

THE RESULTS OF THORACOPLASTY IN PULMONARY TUBERCULOSIS*

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The evaluation of thoracoplasty in the treatment of pulmonary tuberculosis depends on so many factors that accurate assessment is difficult. The present survey is submitted with this in mind. It provides, however, some general figures about the fate of the patients and the effects of the operation on their disease.

The subject matter of this analysis consists of a follow-up of all cases of thoracoplasty for pulmonary tuberculosis, not complicated by empyema, performed by the writer between 1935 and the middle of 1946. The patients were traced by reference to the local authorities, chest clinics, hospitals, and private doctors; a report was then obtained from the medical man most recently in charge of the individual patient. It was inevitable that no information could be obtained about some patients, for owing to the partial destruction of the records in two hospitals in air raids and the unusual movement of population during war years the difficulties ordinarily encountered were increased. Actually the number of cases "lost sight of" was relatively small (7.1 per cent) and could not be regarded as influencing the final results too seriously.

In view of the different sources from which information was derived a very detailed analysis could not be undertaken, and attention was confined to three main points: (1) the patient's capacity for work, with a statement of the present general condition; (2) the presence of tubercle bacilli in the sputum; (3) the presence of cavities in the lung. It can be assumed that the operation was undertaken for disease with cavitation in the lung and with tubercle bacilli in the sputum. Cases of tuberculous empyema were excluded from the survey.

Before analysis of the material some important points affecting the end-results of the operation must be mentioned. Firstly, thoracoplasty is only a local measure aiming at selective collapse used in the course of a general disease; it is not in itself a cure. Secondly, the criteria on which cases are selected for operation are most variable. Sometimes operation is reserved for those patients who have minimal disease of a healing character, in other words "good risk cases"; while at the other extreme the indications may be extended to cover patients for whom nothing else can be done and in whom operation is almost a measure of despair. Other factors which have to be taken into account include the general change in outlook towards thoracoplasty during the years under

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consideration, and the degree of understanding between the surgeon and the physician. In this latter connexion it will be realized that the surgeon is only presented with those patients whom the physician in charge regards as suitable for surgery. This selection varies in different institutions, and, while the decision and responsibility for operation rests finally with the surgeon, the type of case referred to him may well differ in different sanatoria.

Within the last twelve years the actual operation has undergone technical modifications. Originally it was based on the standard Sauerbruch paravertebral thoracoplasty. In this operation the tenth to the sixth ribs were first resected to prevent basal collapse, and then the upper five ribs were removed. It soon became apparent that a more selective apical operation would be possible, and in extent of rib removal, apart from insistence on full excision of the posterior ends, this procedure has been little modified in recent years. Initially a supplementary apicolysis, as originally suggested by Bull, was performed in a few cases. The "cupolaplasty" development of the apicolysis was extended by Gravesen and was also used by the author and his colleagues in the form of a "strip plasty." The "spitzenplastik" of Graf was a similar form of apical mobilization. The Norwegian school, notably Carl Semb, introduced the extra-fascial type of pneumolysis which has become a standard part of most thoracoplasty operations undertaken during the past seven or eight years. Later, the recognition of the distension factor in tuberculous cavities led to the consideration of endo-cavitary suction drainage, which by itself was not found to be effective. However, this Monaldi procedure was used before or after the thoracoplasty in about one-quarter of the cases during the past five years and has been found of considerable value.

The partial operation now performed involves a complete removal of the upper three ribs with free apicolysis and further removal of two to four more ribs. If rib removal below the eighth rib is required it has been found advisable to complete the collapse on that side and not to leave an imperfectly ventilated basal area. The average thoracoplasty was performed in two stages, though one, three, and even four operations were occasionally employed.

