PLATE VI.

Mr. J. E. H. Roberts - - - - Treatment of Empyema

FIG. 1. The lower lobe has expanded leaving long sinus leading to a pical cavity.

FIG. 2. Plain X-ray of drained empyema.

FIG. 3. Same case as FIG. 2 with cavity filled with lipiodol.

FIG. 4. Same case as FIG. 2 in true lateral view with lipiodol.
THE TREATMENT OF EMPYEMA.

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General Considerations.

The physical signs of an empyema vary with the state of the subjacent lung. If the alveoli still contain air the classical signs of absent breath and voice sounds with dulness on percussion are present, but if the lung is compressed and airless, bronchial breathing and bronchophony will be found, and the diagnosis of unresolved pneumonia is often made. When the pus is in an unusual position, as on the mediastinal aspect of the lung or on top of the dome of the diaphragm, abnormal physical signs may be absent. It is in these cases that the history of a pneumonia with a sustained rise of temperature after the initial fall is of such importance. If the presence of an empyema is suspected, steps must be taken to obtain definite proof one way or the other by (1) exploratory puncture; (2) X-ray examinations, or (3) occasionally exploratory operation.

Exploratory puncture should be carried out painlessly by first instilling 1 per cent. novocain solution down to the parietal pleura with a very fine needle. Failure to find existing fluid may be due to the exploring needle being too short to reach the pleura in a fat subject, or to fibrinous clots blocking the needle, or to the needle having passed through the layer of fluid into the lung. The blocking by fibrin may be caused by a blunt needle pushing fibrin before it. This may be obviated by using a sharp needle with a small lateral hole near the end on the opposite side to the terminal bevel. Punctures should be made in several intercostal spaces before failure is acknowledged, and especially through any spot which is tender on pressure.

The fluid obtained should always be examined bacteriologically. A sterile fluid with a foul odour is suspicious of actinomycosis.

The general condition of the patient is of great importance. The ordinary type of empyema is metapneumonic, that is, it does not develop or is not recognized until after the acute stage of the pneumonia is over, by which time the vital capacity has increased. The patients are not acutely ill, and can safely be treated by open drainage. The acute streptococcal empyemas, especially following influenzal pneumonia, are synpneumonic, the vital capacity may be very low, and the patient may be desperately ill with severe dyspnoea and cyanosis. These cases should be treated at first by one of the "closed" methods.

The extent of the empyema:— With very large effusions causing marked displacement of the mediastinum, even of the metapneumonic type, sudden decompression by open drainage may be dangerous. In such cases 800-1,000 c.c. should be aspirated before drainage, or intercostal drainage by a catheter be performed.

The age of the patient:— In infants, the mediastinum is more mobile than in adults, and therefore open thoracotomy is more dangerous. Unless some form of positive pressure anaesthesia is used it is unwise to operate on infants by an open technique.

Bilateral empyemas are usually metapneumonic. It is advisable to drain one side and aspirate the other, draining the second side a few days later. Of 5 pneumococcal and 2 streptococcal cases treated in this manner, all made a good recovery.

Anaesthesia. In the majority of cases local infiltration with 1 per cent. solution of novocain with adrenalin, preceded by an injection of morphine and
hyoscine, will enable rib resection and drainage to be performed painlessly. It is better to infiltrate the periosteum above and below the desired area of rib rather than to attempt para-vertebral injection of 3 intercostal nerves.

If a general anaesthetic is desired, then nitrous oxide and oxygen is the safest.

Closed Treatment of Acute Empyemas.

Aspiration has the advantage that it requires little special apparatus, but the process as frequently carried out is very exhausting to the patient. It has to be repeated at intervals of 48 hours, and during this time toxaemia continues, though to a lessened extent. Infection of the chest wall is frequent, though this may be obviated to some extent by making a small incision down to the intercostal muscle, and keeping this small wound packed open with vaseline gauze. Subsequent aspirations are made through this area.

Closed continuous drainage has the advantage that the cavity is kept free of fluid—though not of fibrin—toxaemia is diminished and the lung is enabled to expand. Occasionally no further operation is required. The disadvantages are that the patient may pull the tube out, though in two cases where this happened no pneumothorax followed, and that in narrow intercostal spaces the pressure of the tube may cause necrosis of the adjacent ribs. The advantages of closed continuous drainage over repeated aspiration, however, in my opinion, are very marked.

