A Paper

ON

SOME PRACTICAL POINTS IN THE TREATMENT
OF PULMONARY TUBERCULOSIS BY
ARTIFICIAL PNEUMOTHORAX

BY

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The idea of treating pulmonary tuberculosis by collapsing the diseased lung was mooted as long ago as 100 years. Except in isolated cases it was not carried into practice until in 1894 Forlanini and Murphy of Chicago introduced it as a therapeutic measure. It remained comparatively neglected until Branner, Spengler, and others took it up and employed it in the treatment of pulmonary tuberculosis on an extensive scale. It was not till some years after the war that English physicians realized its value, and it is only in the last fifteen years or so that it has been widely used in Great Britain.

Although we have the experience of some fifteen years with which to form some estimate of its value and the type of case in which it is applicable, yet even now there is no unanimity of opinion on either point, even among those whose experience is sufficiently wide to render their opinion of value. We meet with all shades of opinion. At the one extreme there are those who maintain that it is valueless in any case, and at the other those who would urge it in every case as soon as a definite diagnosis of tuberculosis of the lung is established. It would appear that the truth lies midway between these extremes, and that although, as Sir James Kingston Fowler has truly said, "artificial pneumothorax is the only advance in the treatment of pulmonary tuberculosis since the introduction of sanatorium treatment as carried out at Nordach," yet the advance, great as it is, is only applicable in something like 5 per cent. of cases. Ninety-five per cent. of sufferers from pulmonary tuberculosis have still to be treated by the old methods of diet, hygiene, and climate. Very great care must be taken in selecting cases for this treatment if it is to maintain its place as the valuable therapeutic measure which all the available evidence, if carefully sifted, indicates that it is. It is not an easy matter to be dogmatic and to lay down hard-and-fast rules for guidance as to the suitability or otherwise of any particular case for artificial pneumothorax treatment. No two cases of pulmonary tuberculosis are identical, and the interpretation by the physician of what he finds clinically, or by the radiologist of what he sees, is subject to so great a personal variation that all that can be done is to indicate on broad lines the chief factors that must be considered in determining this point.

UNILATERAL DISEASE AS A CRITERION

Only those cases in which the disease is unilateral or mainly unilateral are suitable for pneumothorax treatment. At this stage it might appear unnecessary to stress so obvious a point. There are still, however, not a few who would urge collapse of the worse side when the disease is bilateral, or who would, when it is impossible to determine which side is the worse, induce partial collapse of both sides simultaneously. With regard to the latter procedure—that is, bilateral simultaneous artificial pneumothorax—it is difficult to see any justification for it either in theory or judging from such results as are available. Collapse of the worse side when there is appreciable disease on the contralateral side has not in my hands, nor in the hands of many other observers,

yielded good results. Considerable disease on the contralateral side is therefore a definite contraindication to collapse therapy.

Determination of Presence or Absence of Disease on the Other Side

In arriving at a decision in this matter two important points must be borne in mind.

1. The fact that no abnormal physical signs can be detected in the contralateral lung does not indicate that there is no disease in it. It is well recognized that a radiogram of a tuberculous lung will nearly always show more extensive disease than the physical signs indicate, and may indeed show infiltration of the lung where no abnormal physical signs are demonstrable.

2. The presence of crepitations at the contralateral apex does not of necessity indicate the existence of disease at that site. Not infrequently such crepitations are conducted from the opposite side. Here again an *x*-ray is the only reliable means of deciding the point.

It should be clear, therefore, that a radiogram is essential in determining whether a case is unilateral. It may be asked—and indeed often is—whether the *x*-ray is a reliable means of detecting or excluding active pulmonary tuberculosis. For practical purposes it may be affirmed that when there is an active tuberculous lesion in the lung the *x*-ray will show infiltration of the lung tissue, and that the absence of such infiltration can be taken to indicate no such lesion. Instances are occasionally met with of patients who are undoubtedly suffering from active tuberculosis of the lung (as proved by the presence of tubercle bacilli in the sputum) whose radiograms are negative, at all events on one occasion. Such cases are; however, so extremely rare that the absence of infiltration in the radiogram on the contralateral side can be taken for the purpose under consideration to indicate unilateral disease. The reading of *x*-ray pictures of the lung is by no means easy. Prolonged study and considerable experience are necessary for the correct interpretation of the significance of the shadows seen in the radiograms of the chest. Unfortunately, there are many radiologists who are quite prepared to give a definite opinion as to the presence or absence of tuberculosis in the lungs who have neither given that study nor acquired that experience which is essential for their opinion to be of value. It can be definitely stated that *x*-ray pictures of the lungs, when properly interpreted, are the most valuable means of diagnosis of pulmonary tuberculosis that we possess.

