

Bilateral Bronchiectasis: Surgical Management with Particular Attention to the Problem of the Residual Superior Segment of the Lower Lobes *

RICHARD R. CRUTCHER, M.D., E. D. PELLEGRINO, M.D.

From the Department of Thoracic Surgery, St. Joseph Hospital, and the Department of Medicine, University of Kentucky Medical Center, Lexington, Ky.

WHILE IMPROVEMENT in the medical management of bronchiectasis has resulted from the use of antibiotics and postural drainage, resection is still the only available curative measure. Operation mortality and morbidity are now sufficiently favorable to make surgery the treatment of preference in the symptomatic unilateral form of this disease.

No unanimity of opinion exists, however, regarding the management of bilateral bronchiectasis. Here the increased risk of complications, the more stringent requirements for the preservation of lung parenchyma, and the poorer general condition of the patient act as effective deterrents to the surgical approach. In the past decade, unilateral operation has been undertaken in patients with bilateral bronchiectasis with symptomatic improvement and operative complications approaching those in unilateral disease. A smaller number of patients have undergone bilateral resections with encouraging results and diminishing operative risks. More experience is needed in evaluation of operation for extensive or bilateral bronchiectasis with reference to (1) long-term results, (2) indications for operations, (3) choice of unilateral or bilateral procedure, and (4) desirability of preservation of the superior segments of the lower lobes which are often uninvolved.

The present report summarizes the results of operation in a group of patients with bilateral bronchiectasis operated upon by one surgeon (R.R.C.). The study indicates that a significant number of properly selected patients with bilateral involvement will benefit by unilateral resection of diseased segments on the more involved side. Some will be further benefited by judicious bilateral resection. Preservation of the superior segment of the lower lobes appears to be a safe and indeed an indicated procedure wherever preservation of functioning lung is mandatory.

Case Material

Since 1950, a group of 190 patients with bronchiectasis have been studied (Table 1). In this group, 80 patients underwent surgical operation and 110 were treated conservatively. Of those treated surgically, 50 had unilateral disease with unilateral resection. The remaining 30 had bilateral disease; of these, 23 underwent unilateral resection and seven bilateral resection. The superior segment of the lower lobe was preserved after resection of the basilar segments in eight patients with bilateral and three with unilateral disease. The postoperative follow up interval

TABLE 1. *Patients with Bronchiectasis 1950-60*

Total Cases Studied	190
Total Cases Resected	80
Unilateral disease	50
Bilateral disease	30
Bilateral resection	7
Total operations	87

* Presented before the Southern Surgical Association, Hot Springs, Virginia, December 8-10, 1959.

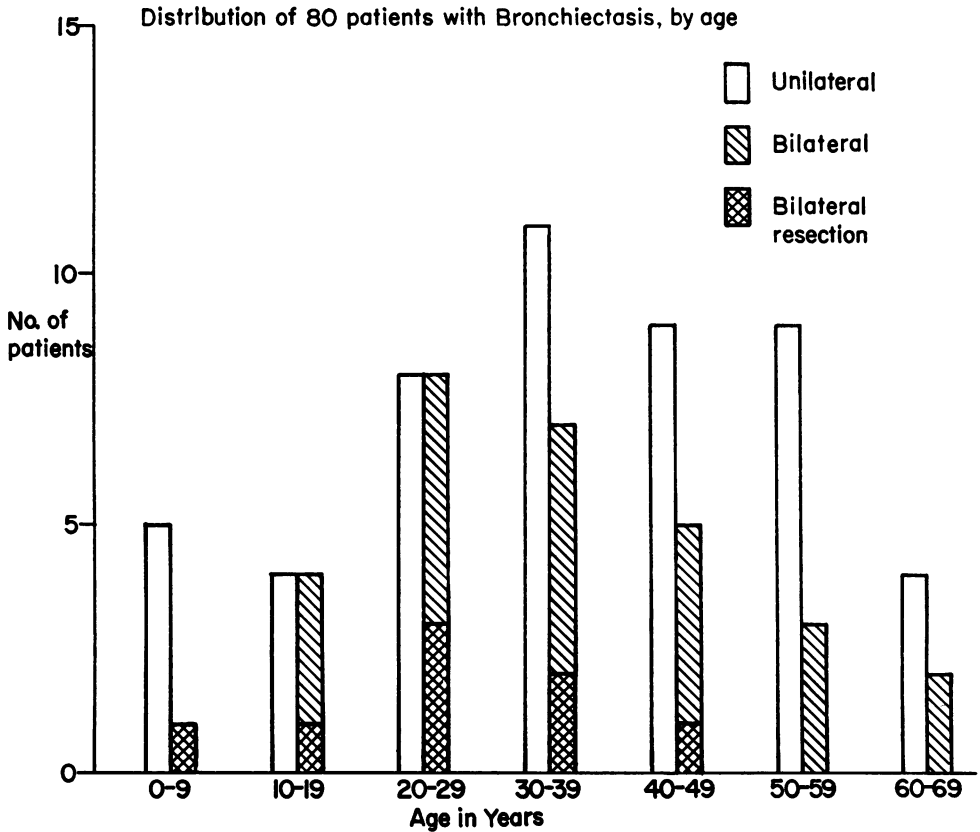


FIGURE 1.

ranged from seven months to 10 years with an average follow up of five years. One hundred ten patients were managed nonsurgically for the following reasons: (1) relatively asymptomatic disease, (2) disease so extensive that removal would have left less than a total of six segments, (3) severity of associated diseases, and (4) refusal of operation.

Age and Sex Distribution (Fig. 1): The youngest patient with bilateral disease operated upon was five years of age and the oldest was 64. There were five patients under 20, and five over 50, with the majority being in the 20-29 and 30-39-year age groups.

In bilateral disease there were 24 women and six men. This was in contrast to unilateral disease where sex distribution was almost equal—26 women and 24 men.

Pre- and Postoperative Evaluation: Pulmonary function studies were done on some of the 30 patients with bilateral disease who comprise the subjects of this report. All, however, were evaluated clinically and considered accept-

able for operation if they tolerated a reasonable degree of physical activity and did not evidence severe pulmonary disease other than bronchiectasis.

Postoperative evaluation of 28 surviving patients consisted of (1) clinical examination, (2) bronchogram, (3) pulmonary function studies in those with more extensive disease and in all but one patient with bilateral resections, and (4) a questionnaire pertaining to their respiratory symptoms, extent of daily activities and subjective estimate of results of operation. All patients with bilateral resections had postoperative bronchography.

