CLOSED INTRAPLEURAL PNEUMONOLYSIS*

A PRELIMINARY ANALYSIS OF 200 CASES

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PERHAPS the single most important collapse measure in the treatment of pulmonary tuberculosis is artificial pneumothorax. The comparative simplicity of the procedure, its proved effectiveness, and the ability to maintain it in an ambulatory way make it a most effective weapon in a widespread public health program. This last point is of major importance in Puerto Rico where, because of the large amount of tuberculosis and the comparative shortage of hospital beds, it is absolutely necessary to convert as large a number of patients as possible to an ambulatory condition, and maintain them in that status.

Unfortunately, in about 20 per cent of cases, pneumothorax is completely impossible because of diffuse pleuritic adhesions. In 50 per cent of the remaining cases pneumothorax is only partly successful because of adhesions which, overlying the diseased portion of the lung make satisfactory collapse impossible.[1, 2]

In 1912, the late Hans Christian Jacobeus[3] of Stockholm devised a method for the cutting of certain types of adhesions in order to make an ineffective pneumothorax effective, and this procedure is being increasingly used as the indications and technique have been perfected. In this paper it is my purpose to present an analysis of the first 200 cases which have undergone the Jacobeus operation performed at the Insular Tuberculosis Sanatorium at Río Piedras from November 1936 to June 1937.

In considering the indications and the contraindications for the operation it must be emphasized at the outset that the mere presence of adhesions is no indication for operation, because in many cases adhesions do not prevent adequate collapse. On the other hand, we feel that it is futile to maintain an unsatisfactory pneumothorax, and attempt to stretch the adhesions by increasing intrapleural pressures. We feel increasingly that there is no set time limit during which pneumothorax need be maintained in order to prove that pneumothorax will be ineffective, and that early pneumolysis will result, not only in earlier

* From a lecture delivered at the School of Tropical Medicine, San Juan, P.R., on Feb. 3, 1938.

closure of cavities, but it will also enable one to obtain an early selective collapse which is so desirable in pneumothorax.

More specifically the indications may be listed as follows:[4, 5, 6]

1. All cases with cavities held open by adhesions which are reasonably suitable for cutting.
2. Adhesions which prevent a suitable selective collapse, particularly in cases with bilateral disease where contralateral collapse is being considered, and the conservation of vital capacity is obviously of great importance.
3. Cases where, because of adhesions, high intrapleural pressures are necessary to maintain a satisfactory pneumothorax.
4. Cases where, because of adhesions and the necessity for high intrapleural pressures, there are severe pressure symptoms such as pain, excessive coughing, troublesome vomiting or marked mediastinal herniation with circulatory disturbances due to the altered position of the heart and blood vessels.
5. Cases with contracting adhesions bringing about re-expansion of the lung.

There are few contraindications to the division of adhesions. Pneumolysis should not be done during the acute stage of fluid formation, nor during an acute empyema. A benign exudate or a chronic afebrile tuberculous empyema is no contraindication to operation, however. In our series of cases 22 per cent had fluid and 8 per cent had a tuberculous empyema preoperatively. Tuberculous disease in the contralateral lung, or contralateral collapse, is no contraindication, provided the disease is not so extensive that some form of therapy may be possible on the contralateral side, or the indications for bilateral collapse therapy exist.

In the actual selection of cases, several points are noteworthy. First, one is frequently misled in the roentgenographic interpretation of the shape, length and position of adhesions. Although the use of stereoscopic films, oblique views and films in an exaggerated lordotic position have been advocated, we have found, as have others[4, 5, 6] that the final decision of whether adhesions can be severed can be made only on direct thoracoscopy. Secondly, the extent to which resection may be carried out in a particular case, depends much upon whether the case is one of unilateral or bilateral disease. In the former, only long, thin and simple adhesions should be cut because, as Dr. Coryllos[6] points out, it is unwise to expose these patients to the dangers of empyema or hemorrhage, since thoracoplasty can be performed with greater success and less danger. In cases of bilateral disease one has to be considerably more radical, and much more extensive resections may be carried out. This obviously will increase the morbidity and mortality. But when one considers the fact that the only chance these patients have is in the production of a satisfactory selective collapse of one of the diseased

