COLLAPSE THERAPY IN THE TREATMENT OF PULMONARY TUBERCULOSIS.¹

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Collapse therapy in pulmonary disease in its broadest sense may be taken to embrace all measures which one adopts to cause the diseased lung or diseased part of the lung to collapse.

The object of this collapse is primarily to secure rest for the diseased organ. There is scarcely any need to remind you that rest to the inflamed organ, be it the myocardium in rheumatic fever or the ruptured tendon in a lacerated wound in the forearm, is the first therapeutic measure in all medical or surgical conditions. Without going into the physiology of the lung it is a fact that the only method we can use to give a lung rest is to collapse or partially collapse it.

Secondly, by allowing the lung to collapse a circulatory congestion takes place in it which is of great value in bringing about the healing of the lesion, and also at the same time the diseased portion of the lung is placed under the best possible conditions for fibrosis to take place.

Again, because of the passive congestion in the collapsed area, the toxins from the lesion are not so easily carried away by the blood and lymphatic circulation, thus the general toxæmia is reduced. The beneficial effect on the toxæmia is often one of the most striking features in pulmonary tuberculosis treated by this measure.

Further, the collapse allows the wall of a cavity in the lung tissue to be brought into apposition, not so much by the external collapsing force, although this may be the causative agent in some special cases, but by the natural retractability of the lung tissue.

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when it is no longer subjected to the influence of a high negative pressure in the pleural cavity.

Before I deal in detail with collapse therapy let me remind you that, with these measures, we are only attempting to place the diseased organ under the best possible conditions to ensure its healing, but that its healing ultimately depends on the ability of the patient to develop sufficient resistance to overcome the disease. Therefore the patient must be placed in the best possible position to gain his immunity to the infection being given rest (in bed at first), good food, good air, and generally good hygienic conditions, and throughout the whole course of treatment this care of the patient must be borne in mind.

Because collapse therapy usually means the putting out of action of one lung it will readily be seen that it is only applicable to those cases which are unilateral, although in certain patients, as I will show later, it is used in a modified method in bilateral cases.

Realizing that collapse therapy is only an adjunct to general rest measures in the treatment of pulmonary tuberculosis, the next step is the consideration of the types of cases which are suitable for this measure. The type in which one meets with most success is that in a young patient with an "early infiltration," i.e., a recent infiltration, limited to a small area. In such a case, if, after two months rest in bed under the best possible conditions, the sputum remains positive, and the lesion unchanged or showing signs of advance, then an artificial pneumothorax will tip the balance in the favour of the patient. It may be argued that prolonged sanatorium treatment alone would have been sufficient to heal the lesion in these cases. It is a fact, however, that workers in this field have seldom regretted the induction of a pneumothorax in these patients, but have often been sorely vexed when, having decided against a pneumothorax, the patient has, at a later date, broken down and the disease progressed.

In the case of a young person with unilateral disease with cavitation, the induction of a pneumothorax should be considered at once, for it is in this type of case that the measure produces its chief successes, for these cases, without some collapse therapy, have a very poor prognosis.

In cases of a fulminating type, with a short history, marked toxic and constitutional symptoms, and extensive unilateral disease, pneumothorax may produce dramatic results; on the other hand, the resistance of the patient may be so little that collapse of the lung is not able to assist the patient in regaining his immunity.

The treatment of bilateral cases will be dealt with later.

The most easily performed method of collapse, and thus the most used, is artificial pneumothorax. In this procedure, air is introduced into the pleural cavity, and thus, by reducing the relatively high negative pressure in the pleural cavity to atmospheric pressure, the lung is able to retract and collapse, provided that there are no adhesions between the parietal and visceral pleura.

The production of an artificial pneumothorax is carried out in this manner. At the initial induction the pleural pressure is read before the injection of air; then 200 to 400 c.c. of air are introduced, and the pressure again read. Because, when air is first introduced into the pleura it is rapidly absorbed, a refill is made on the next day, the pressure being read before and after the introduction of about another 400 c.c. Then one day is missed, and a refill is given the following day; then the interval between each refill is increased by a day each time, until the interval between each refill is a week, a fortnight or a month, according to the requirement of the case. The amount of air put in at each refill depends entirely on the pressure which it is found necessary to keep in order to maintain the desired degree of lung collapse. The pressure usually is just below atmospheric.

