Observations

ON

WAR SURGERY OF THE CHEST.

BY

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AND

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(Concluded from p. 109.)

PART II.

OPERATION.

IN no other branch of war surgery is the technique of the operation more exacting, although the manipulations themselves do not require any exceptional dexterity.

A separate theatre is reserved for chest and abdominal operations and a uniform temperature of 80° is maintained. We have found it possible under all conditions, and we believe it is always possible, to maintain as perfect asepsis in a casualty clearing station as in civil hospitals. Cap, mask, gloves, and gown are worn by operator, sister, and assistant, and changed between each case. No one is allowed in the theatre unless wearing a sterile gown, and patients are brought into the theatre in blankets and pyjamas which have been put through the Thresh disinfectant the night before. The patient has been given omnopon-scopolamine (one ampoule) an hour before operation, and, if not sleeping, is given one-half ampoule half an hour before being taken to the theatre.

For operation the patient should be maintained with the injured side dependent. In the majority of cases the half-sitting posture is the most comfortable. A simple apparatus has been devised which allows free access to the injured side and which can be applied to any table.

If the patient cannot be placed with the injured side of the chest dependent, the lung should be grasped with forceps of the Collin pattern immediately on opening the thorax, and sufficient traction exerted to correct displacement of the mediastinum (Murphy).

The skin is prepared with picric acid (3 per cent.) in spirit; paravertebral anaesthesia is administered for two or three spaces above and below the wound, depending on the extent of the wound and the incision contemplated. To avoid delay, a local infiltration around, but at some distance from, the wound is employed. Novocain 0.5 per cent., potassium sulphate 0.25 per cent., in normal saline, prepared fresh and repeatedly autoclaved, is injected with a Gray's syringe (10 minims of adrenalin per ounce are added just before use). Gas and oxygen should be available to be administered while the hand is inside the chest or if the patient is restless; in the latter event a light nitrous oxide analgesia only is maintained.

The most serious chest cases can be operated upon with this type of anaesthesia—cases which would never be fit for a general anaesthetic, such as ether or chloroform. A more extensive, deliberate, and protracted operation can be undertaken with the minimum of shock to the patient under local anaesthesia combined with gas and oxygen. Respirations are deeper and more regular than with ether or chloroform, and the movements of the lung, mediastinum and diaphragm can be voluntarily controlled by the patient to some extent. The two-stage operation, which will be described later, is possible only with this type of anaesthesia. Post-operative restlessness, vomiting, retching, and coughing never occur, and this plays no small part in the success of the operation, especially in a busy unit where an attendant cannot always be at the bedside.

Never should ether or chloroform be used in chest surgery. The manipulative technique of chest surgery is extremely simple, but the utmost speed is essential. There is no doubt that unless primary union is obtained the patient's condition is made grievously worse by operation. Primary union will not result without bold and thorough excision of the wound area. After the track of the missile through the chest wall has been excised, the gloves of the operator are changed, the instruments used are discarded, the skin is again thoroughly cleansed with picric acid, and fresh towels are used. Rubber dam, if available, or towels are draped about the incision, in such a way as to expose no skin and the minimum of muscle, and fixed with clips. The patient and table should be entirely covered with sterile towels or an operating sheet.

When the position of the wound will permit, resection of the fourth rib from the mid-clavicular to the posterior axillary line furnishes the easiest access to the thoracic cavity. Resection of the rib must be wide enough to allow careful inspection of the cavity. Doyen's periosteal elevator and costotome are the instruments we have found best for resection of the rib. Tuffier's retractor is most satisfactory for obtaining a sufficiently wide opening. It is important, however, not to exert too powerful retraction on the chest wall, as the tendency to shock is thereby increased and the mediastinum unduly disturbed.

Immediately after opening the chest, rapidly mop out the thoracic cavity with gauze wrung out of hot saline carried on a long curved forceps of the Ochsner pattern. Unless there is fresh haemorrhage within the chest—which, of course, must always be attended to first—lacerations of the diaphragm must be first dealt with. Where access to the abdominal cavity through the chest is necessary the diaphragm may be freely incised without hesitation.

No wound of the diaphragm should be left unrepaired whether on the right or left side. Particularly when the missile has tracked through the diaphragm and lodged in the liver, the track through the diaphragm must be excised and the diaphragm incised widely enough to expose completely the track in the liver, and the missile removed. The track in the liver should be thoroughly cleansed out with a Volkmann's spoon, followed by swabs wrung dry out of saline and ether.

