Original Communications.

MEMORANDUM ON WAR SURGERY AT THE 53rd GENERAL HOSPITAL, SUDAN.
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Foreword.

Here is an article which cannot fail to be of interest to surgeons in particular, especially when it is appreciated that it is written by a young surgeon who worked alone in a somewhat isolated small base general hospital, the establishment of which carries but one surgical team. Major Stuppell, obviously, has had sound surgical training together with some experience in traumatic surgery as seen in civil practice and here you will find described in a frank and interesting manner his reactions to the problems connected with the treatment of the first battle casualties he had to deal with. His cases reached him four days after being wounded so that he could make little use of the many valuable communications to the medical press on the early treatment of wounds which have appeared since the war started and he had, rather, to work out his own lines in treatment. It is possible to follow his reasoning and to appreciate his reactions. Others who have had to face or may still face such problems will surely find this article useful and instructive.

A few passing comments may not be out of place and it is believed that such will in no way detract from the excellence and value of the memorandum.
It is noteworthy that in this series of 311 cases, 43 were complicated by fracture. This gives a percentage of 13.8, which is exactly the same figure as reported in an analysis of 200,000 wounds in the Great War.

The 53rd General Hospital was a long way behind the fighting line at that time and it is not surprising that no abdominal cases reached it; those which had not already succumbed were obviously retained in medical units nearer the line. The terrain over which the fighting was taking place at that time was an exceedingly difficult one but supplies of sulphonamide were available and it is a matter for surprise that it was not freely used as was the case in the Western Desert.

The points the writer makes on free drainage and adequate immobilization are worthy of note but surely as much credit, if not more, is due to Winnett Orr as to Trueta in this respect.

It is suggested that small repeated whole blood transfusions, rather than serum alone, would have been better for the anaemia which accompanies large weeping wounds.

X-ray Apparatus.—Supplies of apparatus are now available. The policy in this Command, and one based on the experience of many disappointing if not tragic results, has always been to discourage primary suture unless the case is dealt with really early and under suitable conditions.

Air replacement after aspiration of a hæmothorax. In my opinion 500 c.c. is rather a large amount.

D. C. MONRO, Colonel
(Consultant Surgeon, Middle East).

Our first battle casualties arrived on January 20, and we ceased working on April 8, so that our records cover a period of eleven weeks.

During that time 311 casualties were admitted and 285 operations were performed upon them.

It took approximately four days for casualties to reach us from the front line, at first through a C.C.S. and later through a General Hospital in addition.

The majority of wounds were due to splinters of metal in the lower limb followed, next in order of frequency, by similar wounds in the upper limb.

Wounds in the lower limb were complicated by a fracture of the femur in three cases; by fracture of the tibia and/or fibula in eight; by fracture of the bones of the foot in five and by a penetrating injury of the knee-joint in three.

Wounds of the upper limb were associated with fracture of the humerus in eight cases, of the radius and/or ulna in six and of the bones of the wrist and hand in seven.

The spinal cord was injured in three cases, the skull in six, large blood-vessels in two, important peripheral nerves in four, and the chest was perforated in seven cases. No perforating wound of the abdomen reached us.
Five deaths occurred. Two were in Italian Prisoners of War who were admitted in a condition of impending dissolution. One had been shot in the head and survived for only half an hour after admission. The other had an open pneumothorax and lived for two hours after admission. These cases may reasonably be excluded from our figures, producing a mortality rate of 1 per cent for all admissions. The three fatal cases will be described in detail in their respective sections later.

The first cases to arrive had been dressed and roughly splinted but no surgical treatment had been carried out. A large proportion of them had been given sulphonamide by mouth for periods varying from one to three days but we never received any patients whose wounds had been treated by local sulphonamide pack nor did I ever try this line of treatment myself.

Later in the campaign we began to receive cases which had had early excision of the wound but I cannot recall more than three or four who did not require further attention to the wound, such as débridement or excision of necrotic tissue.

