Remarks

ON

THE TREATMENT OF EMPYEMA.

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WHEREVER and whenever pus is found to exist in the body it is good practice to evacuate it at the earliest possible moment, and the pleural cavity forms no exception to this rule. The only result of delay is to give time for adhesions to form between the parietal and visceral layers of the pleura, where they remain in contact, and more or less thickening of those areas where they are separated by the fluid. These conditions form two of the chief causes for the delay in healing and the consequent necessity for secondary operations.

I leave out of account in this paper the treatment of localized empyema, and confine my remarks to general and diffuse cases.

The site of the opening through the chest wall is best made in the line of the scapula at the ninth rib; when the body is supine this is the most dependent part of the thorax, and affords best and most complete drainage of the cavity; in an ordinary case it is necessary to remove $1\frac{1}{2}$ to 2 in. of the rib, to open the pleural cavity through the centre of the periosteum so exposed and to empty the cavity of pus. It is a good thing in most cases to carry out the resection of rib and to remove the pus with the patient lying supine, as recommended originally by Mr. Godlee, and, before incising the pleura, I allow as much pus to flow away through a $\frac{1}{4}$ -in. cannula as will come, for the purpose of avoiding a possible sudden dislocation of the thoracic organs and any tendency to collapse that might be induced thereby. The pleura is then to be incised, and all fibrin masses, which are most developed, in my experience, in pneumococcal cases, to be got rid of. I wash out the cavity, taking care to allow plenty of space for the reflux current: it does good by washing away small particles of fibrin as well as pus, which, if left, will only form a nidus for the growth of organisms. The usual practice, judging from the descriptions one reads, after the formation of the drain-opening, is to be satisfied with the introduction of a drainage tube and the application of a dressing, and in many cases it is true this is all that is necessary: it is so, in fact, in those cases where the lung is free to expand after evacuation of the pus. It often happens after this that a lung will expand after the first few coughing efforts of the patient, practically up to the chest wall; but there is a large number of cases where this desirable expansion does not take place to any appreciable degree, and at this period of the treatment it is usually primarily due to the fact that the compressed lung, retracted and wedged into the vertebro-costal groove, has become adherent by its visceral pleural covering to the adjacent parietal pleura.

In the course of time such a lung may no doubt in many instances, if the adhesions be not too close, slowly expand and eventually come in contact with the chest wall; but, on the other hand, there are a great many cases where the lung will not expand completely, and still others where it will not expand at all, and in both these types of case some more extensive operation becomes necessary to allow the rigid chest wall to fall in and meet the non-expanding lung.

In my opinion, a surgeon treating an empyema ought not to be content with excision of a piece of a rib and the introduction of a drainage tube. I believe that the principle underlying the operation ought to be to get the lung freed from its adhesions and to give it the opportunity to expand if it can; and it will expand in all these cases after this has been done, unless there are interstitial changes in the pulmonary parenchyma. I have worked on this principle in treating empyema for the past nine years. After the evacuation of the pus, if the lung does not show any tendency to expand, I endeavour to free the adhesions between the two pleural surfaces.

It is probably easiest, and certainly safest, to begin this process of separation posteriorly, where the lung is in contact with costal pleura—another reason for selecting the scapular line as the site of incision and resection of rib as being nearest to the line of adhesion—and I prefer to start the process with my finger; therefore, if it be not possible to reach this adherent line through the opening already made,

I resect the rib next above and a little further backwards, and, through the extra space so gained, work my finger in between the lung and costal pleura. Once started, the separation usually goes with remarkable ease, and the finger can usually strip the lung downwards and then forwards along the diaphragmatic surface and upwards off the pericardium. In the upper region of the cavity it naturally cannot work, but with a thick metal bougie and a long periosteal elevator it has usually been possible to free it fairly well, and in most cases it has been observed that, as the lung became free, its expansion followed the coughing efforts which always result from the manipulation, until in many cases it practically reached the level of the parietal pleura. More often it expanded only partially, but in almost every instance there was a distinct and immediate gain. This expansion has succeeded best and been most complete in children, but has been seen frequently in adults as well. In cases where it is at first only slight it constantly increases, and, in the majority of cases progresses until the lung comes to meet the chest wall. In some of the cases that I have treated (actually six in number), after freeing the lung it did not expand well, but remained partially collapsed and retracted in the posterior part of the pleural cavity, and a thoracoplastic operation eventually became necessary. But I am convinced that in many of the cases, had the freeing of the lung not been done, another and more severe operation would ultimately have been required; and further that, in those cases where this was avoided, a long protracted convalescence was saved.