If oozing occurs, deep catgut sutures should be inserted with a blunt needle. As we have pointed out in an earlier paper on "Abdomens," missiles should not be left in the liver. A complete and thorough toilet of the track is always necessary; haemorrhage is not to be feared. The very low resistance of the hepatic tissues to infection makes it important to remove all sources of infection. Having dealt with the liver, close the diaphragm with mattress sutures of catgut on a blunt needle, except where the diaphragm is stripped from its parietal attachment. We do not believe it is advisable, or ever necessary, to suture the diaphragm to the chest wall (as suggested by Depage).

If the missile has passed through the diaphragm into the abdomen and an injury of a hollow abdominal viscus is suspected, it is wiser to deal with the abdomen after having closed the chest. After repair of the diaphragm, the lung, held with the Collin forceps, should be brought up to the opening in the chest (pneumopexy prolongs the operation and is never necessary), remove the missile or fragment of rib (if lodged in the lung), excise, thoroughly clean and suture the track or lacerations with mattress sutures of catgut, which should not be so tightly tied as to tear out on expansion. For repair of lung tissue a blunt round-bodied needle is used.

Partial lobectomy may be necessary, depending on the degree of laceration of the lung. Total lobectomy and, in one case, excision of both middle and lower lobes of the right lung has been necessary for acute malignant gas gangrene, but has not saved the patient's life. We have been struck by the rarity of finding an open bronchus at operation. For such a condition crushing and ligaturing with catgut is sufficient. It is essential that the visceral surface of the lung should in all cases be approximated, thus mechanically retarding effusion from damaged lung, and lessening the tendency for infective conditions to light up in the lung substance itself. Haemorrhage from the lung need not be feared.

All blood clot, pieces of cloth, fragments of bone, etc., must be carefully hunted for and removed from the thoracic cavity. The toilet of the pleura can better be performed by sponging (as in the case of the peritoneum) than by washing out. The last step before closing off the pleural cavity is to sweep round the chest wall, lung, mediastinum, and diaphragm systematically with swabs wrung dry out of hot saline, and, finally, with a swab wrung dry out of warmed ether.

The chest should always be closed, unless there is extensive gas gangrene of the lung tissue itself adherent to the chest wall.

Time should not be wasted in attempting to repair the parietal pleura in extensive wounds, as it can rarely be done; such pleura as remains can be caught up with the muscle sutures.

The chest must be hermetically closed with the first

layer of muscles, otherwise pocketing will occur, pleural effusion accumulate, the incision break down, and the operation fail. From the time the pleura is opened until it is closed, when the hands of the operator are not actually in the chest, the hole in the pleura should be covered by thick lint wrung dry out of hot saline. This closure is important, even if only for a moment at a time.

Careful approximation of the skin edges is necessary to ensure early and absolute primary union.

At one time we concluded the operation by aspirating the air from the pleural cavity with a Record syringe. From what we have seen of early post-operative expansion of the lung this step is unnecessary.

In some few cases we have left sodium bicarbonate solution in the chest (Witzel's method) and withdrawn it after eighteen hours. We have seen no benefit from its use either in providing an alkaline field to inhibit bacterial growth or in aiding expansion of the lung. A wide gauze dressing with mastisol or "aeroplane dope" reduces the tension on the sutures and binds the layers of the chest wall so as to prevent oozing and pocketing. A binder made of 7 in. adhesive plaster (tying over the dressing) is valuable to retain the dressing, as well as to relax tension on the sutures and leave the sound side of the chest free for expansion; the latter is extremely important.

On completion of the operation the patient should at once be supported in a semi-recumbent position inclined to the injured side.

The "two-stage" operation is indicated in the type of case with the entrance and exit wounds far apart—front and back or lateral—where gross lesion of the bone, or extensive destruction of the tissues, necessitates an extensive operation of both wounds. In such a case, enter the chest through the wound which allows freest access to the pleural cavity and to the part probably damaged. After carrying out the operation as outlined above, leave the patient on the table in a comfortable position, surrounded by hot-water bottles. Give intravenous sodium bicarbonate or blood transfusion as required, administer sodium bicarbonate and glucose, 8 oz., per rectum. Half an ampoule of omnopon should be given if the patient is at all restless. After one or two hours, deal with the other wound. For the second stage, a further paravertebral anaesthesia is frequently not required—merely local infiltration about the site of the incision.

