cases</i>	<i>Organism sensitive to</i>
<i>E. coli.</i>	8	Gentamycin, Carbenicillin and Ampicillin
<i>B. proteus</i>	3	Carbenicillin only
<i>Ps. pyocyaneus</i>	5	Gentamycin and Carbenicillin

Three traumatic amputations, two through the humerus and one through the mid-femoral shaft, and two major peripheral vessel injuries were admitted.

The following cases illustrate the type of injuries seen in this group of patients.

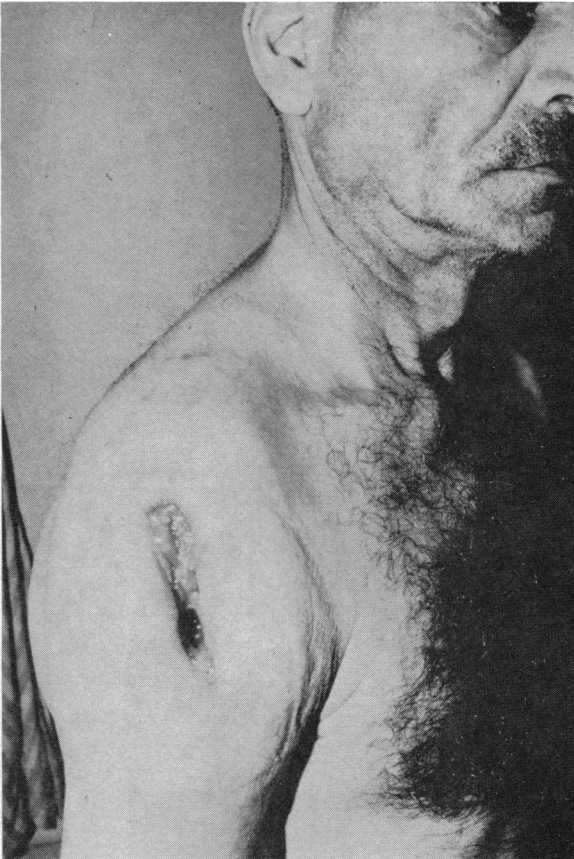


Fig. 2: case no. 39. The same wound three weeks after debridement and excision of the head of the humerus healing by secondary intention.





Fig. 1: case no. 39. An infected gun-shot wound of the right shoulder joint with a necrotic head of humerus lying in the depths.

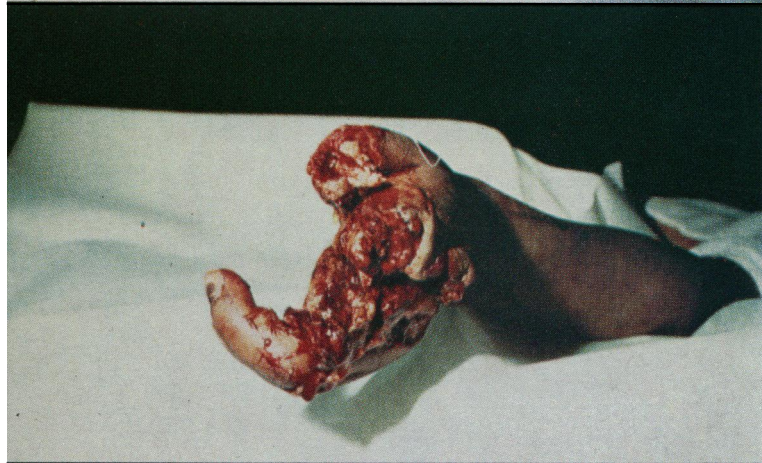


Fig. 3: case no. 70. The right hand of a boy aged nine following the detonation of a home-made bomb.



Fig. 4: case no. 70. The patient's hand two weeks after debridement and primary suture.

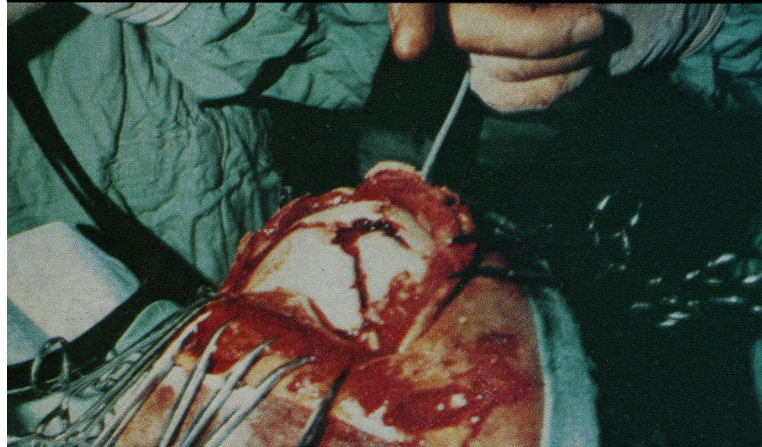


Fig. 8: case no. 67. The compound depressed parietal skull fracture in a boy aged six, who had received multiple injuries following a road traffic accident.