This freeing of the lung is, in my opinion, of so great importance that if a patient be too ill at the time of the evacuation of the pus to enable one to proceed, I believe it ought to be carried out at a secondary operation specially for this purpose. As soon as it is possible for the patient to do so he ought to be encouraged to go in for respiratory exercises, with the object of blowing up his affected lung as quickly as possible. Air no doubt in these efforts passes over from the sound lung across the bronchi into the affected one, and thereby the natural elasticity of the lung is aided, and as it expands the circulation through it, which, as Hodsdon has shown, is in itself an aid to the expanding forces, goes on more freely.

In the course of time it will, however, in some cases become obvious that, even though it has been freed, no further expansion of the lung is going to take place, and then it will be necessary to carry out more extensive resection of ribs. In such cases it has always been my practice to operate on the lines originally recommended by Estlander, making a curved incision along the anterior aspect of the chest wall, and resecting a portion of each of the ribs from the second to the ninth, widest from the centrally-situated ribs, and gradually diminishing the length of each successive piece resected upwards and downwards. While Estlander, however, recommended that the portion of thickened pleura exposed by the removal of the rib should be taken away also, I have always stripped the parietal pleura off the whole internal aspect of the ribs, and in addition have always decorticated the lung by dissecting the thickened visceral pleura off its exposed surface. I decorticated in the first instance in 1897, in the case of the first Estlander's operation which I had to perform, without knowing that the procedure had been recommended and carried out previously by Delorme.¹ As far as my experience goes, the immediate expansion of the lung after decortication is not very great; it has never occurred to such a degree as to be in any way compared to that which takes place in the early stages after simple freeing of the lung at the time of evacuating the pus, and I believe that the latter is by far the more important procedure of the two, but still there is frequently a gain to some extent after decortication, and the expansion will often increase after the operation if the patient be diligent in respiratory exercises.

The advantage claimed for removal of the thickened pleura, —and it is often more than half an inch thick all round the chest wall—is that it gets rid of a dense layer of fibrous tissue of great strength and resisting power, and thereby permits of the ribs falling in, while if it be left it acts as a splint to the ribs as it were, the very last thing that is desired.

Although this method has given quite fair results in my hands, it will not suffice for all cases, and then some further procedure will be necessary in order to obtain obliteration of the cavity. For these cases I have operated in the manner described in the following report of the case in which this was first tried:

A. S., aged 31, transferred April 29th, 1902, to my ward from the medical house where he had been under the care of my colleague, Dr. J. Lindsay Steven, to whose ward he had been admitted on April 17th.

Notes from Dr. Steven: "Patient had been suffering from a cold for about three months before admission; a fortnight ago he had a chill, followed by a stitch in right side at lower and outer part of chest. Continued work for three days after this, but weakness and shortness of breath sent him to bed. Patient has slight cough, greyish frothy expectoration; respirations 34, pulse 136, temperature 100° F., intermittent. General bulging, obliteration of intercostal spaces, defective movement, and diminished vocal fremitus and respiratory murmur, with absolute dullness to percussion over whole right side, back and front. Liver depressed, marked displacement of heart to left side, and extension of dullness to left side of sternum above."

On the same day with local anaesthesia a portion of the ninth rib was resected and 67 oz. of pus evacuated; the lung found completely collapsed and made no obvious expansion though freed.

June 5th, 1902. The lung having scarcely expanded at all, Estlander's resection of ribs was done, along with removal of all the thickened pleura; this was followed by a little expansion of the lung and considerable falling in of the ribs, and he went out perfectly healed August 18th, 1902.

