LUNG RESECTION FOR TUBERCULOSIS IN THE ARMY
A REPORT ON 61 CASES

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Lung resection in pulmonary tuberculosis has been carried out at the Connaught Hospital (Army Chest Centre) since October, 1953, and a general account of chest surgery in Army patients has already been published (Mackay-Dick & Large, 1957). Up to 31st December, 1957, a total of 322 resections in 318 patients had been performed and a preliminary report on the first 125 of these has also appeared (Large, Curry & Harrison, 1957). Of the 318 patients so far operated on, 61 have been retained in the Army and followed up at the Army Chest Centre and this report deals with the details of the operative procedures and the results of follow up. All the patients were male British other ranks serving on regular engagements, most of whom were senior N.C.Os. or warrant officers (officers are transferred to King Edward VII Sanatorium, Midhurst, for treatment). Their average age was 30.3 years. The oldest was 47 and the youngest 20 years of age. Three of the patients had bilateral resections, so the report deals with 64 resections (34 on the right: 30 on the left) in 61 patients.

Type of disease

We admitted a relatively large number of patients with early active pulmonary tuberculosis and it is from these that most of the patients for operation came. On the other hand advanced chronic pulmonary tuberculosis is not often seen at the Connaught Hospital and those cases admitted were usually transferred quickly to civilian sanatoria.

Table 1 shows the type of disease for which resections were done.

All cases had a negative sputum by the time they were operated on. 26 had had a positive sputum at some time before operation: 35 had negative sputa throughout.

Table 1. Type of disease operated on.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Solid lesions which changed little or not at all on chemotherapy</td>
<td>9</td>
<td>14%</td>
</tr>
<tr>
<td>2. Residual disease after bed rest and chemotherapy had resulted in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>radiological clearing and/or cavity closure before operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Non-cavitated at operation</td>
<td>45</td>
<td>70.4%</td>
</tr>
<tr>
<td>(b) Cavitated at operation</td>
<td>10</td>
<td>15.6%</td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>100%</td>
</tr>
</tbody>
</table>
**Indications for resection**

Cases for resection can be divided into two main groups: those in whom the disease remains active in spite of bed rest, drugs and relaxation measures, and those in whom the disease has already been stabilised by these means. The majority of our cases belonged to the second group. Surgery was undertaken because it was considered that the removal of the diseased area offered the best safeguard against subsequent breakdown of the disease. We regarded resection as the treatment of choice except in those with disease too extensive to permit its removal or those with so little radiological evidence of disease remaining after medical treatment that it was felt justifiable to leave them.

In the majority of our patients, all disease which was palpable at operation, or radiologically visible before operation, was removed. Recently, however, growing knowledge of the effects of long periods of chemotherapy has caused us to modify our procedure in certain cases and we have felt it reasonable to operate on more extensive cases by removing only the main areas of disease and leaving behind lesser areas which we felt could be left under chemotherapeutic control. Furthermore we have felt justified in adopting conservative measures in many patients with limited areas of disease which previously would have been removed.

**Pre-operative treatment**

Resection in all our cases was preceded by a course of medical treatment (rest, drugs and sometimes pneumoperitoneum) the length of which varied according to the type of disease and its response to treatment. Normally, resection was undertaken when it was judged that no further improvement of the disease by non-surgical means would occur. This took anything from a few weeks in patients with small solid lesions to many months in patients with more extensive disease. The average time in our series was five months. For some weeks before operation, patients were taught breathing exercises and postural drainage, which were continued after operation under the direction of the physiotherapist.

<table>
<thead>
<tr>
<th>Operation and amount of lung removed</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wedge resections</td>
<td>4</td>
<td>6.2%</td>
</tr>
<tr>
<td>Segmental resections:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One segment</td>
<td>9</td>
<td>14%</td>
</tr>
<tr>
<td>Two segments</td>
<td>38</td>
<td>59.6%</td>
</tr>
<tr>
<td>Three segments</td>
<td>4</td>
<td>6.2%</td>
</tr>
<tr>
<td>Lobectomy:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One lobe (the left upper lobe includes the lingula)</td>
<td>7</td>
<td>10.9%</td>
</tr>
<tr>
<td>Lobe and one segment</td>
<td>2</td>
<td>3.1%</td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Operative and post-operative management**

Table 2 indicates the extent of lung removed by the different types of operation.
Excision of lung tissue was performed by standard technique after freeing the lung of adhesions and applying a bronchial clamp. Raw areas of lung after partial resections were oversewn. In a few of the early cases a space-reducing phrenic crush was carried out when more than one segment had been removed: thereafter this was not done.

Apical and basal drainage tubes were usually left in for 48 hours but if there was persistent air leakage they were left *in situ* for 72 hours. As soon as the tubes were removed the patients were encouraged to get up for toilet purposes and to sit in an arm-chair for an hour a day, but otherwise bed rest was continued for four weeks after operation.

Breathing exercises were started the morning following operation together with postural drainage and shoulder movements.