Fig. 11: case no. 31. Phosphorus burns in an 11-year-old child showing the heaped-up eschars due to the plasma loss associated with this type of burn.



Fig. 12: case no. 31. The same burnt child as in Fig. 11, seen here in a trance-like state under the influence of Ketalar whilst undergoing a change of dressing before re-application of the bacteriocidal cream Sulphamylon.



Fig. 13: case no. 54. A child aged seven undergoing burns toilet and escharectomy in a bath under the influence of Ketalar prior to the application of Sulphamylon cream.

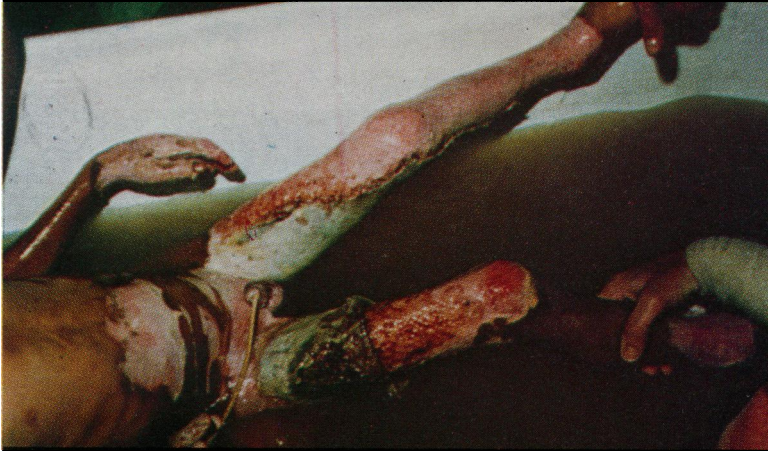
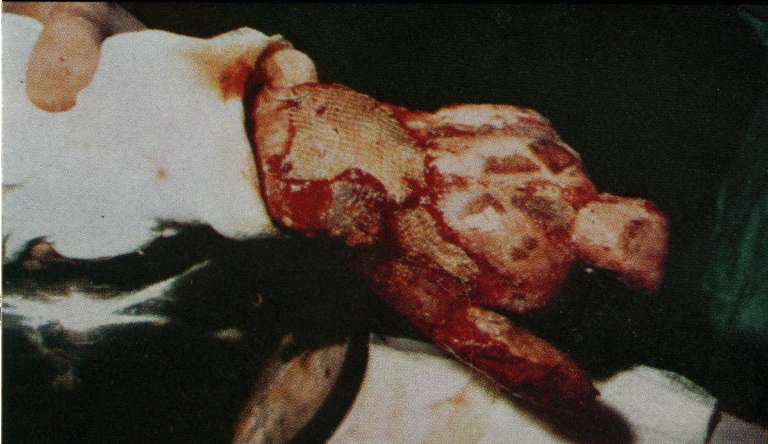


Fig. 14: case no. 56. Reconstruction of a crippled burnt hand after filleting the fingers using their intact palmar skin to provide skin cover.



**Case reports**

**Case No. 39:** A man of 56 had sustained a gunshot wound of the right shoulder joint three weeks prior to our arrival in Jordan. He had received virtually no treatment. A large exit wound was present (Fig. 1) with a necrotic head of humerus lying in a sea of pus. At debridement the head of humerus was dead and completely detached. It was therefore removed. This had the advantage of allowing a thorough exploration of this wound, as well as providing good drainage of pus. The wound was left open and irrigated daily with 5% Hibitane. Closure of the wound by secondary suture was not possible due to the presence of infection. Healing occurred by secondary intention within four weeks without any further surgery (Fig. 2).

**Case No. 70:** A boy aged 9 was playing with a home-made bomb which he was holding in his hand when it accidentally exploded. This patient was admitted within two hours of injury. The boy had sustained traumatic amputations of the thumb, index and middle fingers (Fig. 3). Wound toilet and primary suture were performed. Primary healing was obtained in 10 days allowing early physiotherapy, essential in this type of injury (Fig. 4).

