SURGICAL TREATMENT OF GUNSHOT WOUNDS OF THE CHEST.

THE SURGICAL TREATMENT OF SEVERE PENETRATING WOUNDS OF THE CHEST IN A CASUALTY CLEARING STATION.

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It is generally accepted that the sooner a wound is purged of carrying agents of infection—namely, foreign body and clothing—and of the media suitable for the growth of bacteria—namely, blood clot and dead muscle—the better is the prognosis.

Reflection on the experience of two years of casualty clearing station work reveals the fact that in no group of cases has this axiom been so much neglected as in wounds of the chest. It brings home the very dangerous nature of many of these wounds, and makes one wonder why serious attempts have not been made long ere now to apply to them principles which have led to such marked improvement in the treatment of wounds of other parts. These serious cases have arrived in large numbers at casualty clearing stations, have improved up to a point, and then have succumbed to sepsis, just as in other wounds which have been inefficiently treated.

Wounds of the chest, as seen at an advanced casualty clearing station, may be classified into two main groups from the point of view of prognosis.

Group A.

1. Entrance and exit bullet wounds.
2. Entrance and exit shrapnel-ball wounds.
3. Wounds caused by small fragments of high explosive missiles.

As a general rule these cases do exceedingly well if treated expectantly and aspirated or operated on when occasion demands. They can usually be evacuated to the base in from three to ten days, and the ultimate results are good. Of course, in a certain proportion of such cases there is sufficient visceral injury to cause immediate or early death, but, as they seldom reach the casualty clearing station, they do not come within the scope of this paper.

Group B.

1. Wounds caused by large irregular fragments of high explosive shell which have lodged in the thorax. These are almost always associated with (a) clothing and infection carried in, and (b) open "sucking" wounds of the chest wall.
2. Tangential wounds of the thorax, enfolding the ribs and driving portions of bone, etc., into the pleura and lung.
3. Entrance and exit bullet wounds in which the exit wounds are "explosive" in character.

If treated expectantly only a very small percentage of Group B (1) reach the base, and many of those that are evacuated appear to die from the complications of their wounds.

In Group B (2) and (3) the prognosis is usually not so severe, but an unduly large percentage develop an infected haemothorax unless the chest wall wound is treated energetically. In this latter group the prognosis, when no operation is performed, is always worse in wounds of parts where there is a liberal muscle covering—for example, in the scapular region.

The cases in Group B usually have died hitherto at the casualty clearing station from sepsis and exhaustion, and it is this group of cases which demands more vigorous surgical intervention.

The mortality in all penetrating wounds of the chest at a casualty clearing station appears to vary from 7 to 25 per cent. or over. It is higher in stationary trench warfare, and in casualty clearing stations which are placed near the "line"; that is, there are more of the B group of cases. The question that faces us is: Cannot many of these cases which otherwise succumb be saved by immediate surgical intervention on the lines adopted for other wounds? Recent experience of this type of work has assured me that this is possible. The main factors which have militated against active interference on the part of

the surgeon are: (1) The danger of anaesthesia, (2) lack of experience in chest surgery, and (3) the fact that the surgery of the chest in civil practice has always been associated with very elaborate paraphernalia. One finds, however, that these objections are "phantom," or can be overcome.

As to (1), the majority of these cases can be efficiently anaesthetized by the regional method of local anaesthesia—namely, blocking the intercostal nerves in the intercostal spaces behind the angle of the rib with novocain solution 0.5 per cent. Where general anaesthesia is rendered necessary on account of multiple wounds, or because of restlessness of the patient, anaesthetists who have had experience of this type of case agree that the immediate danger is greatly overestimated, and that the closure of an aperture in the wall of the thorax more than compensates for any risk which is accepted. One must not forget the possible effect of a general anaesthetic on the "sound" lung already overstrained. (2) The operation does not demand manipulative skill beyond that possessed by a good general surgeon; and (3) it can be performed with the ordinary surgical kit of a casualty clearing station.

Principles of Operation.

