PULMONARY FUNCTION BEFORE AND AFTER SEGMENTAL RESECTION AND AFTER "IDEAL" PNEUMOTHORAX TREATMENT*

BY

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Before the advent of antituberculous drug therapy, pulmonary tuberculosis remained a serious disease and the available methods of treatment were limited. In that era the success of treatment was justifiably chiefly assessed by such simple criteria as survival of the patient over a number of years (Foster-Carter, Myers, Goddard, Young, and Benjamin, 1952). With modern advances, which so greatly increase the effectiveness and types of treatment, the patient almost invariably survives and the merits of the various forms of treatment must be assessed on more exacting grounds. These will include freedom from relapse, persistently negative sputum, and return to full activity without any symptoms. In fulfilling this last criterion the pulmonary function of the patient is very important, and as the years of survival approach the normal span this importance will increase. Defects of function that cause little trouble in early life may well produce symptoms in later years, when irreversible changes have continued over a long period and been added to the normal degenerative effects. It is thus now desirable that in the assessment of any form of treatment for tuberculosis it should be considered not only from the point of view of its success against the disease process but also the success with which it preserves, or at least does not further interfere with, normal lung function.

Pneumothorax played a most important part in the preservation of life and health in the days before antituberculous drug therapy and resectional surgery. Recent studies (Scadding, Nicholson, and Hoyle, 1951; Foster-Carter *et al.*, 1952) leave no doubt about this aspect of the matter. However, the complication rate has been high, and, as Savage and Fleming (1955) have mentioned, complications may have ruined the health of the patient and caused marked loss of pulmonary function and chest-wall deformity. The use of antituberculous drug therapy in conjunction with pneumothorax (Birath, 1953; Scadding, 1955) will undoubtedly reduce the number of these tragedies, but the functional results of no such series have yet been reported, and with the loss of popularity of pneumothorax as a form of treatment it will be some time before enough cases can be collected.

Fleming and West (1954) have confirmed Pinner, Leiner, and Zavod's (1942) observation that even trouble-free pneumothoraces may cause gross reduction in function which can only certainly be known by measuring the differential lung function. Functional loss is apt to be much greater where there has been an effusion, even though it has appeared to clear very satisfactorily. Any such loss of function is an unfortunate accompaniment of successful treatment of the disease process, particularly if the original lesion might have been adequately treated by other methods.

Resection has been increasingly used in the treatment of pulmonary tuberculosis, and in recent years has been extended particularly into the field of localized lesions which can be removed by resection of the one or two segments in which they lie. Many series reported (including Overholt, Woods, and Wilson, 1953; Thompson, Savage, and Rosser, 1954; Eerland and Seghers, 1955; Douglass, Bosworth, Judd, and Chang, 1955) demonstrate that in good hands the mortality and the morbidity rates are very low.

In the present study pulmonary function has been assessed before and after thoracotomy for segmental resection, and the results are compared with those obtained in cases of uncomplicated pneumothorax treatment. Few of the pneumothorax cases had the benefit of effective modern antibacterial treatment.

Pneumothorax

At Sully Hospital routine pneumothorax maintenance treatment is not carried out and cases available for study were therefore patients in whom the pneumothorax had either failed to control the disease satisfactorily or who had developed contralateral activation and had then been admitted for further treatment. A total of 62 cases of old pneumothorax have been studied from the point of view of pulmonary function, and from these were chosen all those which had had unilateral collapse for localized disease and which at no time in the course of treatment had developed any detectable fluid or other complication. It is thought that these ideal cases should closely resemble cases of pneumothorax which have the added benefit of anti-tuberculous drug therapy.

Sixteen such cases (about 25% of the total) fulfilled these criteria. In 10 of these (62%) there was localized contralateral disease, the presence of which would tend, because of the method of expressing differential lung function results by the percentage of total function, to minimize the apparent functional loss on the pneumothorax side.

In these 16 cases the extent of the parenchymal disease under the pneumothorax was of the same order as that in the segmental resection series, and the losses of function due to the disease process would be similar.