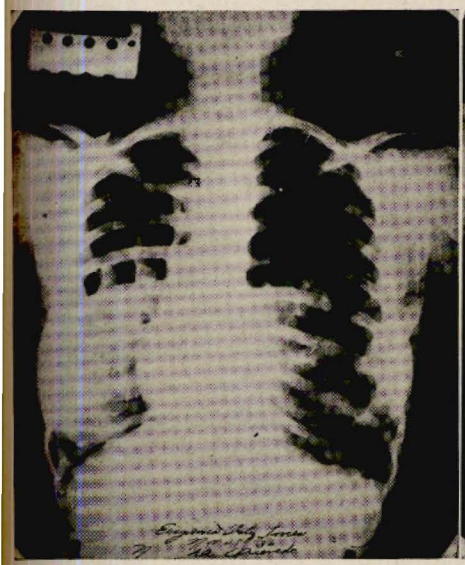
lungs so that some form of collapse may be applied later to the other side, the risk is entirely justifiable. Thirdly, some patients may secure excellent results from multiple stage operations, even though at first the situation appeared hopeless. In this series there are three such cases which ultimately resulted in satisfactory bilateral collapse. The following plates illustrate such a case.

Jacobeus invented the first thoracoscope in 1912 and subsequently modified it in 1916 and 1921. Since that time there have been many modifications and new thoracoscopes proposed, all of which have certain advantages and disadvantages. In our experience we have found that the double unit types of apparatus in which the thoracoscope and cautery are separate, are the easiest to manipulate. We prefer the galvanocautery to the diathermic knife, because of the ability to coagulate and to cut the adhesions with the same instrument. It produces a reliable hemestasis, and there is no danger of faradism which occasionally occurs with the diathermic knife. We are using a direct vision thoracoscope modified after the Kremer Unverricht type with a for-oblique lens. (The Coryllos Thoracoscope-American Cystoscope Makers.)

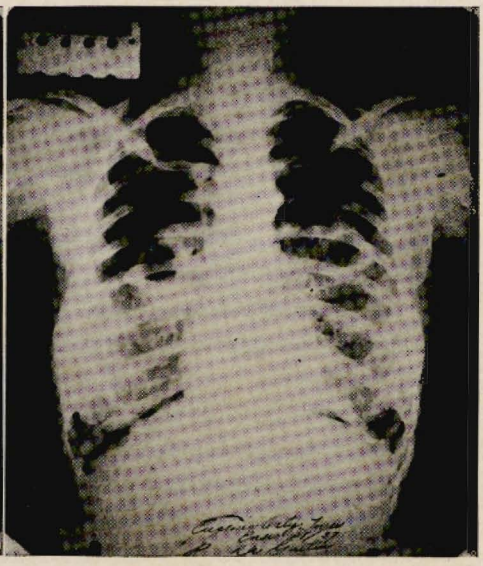
The preoperative preparation consists of shaving and cleansing the skin on the side of the chest to be operated on, and a mild sedative the night before. On the morning of the operation, breakfast is omitted, and the patient given 1/6 or 1/4 gr. of morphine half an hour before going to surgery.

The patient is usually placed on his back, with a slight rotation toward the opposite side. If fluid is present it is aspirated completely the day before operation, but if that has not been done or all the fluid has not been removed, it can be aspirated easily at the time of the operation, by using the sheath of the cautery as a catheter.

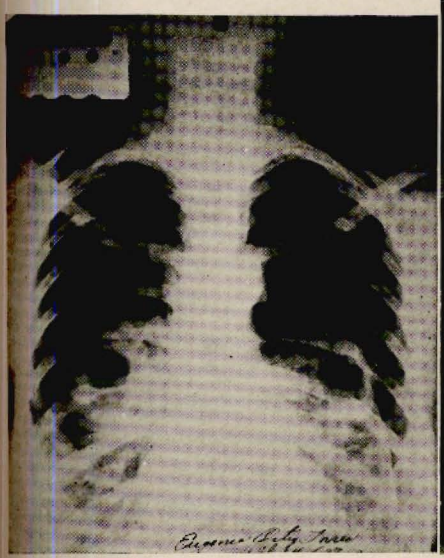
The thoracoscope is usually introduced through the second or third interspace in the midclavicular line, or a little lateral to it. The site for the cautery is determined by the thoracoscopic findings. The entire operation is carried out under local anesthesia with 1 per cent novocaine infiltrated down to and into the parietal pleura at the site at which the trocars will be inserted. At the completion of the operation, air is blown



