Non-tuberculous spontaneous pneumothorax is more common than tuberculous pneumothorax. During the last four years we have seen this accident occur in about 40 cases. During the year 1949 alone, one of us had the occasion to observe 11 cases, while, during the same period, he had only treated three cases of spontaneous tuberculous pneumothorax.  

On the other hand, everyone at present agrees as to the cause of these so-called idiopathic pneumothoraces. Laennec already suspected the part played by the emphysema air bubble which Devilliers confirmed in 1826.  

Attention has again been drawn to this cause during the last 25 years by the anatomical and microscopic investigations of Fisher-Wasels, Miller, and especially, Mariano Castex.  

We need not recall here the general study on non-tuberculous, spontaneous pneumothorax which we had outlined a short while ago; we shall merely emphasize the clinical, radiological and pleuroscopic characteristics on which the mode of treatment may depend.

Treatment is indeed conditioned by various factors based on the patient's examination and clinical history.

1) **When one comes across a first attack** and when the pneumothorax seems on the point of clearing up rapidly without treatment, no special measures are needed. Merely, in a few cases, one should promote pulmonary reexpansion by removing the intrapleural gas.

It is only exceptionally that an operation will have to be considered at the first crisis, either owing to alarming primary symptoms which exsufflation is unable to control, or owing to the presence of lesions requiring radical treatment such as a voluminous air cyst.

It should be emphasized that cases where a non-tuberculous spontaneous pneumothorax heals without treatment and runs a benign course are by far the commonest.

2) **Frequent relapses** of this accident call, on the other hand,
for surgical treatment. When, after a first crisis, the cause of the pneumothorax persists, while pleural symphysis does not take place spontaneously one may fear the occurrence of relapsing pneumothorax which may occasionally involve, successively or simultaneously, both sides. This is a serious complaint. It is serious because it constitutes a considerable social hindrance and is an obstacle to normal activity. Further it is serious because it may end in the dramatic picture of acute asphyxia.

A rather delicate point is the time when one should speak of a relapsing pneumothorax and resort to surgical treatment. Rare relapses at distant intervals may cause one to postpone a decision; on the other hand one should operate without delay when relapses are frequent and occur at short intervals.

In any case relapsing spontaneous pneumothorax is rather common and, according to our experience, includes about one-fifth of the cases of non-tuberculous spontaneous pneumothorax. Among 86 cases, Crenshaw\(^9\) has observed 23 instances of relapsing pneumothorax.

3) *Acute asphyxia* is an alarming accident which may be of immediate danger to the patient’s life. It usually supervenes after a series of relapses, either on one or the other side. It may be due to simultaneous involvement of the two pleural spaces.

When pleural aspirations are of no avail one should operate at once. This event is not extremely rare since it occurred twice in the 11 cases we studied in 1949.

4) *Chronic pneumothorax* occurs when, in spite of exsufflations, air has a tendency not to become resorbed while the lung is not reexpanding. One should not wait too long before resorting to surgery as there is a risk of pleural thickening taking place and constituting a serious surgical complication. The proportion of chronic pneumothorax cases is not high. It occurred twice among the 11 cases we followed up in 1949; however, Meade\(^15\) seems to consider it a rather common occurrence since among 19 cases which had to be operated, eight were relapses and 11 were chronic pneumothorax. Brock among 71 cases also noted a larger number of chronic\(^46\) than relapsing cases\(^6,25\).

Therefore, in the majority of cases of non-tuberculous spontaneous pneumothorax, the treatment is simple and, indeed, healing often takes place in the absence of any treatment. There are three essential circumstances which call for surgical treatment, namely *relapsing pneumothorax*, *severe acute asphyxia* and *chronic pneumothorax*.

The operation will depend on the anatomical causes of the pneumothorax. Before coming to a decision one should endeavour to ascertain these causes. This may be done by means of radio-
graphy, tomography and pleuroscopy. No treatment should be considered before resorting to these three methods of exploration.

I. Treatment methods essentially include:

1) provoked pleural symphysis,
2) removal of one or several large cysts,
3) exeresis of a portion of the pulmonary parenchyma,
4) two subsidiary operations may be needed in certain cases:
   a) pleural decortication,
   b) thoracoplasty.

