OUT-PATIENT TREATMENT OF TUBERCULOSIS

A Study of 604 cases in
which Artificial Pneumothorax
treatment was attempted.

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PREFACE.

A scheme, whereby selected cases of pulmonary tuberculosis are treated primarily as outpatients, has been in operation in Glasgow since 1943. This scheme is still in operation, although modified during the years by changing conditions in the Tuberculosis Service and by new techniques.

No assessment of the scope and value of this scheme has been made except for a brief review of the short-term results of the first 150 cases. This was published by Maclean and Gemmill in 1948.

There have been, as far as I am aware, only three similar schemes reported in English. One by Toussaint in London was begun in 1946, another by Heller was begun in 1945, and the third by Rist in America was begun in 1944. No scheme was exactly similar to this one and, in fact, there were considerable differences. Reference to these will be made later.

It seems to me important that the results of treatment under this scheme should be collected and assessed. There are four main reasons for this opinion.

Firstly: This was an important contribution toward the easing of the problem of the waiting list in Glasgow.

Secondly: Although the waiting list for treatment in hospital is very much reduced, there is still a considerable demand for beds to be saved where possible.

Thirdly: A not inconsiderable number of patients request out-patient treatment rather than treatment in hospital.

Fourthly: The importance of pneumothorax as a method of treatment has been greatly reduced, although from conversation with colleagues here and outside Glasgow, I think it has recently returned to favour again to a certain extent. It is hoped that this study will help to evaluate the use of artificial pneumothorax, especially under out-patient conditions.

I am indebted to Mr. R.S. Barclay, Ruchill and Mearnskirk Hospitals and to Dr. T. Anderson, Reader in Infectious diseases at the University of Glasgow, for their encouragement in the early stages of the study. My colleagues in the Chest Clinic Service made the records of their patients

freely available. Mr. A.R. Roddick of the Central Tuberculosis Administration assisted me greatly in the collection of information and Miss A.F. Christie typed the manuscript. To all these, I offer my thanks.

INTRODUCTION

In the years immediately preceding the Second World War, the notification rate of Pulmonary Tuberculosis in Glasgow continued to fall, reaching by 1939 a record low figure of 1.440 per 1000 of the population. In 1938, the death rate per 1000 of the population had fallen to 0.851; hospital beds available for the treatment of all forms of tuberculosis had risen to 1725, and the number of pulmonary cases on the register was 5713. There was no real waiting list for hospital treatment. Cases normally requiring hospitalisation were admitted within a week or two of being placed on the appropriate list. (See TABLE 1).

The outbreak of war in September 1939 brought this state of affairs to an end. Evacuation of hospitals for emergency purposes reduced the number of beds available to 1374 and, as a result, a real waiting list began to accumulate, reaching 127 by the end of that year. During the two years 1941 and 1942, hospital beds were gradually restored and 1791 were available by the end of 1942. Unfortunately, during this period, there had been an increase in the notification rate to 2.128, and many more cases

TABLE I

STATE OF TUBERCULOSIS IN GLASGOW

1938-49

Year	Notification Rate per 1000	Death Rate per 1000	Beds Available	Waiting List	On Register
1938	1.599	.851	1725	?	5713
1939	1.440	.700	1374	127	5735
1940	1.749	1.17	1588	107	5600
1941	1.892	1.105	1650	261	5659
1942	2.128	1.054	1791	405	5691
1943	2.544	1.013	1921	743	6795
1944	2.527	1.080	1972	1034	7776
1945	2.420	1.033	1761	1092	8782
1946	2.575	1.102	1526	1058	9421
1947	2.535	1.066	1646	1208	10023
1948	2.545	1.142	1745	1500	10169
1949	2.595	1.028	1704	1429	10328

"Beds Available" and "Waiting List" figures include both Pulmonary and Non-Pulmonary.
"Notification" divided into men and women.

required hospital treatment. The waiting list rose to 405, and this inevitably meant a delay of several months before admission took place. No scheme of allowances for Tuberculous persons existed at that time, and very great difficulty was experienced in persuading patients to stop work so that they could rest at home during the waiting period. It became obvious that many patients were deteriorating badly while waiting, especially those in the younger age group with less extensively involved lungs. Discussion then took place between the clinic and hospital members of the Medical Officer of Health's Tuberculosis Staff, with a view to devising some scheme to help overcome this problem.

Of the various methods of treatment then available, pride of place belonged to "Rest in Bed". Next most frequently employed, in this City at least, was Artificial Pneumothorax. This measure, first introduced into Britain by Lillingston in 1910, achieved wide popularity. It was enthusiastically and indiscriminately employed in the inter-war period all over the Country. In Glasgow, considerable experience in the maintenance of pneumothoraces in patients discharged from hospital, had been gained. A pneumothorax refill centre for the City and certain county areas had been established

at the Auxiliary Hospital, 35 Baird Street, which catered for ex-hospital patients. It seemed that use could be made of this centre to develop a scheme for out-patient treatment which could be fitted into the existing Tuberculosis Service.

The Tuberculosis Service was then the responsibility of the Local Health Authority, and organised by the Medical Officer of Health. One of his senior assistants, the late Dr. Stuart Laidlaw, was responsible for the administration of five city clinics, one for each Public Health division of the City, and a Tuberculosis Physician was in charge of each divisional clinic. Junior physicians were available to assist in clinics as required.

The Medical Officer of Health was also responsible for hospital beds in Sanatoria and other Local Authority Hospitals, and his Senior Assistant acted as co-ordinator of hospitals and clinic services.

Patients were transferred from one clinic to another if their address changed from one area to another. This meant that there could be a serious lack of continuity of control. Each clinic had its own weekly refill session at Baird Street Hospital so that alteration in parent clinic meant alteration also in refill clinic, and in the physician in charge of the case.

It was upon this framework that the outpatient treatment plan was built.

The scheme adopted provided for the establishment of four beds at Baird Street Hospital to which selected patients were admitted for the purpose of artificial pneumothorax induction. Admission took place in the morning. Induction was attempted later the same day. If a free space was found, and air introduced, refills were given on the two following days under fluoroscopic control. Patients were then taken home by ambulance and instructed to continue to rest at home. General Tonic measures - e.g., Cod Liver Oil and Iron - were prescribed, and they were given an appointment to attend the next normal refill session associated with their parent clinic, and conducted by the clinic physician. It was realised that a definite morbidity was associated with the use of Artificial Pneumothorax, and arrangements were made for priority admission to hospital, should induction fail or a serious complication arise. Arrangements were also made for thoracoscopy to be carried out in Ruchill Hospital. Patients were admitted after consultation between the Hospital Staff and the clinic physician concerned.

In general, patients were recommended for this scheme by their clinic physician, and each case was

considered by a panel consisting of all clinic physicians under the Chairmanship of the Senior Assistant Medical Officer of Health in charge of Tuberculosis Services. At first, Dr. Stuart Laidlaw, then Assistant Medical Officer of Health, was in charge and latterly, the late Dr. Alexander Maclean. Patients were all supposed to be in good general condition and to have small unilateral lesions, of a nature expected to respond to collapse therapy. Soon after the scheme started, however, these conditions were relaxed.

The notification rate in Glasgow continued to rise and reached 2.575 per 1000 in 1946. With the end of the war emergency and the call-up of nurses, a shortage of nurses ensued and beds available dropped to 1526 in 1946. The number of cases on the register continued to rise steadily to 9421, and the waiting list rose to over 1000. Table 1 gives details of these changes.

Because more new cases were being diagnosed, and the register growing in size, there was an increased demand for treatment which was aggravated by the drop in hospital facilities available. Almost inevitably less suitable types of cases began to creep in. Some were patients who, while under treatment by Artificial Pneumothorax for disease in one lung, were found to have

new or reactivated disease in the other lung. Others had much more extensive disease than was envisaged as suitable in the original scheme, and home conditions continued to be very poor in a large proportion of cases.

In the past 20 years ideas about treatment of pulmonary tuberculosis have been undergoing modification. The predominant position of Artificial Pneumothorax has been under attack since the middle 1930's. It had become obvious that there were many and serious drawbacks to this form of treatment. The indiscriminate application of the procedure left behind a train of Tuberculous Empyemata, Broncho-pleural fistulae, unexpandable lungs and other sequelae before it became generally recognised that thick-walled cavities, acute pneumonic disease, tracheo-bronchial disease and chronic phthisis were among the contra-indications.

Other methods of treatment were becoming more prominent in our ideas, noticably phrenic nerve interruption, either alone or combined, since 1933, with pneumo-peritoneum. In the realms of surgery, the greatest advance was the introduction in 1935, by Carl Semb of Norway, of the technique of extrafascial apicolysis in thoracoplasty. This greatly enhanced the value of the operation which remained, however, a

mutilating one. Still, Artificial Pneumothorax was the method considered in 1943 most suitable for outpatient purposes.

Streptomycin became freely available here in 1949 followed quickly by Para-amino Salicylic Acid. As a result of experience with these drugs, and with Isoniazid, many more cases which were originally of an extensive nature, have become suitable for definitive medical or surgical measures, and the whole scope of treatment has been greatly broadened. There is no doubt that surgery is much more commonly employed now than previously, either after preliminary chemotherapy or preliminary chemotherapy plus medical collapse measures.

This survey ends in 1949, before Streptomycin and Para-amino Salicylic Acid were administered routinely. I thought it best to end there for three reasons. Firstly, it gives a reasonably long follow up. Secondly, I could only have included a small number of cases treated by Streptomycin according to modern standards, and even these would have had a very limited follow up. And thirdly, if the results of treatment under this scheme are found to be good, they ought to be very much better given chemotherapy as a

preliminary or as partial "Cover".

One final point. From Table 1 it can be seen that the death rate and waiting list reached their peak in 1948. During the year clinical impressions to this effect gathered and culminated in a "drive" to treat these cases as outpatients. As will be seen later, 1948 and 1949 provide many more cases of Pneumothorax than other years for this reason.

CHAPTER 1

SOCIAL AND MEDICAL DESCRIPTION OF CASES SELECTED FOR OUT-PATIENT TREATMENT.

CHAPTER 1

SOCIAL DESCRIPTION OF CASES ACCEPTED FOR TREATMENT

Between June 1943 and September 1949, 594 patients were admitted to Baird Street Hospital on 603 occasions, in order to have the induction of an Artificial Pneumothorax attempted. In addition, one patient had his contra-lateral Artificial Pneumothorax induced in London, returning to Glasgow almost immediately thereafter for refills and supervision. For the sake of completeness, this case is included in the series. (See TABLE 2).

Table 2 shows the yearly totals subdivided into males and females. The percentage of men in the total declined from 43.1 in 1943 to 25.3 in 1948, but it increased sharply in 1949 to 37.9.

The ages of patients accepted for treatment ranged from 13 to 53 with an average of 25. 64.3% of women were between the ages of 15 and 25, and 54.5% of men were between these ages.

In Table 3 the yearly figures are further broken down into age-groups, with the average age each year calculated. This indicates that the average age of male cases is higher than that of females, and Table 4

TABLE 2

PATIENTS ADMITTED TO BAIRD STREET

EACH YEAR OF STUDY

	1943	1944	1945	1946	1947	1948	1949	Total
Men	31	50	23	12	15	20	69	220
Women	41	67	36	55	13	59	113	384
Total	72	117	59	67	28	79	182	604
% Men in Total	43.1	42.7	39.7	17.6	53.6	25.3	37.9	36.4

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TABLE 3A

PATIENTS ACCEPTED IN THE SCHEME ACCORDING TO YEAR AND AGE GROUP

M A L E

Age Group	1943	1944	1945	1946	1947	1948	1949	Total
Under 15	1	-	-	-	-	-	-	1
15 - 20	10	19	10	5	1	1	10	56
20 - 25	13	13	6	3	5	7	17	64
25 - 30	1	5	4	1	4	2	11	28
30 - 40	5	10	3	3	4	10	19	54
Over 40	1	3	-	-	1	-	12	17
	31	50	23	12	15	20	69	220
Av. Age	23.5	24.8	22.8	24.	28.2	29.0	29.6	26.7

TABLE 3B

PATIENTS ACCEPTED IN THE SCHEME ACCORDING TO YEAR AND AGE GROUP

F E M A L E

Age Group	1943	1944	1945	1946	1947	1948	1949	Total
Under 15	-	2	2	2	-	1	2	9
15 - 20	15	17	7	24	2	15	26	106
20 - 25	18	26	14	16	4	25	38	141
25 - 30	2	12	9	6	2	6	22	59
30 - 40	6	9	4	7	5	12	20	63
Over 40	-	1	-	-	-	-	5	6
	41	67	36	55	13	59	113	384
Av. Age	22.7	23.9	23.4	22.1	27.3	24.1	25.3	24.

shows that this difference is especially marked in cases over 30 years old.

TABLE 4

PERCENTAGE OF CASES OVER 30 YEARS OLD.

	1943	1944	1945	1946	1947	1948	1949	Average
MEN	19.4	26	13.0	25.0	33.3	50.0	44.9	32.3
WOMEN	14.6	14.9	11.4	12.5	38.5	20.3	22.1	17.9

The proportion of women over 30 selected for out-patient treatment increased slightly over the years.

The proportion of men over 30 increased considerably and this, with the decline in the percentage of men accepted for treatment, illustrates the fact that men are more often first diagnosed in older age groups than women, and therefore tend to be considered less suitable cases for inclusion in such a scheme as this.

OCCUPATION OF PATIENTS

As would be expected in Glasgow, the proportion of heavy manual workers in both sexes was high as shown in Table 5.

In order to obtain a true picture of the variation in the occupational pattern as regards manual work during the survey, Table 6 subdivides the occupation according to the year in which pneumothorax was attempted.

In the case of patients who had bilateral A.P. attempted, the occupation on the second occasion is classed as "other".

The percentage of women doing heavy manual work declined sharply from 34.1 in 1943 to 8.7 in 1949. During this time, the percentage of Housewives rose from 17.7 to 37.4. This was undoubtedly due to the finish of war and transition to more normal modes of living.

The proportion of heavy workers among men decreased steadily as the number of light workers rose due to the re-starting of lighter industries after the war.

The percentage of manual workers among female patients was on the whole, considerably lower than among men, 162 women or 46% being classed as manual workers against 134 or 61% of men.

TABLE 5

OCCUPATION OF PATIENTS SELECTED FOR TREATMENT.

	Manual		Clerical & Professional	Other	Total
	Heavy	Light			
MEN	64	70	26	60	220
%	29.1	31.8	11.8	27.3	100.0
WOMEN	62	219*	69	34	384
%	16.2	57.0*	17.9	8.9	100.0
TOTAL	126	289	95	94	604
%	20.9	47.8	15.7	15.6	100.0

Unemployed Men - 24. Women Unemployed - 21

* Includes 119 Housewives (31%).

TABLE 6.

CLASS OF WORK COMPARED ACCORDING TO YEAR OF TREATMENT

W O M E N

	1943	1944	1945	1946	1947	1948	1949	Total
Heavy Work	14 34.1%	16 24%	9 25%	5 9.1%	1 8.3%	7 11.9%	10 8.7%	62 16.2%
Light Work	9 21.9%	13 19.4%	9 22.2%	21 40%	1 8.3%	17 28.8%	30 26.1%	100 26.0%
House Wives	7 17.7%	21 29.9%	10 27.8%	16 29.1%	4 33.3%	18 30.5%	43 37.4%	119 31%
	M E N							
Heavy Work	10 33.3%	15 30.6%	7 30.4%	3 25%	3 18.8%	5 26.2%	21 28.8%	64 28.8%
Light Work	7 23.3%	12 24.5%	6 26.1%	3 25%	6 37.5%	9 47.3%	27 36.9%	70 31.5%

FAMILY STATUS

TABLE 7

	MEN	WOMEN	TOTAL
MAINSTAY	92 (41.8%)	32 (8.3%)	124 (20.6%)
AUXILIARY EARNER.	103 (46.8%)	193 (50.3%)	296 (49.1%)
SUPPORTED (Non-wage earners)	25 (11.4%)	158 (41.1%)	183 (30.3%)
TOTAL	220	383*	603

* 1 Case states unknown.

As would be expected, a much higher proportion of men patients were the main support of their families than in the case of the women patients, and many more women were supported than men. 31% of all female patients were housewives however, and although some of these undoubtedly were wage-earners, probably the large majority worked at home. The number of women who were unemployed for medical or other reason was 21, and 24 men were similarly unemployed.

HOUSING CONDITIONS

Of the 604 cases admitted for induction, 324 were required to share a room at this time, and also during the first few months at least, of treatment. As can be seen from Table 8 a higher proportion of female patients were overcrowded than of males.

In general male patients enjoyed better housing standards than women throughout the period of the study.

Medical Description of Cases selected for Treatment.

I shall now consider the assessed duration of the disease for which treatment was proposed, the extent of lung tissue involved, and the presence or absence of obvious cavitation.

Assessed Duration: This assessment was based on two lines of investigation, history and radiology. Points in the history of importance in this connection were significant past illness, onset of symptoms and history of contact.

Radiological appearances are more difficult. Soft fluffy shadows indicate recent disease, hard shadows indicate older disease, and where retraction of lung tissue was apparent, this indicated very old

TABLE 8

HOUSING CONDITION OF MEN AND WOMEN

SEX	BED SHARED	BED TO SELF	ROOM TO SELF
MALE	69 31.4%	39 17.7%	112 50.9%
FEMALE	149 40.4%	67 18.1%	153* 41.5%
TOTAL	218	106	265 45%

* 15 unknown.

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disease which had undergone fibrous shrinkage. Nevertheless it was only possible to divide lesions into "recent", (under 12 months) duration and "older", (over 12 months.) This division is shown in Table 9.