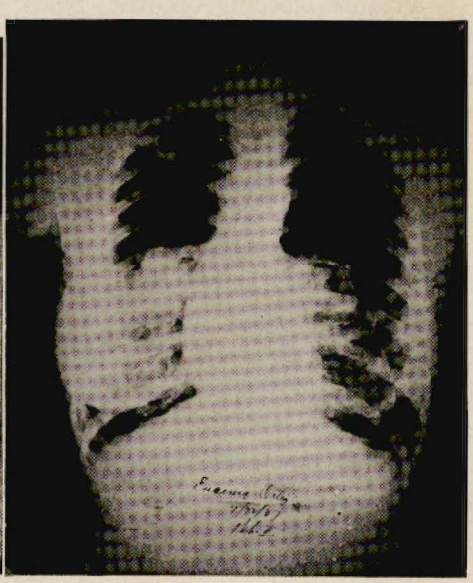
A1—11/28/36 Preoperative plate. Ineffectual pneumothorax on the right with a broad band adhesion, extending from the apex along the mediastinal structures, and attached to the subclavian artery. A cord adhesion extends upward and posteriorlaterally. Pneumothorax is also present on the left. First stage closed intrapleural pneumonolysis on the right, performed 11/30/36, in which the posteriorlateral cord was severed.



A2—1/28/37 Just before the second stage, showing the presence of the medial band, which has stretched somewhat. During this stage, the band was cut through two thirds of its extent. Pneumothorax is being maintained on the left.



A3—4/24/37 Just before the third stage, showing the reduction in the size, and further stretching of the remaining portion of the adhesion which was easily severed completely at this stage.



A4—7/27/37 Three months after completed pneumonolysis, showing marked diminution of the size of the cavities, and now satisfactory bilateral pneumothorax.

into the chest through one of the trocars in order to replace that lost during the operation. Each wound is closed by a matress suture, incorporating the deep layers, in order to prevent as much as possible the production of subcutaneous emphysema. A pressure dressing is then applied.

The patient is placed on his opposite side for 24 hours on return to bed, in order to prevent the formation of new adhesions at the site of the raw and mechanically inflamed pleura. The first refill is given 7 to 8 hours after operation, and daily, or every second day, during the first week.

Generally there is an elevation of the temperature, often reaching 38° to 39°C, the day following operation. This subsides within 2 to 4 days. In our series of 200 cases we had 9 severe febrile reactions lasting 1 to 2 weeks. In 5 of these it was associated with the formation of a serous effusion; in 3, with the formation of a pure tuberculous empyema, and in 1, with the early development of a mixed infection empyema.

A slight subcutaneous empyema is an almost constant complication. This usually disappears within 3 to 5 days. Only exceptionally is it considerable. In 2 of our cases there was a moderately large amount of subcutaneous emphysema, but in no instance did the lung re-expand and become adherent to the parietal pleura because of loss of air.

Profuse bleeding occurred twice; once while cutting a large pleural fold very close to the parietal pleura, resulting in the injury to an intercostal vessel and, another time, while attempting to cut a thick, short cord adhesion. In both instances hemorrhage was readily controlled by coagulation, and in both instances the patients suffered no immediate postoperative effects. In 3 other cases there was moderate bleeding, also readily controlled. All of these cases developed fluid postoperatively. In none did a mixed infection empyema occur.

Immediate spontaneous or traumatic tension pneumothorax did not occur in any of our cases.

Shock or air embolus did not occur in any of our cases.

A small, serous effusion confined to the costophrenic sinus probably occurs in most cases. In our series 81 (40.5%) developed an effusion postoperatively. However, 22 per cent had fluid preoperatively.

In 15 (7.5%) of our cases a pure tuberculous empyema was known to occur. This figure may not be entirely accurate, however, because many patients with moderate postoperative effusions who were afebrile and discharged to continue pneumothorax treatment in the outpatient centers may have had a tuberculous empyema. We do not tap the effu-

sion unless specifically indicated such as by rapid accumulations, large amount, persistent fever or pressure symptoms.