SELECTION OF SUITABLE CASES

Although, as stated above, artificial pneumothorax is only suitable for the treatment of unilateral cases, yet it is not indicated in all such instances. A careful study of several factors must be made in each case before artificial pneumothorax is decided upon. First in importance comes the character of the lesion.

Early Infiltration just below the Clavicle.—This lesion, occurring deep in the parenchyma of the lung, is a common mode of onset of pulmonary tuberculosis. The focus is unilateral, and is situated so deeply in the lung that the pleura is likely to be free from adhesions. It is on this ground eminently suitable for pneumothorax treatment. All such cases should not, however, have the affected lung collapsed immediately, for it must be remembered that a large proportion recover under conditions of rest and sanatorium treatment. They should be given the chance of so doing before collapse is induced. Delay, however, should not be too long if they fail to show signs of improving. If, on absolute rest in bed, the temperature does not subside in a few weeks, the patient continues to lose weight, and the *x* rays show that the

disease is spreading, a pneumothorax should be promptly induced.

Apical Lesions.—Where the lesion is situated actually at the apex we often get a history of recurrences over a period of time. Such lesions are generally fibrotic in character, and are not suitable for artificial pneumothorax treatment. In the first place, pleural adhesions are nearly always present, so that the diseased part of the lung cannot be collapsed, and, secondly, the activity will, as a rule, subside with rest and sanatorium treatment for two or three months.

Basal Tuberculosis.—Recent experience would tend to show that a lesion starting at the base of the lung is not so uncommon a mode of onset of pulmonary tuberculosis as was previously thought to be the case. My own personal experience leads me to believe that such cases, if untreated, are liable to do very badly. I regard the prognosis in them as distinctly worse than in apical cases. Collapse of the lung should be induced as soon as the diagnosis is confirmed. This is, of course, providing the lesion is unilateral.

Unilateral Caseous Pneumonia.—There is a certain difference of opinion with regard to the advisability of pneumothorax treatment for cases of acute pneumonic tuberculosis in which a whole lobe, or even a whole lung, may be involved in a tuberculous consolidation. Nearly all, however, who have had any extensive experience of this treatment have, on occasions, met with such astonishing cures in cases of this type that, bearing in mind that the prognosis in them is very grave if nothing is done, the view that pneumothorax is indicated would appear to be justified.

Other Factors

X-ray Appearances.—Apart from the site of the lesion, its character as ascertained by the radiogram is an important factor in determining the suitability of a case for this form of treatment. It is the exudative type of lesion, which looks soft in the x-ray, with an early tendency to break down with cavity formation, and an absence of fibrous tissue formation, that calls for artificial pneumothorax treatment.

Age of Patient.—This has a very important bearing on the subject under discussion. The younger the patients the more likely they are to be suitable for collapse therapy, for here it is more probable that the lesion will be of the soft, exudative variety, with an absence of fibrous tissue formation, and with a tendency to spread to the adjoining parts of the lung. I rarely induce a pneumothorax nowadays in a patient over 45 years of age except for some special reason, such as frequent haemoptyses of a dangerous severity.

