

## PROBLEMS OF SURGERY IN THE FIELD.

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DURING the three weeks Belgian campaign of 1940, the author had very considerable reason to realize that a surgeon, however experienced in peacetime surgery, in war is liable to be faced by problems entirely new to him. His intention in this paper is to discuss the management of some of the more common types of casualty reaching the advanced surgical unit; his hope is that it may be of service to some of the younger surgeons who have still to face their first battle experience.

The principles and technique of surgery are the same in war as in peace. The difference in war is in the type of casualty to be dealt with and in the conditions under which the work must be carried out. The responsibility of the surgeon at the advanced surgical unit cannot be over-emphasized. On him depend the future of countless lives and limbs. His work is difficult and extensive, calling for the finest judgment. There is no place for an inexperienced surgeon in the advanced surgical unit.

In my experience most of the casualties reached the first surgical station from three to eight hours after the time of their injury. The first aid treatment had, on the whole, been good. In spite of our improved methods of treating shock, of improvements in anaesthesia, of the potency of the sulphonamides in combating infection, in spite of all the experience gained from previous wars, the mortality of abdominal wounds coming to operation remained in the region of 50 per cent. It is my firm belief that this mortality is too high and that it must be improved. I am convinced that many cases could have been saved by better technique and by better pre- and post-operative care and I believe that if personal or "team" statistics were kept they would show very different mortality rates.

I am well aware of the difficulties inherent in the first surgical station in a war of movement. It has to be mobile (my own station moved seven times in twenty-one days) and yet to be fully equipped for the most varied and major surgical undertakings. The orderlies should be well trained and efficient and must be able to stand the utmost strain. In my own unit, about eighty cases were admitted and operated upon on the first day of the war. It is in such times of strain that a surgeon, working for the first time under appalling conditions, is liable to make costly mistakes.

The sorting of casualties into different degrees of urgency, which has probably been carried out in part before they reach the advanced surgical unit, must be checked and the order of cases for operation must be settled. This is not easy when casualties are pouring in.

### HOW TO SELECT CASES.

Firstly, the hopeless cases should be picked out. This is not as easy as one might think. Some hopeless cases, if seen early, look like having a chance and may not show symptoms of severe shock until a number of hours after injury. I well remember seeing a gunner brought in on a stretcher smoking a cigarette and talking unconcernedly. Examination showed that both legs and his right arm had been blown off. Although no tourniquet had been applied, his stumps were not bleeding nor was he complaining. Signs of hopeless shock developed only later.

Secondly cases of limb wounds, where a tourniquet has been applied, must be dealt with. Occasionally the tourniquet has been unnecessary and, in any case, its retention may endanger the function if not the life of the limb. Abdominal and thoracic wounds should then be sorted out, followed by subcutaneous injuries of the abdomen, fractures and finally wounds of the soft tissues.

However urgent his operation, no patient should ever be rushed straight to the operation theatre. I have seen casualties taken directly from the ambulance to the theatre and consider this to be unwarrantable. Time is essential for resuscitation before operation in all

cases of shock or hæmorrhage and is often well spent in making a more accurate diagnosis of the injury. By this means an operative exploration may even occasionally be avoided.

I found that in many cases it was impossible to distinguish between pure shock and internal hæmorrhage. In cases of obvious abdominal injuries, of open chest wounds and of severe limb injuries if signs of shock are evident; it is wise to assume that both shock and hæmorrhage are present. In either case, treatment consists of rest, warmth, morphia, elevation of the foot of the bed and of intravenous infusion. In certain cases however, the differential diagnosis between the two conditions must be made; in cases of blast injury, for instance, with severe signs of shock and indefinite abdominal symptoms. In such cases, it is essential to diagnose a progressive intra-abdominal hæmorrhage at the earliest possible moment and in this respect repeated rectal examinations may be of the greatest assistance.

#### THE MANAGEMENT OF SOME COMMON WAR WOUNDS SEEN IN THE ADVANCED SURGICAL STATION.

As a golden rule the surgeon must bear in mind that his first duty is to save life. He must use the least traumatic, the least shocking and the simplest effective methods of treatment. This rules out strenuous searches for small foreign bodies, primary suture of contaminated wounds, however carefully they have been excised, intestinal resections where closure of perforations will suffice and resections of the colon where exteriorization is simpler and safer.