A mixed infection empyema directly attributable to the operative procedure occurred once. This developed 10 days after the partial severance of a very large fold adhesion in a case with bilateral disease, where a radical attempt was made to control the disease on one side, with the hope of later carrying out some form of collapse on the other. Three other cases had a spontaneous tension pneumothorax develop 4, 5 and 6 months postoperatively, and which subsequently developed mixed infection empyemata. Unfortunately no postmortem examinations were permitted on these patients. Our feeling, however, is that having occurred 4 to 6 months after operation, they cannot necessarily be considered as having resulted from the operative procedure.

In considering the results of closed intrapleural pneumonolysis, it must be pointed out that the primary purpose of the operation is to convert an unsatisfactory pneumothorax into a satisfactory one. Complete pneumothorax itself frequently fails to close thick-walled cavities. In like manner, the severance of all adhesions with the establishment of a complete pneumothorax may still not bring about the closure of certain cavities. The results therefore, as Alexander[4] has pointed out, have to do primarily with the number of satisfactory pneumothoraces ultimately established, and remotely to the end results of pneumothorax.

However, since the ultimate objective in treatment is the conversion of sputum from positive to negative, the analysis of our 200 cases is directed primarily to seeing how many of these cases were so converted, and what has been done to date with those cases in which pneumolysis was either ineffectual or impossible.

The statistical analysis of these cases has, therefore, been made under several groupings: Those with unilateral disease; those with bilateral disease in which there is now some form of contralateral control; those with bilateral disease in which pneumonolysis was either impossible or ineffectual, and which have subsequently gone on to some other form of treatment, and those with bilateral disease in which there was no contralateral control as yet. Finally, an analysis has been made of all the patients who have died, either as a result or during the course of treatment.

Two hundred and forty-six operations were performed on the 200 patients. In 162 cases a single operation was done; in 35 cases, 2 operations were performed; 2 cases had 3 operations, and 1 case had 4 operations.

There were 104 males and 96 females, ranging in age from 11 to 50 years. A single adhesion which was either a string, cord, band, fold or diffuse pleural symphysis was found in 61 cases. The remaining 139 cases had multiple adhesions.

In 104 cases (50.5%) the adhesions were completely cut. In 68 (34%) the adhesions were partially cut. In 15.5 per cent, no adhesions were cut.

GROUP I

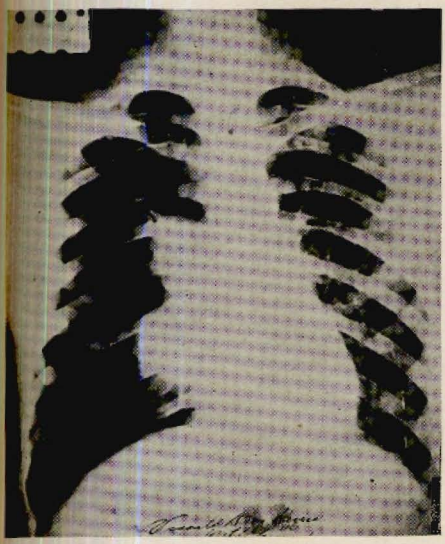
Unilateral Disease

Adhesions	*No.*	*Neg.*	*% Neg.*	*Pos.*	*% Pos.*
Completely cut	55	46	80.4	9	19.6
Partially cut	25	17	68	8	32
Nothing cut	14	6	42.8	8	57.2
Total	94	69	73.5	27	26.5

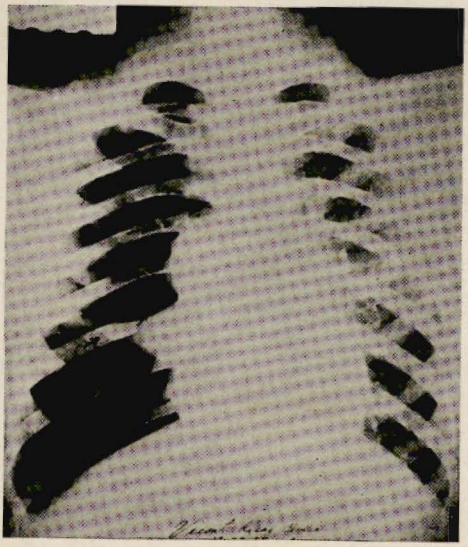
"Partially cut," refers to that group in which all the adhesions were not cut, or in which a large adhesion may have been only partly cut through. As is seen, the severance of some of the adhesions or even the partial severance of an adhesion may bring about sufficient relaxation to allow for satisfactory pneumothorax collapse. It is very difficult to tell just which adhesions are most promising in preventing effective pneumothorax, and our tendency has been to cut all the adhesions possible, keeping within the indications for operability in cases with unilateral disease as pointed out above.