Spontaneous Pneumothorax.—A large proportion of cases of spontaneous pneumothorax are due to tuberculosis of the lung, but not all. A small number are the result of rupture of emphysematous bullae. In those cases that are tuberculous, if the disease is unilateral, the correct thing to do is to maintain the collapse of the lung. In those that are not, this procedure, though not actually harmful, is entirely unnecessary. It is therefore necessary in these cases to establish their tuberculous origin before recommending a therapeutic pneumothorax. If the patient has sputum containing tubercle bacilli, that clinches the matter, and the lung should not be allowed to re-expand. If, however, as is often the case, there is no sputum, or it contains no tubercle bacilli, the lung should be allowed to re-expand, and the sputum should be tested frequently while it is doing so. At the same time the chest should be x-rayed once a week. If, as the lung comes out, infiltration of the lung tissue is seen, it should be promptly re-collapsed, and a therapeutic pneumothorax should be maintained. From the point of view of this treatment no case of spontaneous pneumothorax should be regarded as

tuberculous until this is proved either by the presence of tubercle bacilli in the sputum or by x-ray evidence of infiltration of the lung. When it is so proved artificial pneumothorax is indicated in all cases when the disease is unilateral.

Pulmonary Haemorrhage.—Bleeding from the lung in pulmonary tuberculosis generally ceases with rest in bed, save when, in rare cases, it is due to rupture of a large pulmonary aneurysm, when it will end fatally whatever is done. Collapse of the lung may, however, occasionally be called for to control haemoptysis in two types of cases.

1. Patients who are otherwise progressing satisfactorily may be subject to repeated attacks of haemorrhage which necessitate their laying up for prolonged periods. This is most likely to occur in middle-aged patients with a fibrotic type of the disease. It is the inconvenience that is caused by frequently having to lie up—especially in those who have to earn their living—that justifies attempting to collapse the lung to control the haemorrhage. Pneumothorax is induced in such cases with the sole object of controlling the haemorrhage, and not as a curative measure for the disease.

2. The second type of case in which collapse is sometimes called for is that in which continuous bleeding threatens death from loss of blood. These are very rare, but when met with collapse should be induced as an emergency operation.

In haemorrhage cases it is not always easy to determine the side from which the bleeding is coming. Sometimes the patient can assist from his subjective sensations, but when this help is not available it is reasonable to assume that the bleeding comes from the most affected side, especially if there is extensive disease with cavitation on that side and relatively little disease on the contralateral side.

Extrathoracic Conditions

The presence of considerable disease on the opposite side as a contraindication to this treatment has already been dealt with. We will now consider how far certain extrathoracic conditions militate against its use.

Tuberculous Laryngitis.—Usually tuberculous ulceration of the larynx is a late complication of pulmonary tuberculosis, and by the time that it has appeared the lung disease is extensive and bilateral, so that the case is unsuitable on general grounds for collapse treatment. Early affection of the larynx, while the disease in the lung is still unilateral, does not constitute a contraindication.

Intestinal Tuberculosis.—Tuberculous ulceration of the intestines is practically always a late manifestation of the disease. Here again the pulmonary disease is extensive, and the case, judged by the criteria laid down above, is unsuitable for pneumothorax treatment apart from the intestinal complication. When signs suggesting slight involvement of the intestines are present in an otherwise suitable case they do not prevent collapse being carried out.

Pregnancy.—If possible, pregnancy should, of course, never be allowed to occur in an actively tuberculous woman. When it does occur, or when pulmonary tuberculosis develops in a pregnant woman, collapse of the lung is urgently called for, provided the criteria already laid down are fulfilled. Pregnancy in women suffering from active pulmonary tuberculosis should be terminated if it is of under three months' duration. If longer than that it should be allowed to proceed to full term.

Diabetes.—Diabetes mellitus is not a contraindication to pneumothorax treatment. On the contrary, the best hope for a diabetic patient who develops pulmonary tuberculosis is that the latter disease shall be detected while it is still unilateral. When this happens the lung should be promptly collapsed, the patient put on a generous diet, and the blood sugar content kept within normal limits by as large doses of insulin as may be necessary. The outlook is not, of course, as good as when the lung disease is uncomplicated by diabetes, but I have had several cases

in which I am confident that life has been prolonged for several years.

Cardiovascular Disease.—Severe cardiovascular disease is a contraindication to collapse therapy. A well-compensated valvular lesion of the heart is not, however, in itself a contraindication to collapse of the lung if the latter is urgently called for.

