An Address

ON

SURGERY IN THE TREATMENT OF PULMONARY TUBERCULOSIS.*

BY

H. MORRISTON DAVIES, M.D., M.CHIR.CANTAB.,
F.R.C.S.ENG.,MEDICAL SUPERINTENDENT, VALE OF CLWYD SANATORIUM; CONSULTING
SURGEON, UNIVERSITY COLLEGE HOSPITAL AND KING EDWARD VII
WELSH NATIONAL MEMORIAL ASSOCIATION.

SOME twelve to fifteen years ago, and less, remarks on this subject were almost completely confined to pneumothorax. Even with this limitation the audience was apt to look askance at one, and a "sound" physician might show his soundness by asking, "What is the pneumothorax treatment?" or, "What are refills?" To have said at that time much about the further surgical possibilities when artificial pneumothorax failed was to run big risks of being thought so ultraheterodox (one might say mentally aberrant) that one's influence in the teaching of the simpler forms of treatment was likely to be seriously impaired. Nowadays artificial pneumothorax is referred to familiarly as A.P.; in my place the slang term "gassing" is used. Instead, moreover, of having elaborately to expound the principles to general practitioners, patients are sent to one definitely for this treatment.

The other and, if I may use the expression, more definitely surgical methods of treatment are not yet so widely recognized. They are more serious; they are associated with greater risks; and they are still, in this country, far from being widely known, or, when known, approved of. In respect of these operations one is still looked upon with suspicion and even with disapproval, and the making of converts is a slow but very interesting process.

Because of the general knowledge as regards artificial pneumothorax and the less general knowledge about the other surgical methods, I propose to take up the subject at the point where pneumothorax fails to be complete, or fails altogether.

The object of artificial pneumothorax is twofold: (1) to rest the lung; (2) to collapse the lung. The relative importance of these two varies in different cases. If the case is a fairly early one, even if progressive, rest is of more importance than collapse. It is, of course, true that the more complete the collapse the more complete the rest; but it does not follow that, if collapse is partial only, the rest obtained is of small value. In some cases a moderate partial collapse may be of the greatest value. In the more advanced cases, on the other hand, and particularly in chronic cases of long standing in which mechanical changes are well established and dilatation of the bronchi and cavities in the lung parenchyma are important and serious features, the question of rest is of less importance than that of collapse. The collapse, moreover, to be effectual, must be fairly complete so far as the affected parts of the lung are concerned. In haemorrhage, moreover, if the bleeding is to be arrested by the pneumothorax, the collapse must reach and must involve that part of the lung from which the blood is coming. In these cases, again, collapse is more important than rest.

From the above it becomes clear that the presence of adhesions limiting collapse may not be of great seriousness in the treatment of those cases in which rest is the desideratum, but may completely ruin the value of the method in those in which collapse is essential, even though the collapse may be equal to two-thirds of the lung volume. Statistics show, moreover, that the after-results with complete collapse are most strikingly better than those where collapse is partial and is limited by bands and membranes and adherent patches.

Apart from the consideration whether total collapse is necessary or not for the success in the treatment of any particular case, there are certain additional advantages gained by obtaining it. The symptoms are more quickly got

rid of; infection (in unilateral cases) ceases to be a constant danger; bleeding is often more completely controlled, and the intervals between refills is longer.

It becomes advisable, therefore, in some cases, and necessary in others, to divide, when practicable, those adhesions which are limiting collapse. The adherence of the surface of the lung to the chest wall may be in the nature of a fusion of the two pleural membranes; it may be by means of a broad membranous sheet allowing but little separation, and often vascular. The adhesions may consist of bands, single or multiple, varying in length and in size from the finest threads to cylindrical or flattened bands up to half an inch across. The larger the adhesion the more likely is it to contain vessels of a size demanding respect in their treatment. These band-like adhesions may be attached to comparatively healthy lung or actually over a cavity. They may have the appearance of starting direct from the surface of the partially flattened lung, or the band may be part fibrous tissue, part lung substance which has been drawn out into a cone. In these cases it is often difficult to say by means of the x rays where lung ends and the adhesion begins, though more possible by the aid of the thoracoscope. Where fusion of the membranes has taken place, division is not practicable; in all other cases division may be possible, but this cannot always be determined until the adhesion has been inspected.