Of the group of 14 patients in which no adhesions were cut, 6 or (42.8%) became negative. However, 4 of these patients were negative preoperatively. In 3 of them thoracoscopy with an attempt to sever the adhesions was thought advisable in order to be able to decrease highly positive pressures necessary to maintain satisfactory collapse against the force of the adhesions. In the 4th case it was desirable to obtain a more selective collapse. Because of the size and type of adhesions encountered, and because of the negative sputum status of the patient, it was felt that the risk was unjustifiable, and no adhesions were cut.

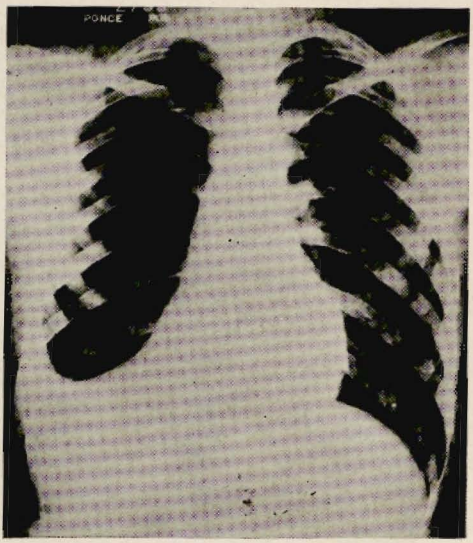
Plates B1, B2, B3, C1, C2, C3 are of cases illustrative of this group.



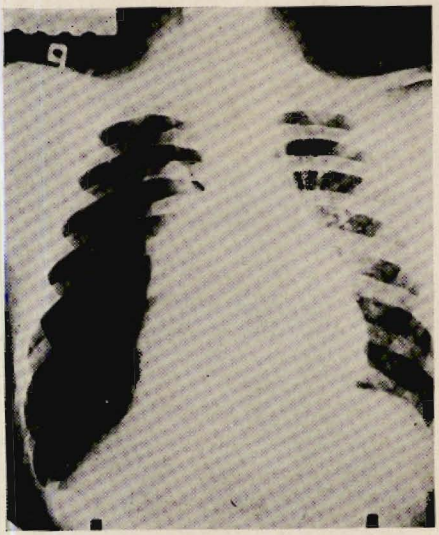
B1—10/10/36 Preoperative plate. The uppermost adhesion is a large fold extending upward and posteriorly. Its appearance here is that of a cord because of its horizontal direction. Below this, there is a cord adhesion extending posteriorlaterally. Extending anteriorlaterally from the lower lobe is a very thick cord adhesion.



B2—11/3/36 Ten days after partial severance of the uppermost adhesion, showing the gaping of the incision site, and the broad posterior attachment. The middle adhesion has been completely severed. The lowermost adhesion was not cut at this stage. A second stage was done 12/11/36 with severance of all adhesions.

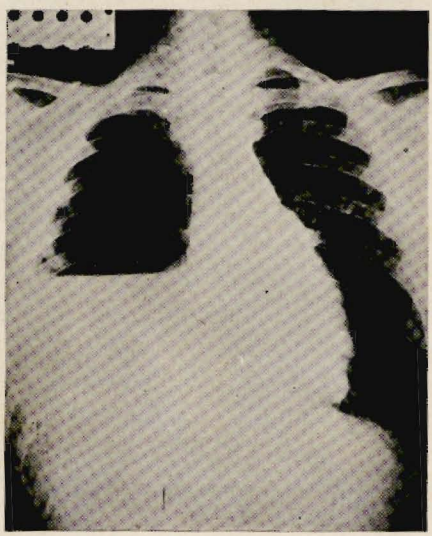


B3—4/5/38 Approximately fifteen months after complete severance of all adhesions. The patient became sputum negative one month after the completed operation, and has remained so.



