Management of Spontaneous Pneumothorax*

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Spontaneous pneumothorax occurring in the apparently healthy individual was first named and described by Itard in 1803. In 1826 Laennec accurately described the occurrence of such a phenomenon, and following McDowell in 1856, who described the condition in a tuberculous patient, the etiology was accepted as tuberculous in the majority of cases until Kjaergaard (1932 and 1933) revealed that patients with spontaneous pneumothorax had no more tuberculous than could be found in the general population. Leggett et al (1934) found negative Mantoux tests in 50 per cent of their cases. Evidence of this basic pathological fact was furthered by Blackford in 1939.

In a review of the literature on this subject, the monumental work by Kjaergaard, the experimental work by Macklin, and the clinical observations of Hamman are easily outstanding. To those interested in the history of our knowledge of this subject from the earliest times up to 1903, we suggest the study of Emerson’s monograph.

Many names have been suggested and used to describe the non-tuberculous, non-traumatic pneumothorax in apparently healthy individuals. Spontaneous pneumothorax is by far the most commonly used; yet it infers that this type of pneumothorax occurs without known cause. From the work of the above, as well as the operative findings and autopsy reports of others, the etiology and pathogenesis is now well established, and perhaps a more descriptive term might be devised. None of the terms as listed in the literature are based on etiology or pathogenesis. Any terms which we have tried to devise that would have such a basis are quite clumsy, and we suggest return to the term first suggested by Kjaergaard in 1933, to wit: “Pneumothorax simplex.”

In the period 1949 to 1952 we have observed and treated 114 patients with spontaneous pneumothorax. Cases due to tuberculosis or other disease or trauma of any type, accidental or surgical, have been excluded from this series.

Source of Material

This material came from Medical and Surgical Chest Conferences at Brooke Army Hospital, Fort Sam Houston, Texas, from the Thoracic Surgery Center, Randolph Air Force Base, Texas, and from private cases.

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273
Age

The average age was 27.5 years. The youngest was a newborn infant, two months premature, and the oldest was 73 years. Fifty per cent of the total cases were under 25 years of age, and 80 per cent were under 30 years of age.

Sex

<table>
<thead>
<tr>
<th></th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>104</td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
</tr>
<tr>
<td>TOTAL</td>
<td>114</td>
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</tbody>
</table>

Types of Spontaneous Pneumothorax

- Pneumothorax — First attack: 61
- Pneumothorax — Recurrent attacks: 47
- Hemopneumothorax: 6

TOTAL PATIENTS: 114

Early in the first part of the series (1949), bronchoscopy and bronchography was done in 25 consecutive cases of initial attacks after expansion of the lungs. There were no positive findings on bronchoscopy, and the bronchograms were all negative. This procedure was then discontinued as a routine practice, being done thereafter only as indicated by symptoms or appearance of the lung after expansion.

Treatment of Unilateral Spontaneous Pneumothorax—First Attack

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed rest only</td>
<td>10</td>
</tr>
<tr>
<td>Thoracentesis only</td>
<td>12</td>
</tr>
<tr>
<td>Intercostal catheter decompression</td>
<td>12</td>
</tr>
<tr>
<td>Thoracotomy with catheter decompression</td>
<td>12</td>
</tr>
<tr>
<td>Thoracotomy with instillation of glucose and catheter decompression</td>
<td>8</td>
</tr>
<tr>
<td>Thoracotomy with insufflation of talc and catheter decompression</td>
<td>5</td>
</tr>
<tr>
<td>Thoracotomy with removal of large bullae and poudrage</td>
<td>1</td>
</tr>
<tr>
<td>Decortication</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL PATIENTS</td>
<td>61</td>
</tr>
</tbody>
</table>

In 10 of the 61 patients, the degree of pneumothorax was quite small and no treatment was given but bed rest. We felt that the pneumothorax was so small that thoracentesis or insertion of an intercostal catheter might be injurious. In 12 cases thoracentesis alone (for the removal of air) was done. In the total 22 cases treated by bed rest only or bed rest and thoracentesis, there are four known recurrences.

In 12 cases treatment consisted of insertion of an intercostal catheter into the pleural space and decompression through a water trap. In 12 cases the catheter decompression was preceded by thoracotomy. In these 24 cases there have been two known recurrences.

