Pulmonary Resection in Cystic Fibrosis

Results in 23 Cases, 1957-1970

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Mearns, M. B., Hodson, C. J., Jackson, A. D. M., Haworth, E. M., Sellors, T. H., Sturridge, M., France, N. E., and Reid, L. (1972). *Archives of Disease in Childhood*, 47, 499. **Pulmonary resection in cystic fibrosis: results in 23 cases, 1957-1970.** The results of pulmonary resection in 23 patients with cystic fibrosis are described. Before surgery, patients were classified into three groups on clinical and radiological grounds, those in whom (A) a good prognosis was expected after surgery, (B) surgery was considered palliative but it was hoped to improve general health and to reduce symptoms, (C) surgery might be immediately life saving. Preoperative and postoperative management is described, and the results are reviewed one year after operation and at the present time. It is concluded that pulmonary resection has a place in the management of cystic fibrosis: it may result in clearing of staphylococci from sputum and pharynx, with lessening of the generalized bronchial changes seen on chest x-ray. Careful selection is essential and surveillance must be continued after operation. Immediate postoperative complications may lead to an increase of localized disease. The ability of the parents or child to accept long-term supervision and medical management is a big factor in success.

The first respiratory symptoms in children with cystic fibrosis (CF) may occur at varying ages, but most patients have such symptoms in the first year of life. The later progression of the pulmonary disease process is extremely variable. In 1953 di Sant' Agnese stated that, 'in cystic fibrosis respiratory disease ushered in by lobar atelectasis represented one of the more severe forms and in many instances was rapidly fatal'. He described 211 patients of whom 22 had atelectasis involving one or more pulmonary lobes, and of these 15 died during infancy. With the intensive treatment which has evolved in recent years the majority of children not only survive the initial illness but recover without chronic symptoms and without radiographic lung damage. Those left with symptoms due to residual damage may, with continued treatment, show no progression of the disease for long periods, but it is unusual to find persisting localized disease without generalized lung involvement.

In 1962 Hodson and France described two forms of bronchiectasis in CF, the less common being a straightforward segmental bronchiectasis affecting a whole pulmonary segment. They considered this to be a sequel either to previous segmental pneumonic consolidation or to a persisting collapse. The other form is peculiar to staphylococcal disease and was described as multiple 'blob' bronchiectasis. These lesions are small and scattered among the small bronchi.

In CF large localized segmental lesions in which atelectasis is a major element may resolve and re-expand after a variable period of time. On the other hand they may either persist unchanged or develop secondary permanent bronchiectasis (Fig. 1).

In 1950 a clinic for patients with CF was started at the Queen Elizabeth Hospital for Children by the late Dr. Winifred F. Young. The patients were seen regularly for treatment and assessment and the progress of localized pulmonary lesions could thus be followed. From the early days it was her belief that surgery should be considered for patients with persistent gross disease localized to one large lung segment, because, though such

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FIG. 1.—Fate of area of collapse.

lesions might remain quiescent for long periods, they were invariably complicated later by further disease in previously unaffected areas of the lungs. A similar outcome has been noted by other authors (Shwachman, Kulczycki, and Craig, 1957; Schuster *et al.*, 1964).

The purpose of this paper is to describe the criteria for pulmonary resection at this clinic and to present the long-term results.

Materials and Methods

Between 1950 and 1968, 218 patients with CF were seen at this hospital and in 23 lobectomy or segmental resection was performed: 16 were female and 7 were male. In 16 the diagnosis of CF was made before the age of 1 year and in only 4 was the diagnosis made after

FIG. 2.—Category A (1) aged 2 years. Gross disease confined to right upper lobe.

the age of 2 years. All but one had had a respiratory infection in the first year of life and in 17 this had occurred by the age of 6 months. In 8 of the 23 patients the localized lesion had been observed from its appearance. In 6 children, seen first when they were over 1 year of age, the localized disease was present on admission to the clinic. Nine were referred from other centres to consider the possibility of lobectomy. All patients

FIG. 3.—Category A (1) aged 12½ years. Gross disease confined to the right upper lobe with bronchial wall thickening elsewhere.