Segmental Resection

Cases were chosen in which, after full assessment, it was decided that segmental resection was indicated and that the removal of one or two segments or less would be sufficient. In most cases this procedure would remove all known disease. The 27 cases formed a consecutive series, and all cases had had prolonged antituberculous drug therapy and showed cavity closure and radiological stability, and were sputum-negative repeatedly. These patients had the purpose of the study explained to them. It was made clear that their co-operation would be entirely voluntary and that the investigations would be of no particular value to their individual case. It was also explained that the necessary information would be obtained only on repetition of the tests after operation. Following on previous studies (Fleming and West, 1954) showing that there were no adverse effects and that the investigation was no great ordeal to the patient, it was thought justifiable to use these methods for purely research purposes. The series of cases studied by bronchospirometry with the Carlens catheter at this hospital now stands at over 400, and the complete absence of complications reported in the first 125 of this series is fully substantiated.

Methods

The chest was examined with particular attention to movements and breath sounds, and diaphragmatic movement was studied fluoroscopically. Investigation of the maximum breathing capacity and differential function was carried out by previously described methods (Fleming and West, 1954).

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Segmental resection was in all cases performed at Sully Hospital in the latter part of 1954 and early 1955, using the methods described by Thompson *et al.* (1954). The investigations were repeated as late as possible after operation. This was often little more than six weeks, as at that stage most of the patients were transferred to widely scattered institutions for graded convalescence. The average time after operation was 8.7 weeks (range 6 to 20 weeks) and the grade of activity of the patients was much the same as before operation.

The number of segments removed in each case averaged 1.3, with a range of 0.5 to 3 (only one case had an upper lobectomy, because of a caseous node adherent to the upper lobe bronchus). The segments were all in the upper lobe or the apex of the lower lobe, with one exception when a lateral basal segment was removed.

Results in "Ideal" Pneumothorax Cases

The group consisted of 16 patients (5 women, 11 men) with an average age of 30 years and a range of 21 to 49 years. The average value of the maximum breathing capacity was 106.6 litres a minute (range 55 to 150).

The average duration of the pneumothorax was 3.09 years (range 1 to 4.5 years) and the average time that had elapsed since the lung expanded was 3.2 years (range, 2 months to 13 years). Five pneumothoraces were on the right side and 11 on the left.

From bronchspirometric studies the departure of the function on the pneumothorax side from the average normal values (right side = 55%; left side = 45%) (Baldwin, Courmand, and Richards, 1948) was as shown in Table I.

TABLE I.—*Departure of Function on Pneumothorax Side From Average Normal Value. Standard Deviations are Given in Parentheses*

Oxygen uptake ..	-10.86% (6.2); range -20 to -1
Minute-ventilation ..	-7.46% (5.9); .. -23 .. +5
Vital capacity ..	-8.3% (5.45); .. -16 .. -4

It should be remembered that over 60% of these cases had contralateral disease, which would cause a small loss of function in the "more normal" lung and tend to diminish the apparent loss on the pneumothorax side when the results are expressed in this way.

Results in Segmental Cases

The average age of the 27 patients in this group was 27 years (range, 15 to 54 years), and there were 9 women and 18 men. The age and sex distributions are thus very similar to those in the pneumothorax group. In 17 the disease was on the right side and in 10 on the left.

Bronchspirometric studies before operation showed the functional loss as compared with the normal (R.L. = 55%; L.L. = 45%) as shown in Table II. This loss is entirely due to the disease process. The average number of segments found to be diseased at operation was 1.3 (range 0.5 to 3). From a consideration of the detailed operation reports and the pathological findings on the resected material Table III is composed. In 26 cases (96%) caseous material

TABLE II.—*Departure of Function on Side With Segmental Disease From Average Normal Value. Standard Deviations are Given in Parentheses*

Oxygen uptake ..	-4.98% (4.9); range -16 to +5
Minute-ventilation ..	-3.42% (5.7); .. -13 .. +6
Vital capacity ..	-2.8% (4.73); .. -10 .. +5

TABLE III.—*State of Expansion of Diseased Segments*

Predominantly well aerated ..	17 (63%)
.. collapsed and fibrosed ..	10 (37%)

was found in the resected segment, but it is evident that in most cases this segment was by no means entirely destroyed and functionless. This is fully confirmed by the bronchographic appearances, which in the 17 cases with an aerated segment showed either no abnormality or minor changes in the subsegmental bronchi, while in the 10 cases of collapsed segment there was invariably bronchiectasis of the segmental bronchus. There was a close relationship

between the appearances in the bronchogram and the state of aeration of the segment.