Lacerations of the diaphragm on both sides should be dealt with by this "two-stage" operation.

There is a percentage of cases in which the treatment between the two stages will recuperate the patient to such a degree that he is fitter for the second stage than he was for the first.

Injuries of the heart or pericardium can be best dealt with by a parasternal flap of the fourth and fifth, or the fifth and sixth, costal cartilages, depending on the probable site of the lesion (the divided cartilages unite rapidly), and this route, in addition, gives free access to the pleural cavity.

Where the missile has passed across the pleural cavity and lodged in the mediastinum, especially high up, it is wiser to enter the mediastinum through the sternum. The missile should be removed, its bed and track thoroughly cleaned, and the pleural opening closed to prevent any leakage from the mediastinum into the pleural cavity. This serves a double purpose—it obliterates a pocket in which pleural effusion might accumulate, and shuts off from the pleural cavity a source of reinfection. It is difficult to deal with the mediastinum through the usual costal incision.

Gross lesions of the pareties under the scapula are always difficult to reach. It is possible to deal with such wounds from either vertebral or axillary border—winging or fixation of the scapula never results if movements are started early enough. Trephining of the scapula is neither advisable nor necessary.

Extensive injuries to the spinal column when associated with wounds of the thorax, even if the cord is not damaged, are usually rapidly fatal.

In the gross wounds of the thorax which cause death on the battlefield, or in the advanced dressing stations, injuries to the phrenic nerve are probably frequent owing to its anatomical situation. We have frequently seen a "flapping" diaphragm under the screen where we pre-

sumed that the phrenic nerve was injured. In one case a diagnosis of hernia of the stomach through the diaphragm was made. At operation the diaphragm was found to be exceptionally high. Death occurred thirty-six hours from the time of receiving the wound; autopsy revealed a phrenic nerve almost completely severed.

A pin-head perforation of the descending aorta, still bleeding after twenty-four hours, was discovered at operation in one fatal case. In four cases leakage from the thoracic duct has been diagnosed. Rapid and extreme emaciation characterized all four cases. Death ensued within twelve to twenty-seven days. In all of these cases the wounds, apart from that of the duct, were so extensive that no surgical interference with the duct could be undertaken.

POST-OPERATIVE TREATMENT.

The post-operative treatment of chest wounds demands greater attention and more minute daily observation of the patient than wounds of any other region.

The patient is kept at rest in the position he finds most comfortable; this is usually semi-recumbent at first, later he is raised to a semi-sitting posture. The patient's position is changed frequently, but the injured side is always kept dependent. If cyanosed, oxygen passed through warm brandy is inhaled. Undue restlessness is not to be allowed; omnopon in small doses is freely administered, if required. Every means of counteracting acidosis is employed. Glucose and sodium bicarbonate (5 per cent. each) are administered per rectum by continuous drip for forty-eight hours (as a rule, about 5 pints can be absorbed in this way in twenty-four hours). Sodium bicarbonate (80 to 100 grains per diem) is given by mouth until the patient is absolutely convalescent. Barley sugar is allowed *ad lib.* The patient sips a 2 per cent. solution of glucose (8 oz. every two hours). Forced and frequent feeding is essential. The bowels are kept acting freely, as an overloaded colon is a source of great discomfort to the patient. Stimulants of all kinds, such as camphor, strychnine, caffeine, etc., are avoided; brandy is given if the patient is an habitual user of it.

Chest cases should be nursed in the open air if possible. Aspiration is carried out as a routine eighteen hours after operation and at the end of the third day. Exploration of the chest is performed at frequent intervals whenever an accumulation of even small quantities of fluid is suspected, and fluid, if found, is removed by aspiration. Fluid must not be allowed to collect after operation. Physical signs are misleading, and nothing but repeated use of the exploring syringe and aspirator, aided by x-ray examination, will keep a chest safely emptied of fluid.

CONCLUSIONS.

