Resection in Advanced Pulmonary Tuberculosis*
Experience with 142 Cases

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In the ten-year period ending 1961, 1,088 patients with pulmonary tuberculosis were admitted to the Hadassah University Hospital, of which 437 were treated in the thoracic surgical department.

This is a study on 142 patients with advanced pulmonary tuberculosis in whom pulmonary resection was done. Its purpose is to evaluate the mortality, the postoperative complications and morbidity and the long-term results in this particular type of patient.

The great majority of these patients had been, prior to surgery, on long-term antimicrobial treatment in various tuberculosis institutions in this country and abroad. A combination of two of the three drugs—streptomycin, PAS, isoniazid—had been given to most of the patients for several years. In streptomycin resistant cases, viomycin, pyrazinamide or cycloserine had been administered. These patients had clinically and/or roentgenologically ceased to improve, or even had lost ground under the medical therapy. Therefore, a decision as to the advisability of excisional surgery had to be taken, after careful assessment of the benefits to be expected and the risks involved.

The indications for surgery in this group of patients were active persistent cavitary lesions, extensive fibrocaseous disease, tuberculous bronchiectasis, destroyed lung tissue and thoracoplasty—or plombage-failures. In the majority of these patients, ventilatory function studies were performed and in a few cases, blood gases were determined. A significant number of salvage cases were given the chance of operation in spite of marginal ventilatory function. These patients had spent years in various sanatoria and had remained sputum positive (for tubercle bacilli) in spite of long-term antimicrobial therapy and collapse procedures. Their chest x-ray films had consistently demonstrated extensive destruction of lung tissue. Their social problem was not simpler than their medical problem. In spite of the high surgical risk in such advanced cases, the results of resection were often very gratifying. This has encouraged us to adopt a rather aggressive attitude in patients for whom surgical treatment constitutes the last and only hope.

The surgical procedure was carried out under endotracheal anesthesia, often with a Carlens tube, using a posterolateral thora
cotomy incision. As much lung tissue as possible was preserved. The bronchial stump was closed with interrupted non-absorbable through and through sutures according to Sweet. All grossly air leaking points were ligated or sutured. An effort was made to cover or approximate all raw surfaces. The remaining segments or lobes were then expanded and two large chest drains were inserted through separate stab wounds and connected to a continuous suction system. The drains were removed usually from two to four days postoperatively depending on the completeness of lung expansion, presence of intrapleural fluid and air leaks. Streptomycin was started several days prior to operation (if it had been discontinued some time before), and continued for about two months. Antituberculosis drugs were resumed per os as soon as feasible. Penicillin and in later cases broad spectrum antibiotics, were used during the first postoperative week. Endotracheal suction was employed when the patient failed to evacuate his tracheobronchial secretions by coughing. Breath-
ing exercises under the supervision of a physiotherapist were started before operation and continued as soon as possible after operation. Early ambulation was employed. The degree of lung expansion in the postoperative period was assessed by frequent chest x-ray films (portable equipment). When the postoperative course had been uneventful, the patients were transferred back to the medical chest department of our hospital where antimicrobial and general treatment was continued. About two months after the operation, the patients were sent back to the tuberculosis sanatorium or the chest clinic which had referred them. From then on, they were under the regular supervision of the regional chest center or dispensary.

**Material**

This study is concerned with 142 patients who underwent pulmonary resection for advanced and far-advanced pulmonary tuberculosis. One patient had bilateral segmental resections and another patient whose right upper lobe had been resected previously, later underwent left apicoposterior segmental resection bringing the number of resections to 144 (Table 1).

The youngest patient in this series was 16 years old and the oldest 68. Most patients were in the third, fourth and fifth decades of life. One hundred and four patients were men and 38 women.

The known history of the disease at the time of operation varied less than 18 months to over 20 years; however, in many patients, the exact time of onset could not be ascertained, as it occurred in Nazi concentration or forced labor camps in Europe during the years of 1940 and 1945. Sixty-seven patients had unstable active disease for three to ten years and had spent the major part of this time in various hospitals.

In spite of prolonged hospitalization with bed rest and antimicrobial therapy, 73 patients (51.4 per cent) had positive sputum at the time of operation. Sixty-six patients (46.4 per cent) had (active) far advanced pulmonary tuberculosis and 76 patients (52.8 per cent) moderately advanced (active) tuberculosis.