SPECIAL POINTS IN TECHNIQUE

The technique of introducing air into the pleural cavity is so well known that it need not be described in detail here. There are, however, some points that are still a matter of dispute and are relevant for discussion. Some standard technique should be adopted if statistical records of the results of this treatment are to be of any value. In many such records we have the bare statement that an artificial pneumothorax was performed, without any details being given as to the degree of collapse that was aimed at or maintained, of the intrapleural pressures, the intervals between the refills, and similar points. Unless some uniformity is maintained in these matters statistics of results are bound to be unreliable.

Degree of Collapse

The pioneers of artificial pneumothorax treatment aimed at producing complete collapse of the lung, and did not hesitate to raise the intrapleural pressure to any attainable degree in order to arrive at this result. Subsequent experience has proved that this method is highly dangerous, in view of the likelihood of its producing rupture of adhesions at their insertion into the lung and a resulting pyopneumothorax (the most dangerous complication of this treatment). There are some authors who now maintain that good collapse is not an essential feature in getting good therapeutic effects. Whilst entirely endorsing the view that high intrapleural pressures *must* be avoided, yet it is my experience that the beneficial effects accruing are generally in proportion to the degree of collapse obtained in the *diseased portion* of the lung. It is perfectly true that in those cases in which "selective" collapse occurs—that is to say, in which collapse of the diseased portion alone takes place as the result of introduction of air into the pleural cavity—good results are seen without complete collapse of the whole lung. But this selective collapse occurs in a relatively small proportion of cases, so that in order to collapse the diseased portion of the lung it is, as a rule, necessary to put out of action the whole lung.

Mediastinal Displacement

The structures in the mediastinum are not fixed rigidly in position. Any increase in the intrapleural pressure may readily displace them towards the opposite side. The mobility of the mediastinum varies enormously in different individuals. In cases of chronic fibroid tuberculosis it is often firmly fixed by rigid pleural and pericardial adhesions, so that moderate rises in the intrapleural pressure do not move it at all. In the more acute forms of exudative disease, however—especially in the young—it is very much more mobile. In rare cases it is so mobile that any attempt to induce collapse causes such distress that the attempt has to be abandoned. Occasionally it is found that, on making a second attempt a few months later, the mediastinum has become more fixed, and collapse is possible without distressing symptoms. Though such extreme mediastinal displacement as this is exceptional, the heart tends in most cases to be displaced towards the opposite side, to a greater or less extent, and avoidance of this is one of the most important points that have to be borne in mind during the whole course of the treatment. Where this tendency is marked it may be obviated by collapsing the lung very gradually, and by giving small refills at fairly frequent intervals

rather than by introducing large quantities of air into the pleural cavity at each sitting. The above remarks refer to the mediastinal displacement that occurs during the induction of a therapeutic pneumothorax. On occasions, during the course of the treatment, a mediastinum which has not appreciably moved while the lung was being collapsed will be found to have suddenly shifted over to the contralateral side. This is usually due to the development of a spontaneous, on top of the artificial, pneumothorax, and is generally, though not always, associated with the development of a pyopneumothorax. Displacement of the mediastinum during the course of the treatment may also result from the collection of fluid in the pleural cavity on the treated side, though in this case the displacement is more gradual than when it is due to a spontaneous pneumothorax.

Intrapleural Pressures

The factors governing the intrapleural pressure are not fully understood. It varies considerably in different individuals. Moreover, even apart from the presence of adhesions, the degree to which the negative pressure has to be reduced in order to produce collapse of the lung is not constant in different cases. As a rule, it is only necessary to *reduce the negative pressure*, or, at the most, to raise it to atmospheric pressure, in order to collapse the lung. A slightly positive pressure is occasionally permissible, but in no case is it justifiable to attempt to collapse the lung by means of high positive pressures—the risk of rupturing an adhesion at its insertion into the lung and producing a pyopneumothorax is too great. When the pressure rises to a high figure in the early stages of the treatment it is an indication that the lung is adherent to the chest wall, and the treatment should be stopped. It is clear from the above that it is impossible to lay down any hard-and-fast rules as to the intrapleural pressure that should be secured. What has to be aimed at is to produce as good collapse of the lung as possible with as low a pressure as possible. What this figure will be will vary in each case. In most instances it will be a small negative one, and must never be a high positive one.