1) We shall insist chiefly on the technical aspect of provoked pleural symphysis, the other operations having no peculiar characteristic in spontaneous pneumothorax. New substances have been used for a long time. Silver nitrate seems to have been suggested by Spengler as far back as 1906 and Brock is still faithful to this procedure. Paul D. Crimm\textsuperscript{10} uses oil which is advocated by a number of authors, in particular Hetherington and Spencer.\textsuperscript{14}

We have adopted the intra-pleural insufflation of talc powder recommended by Bethune.\textsuperscript{4} This technique has already been described\textsuperscript{3} and has been the object of a detailed study by our friend and collaborator J. P. Nico.\textsuperscript{2} We shall merely summarize here some essential points.

We perform two openings into which we introduce the pleuroscopy trocars and cannulas. By means of the pleuroscopec we inspect the pleura and we identify emphysematous vesicles. We destroy systematically with the cautery subpleural bubbles which we observe on the lung as well as those adhesions which are easily resected. Moreover, thanks to these two openings we are able to control through the pleuroscope the talc insufflation and its regular distribution, as a thin layer, over all the pulmonary surface.

To deposit talc into the pleura we use a metallic pulverizer to which we adapt a syringe, the end of which is provided with an air aspiration filter. A metallic stem is placed on the metallic recipient. The stem is introduced into the pleuroscopy cannula. We use pure talc powder, sterilized at high temperature.

An essential point in our technique is the wide disinsufflation we practice before removing the pleuroscopy cannulas. We secure this by asking our patient to make wide expiratory efforts, while the cannula end is stopped during inspiration. At the end of this procedure the patient is submitted to radioscopy. In some cases the lung is near the chest wall or this may be obtained through slight disinsufflation with a needle. One may be sure then that definite adhesion will soon be secured (in one to two days). If a slight space persists between the lung and chest wall, one may rely on symphysis taking place in spite of this. It may take longer and further exsufflations may be required. We have seen it happen
by creating, in succession, several adhesion zones over several days or even several weeks (Figure 1). However, usually, symphysis is obtained within 10 days. The insufflation of talc gives rise to immediate, rather severe pain. It is followed by pains, liquid pleural reaction and sometimes a rather high temperature. These symptoms are benign and seldom persist beyond four to six days.

On the whole we have had excellent results and the method has proved constantly effective.

We do not think like Crenshaw that this method gives rise to more marked functional deficiency than that following thoracotomy. On the other hand, mention has been made of the risk involved through the presence of talc in the pleura, a risk which has been compared to the accidents caused by the presence of this substance in the peritoneum (talc-granuloma). Delarue does not think one need fear this risk but he wonders whether intrapleural talc may not have pulmonary consequences comparable to those he has noted experimentally in the rabbit. Among the numerous cases of intrapleural talc injection we have performed during the last 10 years, we have never had an accident.

2) The removal of one or several large cysts is a simple, quite satisfactory operation. Paul D. Grimm, O. T. Clagett, Meade, Crenshaw, have had an opportunity of using it. We have published a case with O. Monod. In such a case the disease is easily cured by definitely removing the cause without having to sacrifice any extensive parenchyma. This preservation of the pulmonary tissue may be yet more perfect when, as happens sometimes, the cyst is joined to the lung by a slender pedicle. Bariety, O. Monod and Lesobre have had an opportunity to observe conclusive cases of this kind.

3) Exeresis of a part of the pulmonary parenchyma is sometimes required: a segment, a lobe or even more. The operative technique has no peculiar characteristic in these cases. We shall merely
repeat with all the authors who have dealt with the subject that the pulmonary tissue should be spared as far as possible.

4) Finally, in certain cases, one may have to perform pleural decortication. We shall see that the frequency of this emergency has been discussed.

Only in very exceptional instances does one need to resort to a thoracoplasty.

II. Operative indications are dictated, as we have seen, by the course of the disease and its clinical characteristics. We must now consider what type of operation is suitable in each case and, in some measure, determine its choice. The latter essentially rests on the anatomical conditions which are at the basis of the pneumothorax. It is the accurate investigation of responsible lesions which determines the choice of the operation. Whether the indication is a relapsing pneumothorax, a chronic pneumothorax or an asphyxiating form the patient should be submitted to the same investigations:

a) Through adequate radiography and tomography one should endeavor to ascertain the site and number of emphysematous vesicles.

b) Pleuroscopy is indispensable. It is, in our opinion, a capital feature and it gives the most interesting information. We are surprised that American authors should not attach more importance to this examination and should show a tendency to explore the pulmonary surface only at the time of thoracotomy. When one knows what a benign operation pleuroscopy is, while it gives information which, although not so accurate, is practically sufficient, we think there should be no hesitation. To refer only to the most recent publications we observe that Crimm has little to say on the subject, Meade thinks it is inadequate and Crenshaw acknowledges that he has not used it; the latter adds, however, that it might be beneficial and enables one to avoid, in certain cases, a thoracotomy.