TABLE 9

DURATION OF DISEASE ACCORDING TO SEX.

	RECENT	OLDER	UNKNOWN	TOTAL
MALES	134	83	3	220
FEMALES	234	136	14	384
TOTAL	368	219	17	604

The percentage of recent disease in both sexes is the same - 60.9 - rather a remarkable co-incidence. If unknown cases are excluded from the total, the balance becomes slightly in favour of women - 61.8% men and 63.2% women.

In Table 10, these figures are broken down according to the year of commencement of treatment in order to compare cases from year to year.

It is now seen that in succeeding years there was a remarkably steady decline in the proportion of cases with disease classed as recent, and a corresponding relative increase in the number of cases with older disease.

TABLE 10

YEARLY DISTRIBUTION OF RECENT AND OLDER DISEASED CASES

	1943	1944	1945	1946	1947	1948	1949
Recent	56 79%	84 76%	44 79%	44 68%	16 57%	38 49%	86 48%
Older	15 21%	27 24%	12 21%	21 32%	12 43%	23 51%	51 52%

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The Extent and nature of the Disease:

Information available is not always as complete as desirable in case sheets, and unfortunately X-Ray films of the early cases are no longer available. Until 1951 X-Ray films were kept for 5 years and then destroyed. They were not, as a routine, collected and carried forward for each patient so that in many cases, original films could not be consulted. The extent and nature of disease were assessed on straight X-Ray films, usually a Postero-Anterior view only, but often additionally with an apical projection. Tomography was not commonly employed. The usual description followed the practice of dividing each lung field into three Zones, and because this is a convenient method of description, it will be followed here. These three zones are, (1) the area above a horizontal line at the level of the lower border of the 2nd costal cartilage, (2) the area below that line but above a line drawn at the level of the lower border of the 4th costal cartilage, and (3) the area below that line.

This method of description is commonly employed for purposes of comparison, and this is another reason for its use here.

460 patients with unilateral disease were considered for pneumothorax treatment with 142 whose disease was bilateral. 21 of the latter were already receiving pneumothorax treatment, 17 were induced in hospital and 4 were induced at Baird Street Hospital in this series. Table 11 divides these groups further, and relates them to the year of assessment with a view to illustrating the trend of ideas.

It is apparent that, as far as extent of disease is concerned, fewer extensively involved cases were accepted for treatment in the early years of the scheme than in the later years. This tendency to accept a more seriously involved patient is borne out by the raised percentage of cavitated cases from 1946 onward as shown in Table 12.

The probable reason for this lies in the continued rise in the number of patients awaiting hospital. Because of this, more and more pressure was brought to bear on clinic physicians to "do something", other than leaving the case lying at home. The only available method at their disposal was to attempt pneumothorax treatment as out-patients.

I have been unable to obtain sufficient information regarding the size of cavities present to justify any inclusion of this factor in the study. Many original X-Ray films are now destroyed and no

TABLE 11

EXTENT OF DISEASE RELATED TO YEAR OF ASSESSMENT

Year	Unilateral Disease			Bilateral Disease			Total Cases
	1 Zone	2-3 Zones	% 1 Zone Cases to Total	2-3 Zones	Over 4 Zones	% Bilateral Cases to Total	
1943	40	19	56	11	2	18	72
1944	57	44	49	13	3	14	117
1945	30	12	53	12	3	26	57 ✱
1946	33	16	49	13	5	27	67
1947	8	9	29	7	4	39	28
1948	26	33	33	14	6	25	79
1949	66	67	31	37	12	27	182
Totals	260	200	43.2	107	35	23.6	602

✱ In addition there were two cases of whom no details of the extent of the disease were available.

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TABLE 12

YEARLY NUMBER OF CAVITATED CASES AND PERCENTAGE OF TOTAL

CASES	YEAR							TOTAL
	1943	1944	1945	1946	1947	1948	1949	
NUMBER	25	61	28	46	21	54	120	355
PERCENTAGE OF TOTAL CASES EACH YEAR.	35	52	49	69	75	66	66	59

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detailed description of cavities is mentioned.

Summarising this chapter, I would say that 604 patients were accepted for out-patient pneumothorax treatment. The number of men was 220 or 36.3% and their average age 26.8 years. The average age of women was 24 years.

In both sexes the average age rose in the later years of the scheme but this was more marked in the case of men.

68.7% of patients (415) were manual workers but an increasing number of patients came from lighter occupations as the scheme progressed.

31% of Female cases were housewives.

20.6% of patients or 124 were the mainstay of their family, the remainder being either auxiliary wage earners or supported.

Only 265 or 45% of patients had a room to themselves.

The assessed age of the disease was regarded as "recent" in 61% of cases. A higher proportion of cases with older disease was accepted in the later years of the scheme.

In 76.4% of patients the disease was unilateral and in 43.2%, confined to one Zone. More extensively diseased patients were accepted in the later years of the scheme.

CHAPTER 2

THE ESTABLISHMENT AND MAINTENANCE OF THE PNEUMOTHORAX.

CHAPTER 2.

The procedure adopted was described by Maclean and Gemmill in 1948. I have already elaborated this description in the introduction and explained the method of selection.

Of the 604 cases admitted for induction, a pneumothorax was obtained in 512 or 84.8%. 180 of these were men - i.e. a success rate of 81.8% and 332 were women - a success rate of 86.5%.

This difference has no statistical significance, but nevertheless is perhaps not surprising in view of the older male age grouping.

In Table 13 the proportion of successful inductions each year is noted.

If the X^2 test for statistical significance is applied, it is found that P = 0.10. This suggests that the lowering of the percentage throughout the years has some significance.

The explanation lies in the type of case selected. In ninety-two cases, it was not possible to induce an artificial pneumothorax. Ninety of these could be grouped according to the original extent of the disease. Of these 33 were in Class I, 31 in Class II and 26 in Class III. If the number of failures in each class is expressed as a percentage of all cases in the class, it is found that more extensively diseased cases have a poorer

TABLE 13

SUCCESSFUL INDUCTIONS EACH YEAR

	1943	1944	1945	1946	1947	1948	1949
YEARLY TOTAL	65	105	48	61	20	65	148
PERCENTAGE	90	90	86	90	71	82	81

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chance of successful induction. (12.7% failures in Class I, 15.5% in Class II and 18.3% in Class III.)

In addition, cases selected for treatment showed an increase in severity over the years as already shown in Table 11, and this probably accounts for the lowering of the percentage of successful inductions in later years. It is interesting to note that in 1947, the proportion of patients with bilateral disease accepted for treatment was the highest of any year, and the percentage of pneumothoraces successfully induced was the lowest.

It has been mentioned that the percentages of cases with cavitation accepted for treatment rose over the years. A comparable rise in the percentages of cavitated cases among those successfully induced is shown in Table 14.

It does not appear, therefore, that cavitation exercised any influence in preventing the induction of a pneumothorax.

The number of cavitated cases considered for treatment was 355, and in 310 or 87% an artificial pneumothorax was successfully induced. Similarly there were 249 infiltrated cases and 202 or 81% were given a pneumothorax.

TABLE 14

PERCENTAGES OF CAVITATED CASES TO ALL CASES IN EACH YEAR.

	1943	1944	1945	1946	1947	1948	1949
PNEUMOTHORAX ATTEMPTED	35	52	49	69	75	66	66
PNEUMOTHORAX INDUCED	34	54	54	70	76	64	67

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Induction appears to have been uneventful in all the successful cases. There is no record of any complication attending these. In two of the unsuccessful attempts however, it is reported that a minor degree of air embolism accompanied the attempt. Both patients were promptly transferred to a tuberculosis hospital and recovered completely.

Thoracoscopy and Adhesion Section.

The section of pleural adhesions with the object of producing a lung anatomically free, and capable of concentric relaxation has been considered essential for satisfactory pneumothorax treatment for a number of years. It is not pertinent to this study to discuss the reasons for this, but many clinicians believe that thoracoscopy should be performed routinely in artificial pneumothorax treatment, so that a free lung can be obtained as frequently as possible. In this connection, Wright (1952) reviewed 301 thoracoscopies at Colindale Hospital. He found that a free pneumothorax was produced in 75%. In 13%, the pneumothorax was lost because of a complication of the operation.

Foster-Carter and others (1952) have produced evidence to show that the presence of adhesions is

less important than was thought. They emphasise that closure of cavities is the measure of an effective pneumothorax and not the presence or absence of adhesions.

In this scheme, patients in whose case adhesion section was considered desirable, were admitted to Ruchill or, later, Robroyston Hospitals after consultation between the Surgeon concerned and the physician in charge of the case. During 1948 and 1949, a few were admitted to Mearnskirk Hospital in a similar manner.

In all, 111 cases were admitted to hospital for this purpose. Two cases were admitted on two occasions each. Adhesions were completely cut in 12 cases and partly cut in 71. In all 83 (75%) pneumothoraces were classifiable as "Good" following the operation. The classification of pneumothoraces is discussed in the next section.

In retrospect, the difficulties experienced in securing admission to hospital for thoracoscopy appear almost incredible now. Yet, during the years 1948 to 1950, periods of from three to nine months elapsed between patients being accepted for thoracoscopy, and being admitted for that operation. Surgical facilities were very limited during the period of this survey.

Following thoracoscopy, ten cases developed complications. One patient whose adhesions were NOT cut developed an acute spread of disease in both lungs and died a year later. This was probably co-incidental and not a result of the proceedure. The other nine complicated cases all had adhesion section performed. One developed a spread of disease, but the pneumothorax was maintained for 2 years. This patient was well 4 years after cessation of treatment. In 8 cases, an effusion followed adhesion section. The pneumothorax had to be abandoned in 4 of these cases because the effusion was massive and persistent. Of these four, two were retained in hospital, and eventually became healed, one died 2 years later, and one required admission for further treatment after a similar time. The fluid quickly absorbed from the remaining 4 cases and the pneumothorax was continued in each. Unfortunately it recurred in one and she became a chronic case who eventually died.

The other three pursued a satisfactory course. In no case did an empyema supervene.

Classification of Pneumothoraces

It is now convenient to classify the pneumothoraces obtained, and I propose to adopt that used by Foster-Carter, Myers, Goddard, Young and Benjamin in the Brompton Hospital Report for 1952, with a

slight modification.

In that report, Artificial Pneumothorax was classified into three divisions

A. Satisfactory Pneumothoraces. In this division, the lung appeared free from adhesions either from the beginning of the pneumothorax, or after adhesion section. If cavitation was originally present, this had disappeared within one year from induction.

B. Adherent Satisfactory Pneumothoraces. In this division there were some adhesions over the diseased area, but cavitation was absent, or if present originally, had disappeared within one year from induction.

C. Adherent - Unsatisfactory Pneumothoraces. In this division adhesions and cavitation persisted, or an empyema developed within one year from induction of the pneumothorax.

With slight modification, this is the classification used in the study. It was preferred to a more detailed one for two reasons. Firstly it summarises the points upon which I think an artificial pneumothorax should be assessed, and secondly because the information necessary for classification of pneumothoraces in this way could be obtained easily from old case sheets, especially when early films were not available.

The modifications made were two in number. The first concerns cases where the original disease had not cavitated. In this case, if adhesions prevented reasonable relaxation of the diseased area, the pneumothorax was unsatisfactory.

The second modification applied to both cavitated and infiltrated cases. If atelectasis was greater than one lobe in extent, or, if of lesser degree persisted longer than one month, this was also classed as an unsatisfactory pneumothorax.

The 512 pneumothoraces obtained were classified as shown in Table 15. This classification was made at the end of one year of treatment, or at the date of termination of treatment whichever occurred first.

Because of the relatively small number of "Satisfactory" pneumothoraces, these cases have been grouped with the "Adherent - satisfactory" ones, and the combined division called "Good" pneumothoraces. In subsequent discussion this division into "good" and "unsatisfactory" cases will be used frequently.

It is apparent that 1947 and 1949 were two years in which the percentage of "good" Artificial Pneumothoraces obtained, is considerably below average level. In 1947, an unusually low number of patients received out-patient treatment, one reason for which may have been the extensive staff

TABLE 15

CLASSIFICATION OF PNEUMOTHORACES

	1943	1944	1945	1946	1947	1948	1949	
TOTAL A.P.s.	65	105	48	61	20	65	148	512
SATISFACTORY	7	13	13	20	4	9	27	93 ① 18.2%
ADHERENT - SATISFACTORY	37	56	22	28	7	38	60	248 48%
TOTAL GOOD A.P.s.	44 67.7%	69 66%	35 73%	48 79%	11 55%	47 71%	87 59%	341 66.6%
UNSATIS-FACTORY.	21	36	13	13	9	18	61	171

① includes one case still under treatment by Artificial Pneumothorax.

---oOo---

changes which occurred about that time. In 1948, a change of policy took place and it was decided to attempt pneumothorax treatment in as many cases as possible, in the hope that this could ease to some extent, the situation created by the limited hospital accommodation.

Therefore during the latter part of 1948 and in 1949, many more patients were included in this scheme than previously. During this time, the nature and extent of the disease in those accepted, did not differ much from the general pattern over the years. There was a definite increase in the number of cases with older disease however, which in general is less suitable for pneumothorax treatment than more recent lesions.

The combined number of 341 artificial pneumothoraces classified as "Good" contained 198 in whom the disease had cavitated originally, and 143 in whom cavitation had not been demonstrated. The number of pneumothoraces induced in cavitated cases was 307, which means that 64% could be made "Good." Similarly 205 infiltrated cases were successfully induced, and 143 or 70% were made "Good." The difference of 6% is less than twice the standard error and therefore not significant. In the Brompton Hospital series, 75% were classed as "satisfactory" and "adherent satisfactory."

The Duration of Pneumothorax Treatment

This varied from "less than three months" to 6 years. In the case of Good Pneumothoraces, the average duration was 23 months, with outside limits of 3 months and 6 years. The average duration of Unsatisfactory Pneumothoraces was 8 months with outside limits of 1 week and $3\frac{1}{2}$ years. Table 16 shows the duration of "Good" and "Unsatisfactory" pneumothoraces.

Although not shown in Table 17, the average duration of pneumothorax treatment in both cavitated and infiltrated cases was very similar.

The majority of unsatisfactory pneumothoraces were abandoned within six months of induction, and 85% were abandoned within one year. For various reasons, 25 were continued as being of therapeutic value.

The average duration in months, of artificial pneumothorax treatment according to the year of induction, is shown in Table 17.

From this table it may be seen that pneumothoraces induced in 1943, 1944 or 1945, tended to be maintained for a shorter period than in later years. It may be that the staff changes in 1947 to which reference has already been made, is responsible for this, at least in part.

TABLE 16

DURATION OF PNEUMOTHORAX.

Division of Pneumothoraces	Less than 6 months	6-12 months	12-18 months	18-24 months	24-30 months	30-36 months	Over 36 months
Good	16	91	58	56	33	42	45
Unsatis-factory.	122	24	10	7	1	3	4
Total	138	115	68	63	34	45	49

---oOo---

TABLE 17

DURATION IN MONTHS OF PNEUMOTHORACES ACCORDING TO YEAR OF INDUCTION.

	1943	1944	1945	1946	1947	1948	1949
GOOD	20.5	21	21	23	19.5	28	24
UNSATIS-FACTORY.	7	8	16	11	8	6	7

---oOo---

Cases induced in 1944 and 1945 would be in their third and second years of treatment respectively, at that time.

If this is so, it emphasises the desirability of continuity of management as stressed by Young (1949). Different clinical teams in the Glasgow Tuberculosis Service have had different ideas of the duration of treatment, although in general, there has been considerable unanimity of opinion regarding management. Table 18 shows the average duration of pneumothoraces in the study, divided according to the team responsible for the decision to end treatment.

TABLE 18

Duration in months of pneumothoraces

	TEAM 1	TEAM 2	TEAM 3	TEAM 4	TEAM 5
Good	24	23	19	22	24
Unsatis-factory	8	7	6	8	11

Complications of Treatment

These occurred in 35.5% of Good Pneumothoraces and in 57.3% of Unsatisfactory pneumothoraces. Before being considered they had to be present to such an extent as to interfere seriously, either with the course of treatment, or with the progress of the patient. Minor degrees of complication not having

this effect were not considered. The following complications were most commonly encountered.

Tuberculous Empyema

Spontaneous Pneumothorax

Major Effusion complicating the pneumothorax

Spread of disease in the contralateral lung.

These, and some others less commonly encountered, will be discussed in this section.

No case of diabetes was diagnosed in a patient receiving treatment under this scheme, nor was any known case treated by purely out-patient measures. One patient completed pneumothorax treatment and was being considered for work when he was found to be a diabetic sufferer.

Many patients exhibited more than one complication and the absolute incidence of these is shown in Table 19.

Empyema and Spontaneous Pneumothorax I regard as the most serious complications, the former on its own behalf, the latter because it is so frequently the beginning of serious complications. Eight Empyemata occurred during treatment - all tuberculous in nature and yielding pus. This is a low figure compared with that occurring in other surveys. For example Scadding Nicholson and Hoyle (1951) had eight cases in their series of 50 patients. Foster Carter

TABLE 19

Absolute incidence of

Complications

	Good A.P.s	Unsatisfactory A.P.s	TOTAL
EMPYEMA	1	7	8
SPONTANEOUS PNEUMOTHORAX	11	7	18
MAJOR EFFUSION	65	54	119
SPREAD OF DISEASE	57	38	95
OTHER MAJOR COMPLICATIONS	8	6	14

and others (1952) reported 75 cases in their series of 447 patients.

In this series, two cases followed Spontaneous Pneumothorax and the other six, followed an effusion during treatment. Spontaneous Pneumothorax occurred 18 times. As mentioned, it was followed by Empyema in two cases. Of the remaining 16, five had a major effusion, 8 experienced further spread of the disease and only three seemed to recover without incident.