Six months later, February 14th, 1903, he returned and stated he had been in good health and working up to three weeks ago, when he had an attack of influenza; he had pains all over the body, cough, and expectoration; a week before, during a paroxysm of coughing, the cicatrix burst, and pus was discharged. He was readmitted with a sinus in the centre of the old cicatrix, and the lung retracted so as to leave a cavity of considerable size. In order to close this, on February 17th, 1903, I made a long incision over the posterior extremities of the ribs, and with gouge forceps resected $1\frac{1}{2}$ in. of bone from each of the ribs bounding the cavity just external to their tuberosities. The anterior extremities of these ribs having been already divided at the former operation, compression applied to the chest wall now easily depressed the ribs so far that they could meet the lung. He was kept lying as constantly as possible on the affected side, and went out completely healed April 25th.

He was last seen February 26th, 1905, when he stated he had been well ever since he left hospital; the ribs appear to have reunited posteriorly, but to be free anteriorly; the spine is perfectly straight, without the least trace of a curve.

I believe that this additional resection of ribs posteriorly will enable us to get closure of a large pleural cavity in many cases where Estlander's operation is not sufficient to do so, but it will not bring about obliteration in every case, and further operative measures may still be required to effect this. In two cases of this kind I have operated as follows, and the result in both instances has been entirely satisfactory. I believe that any cavity in the thorax could be obliterated by this method, which, at the same time, preserves a bony support to the side operated on.

When, at the time of the resection of ribs posteriorly in the manner described in the case of A. S., it is found that firm compression of the chest wall will not bring the latter into approximately close relation to the lung, I remove the central remaining piece of the highest and lowest ribs which have been resected (namely, the second and ninth) by running a long periosteal elevator along the inner and outer surfaces of these ribs, and then, taking the bone in lion forceps, twist it out of its periosteal canal; the second rib may be troublesome, because of the broad attachment of the serratus magnus to it, and the distance at which this is situated from the wounds.

The increase in the mobility of the costo-muscular flap so obtained is very considerable, but if it should still be insufficient to allow lung and chest wall to meet it can be again increased by removal of the central segment of one of the other ribs; for example, the sixth.

The figure appended shows diagrammatically what is done. Fig. 1 represents a normal chest wall for comparison. Fig. 2 shows a portion of bone resected both anteriorly and posteriorly from each rib from the second to the ninth inclusive, and in addition the central segment of the second, sixth, and ninth ribs removed, so that practically the whole of each of these three ribs is taken away.

I give below the notes of the case in which I first carried out this plan; the lung of this patient was as absolutely collapsed and non-expandable as it could well be, but as the result of the operation complete obliteration of the cavity was obtained.

E. H., aged 15, came under my care on November 9th, 1903. Two years before she had had pneumonia followed by empyema, for which she was treated elsewhere. A sinus had persisted, but the child had gone about until about two months ago, when she suddenly had a severe haemorrhage from the sinus, losing, as it was said, more than a pint of blood. Haemorrhage has recurred several times since then, and somewhat profusely during the few days before I saw her. The patient is undersized, very thin and anaemic, left thorax flattened, dull all over

on percussion, respiratory murmur very feeble and bronchial in type, apex beat is at right nipple, two cicatrices on left chest wall, and one sinus which passes up to apex of the pleural cavity, and from which comes a thin, blood-stained, and very fetid discharge.

Fig. 1.

Fig. 2.

November 13th. Resection of ribs from ninth to the second anteriorly, the lung was so completely collapsed and so solid, and the pleura so dense that nothing was done to free it, but the parietal pleura was removed; the patient's condition, too, became serious from collapse and she was put to bed. She rallied well, and on December 12th I resected the same ribs posteriorly and removed the central segments as described above; this allowed the flap to fall in and meet the lung all over; the depression of the flap was so marked that nearly the whole of the left side of the pericardium became exposed in consequence, and had ultimately to be covered with Thiersch skin grafts, but the cavity of the pleura was quite obliterated four weeks later. She has been seen in January, 1905, and remains perfectly well.