*Brain injuries* should not, in my opinion, be treated in an advanced surgical station. After operation such cases cannot be moved for several days; they are better transferred at once to the neuro-surgeon.

*Severe facial injuries* should be similarly transferred to the plastic surgeon. However urgent and tempting a preliminary repair may seem it is better not to interfere. The final plastic repair may be jeopardized by a too thorough cleaning and revision of the wound. I saw two cases of very severe facial injury. In each the face below the level of the eyes was nothing but a ragged cavity; shock was absent and both men walked into the station unaided. Some cleaning of the wounds was thought advisable and anæsthesia was induced by means of Evipan. Both men died on the table.

*Chest Wounds.*—Some cases of open chest wounds reach the advanced surgical station in good condition with little dyspnœa or signs of shock. When such cases come to operation it may be tempting, after excision of the wound, to extend the incision along the intercostal space, divide one or more ribs and so gain access to the whole side of the thorax and to the diaphragm.

This may yield brilliant results but it has a considerable mortality. I believe it wiser merely to excise the wound, to close it and to drain the pleural cavity through a separate stab incision. As one is unlikely to be able to keep a closed drainage working subsequently open drainage is to be preferred.

In cases of chest wounds complicated by hæmorrhage it is well to remember that considerable bleeding may come from the chest wall. If the hæmorrhage comes from the lung itself it is likely to cease as the lung collapses. If it does not do so, the alternatives are deep catgut sutures or packing; in either case the prognosis is bad.

In certain cases wounds of the chest give rise to abdominal signs. Tenderness and rigidity may be present on the corresponding side of the abdomen. This rigidity does not involve the whole abdomen unless there is also some intraperitoneal lesion. Here again repeated examination of the abdomen for the spread of rigidity and of the rectovesical pouch for an accumulation of blood may be very helpful. In doubtful cases showing mild abdominal symptoms it is better, in my opinion, to deal first with the chest and to watch the patient closely thereafter for the development of signs of intraperitoneal damage, particular attention being paid to the spread of the area of tenderness and rigidity and to the findings of repeated rectal examination. If these signs become positive laparotomy should be carried out immediately.

*Abdomino-thoracic Wounds.*—These may present peculiar difficulties. In some cases the diagnosis is obvious when, for instance, gut or omentum protrudes through the chest wall.

In other cases the diagnosis may be exceedingly difficult. There may be an obvious chest wound with vague abdominal symptoms or, in other cases, although a line joining the wounds of entry and exit may point to abdominal injury, there may be no abdominal symptoms. In such cases the judgment of the surgeon will be taxed to the utmost. If he adheres to textbook teaching he will embark on a combined operation for exploration of the thorax and abdomen through the diaphragm and the patient will probably die on the table.

In tackling such a problem it must be borne in mind that the abdominal injury is the more serious. It is therefore of paramount importance not to allow an abdominal injury to remain unexplored. In such cases a distinction must be drawn between left and right-sided injuries. It must be remembered that the highest part of the liver reaches almost to the level of the nipple. It follows that in any penetrating wound of the right lower chest the liver may be involved whether signs of peritoneal irritation are present or not. I have had to deal with a soldier who had an open chest wound by shell splinter involving the eighth right rib posteriorly. Right-sided abdominal tenderness and rigidity were present with only a slight degree of shock. I excised the wound and, without attempting to explore the chest, packed the pleural cavity with gauze because of considerable hæmorrhage. I then explored the abdomen but found no intraperitoneal damage. The patient was fairly comfortable the following day and was evacuated.

The management of such cases is open to discussion. Here was a man with an open chest wound, with a foreign body in either the pleural cavity, the lung or the liver. X-rays were not available. Right-sided abdominal signs were present without those of intraperitoneal hæmorrhage. Would it have been better to explore the chest widely to visualize the upper surface of the diaphragm? In other words, in case of doubt, is it less shocking to explore the thorax, the chest being already open, or to deal with the wound locally and do a subsequent quick laparotomy? On the other hand, in the presence of definite signs of liver damage or internal hæmorrhage with tenderness of the rectovesical pouch, will an exploratory laparotomy help the patient? In such a case as I have described the injury is likely to be to the upper or posterior part of the liver and an abdominal approach will be unsatisfactory. The inferior and anterior surfaces of the liver can be explored satisfactorily from the abdomen but not the posterior surface. This can be better dealt with from the thorax.