The diagnosis of adhesions between the visceral and the parietal costal pleural membranes is not, in my opinion, possible before a pneumothorax has been attempted; unless it be by pneumograms as suggested by Deist. Adhesions may be suspected as a result of the ordinary clinical and radiological examinations, but that is all. The adherence of the base of the lung to the diaphragm can, on the other hand, be recognized when the dome of the muscle is distorted and flattened. In such cases the dome will show an angle, or even be drawn into a point, midway between the central tendon and the lateral costal attachments; during inspiration some movement of the outer half of the dome will generally accentuate the angular deformity. This type of distortion of the dome is not seen in cases of even extensive shrinkage of the lung if adhesions are absent. It is naturally more frequently observed on the right side.

The division of a single band-like adhesion clearly defined by the x rays as a strand running across the pneumothorax from the partially collapsed lung to the chest wall is comparatively easy with a special long double-edged tenotome passed through an intercostal space, the track having been previously anaesthetized with novocain. This must be done in the x-ray room, the patient being placed with the x-ray tube behind and the screen in front. When the tenotome has been inserted the x rays are turned on, the tenotome is directed so that the cutting edge of the blade rests on the adhesion, which is then divided by slight sawing movements.

When the adhesion is not so clearly defined, or is large, or is difficult of access, and particularly when there are multiple bands or membranes, or the condition inside the pleural cavity is somewhat obscure, then the thoracoscope will give invaluable aid by enabling very precise knowledge of the state of affairs and relationship and character of the adhesions to be obtained. With the vision obtained through the thoracoscope, moreover, those bands or membranes which are found to be interfering with the collapse can be divided as and where required by the galvano-cautery.

The technique is not particularly difficult, though practice is required in locating the adhesion, in manipulating the thoracoscope with one hand and the cautery with the other, and in deciding on the size of the band—the apparent size varies greatly with the distance from the lens. Fortunately practice need not be at the expense of the patient, as considerable skill can be acquired by manipulating the instruments inside a box across which pieces of string of various size and colour have been rigged. To those acquiring a thoracoscope and cautery I would make one suggestion: if, as in mine, the cautery is turned on and off by a sliding collar on the cautery handle, have this fixed in the "on" position and insert in the flexible wires a contact switch suitable for foot work.

Details of the technique are as follows: The table or bed on which the patient lies must be at a convenient height so

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that the surgeon can bend comfortably over the patient, to look down the thoracoscope when it is projecting two to three inches above the chest. It is much easier to look down the thoracoscope when the light in the room is comparatively dim. It is advisable to have a separate battery for both thoracoscope and cautery; it is also wise to have a resistance in each circuit.

The thoracoscope is sterilized by standing it for some minutes in 1 in 20 carbolic acid; all other instruments are boiled. All the instruments should be tested immediately before use. The cautery when hot should give a red glow: if too dark, the charred surface of the adhesion will stick to it; if too bright, bleeding from vessels will not be controlled.

As a general rule it is simpler to insert the thoracoscope through the front of the chest. In this position it is easy to look down it, and while the cautery is being introduced it can be left *in situ*, unattended if necessary, and will retain its position without falling over or dragging on the tissue. The thoracoscope is inserted close to where the adhesion has been localized by the *x* rays; if there are multiple bands, some in the upper and some in the lower part of the thorax, it can be inserted between them. The second or third intercostal space is the commonest site. The cautery is best inserted in the axilla in the fourth or fifth intercostal space. It is easier to work the two instruments if the cautery has to cross the thoracoscope to reach the adhesion.