"A Major Effusion" was one in which the fluid extended above the level of the dome of the diaphragm, and either lasted more than one month or necessitated the abandonment of the pneumothorax. This occurred in 119 cases but in 5 was associated with Spontaneous Pneumothorax so that 114 cases exhibited this as the main complication. The 6 cases which developed empyemata are excluded.

Next in order of importance is considered "Spread of Disease". This refers to the contralateral lung, and indicates either new tuberculosis there, or a reactivation of known disease there. This occurred in 95 cases but 26 of these had a more major complication also. 69 cases showed "Spread of Disease" as the main complication.

The time ofoccurrence of these two complications was quite different, effusion occurring rather earlier in the pneumothorax than contralateral spread.

Table 20 illustrates this.

In both classes of pneumothorax, Effusion tended to occur early, but especially so in the unsatisfactory class, where the maximum occurrence was quite definitely within the first six months. Contralateral spread was most marked in the 12-24 months period in both classes, the greater incidence occurring during the first half of that period.

The other major complications are listed in Table 21.

"Air Embolism" - which had no serious after effects - and "Tuberculous Kidney", were associated with other major complications occurring previously. Each of the remaining 12 listed in Table 21 was the major complication of the pneumothorax with which it occurred. In all cases except "Severe Haemoptysis", the pneumothorax had to be abandoned.

Table 22 lists the major complications according to the principal one occurring in each case. They are also subdivided into cases occurring in "Good Pneumothoraces" and those in "Unsatisfactory Pneumothoraces". The percentages are those of all "Good Pneumothoraces" and all "Unsatisfactory Pneumothoraces" respectively. The complication rate is 21.8% higher in the latter than in the good pneumothoraces.

TABLE 20

TIME OF OCCURRENCE OF COMPLICATION

DURATION OF A.P.	CLASS OF PNEUMOTHORAX					
	GOOD			UNSATISFACTORY		
	No. of A.P.s	No. of Effusions	No. of Spreads	No. of A.P.s	No. of Effusions	No. of Spreads
Under 6/12	341	26 8%	11 3%	171	40 34%	18 11%
6-12 months	325	20 6%	14 4%	49	10 20%	10 20%
12-24 months	234	12 5%	23 10%	25	4 16%	9 36%
24-36 months	120	5 4%	7 6%	8	0	1 12.5%
Over 36 months	45	2 4%	2 4%	4	0	0

TABLE 21

OTHER MAJOR COMPLICATIONS

DESCRIPTION	NUMBER IN GOOD A.P.s	NO. IN UNSATIS-FACTORY A.P.s	TOTAL
ACUTE RESPIRATORY INFECTION	3	-	3
ACUTE NEPHRITIS	1	1	2
ACUTE MENTAL UPSET	2	-	2
SEVERE ASTHMATIC SPASMS	-	1	1
SEVERE HAEMOPTYSIS	1	-	1
AIR EMBOLISM	1	-	1
REFUSED THORACOSCOPY SO A.P. ABANDONED	-	1	1
OTHER TUB. LESION - MULTIPLE, KIDNEY, ABDOMEN	-	3	3
	8	6	14

TABLE 22

MAIN COMPLICATIONS IN EACH CASE

COMPLICATION	IN GOOD A.P.s (341)		IN UNSATISFACTORY A.P.s (171)		ALL A.P.s (512)
	FREQUENCY	RATE	FREQUENCY	RATE	
EMPYEMA	1	0.3%	7	43%	8
S.P.T.	9	2.6%	7	4%	16
MAJOR EFFUSION	62	18%	52	36%	114
SPREAD OF DISEASE.	42	12.3%	27	16%	69
ACUTE RESP. ILLNESS	3	0.9%	-	-	3
OTHER	4	1.2%	5	3%	9
TOTAL NO. OF COMPLICATED A.P.s.	121	35.5%	98	57.3%	219

S.P.T. - Spontaneous Pneumothorax.

82 or nearly half of Unsatisfactory Pneumothoraces were abandoned within 3 months, and 148 within a year. This is undoubtedly the reason why the complication rate in this group is not very much higher still.

I wish now to discuss the course of pneumothoraces with reference to complications in more detail, and those classified as "Good" will be considered first.

Complications in Good Pneumothoraces.

The sex of the patient does not appear to have any bearing on the complication rate. Of the 121 cases with a complication, 39 or 36% were in men and 82 or 35.2% were in women. This similarity was reflected in the rates of the two most frequent complications - "spread of disease" and "major effusion".

The extent of the disease is shown in Table 23.

Major effusion occurred in 18% of this division of pneumothoraces. Foster-Carter and others (1952) found that Effusion occurred in 36% of satisfactory and adherent satisfactory cases. Kayne, Pagel and O'Shaughnessy (1948) state that effusion may be expected in 70% of pneumothoraces and that they are large in 20%. They do not define "large".

The figures in Table 23 have no statistical significance. Nevertheless they suggest that the more extensive bilateral cases have a higher

TABLE 23

MAIN COMPLICATIONS AND EXTENT OF DISEASE

	CLASS I	CLASS IIA	CLASS IIB	CLASS III	TOTAL CASES
EMPYEMA	0	0	0	1	1
SPONTANEOUS PNEUMOTHORAX	6	1	2	0	9
EFFUSION	38	11	5	8	62
SPREAD OF DISEASE	15	15	6	5	42
OTHER	4	2	1	0	7
TOTAL	63	29	14	15	121
NUMBER OF GOOD A.P.s	185	85	42	29	341
PERCENTAGES	34%	34%	33%	52%	35.4%
WITH COMPLICATION.	34%		41%		

complication rate particularly "spread of disease", than less extensively diseased cases. If "spread of disease" is considered using the X^2 test, the value obtained is 7.99 which gives P = 0.05. This confirms that the more extensive the disease, the more likely is there to be a spread in the lung not under treatment.

The nature of the disease is described either as "Cavitated" or "Infiltrated". 198 pneumothoraces were cavitated andof these, 73 or 37% developed a complication. Similarly 143 pneumothoraces were infiltrated and 48 or 34% developed a complication. This difference of 3% is not statistically significant.

Table 24 shows the complications associated with "Cavitated" and "Infiltrated" disease in this group of pneumothoraces. There is no striking difference upon which to comment but the infiltrated lesion being younger and probably still spreading, may give rise to slightly more cases of contralateral spread than the cavitated lesion. The difference shown is not significant however.

Only one Spontaneous pneumothorax occurred in a non-cavitated case, and in this case the disease never came under control. Eight Spontaneous pneumothoraces occurred in cases with cavitated disease as did the one case of Empyema.

TABLE 24

COMPLICATION RATES IN CAVITATED AND INFILTRATED CASES

COMPLICATION	GOOD PNEUMOTHORACES (341)			
	Primary Cavitating (198)		Primary Infiltrating (143)	
	Frequency	Percentage	Frequency	Percentage
EMPYEMA	1	-	-	-
S.P.T.	8	-	1	-
MAJOR EFFUSION	38	20%	24	17%
SPREAD OF DISEASE	20	10%	22	15%
OTHER MAJOR COMPLICATIONS	6	-	1	-
	73	37%	48	34%

On the whole where the original disease had cavitated, complications tended to be more serious than where the original disease was infiltrated.

It was necessary to modify treatment in 61 (18%) of these Good A.P.s. In 13, this took the form of additional out-patient procedure at Baird Street Hospital, and these are detailed in Table 25.

It is not possible to state why further out-patient procedure was embarked upon instead of hospital admission, except that two cases are recorded as un-cooperative patients and both died. Only 6 of the 13 achieved a good result.

The remaining 48 (14%) cases were admitted to hospital. In 16, admission was unconnected with complications. As mentioned earlier, when a patient was accepted for out-patient treatment, the name was retained on the hospital waiting list. As a result of O.P. treatment, many were removed from the waiting list, never having had the opportunity of hospital treatment. For various reasons, e.g. poor general response, or very poor social conditions, some names were retained on the waiting list, and hospital treatment eventually offered. Twelve such routine offers were made in this group of Good A.P.s during the course of treatment and patients were admitted for a period of from 3-6 months. In 3, the pneumothorax was abandoned in Hospital and in 9, it

TABLE 25

OUT-PATIENT PROCEDURES

COMPLICATION CAUSING O.P. PROCEDURE	NO. OF CASES	O.P. PROCEDURES	GOOD RESULT
EFFUSION	2	BOTH GIVEN PHRENIC NERVE CRUSH AFTER LUNG RE-EXPANDED	BOTH
SPREAD OF DISEASE	10	4 TREATED BY CONTRA-LATERAL A.P. 6 TREATED BY STREP-TOMYCIN.	ONE 2
CONTRALATERAL DISEASE INSUFFICIENTLY CONTROLLED	1	CONVERTED TO PNEUMO-PERITONEUM WITHOUT PHRENIC CRUSH	YES

was continued at Baird Street after discharge. Two other cases were admitted to hospital for thoracoscopy and retained because an effusion (nature unknown) followed operation. In one case the pneumothorax was abandoned. Two further cases were admitted because of a complication of pregnancy and retained in hospital for a few months until the puerperium was over. Pregnancy accompanying Artificial Pneumothorax will be discussed in more detail later.

The other 32 cases (9.4% of Good pneumothoraces or 26% of those with complications) were admitted because of a complication in each case.

These are detailed in Table 26.

Although from the viewpoint of the pneumothorax, contralateral Spread of Disease is of less importance than ipsilateral Major Effusion, yet it is just as important or more so from the patient's point of view. Admission to hospital was therefore required much more frequently for contralateral spread than for an effusion complicating the actual pneumothorax.

Complications associated with Unsatisfactory Pneumothoraces.

There were 171 pneumothoraces considered by me to be unsatisfactory in terms of the classification adopted. These pneumothoraces either failed to close cavities within a year, or the period for which they were maintained, or the patient exhibited persistent or massive atelectasis, or adhesions were so numerous

TABLE 26

COMPLICATIONS REQUIRING ADMISSION TO HOSPITAL OF GOOD PNEUMOTHORACES

REASON FOR ADMISSION	No. of Cases Admitted	Total number in Good A.P. Group.
Empyema	-	1
Spontaneous Pneumothorax	2	9
Major Effusion	7 11%	62
Spread of Disease	19 45%	42
Mental Illness	2	2
Air Embolism	1	1
Haemoptysis	1	1
For Thoracoscopy retained	2	-
Pregnancy	2	-
Routine	12	-
Total	48	-

and massive that little relaxation of the diseased area was possible, or an empyema developed within a year.

98 of these cases or 57.3% were accompanied by a complication, and these are listed in Tables 19, 20, 21 and 22. Empyema, Spontaneous Pneumothorax, Effusion, and Spread of Disease all occurred much more often in Unsatisfactory A.P.s than in Good Pneumothoraces the difference being rather less marked in the case of contralateral spread. With regard to the extent of the original disease, comparable figures to those in Table 23 are given in Table 27.

When compared with the complication rates in Good pneumothoraces, it is at once evident that here too there is a higher rate in the most extensively diseased cases. In both Good and Unsatisfactory pneumothoraces, where the original disease was unilateral, extent made no difference to the incidence of complication, and there was little change where limited bilateral lesions were present.

Complications of Unsatisfactory pneumothoraces are further divided into those where the disease had cavitated, and those where it had not. This is set out in Table 28 which is comparable to Table 24.

In this group there are more complications from the infiltrated cases than from the cavitated ones. I think however that from these two tables, the

TABLE 27

MAIN COMPLICATIONS AND EXTENT OF DISEASE IN

UNSATISFACTORY A.P.s

MAIN COMPLICATION	CLASS I	CLASS IIA	CLASS IIB	CLASS III	Total Cases
EMPYEMA	1	4	1	1	7
SPONTANEOUS PNEUMOTHORAX	0	5	2	0	7
EFFUSION	18	22	4	8	52
	31%		27%		
SPREAD OF DISEASE	7	7	7	6	27
	11%		30%		
OTHER	2	2	0	1	5
TOTAL	28	40	14		98
NUMBER OF BAD A.P.s	51	76	23	21	171
% with Complications	55	53	61	76	

TABLE 28

COMPLICATIONS IN UNSATISFACTORY A.P.s ACCORDING TO THE ORIGINAL DISEASE.

COMPLICATIONS	PRIMARY CAVITATING		PRIMARY INFILTRATING	
	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
EMPYEMA	5	4	2	3
SPONTANEOUS PNEUMOTHORAX	5	4	2	3
EFFUSION	30	27	22	37
SPREAD OF DISEASE	18	16	9	15
OTHER	4	4	1	2
TOTAL	62	55	36	61

conclusion must be drawn that there is no real difference between cavitated or infiltrated cases as regards complications produced.

Further treatment in the case of the Unsatisfactory group was given in 90 cases (53%). As with Good pneumothoraces, some had additional active Out-Patient treatment at Baird Street Hospital. There were 6 cases in this group. Because of the fact that the A.P.s were satisfactory, and because treatment was stopped within 12 months in 148 (86.5%) cases, there were many more admissions to hospital in the absence of complications, than in the Good A.P. group.

See Table 29.

Details are lacking of the case of Empyema treated by Hyalase, but he was well and working three years later. This small group seem to have responded better to treatment than the corresponding group which had Good pneumothoraces.

The remaining 84 (49%) cases were admitted to hospital. In 29 cases the Unsatisfactory pneumothorax remained free of complication and admission is classed as routine. The other 55 patients (32%) were admitted as the direct result of some complication, and Table 30 details this.

Similar remarks regarding the gravity of "Spread of Disease" occur in this Group where 24 out of the 27 patients exhibiting this complication required admission.

TABLE 29

OUT-PATIENT PROCEDURES - UNSATISFACTORY A.P.s

REASON FOR O.P. PROCEDURE	NUMBER OF CASES	O.P. PROCEDURE	GOOD RESULT
EMPYEMA	1	HAD A.P. 24 MONTHS. ASPIRATED REPEATEDLY. HYALASE INSTILLED.	YES
EFFUSION	2	ASPIRATED. PHRENIC CRUSH AND PNEUMOPERITONEUM.	YES BOTH
SPREAD OF DISEASE	2	BOTH HAD A.P. 18 MONTHS. TREATED BY STREPTOMYCIN AND P.P.	YES BOTH
UNSATISFACTORY A.P.	1	A.P. ONE MONTH. TREATED BY STREPTOMYCIN.	NO

TABLE 30

ADMISSIONS TO HOSPITAL - UNSATISFACTORY A.P.s

REASON FOR ADMISSION	NUMBER OF ADMISSIONS	NUMBER OF CASES
EMPYEMA	6	7
SPONTANEOUS PNEUMOTHORAX	5	7
EFFUSION	16	52
SPREAD OF DISEASE	24	27
ASTHMATIC SPASM	1	1
OTHER TUBERCULOUS DISEASE	3	4
ROUTINE	29	73
	84	

One of the main uses of anti-tuberculous drugs is the control of this complication.

One final point. Refills of air are normally given once per week although occasionally the interval is longer. One can expect the pleural space to be punctured about 50 times per year for each patient. Some 37,000 intrapleural refills were given in this series but there is no evidence of the occurrence of any secondary infection of the chest wall or pleural space. Personally I have never seen any infection with pyogenic organisms follow artificial pneumothorax refills.

This chapter may be summarised briefly.

604 pneumothorax inductions were attempted, 512 or 84.8% succeeded. Because of the progressive tendency to select less suitable cases, the success rate fell over the period of the study.

The arrangements for thoracoscopy and adhesion section are mentioned. 111 or 21.7% of pneumothoraces had thoracoscopy performed.

Pneumothoraces were classified into Good and Unsatisfactory. The criterion for each group being based on that used by Foster-Carter in the Brompton Hospital Report 1952. 341 were classed as Good, and 171 as Unsatisfactory.

The average duration of pneumothorax treatment

was 23 months in Good cases and 8 months in Unsatisfactory cases. The importance of continuity in management is emphasised.

Complications of treatment are discussed. 35.5% of Good and 57.3% of Unsatisfactory pneumothoraces were accompanied by one or more complications. The principal ones were Empyema, Spontaneous pneumothorax, Major Effusion and Contralateral Spread. Complications are discussed in relation to the extent and nature of the original disease. Complications were more common in Unsatisfactory cases, and in more extensively diseased cases if bilateral. No difference was noticed between the complication rates in cavitated and infiltrated cases.

Further treatment was required in 61 or 18% of Good pneumothoraces and in 90 (53%) of Unsatisfactory ones. This was either by active out-patient measures, or by admission to hospital. Reasons for further treatment were given.

CHAPTER 3

TERMINATION OF PNEUMOTHORAX TREATMENT, AND RESIDUAL DISABILITY

TERMINATION OF PNEUMOTHORAX

TREATMENT

The decision to terminate treatment was taken by the clinic physician responsible for the case. Broadly speaking the reason was either that healing had occurred and the disease was quiescent, or that maximum benefit had been achieved without the disease being regarded as quiescent, or that some complication forced the abandonment of the pneumothorax. The first two groups are designated "Termination by Healing", and the last group is designated "Termination because of Complication". Occasionally the decision to terminate treatment was taken by the patient, and these cases are designated "Termination by Default".

The decision to terminate treatment because of healing was based on several considerations, the standards of which undoubtedly varied from physician to physician. In general, these were as follows:

1. The duration of the pneumothorax. In most areas after $2\frac{1}{2}$ - $3\frac{1}{2}$ years treatment, the question of termination was actively considered.

2. Radiological evidence of retrogression and healing of the lesion.

3. Failure to demonstrate tubercle bacilli in the sputum. This was nearly always by examination of stained smears only, because facilities for the culture

of tubercle bacilli were not generally available to clinics during the period of this survey.