There is another important point with regard to intrapleural pressures that is frequently overlooked. Having obtained good collapse at a certain intrapleural pressure, some workers continue the treatment by introducing at stated intervals sufficient air to bring the pressure back to the same figure. In other words, they will be entirely guided by the pressure as to the amount of air that it is necessary to introduce at each refill. If this procedure is adopted it will often be found at the end of three or four months that the lung has partially re-expanded. The requisite intrapleural pressure to keep the lung well collapsed varies in many cases during the course of the treatment. Careful *x-ray* control is the only method of estimating the amount of air required for each refill in order to keep the lung well and continuously collapsed.

X-Ray Control

It cannot be too strongly insisted that this treatment should never be embarked upon unless there is a reasonable certainty that facilities for *x-ray* control will be available for the next three years. The ideal method of procedure is the one that I employ at my clinic at the Royal Northern Hospital, in which the patients are screened before and after each refill. This is, of course, not possible in all cases. But it should never be undertaken unless circumstances allow weekly *x-ray* control during the induction of the collapse and subsequent pictures or screening every two or three months.

When frequent screenings are done it is of the *utmost importance* that they should be as brief as possible. They should not occupy more than a few seconds. If

this point is not borne in mind there is a serious risk of deleterious effects resulting from cumulative doses of x rays.

ADHESIONS

In most cases of pulmonary tuberculosis some degree of adhesion between the visceral and parietal pleurae is present. Its extent, however, varies greatly. Three degrees may be recognized in so far as they affect collapse of the lung.

1. Universal adhesions.—In some cases the two layers of the pleura may be so widely and firmly glued together that the potential pleural cavity is obliterated. In such cases it is impossible to insert the point of the needle between the two layers of the pleura. If three attempts to get into the pleural cavity, made in different parts of the chest, fail, universal adhesions may be assumed, and further attempts at the treatment abandoned. It is impossible to detect either from clinical or radiological observations the presence of universal adhesions. One can never tell until an attempt is made whether one is going to get into the pleural cavity.

2. Secondly, adhesions, though not obliterating the pleural cavity, may be so widespread and firm as to prevent adequate collapse of the lung. In such cases, though it is possible to insert the point of the needle into the pleural cavity and inject some air into it, yet the intrapleural pressure tends to rise early on in the induction of the collapse and after the introduction of relatively little air. A radiogram will show the presence of multiple broad adhesions. No attempt should ever be made to stretch such adhesions by high intrapleural pressures, and the attempt at a pneumothorax should be abandoned.

3. In most cases adhesions, though present, are not so numerous or so firm as to prevent adequate collapse of the lung. They are most commonly seen extending from just below the apex of the lung outwards to the axilla. They tend to stretch as treatment progresses, though no deliberate attempt must be made to cause them to do so by increasing the intrapleural pressure. On the contrary, it is in the presence of such adhesions as these—especially when they are tenuous—that special care must be taken to maintain a negative pressure throughout, to prevent their breaking off at their insertion into the lung, with a resulting pyopneumothorax.

When a few fine adhesions are present it is a fairly simple operation to divide them. It is, however, an operation which I have ceased to perform. Generally speaking, when they are sufficiently fine and few as to be amenable to division it is unnecessary to divide them, while when they are so numerous and firm as to prevent adequate collapse of the lung they cannot be divided. It is, moreover, an operation that is not devoid of the risk of a resulting pyopneumothorax. The one possible exception in which division may be regarded as justifiable is when one or more divisible adhesions are holding open a cavity. As long as such a cavity remains open there is a likelihood of the patient continuing to expectorate tubercle bacilli. Division of the adhesions and collapse of the cavity will often render their sputum free of tubercle bacilli.