If the patient is nervous, a third of a grain of omnipon should be given beforehand. The tissues of the chest wall through which the instruments must traverse are infiltrated with an analgesic. I use 2 per cent. novocain and adrenaline for this purpose. I also make a puncture incision in the skin to prevent the instruments dragging through it. Both thoracoscope and cautery are introduced through cannulas which are inserted through the chest wall by means of trocars. The thoracoscope is inserted first and a complete study of the interior of the pleural cavity is made. Then, when the decision as to what adhesions shall be divided has been reached, the trocar and cannula for the cautery is inserted. It is advisable to keep the patient at rest for at least sixty hours after the operation.

When pneumothorax fails entirely or the amount of collapse obtained is insufficient to be effective, local or total collapse of the lung can still be obtained by other means.

COLLAPSE OF THE BASE.

Phrenicotomy and Evulsion of the Phrenic Nerve.

If the complete nerve supply to one half of the diaphragm is divided, that dome will not only become paralysed and so be unable to influence expansion of the base of the lung, but it will in addition rise up into the thorax owing to the loss of all muscular tone. The muscle is then influenced by the upward pressure of the abdominal contents and by the intrathoracic pull due to the natural retraction of the elastic tissue in the lung and the contraction of abnormal fibrous tissue. This change of position will produce, or allow, a partial collapse of the lower lobe of the lung. It has been found, moreover (Brunner), that during the ensuing months after the operation the dome of the diaphragm atrophies. This allows of a still further rise, and also, therefore, of a still further collapse. According to Brunner and Felix, the rise of the right dome may be as much as 7.65 cm. and that of the left dome 5.9 cm., while the collapse of the lung may be equal to one-sixth, one-fourth, or even one-third of the volume of the lung. It was to this end that the original operation of phrenicotomy was devised, the nerve being divided as it passed over the scalenus anticus muscle. Results were often disappointing. Sometimes a large phrenic nerve was found and then a fairly complete paralysis and a moderate rise of the dome into the thorax was obtained. Frequently, however, the nerve bundle was small, and little, if any, change was noticed.

The nerve supply to the diaphragm is mainly through the phrenic nerve, which comes from the fourth cervical and occasionally obtains fibres also from the third and fifth cervical. Motor fibres, however, run frequently in a bundle along with the nerve to the subclavius muscle. W. Felix

has described a "doubling" of the phrenic nerve; the second bundle of fibres may be 3 cm. distant laterally from those which are taking the normal course. This accessory phrenic he describes as taking the same course in the neck and in close association with the nerve to the subclavius. It passes into the chest superficial to the subclavian vein, and then turns mesially to join the normal phrenic as it lies behind the innominate vein—the two nerves thus forming a loop round the subclavian vein. This arrangement he describes as occurring in 20 to 25 per cent. of cases. The phrenic nerve is joined by fibres from the sympathetic in the lower part of the neck and also from the coeliac ganglion. The twelfth intercostal nerve also supplies fibres direct to the diaphragm, but these are apparently of little consequence.

Two operations have been devised to overcome the disappointments of simple division of the phrenic nerve.

1. *Evulsion of the Phrenic.*—The nerve is exposed in the neck as it courses over the scalenus anticus muscle. It is divided, and a secure hold is taken of the peripheral end. An attempt is then made by steady traction to draw the whole nerve out from the thorax—that is to say, to pluck the nerve out from its insertion into the diaphragm. When successfully accomplished the length of the nerve evulsed will be from 30 to 40 cm. It will, moreover, have been torn away from connecting sympathetic fibres. It will, in addition, bring with it the lower end of the accessory phrenic, when such exists. Great care is required lest the loop formed by the phrenic and the accessory phrenic tear through the subclavian vein. Other risks of the operation are haemorrhage, particularly from the pericardio-phrenic artery and its two attendant veins which run through the thorax in contact with the phrenic. In one case Sauerbruch had to remove two litres of blood from the thorax as a result of laceration of these vessels. There is also the danger of tearing the lung and producing a pneumothorax or pyopneumothorax. In cases where a pyopneumothorax already exists, there is the possibility that the pleura may get torn and the pus escape into the mediastinum. Division of the vagus in mistake for the phrenic, death ensuing, has been described by Ziegler. Failure to evulse the whole of the nerve is not unlikely when inflammatory processes and fibrous tissue formation have taken place at any point along the course of the nerve.