4. Satisfactory general condition with no clinical evidence of activity or toxaemia.

5. Response to exercise or work. Many patients resumed work while still receiving active pneumothorax treatment.

Patients in this group were all quiescent cases according to the Department of Health for Scotland and Ministry of Health classification.

Table 31 shows the total figures and reasons for termination of the pneumothorax.

The number of Good A.P.s terminated because of healing is surprisingly low - 214 or 63% but if those cases who defaulted from treatment are excluded from the total, the percentage rises to 77%.

It will be noticed that 65% of satisfactory pneumothoraces and 62% of adherent satisfactory pneumothoraces terminated because of healing. This difference is not significant statistically and neither is the difference in rates of termination because of a complication. These rates are 20% for satisfactory cases and 25% for adherent satisfactory cases. It would seem that the presence of adhesions does not in general make any difference to the reason for termination of a

TABLE 31

TOTAL FIGURES AND REASONS FOR TERMINATION OF THE PNEUMOTHORAX.

CLASSIFICATION OF A.P.	REASON FOR TERMINATION			TOTALS
	HEALING	COMPLICATION	DEFAULTED	
Satisfactory	60 65%	18 20%	14 15%	92
Adherent Satisfactory	154 62%	63 25%	31 12%	248
Total Good A.P.s	214 63%	81 24%	45 13%	340
Bad A.P.s	11 6%	143 84%	17 10%	171
Total A.P.s	225 44%	224 44%	62 12%	511

One A.P. is still in being.

pneumothorax.

"Good" pneumothoraces will be considered first, and in Tables 32A and 32B is set out the reason for termination assessed with the duration of pneumothorax treatment.

One case of Good pneumothorax has already been under treatment for 4 years and still continues.

The percentage terminated because of healing rose steadily as treatment continued. As a corollary, complications caused termination of a steadily diminishing proportion. More than half had occurred by the first year.

The defaulters, like the complication group, dropped steadily, and occurred mostly in the first year.

269 pneumothoraces were induced in cases with unilateral disease and completed. Of these 175 or 65% terminated by healing. Of the 71 pneumothoraces induced for bilateral disease, 39 or 55% terminated by healing. This difference of 10% is not significant, but the number of cases of bilateral disease is rather small for assessment.

An interesting comparison can be made between disease which had originally cavitated, and disease originally without obvious cavitation. 127 out of 198 or 64% of cavitated cases terminated by healing, while 87 out of 143 or 61% of infiltrating cases did

TABLE 32A

DURATION OF GOOD PNEUMOTHORACES AND REASON FOR TERMINATION.

REASON FOR TERMINATION	DURATION IN MONTHS						
	Under 6	6-12	18	24	30	36	Over 36
HEALING	0	26	36	45	28	37	42
COMPLICATIONS	6	43	15	9	4	2	2
DEFAULTED	10	22	7	2	1	3	0
TOTAL GOOD A.P.s	16	91	58	56	33	42	44 +

+ 1 Case still on A.P. is excluded.

TABLE 32B

TABLE 32 EXPRESSED AS PERCENTAGES OF TOTAL IN EACH COLUMN

	DURATION IN MONTHS						
	Under 6	6-12	18	24	30	36	Over 36
HEALING	0	29	62	80	85	88	95
COMPLICATIONS	37	47	26	16	12	5	5
DEFAULTED	63	24	12	4	3	7	0
TOTAL GOOD A.P.s	100	100	100	100	100	100	100

so too. From this it would appear that the likelihood of achieving planned termination of treatment because of healing was the same whether the original disease was cavitated or not.

In the case of 16 "Good" pneumothoraces classed as terminating by healing, the termination was precipitated because of a complication. Table 33 gives details of these cases.

Eleven of these had cavitated disease and 5 were non-cavitated. Thirteen patients had unilateral disease and 3 had bilateral disease.

In 81 cases or 24% the "Good" pneumothoraces were prematurely terminated because of some complication occurring during treatment.

"Major Effusion" and "Spread of Disease" are the two most common reasons for termination. The other figures in Table 34 are too small to draw conclusions. In general however, the proportion of bilateral cases has increased from 18% in the group terminated by healing, to 28% in this group. The proportion of cavitated cases terminated by healing, was the same as in this group, viz. 127 of 214 (59%) and 49 of 81 (60%).

The reasons for termination of "Good" and "Unsatisfactory" pneumothoraces are in some respects not easily compared. The group "Terminated because of a Complication" includes a number of cases without actual complication but whose pneumothorax was terminated

TABLE 33

DETAILS OF 16 CASES WHERE TERMINATION WAS HASTENED.

PRECIPITATING COMPLICATION	No. of Cases	EXTENT OF DISEASE		NATURE OF DISEASE	
		UNILATERAL	BILATERAL	CAVITATING	INFILTRATING
ACUTE NEPHRITIS	1	1	-	1	-
PREGNANCY	2	2	-	2	-
TRANSIENT MAJOR EFFUSION	9	6	3	6	3
SPONTANEOUS PNX.	1	1	-	1	-
CHANGE OF SUPERVISION	1	1	-	-	1
SPREAD OF OLD DISEASE IN OTHER LUNG	2	2	-	1	1

TABLE 34

TERMINATION OF GOOD PNEUMOTHORACES BECAUSE OF A COMPLICATION.

COMPLICATION	EXTENT OF DISEASE		NATURE OF DISEASE		NO. OF CASES
	UNILATERAL	BILATERAL	CAVITATED	INFILTRATED	
SPONT. PNEUMOX.	2	-	1	1	2
EMPYEMA	0	1	1	-	1
MAJOR EFFUSION	33	11	27	17	44
SPREAD OF DISEASE	9	6	6	9	15
PREGNANCY	1	3	4	-	4
CHANGE OF SUPERVISION	5	1	2	4	6
OTHER	8	1	8	1	9
	58	23	49	32	81

apparently because it was unsatisfactory. It can be argued that all "Unsatisfactory" pneumothoraces should have been terminated anyway. But the classification is an opinion of my own several years after the event and according to definite standards. Table 35 gives reasons for termination of Unsatisfactory pneumothoraces and sub-divides these reasons according to the duration of treatment. It may be compared with Table 32.

Twenty-five pneumothoraces lasted longer that one year. Eleven of these were terminated because of healing, 7 being cavitated originally and 4 infiltrated. In 2 cases the disease was bilateral. Thirteen of the remaining 14 cases were terminated because of a complication, and the last case seems to have been terminated because it was unsatisfactory. In all, 54 pneumothoraces were ended because they were unsatisfactory.

Table 36 gives the details of 89 cases who were terminated because of complications. Compared with Table 34 it is seen that the overall pattern of complications correlated with the nature and extent of disease, is very similar to the complication pattern in "Good" pneumothoraces as far as premature termination is concerned.

TABLE 35

TERMINATION OF UNSATISFACTORY A.P.s ACCORDING TO DURATION OF TREATMENT

TERMINATION BECAUSE OF	DURATION OF PNEUMOTHORAX (YEARS)						TOTAL
	3/12	3-6/12	6-12/12	12-24/12	24-36/12	Over 36/12	
1. HEALING	-	-	-	6	2	3	11
2. UNSATIS-FACTORY PNEUMO-THORAX	32	15	6	1	-	-	54
3. COMPLICATION	36	24	16	10	2	1	89
4. DEFAULTED	14	1	2	0	-	-	17
TOTAL	82	40	24	17	4	4	171

TABLE 36

TERMINATION OF UNSATISFACTORY PNEUMOTHORACES BECAUSE OF A COMPLICATION

COMPLICATION FORCING TERMINATION	EXTENT OF DISEASE		NATURE OF DISEASE		A.P. CASES
	UNILATERAL	BILATERAL	CAVITATED	INFILTRATED	
EMPYEMA	5	2	5	2	7
SPONT. PNX.	4	1	3	2	5
MAJOR EFFUSION	36	13	28	21	49
CONTRALATERAL SPREAD	11	13	16	8	24
OTHER	4	-	3	1	4
	60	29	55	34	89

I wish now to consider the occurrence of residual disability as a result of pneumothorax treatment.

There is no record of any case in this series being left with a permanent pneumothorax.

(1) Eight Empyemata occurred, all tuberculous, an incidence of 1.6%. Five died within three years, 3 were well and working after 3-5 years intervals. These will not be discussed further.

The remaining residual disabilities are grouped as follows.

(2) Residual pleural thickening.

I have divided residual pleural thickening into slight and marked. In the former group, there is radiological evidence of pleural reaction such as obliteration of the costo-phrenic angle, thickening of interlobar fissures, peaking of the diaphragm or other evidence of pleurisy, but no symptoms referable to this.

The latter group consists of cases more severe than the former, or with rigidity of the chest wall noted, or with symptoms suggesting interference with respiratory function without obvious collapse.

(3) Permanent collapse of all or part of a lung. This corresponds to the "unexpandable lung" of many writers. In some cases, a lobe was collapsed while in others, the whole lung was partly collapsed by massive pleural thickening. In no case was the whole

lung completely collapsed.

In 8 cases, the collapse was segmental involving more than one segment of an upper lobe, often with a small apical pocket of air which was eventually obliterated by pleural thickening.

(4) Occasionally what appeared to be an intra-pulmonary fibrosis occurred producing local diminution in lung volume of not more than 1 lobe in extent. There was no marked pleural reaction to suggest that this was a collapse as defined above.

(5) Two cases of upper lobe bronchiectasis were found in proved tuberculous lungs being treated by pneumothorax. It is impossible to show whether these followed pneumothorax treatment or preceded it. They were only discovered on investigation following haemoptysis after completion of artificial pneumothoraces in both.

I shall consider first, in Table 37, uncomplicated pneumothoraces classified both as "Good" and as "Unsatisfactory".

At first sight it appears extra-ordinary that 58% of uncomplicated Good pneumothoraces were free of residual disability while 78% of uncomplicated Unsatisfactory pneumothoraces were also free of residual disability. The reasons probably are (1) That it is rather difficult to be accurate in assessing Unsatisfactory pneumothoraces because so many of them when stopped early, received

TABLE 37

RESIDUAL DISABILITY IN UNCOMPLICATED ARTIFICIAL PNEUMOTHORACES.

	NO DISABILITY	FIBROSIS	SLIGHT THICKENING	MARKED THICKENING	COLLAPSE	OTHER	TOTAL
GOOD A.P.	127 58%	18 8%	46 21%	10 5%	6 3%	1	219 with 11 Unknown
BAD A.P.	57 78%	3 4%	7 10%	2 3%	1 2%	-	73 with 3 Unknown
ALL UNCOMPLICATED A.P.s	184 63%	21 7%	53 18%	12 4%	7 2%	1	292

other treatment which often completely obscured the picture from the point of view of A.P. after effects. For example many, after termination of the pneumothorax were admitted to hospital, and after a varying period submitted to other collapse measures such as thoracoplasty. (2) Unsatisfactory A.P.s in this group did not last long enough for any sequelae to develop - indeed 51 out of the 57 were abandoned within six months. In the Good group of 127 cases, only 26 were abandoned within 6 months. The difference is largely found in the columns "Fibrosis" and "Slight Thickening" in Table 37, both of which might be expected in A.P.s. of longer duration, and both of which are much commoner in Good A.P.s of longer duration. Of the 21 cases with fibrosis, 19 occurred in pneumothoraces which lasted 12 months or longer. Similarly 47 of the 53 cases with slight residual pleural thickening had pneumothorax treatment for twelve months or longer.

The remaining two Groups of sequelae - "Marked residual pleural thickening" and "Partial Collapse of the lung" show a similarity in incidence rate between Good and Unsatisfactory A.P.s. The former also was principally found after pneumothoraces of longer standing, 10 of the 12 cases occurring after a minimum of 18 months treatment. The latter - partial collapse - had a fairly steady rate of occurrence after 1 year of treatment. In

two cases the collapse involved the whole upper lobe, the remaining cases showed segmental collapse only.

The Group of pneumothoraces accompanied by a complication can now be examined and Table 38 shows the incidence of disability here.

It is obvious from a comparison of Tables 37 and 38, that there is a much greater incidence of residual disability after pneumothoraces which were accompanied by a complication 68% of these cases having residual disability against 37% in uncomplicated cases. It is probable that minor degrees of effusion of a transient nature, not noted clinically were the reason for the incidence of sequelae in uncomplicated cases.

As regards the actual disability, the same trend can be detected here as was seen when considering uncomplicated cases. In this group of complicated cases no disability was found in 39% of Unsatisfactory pneumothoraces. 26% of Good pneumothoraces were also free from disability after treatment, a difference of 13%. Again the early cessation of treatment was noted in "Unsatisfactory" pneumothoraces without residual disability. The incidence of "Fibrosis" and"Slight Pleural Thickening" was much the same as in the uncomplicated group, Table 39 illustrates the complications with which the disabilities were associated in this complicated group. Spread is not included since it concerns the other lung.

TABLE 38

RESIDUAL DISABILITY IN COMPLICATED A.P.s.

	NO DISABILITY	FIBROSIS	SLIGHT THICKG	MARKED THICKG	COLLAPSE	OTHER	TOTAL
GOOD A.P.	31 26%	10 8%	30 25%	29 25%	15 12%	1	121
UNSATIS-FACTORY A.P.	38 39%	5 5%	14 14%	23 23%	11 11%	1	98
ALL COM-PLICATED A.P.s	69 32%	15 7%	44 20%	52 24%	26 11%	2	219

TABLE 39

RESIDUAL DISABILITY IN COMPLICATED

ARTIFICIAL PNEUMOTHORACES

RESIDUAL DISABILITY	NO. OF CASES	EMPYEMA	SPONT. PNX.	EFFUSION
NONE	69	-	5	27
FIBROSIS	15	-	5	7
SLIGHT PLEURAL THICKENING	44	1	-	23
MARKED PLEURAL THICKENING	52	1	2	38
COLLAPSE	26	6	4	15
OTHER	2	-	-	2
NOT KNOWN	11	-	-	2
	219	8	16	114

It can be seen from Table 39 that Empyema always produces serious after effects from the point of view of the functioning lung. At present, no notice is taken of the deaths, and the residual disability is considered as at the latest possible date, either of follow up or preceding further treatment.

The fate of the 8 cases of empyema has been mentioned on page 80. 27 or 24% of effusion produced no noticeable after effects. Only 38 or 73% of the cases with marked pleural thickening were associated with effusion during treatment. The percentages of the serious after effects, marked pleural thickening and collapse, are slightly higher in the Good A.P. Group than in the Unsatisfactory A.P. Group. The actual figures concerned are too small to have statistical significance. It would seem likely that the reason for the slight predominance of disability after Good pneumothoraces is that there is a tendency to maintain them a little longer in the face of an effusion, hoping for speedy resolution. This policy was more noticeable in the early years of the study. Unsatisfactory pneumothoraces seem to have been abandoned promptly at the first sign of trouble.

Summarising this chapter it may be said that 63% of Good A.P.s and 6% of Unsatisfactory A.P.s terminated as planned by healing. The percentage terminated by

healing rose steadily with longer duration of treatment. Approximately the same percentage of cases with cavitated as with infiltrated disease achieved planned termination.

24% of Good pneumothoraces and 84% of Unsatisfactory pneumothoraces ended because of a complication. In the latter group, this also includes cases abandoned because they were unsatisfactory. Most of the complications group were abandoned within a year.

Residual Disabilities are discussed. Pleural thickening and fibrosis are commoner in Good cases probably because of the longer duration of pneumothorax treatment.

CHAPTER 4

RETURN TO WORK

CHAPTER 4

In this chapter I shall be concerned with the initial response of the patient to treatment and a good measure of this would seem to be the ability to return to work.

During the course of collapse therapy, many cases became fit to resume employment, and when given permission to do so, patients usually regarded the event as a milestone in the journey towards "Cure". Some, of course, resumed work without asking the advice of their physician and of these, the vast majority were housewives. It is difficult for a housewife to remain aloof from domestic duties after she begins to feel well again and this was especially difficult in the social group from whom most of these cases came. Domestic help was spasmodic and irregular if present at all. This was the reason why so many gradually drifted back to work without formal leave. Some, of course, became pregnant. A small minority of patients returned to work specifically against advice, or defaulted from treatment. All are included in the gross figures if it is known that they did return to work as indicated below.

It is not possible now, to recall the various grades of activity through which individual cases or

groups of cases, wended their ways towards full activity, and so the title "Return to work" will mean, return to regular whole-time remunerative employment which can include some patients who had a preliminary period of part-time employment for up to 3 months. This term will also include training at an Industrial Rehabilitation Unit of the Ministry of Labour and National Service. In the case of married women or those looking after households, the ability to undertake ordinary domestic duties apart from such heavy work as washing, scrubbing and bed-making, will be considered return to work. The occurrence of a pregnancy is considered to be a return to work, but I shall give more detailed consideration to pregnancy in Artificial Pneumothorax patients in a later chapter.

399 patients returned to work i.e. 77.9% of all pneumothoraces. 299 cases had "Good" pneumothoraces and 100 had "Unsatisfactory" pneumothoraces. The percentage of cases with "Good" pneumothoraces returning to work was 88% while of those with "Unsatisfactory" pneumothoraces, only 58% returned to work. I have not found it possible to determine with accuracy the type of work to which patients returned, but 200 are known to have returned to work of a similar grading to that on which they were employed previously, 83 returned to work of a lighter nature while in 116 cases it was not

possible to compare the two.

The percentages of men and women in this group of 399 cases were 34% men (136 cases) and 66% women (263 cases). These proportions are very similar to those found throughout the study as shown in Table 40.