Four weeks after operation (six weeks for the first 10 patients) we allowed patients up for an hour a day and we increased this by an hour every ten days unless there had been significant complications. When they were up seven to eight hours a day (that is, about 13 weeks after operation) they were discharged on eight weeks' convalescent leave.

**Complications**

The complication rate was small and most of the complications were minor in nature, causing neither delay in the patients' upgrading nor major upset in their well-being. In only three cases was it necessary to delay the patient's upgrading and date of discharge from hospital and in those cases the added duration of stay in hospital was one, five and ten weeks. We found that the complication rate was significantly less in the later part of the series.

Table 3 shows the incidence of post-operative complications.

<table>
<thead>
<tr>
<th>Complication</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effusions</td>
<td>2</td>
<td>3.0%</td>
</tr>
<tr>
<td>Atelectasis</td>
<td>1</td>
<td>1.5%</td>
</tr>
<tr>
<td>Air pockets</td>
<td>3</td>
<td>4.5%</td>
</tr>
<tr>
<td>Bronchopleural fistula</td>
<td>1</td>
<td>1.5%</td>
</tr>
<tr>
<td>Empyemata</td>
<td>1</td>
<td>1.5%</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>1</td>
<td>1.5%</td>
</tr>
<tr>
<td>Localised wound infections</td>
<td>1</td>
<td>1.5%</td>
</tr>
<tr>
<td><strong>Total complications</strong></td>
<td>10</td>
<td>15.0%</td>
</tr>
</tbody>
</table>

Effusions (two cases). Small basal effusions were not uncommon after the removal of the drainage tubes. Most absorbed spontaneously in the course of a few days but two required aspiration. These were heavily bloodstained and were due to continued oozing inside the chest following removal of the tubes.

Atelectasis (one case). Minimal patchy basal atelectasis, usually on the contralateral side, was a common experience in the first few days post-operatively, but collapse of such magnitude as to be regarded as a complication was un-
common, occurring in only one case. This re-expanded within a few days with intensive physiotherapy and postural drainage. Bronchoscopy was not required.

Air pockets (three cases). We have employed a conservative policy throughout the series with regard to post-operative air pockets and it is, in our experience, exceptional for them to persist beyond three months from the date of operation.

In three cases, however, because of either symptoms or the failure of the pocket to start diminishing in size, intervention was thought advisable, and suction via an intercostal catheter or a Foster Carter needle (depending mainly on whether the air pocket contained fluid or not) was applied with good results. The differentiation of simple air pockets from those with fistulae was often difficult. Unless there was clear evidence of fistula formation, such as fever and haemoptysis, we have regarded them as simple air pockets.

Bronchopleural fistula (one case). This showed itself as a persistence of the normal air escape from the drainage tubes beyond the usual time with the development of a large air pocket following their removal. It responded to suction via an intercostal catheter.

Empyema (one case). This was due to Staphylococcus pyogenes and was successfully treated by rib resection and drainage.

Pulmonary embolism (one case). This caused pleuritic pain and a small effusion which absorbed spontaneously and caused no delay in upgrading.

Post-operative chemotherapy

During the first half of the period covered by this report chemotherapy was continued up to the time of the patient’s discharge from hospital. Since then it has been our practice to continue drugs by mouth (I.N.A.H. and P.A.S.) for at least a year after return to duty.

The follow up

When patients left hospital they were sent on eight weeks’ convalescent leave before returning to light duty in category P.7, as described in the War Office publication on the Pulheems system of medical classification (1951). Thereafter they normally attended the Army Chest Centre every three months for review and it has therefore been possible to supervise their activities after operation very thoroughly.

Table 4 shows how long cases have been followed up since operation and how long they have been back at duty.

Table 4. Length of time since operation and length of time back at duty.

<table>
<thead>
<tr>
<th>Time in years</th>
<th>Number of patients followed up since operation</th>
<th>Number of patients back at duty</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 4</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>More than 3</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>More than 2</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>More than 1</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>Less than 1</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
<td>61</td>
</tr>
</tbody>
</table>
Lung Resection for Tuberculosis in the Army

The policy for Army patients has been to keep them at least one year in category P.7 and at least a further year in category P.6 before upgrading them to P.3. This rate of upgrading has not normally been exceeded, but it has been slowed down in those patients who have had significant disease left behind at operation. It is intended eventually to upgrade patients to category P.2 when they have been back at duty for a period of five years. No Army patient has yet achieved this. Table 5 shows the distribution of Army patients by categories on 1st January, 1958.

Table 5. Distribution of categories on 1st January, 1958.

<table>
<thead>
<tr>
<th>Pulheems grading</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O.Rs.</td>
</tr>
<tr>
<td>P.3 ...</td>
<td>12</td>
</tr>
<tr>
<td>P.6 ...</td>
<td>17</td>
</tr>
<tr>
<td>P.7 ...</td>
<td>32</td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
</tr>
</tbody>
</table>

(The corresponding figures for officers are included for comparison)

None of the Army patients followed up at the Army Chest Centre has shown any clinical or radiological sign of spread or reactivation of disease. Only one has shown any disabling symptom directly attributable to the operation. He had a bilateral resection and complained of a moderate amount of dyspnœa on effort since operation.