As an alternative to this operation described by Felix, jun., and Lebscho there is—

2. *The Radical Phrenicotomy of Goetze.*—In this operation the phrenic nerve is divided low down in the neck; the sympathetic fibres running to the inferior cervical ganglion are exposed by gentle traction on the phrenic, and are cut, as is the phrenic higher up again on the scalenus anticus; the nerve to the subclavius is also divided where it comes off the upper trunk at the upper and anterior border of the brachial plexus. Both this and the preceding operation are done under local anaesthesia.

The risks associated with the radical operation are theoretically slighter. Actual experience shows, however, that the complications described as peculiar to the first operation occur very infrequently.

Goetze recommends his operation as a substitute for artificial pneumothorax when social reasons make refills impracticable. Sauerbruch, Brunner, and others regard the paralysing of the diaphragm as the operation of choice in cases of tuberculosis of the lower lobe. They advocate it in moderately severe or severe pyrexial cases when pneumothorax has failed; also in advanced but slowly progressive, slightly febrile cases, not entirely unilateral, in which the question of thoracoplasty comes under consideration either because pneumothorax is from the first impracticable, or has been abandoned voluntarily and recurrence has taken place, or been abandoned involuntarily owing to progressive adherence of the pleural membranes. Symptoms may be alleviated in advanced bilateral disease by unilateral paralysis on the more affected side. Haemorrhage has been arrested by this operation. Sauerbruch advises that phrenicotomy should be done as a preliminary to thoracoplasty as a test of the capacity of the other lung to withstand the strain thrown on it by the major operation. To this group of indications I would add intractable vomiting associated with cough in left-sided cases, or in bilateral

cases in which the left side is the more advanced. One other condition is, I have long maintained, an indication for phrenicotomy: I refer to cases of unresolved pneumonia which, unless some such prophylactic measure is taken, are likely sooner or later to lead to bronchiectasis.

The results of phrenicotomy are, in general, considerable reduction of sputum and of cough and lowering of temperature. Complete disappearance of symptoms must not be expected except in those cases where the disease is limited to the lower lobe. Of 60 cases operated on by Sauerbruch, 17 were improved, none were healed. Of 17 cases treated by Goetze, 7 were apparently healed, 9 were improved, and 1 was worse.

COLLAPSE OF THE APEX.

Apicolysis.

This is the brief term which denotes artificial collapse of the upper part of the lung by mesial displacement of it together with the parietal pleura, this layer of pleura having been stripped off the inner surface of the chest and the space thus formed being filled up by some foreign body, such as paraffin, fat, fibroids, muscle, etc.

By this operation a fairly efficient collapse of the apex of the lung down to the third rib in the nipple line can be obtained. The collapse, as in all operations other than pneumothorax, is permanent. The objection to the operation is that it is necessary to introduce a foreign body into the extrapleural space formed by the separation of the lung and the parietal pleura from the deep surface of the ribs—otherwise the lung would at once re-expand. There is possibly also slight risk in the operation of apicolysis that infected matter, squeezed out of the upper lobe, may be inspired into the lower lobe. An attempt to maintain this space by gas has been repeatedly made and found useless, as the gas is too rapidly absorbed. Paraffin is now used by Sauerbruch, Brunner, and others, with varying degrees of success. It has the advantage over living tissue that, when no complications occur, the volume of the paraffin remains unchanged and so also does the extent of the collapse. On the other hand, complications are not infrequent. The paraffin is an irritant and may give rise to an extrapleural effusion. It is extremely difficult to prevent such an effusion from forcing its way to the surface through the wound and causing a fistula, through which the liquid and the paraffin both escape, and which sooner or later becomes infected. Aspiration of the liquid before it has broken down the scar is difficult, as the paraffin blocks the needle. Once the fistula has formed, it becomes necessary to remove the paraffin and to pack the wound with gauze to maintain the collapse of the lung. Portions of two or more ribs may have to be removed later, to assist in maintaining the collapse and in the healing of the wound. Another serious complication is the direct infection of the paraffin-containing cavity from the lung, or the establishment of a communication between this extrapleural cavity and a cavity in the lung substance itself. Baer does the operation through the front of the chest, while Sauerbruch and Brunner recommend the posterior route. In neither case have the results been too encouraging.