**Case No. 12:** A man of 21 had sustained a high velocity missile injury to the left femur five days previously. A wound toilet had been performed in

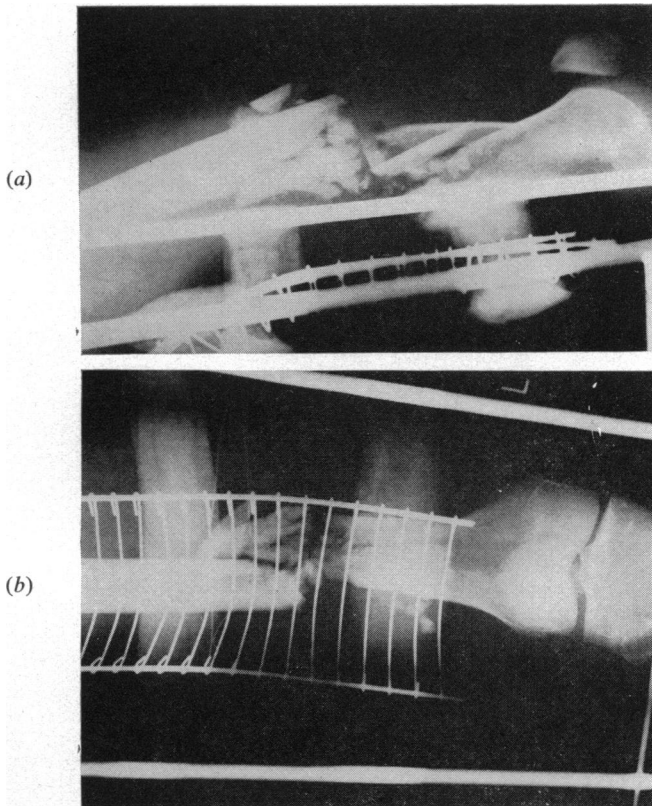


Fig. 5: case no. 12. The X-ray of a shattered right femur in a man aged 21, illustrating the classical comminution of bone that follows a high velocity missile injury.



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another hospital. On admission a further wound toilet was necessary, followed by skin closure five days later. A radiograph of his femur (Fig. 5) demonstrates the shattering of bone typical of a high velocity missile injury. Alignment of bone fragments was obtained by fixed skeletal traction in a Thomas splint.

**Case No. 38:** A child of 7 sustained a missile injury to the right thigh 12 days before admission to our hospital. He had already been cared for at a reception centre but had not undergone any definitive surgery. X-ray demonstrated a severely comminuted fracture of the right femur with loss of bone (Fig. 6). The wound was grossly infected. Wound culture demonstrated the

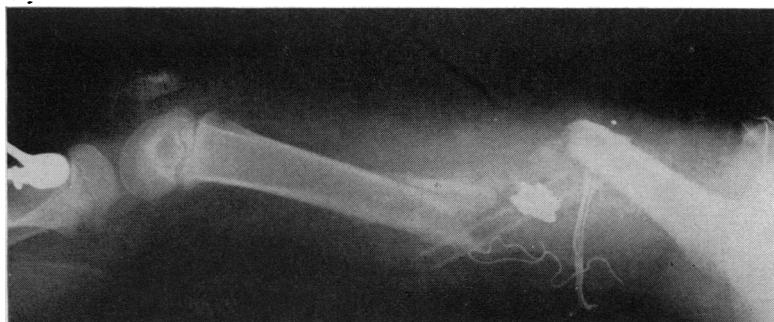


Fig. 6: case no. 38. The femur of a child aged seven following a gun-shot wound. Early callus formation is seen bridging the gap.

presence of *E. coli* and *Pseudomonas pyocyaneus*. Debridement was performed. The large metal fragment was removed at a subsequent toilet. Not until 17 days after admission was the large granulating exit wound ready for skin grafting (Fig. 7).

Subsequently new callus formed rapidly, and when the time came for the team to leave Jordan healing was progressing satisfactorily.

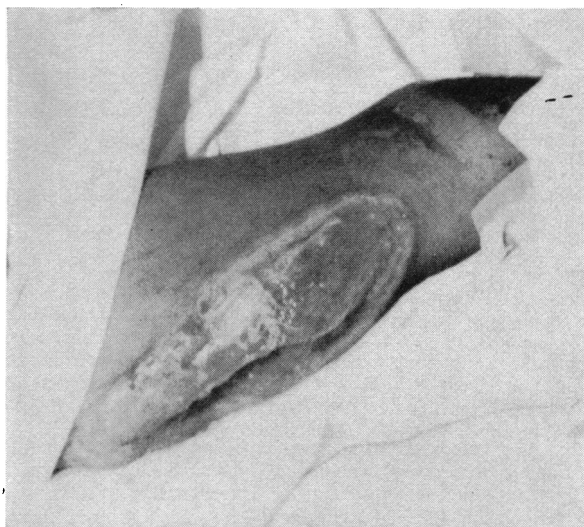


Fig. 7: case no. 38. The large granulating exit wound, associated with the fractured femur seen in Fig. 5, now ready for closure by skin grafting.

### Head and trunk injuries

Forty-three head and trunk injuries were admitted, war trauma accounting for 33 of these (Table IV). Seven head injuries were cared for; the three major cases all followed road traffic accidents, a common cause of trauma in view of the condition of the barricaded roads.