These x-ray and pleuroscopic investigations will reveal the lesions the nature and extent of which shall determine the operation.

1) In some cases, neither through the x-ray film nor through pleuroscopy, does one see bubbles or cysts. These instances are rare and we have only come across them once. One may object that this was due to the inadequacy of our exploratory methods, and, in particular, if we had resorted to an exploratory thoracotomy after the pleuroscopy things might have been different. We shall point out, however, that Meade among eight cases of relapsing pneumothorax explored by thoracotomy came across three in which no lesion could be seen.

In fact, like Meade, our advice is to follow, in these cases,
exactly the same line of action as when one notes the presence of multiple emphysematous vesicles.

2) As a rule, whether revealed by the x-ray film, or radiologically invisible, multiple, disseminated emphysematous vesicles on the pulmonary cortex are the responsible agents of these accidents. Pleuroscopy enables one to see them easily.

In our opinion these are a definite indication for talc injection. We apply this method after the pleuroscopy which has revealed the lesions, or during this procedure. We proceed at the same time to the destruction of those pleural adhesions we have detected. We do not see how thoracotomy, which is after all a much more severe operation, is superior to our method. Meade mentions the long duration of treatment and convalescence in the cases of Hennel and Steinberg and in the case of Brock. As far as we are concerned all our patients treated with talc have been definitely cured in one to three weeks, exceptionally, one month. We have never had a complication or a relapse. Crenshaw and Herbert C. Maler\(^9\) believe that thoracotomy spares the pulmonary function better than pleural irritation, which, however, Crenshaw uses occasionally. One should acknowledge that the difference is slight and that thoracotomy accompanied by the cauterization or puncture of vesicles unquestionably gives rise to a pleural reaction which is probably not very different from that which we secure with talc.

3) When x-ray inspection, which may be very characteristic in certain cases (Figures 2a-e) and pleuroscopy show a voluminous

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**FIGURE 2d**
*Figure 2d:* Completely healed.

**FIGURE 2e**
*Figure 2e:* Actual state after talc projection.
emphysematous bleb or a large cyst, in any case when these lesions are few, there is no question of carrying out pleural symphysis through talc injection. One should in this case perform thoracotomy and simply remove the bleb or cyst. The operation is easily carried out and yields excellent results.

4) When a series of blebs or cysts occupy a whole segment of the lung or a lobe, one should consider exeresis. It may involve one of the three lobes. Often enough an inferior lobectomy will have to be combined with a middle lobectomy.

5) When a chronic pneumothorax is accompanied by a thickened visceral pleura which makes pulmonary reexpansion impos-
sible, one may have to perform pleural decortication. In our experience, indications for this operation have been scarce.

After Brewer, Meade however lays emphasis on this procedure. Among the 11 cases of chronic pneumothorax he has studied, it had to be performed six times. We think there is here an unusual occurrence of peculiar circumstances. Crenshaw has never had to resort to pleural decortication and, among our own cases, there was only one indication. One should know, in this respect, that chronic pneumothorax does not necessarily involve pachypleuritis and the impossibility of pulmonary reexpansion. Excepting cases where expansion is impossible from the start and where it is obvious that a thick pleural sheath exists, one may hope to get, through talc alone, perfect pleural symphysis. We have successfully resorted to this procedure in all our cases of chronic pneumothorax with one exception. Sometimes the establishment of pleural symphysis and pulmonary reexpansion are slightly delayed, sometimes even they occur in successive stages. They are the only difficulties one may expect.

6) If, in spite of decortication, the lung does not succeed in filling up the pleural space, one may sometimes have to resort to thoracoplasty.

This operation may also be necessary in order to secure mediastinal equilibrium after an exeresis. Finally we deem it important not to let the remaining lobe reexpand too much after an exeresis. There would then be a risk of emphysema which would be dangerous for the pulmonary function. This has induced us to complete an upper lobectomy associated with decortication of the lower lobe by a thoracoplasty of the apex in order to avoid an emphysematous transformation of this lobe (Figures 3 and 4).