Technic: Anesthesia consisted of light preoperative sedation and maintenance with either pentothal and nitrous oxide, or with cyclopropane. All patients were routinely intubated and bronchial suction was carried out frequently during the procedure. The thorax was entered through the fifth intercostal space with the patient in the lateral position and, except in a few of the early cases, rib resection was not employed. Resection

was carried out by individually ligating and dividing pulmonary arteries, veins and bronchi in that order. Bronchi were divided first only if secretions were excessive. Bronchial closure was effected with interrupted silk or cotton sutures and the bronchial stump covered with a flap of parietal pleura. Anterior and postero-lateral water-seal drainage were employed routinely, and in the segmental resections suction was maintained at a negative pressure of approximately 12 centimeters of water. Tracheal suction and bronchoscopy were employed when necessary to clear bronchial secretions.

Distribution of Disease (Fig. 2, 3): In 30 patients with bilateral bronchiectasis, a detailed study of both the pre and postoperative bronchograms was made to determine the exact segments involved as well as those free of disease. With the exception of the anterior segment, the upper lobes were infrequently involved in bilateral bronchiectasis and then only in association with disease in other segments. The right middle lobe was the most frequent lobe involved and the lingular segment of the left upper lobe was almost as frequently diseased. We wish to focus particular attention on the fact that the superior segment of the right lower lobe was involved in only three of the 30 cases, whereas the superior segment of the left lower lobe was much more frequently diseased in association with involvement of the

ipsilateral basilar segments (18 of 30 cases). The middle and/or lower lobes were involved in every patient. The most common combination in the bilateral cases consisted of the lingula and the left lower lobe together with the right middle and lower lobes.

In the seven patients who underwent bilateral resection, all known disease was removed in three, and all but one of the diseased segments were removed in the remaining four patients. Table 2 shows the number of segments involved, their location, and the number of segments resected. The anterior segment of the upper lobe was thought to be minimally involved in three patients and this bronchiectatic segment was retained because its removal would have left only the apical posterior segment of the upper lobe on the left side. Retaining this segment was considered preferable when extensive resection of the lower lobe and lingula was necessary.

Results

Symptomatic Results (Table 3): Both the amount of sputum and the degree of hemoptysis were significantly reduced in the majority of patients operated upon. All patients had a productive cough preoperatively. Three were classified as having a slight amount of sputum; postoperatively, two of these were free of sputum and one

Segmental Involvement in 30 patients with Bilateral Bronchiectasis

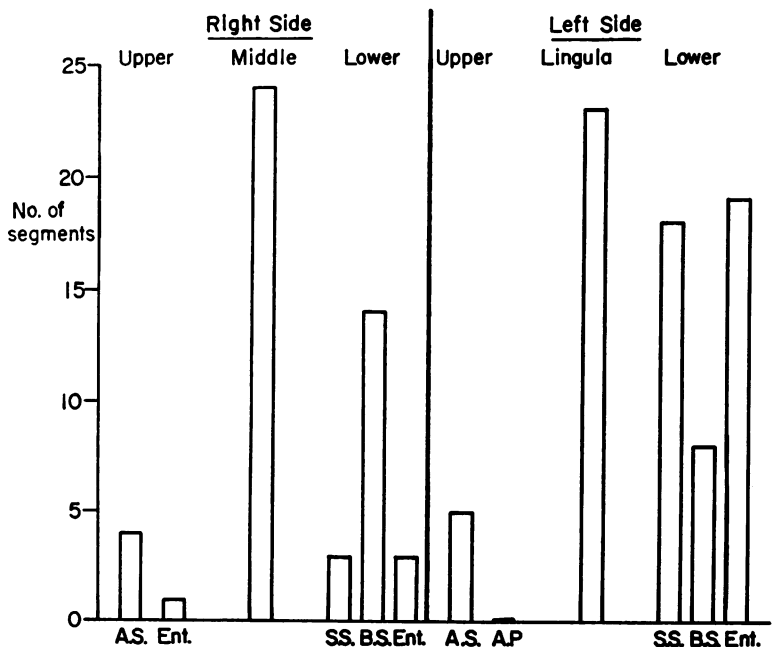


FIG. 2. Distribution of disease in bilateral bronchiectasis. A.S.—Anterior segment; Ent.—Entire lobe; S.S.—Superior segment of lower lobe; B.S.—Basilar segments of lower lobe; A.P.—Apical posterior segment of left upper lobe.

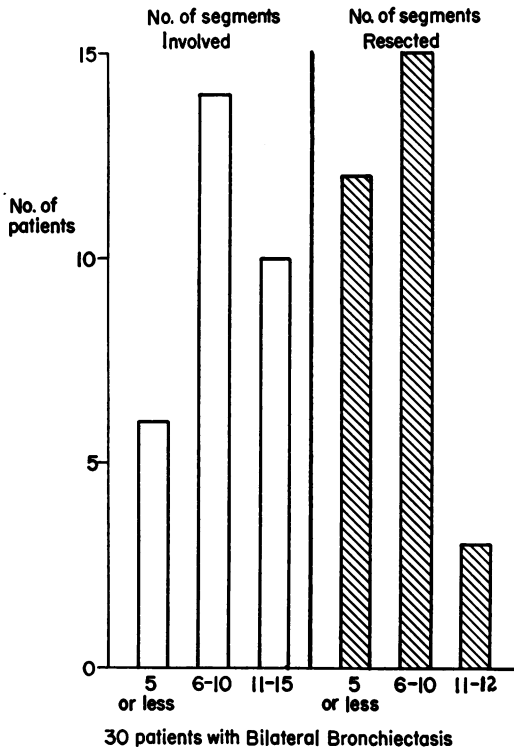


FIG. 3. Comparison of number of segments involved to number of segments resected in bilateral bronchiectasis. (All patients with five or less segments resected have had only unilateral resection.)

was unchanged. Nine patients had a moderate amount of sputum before operation; postoperatively four had less, three were unchanged and one had more sputum. Sixteen patients had a large amount of sputum preoperatively; after operation 14 had lesser degrees of sputum and two were unchanged. Seven patients had foul sputum preoperatively and all were free of this symptom postoperatively.

All but seven patients had some degree of hemoptysis preoperatively. Eleven were classified as slight; seven of these were free of hemoptysis postoperatively and four had only occasional streaking. Eight patients had moderate bleeding before operation and after operation two were free of hemoptysis, four improved and one unchanged. Two patients had severe preoperative bleeding; one was completely free of bleeding postoperatively and one had occasional streaking. All of the bilaterally resected patients were completely free of hemoptysis postoperatively except for one patient with slight streaking.

Over-all Results (Table 4): The patients were grouped as follows: Class I, those with no significant pulmonary symptoms; Class II, those who were markedly improved but still symptomatic; and Class III, patients showing no improvement (poor result). Four of the patients in Class I had occasional cough or sputum with colds only. Seven of the patients with extensive bilateral disease admitted to dyspnea on exertion both pre and postoperatively, but none experienced increase in their dyspnea following resection.