It seems certain that the sex of the patient does not directly influence the response to treatment, although the percentage of men with "Good" pneumothoraces is lower than the other male percentages in Table 40.

The effect of cavitation. Of the 399 who returned to work, 170 (42.6%) were originally classed as "infiltrated" cases and 229 (57.4%) as "cavitated" cases. There were 202 cases of infiltrated disease treated by pneumothorax so that 84% (170) returned to work. Similarly 310 cases had cavitated disease and 74% (229) returned to work. This difference of 10% is 2.8 times its standard error. It has been shown that 6% fewer cavitated cases had "Good" pneumothoraces than infiltrated cases, and it seems reasonable to link the poorer results in cavitated disease with this.

Excluding cases who defaulted, 11 other cases out of 399 returned to work against advice while the disease was still regarded as unstabilised. In 5, cavitation had occurred initially, while 6 were infiltrated in type. All cases deteriorated further and had to stop work after a period varying from 6-18 months.

Before proceeding to consider the main classes of

TABLE 40

PERCENTAGES OF MEN AND WOMEN IN STUDY

	ALL CASES	ALL A.P.s	GOOD A.P.s	RETURNED TO WORK
MEN	36%	35%	32%	34%
WOMEN	64%	65%	68%	66%

pneumothorax cases in more detail, I wish to discuss an amendment to these classes which I shall incorporate henceforth. It will be recalled from Table 17, Chapter 2, that 138 pneumothoraces were continued for less than 6 months. Of these, 98 lasted under three months. A pneumothorax of under 3 months cannot be regarded as of therapeutic importance so I shall delete this group of cases when considering the results of treatment. The modified classes which result from this will be termed "Good" or "Unsatisfactory" therapeutic pneumothoraces, shortened to Good Th. A.P.s. or Unsat. Th. A.P.s respectively, for use in tables.

Nevertheless the mere fact that a pneumothorax was established produced a complication almost certainly referable to it in 28 cases, viz Effusion, Spontaneous Pneumothorax or Empyema. Associated with treatment but probably not directly caused by it were contralateral spread of disease, acute mental upset, or other tuberculous lesion, a total of 13 cases.

That is, 41 cases were complicated in some way, while 57 either defaulted from treatment or had the pneumothorax terminated because it seemed impossible to make it satisfactory.

The division of this group of 98 cases between the two main classes of pneumothorax is as follows. 16 cases classed as "Good," and 82 cases classed as "Unsatisfactory."

One of the 16 Good pneumothoraces is classed as "adherent satisfactory". She was free of any complication as far as her records show yet her pneumothorax was abandoned within three months. She is the "unknown" case in Table 41.

I intend to discuss the follow up of this group of cases in Chapter 5.

It should be emphasised that the term "Returned to work" is not synonymous with the term "stabilised" and Table 42 illustrates this point.

It is seen that of the 150 cases terminated because of a complication four unstabilised cases returned to work. Similarly of the 38 cases who defaulted, 8 with unstabilised disease returned to work.

These are all included as returned to work on the grounds that the patient had benefitted from such treatment as was received to the extent that return to work was physically possible. It is noteworthy that no case whose pneumothorax lasted less than three months was able to return to work without further treatment at home or in hospital unless they had defaulted from treatment. There were 5 such cases, four of whom relapsed.

TABLE 41

REASONS WHY 98 CASES HAD ONLY 3/12 OR LESS TREATMENT BY A.P.

REASONS	GOOD A.P.	UNSATISFACTORY A.P.	TOTAL
DEFAULTED FROM TREATMENT	10	14	24
EMPYEMA	0	4	4
SPONTANEOUS PNEUMOTHORAX	-	4	4
PLEURAL EFFUSION	2	18	20
SPREAD OF DISEASE IN OTHER LUNG.	1	6	7
OTHER	2	4	6
UNSATISFACTORY A.P.	-	32	32
UNKNOWN	1	-	1
TOTAL	16	82	98

TABLE 42

DIFFERENCES BETWEEN NUMBERS STABILISED

AND THOSE WHO RETURNED TO WORK.

GROUP OR SUB GROUP	NO. OF CASES	NUMBER STABILISED		NUMBER RETURNED TO WORK.	
GOOD THERAPEUTIC PNEUMOTHORACES					
ALL CASES	325 +	290 +	89%	289 +	89%
TERMINATED BY HEALING	214	214		207	97%
DEFAULT	35	23	67%	29	83%
COMPLICATION	75	52	69%	52	69%
UNSATISFACTORY THERAPEUTIC PNEUMOTHORACES					
ALL CASES	89	52	59%	56	63%
TERMINATED BY HEALING	11	11	100%	9	82%
DEFAULT	3	1		3	
COMPLICATION	75	40	53%	44	59%

+ one is still under treatment.

In the group terminated because of healing, all 225 cases were considered stabilised, yet only 216 returned to work. The 9 patients who did not return to work despite stabilised disease are detailed as follows.

(1) had a breakdown of contralateral disease previously treated by pneumothorax, and was subsequently admitted for thoracoplasty on that side.

(2) and (3) were receiving treatment by pneumothorax for contralateral disease.

(4) never worked regularly although he was casually employed until he relapsed 2 years later.

(5), (6) and (7) did not work for unknown reasons. They all relapsed later.

(8) was found at the end of treatment to be diabetic. He relapsed after 2 years.

(9) remains well but has simple paroxysmal tachycardia and a proved duodenal ulcer. Despite this, he works spasmodically.

These nine patients are mentioned in detail because of the fact that all were considered fit for work when the pneumothorax ended.

Return to work in the Class of Good Therapeutic Pneumothoraces

The overall percentage who returned to work is 89 in this Class. In cases with Right Lung disease,

the percentage return to work is 90, and, as would perhaps be expected, the percentage who returned to work where disease involved both lungs, is considerably lower being 76%. Where the Left Lung only is involved, the percentage who returned to work is also above average being 94.

There are 10% fewer cases with cavitated disease in the Left Lung group than in the Right Lung group and I think this has influenced the results to the advantage of the Left Lung group.

See Table 43. Consider Class II disease, i.e. extending to 2-3 Zones.

Where the disease was unilateral, 9% more patients returned to work than where the disease was bilateral.

This difference is 1.3 times its standard error, and therefore quite likely to have occurred by chance. If Table 43 is considered as a whole, the initial response to treatment as measured by return to work, decreased steadily as the disease became more extensive. In this case the X^2 test of significance was used and P found to be 0.01, so that the differences in Table 43 are unlikely to have occurred by chance.

It has already been shown (P.92) that overall experience with cavitated disease was less satisfactory than that with infiltrated cases. In this group of Good Therapeutic Pneumothoraces, no difference in results between infiltrated and cavitated cases was found.

TABLE 43

EXTENT OF DISEASE AND RETURN TO WORK

	EXTENT OF DISEASE			
	UNILATERAL		BILATERAL	
	CLASS I	CLASS IIA	CLASS IIB	CLASS III
NO. OF GOOD A.P.s	168	89	47	21
NEVER RETURNED TO WORK	12	9	9	6
RETURNED TO WORK	156	80	38	15
%ge.	93	90	81	71

(See page 106).

In general, it may be said that cavitated disease treated by a "Good" pneumothorax can be expected to produce as good an initial response as infiltrated disease similarly treated. See Table 44.

The influence of the development of a complication can now be studied in this group of Good Therapeutic Pneumothoraces. Those free from complication, and treated by out-patient pneumothorax only numbered 194. Another 15 had some additional treatment. This consisted of routine admission to hospital in 12 cases as explained in Chapter 2 (p.55).

One case was converted to out-patient pneumoperitoneum and two were admitted because of a complication of pregnancy. In all, 209 were free of complications and 199 or 95.2% returned to work.

The remaining 116 Good Therapeutic Pneumothoraces were accompanied by a complication and of these, 90 or 78% returned to work. This difference is 4 times its standard error.

Table 45 lists the main complications which occurred in this group. It can be seen that 86% of cases with effusion returned to work while only 73% of those with contralateral spread did so.

TABLE 44

RETURN TO WORK OF INFILTRATED AND CAVITATED

CASES TREATED BY THERAPEUTIC PNEUMOTHORAX.

	GOOD PNEUMOTHORACES		UNSATISFACTORY PNEUMOTHORACES.	
	NO. OF CASES	RETURNED TO WORK	NO. OF CASES	RETURNED TO WORK
CAVITATED	190	170 89%	53	31 58%
INFILTRATED	135	119 88%	36	25 69%

TABLE 45

EFFECT OF COMPLICATIONS ON GOOD THERAPEUTIC A.P.

WITH REFERENCE TO RETURN TO WORK.

NATURE OF COMPLICATION(1)	NUMBER OF CASES(2)	RETURN TO WORK(3)
EMPYEMA	1	1
SPONTANEOUS PNX. ONLY	9	4 44%
EFFUSION	51 (1)	44 (2) 86%
EFFUSION & SPREAD	9	7 78%
SPREAD OF DISEASE	41	30 73%
OTHER	5	4
ALL COMPLICATIONS	116	90 77%

(1) - includes 2 with Spont. Pnx. also.

(2) - includes 11 with Spont. Pnx. also.

Return to work in the class of Unsatisfactory Therapeutic Pneumothoraces.

This will be considered in a manner similar to that adopted for the previous section, although in some respects e.g. duration of treatment, the two groups are different.

As mentioned previously, it was thought desirable to exclude all those cases the duration of whose treatment did not exceed three months. The number of unsatisfactory pneumothoraces becomes reduced by 82 from a total of 171 to a total of 89 of possible therapeutic value. In this group, 56 or 63% returned to work, a number which is 26% less than in the case of Good Therapeutic pneumothoraces. This difference is 5 times its standard error.

Effect of Extent of Disease.

As with the other class, no difference was experienced which depended on the side involved. The influence of extent of disease is shown in Table 46.

It can be seen that the effect of the extent of disease is similar to that obtained in the "Good" group. The response to treatment of cases in Class II is similar in both unilateral and bilateral cases. It will be recalled that the difference noticed in the "Good" group was not statistically significant (Page 99). These results lend support to the opinion of Foster-Carter and his Colleagues (1952) that disease of the same

TABLE 46

EXTENT OF DISEASE AND RETURN

TO WORK

	EXTENT OF DISEASE			
	UNILATERAL		BILATERAL	
	CLASS I	CLASS IIA	CLASS IIB	CLASS III
No. of Unsatisfactory A.P.s	24	37	19	9
Never returned to work	6	15	8	4
Returned to work	18 75%	22 59%	11 58%	5 56%

radiological extent responds to treatment in a similar manner whether unilaterally or bilaterally distributed.

Effect of Cavitation.

Of the 89 cases in this group, 53 had cavitated disease and 31 or 58% returned to work. The remaining 36 had disease without cavitation originally and 25 or 69% returned to work. This has been included in Table 44 (P.110) for comparison purposes. A patient with cavitated disease treated by an unsatisfactory pneumothorax has the poorest chance of returning to work.

The influence of development of a complication during treatment can now be studied in this class of pneumothorax. 27 cases were free of complication - i.e. 30%. Of these 19 were treated only by pneumothorax, while 8 also received treatment in hospital. No case continued treatment by other out-patient procedures. In all, 20 returned to work or 74%. The remaining 62 cases (70% of the group) suffered a complication of treatment, and only 58% returned to work. These complications are listed in Table 47.

Figures here are too small to justify comparison between the different complications, but if they are combined with figures pertaining to the group of Good pneumothoraces, it can be seen that the difference of 18% between the rates of effusion and spread of disease is definitely significant being 2.4 times its standard error. This indicates that spread of disease under

TABLE 47

EFFECT OF COMPLICATIONS ON UNSATISFACTORY THERAPEUTIC PNEUMOTHORAX WITH REFERENCE TO RETURN TO WORK.

NATURE OF COMPLICATION	NO. OF CASES.	NO. WHO RETURNED TO WORK.		COMBINED FIGURES WITH TABLE 45		
EMPYEMA	3	1		4	2	
SPONTANEOUS PNX. ONLY	3	1		12	5	
EFFUSION	26	20	77%	77	64	81%
EFFUSION AND SPREAD	8	4	50%	17	11	78%
SPREAD OF DISEASE	21	9	43%	62	39	63%
OTHER	1	1		6	5	
ALL COMPLICATIONS	62	36	58%	178	126	71%

treatment is much more serious than a major effusion. In fact, an effusion does not appear to prejudice the outlook for the patient, provided it is the only complication. If "Effusion and spread" is combined with "Spread", the difference is still 18% but this is now 2.6 times its standard error.

Summary of Chapter 4.

The meaning of the term "Returned to Work" is discussed, and this is used as a measure of the initial response to treatment.

299 or 88% of Good Pneumothoraces returned to work while only 100 or 58% of Unsatisfactory Pneumothoraces did so.

The sex of the patient had no bearing on this response.

In general, cavitated cases fared rather worse than infiltrated cases. This was due to the poorer response of these cases when the pneumothoraces were unsatisfactory. Both types of case fared equally well with Good pneumothorax treatment.

The reasons why 98 cases whose pneumothorax lasted less than three months, were excluded from the various groups, are discussed.

The difference between the numbers who returned to work and who were considered stabilised is analysed.

The more extensive the disease, the poorer the response to pneumothorax treatment, as measured by return

to work, is noted.

No difference in response was noted between bilateral and unilateral disease of the same total radiological extent.

The occurrence of an effusion does not appear to prejudice the effect of treatment but spread of disease has an adverse effect.

CHAPTER 5

FOLLOW UP OF ALL PNEUMOTHORACES

CHAPTER 5

In this chapter I intend to discuss the history of the patients in this study, after the abandonment of pneumothorax treatment or where appropriate, the failure of the induction of a pneumothorax. Before doing so it is relevant to make some general remarks.

Information was obtained from the case records of all patients except six. These six died before 1948, and their records were destroyed, but information was kindly supplied by Dr. J. S. Gemmill of the Health and Welfare Department, Glasgow. Details had been noted by him for the article by Maclean and Gemmill (1948) surveying the first 150 inductions in this scheme. Eight patients left the city. In five of these information was obtained from the clinic serving the area in which they resided. Two emigrated and one never contacted her new clinic so the follow up in these cases is incomplete.

Ninety-four cases ended their survey as patients of the Chest Clinic, 60 Florence Street. They were assessed during the period Autumn 1954 to Spring 1955. Several former patients of this clinic were recalled during this time for assessment if the duration of their follow up was under five years. As far as patients of the areas served by other clinics are concerned, the

survey ended during the first half of 1954.

A five year follow up of as many cases as possible was aimed at. This accords with the Department of Health classification of the disease, which defines a "recovered" case as one considered quiescent for an uninterrupted period of 5 years. Recovered cases are normally removed from the register of Tuberculous patients.

In this series of 511 cases, with an artificial pneumothorax, the follow up period was dated from the termination of treatment. Thereafter the condition of each case was reviewed at yearly anniversaries for as long as possible. Where the pneumothorax was converted to pneumoperitoneum, and maintained as an out-patient procedure, the duration of follow-up dated from the termination of pneumoperitoneum treatment. The date from which follow up is reckoned varied with different clinics. Sometimes it was the date of commencement of treatment, sometimes the date of return to work, sometimes the date of termination of treatment. For the sake of uniformity and clarity, I have chosen the latter.

Stabilised i.e. Quiescent cases who remained well, normally attended for routine follow up at a clinic for five years only. Unstabilised cases and those who relapsed, attended for an indefinite period or for 5 years from the date of quiescence.

The follow-up of 50 patients terminated prematurely

because they ceased to attend a chest clinic. Eight of these defaulted for a period, but eventually returned following transfer to a new area, or because of the necessity for further treatment. The 42 cases of whom all trace was lost comprise 8.3% of the total patients (503), but they are distributed over the period up to the fourth anniversary of cessation of treatment in the following manner; 19 defaulted before the first anniversary, 16 between the first and second anniversaries, 4 between the second and third, and 3 between the third and fourth. That is to say, 3.8% of cases entering the first year follow up were lost sight of prematurely. Similarly were lost 3.4% entering the second year, 0.9% entering the third year, and 0.8% entering the fourth year of follow up. This will not affect the analysis following, and these cases will be considered at risk, up to their latest anniversary. They will then be discarded with those whose maximum follow up ended during the next year. Life tables are calculated on the cases KNOWN to be at risk during the year in question.

MORTALITY

In order to calculate death rates, it is necessary to clarify the position of the bilateral pneumothoraces. Previous discussion has regarded each pneumothorax as a "case", because each is subject to the normal run of factors which might influence it. There were 16 such pneumothoraces involving 8 patients. For death rate

purposes, the 511 cases becomes 503 patients.

The follow up of these bilateral cases will date from the termination of the first pneumothorax, except where the second pneumothorax outlasted or immediately followed the first. Where an interval of 3 months or longer elapsed, the induction of the second pneumothorax is regarded as following breakdown on the contralateral side from the first pneumothorax.

It is also necessary to modify the classification of the case since "Good and Unsatisfactory pneumothoraces" were present on the same patient sometimes. Of the 16 pneumothoraces, 10 were classed as "Good" and 6 as "Unsatisfactory"; in the case of patients, 4 as "Good" and 4 as "Unsatisfactory".

90 patients out of 503 whose pneumothorax was terminated, died during the survey period. Progressive pulmonary tuberculosis was the reason for 82 deaths. The other eight were due to a variety of causes. Two were due to Tuberculous Meningitis and occurred in the pre-streptomycin era. One died from Tuberculous Peritonitis and one died during the operation of second stage thoracoplasty. These are included in the deaths due to uncontrolled disease which now total 86. The other four patients died from causes not associated with the treatment of their tuberculosis. One died from Carcinoma Cervix Uteri, one died of Polycystic Kidney, one died of acute intestinal obstruction following a ruptured appendix,

and one died of pyelonephritis. He had been subjected to uretero-colic anastomosis for cystic tuberculosis, before the artificial pneumothorax was contemplated.

