Pneumoperitoneum Therapy in Lower Zone Tuberculosis

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The treatment of pulmonary tuberculosis has been and is a complex problem. In general, rest has been advocated as a beneficial measure in cases with clinical or radiological activity. Unfortunately, rest alone is not usually effective except in limited disease without cavitation. As the lesion of pulmonary tuberculosis becomes established, the picture becomes complicated. Adhesions of the pleura often are responsible for mechanical limitation of the respiratory function of the involved lung. Furthermore, fibrosis is a very frequent major complication producing distortion of the mediastinum and its contents, also fibrosis may be diffuse upsetting the normal physiology of gaseous exchange through the pulmonary alveoli. Many cases in response to immunological phenomena peculiar to infection with tubercle bacilli show either localized or extensive caseation.

Before one attempts to outline a course of treatment for a case of pulmonary tuberculosis, an intensive investigation of the patients as a whole is desirable. Let us for simplicity's sake consider that we are dealing with a group of patients whose only problem is that of pulmonary tuberculosis. We must then, first of all, get a picture of the activity of the case. Are the lesions progressing or regressing? To what extent has pulmonary fibrosis progressed? If there is extensive fibrosis, is there adequate absorption of oxygen and elimination of CO₂?

One must also attempt to evaluate the degree to which the pleura has been involved. Here the history of pre-existing pleurisy is important. Further studies might include bronchospirometry. In those cases in which the pleura is radiologically thickened the problem is straightforward. It is necessary definitely to determine the location, size and character of pulmonary cavities which may be present. Peripherally placed lesions collapse with greater regularity than those more medially situated. Is it an atmospheric, positive, or negative pressure type of cavity? Are the walls of the cavity hard, or soft, is the cavity situated in soft collapsable lung, or is there extensive adjacent fibrosis? A further consideration is that lower zone cavities in tuberculosis are frequently in the apex of the lower lobe. This location is of course

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central. As has already been stressed relaxation of centrally placed pulmonary tissue is not maximum.

There are several mechanical methods of treatment for pulmonary tuberculosis with cavitation advocated to date. In 1931 Dr. Banyai made a new step in the therapy of pulmonary tuberculosis. He used and widely advocated the introduction of air into the peritoneal space. As is well known the intrapleural pressure is negative. The pressure in the peritoneal space is neutral, except in the subdiaphragmatic region where it is negative. Suspended between these two pressures is the diaphragm. It is obvious then that to increase the abdominal pressure would favor an elevation of the diaphragm. Obviously a point against this therapy is that there is bilateral elevation of the diaphragm. In an attempt to give more selective collapse, numerous workers have advocated phrenic interruption on the desired side. This has been very effective, often increasing the elevation of the involved diaphragm by 2 to 8 cm. Since the original paper of Dr. Banyai, many articles have been published and it is the opinion of most workers that lower and mid zone lesions have responded more favorably than those higher placed.

Here then is a form of therapy which appears peculiarly suited to disease involving the lower and mid zone of the lung. The therapy of lower zone tuberculosis is generally considered far from satisfactory. As we have already mentioned, thoracoplasty is best suited to upper zone disease. A limited lower thoracoplasty is technically an unsatisfactory procedure. To use the orthodox thoracoplasty which collapses the lung from above downwards is a wasteful procedure in that healthy lung is unnecessarily defunctionalized. If the lesion is high in the lung, pneumothorax is often beneficial but here again considerable good lung is put out of order in an attempt to effectively collapse the lower zone. Also, pneumothorax is far from innocuous. All who have used this procedure know the frequency of adhesions which require division, this is often impossible and in the others pleural effusion and empyema are by no means uncommon. Even in the technically successful pneumothorax we are often left with a crippled lung due to pleural thickening.

On the other hand, pneumoperitoneum is a relatively safe and easy procedure. There is no absolute location at which this must be done. It seems however that it should not be done over the liver as it has been shown that here puncture of the liver may easily be the cause of an air embolism. Also it is doubtful whether the right lower abdominal quadrant should be used, as here the possibility of adhesions from appendiceal inflammation is obvious. It has been mentioned that puncture of the bowel may com-
plicate pneumoperitoneum. This has been very rare. However, if the bowel were adherent to the peritoneum at the site of induction, it most likely would occur. Thus most workers induce pneumoperitoneum on the left side. Initially 400-700 cc. of air are given. The amount is largely determined by the size of the patient and the objective symptoms which the patient presents. If too much air is given there is usually referred diaphragmatic pain in the shoulders. In maintaining the pneumoperitoneum, air is given periodically at approximately weekly intervals, usually 800-1000 cc. Here again the patient's comfort is the chief point in fixing the quantity to be given. Usually in a short period of time the patients are asymptomatic following pneumoperitoneum. Occasionally individuals complain of anorexia, this is thought to be due to dislocation of the stomach and bowel. Anorexia can usually be obviated by proceeding with therapy in a cautious manner. Peritoneal adhesions are occasionally seen, but these do not appear to affect either the treatment or the effectiveness of the procedure. A few cases have been observed where peritoneal effusion has followed pneumoperitoneum. This has not appeared to affect the patients progress and is usually not considered to contraindicate continuation of therapy. No doubt, peritoneal effusion occurs in those who have tuberculous involvement of their peritoneum. It is interesting to note here that numerous workers feel that air injection into the peritoneal cavity is beneficial in cases of tuberculous peritonitis. A point which seems important to us is that there is little possibility that we will produce a crippled lung as so frequently occurs in pneumothorax because here the pleura is not affected.