The hospital was fortunate in having a trainee eye specialist on its staff. The majority of the 12 eye injuries were associated with a retained intraocular foreign body, usually shrapnel. Only very limited eye surgery was available elsewhere in Jordan.

Eighteen wounds of the trunk were admitted, all followed war trauma. In this group there were two penetrating wounds of the chest and six of the abdomen. There were no facilities in the Field Hospital for the estimation of serum electrolytes, making especially difficult the management of those abdominal injuries that were transferred from other units to our hospital for further treatment.

TABLE IV  
DETAILS OF HEAD AND TRUNK INJURIES

<i>Site</i>	<i>Total</i>	<i>War casualties</i>
Head: Major ... ..	3	0
Minor ... ..	4	2
Neck: Soft tissue ... ..	2	1
Eye ... ..	12	9
Trunk: Soft tissue (including minor fractures of thorax)	10	10
Penetrating chest wounds ... ..	2	2
Penetrating abdominal wounds ... ..	6	6
Spine: Cervical ... ..	2	1
Thoracic ... ..	2	2
Lumbar ... ..	0	0
Total ... ..	<u>43</u>	<u>33</u>

Four spinal injuries were admitted, two following missile wounds, one of which had already undergone exploration in another hospital. All these cases had neurological involvement, three with paraplegia, and one with quadraplegia.

The following case histories illustrate the type of injuries seen in this group.

#### Case reports

**Case No. 67:** A boy aged six was admitted half an hour after injury, having sustained severe descalping injuries, a compound fracture of the right parietal bone, closed fracture of the right humerus, radius and ulna, and open fracture of the left radius and ulna. He was unconscious. At wound toilet the depressed parietal fracture was elevated (Fig. 8). The dura was inspected and found to be torn. He was also bleeding from the middle meningeal vein, difficult to control without diathermy. Haemastasis was eventually achieved using sterspon. It took five or six days for him to return to any sort of conscious level, after which he became extremely restless and had difficulty in identifying his environment especially with splinted upper limbs. He was still in this state when the unit left Jordan.

**Case No. 58:** A man of 50 was admitted with a suspected head injury following a road traffic accident. He was unconscious. There was no scalp

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bruising or fracture. Signs of intracranial tension developed three hours after injury. Burr holes demonstrated a massive intracerebral haemorrhage with pulped brain. During the operation all the lights went out due to a power failure. This did not facilitate this type of surgery already being performed under difficult conditions. A tracheostomy was performed next day. The patient died three days later. It seems likely that the intracerebral haemorrhage precipitated the traffic accident.

**Case No. 28:** A man of 18 sustained a through-and-through gunshot wound of the right upper chest. He was admitted four hours after injury in a shocked state, dyspnoeic and with a flapping segment of the right upper chest. The wounds were debrided and one intercostal drain was inserted, but three to four hours later he developed severe surgical emphysema necessitating a second chest drain and tracheostomy. He made a satisfactory recovery. Both chest drains were removed 72 hours after injury and the tracheostomy tube removed at one week.

**Case No. 11:** A boy of 14 received a missile injury 10 days before with an entry wound in the left supraclavicular fossa. He had had no medical treatment. On examination he was found to have a left brachial plexus nerve lesion and an absent radial pulse. X-ray demonstrated a missile lodged in the posterior mediastinum (Fig. 9) and what was thought to be an aneurysm on the left subclavian artery. At this late stage no wound toilet was performed. He was placed on large doses of antibiotics. After two or three days the left arm

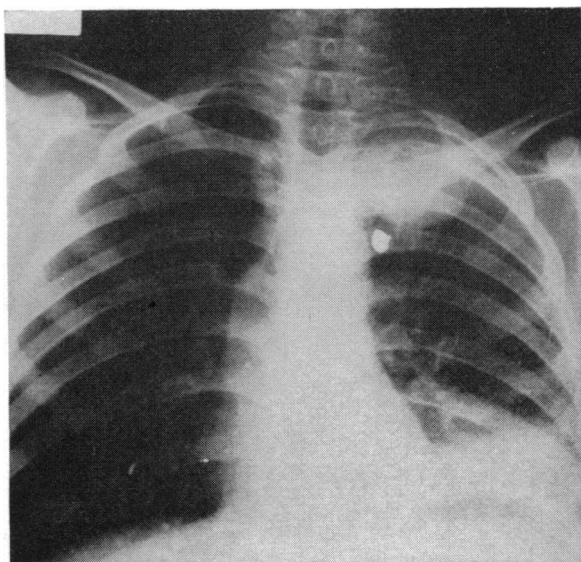


Fig. 9: case no. 11. The chest X-ray of a boy aged 14 following a missile injury to the superior mediastinum. The retained missile and the pulmonary shadow consistent with a left subclavian aneurysm are demonstrated.

became hyperaesthetic. There was no evidence of an increase in the size of the subclavian aneurysm radiologically. It was thought that the hyperaesthesia was associated with peripheral nerve recovery as movement returned to his forearm and fingers three weeks later. The radial pulse never returned. The last check X-ray showed almost complete resolution of the pulmonary shadow.