DISCONTINUATION OF ARTIFICIAL PNEUMOTHORAX

A great deal has been written on the subject of the indications for inducing a therapeutic pneumothorax. We find much less in the literature as to the indications for stopping it. It is clearly undesirable—nor is it necessary—for the treatment, once started, to be continued for an indefinite period. There appears to be a tendency among some workers to keep up the collapse much longer than is actually needful. I have seen some cases kept up for as long as six or seven years. Such a prolonged treatment is a great strain on the patience (and in the case

of private patients, the pocket) of the patient. It is a common observation that a very satisfactory result has been obtained in cases in which it has been found necessary to abandon an artificial pneumothorax for one of the reasons considered below—even after so short a period as six months from its inception. This aspect of the subject may be considered under two headings: (1) Compulsory cessation. (2) Voluntary cessation.

1. In a considerable number of cases it is found that one is compelled to cease the refills. As time goes on more and more difficulty is experienced in introducing air into the pleural cavity without producing a high intrapleural pressure. Coincident with this, control by x rays will show that the pneumothorax is becoming smaller and smaller, the visceral pleura is becoming thickened, and the heart and mediastinum displaced towards the side of the pneumothorax. Such a termination to an artificial pneumothorax is to be regarded as of good omen, and to indicate an obliterative pleuritis, with fibrosis of the lung and an early and rapid healing of the tuberculous process. No attempt should be made to keep the lung collapsed by producing high intrapleural pressures.

2. The treatment may be voluntarily stopped because (a) the disease has spread to the opposite side, or (b) it has done all the good it is likely to. This requires some discussion.

If during treatment there is evidence that the disease has extended to the opposite lung, or that such little disease as was originally present in the contralateral lung is spreading, the lung should be allowed to re-expand. Spread of disease to the contralateral lung is not always an easy matter to determine. In the early days of pneumothorax therapy alarm was experienced on observing in the radiograms, taken as a routine to determine the degree of collapse, extensive mottling in the contralateral lung. It is now, of course, recognized that such mottling is generally due to congestion of the lung, and not to tuberculous infiltration. The x -ray appearances of tuberculous infiltration and congestive mottling are fairly distinctive to the trained eye when they are present separately, but when there is marked congestion of the contralateral lung it is impossible to be certain from a radiogram that there is not tuberculous infiltration present as well. When the latter process has extended to produce softening and early excavation we can be quite sure as to its nature, as congestion does not lead to softening. Generally speaking, however, in the absence of excavation, it is dangerous to express an opinion on the condition of the contralateral lung when a pneumothorax is being done on a radiogram only. It is mainly on clinical evidence that we have to rely in detecting spread of disease to the opposite side. If a patient who up to date has been progressing well starts to lose weight, if cough and sputum which may have disappeared return, and if tubercle bacilli reappear in the sputum and there is pyrexia, a suspicion of spread to the opposite side should be entertained. Detection of physical signs which had not been present before, and possibly a radiogram, will confirm this suspicion, and the treatment should be stopped.

In those cases in which neither the occurrence of spontaneous obliteration of the pneumothorax nor the spread of the disease to the other side has resulted in the treatment being abandoned, it has to be determined how long it must be maintained. As a result of my own experience I have arrived at the conclusion that three years is the average period for which a pneumothorax should be kept up. This would appear to be a reasonable period, in that it is not so long as to put too great a strain on the patience of the patient, and yet is sufficiently long to produce all the benefit that it is likely to. This period of time must not be applied too arbitrarily, as circumstances

of a particular case may indicate prolongation of the treatment beyond it. It is, however, the duration for which an average case should be kept up.

Actual Manner of Termination

It is the practice of some workers, when it has been decided to terminate the treatment, gradually to increase the intervals between the refills, and to diminish the amount of air introduced each time. There does not appear to be any particular point in this procedure. It is my custom, once it has been decided that the treatment should be stopped, to effect this abruptly. If this is done the lung in most cases will take three or four months to expand completely. During this time the patient should be kept under careful observation. A record of the weight should be kept, the temperature taken morning and evening, the sputum (if any) examined weekly, and an *x*-ray taken as often as circumstances permit. If, during the re-expansion of the lung, the result of any of the above observations indicates that the disease is still active, the lung should be recollapsed for a further period.