**FIGURE 1**

*Fig. 1:* There are abnormal shadows in the right lower chest with cavitation laterally and below the right hilus.—**Fig. 2:** A phrenic crush has been done on the right side, giving more selective collapse on this side.
Fig. 3: There are abnormal shadows in the right base with a large cavity just below and lateral to the right hilus. On the left side, there are abnormal shadows in the 2nd interspace anteriorly laterally placed.—Fig. 4: Pneumoperitoneum has been induced. There is a good rise of the right diaphragm associated by a phrenic crush right. There is a new area of parenchial disease in the right upper zone complicated by cavitation. There is regression of the disease on the left side.—Fig. 5: Pneumothorax is induced on the right side with obliteration of the upper zone cavity. Pneumoperitoneum is being maintained. Pneumothorax on the right side has been abandoned. The lesion on the left side becoming more fibrotic in nature.
D. P. was admitted to the hospital on June 15, 1946. The duration of disease was indefinite. He was in good physical condition, afebrile and his pulse was regular and normal. Examination of the chest revealed only dullness over the right base posteriorly. Radiologically there was moderately advanced exudative pulmonary tuberculosis, involving the right lower lobe. There were two small cavities at the apex of the right lower lobe, visualized most clearly by tomographic studies (Fig. 1).

In this case it was felt that pneumoperitoneum offered the best chance of arrest of the disease. Pneumoperitoneum was started in July 1946 and a right phrenic crush was done on July 25, 1946. His sputum decreased in amount from 1 ounce to drachms 2 daily. It is interesting to note that while in this hospital no positive sputums were obtained on this patient, prior to induction of pneumoperitoneum. However, sputum examination done a month prior to admission showed that his sputum was positive for tubercle bacilli. Following induction of pneumoperitoneum, there has been good relaxation of the lower half of the right lung (Fig. 2). His sputum has remained negative to date, eight months after establishment of treatment.

Patient's clinical condition has remained satisfactory. His weight has been maintained. He is afebrile, pulse continues normal. Haematological studies indicate that there has been diminished activity, there being now a low sedimentation rate and the white blood count only slightly above normal.

M. I. was admitted to this hospital on August 1, 1944. On admission patient was found to be underweight. Her blood pressure was normal. Her abdominal examination showed no abnormality. Her genito-urinary system appeared to be within normal limits. Examination of her chest showed bilateral pulmonary tuberculosis with a giant cavity in the right lower lobe and soft parenchymal lesions in the left apex and left infraclavicular region (Fig. 3). On admission, sputum was Gaffky 5. In this case pneumoperitoneum was done and this was made more selective by doing a phrenic crush on the right side on October 13, 1944 (Fig. 4).

Shortly after the institution of this treatment, the cavity in the right lower lung diminished in size and over the succeeding four months the cavity gradually disappeared, being no longer demonstrable either clinically or radiologically. Coincident with the radiological disappearance of the cavity in the right lower zone, sputum became negative for tubercle bacilli.

In August 1945 it was noted that there was cavitation in the right apex and effectively to collapse this area, a pneumothorax was induced on the right side in November 1945 (Fig. 5). The collapse was satisfactory and there was obliteration of the cavity in the right upper zone. Progress in this case has been good. Temperature has remained afebrile and sputum has been consistently negative since the latter part of 1944. In this case atelectasis of the right lower lobe developed as a complication shortly after the initiation of treatment. This atelectatic lobe was observed, and it was found that a minimal degree of bronchiectasis developed, but this was not a complicating factor in the disease, as there was no excessive expectoration of sputum and there were no signs of infective episodes. Bronchoscopy revealed an apparently normal bronchial tree, except for some submucous granulation in the right lower lobe bronchus proper.
Fig. 6: There is a pneumothorax present with approximately 50 per cent collapse. Pneumothorax is complicated by an adhesion in the upper part. There is now approximately 75 per cent collapse of the left lung. The adhesion in the left lung has been divided. There is now approximately 75 per cent collapse of the left lung. The left lung is partially obscured by pleural reaction. The cavity, however, is not visualized.