How should one deal with similar injuries on the left side? I saw such a case in which gut and omentum were protruding through a wound in the left lower chest between the apex of the heart and the splenic area. There was no obvious damage to the protruding bowel nor were there signs of lung injury or of involvement of the general peritoneal cavity. The case actually did not come to operation. How should one tackle such a case? Should one excise the chest wound, replace the bowel and close the diaphragm from above or is it wiser to add laparotomy and close the diaphragm from below? X-rays would help to simplify such cases, particularly in localizing foreign bodies, but unfortunately were not available at the time.

*Abdominal Wounds.*—Here more definite rules can be laid down and I would refer the reader to Mr. Rodney Maingot's excellent recent article on the subject. The length of the incision must be adequate, ample room being provided for complete investigation of the abdomen. A long incision produces less shock than forcible traction used to expose outlying viscera through a small incision. The longitudinal incision through the inner body of the rectus is a good one, being easily extended and time-saving. I also like the transverse incision cutting across both recti, which gives an exposure second to none, though the epigastric vessels may be troublesome.

After the peritoneum has been opened, the first step is the control of hæmorrhage. Thereafter a thorough exploration of all the peritoneal and certain of the extraperitoneal viscera must be carried out. Often damaged intestine presents in the incision and it is tempting to start repair at once. This is most unwise and should always be preceded by a thorough investigation of the other viscera. It is important to realize that lacerations of abdominal viscera are not necessarily produced directly by the missile itself. I have seen a case of very extensive peritoneal damage, with several feet of small intestine entirely detached from the mesentery, caused by a single rifle bullet fired at short range. The damage could not have

been caused only by the bullet. The velocity of a bullet fired at close range is such that its impact on the abdominal wall may produce explosive effects inside the abdomen. The exploration of the abdomen must therefore be complete and yet rapid. These patients cannot stand prolonged anaesthesia and processes of repair are in themselves time-consuming enough.

**Small Intestines:** Localized injuries to the small intestine away from its mesenteric border can be quickly and safely closed by a simple suture and reinforcement with a piece of omentum. Resection should be avoided where possible because it takes additional precious minutes.

**Large Intestines:** Small perforations of the large intestine should be treated by simple suture and reinforcement. Under no circumstances whatsoever should resection and anastomosis of the large bowel be practised in war surgery. This procedure may still have its adherents in civil practice but, in war surgery where prolonged preparation of the patient for operation is impossible and where post-operative care may perforce be limited, it carries too high a mortality. Thus a colon which cannot be safely sutured should be exteriorized. When the patient's condition is grave a simple loop colostomy is quick and safe. If the patient's condition admits, a modified Paul Mikulicz' operation should be performed. Such a colostomy saves the patient much trouble if he survives. Its subsequent closure presents no danger whereas the closure of a loop colostomy is a considerable procedure. If effected extra-peritoneally a faecal fistula is not uncommon; if intra-peritoneally, the conscientious surgeon's sleep is not entirely carefree for several nights.

**Other injuries.**—Injuries to the stomach are treated by suture; rarely is any form of gastric resection required. In such cases extensive damage to liver, pancreas and other organs is likely to be present. Injuries to the spleen are treated by splenectomy. The method of dealing with lacerations of the liver by the insertion of catgut sutures parallel to the edges of the lesion prior to suture, as advocated by Grey Turner, is a most useful one.

Silk is the most useful material for abdominal surgery but I prefer to use catgut for the subcutaneous tissues. Asepsis in war surgery cannot be as complete as in peace time and the infection rate, in spite of chemotherapy, is bound to be higher. The quickest and safest way of closing the abdomen is to use strong interrupted through-and-through silk sutures, as described by Lambotte;—skin, muscles, peritoneum on one side; peritoneum, muscle, subcutaneous tissue on the other side; subcutaneous tissue, muscle, peritoneum again on the first side, and, finally, peritoneum, muscle, skin. This is a quick and reliable method of suture where speed is important.

The bladder is not infrequently injured in penetrating wounds of the lower abdomen. If the patient has not passed urine since his injury, a catheter should always be used. Exploration of the kidney is warranted only by increasing local or general physical signs, by persisting or increasing haematuria or by the presence of a large haematoma in the flank.

**Limb and Soft Tissue Injuries.**—The treatment of contaminated wounds of the soft tissues by excision, the insertion of sulphonamides and complete immobilization, is now well tried and generally accepted. When faced for the first time by such injuries one is often surprised at the extent of the necessary procedure. I confess that I was sometimes embarrassed by cases which at first sight seemed commonplace and I feel that more definite indications for the management of such cases as follow would be helpful.