The lung having been successfully col-
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...lapsed, the patient shows marked improvement in the general constitutional symptoms. The temperature settles to normal, all the signs of toxæmia disappear, the cough and sputum cease, or, if there is a little sputum, it will be found to be T.B. negative.

The next question is how long shall the artificial pneumothorax be kept up. There is no hard and fast rule, but it depends upon the extent of the original lesion. If this was quite small, for example, an early infiltration of limited extent, then I am content with twelve to eighteen months' collapse, the more extensive lesions requiring two, three or five years.

In allowing the lung to re-expand one is faced with two problems. First, one has no definite criteria by which to judge that one is choosing the right time, and therefore to some extent it is a shot in the dark; secondly, the patient who has been made well by a successful artificial pneumothorax is very loath to allow it to be given up for fear of the return of the disease, and therefore, because of these two factors, one often continues with treatment longer than necessary, and so prejudices the chance of the lung re-expanding fully, and of bringing the treatment to a completely successful conclusion, namely, the focus firmly healed in an otherwise absolutely normal lung.

The preceding description has been that of a simple straightforward unilateral disease, and unilateral pneumothorax.

One of the complications of artificial pneumothorax is the occurrence of an effusion in the pleural cavity. This complication occurs in about 40 to 60 per cent. of cases. Usually it is sterile, and requires no special treatment. Some authorities advocate removal of the fluid and its replacement by air; others advise that it should be left severely alone, and that is my own personal opinion. Usually, after the fluid has been present some while, it is absorbed, and the pneumothorax can be carried on as previously. In a few cases, what is termed an obliterator pleurisy takes place. The lung creeps out under the effusion, and the chest wall falls in, and so the pneumothorax cavity becomes smaller and smaller, and finally, in spite of repeated refills of air, it becomes impossible to maintain the pneumothorax. Some authorities view the obliterative pleurisy favourably, as in the majority of cases in which it takes place, the end-result is satisfactory so far as the tubercular disease is concerned, but the patient is left with a shrunken lung, a very thick pleura, and a fallen-in chest wall (almost a natural thoracoplasty). Other authorities attempt to prevent this obliterative pleurisy from progressing by replacing the air in the pleural cavity with a heavy substance, either olive oil or paraffin, to which has been added 5 per cent. gomemol, thus producing an oleothorax.

If the effusion is a tubercular empyema, then it is treated by repeated aspiration of the pleura, and air replacement, and sometimes the injection of the cavity with antiseptics. If the effusion is an empyema caused by pyogenic organisms, it is probably best treated by suction drainage, followed by a thoracoplasty.

I will now consider the more complicated measure in collapse therapy.

If the disease has involved "The sound lung" to only a limited extent, it has been found that, if the diseased lung is successfully collapsed, a beneficial influence is effected on the disease in the sound lung. Probably the beneficial influence is brought about in this manner:

1) By reducing auto-intoxication, and so allowing the general condition of the patient to improve.

2) By diminishing the possibility of repeated aspiration from the "bad" to the "good" lung.

3) By the fact that, when the pressure is raised in one pleural cavity, the pressure in the other pleural cavity also rises to a much smaller extent, and thus the "good" lung is given some rest.

Under such circumstances an artificial...
pneumothorax can only be carried out when the patient is kept under very close clinical and radiological observation in order that the disease in the sound lung may be controlled; for should this show any signs of spreading then other measures will have to be instituted. The induction of a pneumothorax in such a case calls for a nicety of judgment in evaluating the extent and degree of activity of the lesion in the sound lung, and also the resistance of the patient.

**Selective Collapse.**

When the disease in one lung is of quite small extent, and has not broken down to form a cavity it can often be successfully dealt with by what is called a selective pneumothorax. In this type no attempt is made to collapse the lung completely, but the pneumothorax is kept up at a high negative pressure, and if the pleura is entirely free the lung retracts from the chest wall slightly, but what is more important is that the diseased portion retracts considerably more, and the collapse in this portion is greatest, and sufficient to allow the lesion to heal. The advantages of the selective pneumothorax are that the patient suffers less respiratory embarrassment, would appear to be less likely to develop some of the complications of the treatment (e.g., effusion and spontaneous pneumothorax), and, lastly, when the time comes to discontinue the pneumothorax the lung can be expected to re-expand fully.

The success of selective collapse in unilateral disease has led to it being used in some cases of bilateral disease.