Fig. 7: Pneumothorax has been abandoned. There is a considerable rise of both halves of diaphragm. The left diaphragm is considerably higher than the right due to the phrenic crush on the left. The left lung is partially obscured by pleural reaction. The cavity, however, is not visualized.
During the period of subsequent observation, her sputum has been persistently negative and there has been progressive resolution of the densities in both lungs.

J. C. was admitted December 4, 1944. On admission patient showed a moderate degree of wasting. Temperature was normal. There were no signs of physical abnormality, other than in examination of the chest which showed dullness at the left apex posteriorly, with scattered rales in this area. There were signs of a pneumothorax on the left side. X-ray film of the chest showed a 50 per cent collapse of the left lung by pneumothorax. Pneumothorax was inefficient due to an adhesion and there was a large tension cavity present in the upper half of the left lung (Fig. 6). Bronchoscopy, January 1945, revealed tuberculous bronchitis.

In November 1944 a pneumonolysis was done on the left side and there was a good collapse of the left lung (Fig. 7), however, the cavity was still present, although somewhat diminished in size. Shortly after pneumonolysis, patient developed extensive pleural effusion on the left side and it was thought inadvisable to continue pneumothorax. Pneumothorax was allowed to re-expand and the fluid was aspirated from the left chest. In May 1945 a phrenic interruption was carried out on the left side and this was followed by the induction of pneumoperitoneum in July 1945. There was almost immediate obliteration of the cavity present in the left upper lung (Fig. 8). Patient has been observed from this date to March 1947 and has shown a persistent normal temperature with normal pulse. Weight has increased 30 pounds. Haematologically, there are no signs of activity. Sputum has remained consistently negative since May 1945.

G. F. was first diagnosed as suffering from pulmonary tuberculosis in 1941 in a Tuberculosis Clinic in this city. Bed rest was carried out for seventeen months at home without any appreciable improvement in the pulmonary condition. In April 1946 patient was admitted to hospital for further treatment.

**FIGURE 9**

*Fig. 9: Tomogram 6 cm. from the skin of the back, shows a large cavity in the right hilar region.*

**FIGURE 10**

*Fig. 10: Pneumoperitoneum has been established and a phrenic crush has been done on the right. Note the rise of both halves of the diaphragm, greater on the right. There is good relaxation of diseased area. There are also lesions in the upper portion of the left lung.*
Physical examination showed a well developed, well nourished girl with normal temperature and normal pulse. There was no sputum and gastric lavage was negative. The examination of the lungs showed a clear left lung. On the right side there were moist rales and bronchial type of breathing over the upper portion of the right chest. Radiologically, there were signs of soft parenchymal lesions above the 2nd rib anteriorly on the left, and near the right hilus there was a large cavity with soft parenchymal lesions throughout the right lower lobe (Fig. 9). In spite of the negative sputum on admission there was no doubt as to the etiology of this disease, as the patient had previously been proven to have positive sputum. Consequently, an attempt was made to obliterate the cavity in the right hilar region by pneumoperitoneum and a phrenic crush on the right side, this treatment being initiated in May 1946. There was a very satisfactory rise of both halves of the diaphragm, greatest on the right, and there has been radiological disappearance of the cavity in the right hilar region (Fig. 10). The lesion in the left apex has remained stationary.

Clinical progress has been good. Temperature ran a low subfebrile course until January 1947, ten months after institution of collapse therapy. Temperature, however, has been normal for the last three months. Patient has no sputum and repeated gastric lavages have been negative both by smear and culture. There has been persistent obliteration of the cavity in the right hilar region. Weight is being maintained satisfactorily.

CONCLUSIONS

1) Pneumoperitoneum is a safe and simple procedure.
2) Excellent collapse of the lower 2/3 of the lung can be achieved by this means.
3) An added phrenic nerve interruption gives more selective collapse of the diseased side.
4) Duration of pneumoperitoneum treatment is an unestablished factor, but it seems that it should be maintained as long as one would a pneumothorax.
5) Cases are presented which demonstrate the effectiveness of this therapy.

CONCLUSIONES

1) El neumoperitoneo es un procedimiento salvo y sencillo.
2) Por este medio se puede obtener un colapso excelente de las dos terceras partes inferiores del pulmón.
3) La adición de la interrupción del nervio frénico da un colapso más selectivo del lado afectado.
4) No se ha establecido todavía la duración de la neumoperitoneotermia, pero parece que se debería mantener por un tiempo igual al que uno mantendría un neumotórax.
5) Se presentan casos que demuestran la eficacia de esta terapia.

REFERENCES