The overall complications which occurred following surgery are listed in Table 2.

The presence of bronchopleural fistula was suspected when air and a fluid level appeared in the pleural cavity. It became obvious when air leaked continuously for more than 10 to 14 days through the intercostal catheter and when the patient expectorated old blood contained in the pleural cavity. Bronchopleural fistulae were accompanied by empyema; in six patients, encapsulated empyema occurred without evidence of bronchial fistula. In these, various pathogens were cultured from the pus and no tuberculous origin could be demonstrated. Thus, these six cases are listed separately.

When six weeks after the operation the remaining lung tissue failed to fill satisfactorily the space left after the excision of the segment or lobe, the question arose wheth-

**Table 1—Type Resection Performed on 142 Patients**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lobectomies</td>
<td>63</td>
</tr>
<tr>
<td>Segmentectomies (66 patients)</td>
<td>68</td>
</tr>
<tr>
<td>Pneumonectomies</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td>144</td>
</tr>
</tbody>
</table>

**Table 2—Incidence of Complications in Relation to Type of Resection**

<table>
<thead>
<tr>
<th></th>
<th>Broncho-pleural Fistula</th>
<th>Nontuberculous Empyema</th>
<th>Hemothorax</th>
<th>Spread</th>
<th>Space Problem</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Per Cent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Segmentectomy</td>
<td>6</td>
<td>8.8</td>
<td>2</td>
<td>—</td>
<td>16</td>
<td>—</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>4</td>
<td>6.3</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Pneumonectomies</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td>10 (6.9%)</td>
<td>6 (4.16%)</td>
<td>6 (4.16%)</td>
<td>3 (2.08%)</td>
<td>23 (15.9%)</td>
<td>6 (4.16%)</td>
</tr>
</tbody>
</table>
er this rest space should be obliterated surgically in order to avoid infection.

Patients who had an appreciable accumulation of fluid in the pleural cavity following resection, necessitating repeated punctures, are listed under hemothorax (Table 2).

Interestingly enough, we had only six deep wound infections necessitating drainage.

The operative mortality includes all deaths which occurred during the patient's stay in hospital, be it in the surgical or medical chest department without any time limit.

Table 2 shows a pronounced difference in the incidence of complications after the various types of resections. An analysis of these findings seems necessary, therefore.

## SEGMENTECTOMIES

There were no deaths in this group, but as many as eight (12.1 per cent) patients had complications following segmental resections. There was also one case of wound infection and thrombophlebitis each. Forty-eight patients had been classified as moderately advanced and 18 as far-advanced. In the first group, 13 patients had positive sputum before operation, whereas in the second group there were ten positive patients, a total of 23 sputum positive patients. This factor was of significant influence on the morbidity incidence. Thus, three bronchopleural fistulae occurred in the group of 23 positive patients, whereas only three occurred in the group of 43 negative patients (Table 3).

Excision of more than one segment did not increase the incidence of bronchopleural fistula. This type of excision was performed in 27 patients and only three patients of this group (one who was sputum positive preoperatively) developed this complication. This factor contributed to a larger incidence of rest spaces following excision. Thus, 16 patients had residual spaces in the pleural cavity following segmentectomy (Table 2). Of these, seven patients had had more than one segment resected. This residual space occurred twice as frequently in the sputum positive group.

Bronchopleural fistula was treated by continuous intercostal drainage in three patients and this was supplemented by a tailoring thoracoplasty in three cases (two were sputum positive preoperatively). Thoracoplasty was also performed in another five cases for space problems. In four patients it was performed after the space had persisted for more than one month. In one patient it was performed prophylactically at the completion of the resection (Table 3).

## LOBECTOMIES

Sixty-three patients underwent 63 operations in this group. Eight patients had more than one lobe resected, three patients had two lobes resected. There was one postoperative death (1.5 per cent) and 12 interventions (19.0 per cent) were followed by complications (Table 2).

Twenty-four patients had moderately advanced active pulmonary tuberculosis and 39 patients far advanced active tuberculosis. In the first group, 12 patients had positive sputum before the operation and in the second group, 27; a total of 39 patients were sputum positive at the time of operation. The higher rate of complications occurred in the sputum positive group (Table 4).