**Case No. 27:** A boy of 13 received shrapnel wounds to the front of his lower abdomen and legs following a mine explosion. He underwent emergency

laparotomy at another hospital, at which a small segment of jejunum was resected. He was transferred to our hospital two days later.

Examination revealed a very ill looking boy with multiple small puncture wounds of the lower abdominal wall, which itself was oedematous, a large swollen scrotum and multiple injuries to his lower limbs. There was a dependent oedema of the left side of the axilla and thorax. He had not passed urine for 48 hours. It was not possible clinically to determine the exact state of his urethra or bladder in view of the swollen abdomen and scrotum. A cystogram, using a portable MX2 machine, demonstrated an obvious lesion at the base of the bladder with extra-vesical escape of urine (Fig. 10). Operation was immediately undertaken, two holes in the bladder wall were repaired and the bladder was

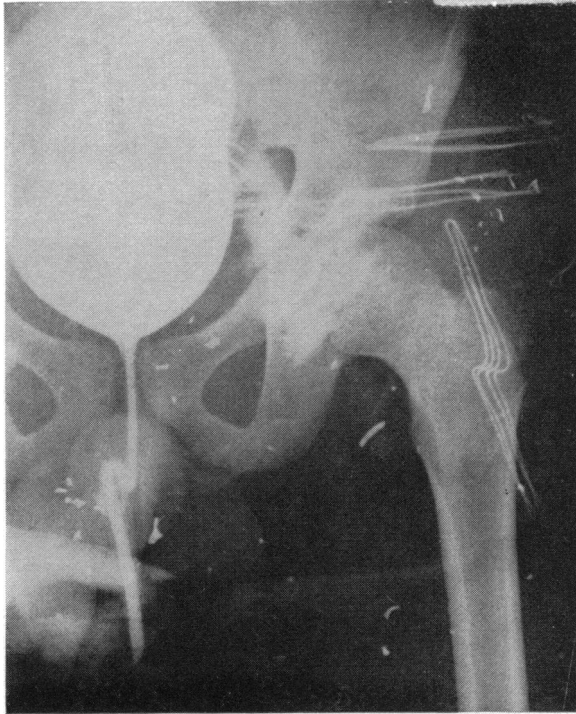


Fig. 10: case no. 27. The cystogram of a boy aged thirteen who had received multiple shrapnel wounds to the abdomen and lower limb demonstrating extravasical escape of urine.

drained both suprapubically and *per urethram*. The retrovesical space was also drained. Two days later he developed small intestinal obstruction which failed to settle on routine treatment, and at laparotomy adhesions were found. After a fairly stormy post-operative course he made a satisfactory recovery.

**Case No. 74:** A woman of 20 received a gunshot wound to the back with the site of entry at the level of T.10 vertebra, damaging her spinal cord and rendering her paraplegic. The exit wound was in the right loin, the missile having traversed the right kidney. She had undergone laminectomy and exploration of the loin wound in another hospital and was transferred to our unit one week after injury. As an added complication she was 39 weeks pregnant. Both spine



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and loin wounds were septic and there was haemorrhage from the latter. Wound toilet was performed.

Blood and urine continued to escape from the loin wound and therefore an intravenous pyelogram was performed to assess the state of her left kidney should nephrectomy on the right become necessary. This demonstrated adequate function on the left. Dye was also seen to be passing down the right ureter. Two days later she was delivered of a normal infant after a labour lasting 20 minutes.

After this she developed peripheral oedema as a result of hypoproteinaemia secondary to protein loss. Her poor nutritional state and electrolyte disturbance aggravated the condition. Replacement therapy with intravenous albumin and electrolytes was quite successful, but she went on to develop a left and right spontaneous pneumothorax necessitating bilateral chest tube drainage and a tracheostomy. She was transferred to the Jordanian Army Base Hospital at the end of our stay. They were able to remove both chest drainage and tracheostomy tubes but she died one week later from pneumonia.

**Case No. 79:** A young boy aged seven whose history on admission recorded that he fell down in the street and would not get up again. X-ray revealed a bullet lodged in the liver, having traversed the 10th thoracic vertebra before coming to rest. Laminectomy in our hospital showed that the spinal cord was damaged beyond repair. Laparotomy was not required, as there was no evidence of haemoperitoneum.