Almost all the wounds, when we received them, were infected and the patients febrile on admission. Those who had fractures were in pain because of the incomplete immobilization of the bone fragments in inadequate splints in the early stages of the campaign but, later, cases began to arrive in plaster casts and these were strikingly free from discomfort.

When our first convoy arrived—it was in the evening—they were at once given pre-medication and taken to the theatre that night, so that the theatre staff worked during the whole of the night until the following morning.

I subsequently realized that this expedition was unnecessary and future cases were left for the night, with a sedative if necessary, and dealt with on the following morning.

As a matter of fact, most of the casualties were so tired and exhausted on admission after travelling for about four days that they fell asleep as soon as they were put to bed.

I can recall only one case which really needed immediate treatment on admission and that was a patient whose anterior tibial artery had been shot through and who began to bleed afresh.

We saw no case of gas gangrene or tetanus. Every wounded man on admission was given 3,000 units of A.T.S. if there was no record on his card of his having already received it.

II.

The wounds with which we had to deal fell into four groups:

1. Through and through bullet wounds with a small point of entry and exit—of the "leech bite" type.

2. Through and through splinter wounds with a small point of entry and a large ragged point of exit.

3. Perforating splinter wounds with a minute point of entry and a large lacerated cavity within the limb, out of all proportion to the size of the wound on the skin.
(4) Lacerated tangential wounds with considerable destruction of tissue.

In wounds of the first group, two possibilities might arise: (a) They might be practically sterile and heal almost by first intention with very little systemic disturbance or (b) the bullet track might be filled with blood-clot. In this event, if the blood was not evacuated early, after a few days the haematoma became infected and the wound painful with a general febrile reaction. In these cases it was sufficient to draw a piece of gauze through the track and so clear out the old blood clot. The wound then settled down and healed well.

The closed plaster method was almost universally employed for wounds of the limbs after a preliminary débridement.

In the early cases the wound was lightly packed with vaselined ribbon gauze which had been previously prepared and sterilized on the spools and, where there was a wound of entry and exit, a piece of gauze was pulled through from one wound to the other, with the idea of encouraging drainage to the surface.

The whole limb was then encased in an unpadded plaster cast.

In the case of the lower limb, the cast included the whole of the foot as far as the web of the toes on the dorsum and beyond the toes on the plantar aspect. If the plaster is not extended to these limits the limb is certain to develop oedema where it is not supported by the cast.

It was found that these cases did quite well for a while and then began to develop a low-grade pyrexia. Upon removing the plaster, the gauze packing was found to be acting as a plug and the wound was full of pent up pus. The temperature subsided when the packing was removed and a fresh plaster applied.

I then asked myself what purpose was served by the vaseline gauze packing and, as I could find no satisfactory answer, I no longer put gauze or any other foreign body into the wound but contented myself merely by covering the surface of the wound with a layer of sterile vaseline gauze to protect it from the plaster cast.

The original purpose of packing the wound with gauze was apparently to keep it open so that the skin would not unite before the base of the cavity was healed. But, in those wounds with which I had to deal, there was usually so much loss of skin that this possibility could not arise and, furthermore, the natural elasticity of the skin tended to keep the wound open rather than allow it to close too soon.

I never used antiseptics of any kind in the wound. Prior to excising and exploring the wound I shaved the skin around and painted it with iodine but, apart from that, I was guided by the principle enunciated as long ago as 1887 by Gamgee, who said that "the question is not one of antiseptics or no antiseptics but of the form and proportions in which they should be employed in particular conditions. The great antiseptic is Life. The living tissues have a natural preservative power which, if guarded and conserved by the surgeon on physiological principles, offers the surest guarantee
for healthy repair which is only an adaptation and extension of normal nutrition."

Apart from one fatal case, the post-mortem findings in which are recorded later, all the wounds did uniformly well.

Two cases, one a splinter wound of the buttock and the other a traversing wound of the thigh, I did not at first put into plaster but contented myself with débridement only, merely covering the wounds with a sterile dressing and a soft bandage.

In a couple of days there was a spreading infection into the cellular tissues underneath the skin. A plaster cast was applied, and in both cases the immobility of the tissues so produced brought about an immediate cessation of the inflammatory process and the condition rapidly subsided.