In eight cases thoracotomy had been followed by instillation of 50 cc. of 50 per cent glucose into the pleural cavity, followed by catheter decompression. There has been one known recurrence.
In five cases during thoracoscopy talc (talcum powder, U.S.P.) was insufflated. There are no known recurrences.

In a total of 37 cases the intercostal catheter decompression was used. In the 22 cases treated by bed rest alone or bed rest and thoracentesis, an average of three weeks was required for complete expansion. The shortest time was eight days and the longest six weeks. Of the 37 in which intercostal catheter decompression was used, 33 were expanded within a few minutes following catheter insertion. Two of the remaining four were expanded by the second day, and the remaining two required six and eight days, respectively.

In one case, even though it was the first attack, the presence of a large bulla evident in the collapsed lung by roentgenogram led us primarily to thoracotomy with removal of the bulla and poudrage. There has been no recurrence in this case.

In the last case in this group, an unexpanded lung developed as a sterile fibrothorax from the initial spontaneous pneumothorax. This patient had received elsewhere treatment in the following order: Bed rest for two weeks, repeated thoracenteses for three weeks, catheter decompression for two weeks. It is of interest to note that active treatment (thoracentesis) was delayed for two weeks, and continuous active treatment (intercostal catheter decompression) was delayed for five weeks. Decortication was necessary. There has been no recurrence.

In the early part of the series (1949), thoracoscopy was done in 25 cases (Curti and Poulson). In only two instances were blebs noted that could not be demonstrated on roentgenogram. For that reason it was discontinued as relatively useless. In the instances where thoracoscopy was done, a catheter was installed for decompression in all cases and instillation of glucose (eight cases) or insufflation of talc (five cases) was done. There were no complications or recurrences from the talc or glucose treated cases. The use of 50 cc. of 50 per cent glucose was discontinued because of pain. Intravenous procaine drip, intravenous morphine, and even the mixture of pontocaine with the glucose failed to reduce the pain to a reasonable degree. Pain was severe in six cases and moderately severe in two. The pain did not abate until an average of 72 hours had elapsed. Insufflation of talc was discontinued for the reason that it was difficult through the thoracoscopy trocars to place the talc exactly where desired. Too frequently it got into the interlobar fissures, mediastinal surface of the lobes, and the diaphragmatic surface of the lower lobe. These places, we feel, are undesirable in the use of talc.

**Recurrent Spontaneous and Chronic Pneumothorax**

<table>
<thead>
<tr>
<th>Unilateral</th>
<th>28</th>
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</thead>
<tbody>
<tr>
<td>Unilateral chronic unexpanded lung</td>
<td>6</td>
</tr>
<tr>
<td>Bilateral: Alternating</td>
<td>11</td>
</tr>
<tr>
<td>Bilateral: Simultaneous</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL PATIENTS</strong></td>
<td><strong>47</strong></td>
</tr>
</tbody>
</table>
Treatment of 34 Unilateral Recurrent and Chronic Spontaneous Pneumothoraces

Thoracotomy with resection of blebs, poudrage, and catheter decompression .................................. 18
Decortication with removal of blebs and catheter decompression ................................................. 6
Catheter decompression ................................................................. 4
Thoracoscopy with instillation of glucose and catheter decompression ........................................ 2
Phrenic emphraxis ...................................................................... 1
Refused treatment .................................................................... 3

TOTAL PATIENTS .................................................................... 34

In the 18 cases operated, blebs or bullae were found in all but one. They were removed by excision, suturing the base, and inversion of this line of sutures by a secondary line of sutures. Poudrage was done by talc followed by catheter decompression. In the last four cases the pleura was also rubbed by gauze (Churchill19) previous to dusting by the talc. In the case wherein blebs were not found, rubbing and dusting with talc alone was done.

In the six cases of unexpanded chronic pneumothorax, it is of interest to note that four of the six developed the condition on their first recurrence. All required decortication of the thick fibroplastic peel. In all but one, upon expansion of the lung blebs or bullae were noted which were removed.

The four cases of catheter decompression, one of phrenic emphraxis, and two of instillation of glucose were all done in patients with marked bilateral emphysema, heart disease, considerable age, or a combination of all three.

There have been no recurrences in the 24 cases subjected to thoracotomy. One of the four treated by catheter decompression had a recurrence six months later, and two of the three refusing treatment had recurrences within the year.