SELECTION OF CASES

The first factor in case selection, as already indicated, was the difference in type of case that was referred for operation at different institutions. In some places the cases submitted conformed to the ideals of selection with limited fibrotic disease at one apex and possibly a small visible cavity. This, however, was the exception rather than the rule, and the majority of patients operated on in this series have had bilateral lesions with the disease stationary or controlled on the non-operated side. It has been fully recognized that major surgical operations in cases with unstable or acute disease are much more liable to failure than those undertaken in cases with stable or chronic lesions; but in the analysis it was

impossible to make an accurate clinical or radiological distinction of all these types. The greatest risk taken was in those cases where all other forms of treatment had failed and in which it was thought just possible that thoracoplasty might bring some relief. Many such cases had a contralateral pneumothorax in addition to extensive disease on the side of operation. It is often a momentous decision to assess just how much respiratory function the patient can safely risk losing by collapse therapy.

Occasionally thoracoplasty was undertaken as an initial measure, the "thoracoplastie d'emblée" of the French, but more usually earlier attempts had been made to control the disease by pneumothorax treatment, or by diaphragmatic paralysis and pneumoperitoneum. These preliminaries imply that the patient had generally been under observation for at least six to nine months and that during this period considerable improvement in the state of the tuberculous lesion had been achieved.

TABLE I
RESULTS OF FOLLOW-UP OF 633 PATIENTS WITH PULMONARY TUBERCULOSIS ON WHOM THORACOPLASTY WAS PERFORMED BETWEEN 1935 AND 1946

Total number	633	
Not traced	45	7.1%
<i>Deaths :</i>		
Within 4 months of operation	17	2.7%
Known to have occurred later	55	8.7%
<i>Present fitness for work :</i>		
Full	375	59.2%
Light	35	5.5%
Unfit or not working	53	8.4%
Not recorded	53	8.4%

The effect of the operation can be considered in various ways. Primarily it reduces the volume of lung and allows cavities to retract and become smaller. It also allows fibrotic contracture to occur within the diseased area of lung. The importance of the fate of the cavity is often not fully appreciated. If the walls of a cavity become approximated and the disease in that area becomes arrested there is the chance of complete and permanent healing; but as the disease becomes more chronic and the cavities become lined with dense fibrous tissue or with epithelium, the chances of permanent closure are small. This has been apparent in post-mortem and pneumonectomy specimens that have been obtained at some later date after thoracoplasty. It has been found more satisfactory to undertake surgical collapse at a stage when the cavity has a chance of permanent obliteration than to delay until the lesion is too fibrotic.

In the present series only thoracoplasties undertaken for lung disease without empyema were included, though cases in which thoracoplasty was undertaken in

conjunction with such supplementary operations as cavity drainage were admitted. The operations were performed in a number of different institutions, and even the surgeon cannot be regarded as a constant factor as there was considerable alteration in the technique and handling of the individual cases from time to time.

TABLE II

ANALYSIS BY YEAR OF OPERATION OF RESULTS OF FOLLOW-UP OF 588 PATIENTS TRACED*

Year of operation	Total number of patients traced	Deaths		Capacity for work at present date (July, 1947)			
		Within 4 months of operation	Known to have occurred later	Full	Ligh	Unfit	Un-recorded
1946	62	3 (5%)	3 (5%)	29 (47%)	12 (19%)	6 (10%)	9 (14%)
1945	64	0	3 (5%)	44 (69%)	5 (8%)	5 (8%)	7 (11%)
1944	100	3 (3%)	8 (8%)	75 (75%)	6 (6%)	3 (3%)	5 (5%)
1943	99	2 (2%)	10 (10%)	68 (69%)	2 (2%)	8 (8%)	9 (9%)
1942	94	1 (1%)	8 (9%)	55 (59%)	5 (5%)	14 (15%)	11 (12%)
1941	40	2 (5%)	3 (7.5%)	27 (67.5%)	1 (2.5%)	4 (10%)	3 (7.5%)
1940	59	3 (5%)	9 (15%)	37 (63%)	3 (5%)	7 (12%)	0
1939	17	1 (6%)	2 (12%)	11 (65%)	0	2 (12%)	1 (6%)
1938	10	0	1 (10%)	8 (80%)	1 (10%)	0	0
1937	24	1 (4%)	6 (25%)	12 (50%)	0	2 (8%)	3 (13%)
1936 and earlier	19	1 (5%)	2 (11%)	9 (47%)	0	2 (11%)	5 (26%)
Total	588	17	55	375 (64%)	35 (6%)	53 (9%)	53 (9%)

* The 45 patients not traced are excluded from this table.