This completely confirmed the views of Trueta (1939) of the paramount importance of immobility in preventing the spread of bacteria along the lymphatic channels.

Foreign bodies, if they were readily accessible, were removed but, if they were difficult of access, they were left.

During the rush periods, some cases which had a small foreign body retained and a wound which was reasonably clean and small were left over. These nearly always developed infection later and had subsequently to be opened up and the foreign body removed.

I found that wounds that were thoroughly opened up and thus permitted free drainage, provided they were adequately immobilized, almost invariably progressed smoothly and healed with much greater rapidity than one is accustomed to expect, taking as the usual standard the rate of healing in non-immobilized tissues.

Not only did the wound heal more rapidly but the infection very quickly became localized, all signs of inflammation in the surrounding area subsided, and the oedema, redness and pain disappeared.

There was a profuse discharge of pus in all cases, the amount appearing to depend on the degree of infection which was present at the time of the débridement of the wound.

I always excised as freely as possible all necrotic and injured tissue but I did not spend an excessively prolonged time in attempting to remove every particle of infected material which in practice appears to be an unattainable ideal. I relied however upon free and adequate drainage.

If the temperature did not subside within three or four days or if, having subsided, it rose again, the plaster cast was removed and the source of the temperature elevation investigated.

It was usual to find that there was a pocket of pus present, where the infection had tracked up into one of the cellular spaces at the periphery of the wound, and this was dealt with by incising the overlying skin so that the pocket was laid open and thus provided with adequate facilities for free drainage. The plaster cast was then re-applied.

Occasionally the patient complained of burning pain under the plaster.
This was due to excoriation of the skin where there was a free flow of pus over it. It could in a large measure be prevented by smearing the skin with vaseline all around the wound before putting on the plaster.

In spite of adequate débridement the application of a closed plaster cast might occasionally fail to produce the usual fall of temperature and it was then necessary to review the case and consider the possible cause of the persistent pyrexia.

Patients who have been evacuated from tropical Africa frequently suffer from metazoal infections and these had to be excluded. But in my experience the most likely cause of the persistent pyrexia was wound infection. As a matter of practical politics it is sound policy to investigate this possibility first. Actually, I was never able to demonstrate malarial parasites in the blood of patients who had been wounded in Eritrea and who were admitted as battle casualties.

In our series of cases of gunshot wounds of the limbs there was one death. This man illustrated in a striking way the clinical features of such a case which proceeds to a fatal termination.

He was a German prisoner of war and had been hit in both legs by machine gun bullets which had tunnelled the shaft of the tibia on one side and scored the surface of the bone on the other.

The wounds of entry and exit were small and appeared comparatively clean. The skin edges were excised, a gauze wick introduced into the wounds for the purpose of drainage, and both limbs were encased in plaster.

He was febrile on admission and his temperature did not subside. Because of this, a week later, one of the plaster casts was removed and the wound inspected. The swelling of the limb had subsided and the wound looked reasonably clean. There was not a great discharge of pus. The plaster was re-applied.

He was given M & B 693 with no fall in his temperature; sulphanilamide was equally unsuccessful.

He subsequently developed septicæmia with the following clinical signs: persistent swinging temperature, variable pulse-rate within wide limits, a progressive anæmia, marked wasting, diarrhoea, an enlarged spleen and enlarged liver and signs of congestion at the base of the right lung.

In view of the comparatively trivial nature of his wounds, the profound systemic disturbance which he showed was considered as possibly due to a concomitant metazoal or other infection, and the following conditions were considered: malaria, amoebic dysentery with hepatitis, typhoid and finally septicæmia.

All the laboratory tests were negative. The enlarged liver with signs at the right base was suggestive of hepatitis but actually the chest signs were due to a septic infarct.

At post-mortem examination, the bullet wounds in the legs were seen to be in an unhealthy condition with no evidence of reaction. There was a localized osteitis around the track of the bullets. Unfortunately it was not possible to obtain a culture of the organisms present in the wounds.
One learnt the following lessons from this case:

1. In traversing wounds of the limbs it may be necessary to open up the whole of the track in order to provide adequate drainage.