FIG. 4.—Category A (2) aged $10\frac{1}{2}$ years. Persistent collapse of right middle lobe as the only lesion.

were under care for varying periods before operation was performed.

Indications for lobectomy were formulated on combined clinical and radiological grounds. Three cate-

gories emerged which appeared to provide a logical basis for surgery.

Category A: radical excision. In this category were those patients with a single gross lesion. Removal of the affected segment or lobe might abolish the chronic productive cough and leave the patient free of gross disease, thereby diminishing the risk of further focal disease developing. This group can be subdivided into cases in which (1) the localized lesion persisted from the initial illness: these typically had recurrent episodes of bronchitis with persistent positive cultures of staphylococci from throat swabs or sputum, but whose general health remained good (Fig. 2 and 3); (2) the localized lesion again persisted, the patient for a time being free from symptoms and no pathogens being cultured, but there was later deterioration of general health with productive cough and recurrence of staphylococcal infection (Fig. 4).

Category B: palliation. While it was considered that removal of the affected segment or lobe would reduce the amount of cough and sputum, it was not expected that the patient would then be without symptoms. In this group a chronic and severe change was present in a single lobe, but minor changes were also present elsewhere in the lung (Fig. 5).

Category C: excision for symptomatic relief—or as a life-saving measure. In these cases one or more grossly bronchiectatic lesions were behaving as lung abscesses producing large volumes of purulent sputum, general toxicity, and deteriorating health (Fig. 6 and 7).

FIG. 5.—Category B aged $10\frac{1}{2}$ years. Gross focal disease in two areas of the right lower lobe with a single 'blob' shadow in the periphery of the left lower lobe.

FIG. 6.—Category C aged 5½ years. Severe cystic disease confined to left lower lobe.

FIG. 7.—Category C aged 15 years. Severe bronchiectasis in right upper lobe with 'blob' bronchiectasis in right lower lobe, and generalized thickened bronchial wall.

Radiological assessment for surgery. The rationale underlying the radiological assessment for surgery was as follows. It was considered that plain films were a satisfactory means of defining localized disease, which either cleared or persisted. Clearance could occasionally mean that a bronchiectatic lesion had drained and was no longer definable on the chest x-ray, but such lesions usually refilled with secretions

and so became 'visible' again at the time of the next acute episode. It later became apparent that one of the large segmental lesions was likely to be irreversible if it persisted unchanged for over 6 months.

The segmental localization of persistent gross disease was usually a simple matter using posteroanterior and lateral films alone. Bronchography was initially used in 4 cases, but after one patient developed a fatal complication after bronchography at another centre, it was discontinued. The rationale behind simple 'plain film' localization of the disease was that (1) dilated bronchi full of retained secretions can be detected by this means, (2) dilated bronchi not so definable must therefore be empty of secretions, must be draining well, and are therefore not an indication for surgery, and (3) bronchography often failed to define secretion-filled diseased bronchi.

This policy was accepted by the surgeons concerned and proved effective, the radiographic findings being generally confirmed at thoracotomy.

Three descriptive terms are used in the present radiological assessment, and derive from radiographic-histological correlation described by Hodson and France (1962).

Thickened bronchial wall pattern, denoting a parallel-line shadow pattern corresponding to the bronchial walls and definable in a much greater degree and more peripherally than in the normal child's chest x-ray. This appears to be due to chronic changes involving all layers of the bronchial wall.

Localized disease mainly represents the focal or 'blob' bronchiectasis which is so characteristic of this disease, when these lesions are full of secretions.

TABLE I
Clinico-radiological Category and Age at Lobectomy
(Age Range 11 Months to 15 Years, 2 Months)

	Age (yr)					No. of patients
	0-3	3-6	6-9	9-12	12-15	
Category A (1)	4	2	1	0	1	}12
(2)	0	1	1	2	0	
B	1	2	2	1	0	
C	0	2	1	0	2	5
No. of patients	5	7	5	3	3	23

Generalized focal disease indicates multiple 'blob' bronchiectasis scattered widely throughout both lungs.