In these cases, taken as a group, there is thus only a small amount of destruction of lung tissue, and in only 37% of them was the involved segment largely destroyed.

Other changes that might adversely affect function were also looked for, but none were found. Localized adhesions over the lesion, present in 48%, had no apparent effect on function.

Findings After Segmental Resection

Chest movement and breath sounds were in all cases normal before operation. After operation, at the time of the repeated function studies, the findings were normal in 89%. In all cases with less than normal chest movement (11%) there was considerable improvement in the ensuing months.

Diaphragmatic Movement.—Before operation this was normal in all except two cases in which the phrenic nerve had been crushed two years previously. The early results after operation are shown in Table IV. In the following

TABLE IV.—*Diaphragmatic Movement in Early Post-operative Period*

Normal full range ..	11 (41%)
50-80% of normal ..	10 (37%)
25% of normal ..	3 (11%)
Fixed but no paradox (2 previous phrenic crushes)	3 (11%)

months all cases with 50% or more of normal function improved until the diaphragm movement appeared entirely normal, though in a few cases this took nearly a year to be achieved. In the cases with less than 50% of normal movement the range of excursion increased steadily, usually to the region of 60%, though the cases with previous phrenic interruption showed no such change. There was no obvious relationship between this impairment of diaphragmatic function and the immediate post-operative course or the functional results, though under conditions of stress it is likely that there must have been considerable effect on function.

Maximum breathing capacity had fallen by an average of 4.8% (S.D. = 11.4; range -47 to +24) of the pre-operative value. This is surprisingly good considering that the patients had not only lost some functioning lung tissue but were only two months removed from a thoracotomy and still on a very modest grade of activity. The average maximum breathing capacity was 120 litres a minute in 27 cases. This is somewhat higher than in the pneumothorax group.

Bronchspirometric Studies

In 27 cases the loss from the normal value (R.L. = 55%; L.L. = 45%) on the affected side is as shown in Table V, which does not take into account the change from the actually observed pre-operative figure which is discussed below. The losses presented here arise from the disease plus the operation. Table VI shows the loss of function

TABLE V.—*Average Departure of Function on the Operated Side from the Normal Figure in 27 Cases. Average Number of Segments Removed=1.3 Per Case. Standard Deviations are Given in Parentheses*

Oxygen uptake ..	-8.1% (4.7); range -18 to +5
Minute-ventilation ..	-5.6% (5.75); .. -20 .. +5
Vital capacity ..	-8.75% (5.5); .. -19 .. +7

TABLE VI.—*Reduction of Function of Operated Lung Following Resection. Standard Deviations are Given in Parentheses*

Oxygen uptake ..	-3.2% (3.66); range -9 to +3
Minute-ventilation ..	-2.2% (6.4); .. -11 .. +5
Vital capacity ..	-5.2% (4.7); .. -12 .. +5

on the operated side following resection. The figure is obtained by working out the percentage of the total function contributed by that lung in each case and subtracting the post-operative from the pre-operative result. These losses represent those due to the operation alone.

Loss of Function

The methods already used in presenting the results in this paper are those usually employed in the expression of

results and changes of function measured by bronchspirometry. However, such methods refer only to the fraction of the total function being performed by the lung under consideration and give no accurate picture of the amount of function lost by that individual lung due to any procedure to which it has been subjected. In the present study the figures already recorded are a useful index for comparison with the pneumothorax series and with other series in the literature where other methods of treatment have been used. We are now chiefly interested in the actual loss of function in the operated lung due to the segmental resection and compared with the measured pre-operative function.

In working out the percentage function of, for instance, the left lung in the ordinary way, the following simple fraction is used:

$$\% \text{ function contributed by the left lung} = \frac{L}{L+R} \times 100,$$

where L is the function of the left lung in absolute values and R is the function of the right lung in absolute values.

On repeating such function studies the state of the patient is rarely the same as in the first examination, and even in the normal and unchanging lung the recorded absolute measurements of function have changed. It is for this very reason that the results of such tests are usually expressed as a percentage of the total function.

In the cases in this series post-operative control was good, and there was no reason to suspect that any change in the function of the healthy lung had occurred between the pre-operative and the post-operative studies. Presuming this to be so, it is possible by simple proportion to obtain a "corrected" value for the absolute figure of the function recorded on the operated side. This is then directly comparable with the absolute figure obtained before operation, as they are both with reference to the same figure—that is, the initial absolute figure for the unoperated side.

