

FATE OF THE LOWER APICAL SEGMENT IN RESECTIONS FOR BRONCHIECTASIS

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In view of the common nature of the operation of lobectomy for bronchiectasis it is rather surprising to find how little unanimity there is with regard to the desirability of preserving the lower apical segment. A proper assessment of the position is only possible if the advantages of leaving that segment can be weighed against the complications which may follow, and it was with this in view that this survey was undertaken.

ADVANTAGES OF PRESERVING THE LOWER APICAL SEGMENT

If the amount of functioning tissue is the only consideration the strongest case for preserving the lower apical segment can be made in bilateral disease. In such circumstances leaving these parts may allow an operation to be done with a good functional result; otherwise the operation would be impossible or be certain to leave the patient seriously short of breath. Because the stakes are higher in these circumstances it is to be anticipated that the price would also be greater and it is not, therefore, surprising to find that writers such as Kergin (1950) have taken a pessimistic view. After getting six bad results in 11 bilateral cases he abandoned the practice of leaving these segments.

In the unilateral case it is unlikely that the patient will be short of breath even if this part is sacrificed, but it is felt that there may still be advantages in preserving it. When a right upper lobe and right middle lobe are left after a total right lower lobectomy there is a considerable dissimilarity between the shape of the hemithorax and its contents. The remaining part of the lung expanding to fill the space under these conditions may result in distortions in the pattern of the bronchial tree which cannot be good for the affected parts. This is a difficult matter to prove statistically, but the follow-up figures presented do indicate that this aspect might be given greater attention than hitherto.

DISADVANTAGES OF LEAVING LOWER APICAL SEGMENT

The slight increase in the length of the operation is not a matter of any great moment and attention has been centred on the complications produced by leaving this part. The possible dangers are persistent air leak, empyema, and persistent collapse of the lower apical segment. The last may result in the development of further bronchiectasis in the retained part and it seems to be the only disadvantage that need be seriously considered.

REVIEW OF CASES

The material used was confined to cases under the care of the author in the period 1947-51 inclusive. By confining the review to this group it was possible to exclude major differences in surgical technique as between one section and another, and it also provided that the selection in all instances was similar. It was a standard policy throughout the period to leave the lower apical segment whenever it was normal.

TABLE I
RESECTIONS FOR BRONCHIECTASIS, 1947-51

Patients treated	233
Dissection lobectomy	198
Deaths	6 (3%)
Pneumonectomy	35
Deaths	3 (8.6%)
Follow-up bronchograms	155

EMPYEMA AND BRONCHIAL FISTULA.—Of the 198 patients treated by lobectomy nine developed empyema. Four of these followed basal segmental resections, and, of the five others, three resulted after other segmental resections and two after whole lobes had been removed. There is no statistical difference between these figures to suggest any particular danger from leaving the lower apical segment. A similar position was found with regard to bronchial fistula, which was present in four patients. All four are already included in the nine mentioned as having empyemata. Of these

four, one was following a basal segmental resection, two occurred after other segmental resections, and one after a whole lobe had been removed.

POST-OPERATIVE BRONCHOGRAPHY.—In view of the absence of any serious increase in the number of complications due to empyema or bronchial fistula the main disadvantage in leaving the lower apical segment must be persistent collapse in the part and the development in it of bronchiectasis. The situation with regard to this has been assessed by a review of the post-operative bronchograms on 155 patients. As 23 of these patients had bilateral lobectomy there was a total of 178 bronchograms under consideration. The cases were divided into four groups according to the bronchographic findings. In group 1 were placed those patients whose remaining bronchi were normal. In group 2 there was only a minor divergence from normal, while in groups 3 and 4 the dilatation was fairly marked or gross. The only abnormality which did not affect the grouping was in a few cases where lobectomy had been done while purposely leaving abnormal areas behind, and where these areas were no worse after operation. In each case the whole bronchogram was considered and an abnormality in any part resulted in down grading. It was found that the bronchiectasis demonstrated in these films came under one of four headings. First, some bronchiectasis shown before lobectomy might be worse. Second, new bronchiectasis might have developed. Third, bronchiectasis might be shown which was not suspected before operation, although after referring back to pre-operative films it could be seen that it was probably there at that time. Fourth, in a few cases the segmental resection might have been incorrectly performed and a bronchiectatic part left. It need hardly be pointed out that these troubles were by no means confined to basal resections.

Table II gives a general review of the material and in it the cases have been grouped under three headings according to the severity of the circumstances. In the first division are put cases with unilateral disease. In the second are examples of bilateral disease where only unilateral lobectomy was thought necessary. The third division contains the patients who were treated by bilateral lobectomy. The figures produced from these divisions were regarded as a test of the system of grouping rather than as having a direct bearing on the subject. It was felt that if the grouping was valid it must show a steady increase in the numbers appearing in the higher groups. The simple calculation of the percentage of patients in groups 3 and 4 does demonstrate this point, but it is a crude