SUMMARY

We have had the opportunity of examining and treating about 100 cases of non-tuberculous spontaneous pneumothorax, of which approximately 40 were since 1945 and 11 in the year 1949 alone. This is usually a benign disease which requires only the simplest measures.

In some cases however the symptoms and course of the disease depart from this usual benign aspect and call for active treatment. One is then dealing with relapsing pneumothorax, chronic pneumothorax or pneumothorax with acute asphyxia.

The choice of the procedure to apply in each case depends on the responsible anatomical lesion.

With diffuse emphysematous vesicles, the commonest occurrence, we do not think it advisable to resort to thoracotomy. Pleuroscopy
is enough to reveal the lesions, resect adhesions and bring about pleural symphysis by talc projection.

When dealing with a voluminous vesicle or an air cyst, either single, or few in number, they may be eliminated by removing them during thoracotomy.

Emphysematous or cystic lesions localized in a part of the lung call for a limited exeresis which usually consists of lobectomy.

Finally in some cases of chronic pneumothorax, with marked pleural thickening, one may sometimes be obliged to perform decortication.

In some cases one may have to complete these procedures by thoracoplasty, particularly in order to avoid hyperexpansion of the remaining lobe after exeresis.

RESUMEN

Hemos tenido la oportunidad de examinar y tratar aproximadamente cien casos de neumotórax espontáneo no tuberculoso, de los que 40 fueron desde 1945 y 11 en el año de 1949 solamente.

Es una enfermedad habitualmente benigna que solo requiere medidas sencillas. En algunos casos sin embargo, los síntomas y la evolución se apartan de este aspecto benigno y necesitan un tratamiento activo. Se trata entonces de un neumotórax recidivant o crónico, o bien es neumotórax con asfixia aguda.

La elección del procedimiento depende de la lesión anatómica responsable.

En el caso de versículas enfisematosas no creemos que sea necesario recurrir a la toracotomía. Basta la pleuroscopía para revelar las lesiones, resección de adherencias y provocar sinfisis pleural por la polverización de talco.

Cuando se trata de una vesícula voluminosa o quiste aéreo, simple o en pequeño número, pueden ser tratadas por excisión durante toracotomía.

Las lesiones enfisematosas o quísticas localizadas en parte limitada del pulmón, requieren exéresis limitada que generalmente es la lobectomía.

Finalmente en algunos casos de neumotórax crónico con engrosamiento pleural marcado, puede uno verse obligado a realizar la decorticación.

A veces hay que completar esto con toracoplastia sobre todo para evitar la extrema expansión del lóbulo restante.

RESUME

Nous avons eu l'occasion d'examiner et de traiter environ 100 cas de pneumotorax spontanés non tuberculeux. Nous en avons suivi 40 depuis 1945, et 11 dans la seule année 1949.
Il s'agit en règle générale d'une affection bénigne, qui ne demande que des mesures extrêmement simples. Toutefois dans certains cas, la maladie perd son habituelle bénignité, et demande un traitement actif. Il s'agit alors soit de pneumothorax à rechutes, soit de pneumothorax chronique, soit de pneumothorax s'accompagnant d'asphyxie aiguë.

Le procédé de traitement qui convient à chacun des cas varie selon les lésions anatomiques.

Lorsqu'il s'agit de vésicules emphysemateuses disséminées ce qui est le cas le plus habituel, nous ne pensons pas qu'il faille avoir recours à la thoracotomie. Grâce à la pleuroscopie, on peut mettre en évidence les lésions, supprimer quand il le faut les adhérences, et réaliser une crymphyse pleurale thérapeutique par projection de talc.

Lorsqu'il s'agit d'une vésicule emphysemateuse volumineuse ou d'un kyste aérien, et que cette lésion est unique, ou en nombre très limité, on doit intervenir par thoracotomie, et en pratiquer l'ablation.

Lorsqu'il y a des lésions emphysemateuses ou kystiques, occupant tout un segment ou tout un lobe du poumon, il faudra réaliser l'exérèse de cette zone de parenchyme.

Dans certains cas de pneumothorax chroniques, avec une plèvre particulièrement épaissie, on peut être amené à réaliser une décortication. Dans certains cas, on peut être obligé de compléter cette intervention par une thoracoplastie, en particulier pour éviter l'hyperexpansion du lobe restant à la suite d'une exérèse.

REFERENCES