Technique. Under novocain infiltration an incision ½-inch long is made in the skin and a suitable trocar and cannula slowly pushed through an intercostal space. A self-retaining catheter of a suitable size is stretched upon an introducer and at once pushed into the cannula as the trocar is withdrawn, thus preventing the entry of air. Holding the catheter in place on the introducer, the cannula is now slipped out of the chest wall and finally the introducer is withdrawn as the catheter is clamped, to prevent entry of air. The catheter is withdrawn until it is estimated that about an inch projects within the pleural cavity, and it is then fixed in position with a large safety-pin and adhesive strapping. The distal end is connected by a glass connection to a tube leading to a water seal in a Woulfe’s bottle. If the cavity contains several pints of fluid, decompression can be done slowly by means of the clamp.

Open Operation.

The site for drainage should be at the bottom of the cavity, usually the 9th rib laterally or the 10th posteriorly. Three inches of rib should be removed sub-periosteally and the cavity opened. All masses of fibrin should be removed by sponge forceps and by gently rubbing the walls of the cavity with gauze. A large drainage tube with an external diameter of ¾-inch and the end cut obliquely should be introduced just inside the pleura so that it rests on the floor of the cavity with the oblique opening facing upwards. The muscles and skin should be firmly sutured around it. A smaller second tube for subsequent irrigation may be added alongside the first. A special tube with a flat internal flange may be used, but has the disadvantage that in some cases the lower part of the lung expands first and occludes the end. The tube as before is connected to a bottle with a water seal under the bed. The small secondary tube should be fitted with a wooden plug. The tube may be secured by a safety-pin and strapping or by an external rubber flange with tapes running round the body.

In stinking empyemas and in secondary open operations on streptococcal cases which have had an intercostal catheter introduced previously, it is often better
not to suture the wound but to rely on the external rubber flange, with a thin layer of vaseline gauze beneath it, to render the cavity airtight.

Post-Operative Management.

It is not necessary to change the tube more than once a week. When the cavity is clean and its capacity under 100 c.c., the size of the tube is reduced, but a small one must be left in until the lung is completely expanded. It is bad practice to remove the tube altogether as long as any cavity remains, however clean, as the sinus in the chest wall will promptly heal and in the majority of cases pus will again collect sooner or later in the cavity.

Irrigation. It is a great advantage to irrigate the cavity regularly after the first day or two. There is no danger provided the fluid is not too hot or too cold, and is not under pressure. The first irrigation should be done with a little normal saline solution in case an unknown broncho-pleural fistula is present. After that Dakin's solution or Eusol is preferable, as it is not only an antiseptic but has the property of dissolving fibrin. The patient should be so placed that the opening in the chest wall is uppermost and the cavity completely filled with the solution, so that all parts of its wall are washed. It is then emptied and the process repeated until the fluid is returned clean; finally the cavity is allowed to remain full for 10 minutes.

Breathing exercises should be started as soon as possible and carried on systematically. These are of two types: (1) Forced expiration with the glottis closed as in blowing up an air ring or the classical coloured fluid in two bottles. In this exercise the air is forced from the sound lung over the bifurcation of the trachea and the lung of the diseased side is expanded; (2) Active inspiratory exercises of the type introduced by Mr. C. MacMahon. These are of much greater value, but must be given by a trained masseuse.

Management of Tube: The tube may at different times be too long or too short. It is too long if a fluid level can still be seen in an erect radiogram below the internal opening of the tube. On the other hand, if the lung expands in the lower part the tube will need lengthening. (Fig. 1, Plate VI.) As after drainage physical signs not only do not give accurate information as to the expansion of the lung, but are positively misleading, it is necessary to keep a watch on the process by other means. At first a rough estimate of the size of the cavity can be made by measuring the quantity of fluid it holds, but there are many fallacies. The most accurate method, when it can be carried out, is by periodical antero-posterior and true lateral radiograms, after introducing lipiodol or other opaque fluid into the cavity. For large cavities a thin barium suspension is excellent and cheaper. Figs. 2, 3 and 4, Plate VI, are from a case in which the cavity was clean, the temperature normal and a probe could only be introduced 2½ inches. Physical signs suggested that the lung had expanded. An ordinary X-ray (Fig. 2, Plate VI) was not helpful. The other two shew that a large cavity still exists and that the sinus occupied by the tube is at right angles to the cavity. On lengthening the tube instead of removing it, the cavity rapidly closed.

Chronic Empyema.

Chronic empyema may be (1) latent, in which the empyema, with or without a bronchial fistula, is not discovered for many months or even years; (2) persistent, in which the empyema persists for an abnormal length of time after drainage; (3) tuberculous.
Caustation of chronic empyema.