C1—2/8/37 Huge cavity on the right suspended by two cord and three string adhesions.

C2—3/11/37 Pushing by pneumothorax, resulted in considerable mediastinal herniation with displacement of cavity, but no closure, and persistently positive sputum. A pure tuberculous empyema is present. Closed intrapleural pneumonolysis was done on 5/4/37, and all the adhesions completely cut. The patient became negative three months after operation.



C3—3/3/38 Approximately ten months after pneumonolysis. The tuberculous empyema, present before operation, still persists.

GROUP II

Cases of Unilateral Disease with Impossible or Ineffectual Pneumonolysis Going on to Further Treatment

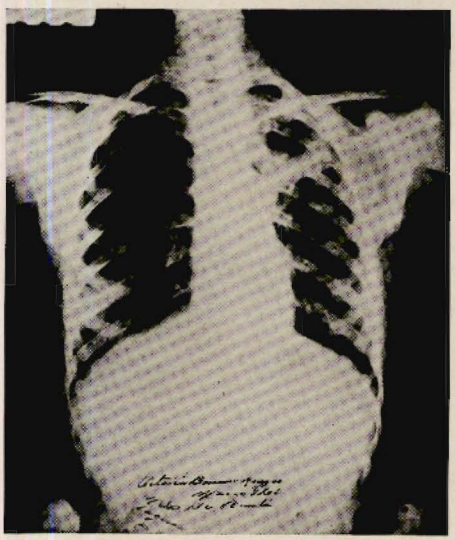
Type of Further Treatment	*No.*	*Neg.*	*% Neg.*	*Pos.*	*% Pos.*
Thoracoplasty	4	3	75	1	25
Phrenicectomy	2	2	100	0	0
Total	6	5	83.3	1	16.7

GROUP III

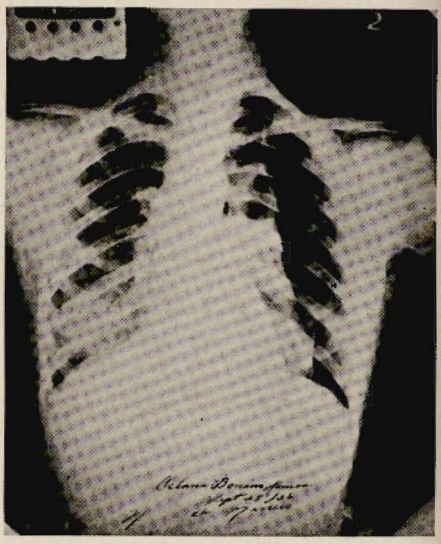
Cases with Bilateral Disease with Contralteral Control

Type of Contralateral Control	*No.*	*Neg.*	*% Neg.*	*Pos.*	*% Pos.*
Pneumothorax	28	13	46.4	15	53.6
Pneumothorax and Pneumonolysis	9	4	44.4	5	55.6
Thoracoplasty	7	4	57.1	3	42.9
Phrenicectomy	0	0	0	0	0
Total	44	21	47.7	23	52.3

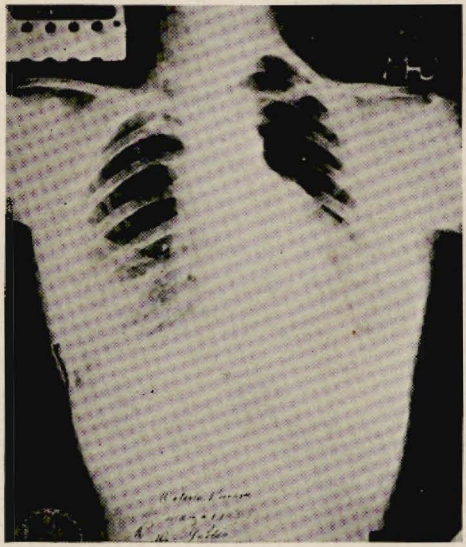
Cases with bilateral disease include those in which there is definite evidence of caseous pneumonic tuberculosis in both sides. Those cases with productive lesions on the contralateral side are considered under unilateral disease.



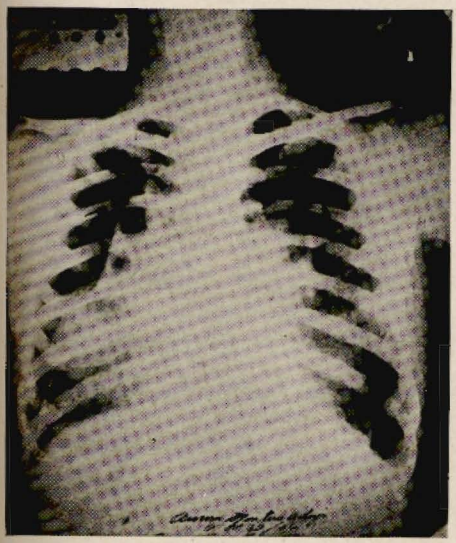
D1—3/7/36 End stage of a caseous pneumonic tuberculous lesion on the left with a large cavity in the left upper lobe.



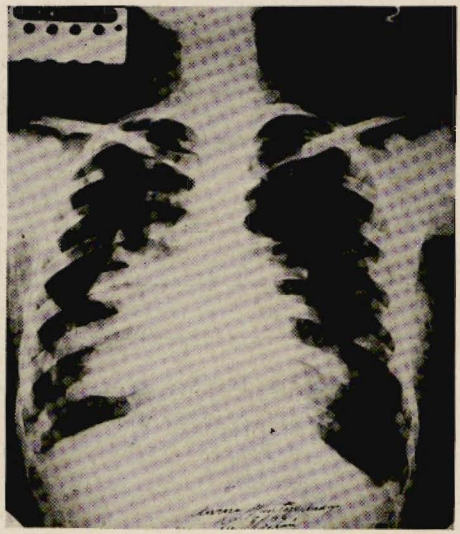
D2—9/29/36 Ineffectual pneumothorax with apex suspended by a band adhesion. There is now involvement of the right apex. First stage closed intrapleural pneumonolysis on the left 12/9/36. Second stage pneumonolysis 4/24/37 with complete severance.



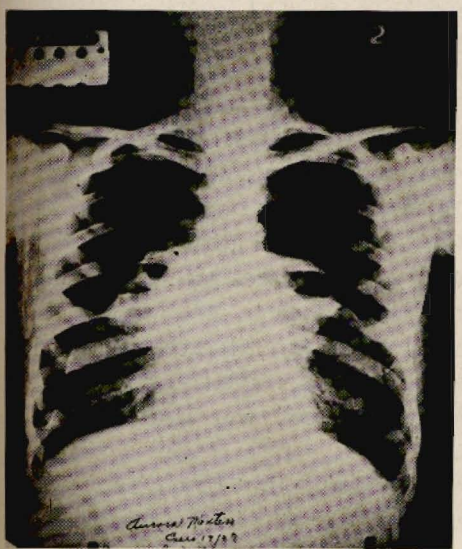
D3—3/17/38 On 10/4/37 a thoracoplasty of three ribs with extrafascial apicolysis was performed on the right. This plate illustrates a completed pneumonolysis on the left with contralateral control by an upper stage thoracoplasty on the right.



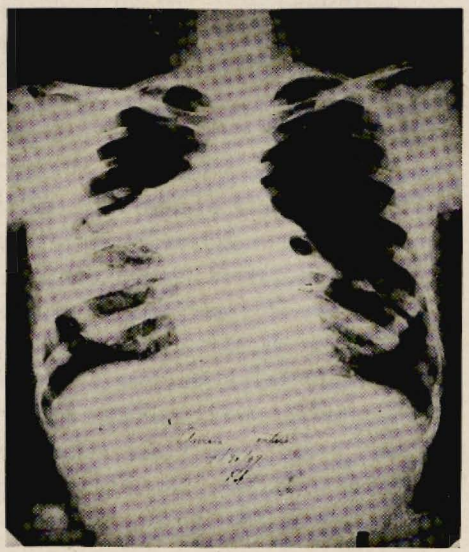
E1—11/30/36 Preoperative plate. Inefficient bilateral pneumothorax because of adhesions suspending cavities in both upper lobes. Closed intrapleural pneumonolysis on the left was done 12/4/37 with complete severance of three cord and three string adhesions.



E2—12/7/36 Three days after operation showing drop of apex, and satisfactory pneumothorax on the left.



E3—1/19/37 After closed intrapleural pneumonolysis on the right with complete severance of a band and two cord adhesions.



E4—9/30/37 Eight months after bilateral closed intrapleural pneumonolysis. There is now a satisfactory bilateral pneumothorax with the patient ambulatory and receiving pneumothorax refills in one of the antituberculosis centers.

GROUP IV

Bilateral Disease with Contralateral Control. Impossible or Ineffectual Pneumonolysis Going to Further Treatment

Type of Further Treatment	*No.*	*Neg.*	*% Neg.*	*Pos.*	*% Pos.*
Thoracoplasty	5	3	60	2	40
Phrenicectomy	2	0	0	2	100
Total	7	3	42.8	4	57.2

Contralateral control of the disease was by means of pneumothorax in the entire group of 7 cases.

GROUP V

Bilateral Disease Without Contralateral Control

Adhesions	*No.*	*Neg.*	*% Neg.*	*Pos.*	*% Pos.*
Completely cut	22	5	22.7	17	77.3
Partially cut	21	1	4.7	20	95.3
Nothing cut	6	0	0	6	100
Total	49	6	12.2	43	87

Many of these cases are still under active treatment, and may eventually have some form of collapse instituted on the contralateral side. It is interesting to note that the closure of a cavity or cavities on the more involved side fellowing pneumonolysis has had a favorable influence on the lesions on the contralateral side in 6 cases with conversion of sputum from positive to negative.

All the groups taken together, 104 cases (52%) were rendered sputum negative. In 66 cases the average rate of sputum conversion was 2 months, in 16 cases it was 4 months, in 17 cases it was 6 months, in 5 it was 8 months and in 1, 10 months.

There were no immediate postoperative deaths, but 21 patients died 2 to 11 months after operation. There were 4 deaths in the group with unilateral disease, 4 deaths in the group with bilateral disease with contralateral collapse, and 13 deaths in the group with bilateral disease without any control on the contralateral side.

Of the 4 cases with unilateral disease, 2 had their adhesions com-

pletely cut, 1 partially cut, and 1 had no adhesions cut. All of these patients were sputum positive and death occurred 6 to 11 months post-operatively. In 2 it was due to the progression of the disease, in one following an acute spread in an ambulatory patient 9 months after operation, and in the fourth following a spontaneous pneumothorax which resulted in a bronchopleural fistula and a mixed infection empyema 6 months after operation.

In the group with bilateral disease with contralateral control, one case had the adhesions completely cut, and 3 cases had the adhesions partially cut. All these patients were positive before death which occurred 2 to 8 months postoperatively. In 3 cases death was due to the progression of the disease after failure to close large cavities. In the fourth, it was due to a spontaneous pneumothorax (4 months after operation) resulting in a mixed infection empyema.

The highest death rate obviously occurred in cases with bilateral disease in which there was as yet no control on the contralateral side. Most of these were desperate cases where the only chance the patient had was in the institution of some form of bilateral collapse therapy. Here, too, we went to the limits of operability. Of the 13 patients in this group, the adhesions were completely cut in 8, partially cut in 3, and not cut in 2. All of these patients were sputum positive before death which occurred 2 to 8 months after operation. In 11 cases death resulted from the progression of the disease, in one from the early production of a mixed infection empyema produced by injury to the lung parenchyma while attempting to sever a large fold adhesion. In another case death followed a spontaneous pneumothorax 5 months post-operatively.

COMMENT

Closed intrapleural pneumonolysis is a most important adjunct to artificial pneumothorax. The ability not only to convert an unsatisfactory pneumothorax into a satisfactory one, but the possibility of creating a greater degree of selective collapse with the conservation of vital capacity, allows for the maintenance of a larger number of patients in a satisfactory ambulatory status which is so important in an extensive public health program. Furthermore, it has made it possible to successfully treat a large number of bilateral cases which would otherwise be hopeless.

Closed intrapleural pneumonolysis is a safe operation and there is 60-80 per cent chance of converting an unsatisfactory pneumothorax into a satisfactory one. In my experience the double unit type of apparatus and the galvanocautery is the easiest and safest to manipulate.

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