Bronchopleural fistulae were treated by intercostal drainage with continuous suction supplemented by thoracoplasty.
The indications for tailoring thoracoplasty were broad in the lobectomy group. Thus, 18 thoracoplasties were performed, 14 of these on sputum positive patients. It was mainly performed when space was a concern, as in ten positive and four negative patients. In the latter group, the occurrence of a space was regarded as less dangerous. This was the reason for not performing thoracoplasty in another four negative patients with residual space after lobectomy, as the space was thought be be benign.

Extrapleural plombage had been performed in five patients and classic thoracoplasty in another five patients at various times prior to the lobectomy. Resection was done because the disease remained uncontrolled in spite of the collapse procedure. However, these patients had the advantage of an already reduced hemithorax-volume at the time of resection, a fact which certainly contributed to an uncomplicated postoperative course. One death followed lobectomy. The patient was a 47-year-old man who had undergone extrapleural plombage on the left side. Six months later, his left upper lobe was resected and the plomb removed. The patient developed a bronchopleural fistula and empyema and died 30 days after the lobectomy from sepsis and respiratory insufficiency.

**Pneumonectomies**

Thirteen patients with one completely destroyed tuberculous lung underwent pneumonectomy. All these patients were chronic far advanced cases and the sputum of all of them was positive prior to operation. There was contralateral disease in all of them either stable or controlled. In all of them, previous surgical measures, e.g., collapse procedures, Monaldi-drainage had been carried out without avail. It is evident from these data that these were extremely advanced poor risk cases in whom prognosis without surgery appeared hopeless and pneumonectomy was regarded as the last chance.

Accordingly, the mortality was high, five patients dying from 36 hours up to two months postoperatively. One patient died of uncontrollable diffuse bleeding from all raw surfaces due to fibrinolysis. Three patients died of massive pulmonary embolism and one succumbed to progressive cardiorespiratory insufficiency.

**Follow-Up**

The present condition of 119 patients of this series has been ascertained. Of these, 110 patients, i.e., 77.4 per cent of the total, are now well and have resumed work.

Considering the time elapsed since their operations, 72 patients are registered as recovered by the Department of Chronic Diseases of the Ministry of Health; the remainder, although stable, are still in the quiescent or arrested inactive stage of the disease.

Fifty-seven patients (86.3 per cent) are well and working after segmentectomy, 36 of them having recovered. There was no late reactivation and no "failure" among these patients. Eight patients discontinued reporting for follow-up; although seven of these had been registered as inactive and stable for periods varying from one to three years, they are not included in the results. Another patient committed suicide two years after operation while being quiescent and stable.

Forty-seven patients (74.6 per cent) who underwent resections of one lobe or more, are well and working, 34 patients being classified as recovered.

Three patients failed to improve after lobectomy and are still under treatment. Reactivation of the disease occurred in three patients from two to three years after...
surgery. One patient died seven months after lobectomy, of brain metastasis. Anaplastic carcinoma of the lung was discovered at operation and removed with the tuberculous process.

Eight patients of this group failed to report, although three were known as inactive and stable at their last examination. They have not been included in the results.

Six patients who underwent resection of a whole lung are now well and working. One patient died of carcinoma of the chest wall two years after operation and the follow up of another patient is unknown.

COMMENT

The late results of pulmonary resection in our series reported above appear gratifying indeed considering that many of our patients must be regarded as salvage cases. In these patients prolonged sanatorium care, antimicrobial therapy, various collapse procedures such as intrapleural or extrapleural pneumothorax, extrapleural plombage, thoracoplasty, cavity drainage, etc., had failed to control the tuberculous process. Their disease had remained active, their sputum positive and not infrequently were their bacilli resistant to streptomycin and isoniazid. Pulmonary resection constituted for these patients more of an "ultima ratio" than a therapy of choice and this explained the considerable mortality in our pneumonectomy cases and the relatively high postoperative morbidity (17.3 per cent) in the entire series.

All postoperative deaths—five after pneumonectomy, one after lobectomy—occurred in advanced active patients with positive sputum and resistant bacilli before operation. Our overall mortality for the 142 patients is 4.2 per cent; this compares favorably with the mortality rate of 5 per cent reported by Bergh and co-workers for 125 lung resections in "moderate and bad risk cases," whereas in 278 "good risk cases" there was no postoperative death. When related to the occurrence of tubercle bacilli in the sputum before operation, these authors arrive at a mortality of 7.6 per cent for sputum positive patients.

Bronchopleural fistula and empyema occurred in 11 per cent of our cases, particularly in patients who were sputum positive at the time of operation. Resistance of the tubercle bacilli to antibiotics and antimicrobial drugs increases the incidence of complications. This was also the experience of Ross and associates who report 31 complications in 238 resections and there are many references in the literature on the high postoperative morbidity in this type of surgery. Segmentectomy is reported to be followed by a higher morbidity than lobectomy, Brouhard and co-workers reporting a rate of 25 per cent with 9.9 per cent bronchopleural fistula and empyema. In our own segmental resections, we had 8.8 per cent bronchopleural fistulae and empyemata, whereas in our lobectomies the rate was 6.3 per cent (Table 2).

Segmentectomy is advisable in cases where a relatively unaffected and adequately ventilated neighboring lung segment can be saved by this limited resection. Whenever this appears improbable or doubtful, lobectomy is preferable.

While lobectomy was followed by a lower rate of tuberculous complications than segmentectomy, it carried a higher overall morbidity, which is understandable in the type of patient we accepted for this operation. A similar experience is reported by Raleigh and Steele, Pecora and Milloy and co-workers.

Taking into consideration that more than three out of four of these unhappy "bad risk" patients—many of whom had been previously refused surgery—are now well and working after pulmonary resection, we feel that our rather aggressive attitude in this type of patient was fully justified.

SUMMARY

One hundred forty-four pulmonary resections performed on 142 patients with advanced tuberculosis, many of them salvage cases, are reviewed and analyzed. The overall mortality rate was 4.2 per cent.

The postoperative complication rate was 17.3 per cent of which 11.06 per cent were
bronchopleural fistulae and empyemata. These complications occurred in 8.8 per cent of the segmentectomies and 6.3 per cent of the lobectomies.

Of the 119 patients whose present condition is known, 110 patients (77.4 per cent of the entire series) are well and working, their sputum negative.

Resumen

Ciento cuarenta y cuatro resecciones pulmonares se llevaron a cabo en 152 enfermos de tuberculosis pulmonar avanzada, muchos de ellos, casos de rescate, y se revisan.

La mortalidad total fue de 4.2 por ciento. La proporción de complicaciones postoperatorias fue de 17.3 por ciento, de las que 11.06 por ciento fueron por fístula broncopleural y empiemas. Estas complicaciones ocurrieron en 8.8 por ciento de las segmentectomías y en 6.3 por ciento de las lobectomías. De los 119 enfermos cuyas condiciones actuales se conocen 110 enfermos (77.4 por ciento de la serie total) están bien y trabajando con esputos negativos.

Resume

144 résections pulmonaires pratiquées chez 142 malades atteintes de tuberculose grave, dont beaucoup étaient dans un état désespéré, sont passées en revue et analysées.

Le taux global de mortalité fut de 4,2%.

Le taux des complications post-opératoires fut de 17,3% sur lesquelles 11,06% furent des fistules broncho-pleurales et des épanchements. Ces complications survinrent chez 8,8% de segmentectomies et 6,3% de lobectomies.

Sur les 119 malades dont on connaît l'état actuel, 110 malades (77,44% du groupe entier) sont en bonne santé et travaillent, leur expectoration est négative.

Zusammenfassung

144 Lungenresektionen wurden bei 142 Patienten mit fortgeschrittener Tuberkulose vorgenommen, darunter viele als Notfälle; sie werden einer Analyse unterzogen.

Die Gesamt mortalität lag bei 4,2%.

Die postoperative Komplikationshäufigkeit betrug 17,3%, darunter befanden sich 11,06% mit inneren Fisteln und Empyembildung. Diese Komplikationen traten bei 8,8% der Fälle von Segmentresektionen und 6,3% der Lobekomien ein. Von den 119 Patienten, deren gegenwärtiger Gesundheitszustand bekannt ist, befinden sich 110 Patienten (77,4%) der gesamten Serie wohl und arbeiten und haben ein negatives Sputum.

References


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