Many kinds of tissues have been utilized, particularly by Tuffier, in place of paraffin—lipomata, fibroids, etc.—and with a varying degree of success. Living tissues transplanted into the extrapleural cavity diminish in volume during the first weeks or months. There is a tendency, therefore, for the collapsed apex, together with any contained cavities, partially to re-expand. When fat is used, some of the fat may liquefy: the liquid globules will work their way to the surface, sometimes as long as two months after the operation, causing a rise of temperature, pain, and a red swelling in the region of the wound. If the skin is incised over this swelling, the liquefied fat allowed to escape, and the wound kept aseptic, it will heal; there will, however, have been some loss of tissue and a corresponding re-expansion of lung. I have recently tried to overcome this objection by the use of living pedicle grafts. Briefly, the operation is as follows:

An incision is made over the second costal cartilage and the adjacent part of the second rib. These parts are exposed and excised. The parietal pleura having been laid bare, it is stripped off by the finger from the inner surface of the thorax,

laterally, in front, behind, and over the apex. The lung, gently pressed aside with the pleura, collapses mesially and leaves an empty space which must be filled up by the graft. In women the graft consists partly of fat from the front of the chest wall, but mainly, when it is large enough, of the breast tissue on the same side. The fat and breast tissue are stripped up in one long strip which is left hinged along the lower edge of the wound. The lower end of the graft is then lifted up, turned over, and tucked into the cavity, and the rest of the strip pushed in after it. The divided edges of the pectoralis major are sewn over the attached end of the graft and the wound closed.

In men there is usually insufficient fat and there is no breast tissue available. I have, in one case, utilized the pectoral part of the pectoralis major muscle, detaching it from its connexions to the chest wall below the second rib and from its insertion into the humerus. This part of the muscle has constituted the graft which has been tucked into the extrapleural cavity. I have just recently seen this man six months after the operation, and have been very delighted with the efficiency of the collapse and the disappearance of symptoms. There has been complete absence of any untoward result from transplantation of the muscle. I feared lest contractions of the clavicular portions of the muscle should be accompanied by contractions of the graft, and that pain and discomfort would ensue. There has been no discomfort whatever.

The indication for apicolysis is that there is disease mainly localized to the upper lobe, particularly that type of chronic tuberculosis which invades the whole upper lobe and shows little or no tendency to spread beyond, and that type also in which there is cavity formation. If the disease is clearly localized, then I consider the operation to be preferable to attempting to collapse the whole lung by artificial pneumothorax, on the ground that it is not a very serious operation, and, when done, there is no need for constantly recurring treatment, as with pneumothorax. When, however, the localization of the disease is less perfect and there is some invasion of the other lobe or lobes of that lung, apicolysis is indicated only when pneumothorax has been tried and failed and there are reasons against thoracoplasty. Apicolysis is of value also in conjunction with pneumothorax when the upper part of the lung is adherent but the lower part is collapsed by gas.

Results.

The results of the seven cases on which I have done apicolysis have been as follows:

1. Paraffin replacement for large apical cavity with retention of secretions. Extrapleural effusion with escape of liquid and paraffin. Permanent obliteration of intrapulmonary cavity but persistence of extrapleural empyema, for which further treatment has been refused.
2. Paraffin replacement. Considerable improvement, but the operation was not extensive enough.
3. Fat replacement. Liquefaction of some of the fat. Incision; aseptic healing of the wound and diminution of symptoms.
4. Fat replacement. No complications; considerable improvement.
5. Fat and breast tissue replacement. Very great improvement.
6. Fat and breast tissue replacement. Two months later liquefaction of some of the fat. Patient admitted to another hospital. Abscess diagnosed and treated as such. Readmitted under me. Excision of part of two ribs. Despite this there is considerable diminution of symptoms. Under treatment.
7. Muscle replacement. Result most satisfactory.