The over-all results in patients who could be followed in the present study indicate improvement in 17 out of 20 patients (85%) with bilateral disease undergoing unilateral resection, and in all patients undergoing bilateral resection. This compares favorably with patients undergoing resection of unilateral disease where 41 out of 44 (93%) experienced improvement.

Morbidity: Patients undergoing lobectomy had the shortest postoperative stay in the hospital, averaging 8.3 days; those undergoing segmental resection, with or without lobectomy, averaged 12.3 days. There was no appreciable difference in the postoperative stay of patients with bilateral or unilateral disease.

In 37 operations for bilateral disease, there were three major and 22 minor complications.

TABLE 2. Bilateral Bronchiectasis Bilateral Resection

Pts.	Segments Involved		No. Seg. Involved	No. Seg. Resected
	Left	Right		
1. D. B.	<i>LLL</i>	<i>RML</i>	6	6
2. E. F.	<i>LLL, Ling</i>	<i>RML</i>	8	8
3. B. R.	<i>BSLLL, Ling</i>	<i>RML, M & PBSRLL</i>	9	9
4. R. M.	<i>BSLLL, Ling</i>	<i>BSRLL, MSRML</i>	10	9
5. D. P.	<i>LLL, Ling, ASLUL</i>	<i>BSRLL</i>	11	10
6. A. R.	<i>LLL, Ling, ASLUL</i>	<i>RML, P & MBSRLL</i>	11	10
7. V. B.	<i>LLL, Ling, ASLUL</i>	<i>RML, BSRLL</i>	13	12

Note: Resected segments italicized.

TABLE 3. *Bilateral Bronchiectasis 28 Surviving Patients Sputum (Degree)*

Preoperative (No. pts.)		Postoperative (No. pts.)			
		None	Slight	Moderate	Severe
No sputum	0				
Slight	3	2	1	0	0
Moderate	9*	1	3	3	1
Severe	16	1	7	6	2
		—	—	—	—
		4	11	9	3

Preoperative (No. pts.)		Hemoptysis (Degree)			
		(Postoperative (No. pts.))			
		None	Slight	Moderate	Severe
No hemoptysis	7	5	2	0	0
Slight	11	7	4	0	0
Moderate	8*	2	4	1	0
Severe	2	1	1	0	0
		—	—	—	—
		15	11	1	0

* One inadequate follow up.

The major complications included one localized empyema and two bronchopleural fistulae and localized empyemata. Each of these major complications occurred in patients with extensive bilateral disease.

Minor complications were as follows: Bronchopleural air-leak with spontaneous closure (nine), transitory atelectasis (seven), and pleural fluid requiring thoracentesis (six). Patients with bilateral disease had a slightly higher incidence of both major and minor complications than those with unilateral disease.

Mortality (Table 5): This includes all hospital deaths and all patients dying within the first two years after leaving the hospital. Patients dying more than two years after operation are listed as late deaths and these are not considered to be related to the original disease or to the operations.

Two deaths occurred in 37 operations for bilateral bronchiectasis. One was a 5-year-old girl with extensive bilateral saccular bronchiectasis who underwent resection of the left lower lobe and lingula. The postoperative course was uncomplicated. She was admitted two months postoperatively with overwhelming bilateral pneumonia and succumbed within 36 hours of admission.

The second patient was a 40-year-old woman with extensive saccular bronchiectasis who underwent resection of the left lower lobe and lingula.

The postoperative course was complicated by persistent atelectasis of the remaining left upper lobe; an abscess developed and the patient expired on the fourth postoperative day following resection of the infected atelectatic lobe.

Progression of Disease: In the 15 patients with bilateral bronchiectasis studied by postoperative bronchography, there was progression of old disease in five. Three of these showed involvement of the anterior segment of the left upper lobe following resection of the lower lobe and lingular segment, at postoperative periods of seven, 4½, and three years respectively. One patient showed progression of bronchiectasis in the anterior segment of the right upper lobe 5½ years following resection

TABLE 4. *Over-all Results—Surviving Patients*

Class*	Unilat.	Bilat. Disease	Bilat. Disease
	Disease	Unilat. Resect.	Bilat. Resect.
	Pts.	Pts.	Pts.
I	33	5	6
II	8	12	1
III	3	3	0
	—	—	—
Total	44	20	7

* Class I—No significant pulmonary symptoms. Class II—Improved but still symptomatic. Class III—No improvement (poor result).

TABLE 5. *Mortality*

Hosp. & Early P.O. Deaths			
	Operations	Deaths	%
Unilateral disease	50	1	2.0
Bilateral disease	37	2	5.4
Total	87	3	3.4

Late Deaths		
	P.O. Interval	Cause of Death
Unilateral		
R. R.	2 years	Hodgkins disease
C. H.	5 years	Unknown (narcotic addict)
F. H.	7 years	Carcinoma of lung
Bilateral		
No late deaths		

of the basal segments of the right lower lobe and the right middle lobe; one showed slight progression manifested by dilatation of the bronchi in the lingular segment nine years after resection of the right middle lobe.

Four patients showed evidence of new bronchiectasis in the late follow up bronchograms. These included the following: (1) Minimal bronchiectasis of the superior segment of the left lower lobe 4½ years after resection of the basal segments of the left lower lobe and lingula, (2) sacular bronchiectasis of the superior segment of the right lower lobe 5½ years following resection of the basal segment of the right lower and right middle lobes, (3) slight dilatation of the anterior segment of the left upper lobe four years following left lower lobectomy, and (4) slight bronchiectasis in the right upper lobe nine years following resection of the right middle lobe (Table 6).

Preservation of the Superior Segment of the Lower Lobe

Eleven patients had 12 resections (one bilateral) of the basilar segments of the lower lobe with preservation of the superior segment. Eight of these had bilateral and three unilateral bronchiectasis. Postoperative bronchography in 10 patients revealed eight of the retained superior seg-