1. Chest cases are as urgent as abdominal cases and should be evacuated direct to the casualty clearing station as soon as they can stand the journey.
2. The better the evacuation from the battlefield, and from the advanced medical units, the severer is the type of case that reaches the casualty clearing station. Thus deaths occur in the casualty clearing station which would otherwise take place further forward. This was particularly noticeable in our "Z" group.
3. The percentage of severe chest wounds reaching the casualty clearing station is very much greater when the casualties are principally due to shelling and bombing, especially of the back areas, when the casualty clearing stations are the nearest medical units.
4. Cases of traumatopnoea should be closed (preferably by suture) at the advanced dressing station, or even, if possible, at the regimental aid post.
5. All chest cases should be given morphine early.
6. Active resuscitation must be carried out at the casualty clearing station immediately upon admission. The majority of severe chest wounds require blood transfusion.
7. The value of x-ray examination in chest surgery cannot be over-estimated.
8. The complete intrathoracic operation is a serious one and should not be lightly undertaken.
9. Local anaesthesia, combined with gas and oxygen (if required), should be employed in chest surgery.
10. Speed and absolute asepsis are essential to success.
11. The operation must begin with *excision in toto* of the wound and end with hermetical sealing of the thorax.

12. No fluid must be allowed to collect in the pleural cavity after operation.

13. Resection and drainage should be a late resort, and are rarely necessary, never unless severe constitutional symptoms of infection are present.

14. Non-operated cases should be treated precisely as post-operative cases.

15. Men who have been exposed to asphyxiating gases bear chest wounds badly.

16. At certain seasons bronchopneumonia is a complication greatly to be feared. (Vide autopsy reports.)

In no class of surgery is team work so essential to success. The surgeon, physician, radiographer, and anaesthetist should work hand in hand. The theatre sister should be particularly quick and methodical, knowing each step in the operation, and avoiding delay by having everything prepared in advance and at hand. A post-operative sister, who has had long experience in the nursing of these cases, is a most important member of the team.

ILLUSTRATIVE CASES.

Appended are brief accounts of six cases operated upon. These have been selected as representative examples of various types of injury and the operations performed.

CASE I.

Pte. D., aged 34. Case of traumatopnoea, missile lodged in right lung, comminuted fracture of fourth and fifth ribs. Operation. Gas infection of pleural cavity treated by repeated aspiration.

Admitted September 18th, 1917. On arrival the patient was in a condition of extreme collapse. Resuscitation for six hours.

Operation (ten hours after wound).—Omnopon-scopolamine; anaesthesia paravertebral and local. Wound, situated in right mid-axillary line, widely excised. Two inches of fifth and four inches of fourth rib removed; large haemothorax; track admitting two fingers entering outer and upper aspect of lower lobe extending to inner and posterior border. Contusion of lower half of injured lobe. Missile removed. Track thoroughly excised and closed with mattress sutures of catgut. Pleural cavity swabbed dry. Chest closed in layers.

Progress.—Aspirations were made at the following periods after operation:

- 18 hours: 7 oz. blood-stained serum.
- 19th day: 9 oz. thick pus. Cultures: aerobic sterile; anaerobic gas producers.
- 23rd day: 7 oz. thick greenish pus, distinct odour. Cultures: aerobic, streptococci; anaerobic, *B. perfringens*.
- 27th day: 1 oz. thick pus. Similar cultures.
- 33rd day: 4 oz. dark-red stinking gas gangrene pus. A rush of gas escaped through trocar on insertion.

Explored on the forty-fifth day: No fluid or gas found. On the sixty-second day the patient got out of bed. He remained quite well, was very active doing light duty in the ward. After operation the patient expectorated blood-stained sputum, followed by thick nummular pus. Expectoration stopped after twenty days. This is a case of a type which three months earlier we should have treated by immediate resection and drainage on the result of the thirty-third day's aspiration. He was evacuated on November 20th, 1917.

It is cases such as this that persuade us that the ability of the pleura to deal with infection is very great, and that resection and drainage is an operation rarely necessary.

CASE II.

Private B., aged 19. Case of missile traversing right chest (haemothorax), mediastinum, and lodging in apex of left ventricle of the heart.

Admitted August 7th, 1917. Entry wound in right posterior axillary line. Closed haemothorax (right). Missile located by x rays on left side, presumably behind pericardium. There was no cardiac irregularity, and no signs of air or fluid in the pericardium. Haemothorax was aspirated on the fifth day (35 oz., non-infected).