Bilateral Spontaneous Pneumothorax

There were 11 alternating and two simultaneous cases. None was of the progressive tension variety, and in only one was there severe dyspnea on admission. The term “alternating pneumothorax” is used in this series only where the contralateral lung had collapsed at least two months after the original side was completely expanded.

In eight of the 11 alternating pneumothoraces, thoracotomy was done on the side of the last attack. Blebs were found in all cases operated. These were removed, followed by pondrage and catheter decompression. There was only one recurrence, and this occurred three months later on the contralateral side. In one case the pneumothorax was treated by aspiration, one by glucose instillation and catheter decompression following thoracoscopy, and one by bed rest alone. There was no recurrence in these three cases. The one treated by bed rest required three months for expansion (refused treatment), and the one treated by thoracentesis took three and one-half weeks, whereas the eight operated were expanded at

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the completion of operation and remained so, and the one treated by catheter decompression was expanded in a few minutes on one side, and on readmission four months later was expanded on the contralateral side in one day.

In the instance of the two simultaneous pneumothoraces, one was treated by bilateral simultaneous catheter decompression, one lung expanding in a few minutes and the other in two days. In the second case, immediate bilateral expansion occurred following catheter decompression and bilateral thoracotomy at four month intervals was done. Blebs were found on both sides. These were removed, poudrage done, and catheter drainage established.

Spontaneous Hemopneumothorax

The onset in four of the six cases was sudden, and all four were in varying degrees of shock when first seen. In the six cases, treatment consisted of multiple thoracenteses, and amounts of blood of 400 to 4,100 cc. were removed by thoracenteses over a period averaging five days. One of us (C.G.) suggested the use of hematocrit in testing samples of blood withdrawn at each thoracentesis in order to determine whether bleeding was continuing, of intermittent character, or had cleared. This ingenious idea has been used and found eminently satisfactory. It is also, we might add, of considerable value in attempting to make the diagnosis of continuing intrathoracic bleeding in trauma to the chest. No operative interference or catheter decompression was used in five cases. All were expanded by the end of two weeks. In the sixth case, expansion of the lung was impeded by a fibroplastic residual and this was decorticated. In two of the cases spontaneous hemopneumothorax occurred in alternating spontaneous pneumothoraces. In one case the hemopneumothorax occurred on the right, and later left spontaneous pneumothorax occurred. In the second case spontaneous pneumothorax occurred on the right, and later hemopneumothorax on the left.

Summary of Treatment of All Cases

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed rest only</td>
<td>11</td>
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<td>11</td>
</tr>
<tr>
<td>Thoracoscopy with insufflation of talc and catheter decompression</td>
<td>5</td>
</tr>
<tr>
<td>Thoracotomy with removal of blebs and bullae, poudrage, and catheter decompression</td>
<td>28</td>
</tr>
<tr>
<td>Decortication</td>
<td>8</td>
</tr>
<tr>
<td>Phrenic emphraxis</td>
<td>1</td>
</tr>
<tr>
<td>Refused treatment</td>
<td>3</td>
</tr>
<tr>
<td>TOTAL PATIENTS</td>
<td>114</td>
</tr>
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</table>

Discussion

Incidence. The incidence of unilateral spontaneous pneumothorax is far more than detailed in the literature. There must be numerous cases never
diagnosed, as the symptoms may be mild or absent and the case is therefore missed unless a roentgenogram is taken. Ten per cent of our cases had no symptoms, being found on routine chest films. In situations where roentgenograms are taken routinely or for even mild symptoms (Armed Forces hospitals), the number found is considerably more than in civilian practice. In the U. S. Army 873 cases were reported as hospitalized in 1943. In 15 per cent it was found necessary to separate them from the Service because they were deemed sufficiently disabled.

*Side involved.* In our series the cases were equally divided as to right and left sides. Charr 21 reports more on the left side and credits this to more pulmonary motion due to cardiac action. This explanation is difficult to accept, as physical activity with obvious increase in ventilatory function seems not to be a factor. Leach 23 reports 38.8 per cent as having no physical activity, and mild or unstated activity in 50.4 per cent of 129 cases. In our series 20 per cent occurred in bed while resting alone, and in 30 per cent more there was only mild physical activity.