Assessment of results of surgery. Immediate postoperative complications were noted, and one year after operation a further assessment was made to determine if there had been benefit from operation, as judged by physical status, bacteriological examination of the sputum, and the radiographic findings.

When evaluating long-term results, the surviving patients were placed in three groups based on clinical and radiological findings, as previously described (Jackson and Young, 1960).

- Group I* Good general health. No persisting cough or sputum. Chest x-ray normal or with a minimal degree of bronchial wall thickening.
- Group II* Good general health but may have persisting productive cough. Chest x-ray shows localized lesion.
- Group III* Persistent pulmonary infection with purulent sputum. Chest x-ray shows generalized focal change.

Clinical management. Patients were admitted for at least four weeks immediately before operation. Physiotherapy was given and general activity encouraged, the aim being to clear the lungs of retained secretion. An attempt was made to clear the sputum of staphylococci with high dosage antibiotics orally and by aerosol. This routine was continued until serial chest x-rays showed no further improvement.

Surgical treatment was carried out at the London Chest Hospital. After an introductory outpatient visit, the patients were transferred on the day before operation. The principles underlying management were to avoid contamination of the bronchial tree, to inflict as little trauma as possible to healthy lung tissue, and to obtain rapid complete re-expansion of the lung postoperatively.

Anaesthesia was usually maintained using an endotracheal tube, and the operation was performed with the patient in the prone position unless the bronchial tree was particularly dry. Frequent gentle bronchial suction was given. Strict attention to control of haemorrhage from the exaggerated bronchial arterial

supply and to the siting of the drainage tubes resulted in a low incidence of pleural complications.

The patients were transferred back to the Queen Elizabeth Hospital for Children as soon as the risk of surgical complications seemed small, usually on the 4th or 5th day. Antibiotics were continued both by aerosol and systemically, if necessary, by intramuscular or intravenous route. Early and frequent physiotherapy was essential and in the younger patients pharyngeal suction was used to clear secretions and encourage coughing. If necessary hydration was maintained by intravenous administration of fluid. In all cases an early return to activity was encouraged.

Results

On the basic assessment for surgery, in this series of 23 patients, 12 were in Category A (8 in A (1) and 4 in A (2)), 6 were in Category B, and 5 in Category C. Clinico-radiological grouping before operation showed that the patients in Category A (1) and (2) were Group II and the patients in Categories B and C were all in Group III.

Nineteen patients had one lobe resected, and 2 had an additional segmentectomy. One had two lobes removed and one had a segmentectomy only. The right upper lobe was the most commonly affected, i.e. in 13 out of 23 patients (Table I and II).

The age of the patients at the time of operation varied from 11 months to 15 years 4 months—most (12) were under 6 years of age.

TABLE II
Segment or Lobes Resected

Right upper lobe	11	Lingula	3
Anterior segment of right upper lobe	1	Lingula and segment of right upper lobe	1
Right middle lobe	2	Lingula and left lower lobe	1
Right middle lobe and segment of right lower lobe	1		
Right lower lobe	1	Left lower lobe	2
Total	16		7

The duration of the lesion before operation varied and in some was not known, the lesion being present on the first radiographic examination. The longest period the main lesion was known to be present before removal was 7 years. In only 2 cases was this period less than 1 year.

Evidence of staphylococcal infection of the respiratory tract, as judged by culture of sputum or throat swab, was found in 15 of the 23 patients when first seen at the hospital; in 6 of these it has been eradicated by treatment from the cultures before surgery. *Pseudomonas* was cultured from the sputum of 3 patients, all of whom were in Category C and this pathogen was not eradicated. No pathogen was isolated from 5 patients.