TABLE 6. *Summary—Bilateral Resection for Bronchiectasis*

Pt.	Age & Sex	Preoperative		Segments Involved	P.O. Interval & Segments Removed		Postoperative		
		Cough & Sputum	Hemoptysis		1st op.	2nd op.	Symptoms	Bronchogram Result	Pulmonary Function
D. B.	11 F	4 yrs. 1 cup/day foul	Small amts.	LLL RML (6 seg.)	4 yrs. LLL (4 seg.)	2 yrs. RML (2 seg.)	Occas. cough	Sl. dilatation ASRUL	Not done
E. F.	36 M	30 yrs. 1 cup/day foul	Small amts.	LLL Ling. RML (8 seg.)	8 yrs. LLL Ling. (6 seg.)	7 yrs. RML (2 seg.)	Mod. cough Min. sputum	No br'sis	TVC 2,916 cc. (75%) 1 sec. VC (77%) MBC 89 L/m (78%)
B. R.	20 M	12 yrs. Sm. amt. yellow	Mod.	BSLLL Ling. RML M & PBSRLL (9 seg.)	6 yrs. BSLLL Ling. (5 seg.)	4½ yrs. RML M & PBSRLL (4 seg.)	Mod. cough Min. sputum Bl. streaks 2 times	No br'sis	TVC 3,380 cc. (75%) 3 sec. VC (97%) MBC 95 L/m (65%)
R. M.	42 M	30 yrs. ½ cup/day yellow	Mod.	BSLLL Ling. BSRLL MSRML (10 seg.)	4½ yrs. BSLLL Ling. (5 seg.)	4 yrs. BSRL (4 seg.)	Gained 35 lb. wt. Min. sputum	Min. br'sis SSLLL & MSRML	TVC 2,980 cc. (74%) 1 sec. VC (71%) MBC 66 L/m (55%)
D. P.	23 F	19 yrs. 1 cup/day foul Dyspnea with exert.	Mod. sev.	LLL Ling. ASLUL BSRLL (11 seg.)	7+ yrs. LLL Ling. (6 seg.)	5½ yrs. BSRL (4 seg.)	Sl. cough Min. sputum Dyspnea with exert.	Br'sis ASLUL	TVC 1,800 cc. (60%) 1 sec. VC (65%) MBC 35 L/m (40%)
A. R.	31 F	29 yrs. 2 cups/day Dyspnea with exert.	None	LLL Ling. ASLUL RML P & MBSRLL (11 seg.)	3 yrs. LLL Ling. (6 seg.)	1½ yrs. RML P & MBSRLL (4 seg.)	Mod. sputum with R.I. Dyspnea with exert.	Br'sis ASLUL	TVC 1,560 cc. (55%) 1 sec. VC (68%) MBC 42 L/m (48%)
V. B.	21 F	19 yrs. ½ cup/day foul	Small amt.	LLL Ling. ASLUL RML BSRLL (13 seg.)	4½ yrs. LLL Ling. (6 seg.)	3 yrs. RML BSRLL (6 seg.)	Sl. cough Sputum with R. I.	Br'sis ASLUL	TVC 2,600 cc. (83%) 1 sec. VC (73%) MBC 74 L/m (72%)

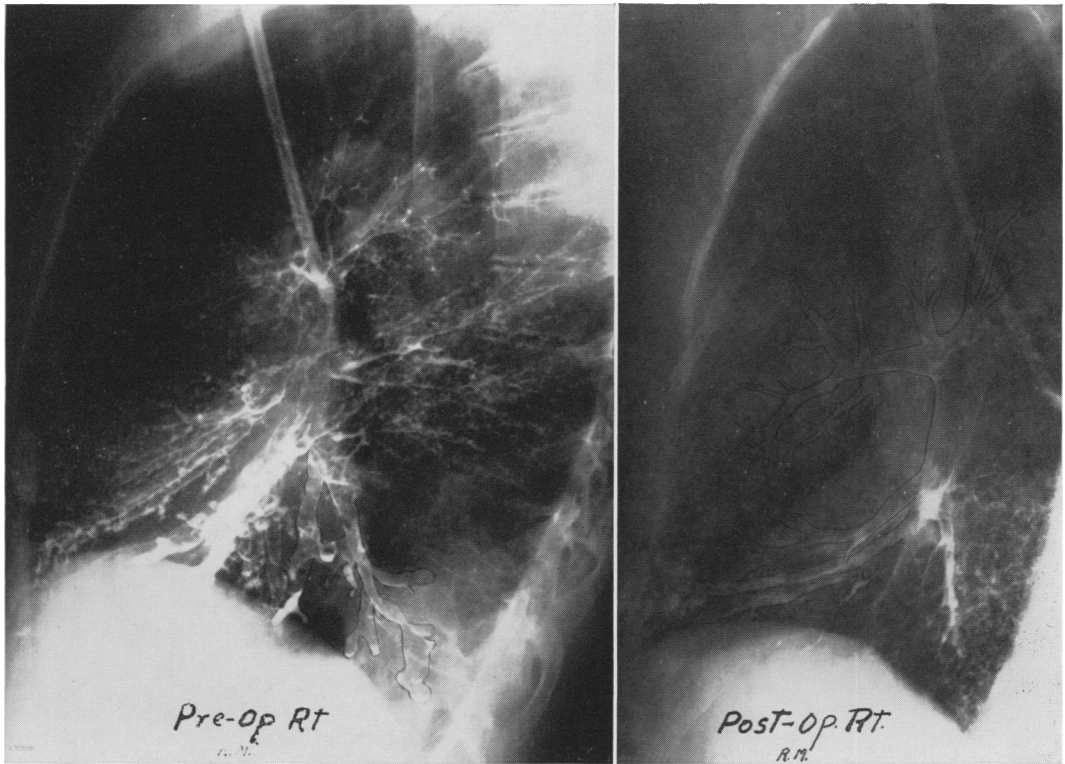


FIG. 4A. Pre and postoperative bronchograms of patient R. R. in Table 6. (Right side.)

ments to be normal and three to show evidence of disease. One patient had definite new saccular bronchiectasis and was classed as a poor result. Another had slight dilatation of the segmental bronchi not present preoperatively, but he did not experience any significant symptoms postoperatively. The third showed emphysema of the remaining superior segment without definite bronchiectasis.

Discussion

The effects of bronchiectasis on life expectancy are difficult to ascertain. In the pre-antibiotic era, most studies were based on hospitalized or autopsied cases and these emphasized the high mortality attributable to the disease, varying from 27% to as high as 47%.^{1, 19, 20} The survivors in most series faced progressive symptoms and disability.

More recent studies conducted on ambulant patients have indicated much lower rates of mortality, progression and disability.^{5, 6, 18, 23} Indeed, some patients with a

paucity of symptoms may show subsidence of symptoms and reversibility of bronchographic abnormalities. Further improvement in outlook has undoubtedly resulted from the use of antibiotics in the treatment of acute infectious episodes and the more widespread use of postural drainage. Quantitation of changes in prognosis is difficult to obtain since most of these reports are not comparable with respect to age, treatment, duration of follow up, or severity of disease. Unquestionably the variations in the natural history of bronchiectasis are better understood as a result of these studies. Most, however, agree that significant amounts of sputum, repeated hemoptysis and recurrent pneumonia rarely subside spontaneously.