DISCUSSION

Most of our patients had disease which had already been arrested and rendered stable by rest and chemotherapy but which could not be regarded as healed without many more years of observation. The object of resection in these cases was to prevent future breakdown of the disease: the operation was a prophylactic as well as a curative procedure. Four and a half years have elapsed since resectional surgery was started at the Army Chest Centre and it is timely, therefore, to ask if the procedure has been justified by its results.

First, has resection reduced the incidence of subsequent breakdown and reactivation of disease in those patients who have been retained in the Army? None has so far broken down. The follow-up period has not been long enough to ascertain that resection is a permanent cure, but the results to date are certainly encouraging. The results of large series of civilian cases (some having been followed up for five years or more) show that the subsequent breakdown rate is very small. It is impossible to say how many of our cases would have broken down if they had not been treated by resection, but clinical experience of the natural history of the disease suggests a not inconsiderable number. Todd, Teare & Gordon (1956) showed that even after several months of chemotherapy tubercle bacilli could still be cultured from a large proportion of solid lesions removed at operation and that, as it was impossible to show clinically
or radiologically which were sterile and which were not, their removal by surgery
was logical provided the operation could be done safely and quickly.

More recently, however, it has been suggested that chemotherapy can
sterilise solid lesions and cavities provided that the drugs are given for long
enough (Stewart, Turnbull & Macgregor, 1956) and a recent clinical series showed
that of 63 patients with sensitive organisms who received more than 18 months’
chemotherapy, none relapsed (Ross, Horne, Grant & Crofton, 1958). It may
be that as we learn more about the effects of such long courses of drugs fewer
patients will have resections and more will be left under chemotherapeutic
control: advancing knowledge in this field has certainly altered our criteria for
selection of cases for surgery over the last 12 to 18 months. In the meantime,
however, we feel that resection in these patients, the majority having begun
treatment at a time when short courses of chemotherapy were the rule, has been
justified by the results achieved.

Secondly, has resection affected the Army patient’s subsequent Service
career? Until a few years ago most Army patients who had tuberculosis were
invalided from the Army because there was a danger of the disease breaking
down after medical treatment as soon as they were subjected to the stresses of
Service life. The exceptional cases who were retained in the Army were kept
in low medical categories for many years, and very few of them ever rose higher
than the equivalent of category P.7. Since resectional surgery started for Army
patients, not only have many been retained in the Army, but they have been
returned to higher medical categories more quickly than was possible after
medical treatment alone. Our routine of upgrading has been such that soldiers
have been returned to light duties in category P.7 five months after operation.
Two years later, many cases have been upgraded to P.3, at which level their
promotion and career prospects are not adversely affected as they are fit for all
ordinary duties. At present they must remain in this category for another three
years, but as our knowledge of the end results of surgery is widened by the
experience of large numbers of cases, it is probable that this time will be reduced
in the future.

Against these advantages must be weighed the risks which are inherent in
any operative procedure. First, what is the operative mortality? Most large
series of resections for all types of tuberculosis show that the operative mortality
is between 1 and 2 per cent (Bickford, Edwards, Esplen, Gifford, Thomas
& Waddington, 1957; Thompson, Savage & Rosser, 1954). The deaths,
however, have usually occurred in advanced tuberculosis of a type which would
not have been considered for retention in the Army. In a series of 238 cases
similar to those described in this paper, Todd et al. (1956) showed no operative
deaths. It can be said, therefore, that the mortality risk is very small, and as
experience grows it is likely to become even smaller.

Secondly, what are the risks of complications? The operative complications
have been shown in our series to be small and only three patients have had their
date of discharge from hospital delayed because of them. Post-operative dysp­
nesia can sometimes be a serious complication if much lung is removed, but
only one of our patients has suffered from this and he has not been unduly disabled in spite of having had a bilateral resection.

On balance, we believe that the advantages of freedom from risk of breakdown of the disease, and in addition the rapid return to full activity, outweigh the operative risks. We consider, therefore, that resection has been justified by the results in 61 patients studied in this report.

SUMMARY

The operative details and follow-up results are given of 61 soldiers who, since October, 1953, have had resection for pulmonary tuberculosis and who have subsequently returned to duty in the Army.

The operative risks were small.

No case in this series has so far shown subsequent breakdown or reactivation of tuberculous disease.

At 31st December, 1957, 12 patients were in category P.3, 17 in category P.6 and the remainder still in category P.7. They have achieved these categories more quickly than they would have done after medical treatment alone.

It is considered that resection in these patients has been justified by the results achieved.

REFERENCES

Lung Resection for Tuberculosis in the Army: A Report on 61 Cases
S. E. Large and G. Kent Harrison

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