THORACOPLASTY.

This is the biggest and the most serious of the operations for the treatment of pulmonary tuberculosis; the results, however, are so good that they fully justify the procedure. It aims at producing almost complete and permanent collapse of the whole lung. The collapse is not so complete as in a perfectly successful case of artificial pneumothorax, but it is superior to that in its influence on the disease, because it is constant. In pneumothorax the degree of collapse varies constantly; it may be complete immediately after a refill has been given, but almost from that moment the lung begins again to expand and expansion continues until the lung is once more suddenly collapsed. With thoracoplasty there is no variation. Pneumothorax enables the lung to heal and when healed it may be allowed once more to function. This is impossible with thoracoplasty; but the type of case selected for this operation has

usually reached that stage at which cavity formation or multiple dilatations of the bronchi make re-expansion, even after a considerable interval, undesirable.

The operation is designed to collapse the whole of the chest wall together with the lung on the affected side. The method of obtaining the result has changed since a decade and a half ago when the Wilms or Brauer-Friedrich operation was in vogue. This change is mainly due to Sauerbruch, who recognized (and put in practice) the importance, above all else, of excision of the posterior parts of the ribs right up to the transverse processes of the vertebrae. Variations of opinion exist as to the number of stages in which the operation should be done—as to the method of anaesthetization, the amount of rib to be removed, and so on—but the essential principle stands.

I cannot discuss the technique here; I hope to publish that in full later. Briefly, the operation entails the removal of portions of the posterior ends of the first ten or eleven ribs through a paravertebral incision. A total of 110 to 140 cm. of bone is removed. The collapse of the chest wall is surprisingly immense, but the actual visible deformity of the patient when dressed and padded somewhat in the axilla is almost *nil*. There is a considerable tendency to scoliosis, but this can be corrected by effort on the part of the patient.

The results on the symptoms are often startling. It is not uncommon to find immediate and complete cessation of all cough and expectoration. One of my patients who had had incessant cough and sputum for two years despite continuous treatment, partly in a Swiss sanatorium and partly in this country, said that the complete disappearance of these symptoms from the time of the operation was alone worth the ordeal. Another, who had his trachea drawn over to the affected side, complained that whenever he coughed his windpipe seemed to vibrate as a tense cord, and that he had the sensation that sooner or later he would suffocate; this sensation disappeared directly after the operation, and this, combined with the cessation of cough and sputum, gave the greatest physical and mental relief.

The operation, as is to be expected, is not always successful; it may be fatal. It must be remembered, however, that most of the cases operated on would almost certainly get progressively worse until they succumbed, and that therefore every case improved or healed is a big gain to set off against those who die. Considering the condition of those who undergo the operation, the mortality ratio is low.

Sauerbruch has operated on 381 cases. The mortality in the first week has been 14 per cent., while 35 per cent. have been practically healed.

Brunner, out of 117 cases, had an 11 per cent. immediate mortality, 22.2 per cent. were improved, and 41.9 per cent. practically healed.

Gravesen, out of 96 cases, had an 8.3 per cent. mortality, while 21.9 per cent. improved, and 44.8 per cent. were much improved or practically healed.

My own figures are much smaller. Out of 25 thoracoplasties done for bronchiectasis and tuberculosis, 20 were for the latter condition. Of these, 7 have become free from symptoms, 5 are considerably improved, while 4, still under treatment, bid fair to come under the "free from symptoms" group. One case died of tuberculous enteritis eleven months after the operation. One case only died immediately after the operation, and that case was complicated by a pyopneumothorax. Previous to the operation on this patient about two pints of pus had to be aspirated every few days.