The distribution of these deaths is shown in Table 48. This table shows the gravity of unsatisfactory treatment. It also shows that the majority of deaths have occurred before the fourth anniversary.

It is now necessary to consider each division of cases in more detail. Deaths in each division will be considered first and then morbidity.

Good Therapeutic Pneumothoraces.

This group comprised 318 patients with 324 pneumothoraces. The deaths in the group will be considered first, and these numbered 21. These are incorporated in Table 49 which is an "Expectation of Life" table calculated as recommended by Bradford Hill. This type of table is used later to calculate "Expectation of remaining well."

Table 49 shows that 90.4% of patients may be expected to survive 5 years after treatment by pneumothorax is terminated. 89.5% survive 7 years. In this group there were 190 cavitated cases of whom 11 died, and 135 infiltrated cases of whom 10 died. Expectation of survival rates for these cases are 89% and 91% respectively at 5 years, the deaths in cavitated cases occurring rather earlier than those in infiltrated cases.

TABLE 48

DISTRIBUTION OF DEATHS IN THE PNEUMOTHORAX PATIENTS

LATEST ANNIVERSARY ALIVE YEAR.	GROUP OF PATIENTS			
	GOOD TH. PNX.	UNSAT. TH. PNX.	PNX. UNDER 3 MONTHS DURATION	ALL CASES
0	2	2	4	8
1	4	3	14	21
2	5	11	4	20
3	7	9	6	22
4	2	5	0	7
5	1	1	2	4
6	0	1	0	1
7	0	1	1	2
8	0	1	0	1
TOTALS	21 (6.5%)	34 (38.2%)	31 (31.7%)	86 (16.8%)

TABLE 49

SURVIVAL RATES OF PATIENTS WITH GOOD THERAPEUTIC PNEUMOTHORAX TREATMENT.

AFTER TREATMENT ANNIVERSARY 1	NO. OF CASES ENTERING EACH YEAR. 2	NO. LOST TRACE OR FOLLOW-UP ENDED. 3	CASES AT RISK 4	NO. DYING IN THE YEAR. 5	PROBABILITY OF SURVIVAL 6	1000 PATIENTS AT EACH ANNIVERSARY NO. ALIVE 7	NO. 8
0	318	9	309	2	$\frac{307}{309} = .99$	1000	
1	307	17	290	4	$\frac{286}{290} = .99$	990	10
2	286	48	238	5	$\frac{233}{238} = .98$	980	10
3	233	50	183	7	$\frac{176}{183} = .96$	960	20
4	176	49	127	2	$\frac{125}{127} = .98$	922	38
5	126	52	74	1	$\frac{73}{74} = .99$	904	18
6	73	33	40	0	$\frac{40}{40} = 1$	895	9
7	39	22	17	-	$\frac{17}{17} = 1$	895	-
8	17					895	

The extent of disease class in this division of cases is given in Table 43, page 100 If the 21 deaths in this division are related to this factor, it is found that 7 deaths occurred in Class I, 3 occurred in Class IIA, 5 occurred in Class IIB and 6 in Class III. The death rate in each class was 4%, 3%, 11% and 29% respectively. Three of the deaths occurred in the subdivision of cases where treatment was terminated because of healing. 97.8% of these cases (214) were expected to survive 5 years. Eighteen deaths occurred in the subdivision where pneumothorax treatment was terminated because of a complication or by default. 83% were expected to survive 5 years.

Morbidity.

The probability of remaining well can be estimated in a similar manner, and this is done in Table 50. Since discussion now concerns pneumothoraces and not patients, both sides of bilateral pneumothoraces are included as separate cases. Except for these bilateral cases, only the results of the initial period of treatment are included. The results of further treatment in unstabilised or relapsed cases are excluded. 289 of the 324 diseased lungs were stabilised by treatment. Approximately 70% of lungs which received treatment are expected to be healed after five years, and 71% of patients in this group are similarly expected to be healed after

TABLE 50

ANNIVERSARY OF CESSATION OF A.P.	NO. OF CASES ENTERING EACH YEAR.	NO. LOST TRACE OR FOLLOW-UP ENDED.	CASES AT RISK	NO. OF BREAK-DOWNS DURING THE YEAR.	PROBABILITY OF REMAINING WELL.	1000 PATIENTS AT EACH ANNIVERSARY	
						NO. WELL	NO. RELAPSED
DURING TREATMENT	324	-	324	35 (Not stabilised)	$\frac{289}{324} = .89$	1000	
0	289	8	281	15	$\frac{264}{281} = .94$	890	110
1	264	15	249	20	$\frac{229}{249} = .92$	837	53
2	229	43	186	12	$\frac{174}{186} = .94$	770	67
3	174	36	138	3	$\frac{135}{138} = .99$	724	46
4	135	37	98	2	$\frac{96}{98} = .98$	717	7
5	96	43	53	-	$\frac{53}{53} = 1$	703	14
6	53	27	26	-	$\frac{26}{26} = 1$	703	-
7	26	12	14	-	$\frac{14}{14} = 1$	703	-

5 years.

The relapses can now be related to the duration of pneumothorax treatment and this is done in Table 51.

As far as stabilisation of disease is concerned, there is a fall in the percentage of cases "not stabilised" as the duration of the pneumothorax increases. These "not stabilised" cases are usually associated with unplanned termination of treatment.

It is seen also that percentages of cases not stabilised were higher in the group whose treatment lasted eighteen months or less, than in the groups with longer treatment.

The number of relapses in stabilised cases roughly parallels this, but is high also in the group whose treatment lasted 2 years. From this, it seems reasonable to infer that two years is the minimum period required for pneumothorax treatment to be fully effective.

Overcrowding at Home.

This was assessed for each case at the time of commencement of treatment. As mentioned in Chapter 1, 324 (55%) were overcrowded and required to share a room, while 265 had a room to themselves. The conditions of the other cases could not be assessed. 174 of the 324 cases of Good Therapeutic Pneumothorax were overcrowded, a proportion of 54%. One third of this group, 58 cases, did not achieve stability or relapsed. 150 cases had a room to themselves. Of these 29 or 19% did

TABLE 51

DURATION OF PNEUMOTHORAX TREATMENT AND

RELAPSES. (GOOD THERAPEUTIC GROUP)

DURATION OF TREATMENT	ALL GOOD THERAPEUTIC PNEUMOTHORACES	NOT STABILISED	RELAPSES. NUMBER AND AS % OF STABILISED CASES.
- 6 months	44	15 34%	2 7%
- 1 year	47	7 15%	9 22%
- $1\frac{1}{2}$ years	58	6 10%	10 19%
- 2 years	56	3 5%	15 28%
- $2\frac{1}{2}$ years	33	2 6%	2 6%
- 3 years	42	1 2%	7 17%
Over 3 years	44	1 2%	7 16%
TOTAL	324	35 10.8%	52 18%

not achieve stability or relapsed.

I do not consider that overcrowding per se was responsible for this difference in the proportion of bad results, but rather that overcrowding can be considered as a measure of the social and economic state of the patient and his family. Nevertheless these figures emphasise that this form of treatment, where there is overcrowding and its attendant ills, carries a graver prognosis than where no overcrowding exists.

A better measure of the actual relapses after satisfactory treatment can be obtained by constructing a table showing the number of relapses in cases whose pneumothorax was terminated as planned because of healing. See Table 52.

Approximately 19% of cases where treatment terminated as planned could be expected to relapse before the fifth anniversary. In fact, 37 cases did so comprising 23 with originally cavitated disease and 14 where the original disease had not cavitated. The percentage of cavitated cases who relapsed is 17 since there were 134 cavitated cases in the group. The percentage of infiltrated cases who relapsed was 17 and there were 81 cases in the group. There is no difference between relapse rates in cavitated and infiltrated cases treated by "Good Therapeutic Pneumothorax."

TABLE 52

RELAPSES IN CASES OF PLANNED TERMINATION.

ANNIVERSARY OF CESSATION OF A.P.	NO. OF CASES ENTERING EACH YEAR.	NO. LOST TRACE OR FOLLOW-UP ENDED.	CASES AT RISK.	NO. OF RELAPSES IN THE YEAR.	PROBABILITY OF REMAINING WELL.	1000 PATIENTS AT EACH ANNIVERSARY No. Well.
0	225	2	223	14	.94	1000
1	209	11	198	14	0.93	940
2	184	39	145	7	0.95	874
3	138	31	107	1	0.99	830
4	106	34	72	1	0.99	822
5	71	31	40	-	1.0	814
6	40	21	19	-	1	814

The extent of disease in this group followed the same distribution pattern as with all "Good Pneumothoraces." 52% of cases were in Class I, 29% were in Class IIA, 14% were in Class IIB and 4% in Class III.

The cases which relapsed were distributed as follows: Class I - 49%, Class IIA - 27%, Class IIB - 22% and Class III - 3%. Rather fewer relapses occurred in Class I and Class IIA cases and rather more in Class IIB and Class III cases.

The fate of "Good Therapeutic Pneumothoraces" where treatment was terminated for reasons other than healing of disease is bad. Table 53 shows that only about 47% could be expected to be well after 5 years.

Thirty five of these cases defaulted from treatment and, as described in the previous chapter, 23 were regarded as stable. It seemed best to group the cases terminated for reasons other than healing, together because of the small numbers.

The effect of a complication on stabilisation and relapse.

As shown in Table 42, page 97, 290 or 89% of the 325 cases in the division of Good Therapeutic Pneumothoraces, were stabilised as result of treatment. One of these is still under treatment and so is excluded from follow up. 52 of the stabilised cases, relapsed during the follow up period, i.e. 18% of stabilised cases. This division includes pneumothoraces accompanied by a complication,

TABLE 53

ANNIVERSARY OF CESSATION OF A.P.	NO. OF CASES ENTERING EACH YEAR.	NO. LOST TRACE OR FOLLOW-UP ENDED.	CASES AT RISK.	NO. OF BREAK-DOWNS IN THE YEAR.	PROBABILITY OF REMAINING WELL.	1000 PATIENTS AT EACH ANNIVERSARY NO. WELL	1000 PATIENTS AT EACH ANNIVERSARY NO. RELAPSED
CESSATION OF TREATMENT.	110	0	110	35 *	$\frac{75}{100} = .68$	1000	320 *
0	75	6	69	2	$\frac{67}{69} = .97$	680	20
1	67	4	63	7	$\frac{56}{63} = .89$	660	73
2	56	4	52	5	$\frac{47}{52} = .90$	587	59
3	47	7	40	2	$\frac{38}{40} = .95$	528	26
4	38	8	30	2	$\frac{28}{30} = .93$	502	35
5	28	12	16	-	$\frac{16}{16} = 1$	467	-
6	16	6	10	-	$\frac{10}{10} = 1$	467	-
7						467	

* Not stabilised.

and those free of any complication. There were 208 without complication and all except 9 were stabilised, i.e. 96%. Subsequent relapses numbered 27, i.e. 14% of stabilised cases. Those accompanied by a complication numbered 116 and of these 26 or 22% were not stabilised. There were 25 relapses in this section or 28% of stabilised cases. It is apparent that the occurrence of a complication during treatment reduces the percentage chance of the disease being stabilised from 96 to 78, and doubles the percentage chance of relapse in those stabilised from 14 to 28. If the complication was severe enough to warrant termination of treatment, the effect was still more marked. 75 cases required this and 23 or 31% of these did not become stabilised.

The number of relapses is not calculated because a large number were admitted to hospital. If the pneumothorax could be continued as happened in 41 cases, only 3 or 7% did not become stabilised.

Obviously much depends on the severity of the complication. Spread of disease occurred in 50 cases in this group. 16 or 32% did not become stabilised and 15 or 44% of those stabilised, relapsed later. Five of the relapses occurred on the side treated by pneumothorax. This gives a 15% relapse rate where the disease was stabilised, a figure similar to that obtained in uncomplicated cases. In 51 cases, the complication was an effusion. Of these 8 or 16% were not stabilised and

8 or 19% of the stabilised cases relapsed. From this it is seen that the immediate effects of an effusion are much less serious than those of contralateral spread of disease as regards stabilisation, and the later effects as regards relapse are less serious still.

The influence of extent of disease.

As mentioned previously, 167 cases in this division of Good Therapeutic Pneumothoraces were in Class I, i.e., the disease involved only one Zone. 157 of these or 94% were stabilised by treatment and 22 or 14% of those stabilised, relapsed. Comparable figures for other classes are as follows. In Class IIA of 89 cases, 78 or 88% were stabilised and 13 or 17% relapsed. In Class IIB of 47 cases, 40 (85%) were stabilised and 14 (35%) relapsed. In Class III of 21 cases, 14 (67%) were stabilised and 3 (21%) relapsed.

As far as stabilisation is concerned, the percentage number decreases as the extent of disease increases. This does not seem to be due to the extent of disease per se, but rather to the effect of complications in more extensive lesions. The stabilisation rates for uncomplicated cases in the four classes of extent of disease are given now. In Class I there were 114 uncomplicated cases, 6 or 5% of whom were not stabilised by pneumothorax treatment. Class IIA figures are 55 cases, 2 or 4% not stabilised - Class IIB, 28 cases, 1 or 4% not stabilised, and Class III, 11 cases, 1 or 9% not stabilised.

The corresponding percentages for complicated pneumothoraces are, Class I 8%, Class IIA 26%, Class IIB 32%, Class III 60%.

Relapse presents rather a different picture. The percentage of stabilised cases who relapsed rises as the disease becomes more extensive. This rise is shared by both complicated and uncomplicated cases, but the percentages are much lower in the latter group. These are given in Table 54.

It will be noticed that the Class II cases behave similarly as far as stabilisation is concerned whether the disease is unilateral or bilateral. No such similarity of behaviour is noticed however when relapse rates are considered.

The combined unstabilised and relapsed cases for each class of disease are as follows:

Class I 32 bad results or 19%

Class IIA 24 bad results or 27%

Class IIB 21 bad results or 45%

Class III 10 bad results or 48%

These figures are given for purposes of comparison.

The Unsatisfactory Pneumothoraces of longer duration than three months, numbered 89, and this included eleven terminated because of healing. These have been included in the group terminated because of healing since their number is too small to justify separate analysis. Nevertheless it must be recorded that 8 of the eleven were

TABLE 54

RELAPSES IN GOOD THERAPEUTIC PNEUMOTHORACES

	CLASS I	CLASS IIA	CLASS IIB	CLASS III
COMPLICATED	10 (20%)	6 (24%)	8 (62%)	-
UNCOMPLICATED	12 (8%)	7 (13%)	6 (22%)	3 (30%)

well and working after follow up ranging from three to nine years. The overall follow up data of the 78 cases where the pneumothorax was terminated, either because of a complication, or because of default, or merely because it was unsatisfactory, is given in Table 55.

The fate of the group admitted to Hospital is very similar to that of those cases not admitted and the original extent of disease was also similar.

No useful purpose will be served by discussing this group of cases in detail. The number involved is comparatively small and only 25 or 32% were working. See Table 56.

The 25 patients now working comprise 12 not admitted to hospital after failure of artificial pneumothorax treatment. Three required admission later.

Five other cases were treated as out-patients by pneumoperitoneum, or streptomycin or in one case of Empyema, by Hyalase.

Eight cases required treatment in hospital.

TABLE 55

ULTIMATE FATE OF 78 UNSATISFACTORY PNEUMOTHORACES.

	ALL CASES	ADMITTED HOSPITAL	NOT ADMITTED
STILL UNDER TREATMENT	16 21%	6	10
DIED	34 44%	17	17
WORKING	25 32%	13	12
LOST TRACE	3 4%	3	-
	78	39	39

TABLE 56

SUMMARY OF RESULTS ACCORDING TO EXTENT OF DISEASE

	CLASS I	CLASS IIA	CLASS IIB	CLASS III	TOTAL
ALL CASES	18	34	18	8	78
DIED	9	13	6	6	34 44%
WORKING	6	11	6	2	25 32%
STILL UNDER TREATMENT	3	7	6	0	16 21%
LOST TRACE	0	3	0	0	3 4%

Follow up of Patients with Pneumothoraces of under three months duration.

It is difficult to compare the 98 patients in this group with other groups because of the short duration of treatment. I regard these pneumothoraces as incidents in the case history of the patients, although in 41 patients, attended by one of the described complications. See Table 41, page 96.

No cases of bilateral pneumothorax occurred here so that the number of cases, and of patients is the same.

It seems best to consider this group as divided into those suffering a complication and those free of complication. The former division can be compared with other groups suffering a complication. The latter division is very comparable to the group of failed inductions, and can be considered as part of that group.

A complication occurred in 41 patients whose pneumothorax lasted less than three months. 13 patients had Class I extent of disease, 19 Class IIA, 8 Class IIB and 1 Class III, and a summary of results is as follows. See Table 57.

This table is comparable to Table 56, and the results therein are also similar. This is as one would expect, the complication being to a large extent, the factor which determines the outcome in this division of cases.

Thirty two patients were admitted to hospital or

TABLE 57

PNEUMOTHORACES LASTING LESS THAN 3 MONTHS.

SUMMARY OF RESULTS IN COMPLICATED CASES.