Immediate postoperative period. Thirteen patients had a satisfactory immediate postoperative course, though 8 of these have transient small areas of collapse consolidated on postoperative chest x-rays. Only 3 of these were kept in hospital more than 5 weeks after operation; two for social reasons and the third for 12 weeks because of an increase in cough and sputum. Only 4 of the total were kept over 8 weeks, 3 being in Category C in which a prolonged postoperative convalescence can be anticipated.

One patient died on the eighth postoperative day, having developed obstructive bronchitis with cyanosis, which was treated by bronchoscopy and assisted ventilation.

Assessment one year after operation. Twenty-one of the 22 surviving patients were judged to have had definite benefit from surgery, the exception being one patient in Category C in whom improvement might be considered doubtful, but even her volume of sputum was reduced in the first 6 months after operation. The frequency of cough and volume of sputum were reduced in all the remaining patients, 6 of them being completely free of productive cough.

Hospital admissions. Only 2 of the 22 patients needed admission to hospital in the first postoperative year, one after an attack of measles and the other for treatment of acute bronchitis.

Physical examination. Four of the 22 patients were found to have added sounds on auscultation of the lungs and these were localized to one area.

Weight gain for the year was normal or above average in 19 patients. Two patients failed to gain and 1 had lost weight, these 3 patients being in Category C.

Culture of sputum or throat swab. Sixteen of the 22 surviving patients had cultures which were free of pathogens. The 5 patients of these 16 who were free of pathogens before operation, continued so. 12 of the 15 patients who had positive cultures for staphylococci when first seen were now clear. Removal of diseased lung tissue probably helped in eradicating the pathogen from 6 patients who had failed to clear before excision, and may have prevented recurrence in the other 6. 2 of the 3 patients who had persisting positive cultures of staphylococci were treated before 1958, when a lower dose of antibiotic was used and before the introduction of neomycin by aerosol.

Pseudomonas was only cultured from patients in Category C, this being present in 4 of 5 patients before operation and persisting after operation in 3 of the 4 survivors.

X-ray results.

Category A. 3 of the 4 patients with bronchial wall thickening before operation returned to normal. During the one-year follow-up, 2 had transient collapse-consolidations which cleared. One patient in the immediate postoperative period developed segmental collapse with consolidation which was still present one year later.

Category B. 3 of 5 patients had cleared the bronchial wall thickening seen before operation. 3 others had transient lung changes in the post-operative year. No new permanent lesions developed.

Category C. The 4 surviving patients had bronchial wall thickening present before operation, and this persisted. New localized lesions developed in 3 patients.

Long-term follow-up—present clinico-radiological status (Tables III and IV). In brief, 14 of 22 patients surviving the postoperative period are known to be alive (their ages ranging from 3½ to 20½ years), giving a follow-up time of

TABLE III
Present Clinico-radiological Status

	Group I	Group II	Group III	Died
	4	6	4	8
Category before surgery				
A	3	3	2	3 + 1 lost to follow-up
B	1	2	1	2
C	0	1	1	2 + 1 immediate post-operative death

TABLE IV
Survival After Surgery

Years (after surgery)	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9+
No. of patients alive	1	0	3	2	3	3	2	1	4	2
Died	0	0	1	1	1	1	1	1	1	0
Age at death (yr)			6.6	8.4	14.7	20.6	19.5	18	15.8	

(Plus 1 lost to follow-up and 1 immediate postoperative death.)

between 1 year and 9 years 8 months. 7 have died, the period before death ranging between 3 years and 8 years 2 months. One patient left the country after 2½ years. Details are as follows.

Category A. Eight of 12 patients are known to be alive and 1 is lost to follow-up. 3 are now in Group I, 3 in Group II, and 2 in Group III. Of the last 2, 1 developed portal hypertension associated with deterioration in the lung disease, and the other developed a new area of localized disease in the immediate postoperative period. She has been followed up for 8½ years and, though she now has a chronic productive cough and is short of breath on exertion, she is able to do an office job.