DANGERS AND COMPLICATIONS OF ARTIFICIAL PNEUMOTHORAX THERAPY

Pleural shock and air embolism have always been regarded as the two chief dangers of the induction of a pneumothorax. With due attention to technique they can, as a rule, both be avoided, and their occurrence is becoming less and less frequent.

Clear Pleural Effusions.—If frequent *x*-ray examinations of the chest are made during the treatment a small amount of fluid will be seen in the pleural cavity at some time in practically all cases. Less often large collections accumulate. Provided that they remain clear they have in themselves no deleterious effect on the patient, nor do they affect the prognosis adversely. The question that arises is the correct method of dealing with them. If such effusions cause any embarrassment to the patient they should, of course, be removed. It is my custom generally to remove large effusions, even in the absence of distress, and to replace the fluid with air. Frequently, for some unexplained reason, the fluid will not reaccumulate after two or three tapplings. Moreover, the patient, though not actually embarrassed by the effusion, will often feel more comfortable with air in the pleural cavity rather than fluid.

Pyopneumothorax.—Pyopneumothorax is the one really serious danger associated with collapse therapy. Since the adoption of low-tension pneumothoraces it is much less common than it was when attempts were made to produce collapse of the lung by the production of high intrapleural pressures. It results from the rupture of an adhesion at its insertion into the lung. A hole in the lung is thus produced, and the pleural cavity becomes infected by organisms passing into it from the bronchi—that is, a bronchial fistula is established. This is most likely to occur when a few fine adhesions are present, and, as already mentioned, these are most commonly seen extending from the region of the apex outwards to the chest wall in the axillary region. In the presence of such adhesions special care must be taken to collapse the lung gradually and to keep the intrapleural pressure low. The supervision of a pyopneumothorax, though not of necessity uniformly fatal, constitutes a serious danger to the patient, and renders the prognosis very grave.

It is a complication that may result after the division of adhesions. The probable explanation of its occurrence at that time is that, in addition to the main adhesions, there are present finer ones, which break off at their insertion into the lung after the division of the former. With due care and forethought the occurrence of pyo-

pneumothorax can be reduced to a minimum, but even then it will happen on occasion.

Haemothorax.—The collection of blood in the pleural cavity is very rare. I have only met with one case. In that the fluid was pure blood. The blood was removed and the patient made a good recovery.

CONCLUSIONS

The chief points that have been stressed in this article are:

1. That in artificial pneumothorax we have a valuable form of treatment for something under 5 per cent. of all cases of pulmonary tuberculosis.
2. That the remaining 95 per cent. of cases have still to be treated by the old methods of diet, hygiene, and climate.
3. That great care must be taken in the selection of suitable cases along the lines laid down.
4. That the patient must remain under careful medical supervision during the course of the treatment, especially as regards *x*-ray control.
5. That the operator should aim at producing as good a collapse as possible, with the minimum amount of mediastinal displacement, and as low an intrapleural pressure as possible.
6. That the treatment should not be continued for too long, three years being the correct time for an average case.
7. That the great danger that has to be guarded against is the supervention of a pyopneumothorax.

THE EFFECT OF FLUID COMPLICATING ARTIFICIAL PNEUMOTHORAX

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Of eighty cases, T.B. positive, in which I induced artificial pneumothorax at Midhurst between 1924 and 1930, and all of which have since ceased refills for various causes—from completion of treatment to obliteration by adhesion—fluid appeared at some time during the treatment in forty. No case is considered unless fluid was demonstrable by physical signs and/or *x*-ray examination. These forty patients have been followed up by a special form to find out their condition in November, 1933, and therefore at intervals of three to nine years from the date of induction, in an attempt to assess the influence of the complication.

Summary of Results

	Alive		Dead	Totals
	T.B. +	T.B. - or no Sputum		
Completed treatment ...	—	14	—	14
Continued treatment: fresh disease appeared	4	1	1	6
Obliterated { With spread ...	—	—	3	3
{ Without spread	1	10	1	12
T.B. Pyopneumothorax ...	1	—	4	5
Totals ...	6	25	9	40

The above table shows that fourteen patients carried on refills until it was considered safe in the individual case to allow re-expansion; this was, on an average, three years from the date of induction. Two only required gas replacements, and only one has had accessory