	CLASS I	CLASS IIA	CLASS IIB	CLASS III	TOTAL
ALL CASES	13	19	8	1	41
DIED	3	10	6	0	19 (46%)
WORKING	6	7	2	0	15 (37%)
STILL UNDER TREATMENT	3	2	0	1	6 (15%)
LOST TRACE	1	0	0	0	1 (2.4%)

given other active treatment, and 8 were treated by rest at home. After a follow up of from 2 to 5 years, 17 of the 32 were dead, and 4 were still receiving treatment. Also 2 of the 8 were dead and 2 were still receiving treatment. After the same follow up period, the number of cases who remained well is 15 or 37% and this is of a similar order to cases of satisfactory pneumothorax where treatment had to be terminated because of a complication. (Page 124, Chapter 5.)

The remaining 57 cases of this group of pneumothoraces which lasted three months or less, did not experience any complication of treatment. 12 (21%) died and 25 (44%) became well and remained so.

This is a similar result to the overall result in the group whose pneumothorax inductions were unsuccessful. I have therefore combined these two groups to provide a life table, (Table 58), which shows that 69% of patients would be expected to survive 7 years after active treatment was completed in the first instance.

This is a heterogeneous group comprising patients who had no treatment and returned to work against advice, those who had rest in bed at home or in hospital, those who had other out-patient procedures such as Streptomycin, phrenic nerve interruption with or without pneumoperitoneum, those who had treatment along similar lines in hospital and those who had surgical procedures such as thoracoplasty or extra-pleural pneumothorax. It also includes 24 failed

TABLE 58

COMBINED GROUP OF FAILED INDUCTIONS AND UNCOMPLICATED PNEUMOTHORACES LASTING UNDER THREE MONTHS.

ANNIVERSARY OF TERMINATION OF INITIAL TMT. OR FAILURE OF A.P.	NO. OF CASES ENTERING EACH YEAR	NO. OF CASES LOST TRACE OR FOLLOW-UP ENDED.	NO. OF CASES AT RISK	NO. OF DEATHS IN THE YEAR.	PROBABILITY OF REMAINING ALIVE.	1000 PATIENTS AT EACH ANNIVERSARY	
						NO. ALIVE	NO. DEAD
0	155	8	147	3	.98	1000	-
1	144	6	138	11	.92	980	20
2	127	9	118	8	.93	902	78
3	110	14	96	4	.96	839	63
4	92	32	60	3	.95	805	34
5	57	18	39	2	.95	765	40
6	37	10	27	1	.95	727	38
7	26					691	

cases about whose treatment nothing is known. There is no purpose in subdividing this group according to treatment because of the small numbers involved, but it can be divided according to whether the case received further active treatment or not. 69 did receive such treatment at home or in hospital and a life table is given in Table 59.

Comparable figures for those cases not given active treatment after failure of pneumothorax attempt are given in abbreviated form in Table 60.

These groups are very similar as regards survival rates. The numbers involved are small and the slight unevenness in distribution of deaths in such a small sample, negatives in my opinion the differences in survival rates. Those receiving other treatment were on the whole more severely ill than those who did not. The former group contained 51 with more than one Zone involved against 39 in the other group. The morbidity in the two groups was very different however: only 22 out of 62 patients in the "No other treatment" group were working when their follow up ended. 40 patients in the "other treatment" group of 69 patients were working when their follow up ended.

I therefore propose to keep this combined group for comparison with the treatment groups and the overall results from these are shown in Table 61.

From this it is evident that the overall results of pneumothorax treatment where the pneumothorax could be

TABLE 59

SURVIVAL OF PATIENTS GIVEN ACTIVE TREATMENT AT HOME OR IN HOSPITAL OTHER THAN ARTIFICIAL PNEUMOTHORAX.

ANNIVERSARY	NO. OF CASES ENTERING EACH YEAR	NO. OF CASES AT RISK	NO. OF CASES ALIVE AT END OF YEAR.	PROBABILITY OF SURVIVAL	1000 PATIENTS No. ALIVE.
0	69	66	64	= .97	1000
1	64	63	60	= .95	970
2	60	55	50	= .91	921
3	50	40	39	-.98	838
4	39	24	22	= .92	821
5	22	12	12	= 1	755
6	12	8	8	= 1	755
7	8				755

TABLE 60

ANNIVERSARY	NO. OF CASES ENTERING EACH YEAR.	NO. OF DEATHS EACH YEAR	PROBABILITY OF SURVIVAL	1000 NO. ALIVE	PATIENTS NO. DEAD
0	62	1	.98	1000	20
1	56	6	.88	980	118
2	45	2	.95	862	43
3	39	2	.95	819	41
4	34	0	1	778	0
5	19	1	.93	778	54
6	13	1	.90	724	72
7	8			652	

TABLE 61

OVERALL RESULTS ACCORDING TO NATURE OF TREATMENT

	NO. OF CASES	MORTALITY	WELL AND WORKING.
No Pneumothorax treatment.	131	26 20%	62 47%
Unsatisfactory Pneumothorax treatment	89	33 37%	33 37%
Satisfactory do.	318	21 7%	263/324 * 73%

* There were 324 pneumothoraces in 318 patients.

classed as "Good" are better than the overall results where active treatment other than this was given, and very much better than where the pneumothorax was unsatisfactory.

The effect of Pregnancy.

During the course of this study, 71 patients became pregnant. Thirty six pregnancies occurred during the course of treatment, and thirty five occurred during the follow up period. The after history of these women will now be considered, and those occurring during treatment will be taken first.

In six patients, the pneumothorax was in the unsatisfactory division. All had unilateral disease originally in both Class I and Class IIA. In two cases the pneumothorax lasted less than 3 months and neither of the patients were stabilised when their follow up ended 1 and 6 years later respectively. The other four cases were treated as follows. One had a pneumothorax for 10 months. After five months treatment, Abdominal Hysterotomy was carried out when she was four months pregnant. She had to be re-admitted to hospital three months later because of a spread of disease into the other lung. Fortunately she became stabilised and was well and working 7 years later. Two other pneumothoraces were terminated because of the pregnancy. One of these also had contralateral spread of disease and she was still under

treatment three years later. The other did not experience a complication other than the pregnancy but died after three years because of unstabilised disease.

The fourth case was confined after $2\frac{1}{2}$ years pneumothorax treatment. This was continued a further 6 months and terminated by healing. This patient was well on her third anniversary.

Thirty pregnancies occurred with a "Good" pneumothorax. Six of these pneumothoraces were accompanied by a complication. In three of the six, this complication followed confinement. Two of the three were still under treatment three years later but the third was well on her 5th Anniversary.

In the other three of the six pneumothoraces, the complication preceded confinement. One was still under treatment 3 years later, one was stabilised but her contralateral disease relapsed, and one had a second pregnancy and was well on her 4th Anniversary. The remaining 24 "Good" pneumothoraces with pregnancy were unaccompanied by any other complication.

Two defaulted from treatment, one before confinement and one after. One of these died 1 year later and the other was still receiving treatment 3 years later, when last contacted. As mentioned in Chapter 3, Table 33, 2 pneumothoraces were terminated because of "healing" but the termination was accelerated by pregnancy. Both patients were well 5 years later.

Four other cases were classed in Table 34 as terminated because of a complication - the complication being pregnancy. Two of these had artificial pneumothoraces for 18 months and were well 3 years later. The other two had pneumothorax treatment for only 6 months. Both suffered relapses or were unstabilised. Each of the remaining 16 patients in this group experienced a normal pregnancy and confinement during the course of an uncomplicated artificial pneumothorax. Treatment was continued for some time after confinement, and indeed three cases had a second pregnancy during treatment. In all cases, the pneumothorax was terminated because of healing but regrettably, two cases relapsed within two years. One relapse followed a fourth pregnancy since tuberculosis was diagnosed, the other had no special feature.

The number of cases is rather small to allow of comparisons except of the broadest nature. The 30 patients with "Good" therapeutic pneumothoraces who became pregnant can be compared with all "Good" therapeutic pneumothoraces.

Twenty of the 30 patients, i.e. 67% remained well compared with 73% of all cases as shown in Table 61. The sub-group of 22 who had no complication excluding those who defaulted, were 91% stabilised (20 cases). Another 2 (10%) relapsed afterwards. These figures seem to suggest that pregnancy accompanying a good pneumothorax does not

alter the prognosis warranted by the disease itself.

I turn now to the 35 women whose pregnancy occurred after treatment had terminated. Twenty five were associated with pneumothoraces terminated because of healing. Of these 5 (20%) relapsed after confinement. None relapsed during pregnancy. The gross relapse rate of all cases terminated because of healing is 16% (37 out of 225 cases.)

The remaining 10 pregnancies followed pneumothorax treatment terminated because of a complication. Four were not stabilised and three of them developed further spread following confinement. The fourth had had a thoracoplasty and is now a chronic case. Six were considered stable despite the complication. Three are well after 3, 4 and 5 years and three required further treatment after confinement.

These figures suggest that pregnancy occurring after the disease was considered healed, does not alter the relapse rate. But where pneumothorax treatment was not concluded because of healing, pregnancy has an unfavourable effect.

SUMMARY OF CHAPTER 5.

This chapter deals with the follow up of all cases. This began when treatment ceased or the induction of a pneumothorax failed. Each case was reviewed at yearly intervals thereafter and the period ranged from 0 to 10 years.

The mortality among the 503 patients was 86 or 17.1%. The distribution of this among various treatment groups is shown, and a life table is included. This shows that 10.5% of patients treated by Good Therapeutic Pneumothorax may be expected to die before the 6th Anniversary (21 deaths.) Only 3 deaths occurred in the sub-group where treatment was terminated because of healing.

The morbidity rate is next considered and Good Therapeutic Pneumothoraces are discussed first. Of the 324 cases who started treatment, 35 were not stabilised (i.e. 11%) and a further 52 (18% of Stabilised cases) relapsed. A similar table to that used for mortality, shows that 70% are expected to be well and working after 7 years.

The influence of the duration of the pneumothorax is discussed and an optimum period of at least 2 years suggested.

225 pneumothoraces were terminated because of healing. 37 (19%) relapsed, mainly before the second anniversary.

No difference was noted in the relapse rates of cavitated and infiltrated cases. More relapses occurred where the original disease was bilateral, than where it was unilateral.

If a complication occurs, the chance of the disease being stabilised is reduced from 96% to 78% and the chance of relapse increased from 14% to 28%. The effects of effusion and contralateral spread are compared.

Where the original disease was of Class I extent, 96% were stabilised. As the disease became more extensive, so the rate fell to 67% of Class III cases. This is principally due to the rise in the percentage of complications in more extensively diseased patients. Relapse rates also rose as the disease became more extensive but this was independent of the occurrence of a complication.

Seventy eight unsatisfactory pneumothoraces lasted longer than three months, and were terminated either because of a complication or default. Only 25 or 32% were well and working when their follow up ended.

98 patients had pneumothorax treatment for less than 3 months. 41 developed complications and their fate is similar to those with unsatisfactory pneumothoraces terminated because of a complication. 46% were dead and 37% working. 57 did not develop a complication and they are considered together with the group of cases where induction of a pneumothorax was unsuccessful.

69% of these patients are expected to be alive on the 7th Anniversary. Where further active treatment could be given, 75.5% survived but where no further active treatment could be given, 65% survived 7 years. Reasons for this difference are given.

The effect of pregnancy is discussed.

CHAPTER 6

OCCURRENCE OF CONTACT CASES.

CHAPTER 6

During the course of this study, it occurred to me that the Public Health aspect of domiciliary treatment should be investigated in order to determine if possible, whether there was any increased risk with this method to the other inmates of the house. It is the duty of clinic chest physicians and Health Visitors to try to teach patients how to limit the spread of tubercle bacilli. The Health Visitor also tries to teach the rest of the household how to protect themselves as well as possible.

Obviously after a case is removed to hospital and no other case has occurred in that household, there should be little or no likelihood of further disease in that family from that source. Yet Deeny (1947) showed that tuberculosis in an urban community tends to spread in small localised epidemics involving the patient's house and neighbouring houses. In his series, houses were not the tenement or flatted properties which form the bulk of houses in this city, but consisted of individual terrace houses. This gives a population density much less than in Glasgow, and a more effective house isolation.

In theory, a case of active pulmonary tuberculosis lying at home and producing tubercle bacilli, is a possible source of further infection in the household.

However it could be argued that given reasonable home conditions for isolation of the patient, good Health Visitors to teach hygiene, and treatment which rapidly brings the disease under control, the risk becomes minimal.

To attempt an investigation into the Epidemiology of Tuberculosis along the general lines suggested by Deeny, is outwith the scope of this study. Indeed it soon became apparent that many difficulties stood in the way of the collection of information even for a very modified survey.

The first difficulty was the frequency with which many patients changed their addresses. This made it impossible to obtain full details of the number of contacts and environmental conditions of the study cases in question. A "study" case is any one of the 596 patients considered for artificial pneumothorax treatment in this scheme. It was decided therefore, to limit the search for contact cases to those occurring in the same house as the patient. The next difficulty was the lack of routine examination of contacts. In Glasgow, during the period of this study, the facilities for radiology available to the chest clinics were very limited. There were two units operating. One was at Ruchill Hospital. This unit served the Infectious Diseases Hospital, and the 300 bed sanatorium wing, two

chest clinics and had other minor committments. The other unit was at Florence Street Clinic. It was smaller, served the remaining 3 city chest clinics, the chest clinic in Rutherglen, and had numerous other minor committments. With these facilities it was obviously impossible to offer chest radiography to all contacts. Therefore this examination was only offered to the immediate contacts of new sputum-positive patients. With very limited laboratory facilities also, most sputa were examined only by direct smear, so that obviously a considerable number of contacts of active cases were not examined. It is extremely difficult to estimate the number of contacts examined during this period, but from scrutiny of X-Ray request cards I should say not more than 20% of contacts were examined.

Cuthbert (1954) showed that only 66% of contacts in Leicester could be expected to respond to the offer of Chest Radiography. But here, with our poorer facilities, the figure is 20% as mentioned.

The contact cases with which we are concerned here, were diagnosed on examination either because of symptoms, or because they were contacts of sputum-positive patients. Information about these cases was obtained as follows.

An Index of Houses in Glasgow is maintained by the Health and Welfare Department. On this is recorded the name and date of notification of each registered case of tuberculosis at that address so that all cases

of tuberculosis which have occurred in any particular house can be ascertained. The address card or cards of each study case was consulted, and a note made of those cases where tuberculosis was notified in the same household subsequent to the notification date of the study case. Following this, case sheets, Health Visitors records, and certain cases themselves were consulted. Selection of these contact cases was made thereafter.

Certain principles were followed.

1. Since the period in the history of the case about which I was concerned, was that during which the patient was under treatment at home, all contact cases notified prior to three months after the induction or attempted induction of the pneumothorax were discarded. When it was apparent also, that the probable duration of disease in the contact case indicated a time of infection earlier than the time artificial pneumothorax was attempted in the study case, that contact case was discarded. No definite time limit could be fixed at the other end.

The second principle was that the contact case must have been infected by the study case within the period previously mentioned. In some households, the study case was not the only tuberculous patient at the time the pneumothorax was attempted. In these households, if another case occurred subsequent to the attempt at pneumothorax treatment, there was obviously great doubt

as to the source of infection. I therefore decided that if another tuberculous patient on the active register had lived in the household within a period of up to 6 months prior to the attempt at pneumothorax induction, then no subsequent case could be counted.

A small group of three contact cases were found in circumstances which suggested that they were infected by a case other than the study case. In two of these, the study cases had been well for 4 and 5 years respectively after cessation of treatment, when a child of each developed a primary infection. These two study cases remained well for a further 2 years each. The third study case was admitted to hospital because pneumothorax failed. He was discharged still active and died 1 year later. The contact case here was notified 8 years after his death and the disease appeared to be of recent origin.

I decided that a reasonable sample of contact cases would be provided by investigating all study cases from three of the five city chest clinics. Two of these lay to the North of the River Clyde, one to the South, and the number of patients involved was 412 or 69% of the whole study. Forty four contact cases were noted and investigated. Application of the principles mentioned previously reduced this number to 23 to be considered in more detail. These cases are listed in an appendix.

Six contact cases were associated with patients

treated in hospital. Treatment in hospital occurred in two ways. Either the attempt at Artificial Pneumothorax failed, and patients were admitted three to six months later, or the pneumothorax was unsatisfactory, abandoned within three months, and the patient admitted similarly.

72 of the 412 patients investigated belonged to this group, so that the 6 contact cases give a rate of 8%. Four of the 6 were infected during the waiting period (i.e.6%) and two were infected after discharge from hospital. In five of the 6 households the patient had to share his room. Three of the 4 contact cases infected during the waiting period came from these overcrowded houses.

Two contact cases occurred in association with study patients who had had over six months out-patient treatment, and who then were admitted to hospital because of a complication. Both cases were discharged unstabilised, and both contact cases occurred subsequent to discharge.

One household could isolate the study case in a separate room but in the other household, the patient had to share a room although having his own bed. There were 41 cases treated similarly in the study group which gives a contact case rate of 5%.

Fifteen contact cases occurred in association with study cases treated as out-patients. There were 299 study cases in the group similarly treated which again gives a contact case rate of 5%. Ten of the fifteen contact cases

were infected after cessation of pneumothorax treatment, and were not notified until after the patient was known to have relapsed. The other five contact cases were apparently infected during the course of pneumothorax treatment, a rate of 1.7%.

Two main points would seem to arise out of these figures. Firstly: Untreated patients at home or patients receiving treatment which is inadequate (as estimated by the necessity for admission to hospital), produce contact cases at the rate of 5%. Secondly: Patients receiving apparently satisfactory pneumothorax treatment at home produce contact cases at the rate of 1.7%.

Housing conditions in relation to contact cases.

These conditions were assessed when the patient was initially considered for out-patient treatment. If sputum-positive and overcrowded, the patient and his family became eligible for priority rehousing under a scheme of the Corporation of Glasgow. Few were rehoused in less than nine months. Usually the waiting period, particularly in the most grossly overcrowded cases, was around eighteen months and often more since fewer large houses were built.