**Burns**

TABLE V  
DETAILS OF THE BURNS CASES

<i>Case No.</i>	<i>Age</i>	<i>% Burns</i>	<i>Agent</i>
17	25	7	Petrol—Thermal
22	24	4	Petrol—Thermal
31	11	30	Phosphorus
52	10	3	Phosphorus
54	7	34	Phosphorus
56	26	30	Petrol—Thermal
57	14	12	Petrol—Thermal
71	30	70	Petrol—Thermal
88	20	8	Hot water
89	3	2	Hot fat

Ten burns cases were admitted, four of whom had skin loss of over 20%. Petrol and phosphorus were the causative agents of the more severe burns (Table V). Some of these cases were burnt five to ten days previously and had had no treatment, as a result of which they were very infected when first seen. Many had large caked-up eschars due to the great plasma loss associated with a phosphorus burn, under which pus was trapped. Sodium bicarbonate was used in the primary toilet of two of our burns cases, but it is doubtful if at this late stage there were any phosphorus particles remaining.

As with the gunshot wounds the great problem with these cases was the control of infection prior to skin grafting. To assist removal of the eschars and debridement these patients were placed in a bath of diluted

hibitane each day for about an hour. The water was agitated by the nursing staff. The patients only tolerated this treatment under the influence of the drug Ketalar (ketamine), which was found to be most valuable as it produced a form of 'dissociative anaesthesia' with a reasonable degree of analgesia. Most the burns cases requiring immersion treatment were young children, who found the procedure both frightening and painful, particularly when attempts were made to manipulate their limbs and bathe off the eschars. Using an intramuscular dose of Ketalar, 10 mg./kilo of body weight, the patients were able to undergo the treatment for 30–50 minutes before showing signs of discomfort.

Following the bath 10% Sulphamylon (mafenide acetate) cream was smeared on to both the eschars and the raw areas. The cream is of a buttery consistency, and the term 'buttering the patient' describes its application. The layer of cream was covered with one thickness of gauze and the patient laid between clean sheets. Daily bathing and application of Sulphamylon was continued both before and after the eschars had separated. The burnt areas were usually ready for skin grafting some five days later.

The grafted areas in the majority of cases were left exposed. Mosquito nets were used to cover these patients to prevent contamination from flies and to act as a deterrent to the numerous visitors which this type of patient seemed to attract. In spite of these efforts patient isolation proved difficult.

The results of treatment in the burns cases were very gratifying. At the end of our five-week stay in Jordan no further skin grafting was necessary. Unfortunately, however, one patient died.

#### Case reports

**Case No. 31:** A child aged 11 sustained phosphorus burns 10 days prior to hospital admission. There were full thickness burns affecting her face, anterior chest and both upper limbs and superficial burns affecting the face and hands. The caked-up eschars due to the great plasma loss associated with a phosphorus burn were well demonstrated in this case (Fig. 11). Split skin grafts had to be applied soon after admission to prevent contracture of her upper eyelids. Intramuscular Ketalar (ketamine) was used for the burns dressing; it placed the child in a trance-like state (Fig. 12) for about 20 minutes which allowed sufficient time for the procedure to be carried out.

**Case No. 54:** A child aged seven sustained phosphorus burns two days before admission to hospital. There were circumferential burns to both lower legs including the perineal and buttock areas, full thickness skin loss was present over most of this area. Intramuscular Ketalar was given to this case prior to daily bath toilet to remove the eschars (Fig. 13), followed by the application of Sulphamylon cream. The burnt areas were ready for skin grafting five days after the eschars had separated. Split skin was obtained from the back of the chest in this child after raising the skin from the rib cage with subcutaneous saline.

**Case No. 56:** A man aged 26 sustained 30% burns following a petrol fire one week prior to admission to our hospital. He had received adequate fluid replacement therapy in one of the Jordanian Medical Service reception centres. There was full thickness skin loss over his back and dorsal aspect of both hands,

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associated with charring and clawing of the fingers. All the burnt areas were septic. His hands presented one with a most difficult problem. Early escharotomy revealed a deep burn down to the dorsal aspect of the interphalangeal joints, all of which were contracted. Fortunately the thumb was spared. At a subsequent operation the fingers were filleted and the surviving palmar skin used to refashion the hand (Fig. 14) in the form of a pincer.

**Operations**

Two hundred and forty-four operations were performed in the theatre (Table VI). Fifty-three cases required wound debridement, the majority of which followed war trauma. Some of these had already received initial surgery in the Jordanian Hospitals. The nature of many of these wounds, however, was such that 77 cases required redressing or a re-toilet under a general anaesthetic before infection could be brought under control. In

TABLE VI  
NATURE OF OPERATIONS PERFORMED

<i>Type of operation</i>	<i>Number</i>
Wound debridement ... ..	53
Redressings, re-toilet, POP application ... ..	77
Delayed primary suture/2° suture ... ..	24
Skin grafting ... ..	48
Eye operations ... ..	14
Intracranial procedures ... ..	2
Caldwell Luc ... ..	1
Laminectomy ... ..	1
Tracheostomy ... ..	4
Intra-abdominal procedures ... ..	4
Internal fixation of fractures ... ..	2
Sequestrectomy for chronic non-traumatic osteomyelitis ... ..	3
Minor procedures ... ..	11
	<u>244</u>

24 cases wound closure by the accepted method of delayed primary suture or secondary suture was possible. Forty-eight cases, including the burns cases, required skin grafting to effect closure.

