Indications for the Operation.

The main indications for this thoracotomy in war surgery are: (1) Removal of a large foreign body; (2) suture of torn lung; (3) exploration of haemothorax with evacuation of blood clot and septic material.

The method can be applied when the chest is to be opened through either the wound of entry or exit, since it is quite easy to saw the two portions of traversed rib longitudinally; and the subsequent closure is so much simplified.

Lastly, a modification of this method affords a great saving of time in those operations for infected haemothorax where "air-tight" drainage is so advantageous. According to Elliott and Henry, "This procedure (that is, sewing pleura, muscle, and skin in layers tightly round the tube, after resection of rib) adds at least fifteen minutes to the time taken for the operation, for it is not an easy matter to sew up inelastic pleura." Two inches (6 or 7 cm.) of rib are exposed, a disc 1 cm. across is cut out with a trephine and the rest of the operation completed as described above. If a larger drainage tube is needed, the opening can be widened with nibbling forceps. The pleura, by means of its attached piece of rib, is closed with two stitches; the tube is air-tight and the whole proceeding has taken but a few minutes.

In civil practice this operation will afford an ideal route for exploratory thoracotomy, pneumectomy, etc.

Advantages of the Method.

This thoracotomy is simple and quick, provides perfect access to the chest contents, and moreover ensures a rapid perfect closure.

It was originally with the idea of saving time that this operation was thought out. One of the lessons war surgery has taught is that not only the recovery of the individual but the welfare of many patients often depends to a great extent on the speed at which the surgeon works.

Again, the operation which gives as an end result the closest approximation to the original normal anatomical condition, without risk or other disadvantage to the patient, is always the ideal at which one should aim.

REFERENCE.

¹ Elliott and Henry, *BRITISH MEDICAL JOURNAL*, March 31st, 1917.

THE EARLY OPERATIVE TREATMENT OF PENETRATING GUNSHOT WOUNDS OF THE CHEST.

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THE necessity of early operation in gunshot wounds of the chest is now established. There is no doubt that many lives are saved, and convalescence shortened by early and complete operation in a casualty clearing station, and I hope these short notes of my own experience may be of value.

*Nature of Wounds and of Projectiles which
Caused Them.*

(a) Clean through-and-through wounds caused by a rifle bullet or shrapnel ball, with small wound of entrance or exit, require no early operation. Aspiration of the haemothorax may be necessary. Frequently the shrapnel ball is under the skin and may be removed.

(b) However, a rifle bullet or shrapnel ball frequently strikes bone, scapula or rib, and makes a large wound of exit. This, if not operated on very soon, becomes very septic, and, an open track being left to the pleura and lung, gives rise to secondary complications. Such cases should be dealt with, the exit wound completely excised down to the pleura, all loose fragments of bone removed, the wound cleansed, and sewn up if possible.

(c) Tangential wounds of the chest are amongst the most fatal when associated with much rib damage. Fragments of bone and clothing are driven into the pleura and lung, and there is a large sloughing wound with an open track to the pleura. The diaphragm is frequently injured, and there may be penetrating wounds of abdominal viscera. In all of these cases a complete and careful excision of the whole wound is necessary. Pleura and lung must be

cleansed of bone fragments and cloth, and the diaphragm closed if wounded. If necessary more rib must be excised in order to be well clear of damaged tissue and to allow the wound to be closed.

(d) Through-and-through wounds caused by shrapnel or high explosive have large entrance and exit wounds with ragged much-damaged edges. In these both the entrance and exit wound should be completely excised down to the pleura, all damaged tissues removed, and the wound closed if possible by suture.

(e) The large group of cases is that in which a missile is retained in the chest cavity. Rifle bullets and shrapnel balls can be left, the progress of the case watched, and if sepsis supervenes they can be removed at the base. But the case is different with ragged pieces of shell. Here there is much laceration, and fragments of clothing are carried in. If the fragment is really small it may be left. If large and in an accessible position it should always be removed. Toilet of wound, for example, excision of all lacerated tissue down to the pleura, should be carried out, the metal fragment removed if possible, and the wound closed in successive layers.

Preparation for Operation.

Time to Operate.—Wait for shock to pass off. To get clean results, operation should be done in the first twenty-four hours. This follows experience of ordinary wounds. Thus, if early and completely excised wide of damaged tissue, and sewn up, they should heal by first intention.

X ray is essential. A plate should be taken, and should show bone as well as fragments embedded in lung. The metal fragment must be carefully localized.