If the above figures are combined, we have the observation that out of 514 patients who submitted to this operation, 237 derived very considerable benefit from it.

Just as after pneumothorax treatment it is possible in many cases for the patient to return to work, so, too, is it possible for cases who have had thoracoplasty done. But just as it is essential for patients with a pneumothorax to consider their health, be regular in their habits, and careful in their exercise and in the avoidance—if possible—of infections, so, too, is it the case with patients who have undergone the major operation.

Cases suitable for this operation are selected from among those on whom pneumothorax has been tried and has failed *in toto*, or in whom the amount of collapse is inefficient and cannot be improved; also from those on whom a pneumothorax has been done and in whom the lung has re-expanded with return of symptoms and recrudescence of signs. The

greatest consideration must be given to the sound side. In my opinion, any evidence of activity in this lung is a contra-indication to operation on the other. This view is not held by all Continental surgeons. Moreover, if, in the past, the less affected lung has been at all extensively implicated—that is, if there has been more than slight scarring or slight root involvement—there is too much danger from the strain that thoracoplasty will throw upon this lung. Slight myocarditis is no bar to the operation; but the presence of additional disease, tuberculous or otherwise, elsewhere than in the larynx, is an absolute contraindication. I have already mentioned that Sauerbruch favours a preliminary phrenicotomy on the affected side as a means of obtaining information as to the ability of the sounder lung to withstand the strain of a complete thoracoplasty.

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PURULENT PNEUMOCOCCIC PERICARDITIS: PERICARDIOTOMY: RECOVERY.

BY

ARTHUR J. HALL, M.D., F.R.C.P.,
PROFESSOR OF MEDICINE, UNIVERSITY OF SHEFFIELD;

AND

VINCENT TOWNROW, F.R.C.S.,
ASSISTANT SURGEON, SHEFFIELD ROYAL HOSPITAL.

THE number of cases in which a purulent pericarditis of pneumococcal origin has been successfully opened and drained is not large. This is not to be wondered at, seeing that the condition is only one item in a serious general infection, and its very presence points to an extension beyond what occurs in most cases. Apart, however, from its interest in this respect, this case is exceptional in the time at which the pericardial infection began.

On September 23rd, 1923, a youth, aged 17, whilst walking in the country was suddenly seized with dizziness and acute pain over the left front of the chest. He had difficulty in getting home. As the pain became more severe he was admitted to hospital on September 25th, the third day of disease. He was then in great distress, and there were signs of pericardial effusion. It was impossible to examine the back of the chest as the slightest attempt at movement caused extreme embarrassment to the breathing, and much distress. He vomited at frequent intervals. He was collapsed and grey with a moist skin. The tongue was furred. There was herpes on the lower lip. His temperature was 102.8°, pulse 120, and respirations 40.

On September 26th he was no better in spite of treatment, and paracentesis was decided upon. The area of cardiac dullness was much increased to both sides. The heart beat could be felt indistinctly, well within the left edge of the dullness, and for a short period a pleuro-pericardial friction sound was heard at the upper part of the left border. When examined again a few hours later it had disappeared.

Paracentesis pericardii was performed (V. T.). The needle was introduced in the fifth space $1\frac{1}{2}$ inches from the sternum, passing backwards, slightly upwards and inwards, and 300 c.cm. of sero-fibrinous straw-coloured fluid were drawn off. This gave immediate relief. After its removal pericardial friction sounds were heard over the upper part of the dullness. The fluid contained many polymorphonuclear leucocytes with Gram-positive diplococci; pneumococci were obtained culturally.

During the next three or four days the temperature fell gradually to normal. He slept well; the breathing, though still frequent, was not distressing. There was no cough or sputum. The herpes became more marked. Occasional pleuro-pericardial friction was heard just inside the left nipple line, also bronchial breathing in the left upper chest in front, and pleural friction in the left axilla. There was also some dullness with diminished breath sounds at the left base behind.