One hundred and twenty-five units of blood were used. It was stored in a 4 cubic foot conservatoire type loading cabinet with the thermostat suitably adjusted.

The hospital's equipment included a Portaclave capable of sterilizing all the necessary instruments and drapes. The water was heated either by electricity (6,000 watts), from our own power supply, or by a petrol burner. One hour was required to produce sufficient steam and pressure prior to autoclaving, thereafter each cycle took about 40 minutes. The electrical heating unit broke down after four weeks and the petrol burner was then used. The machine blew up three days before we left Jordan, due to a petrol leak. It was fortunate that before this incident the machine had been placed outside the building at the time of change-over from electric to petrol heating. Chemical sterilization was then used.

Disposable sterile paper drapes were used in the majority of surgical

operations, thus saving time and conserving water, both valuable commodities wasted when sluicing drapes.

### Mortality

Ten patients died, four of whom were over 70 years old. Three of these were moribund on admission. No child died (Table VII).

TABLE VII  
CAUSES OF DEATH

<i>Case No.</i>	<i>Age</i>	<i>Injury</i>	<i>Time interval between injury and death</i>
9	70+	Fracture C6 paraplegic	14 days
20	70	Fracture R. upper humerus	8 days
34	20	G.S.W. L. shoulder Acute R.V. failure	3 days
42	22	Intra-abdominal injury	13 days
58	51	Intracerebral haemorrhage	3 days
71	30	70% burns	2 days
74	20	G.S.W. abdomen and spine R. kidney injury and paraplegia	42 days
76	20	G.S.W. abdomen Major vessel injuries	6 hours
80	70+	G.S.W. hands	28 days
84	70+	Mid-thigh amputation	28 days

### Case reports

**Case No. 34:** A man of 20 had received a gunshot wound to the left shoulder and both thighs two days before admission. On admission he was found to be in acute right heart failure. There was no evidence of chest injury or cardiac tomponade. He died soon after admission.

**Case No. 42:** A girl of 22 had undergone a previous abdominal operation in another hospital following a gunshot wound. She was admitted to our hospital two weeks after injury in a moribund state with a large abdominal wall defect. No surgery could be contemplated. She died two days after admission.

**Case No. 76:** A man of 20 with a gunshot wound of the abdomen was admitted two hours after injury. The patient died on the operating table at laparotomy, exsanguinated from major vessel injuries.

### Discussion

The nature of the work undertaken by No. 2 Field Hospital R.A.M.C. was more akin to that seen in a Base Hospital rather than a Field Medical Unit. The surgical and nursing facilities that the hospital offered attracted the more severe gunshot wounds of the limbs associated with bone involvement, and the more severe burns. The minor soft-tissue through-and-through wounds and the superficial burns were cared for by the smaller medical units. There were no facilities for evacuation of the patients after initial surgery. All subsequent surgery and rehabilitation had therefore to be undertaken in the one hospital.

The work load was extremely heavy during the first four or five days,



especially as there were several evening and night emergencies. The presence of a second Field Surgical Team would have been most welcome, especially during this first week. The normally quoted figure of 12 to 16 cases per 24-hour period was achieved, but this could not be maintained for more than a few days if cover was required at all times for emergency admissions.

**Infection.** Many of the casualties had infected limb wounds containing organisms that were resistant to the more common antibiotics. It is interesting to speculate as to why a country like Jordan should have a problem of drug resistance. The finding that in Jordan even the most sophisticated antibiotics could be purchased over the counter without prescription, and that some of our patients had received antibiotics for too short a period or insufficient dosage prior to admission, might account for this resistance.

No cases of tetanus were seen among the casualties in our hospital or those of any of the other international hospitals operating in Jordan. The reason for this was not quite clear, since many of the casualties were late in receiving any definitive treatment and none of them had received either active immunization in the form of toxoid or any anti-tetanus serum.

The incidence of gas gangrene was not known as the majority of injuries were inflicted at least one week before the arrival of the international teams. Those suffering from gas gangrene, with its short incubation period of only up to two or three days, would have died before medical aid became available. Marka Military Hospital, which admitted casualties early in the conflict, reported no cases of gangrene. This would be in accordance with MacLennan's findings (1943) of the low incidence of gas gangrene in the North African campaign conducted in a similar type of terrain.

There will undoubtedly remain in Jordan the problem of chronic osteomyelitis. Although nearly all the compound bone injuries had stopped discharging pus at the end of our five-week stay, infection is sure to return to some of them from a flare-up of a latent focus.