Another patient was operated on in February, 1904. The lung failed to expand in the slightest degree after being freed in the first instance and later decorticated, but by resection of the ribs posteriorly and removal of the central segments of the second, seventh, and ninth ribs perfect closure of the cavity resulted. Fig. 3, from a photograph taken March 1st, 1905, shows that no scoliosis has followed the operation.

Fig. 3.

One of the causes of failure to obtain closure of the cavity in many cases after Estlander's operation is that the ribs can only collapse to a certain degree; after they have sunk inwards as far as they can go it will be found, I think, that their margins are so jammed together, possibly imbricating to some extent, that they cannot possibly go further. In both the last-mentioned cases this imbrication had taken place to such an extent that there was considerable difficulty in getting even an elevator in between the ribs, and it was not easy to get the bone forceps to work.

The operation devised by Schede has, in my opinion, the disadvantage of removing so much of the ribs that the spine is deprived of the greater part of its support on one side, and

as the result there is a decided liability to the development of a high degree of scoliosis.

By the method here advocated free mobility of a large flap, with the preservation of a large segment of several of the ribs, is obtained. As far as I can determine by examination of my two patients, bony union has occurred across the gaps made in the ribs, and Roentgen photographs tend to bear this out also; the spine remains supported, and in neither of these patients is there any scoliosis present.

Tuberculous Cases.

With regard to the treatment of tuberculous empyema and pyopneumothorax, doubt has sometimes been expressed as to the advisability of operating, and it has been stated there is a decided risk of stimulating the tuberculous process to increased activity as the result of operative interference. I am strongly of opinion that many of these cases ought to have the benefit of operation, and I was much interested in reading a recent paper by Professor Findlay² in which he records 2 cases of pyo-pneumothorax considerably improved by drainage, along with general treatment carried out according to the ideas prevailing at the present day regarding the treatment of tuberculosis, and he urges that "the subject should be reconsidered apart from the influence of old-established usage and predilection," with which opinion I entirely agree.

But operation in these cases ought to be carried out in such a manner that obliteration of the cavity should be aimed at in the shortest possible time. We ought not to be satisfied with drainage alone. Probably the best thing that could happen to a lung which is the seat of active tubercle is that its everlasting motion of expansion and contraction should be arrested, and this is the result of empyema in most of these cases, as long, at any rate, as the fluid is allowed to remain in the pleural cavity.

In operating in these tuberculous cases, I consider that no attempt should be made either to free the lung or to "decorticate" it, or, in fact, to do anything specially directed towards favouring its expansion; but, by resection of ribs in front and behind (if necessary, along with removal of the central segments of the highest and lowest of these ribs, though not necessarily done at the same sitting), and always associated with stripping of the whole of the parietal pleura off the chest wall, we should endeavour to make the latter meet the lung as quickly as possible and so obliterate the cavity, and get rid of the discharge which results from its persistence: and at the same time endeavour to get the general condition of the patient improved by every means available.

REFERENCES.

¹ *Gaz. des Hôpitaux*, 1894. ² *Trans. Clin. Soc. Lond.*, vol. xxxvii.

A CONTRIBUTION TO THE TREATMENT OF CHRONIC EMPYEMA.

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MEDICAL literature is so vast that it is not possible to discover whether any treatment is novel, or whether it has been tried and discarded. The one of which I am going to give an account occurred to me some year or two ago, and during that time I have taken the opportunity of discussing it with some number of authorities, and have been told that they have not come across it in the literature. For this reason I give a description of the apparatus used, and hope to be able to record some number of cases at no far distant date.

The application of a negative pressure to the pleural cavity is so simple and obvious that the idea must have entered the minds of many, but possibly some had not the time, others not the inclination, to devise the necessary apparatus.

METHOD OF RECORDING PROGRESS.