In bilateral pneumothorax both artificial pneumothoraces are kept up at a high negative pressure. The second pneumothorax may be induced within a day or two of the first, or the second may only be started some weeks or months after the first. These cases require very careful attention and it is seldom wise to allow them to go out of hospital or sanatorium while undergoing this treatment. If the one pneumothorax is only partially successful, because of adhesions, then these adhesions can be dealt with by the thoracoscope.

Bilateral pneumothorax is seldom continued for more than a limited number of months.

**Artificial Pneumothorax Complicated by Intrapleural Adhesions.**

In quite a number of cases after the artificial pneumothorax has been induced and continued for some time, perhaps three to six months, it will be seen on the skiagram that one portion of the lung has completely collapsed, but that another portion, usually the portion in which the disease is, is only partially collapsed, and is prevented from collapsing completely by the presence of an adhesion or adhesions which are running from the parietal to the visceral pleura, and are holding out the diseased portion of the lung. In such a case the sputum of the patient usually remains T.B., and if, as is very often the case, the portion of lung held out contains a cavity, then the sputum is invariably positive, and in such cases one has not attained the result one set out to do, namely, to collapse the diseased lung, and to render the patient T.B. negative, but what is of much greater importance is that, in such cases, unless the adhesion is cut, and the cavity closed, it is invariably only a matter of time before the disease spreads into the other lung (probably by aspiration), and the patient’s days become numbered.

This last statement, I realize, is a very dogmatic one, but I believe that it is as invariably true as anything in medicine is variable. Fortunately there is a comparatively simple means of dealing with some of these adhesions. A thoracoscope is introduced in the pleural cavity, and the adhesion can be seen. Another cannula is introduced into the pleural cavity at a suitable position, and a long needle is passed in, through which novocain is injected to anaesthetize the parietal base of the adhesion. The needle is then withdrawn and a diathermy
cautery is passed in, and directed to the base of the adhesion, which is coagulated and then cut through. This procedure has two serious complications: (1) Infection of the pneumothorax cavity from rupture of the burnt lung stump. (2) Haemorrhage from an intercostal artery. In some forty-five cases that Dr. Scott Pinchin and I have done we have not met this latter complication. The first complication we have seen.

In the majority of cases where it is possible to deal with the adhesions in this manner, after the procedure the lung collapses, the cavity closes, and the sputum becomes negative. By means of cautery of adhesions such cases are being saved from the severe and mutilating operation of thoracoplasty.

For cases of unilateral disease in which, owing to a very adherent pleura, it is impossible to induce a pneumothorax, and for those cases where a pneumothorax has been rendered incomplete by the presence of adhesions which are not amenable to division by the thoracoscope, there are other methods of collapse therapy available.

Phrenic Avulsion.

In this procedure a considerable length of the phrenic nerve on the diseased side is avulsed, thus permanently paralysing the diaphragm on that side, and allowing it to rise and be forced up by the intra-abdominal pressure, thus compressing the lung, and also assisting in giving it rest.

This procedure is not only used in the two types of cases previously mentioned, but is often done as the method of choice when the tubercular lesion is situated at the base of the lung.

Extra-Pleural Pneumolysis.

In this operation the parietal pleura is stripped from the ribs over the diseased portion of the lung, and then some foreign material (such as paraffin or fat) is introduced into this cavity to keep the lung compressed. This measure is particularly useful in old fibrotic apical cavities which cannot otherwise be collapsed.

Thoracoplasty.

Thoracoplasty may be complete or incomplete; that is to say, varying portions of some or all of the ribs on the affected side are removed, thus allowing the chest wall to fall in and collapse the lung, and compress it against the vertebral column and mediastinum. This operation is a severe one, and therefore one often hesitates to advise the patient to undergo it, but if the disease is unilateral, and there is a cavity which cannot be collapsed by other more conservative measures, I am convinced that it is one's duty to advise this operation provided the patient's general condition is sufficiently good, and that the patient is offering reasonable resistance to the disease.

Although I have dealt with collapse therapy at some length, it must not be thought that it will be the final word in the treatment of pulmonary tuberculosis. One looks forward to the day when sero-therapy or chemotherapy will enable us to deal successfully with the disease, yet those of us who are especially interested in this disease are convinced that, at present, it is our most effective weapon to deal with the local lesion in the lung while the patient is gaining his resistance to overcome the ravages of the tubercle bacillus.

The Antagonism of Hyperthyroidism and Pulmonary Tuberculosis.

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It is interesting and not sufficiently recognized that two wasting diseases like hyperthyroidism and pulmonary tuberculosis...