**Rehabilitation.** There were no trained civilian physiotherapists available there. The subsequent rehabilitation of some of our patients who had sustained major fractures was therefore going to present a problem to the Jordanian Government. The British Hospital was fortunate in having access to a trained physiotherapist from Cyprus three days a week. Furthermore, there was no limb-fitting service available in the country, a facility that would have to be offered for subsequent rehabilitation.

**Wound closure in hand injuries.** If conditions are favourable, wounds of the hands should be treated by debridement and primary skin cover,

either by suture or graft (*Field Surgery Pocket Book*, 1962). In Jordan, with physiotherapy at a premium, it was essential to restore early function in the extremity in the shortest possible time. It is interesting to note that in Vietnam immediate skin closure is discouraged based on experiences during the war. Delayed primary closure is recommended at four to seven days if the wound then appears clinically to be clean (*War Surgery*, 1969).

Special problems were encountered during intracranial surgical procedures. The most difficult was one of haemostasis of bleeding dural vessels. Electrocoagulation, so necessary in this type of surgery, was not available to us. No diathermy machine was on the scale of equipment of a Field Hospital. Provision is now being considered.

**Ketalar.** Two hundred and thirty general anaesthetics were administered. Ketalar (ketamine) was given 51 times to 22 patients, some therefore received it two to three times. It was used as the sole anaesthetic agent on 33 occasions. In the majority of cases it was given by the intramuscular route, 10 mg./kg. body weight, occasionally supplemented by intravenous booster doses of 2-3 mg./kg. The absence of accessible veins in some of our burns cases made the intramuscular route more desirable. Atropine was used as the premedicant to all Ketalar anaesthetics, and this appeared to reduce salivation commonly produced by this agent.

One of the advantages of Ketalar (ketamine) is that patients under its influence retain their laryngeal reflexes. Respiratory exchange was adequate and they were able to maintain their own airway. This enabled the nursing staff to look after some of the patients, especially those undergoing burns treatment, without the constant supervision of the anaesthetist, thus freeing him for some more urgent task. Intubation is not necessary when using this agent, a procedure that can be very difficult in those patients with severe face and neck burns (Brown, Cole and Murray, 1970). Occasional limb movement occurred in some of the patients under the influence of Ketalar and in others their muscle tone was increased, not severe enough, however, to interfere with surgery. The undesirable post-operative sequelae associated with Ketalar were uncommon. Two patients suffered with severe vomiting and one, aged 11, became confused, and when fully recovered complained he had experienced bad dreams. Intravenous diazepam (Valium), dose 0.3-0.5 mg./kg. as reported by Knox, Bovill, Clarke and Dundee (1970) seemed to control these complications.

The average age of patients receiving Ketalar was 12 years. It was insisted that all patients recovering from the effects of this agent should be allowed to do so quietly and undisturbed, as recommended by the manufacturers (Gorringer, 1970). The low post-operative complication rate might be attributed to these factors.

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**Sulphamylon.** The use of Sulphamylon cream in our burns cases was not accompanied by burning pain as these patients remained under the influence of Ketalar during its application. Skin rashes, a known complication of the cream, were not specifically looked for. Sulphamylon application to large surface areas has been reported to cause a metabolic acidosis (Aaby, 1968), but provided the pulmonary buffering mechanism is not interfered with, a harmless tachypnoea results. Interference with this mechanism, the most common cause being bronchopneumonia, results in laboured respiration. In these cases the cream must be removed to prevent progressive uncompensated acidosis. Fortunately none of our cases clinically presented us with this problem. There were no facilities for the estimation of blood pH. It is reported from Vietnam that the mortality in patients with 50% or less total burns has been significantly reduced by the topical application of Sulphamylon (Aaby, 1968).

After the first few days of treating the burns cases by closed methods, it became apparent that if the infection was to be brought under control daily bathing and application of Sulphamylon cream was mandatory. Lowbury and Jackson (1970) showed the improvement in effectiveness of prophylaxis that resulted from more frequent change of dressings with the daily application of an anti-bacterial cream.

The Field Hospital treated 563 patients in its casualty department. Patients were only seen on a one-visit basis, there being no facilities or time for subsequent follow-up treatment.

With a few exceptions the equipment of the Field Hospital was perfectly adequate for the relief/disaster situation that was found in Jordan. Only a small quantity of additional stores had to be flown in from Cyprus to meet the extra requirements of the hospital. Re-supply from Cyprus was on alternate days. The freighting totalled 11,685 lb., and of this 3,000 lb. was oxygen.

The hospital was in Jordan for five weeks. Twenty-two casualties remained as in-patients in the very capable hands of a Finnish Surgical Team that took over the hospital the day before we left. It is many years since an element of a British Field Hospital was used to assist war-wounded. There can be no doubt that the relief operation, quite apart from its humanitarian aspect, provided valuable practicable experience in the surgical care of battle casualties.

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