(1) Removal of the drainage tube before the cavity is obliterated.
(2) Persistence of the infection in the cavity from
   (a) failure to remove fibrin at the time of drainage;
   (b) improperly placed opening, so that a pool of pus remains at
       the bottom of the cavity;
   (c) the drainage tube being too long or too short.
(3) Delayed expansion of the lung caused by
   (a) thick deposit in pleura;
   (b) broncho-pleural fistula;
   (c) fibrosis of lung.

The last two causes are comparatively rare.

(4) A foreign body in the cavity, usually a tube or other drainage material.

   Rarely a sequestrum from the rib.
(5) Unsuspected tuberculosis, actinomycosis, or growth.

Examination of patient. These patients are often suffering from long
continued toxæmia; they are anaemic, the cardiac muscles degenerate and amyloid
disease may be present. In all cases sputum, if present, should be examined for
tubercle bacilli. If a sinus is present a radiogram after the introduction of
lipiodol should be taken. If not, some lipiodol may be introduced through the
exploring needle.

Preliminary treatment. In most cases, treatment should begin by redrainage
of the cavity in a proper place, taking the opportunity to obtain a piece of parietal
pleura for histological examination. If irrigation and breathing exercises are now
carried out, in many cases the lung will expand and further operation be rendered
unnecessary. If it does not, further operation is postponed until the condition
of the patient, as shewn by functional heart tests, warrants it.

Operations for Chronic Empyema.

(1) Decortication. In a few cases, if the cavity can be freely opened up,
it is found that the layer of deposit on the visceral pleura can be peeled off and
that the lung thus freed will immediately expand. In my experience the operation
is a disappointing one, even if decortication is possible the lung does not always
expand. I have, however, had a successful case in which the empyema had
been draining for seven years!

(2) If the lung cannot be made to expand, it is generally necessary to col-
lapse the chest wall down on to the lung. The old operations of Estlander and
Schede are unsatisfactory, the former because mere removal of ribs does not
mobilise the rigid chest wall, the latter because the removal of the whole thickness
of the chest wall is a dangerous operation, with a mortality of 50 per cent., and
does not cure a good many of the remaining cases.

Author's operation. The operation is performed in multiple stages according
to the condition of the patient. In one, two, or three stages, according to the size
of the cavity, the ribs overlying it must be resected sub-periosteally. The stages
of decostalization proceed from above downwards, and the opening in the chest
wall is sealed off at the time of operation. The cavity is then laid open along its
antero-superior margin, the incision is then continued round the apex of the cavity in
such a way that the thickened parietal layer with the overlying intercostal muscles
and periosteum form a pedunculated flap that is hinged posteriorly. Where the vis-
ceral layer of thickened pleura runs into the parietal layer posteriorly a wedge of
fibrous tissue is resected so that the outer wall of the cavity is mobilised and comes
into contact all over with the inner wall. Vaseline gauze is now placed on the
outer surface of the chest wall flap and the skin and superficial muscle is sutured. Another pad of gauze is placed on the skin and strapped tightly with adhesive strapping. Ten days later the vaseline gauze that lies under the skin is removed and the external pad is renewed. (Figs. 5 and 6.)

**FIG. 5.**
Diagram showing decostalization over a chronic empyema cavity.

**FIG. 6.**
(a) Longitudinal section through chronic empyema cavity before thoracoplasty. (b) The operation completed: the gauze pack is seen lying deep to the skin and extracostal muscles. (c) The end result, viz.: complete adhesion between the visceral and parietal layers of pleura.


**Tuberculous Empyema.**

A pure tuberculous empyema with no secondary infection should not be treated by open drainage. In the majority of cases nowadays this condition supervenes on an artificial pneumothorax. Treatment is by repeated aspiration combined with pleural wash-out. This is carried out by inserting two needles, one at the bottom and the other at the top of the cavity. The cavity is then filled with the irrigating fluid from below upwards, the air escaping through the upper needle. The cavity is filled and emptied until the fluid used comes back clean, and then by connecting an artificial pneumothorax apparatus to the upper needle, air is withdrawn, so that a negative pressure is left. This procedure is carried out weekly until the lung is either expanded, or has ceased to expand.

A secondarily infected tuberculous empyema may be treated as above, but usually requires drainage. The drainage may be by intercostal catheter with under water seal, which is best placed in the anterior axillary line, so as not to interfere with the subsequent thoracoplasty which will be necessary in practically all these cases.

**REFERENCE:**