Operation (fourteen days after wound, on account of continued pyrexia and missile being retained).—Omnopon-scopolamine; paravertebral and local anaesthesia (no gas and oxygen). Chest opened by parasternal incision through fourth, fifth, and sixth cartilages on left side. The missile was searched for behind the pericardium, but not found. No haemothorax on left side. On palpating the pericardium and heart the missile was felt in the heart muscle. The pericardium was widely opened, and the missile (quarter of an inch square) found lying superficially in muscle on the posterior aspect of the apex. No fluid in pericardium; thin, non-adhesive, sero-fibrinous film covering visceral and parietal pericardium. Unfortunately, owing to difficulty of accurate localization by x rays of a missile in the heart (especially at the apex, where movements are at their maximum and the limits of the pericardium are so close), the pleural cavity had been unnecessarily searched. Even the gentlest attempts to grasp the heart laterally, or to raise its apex (on catgut sutures), caused it to stop beating. As fourteen days had elapsed since wounding, and there was no inflam-

matory process round the missile, it was judged wisest to leave it *in situ*. The pericardium and chest were closed. During handling of the heart and pericardium the patient complained of no pain or distress, either cardiac or respiratory, although local anaesthesia only was used.

Progress.—Uninterrupted recovery. No cardiac irregularity was observed after operation. The patient was out of bed three weeks before evacuation, doing light duty in the ward. He was evacuated on November 4th, 1917.

CASE III.

Pte. McC., aged 19. Case of traumatopnoea (eighth space, left, in posterior axillary line) with missile and fragments of rib embedded in diaphragm.

Admitted August 27th, 1917. Condition fair, but patient complained of acute pain in epigastrium. Respiration typical of diaphragmatic injury. X rays showed "stutter movement" of diaphragm and large shell fragment probably impacted in diaphragm.

Operation (immediately after admission; eight hours after wound).—Omnopon-scopolamine; paravertebral and local anaesthesia. Gas and oxygen while hand was inside thorax. Haemothorax cleared. Lower lobe of left lung lacerated. Missile, 2½ in. by ½ in. by ½ in., found lodged in diaphragm. Two sharp spicules of bones and missile impacted in highest part of diaphragm, apparently causing the pain. Laceration (½ in.) of diaphragm close to costal border, and a second laceration where the missile was imbedded. Both lacerations of diaphragm and laceration of lung sutured. Chest closed. Immediately after operation the pain was relieved.

Progress.—Lung in total expansion within twenty-four hours. Four days after operation temperature rose to 104°; pulse 106; respirations 26. In spite of the pyrexia drainage was not considered, but on the tenth day, as pyrexia continued, aspiration was performed—1 to 2 ounces of perfectly sweet, blood-stained serum found. The temperature rose to 102° on the twenty-fourth and again on the twenty-eighth day. Nevertheless he made an uninterrupted recovery. He was out of bed on the thirty-ninth day, and did light duty in the ward for one month after. He was evacuated on November 4th, 1917.

CASE IV.

Sgt. B., aged 39. Case of penetrating wound of chest with perforation of diaphragm; missile lodged in liver.

Admitted September 11th, 1917 (four hours after wound). Condition, grave shock, resuscitation for three hours.

Operation.—Omnopon-scopolamine; paravertebral and local anaesthesia. Gas and oxygen while hand was in thorax. Small open wound in tenth space (right) in anterior axillary line and chipping of ninth rib. Wound excised *en masse* into pleural cavity. Incision extended; four inches of ninth rib removed. Small haemothorax with some blood clot. Lung two-thirds collapsed. Perforation in diaphragm the size of a threepenny bit. Active bleeding through hole in diaphragm, believed at first to come from diaphragm. Wound of diaphragm excised and incised extending one inch back and front from wound. Very small perforation found in liver, bleeding freely and suggestive of arterial blood. Track cleaned out with Volkmann's spoon. Incision made in track wide enough to admit index finger. Missile (high explosive fragment ½ in. by ½ in.) found three inches deep and removed. Bed of missile thoroughly cleaned with Volkmann's spoon and swabs wrung out of hot saline, finally one swab wrung out of warm ether. Track closed with four deep catgut sutures. Some blood clot lying below the diaphragm. Subphrenic space and right peritoneal cavity swabbed dry. Diaphragm closed with catgut sutures. Pleural cavity swabbed dry. Chest wall closed.