In the case of the left lung

$$\text{"Corrected" } L_2 = \frac{L_2}{R_2} \times R_1,$$

where R₁ is the pre-operative absolute value for the right lung, R₂ is the post-operative absolute value for the right lung, and L₂ is the post-operative absolute value for the left lung.

This calculation is carried out separately for the oxygen uptake, the minute-ventilation, and the vital capacity.

The percentage loss of function of the left lung is then

$$\frac{L_1 - \text{"Corrected" } L_2}{L_1} \times 100,$$

the result giving an easily recognizable estimate of the amount of function that the individual lung has lost from the procedure.

I am not aware of results being previously reported in this way, but it has obvious advantages, and, further, allows the loss per segment removed to be calculated.

Table VII shows the loss of function per segment removed. This is expressed as a percentage of the pre-operative function of the operated lung (100%). For the compilation of Table VII the total percentage loss of function in the lung is divided by the number of segments removed. For these purposes anything less than a segment was counted as 0.5, the apical lower as 1.5, and the left apico-posterior as one segment. In the intact lung this gives 10.5 segments on the right and 9.5 on the left, so that each segment is contributing

approximately 10% of the function of one lung. The results given in Table VII are thus very satisfactory, as the loss of oxygen uptake is much less than that figure and the ventilation only slightly more. The loss of vital capacity is somewhat greater, but this may be largely accounted for by the early stage in the post-operative period at which the tests were done, and the already-mentioned improvement in diaphragmatic movement in many cases in the ensuing months would suggest that the vital capacity would improve with time.

TABLE VII.—Percentage Loss of Lung Function Per Segment Removed. Standard Deviations are Given in Parentheses

Oxygen uptake ..	-7.13% (17.3); range -26 to +14
Minute-ventilation ..	-10.8% (27.2); " -40 " +10
Vital capacity ..	-17.5% (20.0); " -35 " +22

It should be remembered that the actual disease in the segment had caused a small loss of function from the average normal figure, and this would tend to reduce the loss demonstrated after removal of that portion of the lung.

The higher standard deviations in Table VII are largely due to the fact that the length of the scale in use has been doubled as compared with previous tables (previous tables 0-50%, this table 0-100%).

This method of presenting the results throws markedly into prominence losses that are not at all conspicuous in the standard method of presentation.

An average good result is illustrated by the following case.

A woman aged 26 had cavitated disease in the apical segment of the right lower lobe. Bronchography showed bronchiectasis of the segmental bronchus, and at thoracotomy the segment was found to be collapsed and fibrosed, with a caseous lesion. Fig. 1 shows the traces taken at bronchspirometry and the results obtained.

These figures show a moderate pre-operative decrease in function (6-9%) due to the destruction of the segment. This is followed by an increase in the maximum breathing capacity and a very small further loss of function (1-2%) when expressed in the usual way. For this single and functionless segment (counting as 1.5) the percentages of loss of the functions of the right lung were 4.3, 4.0, and 2.7 respectively.

FIG. 1.—Example of average good functional result after segmental resection. Bronchspirometry traces and results before and after segmental resection.

Discussion

The pneumothorax cases are not the most satisfactory series as a basis for comparison, but this is a difficulty commonly met with. As Gaensler, Watson, and Patton (1953) point out, the really successful cases of re-expanded pneumothorax are not hospitalized and are unlikely to be accessible for study, while most of the cases still connected with hospitals are in some way complicated. It should be clearly realized that the cases in this group are ideal pneumothoraces and by no means represent the average result in the past. They are intended to give only an indication of the loss of function that may be expected from a pneumothorax induced at the present time with the advantages of antituberculous drug therapy, and they do not give any indication of the state of affairs to date. Gaensler *et al.* (1953) found that in 62 patients who had at one time had a therapeutic pneumothorax the re-expanded lung contributed on the average only 30% of the total oxygen uptake. They also found, as encountered in the 62 cases in this study, that many of these cases were complicated in various ways and the average was produced from a great variety of results. The 16 cases were selected to avoid this difficulty as much as possible. The comparison of them with the resection cases is admittedly open to criticism, but it is suggested they do provide some yardstick on which to judge the functional results following surgery.