Two patients have died in the late teens 7 years after operation, having had 5 years of good health. A third patient was well for 18 months but then his lung condition deteriorated for a further 18 months before his death, when his parents were unable to accept the continued supervision and medical management needed to keep any patient with CF in good health.

Category B. 4 of 6 patients survive: 3 are in Group II and 1 in Group III. All these patients had evidence of other localized disease at the time of operation. There has been little change in 3 patients, but the one in Group III developed radiographic changes in the immediate postoperative period that have persisted, and a further area of localized disease has also developed.

Two patients have died, one 8 years after operation, her death being accelerated by the development of diabetes. The other patient survived 4 years, only needing admission to hospital in the final illness.

Category C. 2 of 5 patients survive, the follow-up in one being 4½ years after removal of the left lower lobe and lingula. There is now a localized lesion in the remaining left lung tissue, she has a productive cough, but continues to grow and gain weight and is still with Group II. The other patient with a 2½ year follow-up still produces a lot of sputum, is short of breath, and losing weight, though she still works part-time and is in Group III. 3 patients have died, one having a reasonably

active life for nearly 5 years. The second had only doubtful benefit for 6 months after operation but survived a further 2½ years. The remaining patient died in the immediate postoperative period.

Discussion

Study of the chest x-rays of all the patients attending the clinic showed regions of collapse or collapse with consolidation more frequently in the right lung than the left (87 : 46) and the right upper lobe was the most difficult to clear. The right middle lobe, though as frequently involved, usually cleared with intensive medical treatment.

Schuster *et al.* (1964) also drew attention to the fact that, in their surgically-treated patients, the right lung was more often affected than the left and that the right upper lobe was most often involved. The findings in the present series of surgically-treated patients were similar (13 out of 23 patients).

Clinical observation led the late Dr. Winifred F. Young to believe that segmental or lobar collapse or collapse/consolidation could take up to 6 months to resolve even with intensive medical treatment, and therefore the question of operation should not be considered without this period or an even longer period of treatment. Serial chest x-rays at monthly intervals were taken of all patients with these lesions until maximum resolution was achieved. Review of these x-rays shows that the majority of such lesions can be expected to clear within 6 months, though some do persist longer before finally resolving; 88 lesions resolved in 3 to 6 months, 24 in 6 to 9 months, and 14 in 9 to 12 months. Andersen in 1955, discussing her experience of lobectomy in CF, gave persistence of a segmental atelectasis for at least 6 months as one of the criteria for resection.

The serial chest x-rays of all patients with CF seen during the first 5 years of life at this clinic also show that collapse or collapse/consolidation which persists longer than 1 month is most likely to occur in the first 3 years of life. Approximately 20 to 25% of all patients with CF developed this

lesion in the first 2 years and by the fourth year the incidence had fallen to less than 5% (Table V).

TABLE V

Incidence of Lobar or Segmental Collapse or Consolidation Seen on Chest X-rays of Cystic Fibrosis Patients up to 5 Years of Age

Age (yr)	0-1	1-2	2-3	3-4	4-5
No. of patients x-rayed	95	102	113	107	92
No. of patients with area of collapse present	26	20	13	5	7

It is impossible to determine whether this fall in incidence is due to a change in the effect of the disease with increasing size of the airways, or to the prevention of this complication by the more intensive treatment now applied in this clinic of relatively minor respiratory symptoms.

There are only a few patients with CF in whom operation will be considered—those with single infected lesions, in which lung tissue is largely nonfunctioning. It is accepted that, though a lesion may be clinically and radiologically localized, it is probable that the whole of the tracheobronchial tree is reacting, or will react, abnormally to various triggering mechanisms, among which the most important has been considered to be infection. It is therefore logical in the case of persistent collapse without proven bronchiectasis to remove a localized lesion that acts as a source of infection, provided that the actual operation itself does not act as a trigger mechanism for the rest of the lungs. Shwachman *et al.* (1957) and Schuster *et al.* (1964) showed that operation was well tolerated provided there was adequate preoperative care. The same is true of the cases now reported.