Progress.—Uninterrupted recovery. Lung in complete expansion after twenty-four hours. On aspiration, 5 oz. sterile serum. Out of bed fifteen days after operation. Evacuated November 20th, 1917. Doing light duty in ward for three weeks before evacuation.

CASE V.

Gunner C., aged 31. Case of penetrating chest wound; haemothorax; laceration of diaphragm, liver and kidney, with hernia of colon.

Admitted September 27th, 1917. On arrival at casualty clearing station he was moribund. Active resuscitation; heater-bed, sleep (omnopon), intravenous sodium bicarbonate (2 per cent.) 20 ounces. Rallied very slowly. Blood transfusion 600 c.cm., with Kimpton-Browne tube. (As this patient belongs to No. 3 blood group there was delay in finding a donor to correspond.)

Operation (6 hours after admission).—Prepared and taken to theatre directly after blood transfusion, condition being much improved. Pulse-rate 130 to 140; blood pressure 85; respirations rapid; right chest not moving; entire abdomen rigid. Large entrance wound, admitting three fingers (not sucking), just to right of body of third lumbar vertebra. Dirty jagged exit wound admitting three fingers over the costal cartilage of the ninth rib (right) in anterior axillary line. Colon herniating through exit wound, gangrenous patch size of 1 franc piece with half-inch laceration. Anaesthesia, paravertebral and local. Incision from edge of third lumbar vertebra to cartilage of ninth rib. Excision *en masse* of entry and exit wounds with deep muscle of back. Gangrenous patch in bowel excised and opening closed with Czerny-Lembert sutures of linen thread. Colon replaced in peritoneal cavity. Chest entirely full of clotted blood. A widely open laceration of the diaphragm, 5 in. long, ½ to ¾ in. from parietal attachment. Lung almost completely collapsed. Blood

clot removed. Pleural cavity swabbed clean. Diaphragm sutured with catgut. Laceration of outer and lower border of liver admitting three fingers, but liver not bleeding. Peritoneal cavity swabbed dry, peritoneum closed. Right kidney split across beyond repair. Nephrectomy. Incision closed except for small two-way catheter left in para-renal space for forty-eight hours. The operation was carried out entirely under local anaesthesia—no gas and oxygen. An almost continuous conversation was carried on between the patient and the anaesthetist during the whole operation.

Progress.—On account of difficulty in finding another donor of his blood group, sodium bicarbonate was given intravenously at the end of the operation. Recovery was complete and uneventful. The lung was in almost complete expansion in less than forty-eight hours. Although the patient remained perfectly well and had never complained since operation, on the twenty-first day an increasing area of dullness was noted in right chest. On exploration, fluid was found and 48 oz. of thin serum, of the colour and consistency of olive oil, was withdrawn by aspiration. Cultures, staphylococci. Explored ten days later—no fluid found. He was evacuated on November 20th, 1917, perfectly well.

CASE VI.

Sgt. G., aged 32. Case of chest crushed by falling in of dug-out. Subscapular fracture of four ribs (third, fourth, fifth, and sixth) on left, and two ribs on right side. Small haemothorax or haematoma of lung (left). Detained at advanced dressing station for twenty-four hours.

Admitted September 6th, 1917. On arrival at the casualty clearing station he was deeply under the influence of morphine, but coughing and complaining of intense pain in the left scapular region. Kept submerged with omnopon for five days. Each day an effort was made to discontinue omnopon, but violent coughing and pain made this impossible. X rays showed over-riding of fractured ends of fourth, fifth, and sixth ribs (left side) to the extent of nearly three inches; the third rib on left, and the two ribs on right showed clean fractures. Effusion in left pleural cavity increasing. It was decided to undertake this most serious operation because it seemed impossible to relieve the pain otherwise, and the patient's condition was becoming rapidly worse.

Operation (September 9th).—Omnopon-scopolamine; para-vertebral (six spaces) and local anaesthesia. A curved incision was made from the second to the seventh intercostal space (left), internal and parallel to the vertebral border of the scapula. Pleura found open in the fourth, fifth, and sixth spaces. Three inches of each of these ribs removed. Haemothorax (3 to 4 oz.) cleared out. Left lung in almost total expansion, with its entire posterior surface excoriated, and showing minute petechial haemorrhages in its substance. Pleural cavity swabbed dry. Incision closed. No gas and oxygen given.