2. If the temperature does not fall to normal within three or four days after the application of the plaster the latter must be removed and the condition of the wound investigated.

Normally, following débridement and the application of a plaster cast, the temperature rises to 102°F or 103°F Fahrenheit, but it quickly settles and should show no further rise.

It sometimes happens that a patient does not respond so well or so quickly as one would like. In this event, a blood-count is of paramount interest and significance.

Facilities for the identification of the infecting organism may not be readily available but an examination of the blood can usually be carried out without much difficulty.

A severely wounded man may not be bleeding when he arrives at the base hospital but one must not forget that he must, of necessity, have lost a considerable quantity of blood when he received his wound. The continued loss of serum from a large surface, as well as prolonged suppuration, even in the absence of hæmolytic organisms, invariably leads to a progressive anaemia, and it is most important to be on the watch for the suspicious pallor which these patients show.

A blood-count will throw a flood of light on the situation and will indicate the appropriate line of treatment.

We had one case, with a very extensive splinter wound of the buttock, which well illustrated these points.

The wound had been excised and encased in a plaster spica at the C.C.S. Owing to the extensive loss of skin over the buttock, a wide area of tissue was laid bare, and a seepage of blood-stained serum continued for several days. This ceased, and was replaced by a fairly profuse discharge of pus.

The temperature was 100°F on admission, and continued to oscillate between 99° and 100°F for many days. The plaster was twice removed in an effort to find some pocket of pus that would account for the persistence of the temperature. But the wound was rapidly filling in with granulation tissue and the surface, within a fortnight, was almost flush with the surrounding skin. The granulations were healthy and there was no sign of serious infection.

A blood-count, however, revealed that the hæmoglobin was only 40 per cent of normal, and a white cell count showed a high polymorphonuclear leucocytosis.

These facts gave the clue to the appropriate line of attack; a drip blood transfusion of 1,000 c.c., augmented by sulphapyridine by mouth brought the colour to his cheeks and the temperature to normal.

There may be an important place in the treatment of these cases for transfusion with dried plasma or serum but I had no opportunity of trying them.
In the early phases of the campaign we gave sulphonamide more or less as a routine to all infected cases but I subsequently found that adequate surgical treatment of the wound, with complete immobilization, was sufficient in the great majority of cases and I came to reserve sulphanilamide and sulphapyridine for resistant cases such as the one which I have just described.

III.—Fractures.

We dealt with thirty-six compound fractures made up as follows:

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<tr>
<th>Fracture Site</th>
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<td>Femur</td>
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<tr>
<td>Tibia and Fibula</td>
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<td>Tarsus and Metatarsus</td>
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<td>Humerus</td>
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<tr>
<td>Radius and Ulna</td>
<td>7</td>
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<tr>
<td>Carpus and Metacarpus</td>
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Every compound fracture that arrived at this hospital was infected although in the majority of cases the degree of infection was not serious. In the early stages of the fighting the patients were admitted febrile and, frequently, in considerable pain from incomplete immobilization of the fractured bone; but later cases were dealt with at the forward units and the limb encased in plaster casts. These patients were strikingly free from discomfort.

I formed the opinion that the views I have already expressed with regard to packing the wound with gauze, or leaving it open and merely applying a layer of vaseline gauze over the surface of the wound to protect it from the plaster, apply even more strongly to compound fractures than to wounds involving the soft tissues only. I could see no justification for putting into the wound foreign material which served more to prevent than encourage drainage.

It is necessary to protect the wound from the plaster cast, however, not so much for the sake of sterility but because, unless the vigorous young granulation tissue is held back by an impermeable dressing, it tends to grow into the interstices of the plaster bandages and is very painful when the plaster is removed.

Where débridement was necessary prior to the application of the plaster there was always a sharp rise of temperature to 102° or 103° F. but it fell to normal in three or four days.