The effectiveness of any treatment for bronchiectasis must thus be assayed in terms of symptomatic improvement, diminution in disability, and increase of the pa-

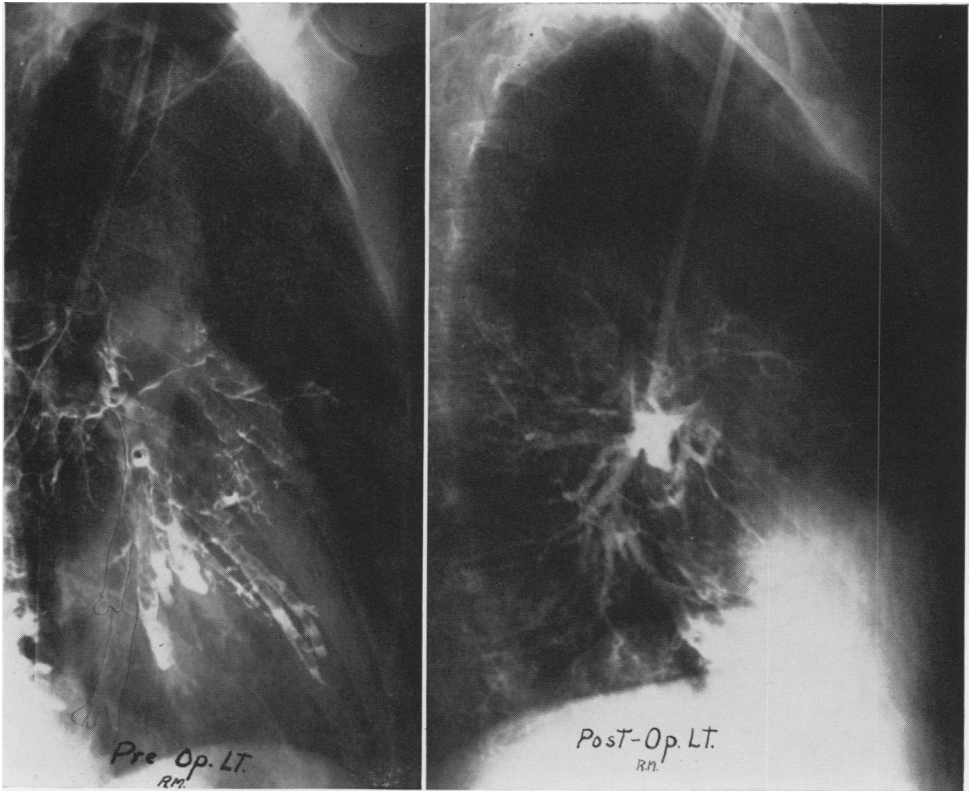


FIG. 4B. Left side.

tient's ability to carry on his daily activities. These are notoriously precarious criteria but they are probably more reliably evaluated in patients with bilateral bronchiectasis such as those studied here. Such patients rarely experience lasting spontaneous remissions: Progression of symptoms and disability is the usual outcome.

The decline in operative mortality for bronchiectasis has been striking in the past two decades. Over-all rates below 4 per cent are now generally reported in the larger series studied.^{3, 7, 12} The mortality in bilateral resections has also dropped to reasonable levels. In 1942, Bisgard and Swenson² had five deaths in 37 cases. In 1950, Lindskog¹⁴ performed 12 bilateral operations with no deaths, and in the same year Kergin¹³ reported four deaths in 31 bilateral procedures.

The first extensive experience with the surgical treatment of bilateral bronchiectasis was reviewed in 1950 by Kergin.¹³ He performed unilateral operation on 27 patients and bilateral resection on 31. Fifteen of the 18 with bilateral resections who could be followed were asymptomatic post-operatively and showed no deterioration of lung function despite the resection of considerable lung tissue. Since then, others have undertaken unilateral or bilateral resection in patients with bilateral disease and have emphasized the value of operation.^{4, 10, 11, 17} Operative mortality and complications are not appreciably greater than in the surgical treatment of patients with unilateral bronchiectasis.

The results in the 30 patients reported here are in agreement with those quoted immediately above; namely, that symp-

omatic improvement is obtainable to a significant degree in a sufficient number of patients with bilateral bronchiectasis to make operation worthy of consideration in patients with persistent or progressive symptoms.

Extensive bilateral bronchiectasis should not *per se* constitute a contra-indication to resection provided that a total of six or more normal segments can be preserved. Five of the patients in the present series had nine or more segments resected and none experienced postoperative increase in symptoms of pulmonary insufficiency. As measured by their ability to carry on the activities of their stations in life, most patients were able to perform at least as well as preoperatively. Postoperative measurements of pulmonary function in the patients with bilateral resections showed minimal reduction in ventilation in three

and moderate reduction in another three; all were subjectively improved nonetheless.

Experiences with the effects of operation on pulmonary function of patients operated upon for bronchiectasis have been variable. A discrepancy between the patient's ability to function and objective measurements has been a common finding. Taylor, Roos and Burford²¹ found that 10 of 12 patients undergoing bilateral resection were able to carry on their usual activities despite significant ventilatory abnormalities. Long *et al.*¹⁵ studied a group of patients having resections, seven of them bilateral, and showed the maximal breathing capacity to be the same pre and postoperatively in 82 per cent of 44 patients. In 19 patients the maximum breathing capacity was increased postoperatively. In contrast, Mannix¹⁶ studied 13 patients with bilateral resections and showed deterioration of their pul-