Progress.—Aspirations were made at the following periods after operation:

- 18 hours: 10 oz. blood-stained serum.
- 11th day: 1 oz. blood-stained serum haemolysed.
- 14th day: 12 oz. blood-stained serum with streaks of pus.
- 19th day: 10 oz. thick, foul-smelling pus. Cultures: aerobic, staphylococci; anaerobic, gas producers.
- 24th day: 20 oz. thick, foul-smelling, yellowish-green pus. Cultures: staphylococci and gas producers.
- 28th day: Explored; no fluid found.
- 31st day: 7 oz. fluid, more serous and sweeter.
- 33rd day: 6 oz. thin yellowish serum, sweet.
- 36th day: 4 oz. yellow serum, streaked with pus, sweet, sterile.
- 42nd day: 8 oz. yellowish-red serum, sweet. Cultures: aerobic, sterile; anaerobic, gas producers.
- 45th day: Explored; no fluid found.

Convalescence uninterrupted. He was out of bed on the seventieth day, and evacuated on November 20th, 1917.

As the hospital had to be cleared, this patient, together with two others, was evacuated before being put on light duty. All aspirations were made in practically the same place in the left mid-axilla. They appeared to empty a small localized collection. Otherwise the lung was in complete expansion eighteen hours after operation. Although this case was operated on under the most rigid asepsis and there was not even an abrasion of the skin, bacteria gained entrance to the pleural cavity. The wound itself healed by first intention. Immediately after operation the patient lost his pain and it did not return. The success of this operation, in spite of a subsequent empyema, suggests that more radical surgical measures might be adopted in similar cases in civil practice. The rapid recovery by aspiration from an empyema infected by aerobes and anaerobes demonstrates that repeated aspiration should be resorted to before considering resection and drainage. The mortality of the latter operation in chest wounds at casualty clearing stations is nearly 50 per cent. (Elliott).

THE School of Maritime Hygiene at Naples has, by permission of the Italian Minister of Marine, assumed the name of the late Professor Alessandro Pasquale, colonel in the medical service of the Italian army, its founder and organizer. He made it a centre of higher study in hygiene and tropical pathology for the special instruction of medical officers of the navy.

A PRELIMINARY NOTE ON THE TREATMENT OF INFECTED HAEMOTHORAX.

BY

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THE surgical treatment of infected haemothorax depends, as in other infections, on the stage at which the case is seen and the necessity for intervention recognized. Resection of rib, evacuation of fluid and clots, the removal of foreign bodies when possible, and immediate closure of the pleural cavity, is ideal, and is being more and more widely adopted at the casualty clearing stations. It is only applicable in the earliest stages of the infection, and at present the published records leave some doubt as to the results and the number of cases in which a secondary drainage has to be established. Experience of men detained on the lines of communication as unfit for further transport shows that when recurrence of symptoms arises these patients very rapidly become seriously ill.

A high degree of surgical judgement is required in the selection of cases of infected haemothorax suitable for immediate closure. As experience increases, and facilities for early operation are improved, we may expect much better results; but at the present time there are a large number of cases which cannot be treated in this way—the infection has passed beyond the contents to the walls of the pleural cavity.

I have had some opportunities of treating cases of this kind by a method of irrigation through a special cannula (Fig. 1), which appears to be of promise. The curved silver cannula has no terminal aperture, and is perforated with twelve small holes. It is employed in the following manner:

FIG. 1.

A sufficient opening is made into the chest by resection of a length of rib, preferably the eighth. Tuffier's spreader is then inserted, the pleural cavity wiped out, and perhaps a foreign body is removed or other complication dealt with. A point on the chest wall towards the upper limit of the cavity is selected where the cannula may most conveniently be introduced. This is usually in the third or fourth space, about or just external to the mammary line; a small incision is made through the skin, and the cannula pushed through the intercostal muscles into the

FIG. 2.

chest. The tip of the cannula should point outwards and downwards, and the instrument is fixed in position by two sutures to the skin. The original incision is then closely sutured around a tube which may be long enough to reach into a bottle of antiseptic fluid (Fig. 2). The tube of a Carrel ampoule is then attached to the cannula, and