(1) Perforating bullet wound, the wound of entrance being below the right great trochanter, the wound of exit being at the left costal margin. X-rays showed no bony injury and there were no signs of intraperitoneal damage, but the whole anterior abdominal wall was grossly contused. Should such a track be laid open and excised throughout its length or was the surgeon wise in dealing with the wounds of entrance and exit and in draining the abdominal wall by a small incision?

(2) I had to deal with a soldier both of whose buttocks had been perforated by the same bullet. I opened both tracks and found extensive damage, the gluteus maximus being greyish and lifeless for about an inch on both sides of the tracks. Having excised all the damaged tissue, I packed the remaining trench lightly and sutured the subcutaneous tissues and skin over the packing, allowing drainage by the four orifices. Sutures in such a case,



even with drainage, are dangerous and I believe now it would have been better to leave the wounds open.

(3) An even more common case is a through-and-through bullet wound of the thigh. I remember such a case, in the upper third of the thigh, in which both wounds were quite neat, that of exit being larger and slightly irregular. In this case both the wounds were excised only. Is this enough? In view of the difficulty and danger of a complete excision of such a track, I think most surgeons would agree that it was, but what is the chance of a serious infection starting in the depths of the wound?

I saw a similar case complicated by a fracture of the femur. This man had been hit by a high velocity bullet from a fighter plane. The fracture was transverse, with a few small separated bone fragments, and the bullet had not been deflected by the bone. There was little bleeding and no swelling of the thigh. In such a case, should one open the thigh widely, to excise the track and remove the bone fragments, if completely loose, from the periosteum, thus causing considerable shock, or was it safe merely to excise and lightly pack the wounds before applying a hip plaster?

(4) Another difficult decision has to be made in the case of multiple injuries of the soft tissues. These are usually inflicted by the explosion of grenades. Cases are seen in which the man has been hit by a dozen or more splinters. Each in itself is not serious but contains a fragment of grenade casing. I have seen such cases in a very severe state of shock after operation. Excision of a dozen wounds takes a long time. It is better to institute thorough shock therapy for several hours in these cases; then to undertake operation with several surgeons working at the same time.

(5) Severe crushing injuries of the limbs call for the greatest surgical judgment. If a man arrives eight to ten hours after a severe crush injury of the leg and the surgeon, fearing gas gangrene, amputates the limb in the presence of shock, the patient will almost certainly die on the table. The outlook is very much improved by a few hours purposeful shock treatment. Better a live patient running the risk of gas gangrene than an immediate fatality.

The problem of amputation or conservation of a badly injured limb is one of the most difficult which the surgeon has to face. In civilian surgery, where constant post-operative supervision is possible, there is a natural and justifiable tendency to conservatism. Even in the best surroundings such conservatism has occasionally cost a patient his life. In war surgery risks of infection are greater and post-operative care may be of necessity sketchy, either owing to the numbers to be treated or on account of difficulties in transport. The tendency should therefore be, in cases of doubt, to amputate. No definite rules can be laid down, however, because sometimes a limb must be amputated, even when its main blood supply is not severed, and conversely a limb with a good collateral circulation can occasionally be saved although its main arterial supply has been divided. In war surgery, therefore, conservative principles must be modified. When in doubt amputate above the damaged area.

I have twice seen a guillotine amputation performed through a badly soiled wound. One of these cases was a badly smashed elbow and the other a very severe wound of the lower third of the thigh. Both were brought in within six hours of the injury—both died of gas gangrene within twenty-four hours. This is a very grave mistake. Amputations should be performed through healthy tissue above the injury, with a tourniquet, at the root of the limb. It takes very little time to cut skin flaps and these should be loosely approximated after the application of sulphonamide powder. Wounds of joints should be excised down to and including the synovial membrane and the cavity of the joint should be explored and irrigated with sulphonamide solution. The articular capsule should be closed with catgut without tension, drainage effected and the limb immobilized in plaster.

#### SUMMARY.

(1) Cases seen in the advanced surgical stations of field warfare call for the greatest surgical skill and judgment.

(2) Many of the injuries are not encountered in civilian surgery.

(3) The management of a number of cases actually encountered in the Belgian campaign is discussed.