*Recurrence rate.* There were 47 cases of recurring spontaneous pneumothorax in our series, and when one adds the 11 bilateral and the 11 recurrences after treatment or refusal of treatment, the total is 69 recurrences out of 114 cases (60.5 per cent). The recurrence rate as reported is from 5 to 45 per cent. 4, 23-27.

*Etiology.* There are many 4,7-10,12,13,28-39 excellent dissertations on etiology. Only a brief review of the experimental work and clinical substantiation is in order here, for it forms the basis of our ideas concerning, first, the active treatment of the first attack, and second, surgical intervention in recurrent cases. Kjaergaard 4 felt that spontaneous pneumothoraces were due to the rupture of subpleural vesicles of two types—one, a vesicle developing in the apex adjacent to old tuberculosis, and second, emphysematous vesicles occurring on the basis of localized emphysema without scar tissue. As the majority of vesicles and blebs are found in the apices, the observation of Ornstein and Lercher 26 concerning disproportionate overventilation of lung apices during a Valsalva maneuver may well explain the anatomical location. Macklin 7, 8 pointed out on both experimental and clinical evidence that first there was atelectasis or some form of partial bronchial obstruction giving local obstructive emphysema with resultant break in the alveoli, permitting air to enter the pulmonary paravascular tissue. From the interstitial emphysema air traveled up and into the mediastinum. The mediastinal emphysema could then break into one or both pleural cavities and/or go up into the neck or even travel retroperitoneally. He also produced pneumothorax from experimentally produced mediastinal emphysema. One of us (L.M.S.) has seen cases of large bleb formation in certain pneumonias of childhood, and spontaneous pneumothorax in cases of severe dyspnea in bronchial foreign bodies and in "bull-neck" diptheria, all of these being evidences and results of obstructive emphysema. Hamman 9 furthered this contention in pointing out the clinical relationship between mediastinal emphysema and spontaneous pneumothorax. These contentions of Kjaergaard, Macklin, and Hamman
have many supporting clinical reports.\textsuperscript{28-30,31-36,40} Hamman\textsuperscript{9} reported that two cases out of 27 spontaneous pneumothoraces had mediastinal emphysema. Dickie\textsuperscript{32} reported that in 20 patients, six had pneumothorax alone, seven pneumo-mediastinum, and seven had both.

Draper\textsuperscript{28} points out that although spontaneous mediastinal emphysema and spontaneous pneumothorax may occur together, the vast majority of pneumothoraces occur without demonstrable mediastinal emphysema. We concur in this, for in our 114 cases, we did not see mediastinal emphysema in any, and in only one case could Hamman's sign\textsuperscript{9} be heard. This patient was a physician in whom the crackling noise synchronous with the heartbeat was audible without a stethoscope; yet the mediastinal emphysema was not detected by roentgenograms. Wise\textsuperscript{36} makes, we feel, an important point in stating that in many cases of spontaneous pneumothorax in which mediastinal emphysema was not recognized previously, the symptoms are severe and similar to those with spontaneous pneumothorax. Perhaps when cases require differential diagnosis between coronary occlusion, dissecting aneurysm, ruptured peptic ulcer (Hamman\textsuperscript{9} and Miller\textsuperscript{34}), and spontaneous pneumothorax, and if no air is seen in the pleural cavity, the precordium should be carefully and repeatedly auscultated and a search for roentgenographic evidence of mediastinal emphysema should be done repeatedly.

The facts and theories as substantiated by clinical and experimental evidence are not, as at first glance, contradictory, for whether there is an escape of air directly from the "valvevesicle" (Kjaergaard) into the pleural cavity, or from the mediastinum (Macklin), both require certain changes in the lung parenchyma (localized obstructive pulmonary emphysema—Macklin, or localized emphysema on the basis of scar tissue—Kjaergaard). It may be presumptuous to interpret other men's experimental work, but on the basis of our clinical experience it might not be unreasonable to assume that these two are different phases of the same or similar processes, Macklin's being more of the acute type, whereas Kjaergaard's statements as to pathogenesis obviously refer to lesions that require time to evolve. Perhaps the vesicle or bleb may result quickly, but the "scar" of the lung parenchyma requires time.