Anaesthetic.—Local anaesthesia with novocain is the best. If necessary, a few whiffs of chloroform and ether can be given. Frequently, with multiple wounds, a general anaesthetic is necessary, and in my experience is well taken. No intratracheal pressure apparatus is necessary.

Operation.

Wide and careful excision of wound and damaged tissues is the first thing. Resection of rib. It is necessary to allow plenty of room, so that a good view may be obtained and the whole hand passed into the pleural cavity. To do this wide resection of rib is necessary; three inches may be removed from two adjacent ribs or six inches of one. The pleura is then exposed. If there is a large opening, with pneumothorax, the edges should be excised, and the hand put into the pleural cavity and the metal fragment removed. If the wound is small, with little or no sucking in of air, a small incision should be made into the pleura, and the lung quickly grasped with a pair of toothed forceps. Moynihan's or tissue forceps are excellent. The lung is then firmly pulled to the wound, and the incision in the pleura enlarged. It is then possible to gradually evacuate the haemothorax and only allow a small amount of air to enter. The grasping of the lung with forceps and firmly pulling on it prevents it from collapsing, and, in my opinion, should always be carried out, for sudden and massive collapse of the lung is one of the great dangers of the operation and should always be prevented if possible. After exposure of lung, the metal fragment can often be seen and picked out, for, as Colonel Elliott and Captain Henry have shown, the lung itself offers little resistance, and the fragment either tends to pass right through or remain in the pleural cavity or surface of lung. Some fall to the most dependent part of the pleural cavity. If, however, the metal fragment is embedded in the lung, the wound of lung should be sought for and the track of the missile followed up; this can be done with the knife, the track being held in good view, or with a thermo-cautery. Another method is to insert the finger in the track, feel for the fragment, and extract with forceps or scoop, but the obvious danger of this is detachment of a clot from a large vessel and not being able to see what one is doing. Any haemorrhage is now controlled. If large, the wound of lung should be sutured with catgut. The pleural cavity should be washed out with flavine or Dakin's solution; by this fragments of clothing which may have been overlooked are removed. Some flavine may be left in the pleura.

The pleura is then, if possible, completely closed, leaving any infection "to be dealt with by the natural power of the pleura to dispose of infection," which has been shown

by Colonel Elliott and Captain Henry to be very strong. The parietal pleura should be sewn together if possible; if the opening is too large then it may be stitched to the lung and visceral pleura. The skin and muscle are brought together with a few interrupted sutures. Where the skin, however, cannot be closed the wound should be firmly packed with gauze, a salt or paraffin pack, and strapped.

After-Treatment.

This depends on the progress of the case. The majority, where the ideal early operation can be carried out, should do very well and make an uninterrupted recovery. It is extraordinary how quickly a lung will expand after the pleura is closed. If much blood should collect it should be aspirated. If gas infection or empyema supervene the ordinary treatment should be carried out and the pleural cavity drained. This can be done through the original wound if dependent; if not, a lower rib should be resected and the cavity drained.

Localized Collection.

A local collection of pus round the wound may develop and require evacuation.

Conclusions.

The ideal methods of modern war surgery are (1) early operation, (2) complete excision of wound and damaged tissues, (3) removal of metal fragment and clothing, (4) mechanical cleansing of wound (the use of strong antiseptics is to be avoided), (5) complete suture of wound. Provided one can get early and complete operation, there is far more danger from secondary than from primary infection.

The treatment of wounds of the chest, therefore, follows the same lines as those of the abdomen, head, knee, or other joints; they require just as early operation, and it will be found that the results are just as good.

THE TREATMENT OF GUNSHOT WOUNDS OF THE ELBOW-JOINT: A PLEA FOR PRIMARY EXCISION.

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THE ultimate results of the injuries inflicted in gunshot wounds of the elbow-joint cannot be regarded as satisfactory. In the majority there is complete, or almost complete, ankylosis. If the wound pursues a thoroughly aseptic course, and the injury is confined to the olecranon or one of the epicondyles, the joint may regain a fair range of movement. But when, as in the majority of instances, the wound becomes septic and the bones are badly comminuted, especially if the lower end of the humerus is involved, the results are deplorable. Effective drainage is very difficult to carry out, even if Carrel-Dakin's method is employed. Acute septic inflammation nearly always follows. The whole region of the elbow becomes immensely swollen. Accurate reposition of the broken fragments is out of the question. A great deal of new bone is thrown out, many of the fragments become necrosed, and after a prolonged illness running into many months the elbow is left either ankylosed at an awkward angle, so that often the patient cannot use his hand to feed himself, or at best with a limited degree of flexion and extension, with rotation at the shoulder-joint as a clumsy substitute for supination.

