is remarkable how the lung of the operated side may expand and remain healthy, according to reliable clinicians, while the other lung develops well-marked signs of inflammation. As Captain Anderson states, this fact may really turn the scale favourably in the patient's chances of recovery—another reason for complete closure.

The patient should be well "doped" before operation. He should be made very drowsy, but at the same time be capable of being roused and of doing what he is asked to do. Opium, or some similar preparation of opium, is more satisfactory from many points of view than the alkaloid morphine alone. Scopolamine is given with advantage with the first dose, but is omitted from the second, if a second dose is necessary. The same amount of care in preparation of the patient and administration of the local anaesthetic should be exercised as when a general anaesthetic is chosen for these cases. A specially skilled anaesthetist is usually selected in the latter case.

If he is in any way "fit," the patient should be warned in a tactful way that he may feel extraordinarily distressed and apprehensive during the operation, that, indeed, the operator expects this, but that he should try to lie and breathe quietly, that struggling and excitement will only increase his distress, and that the symptoms will pass off very quickly when the operation is finished. If, in spite of such warning, he is very restless, a small amount of general anaesthetic should be given.

The Importance of Speed.

Speed is of the utmost value in certain cases; therefore the plan of the operation should be mapped out beforehand and understood by all assistants. Suitable instruments should be handy at each stage of the operation, and a sufficient number of sutures, on needles of various sizes and curves, should be prepared. The operator must not "lose his head" when things become alarming. He is assured of a speedy peace when the pleural cavity is closed. It is wonderful, at this alarming stage, what a soothing effect a few whiffs of general anaesthetic may have, but the anaesthetic should be given for as short a time as possible. It is in these circumstances that a positive pressure apparatus would probably be of great value.

In Multiple Injuries the Chest Wound takes Precedence.

When a "sucking" wound of the chest is accompanied by an intra-abdominal injury, the chest should always be dealt with first. Sometimes the abdominal condition can be effectively treated by prolonging the chest wound downwards and forwards. In such cases care must be taken to suture the diaphragm (air-tight) to the chest wall around the periphery of the wound. It is astonishing to what a height and at what tension the diaphragm can be sutured in this way, with practically no subsequent distress to the patient.

Introduction of Antiseptic Fluid.

If the foreign body cannot, for various reasons, be removed at the primary operation, a small quantity (1 to 3 oz.) of one of the recently devised antiseptic solutions (flavine, brilliant green, iodoform 1 per cent. in liquid paraffin) should be left in the pleural cavity. This may have the effect of delaying or limiting septic processes until the foreign body can be dealt with at a second operation. When the intrapleural conditions have been thoroughly "cleaned up," I doubt whether the use of such fluids is essential, but, so far as one can judge, they are not harmful.

Conclusion.

It must be remembered that the operation is undertaken with two great objects in view—(a) to prevent sepsis getting a hold, and (b) to tide the patient over the dangerous period. Complete closure of the chest wall attains these objects more successfully than when drainage is used.

Patients subjected to such operations should not usually be evacuated until about ten to fourteen days after operation.

REFERENCE.

¹ BRITISH MEDICAL JOURNAL, 1917, vol. i, p. 319.

PLASTIC TRANSCOSTAL THORACOTOMY.

BY

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THE development of thoracic surgery as a special department of military surgery has made great strides in the past year. Thanks to the pioneer work of Major G. E. Gask, D.S.O., R.A.M.C., and M. le Médecin-Major Duval, of the French Medical Service, chest surgery has now been placed on a sound basis, and in the hands of experts is yielding good results. The technique of thoracotomy and subsequent manipulation of the lung as practised by these operators is simple and quick. The complete closure of the chest, however, is not so easy, and in many parts of the chest wall is extremely difficult owing to the thinness of the pleura and the rigidity of the thoracic wall. By means of the plastic operation I have devised this difficulty would appear to be overcome; it is now possible to close the chest soundly in a few moments, as against the ten to fifteen minutes or more of the usual methods.

Method of Operating.

To open the chest in a patient of average size the selected rib is exposed for about 5 in. (22 to 23 cm.), the periosteum is incised, and the cut A made about 1½ in. (4 cm.) long, ½ cm. from the lower border of the rib, the saw being directed upwards so that the rib is sawn with bevelled edges. As soon as the chest is opened a key saw is introduced and the cut B made. As indicated in Fig. 1,

FIG. 1.

the cut stops just short of the rib margin in order to avoid injury to the intercostal vessels. From this point the third cut, C, is made in such a way that the cut end of the rib is rounded off and no sharp points are left which may tear the glove.

In the same way the cuts B' and C' are made on the other side of A, and the sawing is complete. In order to facilitate the rib section, a special key saw has been devised with a blunt end and double edge, so that one can saw in either direction, that is, forehand or backhand, without having to take out and reintroduce the saw. The two pieces of rib with attached pleura are now turned outwards on the hinge of intercostal tissue as shown in Fig. 2. In this way an opening 3.5 cm. wide is pro-

FIG. 2.

vided, which is easily increased to 6 cm. by "spreading" the adjacent ribs in the usual way. Through this opening an average size hand can easily be passed, and the required manipulation of the lung carried out.

To close the chest two or three stitches of stout catgut or silkworm-gut are passed round the rib, care being taken to keep the point of the needle against the rib to avoid the vessels and nerve. The sections of rib are now turned back into their original position, where they fit into place like pieces of a "jig-saw" puzzle; the stitches are tied, and in a few moments the chest is closed, with the cut edges of pleura in close proximity. A layer of muscle and fascia is stitched over the rib to reinforce the line of suture, the skin incision is closed, and the chest wall is restored to normal.

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