Fractures of the shaft of the humerus were immobilized in a plaster abduction frame with the whole limb, including the shoulder-joint, included in the case. It was found that the U-shaped plaster slab that one uses for simple fractures of the shaft of the humerus was insufficient to provide adequate immobilization for these comminuted infected fractures with which we had to deal. Abduction of the arm was maintained by means of a Cramer wire splint, suitably bent, and incorporated in the plaster.

The degree of abduction, forward flexion and external rotation of the arm necessary for anatomical reduction of the fracture varied with the level.
Watson Jones (1940) says that generally the best position is one of forty degrees abduction and thirty degrees forward flexion.

With the patient anaesthetized and lying on his back it was somewhat difficult to be sure that the limb was held in the correct position while the plaster was hardening and it was found that the procedure was rendered considerably easier if the plaster was put on in such a way that each joint was immobilized in turn, starting at the shoulder.

A simple and satisfactory rule for obtaining the position recommended by Watson Jones is to hold the arm in such a position that the thumb of the injured limb is in a vertical line with the patient’s nose, with the elbow at a right angle.

These comminuted fractures of the shaft of the humerus may take a very long time to unite and it is important to refrain from removing the plaster before X-ray evidence shows that there is firm consolidation of the callus. In any event, the union must be tested clinically when the plaster is removed and, if there is any doubt about the result, the plaster must be re-applied for a further period. Failing this, the callus already laid down will be absorbed and permanent non-union may result.

Two of our cases of fractured humerus were complicated by injury to the musculo-spiral nerve. In these cases the plaster on the forearm was extended into the palm so as tocock up the wrist.

When this requires to be done the plaster in the palm must extend sufficiently far forward to fix the metacarpo-phalangeal joints so that extension of the fingers can be carried out by means of the lumbrical and dorsal interossei muscles. If this is not done, extension of the fingers is impossible.

Fractures of the shafts of both bones of the forearm, especially in the upper third, are exposed to the risk of cross union.

Such a case was sent to us with the arm already in plaster. The patient had a very severe lacerated wound of the upper third of the forearm with an associated fracture of both the radius and ulna. The limb had been put up in the position mid-way between pronation and supination with the elbow flexed to a right angle.

We were able to X-ray the patient about three weeks after the original wound. By that time cross union had occurred.

Wounds of the forearm, with fracture of both bones in the upper third, should be put up in the fully supinated position to overcome the pronation of the lower radial fragment and further precaution against cross union should be taken by making the plaster cast oval in section instead of circular or by inserting wooden pegs between the two bones—over a layer of plaster.

Whenever plaster was applied to the hand great care was taken to see that the plaster did not extend beyond the proximal crease in the palm; that the plaster bandage extending over the web between the thumb and index finger was not too bulky and that the plaster was well cut away from the dorsal aspect of the first metacarpal so that all the fingers except the
one injured had free movement. It was found that fingers that were not thus adequately cared for very rapidly became stiff. For the same reason, any finger that had to be immobilized was always put up in the flexed position so that the movement of the other fingers was not interfered with.

Compound fracture of the femur accounted for three of our cases. One was per-trochanteric and the remaining two through the shaft. They were dealt with on the Böhler traction apparatus.

A steel pin was first thrust through the tibial tuberosity, and traction was then made on the limb until the measurements from the anterior superior iliac spine to the internal malleolus were equal on both sides.

X-ray apparatus was not available so we had to rely for the first attempt at reduction on clinical judgment. In practice, this is not so serious a handicap as might be supposed since, when strong traction is made on the limb in the Böhler apparatus, any gross deformity of the femur is automatically reduced and any tendency to backward bowing of the shaft of the bone can be corrected while the plaster is still soft by suspending the cast by means of a broad bandage from the vertical frame which forms part of the apparatus.

With the limb extended on the frame the wound was dealt with, any completely loose fragments of bone being lifted out. The wound was then covered with a layer of vaseline gauze and plaster applied to the whole limb from the pelvis to the toes incorporating the pin in the tibia. In one of the cases it was deemed advisable to include the sound thigh in the plaster spica but, in the remaining two, only one hip was immobilized, the sound limb being left free.