The results of primary excision of the elbow-joint, on the other hand, are wonderfully good, provided sufficient bone is removed—that is to say, the lower end of the humerus just above the level of the epicondyles, the whole of the head of the radius and the ulna at the same level. I have notes of five cases in civil practice performed for injury in which the joint was excised in this way, with complete restoration of movement and recovery of the muscles so that the arm was to all intents and purposes as strong and as useful as it was before. Even if the conditions are such that the wound is already infected, the drainage is so free that a serious degree of sepsis can usually be avoided, and there is not that enormous mass of callus thrown out, binding everything together and

locking the fragments so that they cannot move. It is true that, owing to the necessity of re-educating the muscles of the forearm, which have been separated from their attachments, it may be twelve months before recovery is complete, but the fingers and wrist can be used after the first few weeks, and, if a suitable splint is provided, the elbow as soon as the wound is sound.

The operation, of course, is much more tedious when performed for injury than when performed for disease. The muscles cannot be so easily separated from their attachments, and when the bones are comminuted and the fragments displaced, there is need of careful dissection, which may take up valuable time. But provided the operation can be done before septic infection has spread far, and sufficient bone is removed, the results are so different from those of the conservative method of treatment that there is no comparison between them.

It is not, of course, possible to say whether the conditions at a casualty clearing station are such as to allow a proceeding of this kind to be carried out at a time when every moment is required, but the only conclusion at which one can arrive from three years' experience at a base hospital, is that if primary excision of the elbow were adopted more generally a great deal of illness and suffering would be saved and much more useful limbs would be left. Excision can, of course, be performed later with an excellent result, and doubtless in many cases it will be, but this means a second operation of some gravity and a second period of convalescence before recovery is complete.

Memoranda:

MEDICAL, SURGICAL, OBSTETRICAL.

REAMPUTATION.

THE following technique has been evolved in the Dartford War Hospital in the large number of reamputations performed here. Various points were gleaned from various sources, and among the most valued recent suggestions is that of Major W. A. Chapple¹ to employ button sutures of relaxation in the deeper parts of the flap.

Preliminary.—During the waiting period use a weight and pulley with adhesive plaster to bring down the skin. Clean up the surface as thoroughly as possible but do not wait for all small pockets to become healthy. A fortnight is long enough.

Stage 1.—Apply a tourniquet. Curette the whole surface, especially any pockets, whilst flushing thoroughly with a dilute antiseptic.

Stage 2.—(Usually needed but not always.) Make a free incision down to the bone on the outer side of the limb, exposing it to above the intended line of section.

Stage 3.—Make a circular incision round the bone near its end, through the periosteum, above the point at which there are spurs and plates of new bony deposit; but where these extend up the shaft far, then at 1 in. from the surface of the stump. Carefully peel the tissues, including the periosteum, off the bone, splitting them through the outer incision.

Stage 4.—Cut the bone either with a Gigli saw, which we have been frequently employing for the past eighteen months, or by the ordinary saw if the tissues can be retracted sufficiently. Use a cloth retractor with a hole in it to slip over the end of the bone. I devised a special metal retractor but it did not work satisfactorily.

Stage 5.—Study the stump; see whether any of the fleshy mass needs to be trimmed to enable the skin to cover it. Free the skin from the underlying muscular tissues for 1½ in. to 2 in.; avoid scoring the subcutaneous fat.

Stage 6.—Remove the tourniquet; check all haemorrhage with ligatures and hot wet swabs.

Stage 7.—Suturing. Unite the periosteal sheath over the bone by a catgut mattress suture. Place two or three catgut sutures into the muscles, approximating them or inverting them as the case requires. Put in two or three silkworm-gut sutures, piercing rubber tubing in the way described by Major Chapple, compressing the flaps into good apposition.

One small rubber drain should be placed from the deepest part by the bone to the outer incision; another at the inner corner of the wound just under the skin flaps, which should be sutured at intervals of ½ in. A very useful skin suture is often employed by my colleague, Mr. Bost. It pierces the skin ½ in. from the edge then returns ¼ in. from the edge, which is thus slightly everted and closely apposed.

Since this technique has been used (1) we have taken to earlier operation; (2) we have removed rather less bone; and (3) we have had better results in the way of primary union.

¹ BRITISH MEDICAL JOURNAL, August 25th, 1917, p. 242.