TABLE VIII.—Percentage Loss of Function Below Normal Values. Mean Values. Standard Deviations are Given in Parentheses

	M.B.C. (l./min.)	Oxygen Uptake	Ventilation	Vital Capacity
Ideal pneumothorax (16 cases)	106.6	-10.86 (6.2)	-7.46 (5.9)	-8.3 (5.45)
Segmental lesion (27 cases)	—	-4.98 (4.9)	-3.42 (5.7)	-2.8 (4.73)
Segmental resection (27 cases)	120	-8.1 (4.7)	-5.6 (5.75)	-8.75 (5.5)

Table VIII gathers together the results shown in Tables I, II, and V for ease of comparison. These results are diagrammatically presented in Fig. 2, where the average normal value is taken as 50%. The numbers on top of the columns state the loss from this value.

The maximum breathing capacity is somewhat lower in the pneumothorax group than in the segmental resection group, though these groups are well matched with respect

FIG. 2.—Percentage of total function compared with average normal figures. The second and third blocks refer to the segmental series. The distance separating the tops of the columns from the average normal line represents the reduction in function. The loss following operation is very small.

to age and sex. In the pneumothorax group the slightly greater loss of oxygen uptake than ventilation and vital capacity suggests that pleural factors are of importance even in this group without definite pleural complications. It can be seen that the deviation of the function from the average normal value is slightly less in the cases subjected to segmental resection than in the pneumothorax cases. Thus, from the point of view of function segmental resection is rather preferable to the best that has been offered with pneumothorax treatment. This is emphasized when it is remembered that the loss of function due to contralateral disease is concealing some of the loss due to the pneumothorax. It is not intended to discuss at any length the more general aspects of the merits of these treatments, but it is relevant to mention that in 96% of the cases in this series of resections actual caseous disease was still present after many months of antituberculous drug therapy. Such caseation must remain a constant menace to the health of the patient and is surely better removed if this can be done with safety.

Really prolonged drug treatment appears to reduce the number of such cases in which tubercle bacilli can be cultured from the residual caseous lesions, and if these findings are further substantiated the attitude to resection will obviously need modification.

In assessing cases before surgery, when radiological stability has been achieved after some months of antituberculous drug therapy, it has been possible, using all previous radiographs, two-plane tomography, and bronchography, to come to an accurate estimate of the extent of the disease. In the present cases the assessment made at thoracotomy was identical with that made before operation. This experience is, with very few exceptions, borne out by large numbers of patients at Sully Hospital and is contrary to the findings of Logan (1955), who reported that the correlation was good in only slightly more than 50% and fair or poor in the rest. In our cases bronchography with watery propylidone ("dionosyl") has proved a safe procedure, and in many hundreds of cases there have been none of the unfortunate experiences of the type recorded by Perry (1955) with oily media. In this series the cases in which bronchiectasis of the segmental bronchus was present have invariably had a contracted and fibrosed segment with little or no function. In those cases where the bronchi were either normal or the changes were limited to the subsegmental level, the segment was predominantly well aerated, of approximately normal volume, and there was little loss of function. Our experience is thus, in general, in agreement with that of Shaw, Collins, and MacNamara (1954) on the value of bronchography in the segmental localization of tuberculous disease.

In the series as a whole, before operation (Table II and Fig. 2) there were small losses of function due to the disease. In these the oxygen uptake was slightly more affected than the ventilation and vital capacity, a fact which would suggest a slight pleural factor but is more likely to be due to the small amount of bronchiectasis. This is confirmed by the observation that in the individual cases with segmental collapse there was a tendency for the oxygen uptake to be more affected than usual.

The studies following segmental resection could with profit have been postponed to a later date, but for the administrative reasons mentioned this was not possible. At the stage of eight weeks after thoracotomy it is unlikely that the chest wall has returned to its maximum mobility, and the observations made on the movements of the diaphragm show that at this stage it is impaired to some degree in nearly 60% of cases, but that in all it improves over a period of months and in 78% it returns to the normal excursion. This impairment of function probably accounts for the small drop (-4.8%) in the maximum breathing capacity and for much of the loss of vital capacity on the operated side.

The results of the differential function studies following resection recorded in Tables V and VI and Fig. 2 show a small loss of function which is similar to that recorded for

small numbers of segments by Taylor, Petter, and Whittenberger (1955), using the same methods of presentation.