RESULTS AND COMMENTS

The results of the follow-up with regard to mortality and present fitness are summarized in Table I, and are analysed according to year of operation in Table II.

Out of 633 cases operated on, 588 were followed up, leaving 45 which were not traced. The reports on the present condition of the patients have been provided by the medical men who most recently have had care of them. Only a proportion have been seen and assessed regularly by the surgeon since operation.

Sex incidence

The series contained approximately equal numbers of men and women, and the results of operation in the two sexes were similar. The lighter skeletons and musculature of women make them more suitable subjects from the technical point of view, and on the whole the reaction to operation has been more favourable in them than in men.

Early deaths

Seventeen patients died as a result of operation, giving an operative mortality of 2.7 per cent. This includes all patients who died in hospital within four months of the operation. The usual cause of death was atelectasis or aspiration infection in the base of the lung on the operated side, followed by spread of the disease to the opposite side. Secondary pyogenic or tuberculous infection of the subscapular dead-space occasionally occurred and was followed by breakdown of the wound with subsequent deterioration from general sepsis. In a few cases consolidation-collapse of the upper lobe produced the equivalent of the "black lobe" that is seen in pneumothorax treatment; this usually led to gross paradoxical movement of the mediastinum with later spread of the disease to other parts of the lung. Haemoptysis followed by a diffuse spread of disease was another cause of death. Only one death was attributed to shock, though there were two fatalities from secondary haemorrhage. There was no death during the actual operation, and no case of pulmonary embolism.

Later deaths

Fifty-five patients are known to have died more than four months after the operation, giving a percentage of 9.4 per cent. This figure is possibly lower than it should be, since it is reasonable to presume that some of the patients who were not traced may have died and this fact has not been recorded.

The usual cause of death was an exacerbation of the disease below the collapsed area of lung or in the opposite lung at a variable interval. In many instances the disease for which thoracoplasty was undertaken did not appear to have become quiescent, and in these the "weak spot" appeared to be just below the thoracoplasty which may not have been sufficiently extensive. On the other hand re-activation after a prolonged period of stability was often seen and usually occurred on the opposite side. A number of patients died from causes other than tuberculosis—for example, two were killed in air raids, two died from carcinoma of the breast, and three from pulmonary infections other than tuberculosis. There were also fatalities from coronary disease, making a total of 10 deaths which were not due to tuberculosis.

Survivals

Out of a total of 633 patients, 616 survived the operation for a period of more than four months. From this must be subtracted the later deaths already mentioned (55) and those not traced (45), so that at the present time 516 (81 per cent) of those operated on are known to be alive.

The selection of cases largely governed the ultimate results, and where few risks were taken a recovery rate of 86 per cent over a three-year period was reported from one sanatorium. In another institution where greater risks were taken this rate was reduced to 74 per cent.

In more recent cases sufficient time has not lapsed to decide whether thoracoplasty has achieved its effects. For this reason no patients operated on within the last twelve months have been included. Beyond this period it is still open to doubt for another year or so whether a final assessment can be made, but the operation can be regarded as having served its purpose if cavities have been closed, the sputum been converted, and the patient capable of reasonable activity. The period of survival following operation is a most important factor in assessing the results of operation, and has been given in Table II.

Capacity for work

Some comments are required on the categories of working capacity. Many patients at full work were undertaking light jobs which were socially and economically satisfactory, but required relatively little physical effort. On the other hand, many women stated that they were not working, though on further inquiry it was found that they were doing their full household duties, including the care of several children. The patients working include medical men and nurses doing almost full work. Twelve women were reported as having safely borne one or more children since the operation.