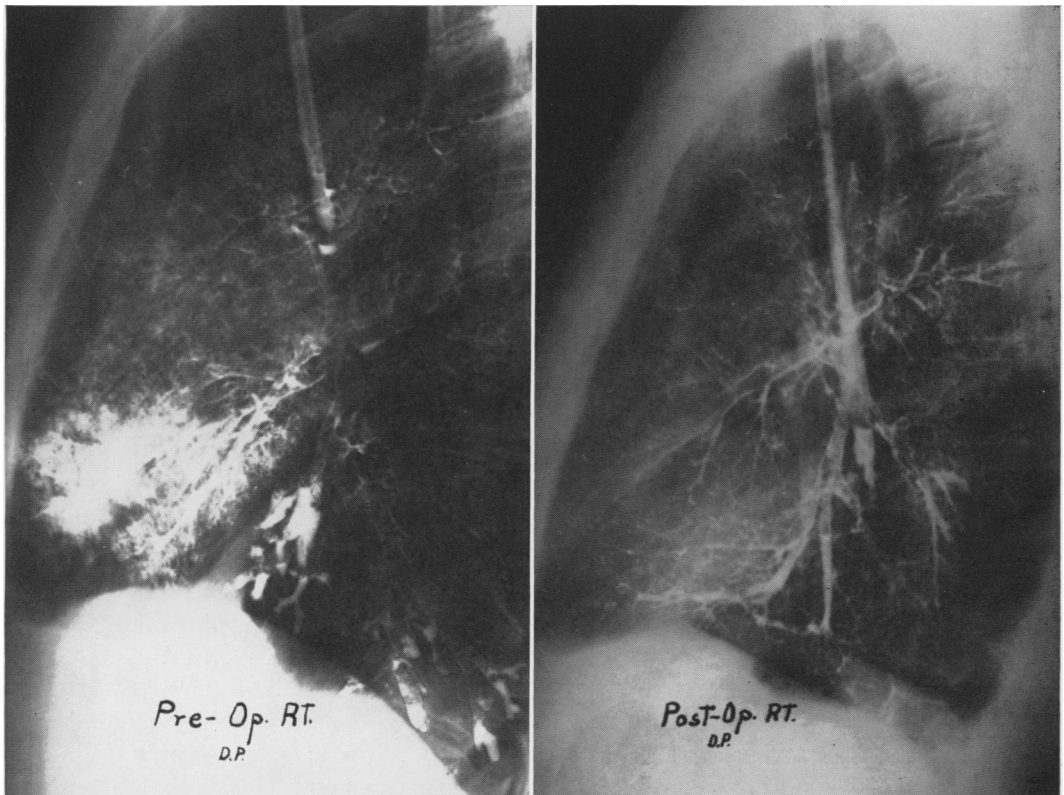


FIG. 5A. Pre and postoperative bronchograms of patient D. P. in Table 6. (Right side.)

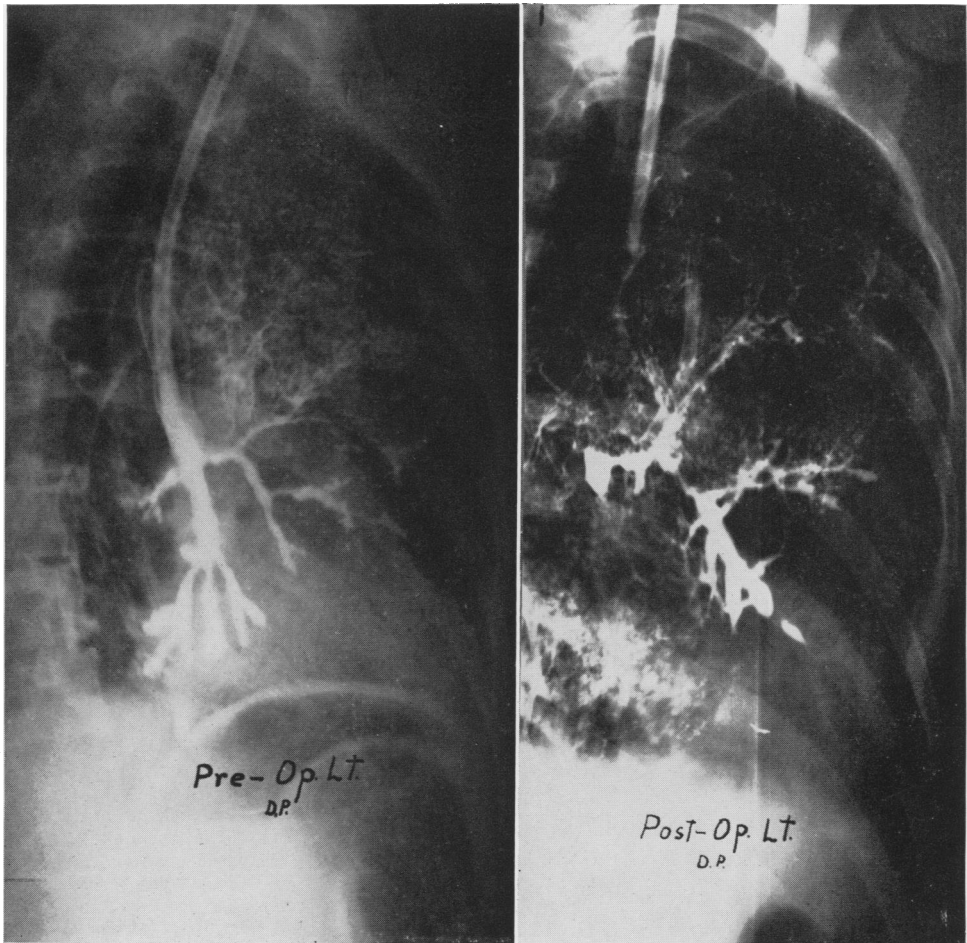


FIG. 5B. Left side.

monary function postoperatively. Eight of his patients were improved despite the adverse effect of operation on lung function measurements. In a recent study of three patients with extensive bilateral resections, Harrison *et al.*⁹ also found the clinical response to be better than the objective measurements would have indicated. These discrepancies deserve emphasis and further study at longer postoperative periods. They are important to consider in planning operation in extensive bronchiectasis.

The surgical approach to bilateral bronchiectasis, whether it involves unilateral or bilateral resection, requires some decision regarding the superior segments of the

lower lobes. Whitwell,²² in a careful pathologic study of 114 resected specimens, pointed out that the superior segment was uninvolved in 68 per cent. In our 30 patients with bilateral disease, the superior segment was diseased only three times on the right side and 18 times on the left. Kergin¹³ left the superior segment in place in 11 patients after resection of the basilar segments. He experienced pleural complication in five, and failure of expansion in one. In four of these six, bronchiectasis developed in the retained segment. As a result he advised against saving the normal superior segment. This view has not been supported in more recent studies. Collis⁴

reviewed 74 basal segmental resections in 233 patients whose superior segments had been preserved. Later, five patients developed bronchiectasis in the retained segment, but this was outweighed by the lesser incidence of new bronchiectasis in the upper lobe when the superior segment had been removed. Hoffman¹¹ reported on the preservation of the superior segment in 51 patients with basilar resections and made the strong point that early postoperative bronchograms may reveal bronchial dilatation or failure to fill; however, later study over a two to six-year-period showed

full aeration in most patients. He suggested that the superior segment be preserved whenever there are more than two lobes involved. In reporting on 12 basal segmental resections, Helm and Thompson¹⁰ confirmed Collis and Hoffman's findings. In our total series the superior segment was preserved in 12 basilar resections, three times in unilateral operation and nine times in bilateral. In only two of these did new bronchiectasis develop and in only one was it more than slight.