Following this treatment the patient was taken off the frame when the plaster was dry and, as soon as he was fit—in a few days time—sent for X-ray for confirmation of the position of the fracture. X-ray examination was now of course a simple matter since the patient was completely mobile.

The per-trochanteric fracture was anatomically reduced and required no further manipulation. The wound in the second case was so extensive that it had been possible to impact the ends of the two fragments manually. In the third case, a badly comminuted fracture of the lower third of the shaft of the femur, there was some backward angulation. This was readily corrected by sawing through half the circumference of the plaster on the dorsal aspect opposite the angulation, correcting the angulation, and then filling in the wedge so formed with fresh plaster.

IV.—WOUNDS OF BLOOD-VESSELS.

Two cases presented injury to an important blood-vessel as the outstanding lesion.

In one the anterior tibial artery was shot through immediately in front of the ankle. This was the only case which required urgent treatment on admission to hospital. There was a recurrence of the primary haemorrhage
just after he arrived and the vessel required to be ligated. He made an
uninterrupted recovery.

In the second case a bullet had traversed the lower third of the arm,
from the lateral to the medial side, grazing the chest wall as it escaped. The
brachial artery was severed as the missile traversed the arm and the median
nerve was bruised at the same time but no other important structures were
damaged.

On admission three days later, the patient presented a pulsatile swelling
in the lower third of the arm and an absent radial pulse. The circulation
in the periphery of the limb was satisfactory and there was no loss of move­
ment or anaesthesia of the hand or fingers.

In view of the apparently quiescent state of the wound, it was treated
conservatively for three days. By that time, however, oedema began to
appear higher up the arm, and the limb was painful.

Through a longitudinal incision the deep fascia was incised and blood-clot
turned out of the lacerated brachialis muscle. The two cut ends of the
brachial artery were found without much difficulty and ligated and the
wound was closed with a small drain under the skin. Apart from a mild
infection along the suture line the patient made an uninterrupted recovery.
Slight tingling over the skin area of the fingers supplied by the median
nerve still persisted when he was evacuated.

The treatment of this case followed the lines recommended by Sir G. H.
Makins but actually nothing was gained by delaying the exposure and
ligature of the torn vessel and it seems likely that the infection which
developed might have been diminished if the haematoma had been cleared
out earlier.

V.—WOUNDS OF PERIPHERAL NERVES.

Four cases presented nerve lesions as an important feature of the injury.
Two cases of fractured humerus were complicated by a lesion of the musculo­
spiral nerve and one case of fracture of the radius showed the features of a
lesion of the posterior interosseus nerve.

Since all these cases were several days old when they reached us, and
were already infected, no attempt was made at suture of the nerve. The
only special provision was the inclusion of a cock-up in the plaster cast.

It might have been wiser to have exposed the damaged nerve and
perhaps tethered the ends together, if they were divided, but as these cases
were subsequently evacuated I lost sight of them and I cannot say what
the condition of the nerve will be when the wound is healed, the fracture
united and the plaster removed.

One patient had been shot through the popliteal fossa from the lateral
to the medial side. The wounds were small and clean—of the "leech bite"
type—but when he arrived at this hospital, three days after the injury, he
was already in considerable pain.

The wound itself did not trouble him but the painful area corresponded
to the distribution of the long saphenous nerve and later spread to that of the internal popliteal.

An injection of novocain into the long saphenous nerve as it lay over the medial aspect of the knee-joint produced immediate relief which, however, was only temporary.

The skin over the inner side of the leg and foot became hyperaesthetic and developed a punctate erythematous rash. He could not bear the bedclothes to touch his leg and his condition became pitiable.

The popliteal fossa was exposed through a midline longitudinal incision, and the internal popliteal and long saphenous nerves were found to be involved in dense scar tissue which had formed along the track of the bullet. The nerves were freed, and the patient's symptoms gradually began to disappear. A week after the operation he was considerably relieved but whether the relief continued I cannot say because he was evacuated at that time.