These losses are somewhat less than those described by Gaensler *et al.* (1953) after resection of one or two segments. They also fail to show any striking excess of loss of oxygen uptake over ventilation, a finding which the work of Gaensler *et al.* (1953) prompted them to suggest that much of the loss of function following segmental resection was due not so much to decrease of functioning lung tissue as to post-operative haemothorax, parietal pleural fixation, and eventual fibrothorax. The figures presented here do not support this contention, and suggest that the great part of the loss of function is due to removal of lung tissue. It is felt that the careful technique (Thompson *et al.*, 1954) aimed at the early and complete re-expansion of the lung and the avoidance of the accumulation of any fluid in the chest is of the greatest importance in achieving this result.

It is apparent that the usual method of presenting the function of one lung as a percentage of the total function, while being useful in isolated studies, has in follow-up studies the disadvantage of obscuring changes that have taken place in the only lung which has been subjected to procedures likely to change the function. It is surprising that the method described here has not been used in previous reports on function following surgery. While the mathematics involved in bronchspirometry results are of the simplest, they are not always so regarded by those not familiar with them, and one is therefore reluctant to introduce a different method of presentation. However, the calculation of the change in function of the actual lung under consideration is not only a more useful but also a simpler and more easily understood concept. This enables (Table VII) the actual percentage loss of the lung per segment removed to be calculated. The results so obtained have been shown to be of a very reasonable order, particularly as in 63% of the cases the lung tissue was predominantly aerated and functioning.

The losses from segmental resection are similar to those reported for extrapleural pneumothorax (Gaensler and Strieder, 1950) and for five-rib thoracoplasty (Lindahl, 1954).

In this study the rather wide scatter of the results as indicated by the high standard deviation and range is a matter of some concern. Other reports do not include estimations of the standard deviation, but Taylor *et al.* (1955) give their range of values, and these appear to be much the same as those observed in the present study. Such scatter would appear to be inevitable in this type of biometric work.

Summary

From 62 cases of old pneumothorax studied, 16 (about 25%) were chosen as being "ideal" and the functional results analysed; 10 of these also had contralateral disease.

Twenty-seven cases with localized tuberculosis were studied before and after segmental resection. Physical signs, fluoroscopy, maximum breathing capacity, and differential lung function were investigated in the early post-operative period (8.7 weeks average).

In the "ideal" pneumothorax series the average loss of function was a little greater than that due to segmental resection.

In the segmental series the loss of function due to the disease was small, and in 63% of cases the segment was predominantly well aerated. The bronchographic appearances were closely related to these findings.

After operation there was often limitation of the movement of the diaphragm, but this almost invariably improved in later months.

The loss of function after resection was small. A method of expressing this as a percentage of the initial function of the operated lung is described and the per-

centage loss per segment is calculated. This demonstrates that the loss is of the order to be expected from the removal of the lung tissue alone.

The extent of the disease can almost invariably be accurately assessed by study of all previous radiographs, two-plane tomography, and bronchography.

Thanks are due to the patients whose willing co-operation has made this study possible and to the consultant staff of Sully Hospital for permission to investigate patients under their care. I thank Dr. L. R. West, who constructed the excellent equipment used and whose practical assistance has been invaluable.

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TOTAL COLECTOMY AND ILEO-RECTAL ANASTOMOSIS IN DIFFUSE ULCERATIVE COLITIS

BY

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In view of the increasing incidence of surgery in the treatment of ulcerative colitis it seems an appropriate time to record the results achieved by total excision of the colon and restoration of continuity by ileo-rectal anastomosis. The results reported in this paper are those of a consecutive series of 47 cases of the diffuse disease involving the colon and the rectum treated by this method since 1951. Before operation every patient had been under experienced medical treatment, and surgery was undertaken only because this had failed to arrest the progress of the disease. On some desperately ill patients operation was performed as an emergency life-saving measure.

The concept of the preservation of the rectum in all except the very rare case, so that a normal route of evacuation may be established, has been referred to previously (Aylett, 1954, 1955). It can only be justified if it can be shown that: (a) the procedure can be carried out with low mortality and low post-operative morbidity; (b) the large majority of the patients return to full health and full economic ability and that the number of bowel actions, increased as a result of the excision of the colon, interferes little if at all with their lives; (c) the inflammatory changes in the rectum resolve in most cases; and (d) should the disease persist or recur in the remaining rectum to an extent sufficient to endanger health an ileostomy can be established and the rectum removed without risk.