The aim of surgical treatment in these patients was to slow down the progression of the disease, to prolong life, and, perhaps even more important, to improve the quality of that life. Reduction of the frequency of cough and of the volume of sputum can only be a change for the better. CF has such a variable course and unpredictable prognosis that it is difficult to be certain that any one factor has changed the course of events, especially as in the past 10 to 15 years improved results have been reported from many clinics. It is our firm impression that the majority of patients have benefited from excision of localized disease. At 1-year follow-up the benefit was doubtful in only 1 patient. The incidence of chronic infection was reduced and evidence of thickened bronchial walls

cleared in 6 or 9 patients in Categories A and B. In chronic lung disease a thickened bronchial wall pattern has been considered to represent chronic infective changes in the bronchial wall (Hodson and Trickey, 1960). Examination of the excised lobes or segments leaves no doubt that this lung tissue was performing no useful function and was probably acting as a continuing focus of infection to the rest of the lungs.

At the present time 7 patients have died in the later follow-up period. The 2 deaths in Category A (1) are particularly disappointing as it had been hoped that resection would prevent progression of the disease. Patients in Category A (2) and B had deterioration in health with exacerbation of infection in existing lesions before operation. It is doubtful if they would have lived as long without operation. Anything that would give the patients in Category C more than a few months of life must be regarded as beneficial.

Experience gained with the earlier cases influenced later decisions as to the suitability and the timing of the operation. It became apparent that young children tolerated the operation well. It has been shown that simple collapse or collapse with consolidation is most likely to occur in the first 3 years of life. Therefore in recent years Category A patients have been operated on at an earlier age, without waiting until there has been deterioration in health or increase in demonstrable disease, as occurred in Category A (2) patients. The results to date with this approach are encouraging.

Pathological findings in resected specimens.

The resected specimens included several different types of bronchiectasis. In some, the lobe was massively collapsed and thus airless. In others it was well aerated though there was severe 'airway' disease in the lobe; this was always obstructive, sometimes obliterative, and might affect mainly either the bronchiolar or bronchial airways.

The massively collapsed lobes were small and plum-coloured because of alveolar wall congestion arising from the haemodynamic changes associated with collapse. In one such lobe an unexpected mycetoma, about 1 cm in diameter, was found. Endobronchial abscess formation does not necessarily occur in massive collapse, but in the case illustrated in Fig. 6 intrabronchial ulceration had occurred, presenting an overall picture of typical 'cystic bronchiectasis'.

In other cases the lobe was aerated, only slightly reduced in volume, and with virtually no pleural adhesions. After resection the lobes became airless and appeared 'hobnail' because now the

numerous small abscesses in the airways distended the pleura. The lung inflated satisfactorily with fixative; thus though most of the airways were blocked with secretions or obliterated by fibrous tissue, clearly enough were patent to maintain aeration by collateral drift. In this case the changes were confined to small bronchi and bronchioli.

In other cases an endobronchial abscess started proximally in a larger airway, with the abscess cavity more than a centimetre in diameter, the airway being obliterated but the lung beyond still aerated.

Enlarged lymph nodes with numerous mitotic figures in germinal centres were a feature of some of the cases.

No correlation emerged between the pathological type of bronchiectasis and the reason for surgical resection.

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We present in this paper the first reported series of patients with cystic fibrosis in Great Britain to undergo pulmonary resection. It is presented by the authors to acknowledge that this surgical treatment was initiated by

the late Dr. Winifred F. Young. She had been interested in the result of surgery reported by Dorothy Andersen (1955). At a preliminary consultation with Sir Thomas Holmes Sellors he agreed to perform resection in suitable patients. The decision to refer each case for surgery was primarily made by Dr. Young and, after consultation, the operations were performed by Sir Thomas Holmes Sellors up to 1967 and, since that time, by Mr. M. Sturridge.