VI.—INJURIES OF THE SKULL.

We dealt with six serious injuries of the skull with one death. The points of interest which were brought out were:

(1) A deceptively small and innocent-looking external wound may be associated with a fracture of the cranium and the retention of a missile within the cranial cavity. For this reason it is essential to X-ray every injury of the skull. Failing the means of radiography, every skull wound ought to be explored.

One case arrived from the C.C.S. with a small wound on the forehead which had been excised and sutured. The day following admission, the patient developed meningeal symptoms.

Exploration of the wound revealed a fractured skull with a lacerated dura. He recovered following drainage and massive doses of sulphonamide and subsequent X-ray examination revealed the presence of a minute fragment of metal deeply situated within the cranial cavity.

(2) Primary suture of wounds of the scalp under field conditions, like primary suture of wounds in other soft tissues, is a dangerous procedure and is very likely to be followed by spreading infection which is rendered all the more precarious if there is an associated but unrecognized fracture of the skull.

Two cases arrived which had been primarily sutured. They were both infected and had oedema of the upper part of the face. Removal of the sutures and free drainage was followed by improvement.

(3) Very considerable damage may have been inflicted on the contents of the skull with no visible signs of external injury.

One patient—the fatal case—was admitted with multiple wounds, including a superficial searing wound of the cheek.

His condition appeared to be reasonably satisfactory for about a week when he developed signs of an intra-cranial lesion.
R. Stuppell

He died quite suddenly and post-mortem examination revealed a massive sub-dural haemorrhage. He had been wounded by a nearby shell burst but he could not remember the details of the incident and no exact information was forthcoming.

(4) The intense headache which may be a late result of blows to the head may be greatly relieved, and the condition of the patient much improved, by the administration of a saturated solution of magnesium sulphate in water per rectum. It is best given very slowly by means of a drip apparatus.

One of our cases had been struck on the head by a splinter of shell. He was fortunately wearing his steel helmet at the time and this was smashed but it saved his skull from serious damage, the only injury that he sustained externally being a superficial wound over the mastoid process.

About a week after the injury he began to complain of very severe headache.

X-ray examination failed to disclose the presence of a fractured skull but there was blood in the cerebrospinal fluid.

He was nursed with his head elevated and magnesium sulphate solution was given in a rectal drip. His headache rapidly disappeared and the whole syndrome subsided.

VII.—Penetrating Wounds of the Chest.

We dealt with seven penetrating wounds of the chest with one death. Our series of cases fell into three groups:

1. Traversing wounds with a small point of entry and exit, and no demonstrable haemothorax.
2. Traversing wounds with a closed haemothorax.
3. Penetrating wounds with an open pneumo-haemothorax.

Cases in the first group presented the clinical picture of pneumonia, with the characteristic rusty sputum, etc., and they did very well under purely medical treatment with M & B 693.

Those in the second group, which included one fatal case, were less satisfactory. They were treated by repeated aspiration of blood from the pleural cavity and replacement with air. In three cases, the haemothorax became infected and had to be drained by rib resection. These recovered but only after a fairly stormy convalescence.

The third group presented the same complications as the second with the added difficulty and danger of the sucking wound which had to be closed.

The details of the fatal case are as follows:

According to the Field Card he was received at the C.C.S. on the day that he was wounded in a very distressed condition.

Twenty-six ounces of blood were aspirated from his chest, with relief of his dyspnea.

On the following day, he was passed on to the next hospital, where a
further 350 c.c. of blood were aspirated, and this time replaced by 100 c.c.
of air.

He arrived at this hospital seven days after he had been wounded. He was collapsed with a subnormal temperature and a rapid pulse. He had a massive hæmothorax on the left side with small closed wounds of entry and exit.

He was left undisturbed for three days, when his temperature began to rise, and it was considered advisable to aspirate some of the contents of his pleural cavity.

450 c.c. of blood were withdrawn and 500 c.c. of air were introduced in its place by means of an artificial pneumothorax apparatus.