\textbf{Methods and Basis of Treatment}

In general, we feel that whether the source of air leaking into the pleural cavity is directly from the vesicle or bleb, or indirectly from such sources via the mediastinum, the problem is one of overcoming the effects on the lungs. If the leak is directly from the vesicle or bleb, it is obvious from the results that sudden expansion of the immediate adjacent normal, but collapsed, lung stops the leak. If we consider the indirect route (interstitial emphysema and mediastinal emphysema) being treated by immediate expansion, we have an even better basis for such treatment. This route requires the presence of partial atelectasis of at least a segmental or sub-segmental degree. Under such circumstances, leaking of air into the pulmonary parenchyma from the emphysematous area distal to the partial atelectasis would certainly continue or tend to be prolonged, as the factor
of air drift could not be effective. There could be no air drift across a segmental plane if the segments adjacent to the one containing the partial atelectasis are collapsed as part of the pneumothorax.

It is often difficult to visualize bullae by roentgenogram and only rarely can one see vesicles or blebs. Sycamore demonstrated the fact that bullae can be seen after reexpansion of the lung. Kjaergaard, Gordon, and Castex and Mazzel have discussed this problem. The difficulty of visualizing any abnormality by roentgenogram with exception of the pneumothorax is commonly encountered. Bullae and blebs have in our experience been most evident when the lung was collapsed or in the process of expansion. The absence of such findings on roentgenogram does not constitute contra-indication for surgery, for in the combination of our series and those of Brock, Meade and Blades, Brewer, Dolley and Evans, and Haver and Clagett, 91 per cent had blebs, bullae, cysts, etc., found at operation.

Spontaneous pneumothorax — Initial attack. Considering the relative greater speed and expansion of the greater percentage of such cases by intercostal catheter decompression, as compared to bed rest alone or bed rest and intermittent thoracenteses, we can find no reason for not interfering where possible as promptly as possible. The expansion of the greatest majority of cases in from a few minutes to two days, as compared to an average of three weeks, is important from an economic standpoint. In these days of not only a shortage of hospital beds, but also high cost of hospitalization and economic loss to the patient hospitalized for long periods, this time differential should be of great significance.

The natural reluctance to put a foreign body (i.e., catheter) into the pleural cavity in a type of case in which the majority will eventually resolve themselves is understandable, but we would like to point out that in the 37 cases in which intercostal catheters were installed by 11 different operators, there were no complications (no infections and no residual complications). Considering the absence of complications, the ease and rapidity of treatment, and the relative lessened economic cost, we feel this is by far the choice of treatment. In addition to these factors, the obvious advantage of immediately reducing or eliminating pleural complications of infection and/or unexpanding lung is of value even in the few cases in which these complications occur following the initial attack.

The routine of our use of intercostal catheter decompression is approximately as follows: As soon as there is roentgenographic evidence of spontaneous pneumothorax, an intercostal catheter varying from 16 to 20 French is inserted via trocar under local anesthesia in the second interspace anteriorly in the male, and in the anterior axillary line high in the axilla in the female just posterior to the lateral edge of the pectoralis major muscle. This is immediately attached to a water trap and the patient is asked to cough repeatedly or strain after deep inspiration with closed glottis, following which a portable semi-sitting or erect roentgenogram is made. If the lung is found to be completely expanded, the roentgenogram is repeated in 12 hours, and if the lung is still expanded at that time, the catheter is left in place but clamped. The roentgenogram is then repeated 12 hours...
later, and if the lung is fully expanded, the catheter is removed. In the removal one should be careful not to permit any air to escape into the pleural cavity. A safe way to do this is to have the patient hold a deep breath and strain against the closed glottis during the removal. This technique is used whether the intercostal catheter decompression is used alone or in conjunction with instillation of glucose or insufflation of t alc.

In the majority of cases treated by catheter and water trap decompression, the lungs were expanded without suction. In four after elapse of 24 hours without adequate expansion—constant suction of 10 to 14 cm. of water was used. This is a helpful adjunct to the therapy.

The use of a needle placed in the pleural cavity and fixed to the chest wall (Chandler, Marriott and Foster-Carter) appears to us to have the disadvantage of being easily dislodged and readily blocked. We feel that if one wishes to permit a constant egress of air from the pleural cavity, a catheter and not a needle should be used.