A localizing x-ray examination is of extreme value. The extent of damage and route of attack can thus be much more accurately gauged and the operative procedure simplified. If, however, for any reason x rays are not available, I am satisfied that much is gained by the excision of the wound in the chest wall and closure thereof, with modified search for the foreign body. In several cases I have removed the foreign body successfully at a later date, when the patient's condition had improved. The wound in the chest wall should be completely excised, all loose and sharp fragments of rib being removed. The pleural cavity should then be wiped out, if the lung has collapsed and haemothorax exists. A search for the foreign body should now be made, the wound being enlarged if necessary to admit the hand. This may not be required, however, if the lung is adherent. It may be possible to palpate and control the affected part of the lung with two fingers, especially if the foreign body is lodged in the lower border. The fragment, with any carried-in clothing, is now removed, the lung being grasped by the hand or fingers. In some cases the affected part of the lung may be completely excised. The wound of the lung is treated by suture, plugging, smearing with an antiseptic paste, etc., according to indication, just as in wounds of other parts. Often the greater part of the damage has been done by portions of rib driven in, and these frequently cause several separate wounds of the lung.

Whether antiseptics should be used in the pleural cavity or not is still a moot point. I have used solutions of flavine and brilliant green without any untoward effects and probably with advantage.

The aperture in the chest wall is closed by catgut suture. Suture of overlying muscle may be used for this if the pleura is deficient, but the latter can usually be approximated. Suture of the muscle layer completes the closure of any minor deficiencies. The skin wound is closed by sutures at wide intervals, a dressing is applied and fixed by adhesive plaster. The great matter is to get the chest completely closed.

The marked improvement in a patient's condition during an abdominal operation on closure of the diaphragmatic wound was expounded by Captain Lockwood, and has been accepted by all. The same astonishing mechanical phenomenon appears after closure of open wounds of the chest.

If the operation is performed under local anaesthesia the patient can be got to expel a part or the whole of the air in his pleural cavity as the last suture is being tightened.

The whole aim of the operation is prophylactic against sepsis, and to bring the patient as nearly as possible to the *status quo ante*. If it fails, a secondary drainage operation may be required later. The procedure helps to eliminate secondary infection from the outside.

The lung expands gradually and apparently in inverse ratio to the amount of visceral damage. I have seen several cases in which a pneumonic condition appeared on the healthy side, and where the patient was apparently tided over the crisis by the activity of the wounded lung.

While operating on cases of infected haemothorax with open "sucking" wounds or severe rib injury, I have on several occasions found the lung adherent to the chest wall in the neighbourhood of the wound. The haemothorax is shut in by these adhesions. I have seen the same at two autopsies. Is this an attempt by nature to close an open chest cavity? It would explain the anomalies in clinical signs found in some cases and might account for the occasional difficulty in getting a sample of pleural fluid when an infected haemothorax is present. In two cases I have seen recent adhesions of the sound lung to the chest wall. I think this may be more common than is generally accepted.

Of course, one is dealing with a class of case in which the injury is very severe and the operative mortality must be high. When one considers that the large majority of cases will die if "left alone" the results indicate a very considerable advance on the more conservative methods of treatment.

Cases in Group B (2) and (3) do almost uniformly well if treated on these lines. Those earlier cases which died appeared to succumb to a secondary infection of the pleural cavity from the infected wound of the chest wall.

In the majority of the simpler cases of septic haemothorax which died in the casualty clearing station to which I am attached a streptococcus appeared to be the main infection. It is probable that systematic very early exploratory aspiration and culture will indicate means whereby this mortality may be reduced. It appears to me that this branch of surgery, although still in its infancy, has already saved many lives which would otherwise have been lost. Results will improve with improved technique and further investigation.

These are the factors which incite me to put in print my early findings. From my point of view, these remarks are premature, but, if I succeed in attracting attention to what has been a somewhat stagnant field of surgery, this article will have served its purpose.

In a working period of approximately two months the following results were obtained:

Total cases of Group B operated on and chest wall closed	58
Evacuated apparently doing well	44
Died	14
Required secondary operation (drainage, etc.)	12
Number of cases with multiple wounds	29

Attached are the short original unaltered notes of the last six consecutive cases included in the above statistics.

CASE I.

Pte. A., wounded 1 a.m. June 16th, 1917. Large shell wound through left arm. Fragment proceeds through latissimus dorsi into left chest—open sucking wound. Haemothorax; surgical emphysema. Patient getting progressively worse since admission. Symptoms: dyspnoea, with sense of suffocation; cyanosis. Pulse 140.

June 16th, 3 p.m. Under morphine, local novocain, chest wall wound excised with four inches of sixth rib. Large wound of lung felt, but owing to patient's very precarious condition no extensive search for foreign body was made. One ounce of 1 in 1,000 brilliant green was put in chest after swabbing out. Closure of pleura. The patient began to improve immediately. Chloroform administered for rough trimming of arm. Pulse after operation 120.