Preservation of the superior segment is an important aspect of operation for bi-

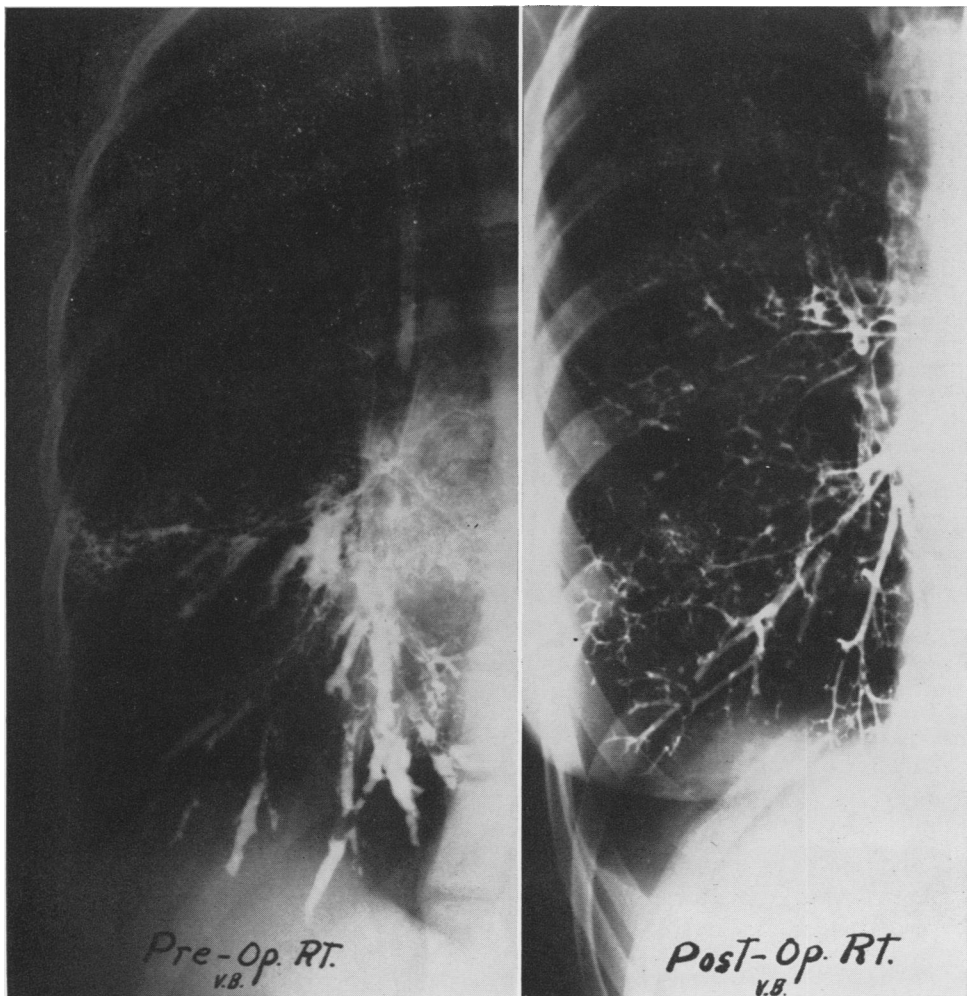


FIG. 6A. Pre and postoperative bronchograms of patient V. B. in Table 6. (Right side.)

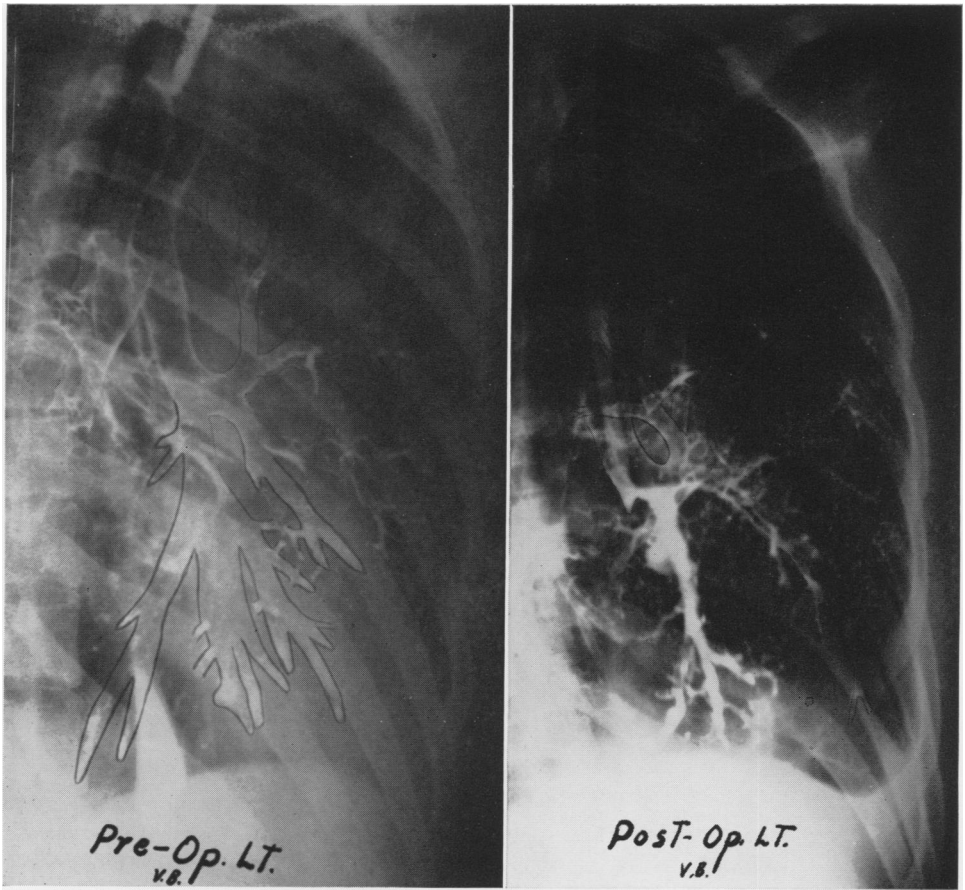


FIG. 6B. Left side.

lateral extensive bronchiectasis since it permits removal of more diseased tissue than might otherwise be possible, so that further compromises of lung function can be avoided. Routine removal of normal superior segments would preclude operation for some who might benefit by it; also, in extensive unilateral disease retaining the superior segment may prevent pneumonectomy. Harrison *et al.*⁹ have suggested that extensive bilateral resection may be less damaging to pulmonary function than pneumonectomy.

Approach to the Patient with Bilateral Bronchiectasis

Bronchiectasis, except in the case of severe and repeated bleeding, is rarely a disorder requiring hasty action or decision

with regard to operation. Most patients with this disease should be approached first with measures directed toward control of infection, diminution of sputum and hemoptysis. Particular emphasis must be placed on the proper and continued usage of postural drainage and prompt treatment of respiratory infections with properly-chosen antibiotics. Prolonged antibiotic treatment is usually not helpful and may even be harmful. When these measures are used to maximum efficiency, a substantial number of patients will show improvement in general well-being and a lessening of respiratory symptoms.