Table 62 shows that a higher proportion of contact cases came from over-crowded households than from non-overcrowded ones. It also confirms that those cases receiving active home treatment caused fewer contact cases than patients not receiving active home treatment.

TABLE 62

COMPARISON OF HOUSING CONDITIONS

	NOT OVERCROWDED	OVERCROWDED
ALL STUDIED CASES	168	244
ALL CONTACT CASES	5 3%	18 7.4%
STUDIED CASES TREATED ONLY BY PNX.	124	175
CONTACT CASES OF THESE	3 2.4%	12 6.9%
STUDIED CASES TREATED OTHERWISE	44	69
CONTACT CASES OF THESE	2 4.5%	6 8.7%

The estimated time of infection of the contact case can be related to the type of treatment received by the study case. If a contact case had been infected during the waiting period for hospital or during the course of pneumothorax treatment, it was regarded as having been infected "earlier". Where infection occurred after completion of treatment or during relapse of the disease, the contact case was infected "later". Using this description, 9 contact cases occurred "earlier" and 14 occurred "later". Five of the nine were associated with 299 patients given out-patient treatment only, i.e. 1.7% and four were associated with 113 patients treated by other means, i.e. 3.5%. In a similar manner, 10 "later" cases were associated with 299 treated as out-patients only, i.e. 3.4% and 4 "later" cases were associated with 113 patients treated otherwise, i.e. 3.5%.

From this it would appear that early transmission of infection is largely controlled by effective pneumothorax treatment.

It is interesting to note that the small group of 41 cases who had mixed treatment, i.e. were admitted because of a complication, produced 2 contact cases. Both occurred in the "later" group. It seems that pneumothorax initially controlled the disease at least partially, before the all-important complication occurred which necessitated admission.

It would seem therefore, that the risk of infection at home from patients treated by Artificial Pneumothorax as out-patients, is small. It is necessary, however, that the disease should be controlled rapidly by treatment, and that the patient should have a room to himself. It is also important that the Health Visitor should be able to teach both the family and the patient how to prevent the spread of infection.

CHAPTER 7

DISCUSSION

CHAPTER 7

I have endeavoured to give a detailed account of a scheme of treatment of pulmonary tuberculosis, by out-patient artificial pneumothorax, and to analyse the results obtained. In this discussion these results will be compared with those obtained by other workers, and I shall show, I hope, that this scheme has been worth-while. This is not the only out-patient treatment scheme which has been established, but as far as I am aware, it was the first in this country. Other schemes have been reported by Heller (1949), Cuthbert (1950), Toussaint (1951), Rist (1954) and Stradling (1955) and there were others in Belgium and Spain. No other scheme is strictly comparable with this one, and the differences will be mentioned when considering individual reports. The results of more orthodox lines of treatment reported by other workers will also be considered.

Such reports deal with surveys of patients who received their preliminary treatment in hospital, and, when considered ready, had artificial pneumothorax induced. They were retained in hospital thereafter for long enough to have thoracoscopy performed if necessary, and long enough for complications associated with pneumothorax to have occurred. As a result, when discharged, these patients had, on the whole, satisfactory pneumothoraces and disease probably stabilised. For comparison,

I shall use the "Good Therapeutic Pneumothorax" division of cases in the main.

Heller (1949) started his scheme in 1945 for similar reasons to those here. Artificial Pneumothorax was only one of the methods used, and the cases were carefully selected after preliminary bed rest, with or without pneumoperitoneum. 50 cases were considered for artificial pneumothorax, 3 inductions failed and 14 were abandoned shortly afterwards because they were unsatisfactory.

33 pneumothoraces were of therapeutic value, and 27 or 82% had returned to work when the article was written. 89% of cases in the comparable division of this study returned to work.

Cuthbert (1950) preferred to commence "Domiciliary Treatment" by pneumoperitoneum or phrenic nerve interruption. Artificial pneumothorax was only employed after the disease had passed the acute phase. No results are given in his article.

Rist, in America, started his small scheme in 1944. Seven patients were admitted to a private hospital, had collapse therapy started and were discharged to have refills in his private "office". Encouraged by the results, he continued until 30 patients had been treated under similar circumstances. Unfortunately his original article which deals with the first seven cases is unobtainable, but it is summarised in the second article

(1954) which continues to deal with the other 23 cases. No details of the pneumothorax, of stabilisation or of follow up are given. None of his 30 cases were under 20 years of age. Thirteen were between 20 and 30 years, 10 were between 30 and 40 years and 7 between 40 and 50 years. They were in an older age-group than the cases in this series, and the number with more extensive disease was greater. Two were in Class I, 11 in Class IIA, 3 in Class IIB and 14 in Class III. Four Class III cases were treated by pneumoperitoneum but as out-patients. In all 17 or 57% were returned to work without requiring other forms of treatment. 77% of cases with unilateral disease (10) and 41% of cases with bilateral disease (7) were in this group.

Details of the meaning of these results are lacking, and the number of cases is small, but for comparison, 78% of our cases with unilateral disease were well and working at their last follow up. Of our bilateral cases, 54% were similarly well and working.

In London, Toussaint, the Senior Chest Physician in his area, has been operating a scheme of domiciliary treatment since September 1946. Between then and June 1949, 70 patients had treatment by Artificial Pneumothorax begun. Eleven had a period of hospital treatment because of some complication. The duration of in-patient or out-patient treatment is not mentioned, but 60 cases (86%) were well and working in June 1954. This result appears

better than that achieved in Glasgow where the overall percentage of those well and working when their follow up ended was 73%.

The differences between the two series are of great importance. All of Toussaint's pneumothorax cases were very rigidly selected. (1) He required good home conditions suitable for the provision of an initial period of 6 months bed-rest, and with facilities for isolation of the patient. (2) The disease had to be unilateral and preferably confined to the upper zone. Cavitation, if present, was "not large" and toxaemia was absent. (3) He also notes "I have experienced little difficulty in the provision of home helps". The situation here has been exactly opposite for many years.

As mentioned in Chapter 5 page X 81% of Good Therapeutic cases in this series were stabilised where there was no overcrowding, and only 67% where overcrowding existed. On Page X is mentioned that 19% of Class I cases were unstabilised or relapsed, i.e. 81% were well and working. In this class of 167 cases, 82 were not overcrowded, and of these 3 were not stabilised. In addition, 10 cases relapsed. Sixty-nine were well and working, i.e. 84% a figure very close to the 86% of 70 cases obtained by Toussaint, without allowing for the effect of initial bed rest.

He also mentions the occurrence of contact cases from patients in his scheme, and his figures are interesting.

His method of selection is not mentioned, but from his 70 pneumothoraces, no subsequent contact case occurred by mid 1951. From his 126 patients with pneumoperitoneum, 10 cases (8%) occurred. This can probably be ascribed to the more rigid standards of selection of pneumothorax cases especially as regards housing, and possibly to the quicker control of the disease achieved by pneumothorax.

Stradling (1955) describes his scheme of "Clinic Management". This is not an out-patient treatment scheme such as the others which have been mentioned. His scheme is one of short-term admission to General Hospital beds which are under Chest Clinic direction. The purpose of admission is to institute collapse therapy or deal with some factor which cannot conveniently be done at home. He describes 64 cases treated along these lines but they cannot conveniently be compared with those in this study.

The other groups of cases with which I wish to make some comparisons, all received preliminary treatment in hospital by rest and had their pneumothoraces induced there. No doubt they would be retained long enough to ensure that the pneumothorax was effective. Early complications, if any, would have occurred in hospital so that after discharge, these pneumothoraces could be expected to produce fewer complications than those in this study. It should also be remembered that in most cases, the follow up period dated from discharge from hospital and

not from the termination of treatment.

Scadding, Nicholson and Hoyle (1951) reviewed 54 pneumothoraces in 50 patients, which were all under the care of one physician. Five years after induction, 76% were well and 14% were dead.

Harris, Poles and Anderson (1952) followed up 315 cases of Artificial Pneumothorax terminated because of healing. The follow up period ranged from 6 months to 5 years and they found an overall breakdown rate of 10.2%. From their figures it is possible to calculate the "expectation of remaining well" as has been done in Chapter 5. If this is done 84% would be expected to be well at the 6th Anniversary compared with 81% in this study. (Table 52 page 123).

Foster-Carter, Myers, Goddard, Young and Benjamin (1952) reviewed the patients discharged from the Brompton Hospital and Frimley Sanatorium during 1934 to 1942. Five years after discharge, the survival rate after satisfactory pneumothorax treatment for cavitated disease, was 86%. In this study the rate is shown on page 115 to be 89%.

It should be noted that this was a selected group from a rather better social class than the average case treated in an erstwhile Local Authority hospital. In addition they were seen by a physician to the Brompton Hospital, and considered likely to benefit from treatment there and later at Frimley Sanatorium. Nevertheless one

third of the combined "Satisfactory" and "Adherent Satisfactory" groups of cases required further treatment after completion of the pneumothorax. Two thirds (67%) remained well. In this study, a similar division of pneumothoraces was called "Good" and 26.5% were left unstabilised by treatment or relapsed afterwards i.e. were considered to require further treatment. Put another way, according to the "expectation of remaining well" Table, (Table 50, page 119) 70% are expected to be well and working 5 years after termination of pneumothorax treatment.

The group of Unsatisfactory pneumothoraces are mentioned in the report by Foster-Carter and his colleagues. Of these, 46% of cavitated cases survived five years. In this series the figure of 54% who survived 5 years applies to both cavitated and infiltrated unsatisfactory pneumothoraces. This difference of 8% is probably caused by the inclusion in this study series, of the infiltrated cases, and by the smaller number of Class III cases. One conclusion from the Brompton Hospital series is that the result of treatment of cavitating disease by unsatisfactory pneumothorax is worse than where no pneumothorax was employed. With this I agree and would include infiltrated disease also.

Roberts and Lyons (1955) reviewed 394 cases discharged between 1942 and 1948 from the Grosvenor Sanatorium, Kent, with an artificial pneumothorax. The

overall mortality in each class of their cases is compared with figures referable to this study in Table 63.

I cannot compare the follow up period because our cases begin their follow up at termination of pneumothorax while the Grosvenor series begin their follow up on discharge from hospital. It is likely that the periods will be comparable, although their pneumothoraces were maintained longer than ours. The Grosvenor series of cases are those discharged from hospital with an artificial pneumothorax. These probably correspond to the Good Therapeutic Group with some of the early complicated cases deleted.

Roberts and Lyons do not give the figures of all their cases who required further treatment. They note however as regards their "recent" group i.e. cases induced between 1946 and 1948, that 60 out of 82 unilateral pneumothoraces (73%) were well and working without additional treatment. The follow up was from 5 to 7 years after discharge from hospital. In view of this, and of the duration of their pneumothorax treatment, a comparable period would be 3 to 5 years from the termination of treatment as in this series. Comparable figures to Roberts and Lyon's 73% are my 72.4% and 70.3% for 3 and 5 years respectively.

I think it apparent, that the results of treatment obtained in this study, with "Good Therapeutic Pneumothoraces" are comparable with results of pneumothorax

TABLE 63

MORTALITY IN EACH CLASS OF DISEASE

	CLASS I	CLASS II	CLASS III
GROSVENOR SANATORIUM SERIES			
No. of Cases	43	195	156
DEATHS	2 4.7%	10 5.1%	29 18.6%
THIS SERIES			
No. of Cases	167	136	21
DEATHS	7 4.2%	8 5.8%	6 28.6%

treatment obtained elsewhere. These results have been obtained despite several unsatisfactory features of the scheme, and if these are remedied, domiciliary treatment under clinic management can provide a very effective method of treatment. One of the criticisms of this scheme referred to the idea of "Crash Pneumothorax" which was employed here. Active pulmonary Tuberculosis having been diagnosed, the patients were subjected as urgently as possible to Artificial Pneumothorax without any preliminary rest in bed. The strange thing is that results were no worse, and it would seem that insistance on strict and prolonged bed rest is unnecessary. Now, preliminary chemotherapy and rest in bed at home for a short period is advised before collapse measures are instituted.

Another criticism referred to the unsuitable social conditions of many patients, as far as out-patient treatment was concerned.

The Medical Officer of Health's report for 1952 estimated that 47% of houses in Glasgow were of one or two apartments and 28% of people in Glasgow were living three to a room. Facilities for isolation were often non-existant; washing and cooking arrangements were primitive; and communal toilets abounded. Cases living under such conditions should have been treated in hospital, but there were few beds for them even with very great priority on the admission roster. Patients

living in such circumstances can now be admitted reasonably promptly to hospital and there is no need for such unsuitable cases to have purely out-patient treatment. Unfortunately the rehousing of such cases still lags far behind the need.

For unknown reasons, pneumoperitoneum was late in obtaining favour in this area. In one area of the city pneumoperitoneum was commonly employed after 1949, but prior to this it was very seldom used as an out-patient procedure ab initio. Many of the cases in this series would probably have done better if treated, at least initially, by pneumoperitoneum.

Young (1949) has emphasised the necessity for continuity of management.

This is one of the advantages of a scheme such as Stradling's "Clinic Management" and although a high proportion of cases in this study enjoyed continuity of control, many did not. Change of control occurred on admission to or discharge from hospital, and on transfer to a different area of the city. During the Survey period the staff in all Glasgow clinics except one, changed, especially during the period 1947-48. Each clinic served a population of 200,000 approximately. In 1945 there were 6 full time physicians and one half time physician in the service. In 1948 the number had risen to 8 when the National Health Service started. There are now (1955) 15 whole time physicians and one part-

time physician in the city clinics.

The effect of chemotherapeutic drugs such as Streptomycin, Para Amino Salicylic Acid and Isoniazid has been to improve the prognosis for patients suffering from this disease to a very great extent. Their beneficial effect has been felt particularly as a preparation for either collapse or resection techniques. Pneumothorax in suitable cases produces excellent results and may be expected to produce better results still when combined with these drugs. Adequate out-patient treatment of tuberculosis is obviously of great importance today. Prolonged hospital treatment of any disease is undesirable from the patient's point of view and a form of treatment which gives a reasonable chance of cure combined with a reasonable life, is obviously more cheerfully accepted by the patient than prolonged isolation from friends and family. Undoubtedly too, a certain stigma still is attached to a patient who has had prolonged treatment in hospital.

Out-patient pneumothorax which has given reasonably good results in the past, has an even better future ahead of it thanks to chemotherapy and better selection of cases. Chemotherapy with bed rest is now established as the first step in active treatment. It has greatly reduced the incidence of undesirable complications, which were the biggest drawbacks to Artificial Pneumothorax treatment. The incidence of

empyema, already low in this series, has been abolished entirely since about 1950. Major effusion rarely occurs and spread of disease while under treatment is also uncommon.

Obviously there is now no justification for attempting this form of treatment in unsuitable cases, and, after preliminary measures, a proper selection must be made. The disease should be non-fibrous in nature and of recent origin. It should be unilateral involving less than 3 zones, and should be reasonably quiet and not in an acute spreading phase. The patient's home conditions must permit of a separate room being allotted for his use. There must be full toilet, washing, and cooking facilities available.

Surgery is now so readily available that the unsatisfactory pneumothorax becomes a thing of the past. When required, thoracoscopy, adhesion section, and phrenic nerve interruption can be carried out without any delay, and normally not more than 3 months should be required to establish a good pneumothorax where possible. Ideally a few beds should be reserved in hospital for special procedures on out-patients, and these should be under the direction of the clinic team. These could then be used for induction of Artificial Pneumothorax and for minor surgical procedures associated with this treatment.

Continuity of management is of great importance.

It can be achieved easily in an out-patient treatment scheme where the same team is responsible for the patient both at the clinic, and during his necessary but short periods in hospital. The patient benefits from the continuity of ideas and policy in his case, while the physician benefits from the clinical experience gained because the patient is constantly under his care.

I do not claim that out-patient artificial pneumothorax can be universally employed. I am certain, however, that out-patient methods can be used in many cases, and that where indicated, artificial pneumothorax under such conditions, gives results at least as good as those given by any other method of treatment.

APPENDIX A

CASES OF TUBERCULOSIS AMONG CONTACTS OF 412 STUDY PATIENTS

Contact Case No.	Relationship to Study Case	Housing State of Family	Treatment Group	Estimated Time of Infection of Contact Case.	
				Earlier	Later
1	Sister (23)	Own Room	In-Patient	D W P	
2	Son (2)	Over-crowded	"		A D H
3	Son (6)	"	"	D W P	
4	Son (3)	"	"	D W P	
5	Son (8/12)	Own Room	Combined In and Out Patient		D. Rel.
6	Brother (19)	Over-crowded			D. Rel.
7	Son (9)	"	In-Patient	D W P	
8	Brother	Own Room	Out-Patient	D A P	
9	Sister (23)	"	"	D A P	
10	Fiance	"	"		D. Rel.
11	Husband	Over-crowded	"		D. Rel.
12	Daughter (3)	"	"		D. Rel.
13	Brother (19)	"	"		D. Rel.
14	Sister (26)	"	"		D. Rel.
15	Wife	"	"		D. Rel.
16	Son (16)	"	"		D. Rel.
17	Son (13)	"	"	D A P	
18	Nephew (23)	"	"		D. Rel.
19	Son (20)	"	In-patient		D. Rel.
20	Sister (19)	"	Out-Patient	D A P	
21	Brother (20)	"	"		D. Rel.
22	Brother (19)	"	"	D A P	
23	Brother (2)	"	"		D. Rel.

ABBREVIATIONS -

D W P = During waiting period for admission

D A P = During pneumothorax treatment

D. Rel. = During relapse after treatment

A D H = After discharge from hospital

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