TABLE II
POST-OPERATIVE BRONCHOGRAMS

Type of Case	Total	Groups				% in Groups 3 and 4	Bronchogram Index
		1	2	3	4		
<i>Unilateral Lobectomy</i>							
Single lobe ..	27	21	3	1	2	11%	1.33
Combined lobes ..	6	5	0	0	1	16%	
Leaving lower apical segment ..	29	22	4	2	1	10%	
Other segmental lobectomy ..	35	30	4	0	1	3%	
<i>Bilateral Disease with Single Lobectomy</i>							
Single lobe ..	7	5	1	0	1	14%	1.51
Leaving lower apical segment ..	16	12	2	0	2	13%	
Other segmental resection ..	10	7	2	0	1	10%	
<i>Bilateral Lobectomy</i>							
Leaving both lower apical segments ..	11	5	4	1	1	18%	1.56
Leaving one lower apical segment ..	7	6	1	0	0	0%	
Other bilateral ..	5	2	3	0	0	0%	

way of assessing the position and nullifies to some extent the advantage of having four groups. The use of a device called the bronchogram index gives full weight to the entry of each case in its own group and the figures produced by employing this suggested that the system of classification was showing a reliable result.

BRONCHOGRAM INDEX.—Professor Lancelot Hogben was kind enough to review the material from a statistical point of view and it was on his suggestion that the index was used. It is based on the following formula, where the total number of cases is represented by the letter N and the numbers in each of the groups 1, 2, 3, and 4 are given the letters *a*, *b*, *c*, and *d*.

$$\text{Mean bronchogram index} = \frac{a + 2b + 3c + 4d}{N}$$

Using this formula, if all the cases in the division were in group 1 the bronchogram index would be 1.

$$\text{Bronchogram index} = \frac{a}{N} = 1, \text{ since } a = N.$$

If, on the other hand, all the cases were in group 4 the index would be 4.

$$\text{Bronchogram index} = \frac{c \times 4}{N} = 4, \text{ since } c = N.$$

The simple explanation of the position is that the nearer the index is to 1 the better is the position, and conversely the nearer it is to 4 the worse is the situation. The index has the great advantage that it takes into account all the individual groupings.

CAUSE OF BAD RESULT.—It will be noted from Table II that there are 14 cases in which the

bronchographic findings fell into groups 3 or 4, and it is also seen that seven of these occurred in basal segmental resections and seven were found in other resections. In Table III a closer analysis is made of these 14 cases.

TABLE III

Type of Resection	Cause of Bad Result				
	Total Bad	New Bronchiectasis	Missed Pre-operatively	Operation Error	Worse Bronchiectasis
Basal ..	7	5	0	1	1
Other ..	7	1	1	2	3

It will be seen that new bronchiectasis was the cause of the bad result in five of the basal resections. In all these five the new disease was in the lower apical segment. An operative error was made in one case which had nothing to do with the lower apical segment, and in one case worse bronchiectasis was present in the upper lobe.

In the group of other resections there were two operative errors and one instance of bronchiectasis overlooked in the pre-operative bronchogram. Of the other four, one was bronchiectasis which had developed in an upper lobe previously normal and three were due to worse bronchiectasis in the upper lobe. All were after lower lobectomies. From this it will be seen that, whereas in the basal resections there is only one case of worse or new bronchiectasis in the upper lobe, in the group of all other resections there are four instances of this. This position was put to Professor Hogben, who said that although the figures were not statistically significant they were suggestive of a difference in factors operating. A possible explanation of this might be that the presence of the lower apical segment allows the upper lobe to expand to its normal shape and helps to prevent the development of bronchiectasis in it. If this be true, it represents an advantage to counterbalance the disadvantage of five cases of new bronchiectasis in the lower apical segment, and explains why there are seven cases in each group.

In passing it is of importance to note that of the five cases of new bronchiectasis in the lower apical segment, one was not considered bad enough for further operation but in the other four the new disease was resected with a group 1 result in three.

FATE OF THE LOWER APICAL SEGMENT BY OPERATION.—Up to this point numbers have referred to patients who may have had single or bilateral operations, but in Table IV numbers of actual operations are considered.

TABLE IV
FATE OF LOWER APICAL SEGMENT

Type of Case	Total	Group				% in Groups 3 and 4	Bronchogram Index
		1	2	3	4		
Unilateral disease. Basal segment removed ..	29	22	4	2	1	10%	1.38
Bilateral disease. Single lobectomy. Bilateral lobectomy. Both lower apical segments left	16	12	2	0	2	13%	1.5
Bilateral lobectomy. One lower apical segment left ..	22	16	4	1	1	9% } 0% }	1.4
Total basal resections ..	74	56	11	3	4	9.5%	1.4
All other lobectomies ..	97	77	13	1	6	7.2%	1.3

From this grouping it will be seen that a total of 74 basal resections produced a bronchogram index of 1.4, whereas all other resections gave a figure of 1.3. The proximity of these figures leads to the conclusion that the disadvantage of leaving the lower apical segment is very small and a corresponding small case need only be made out for the advantages of retaining it in order to justify its retention in all cases.

SUMMARY

The post-operative findings in 233 cases of bronchiectasis treated by resection are reviewed.

Follow-up bronchograms of 178 operations in 155 patients are reviewed.

New bronchiectasis developed in the lower apical segment in five cases after 74 basal segmental lobectomies.

The disadvantage of the above was to some extent balanced by a higher rate of worse bronchiectasis in the upper lobe in patients having the whole lower lobe removed.

Figures from all operations show only a very slight disadvantage from retention of the lower apical segment.

It is suggested that this slight disadvantage is a small price to pay for the advantage of retaining this portion of lung tissue.

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