The advantage of earlier expansion by catheter decompression is shown by Hughes and Lowry who averaged 11½ days for expansion in 27 out of 40 cases in which a catheter was used. As comparison they point out average expansion times without catheters as follows:

<table>
<thead>
<tr>
<th>Time</th>
<th>Average Expansion Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 4 weeks</td>
<td>- - - - Ornstein and Lercher</td>
</tr>
<tr>
<td>4 weeks</td>
<td>- - - - Rottenberg and Golden</td>
</tr>
<tr>
<td>7 weeks</td>
<td>- - - - Hyde and Hyde</td>
</tr>
<tr>
<td>1 to 9 weeks</td>
<td>- - - Niehaus</td>
</tr>
<tr>
<td>6 weeks to 2½ months</td>
<td>Kjaergaard</td>
</tr>
</tbody>
</table>

Recurrent attacks and chronic pneumothorax. Following our reasoning as the basis for treatment in our initial attacks, and considering the percentage of recurrences, it is logical then to either decompress immediately by catheter and/or follow up by thoracotomy in recurrent and chronic pneumothoraces. Those in distress due to the degree of loss of functioning pulmonary parenchyma are first decompressed and expanded by catheter, or at least decompressed by catheter, and then when the patient is without dyspnea, we follow this by thoracotomy. Patients not dyspneic are not decompressed if a thoracotomy is to be done. In those advanced in age or with associated marked pulmonary emphysema, or heart disease, or a combination of all three, treatment may end with expansion of the lung by catheter. This conservatism is open to some question, for a patient with lowered pulmonary function and/or cardiac reserve is more distressed and is certainly less capable of surviving repeated attacks of sudden reduction in pulmonary function than one who is otherwise well. We have taken this into account, and in 24 of the 34 recurrent cases of spontaneous pneumothorax operated, two had reduced cardiac reserve, one had considerable pulmonary emphysema and arteriosclerotic heart disease, and one was 73 years of age, besides being emphysematous with beginning cor pulmonale. Age in itself does not constitute a contra-indication for operation.

Thoracotomy in these cases consists of posterolateral incision, opening of the pleural cavity by rib resection or intercostal approach, removal of
blebs, bullae, or cysts by clamping relatively good lung proximal to the base of the lesion, and excision and suture closure (a second layer enfolds the first suture line). Airtight closure is checked by filling the pleural cavity with saline and having the anesthetist expand the lung with positive pressure. The saline is then removed and talc is placed on the costal surfaces of the lobes. Care is taken to keep the talc out of the mediastinum, off the mediastinal surface of the lobes, and off the diaphragmatic surface of the lower lobes. As the talc is placed, care is also taken to see that the chest wall muscle layers are not dusted by it. Intercostal drainage, antero- and posterolateral, is established and attached to water traps, and closure of the thoracotomy is done while the lung is inflated.

Operative interference in the past, as shown by reports, has a firm basis in the operative findings. Brock\(^5\) (1948) operated eight of 46 cases, finding large cysts requiring excision or resection by lobectomy. Meade and Blades\(^5\) (1949) reported eight recurrent and 11 chronic cases operated. In the eight recurrent cases, five had multiple blebs, and only in three were no findings noted. In the 11 chronic cases, three had ruptured bronchogenic cysts, five had leaking blebs, one had a bronchopleural fistula held open by an adhesion, and in only two were no causes found. Brewer, Dolley and Evans\(^1\) (1950) found ruptured congenital cysts, blebs, or bullae in 14 out of 15 cases. Thus, in a total of 41 cases operated\(^1,5,15,16\) there were obvious pathological findings in 35. In our series of 37 thoracotomies on 36 patients (one bilateral thoracotomy), findings of blebs, bullae, or cysts were noted in 33.

Cases which fail to respond promptly to methods of expansion have been shown by numerous authors to become chronic pneumothoraces in a considerable percentage. Haver and Clagett,\(^17\) Babington,\(^30\) Elghammer,\(^51\) Hedgpeth et al.,\(^52\) Ehrlich,\(^53\) and Kjaergaard\(^4\) have all shown that if the pneumothorax is left unexpanded long enough, it will fail to expand. Thus, by temporizing and waiting in the case of chronic pneumothorax, one may have to decorticate the lung, as well as remedy the source of the leak, when surgery is finally done.

**Bilateral spontaneous pneumothorax.** The incidence as reported in the literature is, we feel, as with the unilateral spontaneous pneumothorax, no true index of its frequency. The understandable reluctance to report a single case, or at the most a few cases, certainly contributes to this. Oechsl\(^54\) reviewed the literature up to 1934 and reported 77 bilateral spontaneous pneumothoraces. Glickmann and Schlomovitz\(^55\) in 1936 increased this by review of the literature up to 82 cases. Cooch\(^56\) by 1948 collected 44 alternating spontaneous pneumothoraces to which he added one. Our addition of 13 cases (alternating and simultaneous pneumothoraces) is an indication that approximately 10 to 12 per cent of any large series of spontaneous pneumothoraces will be of the bilateral variety.

In instances of alternating collapse of the right and left lungs, unless there is a strong contra-indication to surgery, the patient should be given the protection of at least one lung that will remain expanded. This protection is even more important in cases of simultaneous collapse. There is no question in our minds that it is not elective, but imperative, that at
least one side be operated. Actually the same treatment should be afforded both types of cases, for it is purely fortuitous whether the patient is seen at any given time with an alternating or a simultaneous collapse. Three of our alternating pneumothorax cases gave a history of previous simultaneous collapse (one having had simultaneous collapse twice), and one of the two simultaneous cases gave a history of four attacks of previous alternating collapse.

Spontaneous hemopneumothorax. Kjaergaard\(^4\) reported two out of 51 spontaneous hemopneumothoraces in the literature up to 1932. After a period of 10 years (1942), Hartzell\(^1\) found 40 in the literature and added three of his own. In 1952 Holloway, Speir and Sadler\(^4\) found 80 reported cases up to 1950 with 20 per cent mortality. All agree that the source of the bleeding is the tearing of a vascular adhesion with bleeding from either end of the adhesion. Holloway et al,\(^1\) in their excellent article present cases demonstrating the need for thoracotomy. Their indication is soundly based, as is any indication for thoracotomy, in continued intrathoracic bleeding.

As stated, none of our six cases was operated because of continued bleeding. In reviewing the cases in detail, we feel that two of them were extremely fortunate to have survived with the only treatment being that of multiple thoracenteses. If the bleeding is from the pulmonary side of the torn adhesion, immediate expansion of the lung might be curative, depending on whether the bleeding is from the pulmonary or systemic circuit. Furthermore, it is most doubtful if pulmonary expansion will stop bleeding from the chest wall side unless it is part of a huge clot. Such a circumstance would hardly be desirable, for then the patient would surely require far more surgery (decoration).

In the future, we will follow the lead of Holloway et al,\(^1\) in cases of continued bleeding and operate to ligate the source. With our knowledge today of blood replacement, it is not unreasonable to assume that the patient can be brought to surgery in relatively good condition and at a time most suitable for his survival.

**SUMMARY**

We feel that all initial spontaneous pneumothoraces, unless practically expanded when first seen, should be promptly treated by intercostal catheter decompression. All cases of recurrent spontaneous pneumothorax, chronic pneumothorax, and bilateral recurrent pneumothorax should be treated by surgery as described. Spontaneous hemopneumothorax should be treated by prompt and energetic thoracentesis and operated when there is evidence of continuing intrapleural bleeding.

**RESUMEN**

Creemos que todo neumotórax espontáneo inicial que no sea expandido cuando se ve por primera vez, debe tratarse inmediatamente por descompresión por la vía intercostal por medio del catéter. Todos los casos de neumotórax espontáneo recurrente y de neumotórax espontáneo bilateral
y neumotórax espontáneo crónico, deben tratarse por la cirugía como se ha descrito. El hemoneumotórax espontáneo, debe tratarse prontamente por toracentesis y se debe operar cuando hay evidencia de hemorragia intrapleural continua.

RESUME

Les auteurs estiment que les pneumothorax spontanés apparaissent pour la première fois devraient être rapidement traités par exsufflation à l'aide d'une ponction intercostale, sauf dans les cas où il sont pratiquement déjà en réexpansion quand ils sont vus. Tous les cas de pneumothorax récidivants bilatéraux devraient être traités chirurgicalement ainsi que les auteurs le décrit. L'hémo-pneumothorax spontané doit être traité par une rapide et importante thoracentèse et opéré quand il y à des signes d'hémorragie intrapleurelle persistante.

REFERENCES

43 Castex, M. R. and Mazzel, S.: As quoted by Tyson and Crandall.19