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APPENDIX A

Analysis of Fatal Cases

Category	Lobes Resected	Age at Operation	Length of Follow-up	Resection
A	RML	10½ (1960)*	7½	Well—no admission for 5 yr, then acute episode—patient completely non-co-operative; progressive downhill course for 2½ yr.
	RUL	12½ (1961)	7	5½ yr after operation active and working; acute infection with rapid deterioration in next 2 yr (not seen at Q.E.H.)
	RUL	5½ (1966)	3	Well for 18 mth without cough; insidious symptoms with gradual deterioration
B	Ant. seg.	7½ (1959)	8	Poor home; admissions during school holidays for supervision; slow deterioration until 1 yr before death, when diabetes developed, followed by rapid progression of chest disease
	RML	10½ (1959)	4	Well with minimal cough for 2 yr; gradual increase in symptoms; only further admission for terminal care
C	RUL	15½ (1962)	5½	Some reduction in cough and sputum postoperatively but needing frequent attendance for physiotherapy; remained active until 6 months before death
	RUL	3½ (1957)	3	Sputum reduced for 6 mth and patient able to be home for periods of time; this had not been possible in year before operation
	RUL	7 (1966)	Died 8th postoperative day	Obstructive bronchitis with cyanosis

*Year of operation.

APPENDIX B

Follow-up of Patients Still Living

Group	Age at Operation (yr)	No. of Years Follow-up	Resection	Present State	Immediate Post-op.	Progress	Present X-ray
A1	1 1/12 (1961)*	8 7/12	LLL	Mod.	Bronchoscopic suction twice	No admission for 3 yr post-op.; in last 4 yr intermittent bronchitis	TBW†
	2 (1964)	5 6/12	RUL	Good		No admissions	Normal
	1 (1967)	3	RUL	Good		Admitted in 1st post-op. yr, with bronchitis; nil since	Normal
	2-8 1/12 (1969)	1 2/12	RUL	Good		No admission	Normal
	5 4/12 (1965)	5 3/12	RUL	Poor	Bronchoscopy once	Well for 3 yr with 1 admission; then deteriorated with portal hypertension	TBW; generalized focal disease ?
	6 10/12 (1957)	2 6/12	LLL	Lost to follow-up		No admission for 2½ yr	
A2	10 10/12 (1960)	9 8/12	Lingula	Mod.	Pyrexial illness; localized changes which persist	No admission for 4 yr; working; intermittent sputum; last admission 4 yr ago	TBW apical focal changes
	4 3/12 (1961)	9	RML	Mod.		No admissions; seldom coughs; sputum after physiotherapy	TBW focal change RU zone
	8 3/12 (1961)	8 10/12	Lingula	Poor		Approx. yearly admission since operation; dyspnoeic but working	TBW generalized focal changes
B	3 8/12 (1961)	8 8/12	Lingula, apical seg., LUL	Mod.	Persisting abnormal signs and sputum Pocket of air	Admitted 1st yr post-op.—measles; nil since; intermittent abnormal signs; active; sputum after physio. and exercise	No TBW, but generalized focal changes
	7 6/12 (1963)	6 10/12	RUL	Mod.		One admission; active; very small amount of sputum	TBW; no localized lesion
	4 1/12 (1966)	4	RLL	Mod.		One admission; occasional cough with sputum	TBW, localized focal lesion RUL
	2 3/12 (1967)	3	RUL	Mod.		One admission because of increase in sputum and loss of weight; active; minimal sputum	TBW, persisting focal LUL
C	5 4/12 (1965)	4 8/12	LLL and lingula	Mod.	Pneumothorax	Much improved post-op. 3 admissions since; active but dyspnoeic on exercise; productive cough	TBW, permanent focal change LU zone; intermittent change RUL
	14 4/12 (1967)	2 10/12	Lingula	Poor	Poor general condition	Less sputum and more active for 1 yr, then frequent admissions—now breathless with copious sputum	TBW, general focal changes

*Year of operation. †TBW, thickened bronchial wall.