The patient gradually improved, but on June 22nd still had a temperature of 102° and pulse 96. Chest aspirated; bacteriological examination negative. Only ½ oz. fluid obtained. No trace of brilliant green. Right lung showed signs of basal congestion, which Colonel Herringham considered was probably pneumonia.

On June 26th temperature 102° and pulse 108. Dull patch at base of left lung behind. Under local novocain, portion of ninth rib resected over dull area and localized abscess evacuated with large foreign body, wedged in body of tenth dorsal vertebra. This cavity communicated with a bronchus, but was shut off from pleural cavity. Carrel-Dakin. Progress steady. Patient evacuated in excellent condition, with normal temperature and pulse, on July 7th, 1917.

Note.—Here the affected lung carried the patient through his pneumonic crisis. Simple closure immediately improved the patient's condition.

CASE II.

Prisoner of war, H. S., wounded June 15th, 1917. Entrance and exit shell wound, right chest. Operation June 18th, 1917, under local anaesthesia with omopon. Large posterior sucking wound excised. Thorax wiped out. Lung found adherent to exit wound, partially blocking it. Streptococcal haemothorax. Symptoms of suffocation. Chest wall closed.

Improvement for twelve hours; death after twenty-four hours from streptococcal septicaemia. Extensive wound in lower lobe of right lung.

Note.—Streptococcal infections are always severe. Sucking wounds which are closed late have always a more serious prognosis.

CASE III.

Pte. B., high explosive wound, chest and left leg, June 16th, 1917. Entrance and exit wound, right scapular region with large open wound in neck; fracture of first rib behind angle. Extremely collapsed. Breathing very distressed. Under chloroform, partial excision of track. Bipp, paraffin pack, entirely plugging opening in neck. Severe bronchitis of "sound" lung.

June 22nd. Aspirated, 20 oz. Negative bacteriological report.

June 26th. Temperature and pulse normal.

July 3rd. Evacuated, well.

Note.—When the track cannot be efficiently excised and closed a paraffin pack (gauze wrung out of liquid paraffin) is extremely efficient.

CASE IV.

Pte. J., wounded June 21st, 1917. Under chloroform and oxygen, wound of left lower chest with tear of tip of lower lobe of lung and diaphragm. Foreign body removed from diaphragm, which was sutured with catgut. Upper wound small; excised. Fragments of rib removed from entrance and exit wound of lung; 40 c.cm. brilliant green injected (into pleural cavity), chest wall closed. Multiple wounds of left arm; partial excision and Carrel.

July 2nd. Temperature normal but breathing easily disturbed by moving.

July 4th. Evacuated, apparently well.

CASE V.

Pte. P., wounded 12 midnight, July 2nd, 1917. Operated on twelve hours later. Much shock; hypertonic intravenous saline. Resection of fractured ribs in front. Hernia of omentum into chest cavity. Excision of wounds. Hernia reduced. Diaphragm closed by six sutures; chest wall closed by suture. After wiping out haemothorax and 1 oz. brilliant green injected, bullet casing removed from spleen. Spleen and kidney drained, packed with gauze; only upper pole of kidney damaged.

July 12th. This patient has made practically an uninterrupted recovery.

CASE VI.

Second Lieutenant X., wounded June 30th, 1917. Wound of kidney, spleen, and large tear of diaphragm from chest wall. Haemothorax wiped out; brilliant green injected, and diaphragm stitched to chest wall with mattress sutures. Fragment of shell removed from above spleen. Upper pole of right kidney pulped; spleen and kidney packed; no apparent injury to lung. Uninterrupted progress.

July 8th. Patient evacuated, well.

THE SURGICAL TREATMENT OF SEVERE WAR WOUNDS OF THE CHEST.

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The early treatment of penetrating wounds of the chest is one of the problems of the present war which is of the greatest importance.

Up to now the materials for the discussion of the problem have been relegated mainly to the physician, and it is only recently that the surgeon has had the opportunity of operating on any but late cases. Accordingly the results of a sufficient number of cases on which to form a just estimate of the value of operative treatment as compared with expectant measures have not been available.

We have collected the results of our experiences of these cases, and we offer them as a contribution to the discussion.

During the earlier part of the period the results have led us to believe that, except in cases where the general condition of the patient will not allow of these measures, there is no defensible reason why chest injuries should not be treated at the earliest moment on exactly the same principles as wounds of other parts. It is generally admitted that the proper treatment for open wounds of limbs is to excise all the lacerated tissues and to remove the foreign body. In so far as these measures are not carried out with perfect technique and success, so