The intrapleural pressure recorded before the aspiration was commenced was plus six centimetres of water, with no respiratory excursion. Following the aspiration of blood and its replacement with air the manometer showed an excursion of several centimetres but the mean intrapleural pressure was the same. His immediate condition improved and he was less distressed.

Six hours later, he became distressed again with a rapid pulse-rate, but he gradually improved and by the following morning he was considerably better. A few hours later, however, he collapsed and died.

Post-mortem examination revealed the following features:

The left pleural cavity was three-quarters full of blood. The lung was completely collapsed. The bullet had fractured a rib at its point of entry, tunnelled its way through the upper lobe of the lung from the periphery to close to the hilum, and fractured another rib at its point of exit.

The pleura, where the blood had been in contact with it, was covered with a fairly heavy deposit of dark red fibrinous material which had obviously been deposited from the blood. It was fairly adherent to the pleura. This deposit ceased abruptly along a horizontal line which corresponded to the fluid level in the chest and, above this level, the pleura was normal in appearance.

The heart and pericardium were displaced markedly to the right but otherwise showed no abnormality. The right pleural cavity and its contents appeared to be normal.

The conclusions which I drew from a study of these penetrating wounds of the chest were as follows:

(1) Cases without demonstrable hæmothorax, but showing clinical signs of pneumococcal pneumonia, should be treated medically. They respond very well to M & B 693. It may be that a low-grade pneumococcus is the invading organism.

(2) Cases with a closed hæmothorax present a problem which has not been completely solved. If these cases are left without aspiration two unpleasant sequelæ may develop: (a) they may become infected—in fact they are very prone to do so; (b) the deposit which was seen post mortem
will tend to bind the lung down in its collapsed condition and interfere with its subsequent expansion.

On the other hand, if aspiration is carried out too early, there is a very serious risk of encouraging further haemorrhage and this does not appear to be completely guarded against even when the blood withdrawn is replaced by an equal quantity of air.

(3) Closed suction drainage of an infected hæmorrhax may be improvised by means of a Dakin funnel.

The opening at the top is fitted with a rubber stopper through which a hole has been bored and a short piece of glass tubing fitted. To the lower end of the funnel is attached a piece of rubber tubing and a screw clamp. The apparatus is fastened to the side of the bed.

If now the funnel is filled with water and the drainage tube from the chest attached to the connexion at the top of the funnel, when the screw clamp is opened so that the contents of the funnel escape drop by drop into a receiver, a negative pressure will be created which is communicated to the pleural space.

The rubber tubing from the lower end of the funnel should end below the surface of the water in the receiver as otherwise air tends to enter the funnel and the suction is diminished.

(4) Following rib resection and closed drainage, a time comes when the empyema cavity is localized and a short drainage tube may be introduced into the chest and the discharge allowed to escape into the dressing on the chest wall.

These cases heal up much more rapidly if the patient is allowed up since by this means expansion of the lung is encouraged and the empyema cavity more quickly obliterated.

It is a universally accepted surgical teaching that every penetrating wound should be explored, haemorrhage arrested and damaged tissue excised and there is no reason why chest wounds should be excluded from this basic principle.

Schröire (1940) reports a series of stab wounds of the chest in which immediate thoracotomy was carried out with universally satisfactory results.

I think that the answer to this problem of hæmorrhax is that these cases should have been submitted to immediate thoracotomy.

The reason why we are faced with these unhappy dilemmas in dealing with chest wounds which are presented to us a week old is that, at that stage, we have to "make the best of a bad job."

VIII.—Summary.

A brief description is given of the cases with which the Surgical Division of the 53rd General Hospital had to deal during ten weeks of the fighting in Eritrea.
The campaign was characterized by difficult country from which the wounded had to be evacuated and the considerable distances over which they had to be transported.

The striking absence of gas gangrene is noted. The closed plaster treatment of wounds was completely vindicated. The treatment of fractured femurs in plaster with a pin through the tibial tuberosity solved the problem of mobility of the wounded man and some views on the problem of penetrating wounds of the chest are expressed.

REFERENCES:


