Surgical Treatment of Residual Cavities Following Thoracoplasties for Tuberculosis*

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During the past six years we have performed 875 consecutive stages of thoracoplasty upon 325 patients. These patients all had far advanced pulmonary tuberculosis with cavitation. In 35, bilateral cavitation was present. One hundred forty-five were over forty years of age and sixty were past fifty years of age. The operations were performed with a mortality rate of 0.94 per cent per operation and 2.5 per cent per patient. This low mortality rate in a group of patients which included such a large percentage of older individuals was a matter of satisfaction to us. Two hundred sixty-three patients were observed over a sufficiently long period of time postoperatively to be statistically valuable. Sixty-two per cent had a conversion of sputum evidenced by repeated seventy-two hour negative concentrates and cultures. Sixty-two patients were treated too recently to evaluate or could not be traced. Of the thoracoplasty failures, 79 patients were operated upon 89 times in an effort to arrest their disease and close their cavities.

Attempts of other surgeons1-4 to analyze the cause of failure of primary thoracoplasty have brought forward a number of reasons, the most commonly offered of which are:

1) Giant upper lobe or positive pressure cavities.
2) Inadequate surgery, under which heading are included failure to remove a sufficient number or length of ribs or transverse processes, and too prolonged an interval between stages.
3) Unfavorable location of the cavity.
4) Heavy walled cavity or thickened pleura.
5) The presence of pneumothorax or empyema.

The residual cavity following thoracoplasty continues as a

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challenge to the ingenuity of thoracic surgeons in spite of the numerous attempts to solve the problem over the years. Semb suggested an apicolysis, Coryllos and Ornstein reported open drainage with pedicled muscle flaps used to plug the cavities, Dolley and Jones and Alexander have suggested lobectomy or pneumonectomy, Matson used an extrapleural gauze pack, Eloesser used open cavity drainage with a skin flap. Various types of revision operation have been reported by Davidson, Coryllos, Hochberg, and Judd.

Our first group consisted of 44 patients upon whom a revision thoracoplasty was performed. In the analysis of causes for failure of the original operation in this group, we were confronted with the fact that 30 patients had demonstrable tuberculous endobronchial disease and 12 had giant or apparent tension cavities. Inadequate surgery was conceded to be a major factor in 10 patients. These were the three major causes of failure although a number of lesser reasons were present in a scattered group of patients, as shown in Table I.

In some patients several factors may be involved as a cause of failure; therefore the table will not balance numerically.

In the earlier thoracoplasties of this series the transverse processes were not removed. As experience accumulated, however, we became more radical and the removal of the processes became almost routine. In addition, we disarticulate the ribs and often resect the first, second, and third costal cartilages at an anterolateral stage. With the wider resection of ribs and processes, the resort to revision became less frequent.

Thirty-four of the 44 patients who underwent a revision thoracoplasty were over 40 years of age, the average age of the entire group being 40 years. Three of the operations were of a Schede type, performed in treatment of a residual cavity with empyema.

<table>
<thead>
<tr>
<th>Table I</th>
<th>Causes of Failure of Thoracoplasty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endobronchial disease</td>
<td>30</td>
</tr>
<tr>
<td>Giant or tension cavities</td>
<td>12</td>
</tr>
<tr>
<td>Inadequate surgery</td>
<td>10</td>
</tr>
<tr>
<td>Fibrous induration of lung</td>
<td>6</td>
</tr>
<tr>
<td>Thickened pleura</td>
<td>5</td>
</tr>
<tr>
<td>Bilateral cavities</td>
<td>5</td>
</tr>
<tr>
<td>Thoracoplasty over empyema</td>
<td>2</td>
</tr>
<tr>
<td>Tuberculous bronchlectasis</td>
<td>2</td>
</tr>
</tbody>
</table>
These patients were followed for an average period of 21.6 months after the last operation. Conversion of sputum was determined only after a series of negative seventy-two hour concentrates and usually with one or more negative cultures.

There was no surgical mortality and only one late death, due to progression of disease 32 months following revision. Twenty-four patients converted their sputum postoperatively. Two patients had a negative sputum preoperatively but had x-ray evidence of an open cavity. Both remained negative and their cavities were apparently closed. A satisfactory result was thus obtained in 59 per cent of patients (Table II).

Among the 18 therapeutic failures, 15 had tuberculous endobronchial disease. Four of these also had bilateral cavitation. Three of these patients were subsequently controlled by means of pulmonary excision and one by an open cavernostomy.

The revision technique used was not radical. In those patients who had not had the cartilages removed previously, an anterolateral stage was the initial step, at which time the first three cartilages and regenerated ribs were removed. Three weeks later the posterior incision was reopened and the transverse processes, if present, as well as all regenerated ribs were resected. The first intact rib was also removed at this time. No attempt was made to do an apicolysis or effect an extrapleural separation in the gutter. Generous use was made of intravenous fluids and whole blood transfusions.

Our statistics tend to give a more favorable view of revision than we actually hold. The majority of our revisions were performed in the earlier part of the present series when the transverse processes were not removed. As the original operation became more radical and as other methods of treatment of residual cavities became available, the use of revision became less frequent. Given an adequate original operation and having in mind the role played by bronchial obstruction in preventing cavity closure, it is difficult to believe that a revision has much to offer. The increased tissue rigidity resultant from the original thoracoplasty in addition to the mechanical factors remaining in the bronchus

<table>
<thead>
<tr>
<th>Total No. Cases</th>
<th>Death Early</th>
<th>Death Late</th>
<th>Sputum Conversion</th>
<th>Sputum Negative Preop.</th>
<th>Per cent Satisfactory Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>0</td>
<td>1</td>
<td>24</td>
<td>2</td>
<td>59</td>
</tr>
</tbody>
</table>
or pulmonary parenchyma would make secondary cavity closure a difficult procedure.

Our present concept of the revision operation is that it has proven to be safe, and in patients free of endobronchial disease who have had inadequate initial surgery, it is effective. Other more logical methods of treatment of patients with endobronchial disease make the use of revision in such patients questionable.

**Extrapleural Pneumonolyses**

Since Tuffler\(^\text{13}\) first described extrapleural pneumonolysis in 1891 and used fat as a filling for the extrapleural space in 1910, there has been a continued search for a satisfactory filling material. Fat, muscle, gauze, air, oil, and paraffin have all been used and as often abandoned. Bull\(^\text{14}\) in 1920 reported the use of extrapleural fat in an attempt to close residual cavities under thoracoplastic collapse. Nissen\(^\text{15}\) stated that extrapleural pneumonolysis could be used advantageously when, after the ribs are resected, a rigid system of cavities does not collapse completely. Hans Alexander\(^\text{16}\) advocated either a temporary gauze or permanent paraffin filling in pneumonolysis as a supplement to ineffective thoracoplasty. He reported no particular difficulty in making such a pleural separation. Matson\(^\text{10}\) reported the successful use of gauze in a plioform envelope for an extrapleural filling in patients with residual thoracoplasty cavities. Denk\(^\text{17}\) and Corylos,\(^\text{6}\) on the other hand, reported technical difficulties in stripping the uncollapsed cavity from the regenerated ribs. Wilson and Baker\(^\text{18,19}\) first reported the use of the polymeric form of methyl methacrylate (lucite) as an extrapleural filling.

Our first efforts toward residual cavity closure by extrapleural pneumonolysis were made in 1942 when gauze packing was inserted in the extrapleural space in a series of ten patients. In these operations a posterior approach was used through the bed of a regenerated rib or through the bed of the first previously un-removed rib. The dissection was extremely difficult. Adhesions in the gutter or in the apex in the area of the cavity usually made a complete separation impossible. In two cases the pleura was torn during the dissection and the effort was abandoned. Both patients recovered uneventfully. In eight patients a space was created after tedious extrapleural dissection which was considered adequate for packing. This was snugly packed with gauze and the wound was completely closed. After three weeks the wound was reopened, the pack removed and the wound then repacked at frequent intervals until the sinuses healed. Seropurulent drainage persisted for several weeks but all wounds eventually healed. There were no operative fatalities and no late deaths. Two cases,
as stated, were abandoned without packing because of pneumothorax. In five patients cavity closure was not obtained and the sputum remained positive. In three patients cavity closure and sputum conversion were obtained. A 30 per cent rate of success did not seem sufficient to compensate for the danger of opening into the cavity and for the long period of drainage that resulted postoperatively, and the operation was abandoned.

Following Wilson and Baker's work with methyl methacrylate as an extrapleural filling in 1946, a second series of extrapleural dissections following thoracoplasty failure was begun. In these patients the "lucite" balls were used as an extrapleural filling. In this group also there were ten patients. Two patients had two operations, one posterior and one anterior, in an attempt to develop a satisfactory space. In this group, also, the operation was abandoned in three cases because of an accidental tear of the pleura. In spite of added experience, the dissection in these cases was also tedious and difficult, owing to the invariable presence of dense adhesions over the area of involvement. In two patients cavity closure and sputum conversion were not obtained. In three patients the sputum was negative before operation but unmistakable x-ray evidence of persistent cavity was considered an indication for the operation. In two of these the cavity was closed and the sputum remained negative. In the third, a postoperative infection in the extrapleural space necessitated the removal of the lucite balls. Cultures of the pus revealed pyogenic organisms with no tubercle bacilli. The wound is still draining and the sputum remains negative. In two patients cavity closure and conversion of sputum were obtained.

In this series, also, the results obtained hardly justify the risks involved. We are satisfied from this series and from results in a larger group in whom the lucite pack was used as a primary operation that the material itself is superior to any previously used as an extrapleural filling. It is non-irritating, light in weight, and results in few infections. In spite of the reports of some

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**TABLE III**

Results of Extrapleural Pneumonolyses

<table>
<thead>
<tr>
<th>Packing material</th>
<th>No. of patients</th>
<th>Deaths</th>
<th>Sputum negative initially</th>
<th>Sputum converted</th>
<th>Failures</th>
<th>COMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Traumatic pneumothorax</td>
</tr>
<tr>
<td>Gauze</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Lucite</td>
<td>10</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>TOTAL</td>
<td>20</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>12</td>
<td>5</td>
</tr>
</tbody>
</table>
authors\textsuperscript{2,10,16} as to the ease with which the apex could be stripped and the lung freed from the gutter in these operations, we have had a great deal of difficulty in the dissection. Since there are other methods of treatment of these residual cavities more physiologically sound which yield a higher measure of success, we now reserve the extrapleural operation for a small group of patients who are not in satisfactory condition for lobectomy or pneumonectomy, in whom we feel the residual cavity will not close with the addition of a revision thoracoplasty and in whom an open cavernostomy with flap drainage is not possible. The results of the extrapleural group of operations are shown in tabular form in Table III.

**Open Cavity Drainage**

Open drainage of tuberculosis cavities is probably the oldest form of surgical therapy used in the treatment of pulmonary tuberculosis. Sauerbruch\textsuperscript{20} in 1930 stated that the surgical management of tuberculosis had followed a roundabout way and was then back to the method with which it began, pneumonotomy. Alexander\textsuperscript{9} states that drainage of tuberculous cavities has been carried out in isolated cases for centuries but rarely has it been advocated with enthusiasm. Open drainage of tuberculous cavities has attracted the attention of a number of American surgeons. Eloesser expresses the most current opinion in his excellent analysis of tension cavities and standardizes the technique.

"It is not reasonable to attempt to collapse an insufflated cavity, the content of which is under positive pressure by removing the surrounding ribs; some method which abolishes or counteracts the insufflating mechanism would seem more logical. Incision and drainage of tuberculous cavities has been tried repeatedly only to be abandoned. The method is the earliest one of surgical treatment but it has been fraught with so many dangers and difficulties that none of the countless surgeons who have attempted it have remained faithful to it. A *sine qua non* for the cavernostomy with a valve skin flap is that the cavity have no bronchial communication, or a small one. In the presence of a large communication the valve will not produce a negative pressure."

Several European surgeons\textsuperscript{24,25} have recently reported favorably on open drainage of post-thoracoplasty cavities by the Eloesser technique. They were not greatly concerned with the patency of the draining bronchus. In the majority of cases after drainage, silver nitrate caustic stick was applied repeatedly to the cavity walls and bronchial orifices until the cavity was obliterated. Le Carboulec\textsuperscript{26} states that in applying cauterization in caver-
nóstomies it is not a question of obliterating a bronchus and hoping by this means to achieve cure of the cavity, of which it is tributary, by some atelectatic effect, but rather of destroying the tuberculous focus at its site. The cavity, once relieved of its caseous burden, heals, no matter what the means employed, by swelling and contraction of its walls. In his series of 21 cases published in 1945, he reports 19 cures and two deaths, one from the too prolonged use of evipan and one from air embolism.

O'Brien says, "Many cavities, apparently blocked, close readily after thoracoplasty. The only way we can be sure a cavity is blocked is to do a thoracoplasty first." With our present knowledge this is perhaps a good philosophy but it will inevitably leave us with a number of residual apical tension cavities. The anatomical attempts to obliterate that type of cavity by revision thoracoplasty or extrapleural compression have not been encouraging. There remains then a physiological approach, one method of which is by open drainage.

The most dramatic results from the use of streptomycin in tuberculosis have been obtained in patients with draining tuberculous sinuses. We have repeatedly seen patients with multiple chest wall and other sinuses connected with tuberculous bones and joints heal in a short period of time once drainage was established and streptomycin therapy initiated. This beneficent effect of streptomycin in sinuses caused us to wonder whether it could not be used in closing the sinus tracts following cavernostomy at an earlier date than would otherwise be possible. We were able to secure a supply for a trial and although the work is too recent to be of any statistical value, the early results are encouraging and justify a preliminary report.

Open cavernostomy by the Eloesser technique has been performed on eleven patients who had residual cavities after thoracoplasty. The first operation was done in 1942 for a slitlike upper lobe cavity following a seven-rib thoracoplasty in a 48-year-old male. The cavity drained for eighteen months and then closed spontaneously. The sputum has remained negative since shortly after the drainage.

The second patient was 37 years of age. He had endobronchial granulations around the right upper lobe orifice and a right apical cavity which enlarged under pneumothorax. A right thoracoplasty was performed in November, 1944. After the anterior stage, a Monaldi catheter was inserted into the cavity. The cavity apparently closed on completion of the thoracoplasty but reopened a month later and remained open in spite of a revision which was performed in August, 1945. A two-stage cavernostomy by the Eloesser technique was completed January 28, 1946. The sputum
became negative one month following cavity drainage and has remained negative. The culture from the sinus drainage was also negative for acid-fast organisms. By February 28, 1947, the tract had narrowed to a sinus and streptomycin was available. He was given 1.8 grams of streptomycin per day for two weeks. The skin flap was then freed, the sinus dissected and a graft of the pectoralis muscle used to plug the opening. The wound was closed tightly and streptomycin continued for two weeks postoperatively. Healing was by primary intention and the wound has not reopened. The sputum remains negative.

The third patient, a colored male 35 years of age, resulted in a fatality. He was admitted November, 1945 with a 5 cm. cavity in the right upper lobe. There was granulation tissue around the right upper lobe orifice with resultant narrowing. A six-rib, right thoracoplasty was completed June 11, 1946. During both the first and second stage operations a traumatic pneumothorax was created. The lung quickly reexpanded on both occasions and no complications were encountered. On August 12, 1946, the sputum remained positive and a residual oval cavity persisted in the compressed upper lobe. A two-stage cavernostomy was decided upon. The gauze pack was removed August 21, 1946 after ten days and an opening made into the cavity with the electrocautery. Pneumothorax was not encountered at operation. The afternoon of the operative day, however, a pneumothorax developed and the temperature was elevated to 104°F. An intercostal catheter was inserted and suction applied. Penicillin in doses of 40,000 units every three hours was given. The lung reexpanded completely in ten days but the temperature remained elevated. He died suddenly 26 days postoperatively at a time when we were encouraged to believe he was recovering. Permission for a post-mortem examination could not be obtained. The occurrence of a pneumothorax following the reexpansion of two previous traumatic pneumothoraces and a subcostal gauze pack emphasizes the difficulty occasionally encountered in obtaining pleural fusion.

Eight other cavernostomies have been completed three months or longer. All of these patients have a negative sputum and a negative culture from the sinus tract. Four of them who had a cavernostomy completed from five to eight months ago, were given a month's course of streptomycin and the sinuses closed. Streptomycin was continued for a month postoperatively. Three are completely healed and one has a small amount of superficial drainage which is expected to cease without further surgery. The sputum remains negative in each case. One patient who completed his cavernostomy three months ago is on streptomycin preliminary to an attempt to close the tract. Three patients have a negative
sputum but the amount and character of the drainage prevents an early attempt at closure.

In summary, then: Eleven patients have completed a caver-nostomy. One patient died postoperatively, one sinus closed spontaneously, five were closed with the aid of streptomycin, one is being prepared for closure, and three are draining actively. All have a negative sputum (Table IV).

**Pulmonary Excision for Tuberculosis**

Following unsuccessful attempts at removal of tuberculous pulmonary tissue by Block in 1881 and Ruggi in 1885, Tuffier resected the apex of a lung for tuberculosis and obtained a subsequent cure. The patient died seven years later of meningitis. In 1921 Jessen could find only 12 successful recorded instances of pulmonary excision for tuberculosis. Thornton and Adams in 1942 were able to collect 29 cases of pneumonectomy and 46 cases of lobectomy for tuberculosis. They added five cases of lobectomy of their own. There were 44.8 per cent deaths in the pneumonectomies and 25.4 per cent deaths in the lobectomies. In 1946 the reports by Sweet and Overholt were indicative of the trend toward pulmonary excision. Sweet reported 27 lobectomies with 25.9 per cent total deaths and 13 patients apparently well with negative sputum. In 36 pneumonectomies there were 14 deaths (38.9 per cent), operative and late, and 16 patients with a negative sputum. Overholt reported on 200 operations. The case fatality rate in the lobectomies was 11.4 per cent and in the pneumonectomies 17.4 per cent. There was a sputum conversion rate of 50 per cent. These statistics were on the group of patients operated upon from 1944 to 1946 after the technique of operating in the face-down position had been developed.

In the past 18 months lobectomy or pneumonectomy has been performed on 14 patients at the Oteen Hospital who were considered thoracoplasty failures. These operations were performed by the senior author or by Dr. Julian A. Moore, consultant in thoracic surgery. In the first case a left upper lobectomy was done for a residual cavity which had persisted in spite of a revision thoracoplasty. Recovery was uncomplicated and he was

<table>
<thead>
<tr>
<th>TABLE IV</th>
<th>Results of Cavernostomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>Deaths</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
</tr>
</tbody>
</table>
ultimately discharged with an arrested status after completing the required period of rehabilitation.

The second patient had a right upper lobectomy December 28, 1945, for a residual thoracoplasty cavity. He developed a moderate spread in the perihilar area of the contralateral lung and a positive sputum has persisted. The spread was stabilized with the aid of pneumoperitoneum treatment and he left the hospital AWOL in December, 1946. He was clinically well but the sputum was positive.

In the third case a left upper lobectomy was done for a residual cavity following a five-rib thoracoplasty performed in May, 1945. The lobectomy was done January 17, 1946. The postoperative course has been complicated by a mixed empyema with Friedlander's bacillus as the predominating organism. A bronchocutaneous fistula was also present. After a prolonged and often dangerous course, aided by streptomycin therapy the wound has nearly healed. The sputum has been repeatedly negative on concentrate and culture. He is still a bed patient but will ultimately recover.

The fourth patient had a right upper lobectomy for residual cavity on March 14, 1946. He presents our only fatality. He was a colored male 25 years of age who had a six-rib thoracoplasty completed February 23, 1945. He had a moderate hypertension with a blood pressure averaging 140/90 preoperatively. Following lobectomy the temperature was elevated to 103°F. for ten days. It had started to fall by lysis, however, when on the thirteenth postoperative day he died suddenly. Permission for autopsy was refused but it was felt that death was due to a pulmonary embolism.

The experience gained from these four cases convinced us that the operation had merit but that complications made it hazardous. At this time we became familiar with Overholt's\textsuperscript{54} technique of operating in the face-downward position. We were able, without expense, to modify our Albee-Comper orthopedic table so that it could be readily adapted to operating upon patients in the prone position. At the same time, streptomycin became available to us. Since adopting the Overholt position and with the pre- and postoperative use of streptomycin, we have been able to do six successive pneumonectomies and four lobectomies for residual thoracoplasty cavity without a serious complication and with an apparent conversion of sputum in each case. Equally as favorable results were obtained in four other cases of pulmonary excision which were done as elective measures without a previous thoracoplasty. Although several of these cases were done too recently to consider the results permanent, the evidence at hand convinces us that lobectomy or pneumonectomy for a residual thoracoplasty cavity is a safe procedure in a properly selected case if:
1) The operation is performed in the prone position.
2) Streptomycin is administered pre- and postoperatively.
3) A skilled anesthetist is available.
4) Blood in adequate amounts is used to replace loss and to combat shock.

The results of our lobectomy and pneumonectomy group are shown in Table V.

**SUMMARY**

1) In an effort to salvage 79 failures from a series of 325 patients who had undergone a thoracoplasty, 89 secondary operations were performed.
2) Fifty of these patients had a conversion of sputum, a salvage of 68.8 per cent.
3) These secondary operations were performed with only two deaths, an operative mortality of 2.5 per cent.
4) In the light of our present knowledge, the best results in cases of thoracoplasty failure are obtained with lobectomy or pneumonectomy.
5) If a single cavity persists in a patient unsuited for excision, an open cavernostomy offers a good chance of sputum conversion.

**TABLE V**

Results of Excision Therapy

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number</th>
<th>Deaths</th>
<th>Negative sputum</th>
<th>Empyema</th>
<th>Spread</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lobectomy</td>
<td>8</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>6</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>14</td>
<td>1</td>
<td>13</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**TABLE VI**

Results of Entire Series

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number</th>
<th>Deaths</th>
<th>Sputum negative preop.</th>
<th>Sputum converted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision</td>
<td>44</td>
<td>1</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>Extrapleural gauze pack</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Extrapleural lucite pack</td>
<td>10</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Cavernostomy</td>
<td>11</td>
<td>1</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Excision</td>
<td>14</td>
<td>1</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>TOTAL</td>
<td>89</td>
<td>3</td>
<td>5</td>
<td>52</td>
</tr>
</tbody>
</table>
RESUMEN

1) Se realizaron 89 operaciones secundarias en 79 fracasos de la toracoplastia en un serie de 325 pacientes.

2) Se convirtió el esputo en cincuenta de estos pacientes, es decir, se salvó al 68,8 por ciento.

3) Se llevaron a cabo estas operaciones secundarias con sólo dos muertes, o sea una mortalidad operatoria del 2,5 por ciento.

4) A la luz de nuestros conocimientos actuales, los mejores resultados en casos en que fracasa la toracoplastia se obtienen mediante la lobectomía o la neumonectomía.

5) Si queda sólo una cavidad en un paciente no apropiado para la extirpación del pulmón, la cavernostomía abierta ofrece la mejor oportunidad de convertir el esputo.

REFERENCIAS