Under the heading of "light work" are included patients who either have not been allowed to return to their full duties or are actually physically unfit; but a number of patients whose financial status has relieved them of the necessity of working come under this heading.

Under the heading "unfit" are included a few who have not been allowed to return to work as it is only a year since their operations, but in most instances this heading covers those in which there has been some later spread of disease or deterioration.

A number of cases who had infected wounds as a result of operation have had to continue with dressings over the sinuses leading to the dead-space. The majority of these are able to do light work only, though one or two have returned to their full occupation.

Tubercle bacilli in sputum

Complete records of the effect of the operation on the sputum were not obtained, but it can be assumed that in all, except in a very few instances, the sputum was positive before operation. Reports on the results of recent examination of the sputum for tubercle bacilli were obtained in 457 cases; of these, 73 (16 per cent) were positive and 384 (84 per cent) were negative or reported sputum-free. These figures must be regarded as an approximation.

since the sputum conversion figures will be largely dependent on the thoroughness of the investigation ; in other words, where repeated laryngeal swab cultures, or guinea-pig inoculations are made, positive findings are likely to be more frequent than where an occasional direct slide examination is made. Yet it cannot be assumed that a positive sputum is an indication of operative failure, since the bacilli may come from lesions in another part of the lung, or from endo-bronchitis or bronchiectasis in or around the area of the collapsed lung tissue. Where bronchographic studies of the post-operative lung have been made it has been found that the incidence of bronchiectasis is high. This change occurs frequently in the collapsed lung, and also when atelectasis of the base was noted as a post-operative complication. The bronchial dilatation accounted in some cases for haemoptysis at a later date. It is, however, surprising that an extensive bronchiectasis should give so few symptoms.

Closing of cavity

The closing of cavities after thoracoplasty is a difficult matter to determine even with tomography and specially exposed films. In some instances it has been possible to trace the outline of the cavity in consecutive radiographs during the stages of thoracoplasty, but in others bars of regenerated bone, extrapleural spaces, and the like make it almost impossible to decide on the persistence or absence of the cavity. A record of whether or no the cavity appeared in recent radiographs to be closed was obtained in 424 cases ; in 387 (91 per cent) it appeared closed, and in 37 (9 per cent) still open. It will be noted that the proportion of cases reported as "closed" corresponds roughly with proportion of sputum conversions. It has already been indicated that the term "cavity" is a radiological convention, since very small or microscopic areas of ulceration not obvious in the radiograph have just as much title to the term as those which are clearly visible. Similarly we accept radiological evidence for cavities, but cannot be certain whether their obliteration and healing is complete or if the operation has converted them into narrow slits which are still potentially open.

It had been hoped to provide a statistical analysis in the form of a life table which could be compared with results such as have recently been produced by Tattersall (1947). These figures, based on the tuberculous population in the City of Reading, illustrate the fate of patients who were subjected only to sanatorium regime and not to active collapse therapy. However, after consultation with Dr. Tattersall, it was decided that there were too many variable or unknown factors in this thoracoplasty series to permit preparation of such a table. Another important series of thoracoplasty results was that produced by Hurford (1941) from Colindale Sanatorium, where a number of operation cases were compared, as regards survival, with those patients who declined to submit to the thoracoplasty that was recommended to them. This group showed the advantages of

the operation in increasing the span of life. The present series similarly suggests that thoracoplasty confers considerable benefit on a large proportion of those patients who have submitted to the operation.

Without the co-operation of many local authorities, medical superintendents, tuberculosis officers, and other medical men it would have been impossible to provide the figures in this article, and to all these my most grateful thanks are offered. Dr. W. H. Tattersall has spent many hours in attempting to construct statistical tables for which, unfortunately, under critical review, the material proved unsuitable. Nevertheless, my appreciation and knowledge of his work was not one of my least rewards.

REFERENCES

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