If these measures fail to control symptoms, or if the patients cannot adhere to the outlined regimen, judicious operation should be planned. This must be predicated

on adequate, complete bilateral bronchography as a means of assay of the extent of disease and a baseline for measurement of future progression. With bilateral bronchiectasis, bilateral resections may be in the therapeutic plan, and relationship of each phase of treatment to the other must be envisioned as early as possible. We prefer operation on the more affected side first, in contradistinction to the recommendation of Kergin¹³ and Mathey,¹⁷ since many of our patients had relief of symptoms sufficient to forestall contralateral operation or to make it unnecessary. By preoperative attention to bronchial drainage and treatment of infection, the postoperative complications can be minimized. At least six months to one year should elapse before additional resection is considered and this should be contemplated only if significant bleeding, sputum production and recurrent infection persists.

The operative procedure should aim at the preservation of all possible normal lung parenchyma. Clinical and laboratory investigation of pulmonary function should be performed in all patients undergoing bilateral operation. Consideration must be given to the fact that the resection of bronchiectatic lung may improve lung function even if the total amount of lung tissue is diminished thereby. It has been shown that the segmental vessels are intact in bronchiectatic segments, with resultant perfusion of poorly functioning lung parenchyma.⁸ Resection of such an area can improve lung function.

In order to attain symptomatic relief, it may not be necessary to remove every vestige of bronchiectatic lung. We have felt it wise on certain occasions to leave slightly damaged segments, particularly of the upper lobe, undisturbed rather than to do pneumonectomy. Bilateral resection of major diseased areas may be preferable to unilateral resection of *all* diseased segments.

Summary

1. Thirty patients with bilateral bronchiectasis treated surgically were studied over a 10-year period with an average postoperative follow up of five years. Twenty-three patients underwent unilateral resection and seven bilateral.

2. All patients except three showed symptomatic improvement after resection. The more striking improvement occurred in the group operated upon bilaterally. Two patients died within the postoperative period. Only one death was attributable to the operation, and none to bilateral procedures.

3. Minimally involved segments were not removed in four patients having extensive resection of bilateral disease.

4. After extensive pulmonary resection there was some objective but no subjective evidence of deterioration of pulmonary reserve.

5. In 80 patients with bronchiectasis, the superior segment of the lower lobe was preserved after basilar resection in 11 patients. Late complications occurred in three and were significant in only one.

6. A plan of approach to the patient with extensive bronchiectasis is described.

Bibliography

1. Bradshaw, H. H., F. J. Putney and L. H. Clerf: The Fate of Patients with Untreated Bronchiectasis. *J. A. M. A.*, **116**:2561, 1941.
2. Bisgard, J. D. and S. A. Swenson: Bilateral Lobectomy for Bilateral Bronchiectasis. *Arch. Surg.*, **54**:483, 1947.
3. Chesterman, J. T.: Results of Surgery for Bronchiectasis. *Brit. J. Surg.*, **39**:263, 1952.
4. Collis, J. L.: State of the Lower Apical Segment in Resections for Bronchiectasis. *Thorax*, **8**:323, 1953.
5. Evans, W. A. and L. J. Galinsky: The Diagnosis of Bronchiectasis in Young Adults: Prebronchographic Manifestations Observed Among Military Personnel. *Am. J. Roentgenology*, **51**:537, 1944.
6. Fine, A. and T. B. Steinhause: Non-disabling Bronchiectasis. *Radiology*, **46**:237, 1946.

7. Ginsberg, R. L., J. C. Cooley, A. M. Olsen, J. W. Kirklin and O. T. Clagett: Prognosis of Bronchiectasis After Surgical Resection. *Surg., Gynec. & Obst.*, **101**:99, 1955.
8. Gobbel, W. G., J. Gordon and G. Digman: The Pulmonary Artery in Bronchiectasis. *J. Thoracic Surg.*, **21**:385, 1951.
9. Harrison, R. W., W. E. Adams, E. T. Long, B. Burrows and A. Reimann: The Clinical Significance of Cor Pulmonale in the Reduction of Cardio-Pulmonary Reserve Following Extensive Pulmonary Resection. *J. Thoracic Surg.*, **36**:352, 1958.
10. Helm, W. H. and V. C. Thompson: The Long-Term Results of Resection for Bronchiectasis. *Quarterly J. Med.*, **27**:353, 1958.
11. Hoffman, E.: The Late Results of the Conservation of the Apical Segment of the Lower Lobe in Resections for Bronchiectasis. *Thorax*, **10**:137, 1955.
12. Jones, R. S. and F. H. Cole: Bronchiectasis—Clinical & Pathological Findings & Concepts of Pathogenesis. *Southern Med. J.*, **45**:101, 1952.
13. Kergin, F. G.: The Surgical Treatment of Bilateral Bronchiectasis. *J. Thoracic Surg.*, **19**:257, 1950.
14. Lindskog, G. E. and R. D. Alley: Bilateral Bronchiectasis. *Arch. Surg.*, **60**:465, 1950.
15. Long, J. H., C. M. Norris, W. E. Burnett and M. R. Wester: Bronchspirometric Studies in Bronchiectasis Before and After Lobectomy. *J. Thoracic Surg.*, **19**:477, 1950.
16. Mannix, E. P., F. Gerbasi, C. E. O'Brien, R. H. Adler, W. A. McAlpine and H. Kerr: Bilateral Bronchiectasis—A Clinical and Physiologic Evaluation of the Results of Surgical Treatment. *J. Thoracic Surg.*, **26**:140, 1953.
17. Mathey, J. and J. Toussaint: Les Ressections Pulmonaires Segmentaires pour Bronchiectasies. *Acta Chirurgica Belgica*, **49**:747, 1950. Supplement 1.
18. McKim, A.: Bronchiectasis as Seen in an Ambulant Clinic Service. *Am. Rev. Tuberc.*, **66**:457, 1952.
19. Ogilvie, A. G.: The Natural History of Bronchiectasis. *Arch. Int. Med.*, **68**:395, 1941.
20. Perry, K. M. A. and D. S. King: Bronchiectasis: A Study of Prognosis Based on a Follow-up of 400 Patients. *Am. Rev. Tuberc.*, **41**:531, 1940.
21. Taylor, F. H., A. Roos and T. H. Burford: Respiratory and Circulatory Studies in Patients After Bilateral Lobectomy. *J. Thoracic Surg.*, **20**:974, 1950.
22. Whitwell, F.: A Study of the Pathology and Pathogenesis of Bronchiectasis. *Thorax*, **7**:213, 1952.
23. Wynn-Williams, N.: Bronchiectasis: A Study Centered on Bedford and Its Environs. *Brit. Med. J.*, **1**:1194, 1953.