Before describing the method of treatment I would like to draw attention to a way of estimating the progress in any individual case. The methods in general use are manifold, and I do not for a minute wish it to be supposed that the following can replace any, but will, I believe, occasionally assist when the other means give equivocal results. The probe teaches much as to the extent of the space between the thoracic wall and the lung; breath sounds, percussion, etc.—all these points assist, but are all occasionally at fault.

It would be out of place to explain how thickened pleura, fibrin, fibrosed lung, may cause errors, for detraction of one method does not enhance another.

It is possible, however, to measure the actual volume of the space between the chest wall and the lung without causing any discomfort to the patient or consuming much time. The method is simply a modification of the volumometer. This necessitates an approximately airtight joint, between the chest wall and the apparatus, the arrangement of which is astonishingly easy. At first a guttapercha oncometer was moulded to fit the chest wall and fixed to it by means of strapping; there was no difficulty in making the junction airtight, but a slight negative pressure caused hyperaemia of the granulations around the wound and pain, and for this reason another plan was adopted.

A soft rubber tracheotomy tube was cut short and used as an empyema tube, the rubber guard fitted tightly against the chest wall, and prevented an appreciable amount of air from leaking in. Strapping was used to hold the tube in place, but as a rule the junction was airtight without its assistance. A glass tube was fitted into the tracheotomy tube, and this could be connected to the modified volumometer, which consisted of a Woulff's bottle, a mercury manometer, and a small bicycle pump with the washer reversed, so that it acted as an exhaust and not a force pump. The capacity of the bottle was 350 c.cm., that of the pump 50 c.cm.; the tubing was fine, and therefore the capacity of it may be neglected.

One of the orifices of the Woulff's bottle is attached to a three-way tube, one branch of which passes to a manometer and the other to the pump; the other orifice is connected to the empyema tube. The bicycle pump is then pulled out, and the fall of pressure recorded by the manometer is noted. The tube is then disconnected from the chest, and attached to an airtight vessel. The pump is then pulled out again, and the fall of the mercury noted; if it be less than above, water is poured into the vessel and trial made again; by adjusting the amount of water in the vessel the fall in pressure can be made the same as when the apparatus was connected with the empyema. The volume of air in the vessel can then be estimated by pouring in water from a measure to fill it.

A rather better method requires an elementary knowledge of mathematics. If the volume of the pump be 50 c.cm. and that of the bottle 350 c.cm., on closing the second opening and drawing out the pump, the fall in pressure would be x

$$\frac{350}{350 + 50} = \frac{760 - x}{760} \therefore x = 95 \text{ mm. Hg (barometric pressure 760 mm. Hg).}$$

Now if the fall on pressure be f mm. Hg when connected with the empyematous cavity, then the volume of that cavity (V) can be estimated by the following formula:

$$\frac{350 + V}{400 + V} = \frac{760 - f}{760}$$

It is scarcely necessary for me to add that the cavity should be emptied before making the above observations by letting the patient cough when lying in a suitable position. Every few days the volume can be measured and the progress recorded in actual numbers; care should be taken to prevent the formation of pockets of pus, which would render the observations valueless.

TREATMENT.

The treatment consists in the application of a negative pressure to the pleural cavity for several hours every day. Attempts have already been made in this direction by draining through a long tube, the lower end of which was placed in a vessel upon the floor; this did not allow of the removal of flakes of fibrin first, a proceeding which seems to me an essential part of the treatment of an empyema of some weeks' standing. The same objection applies to Turner's tube and valve; the negative pressures obtained by these appliances is very slight.

The development of a negative pressure of 10 to 15 mm. Hg can be easily maintained by inexpensive apparatus. In selecting the pump one must remember that there may be a slight leak at the chest wall, so that it is wise to choose a form which will remove considerable quantities of air, and not one which is designed to develop a perfect vacuum. For this reason, Sprengel's mercury pump is not at all fitted for the purpose. Fischer's filter pump is almost ideal, because the regulation of the negative pressure developed is easily carried out by altering the length of tube used, and that form of pump requires very little water, less than half a gallon an hour, and thereby gives but little trouble.

It would not be wise to connect the pump direct with the