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Hospitals of the » » »
University of Minnesota

Part II
Cysts of the Lung

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STAFF MEETING BULLETIN
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William A. O'Brien, M.D.

I. CYSTS OF THE LUNG

Leo G. Rigler

The interest attached to the various types of lung cavities which have been grouped together under the name of lung cysts is attested by the voluminous literature on the subject. Schenck, in 1936, collected some 130 major references and since that time there have been at least 25 more contributions centering around this subject. For the purposes of this discussion echinococcus and dermoid cysts will not be considered.

Regarded as a rather academic problem a decade ago, lung cysts were thought to be rare and of relatively little clinical significance. With the striking advances of thoracic surgery in the past ten years, the possibilities of curative procedures have greatly enhanced the importance of the distinction from other intrathoracic abnormalities which require other types of treatment, and the accurate diagnosis of this condition has attained a high degree of practical importance. This can be best illustrated by the history of the following case.

Case 1

, 22 years of age, was admitted to the University Hospitals because of a cough with purulent expectoration, apparently the residual of an operation elsewhere for empyema. In October of 1939 she developed a cold followed by a cough with fever. This became productive and she began raising foul sputum December 1, 1939. Roentgen examination was first made on February 28, 1940 at which time a pocket of fluid and air was found in the left posterior chest. This was diagnosed "encapsulated empyema" and a rib resection was done on March 15. She improved greatly, following this operative procedure, and the drainage tube was removed in three weeks. Shortly thereafter she had a recurrence of fever and cough. Another attempt atdrainage was made in July but was unsuccessful. She developed recurrent attacks of coughing with expectoration, chills and fever.

Her past history was of great significance. At the age of 4 she had influenza, coughed and was ill a long time. At 13 she had pneumonia and pleurisy and two years later she had left lung pneumonia. Since that time she has had a cold with a cough each winter. She was injured in an accident in 1937 and was told she had a hemorrhage in her lung.

On entrance the physical signs indicative of a mass in the left posterior chest were found but there were no rales or other evidences of active inflammation about the mass. The leucocyte count was only slightly elevated and the temperature was only a degree above normal. 125 cc. of foul pus was aspirated from the left chest.

Roentgen examination at this time revealed a large pocket of fluid and air in the left posterior chest (Fig. 1).* This measured about 9 cm. in diameter, was sharply outlined, and reached the posterior chest wall. It lay very low, the inferior margin reaching the 11th posterior interspace. The diaphragm was not elevated, the heart was slightly displaced to the right and there was no evidence of thickening of the pleura elsewhere in the left chest. The cavity was round and did not extend out from the posterior pleura in a semicircle as is the case in encapsulated empyema. The absence of the characteristic findings of encapsulated empyema listed above, the absence of signs of collateral inflammation in the remainder of the right lung and the pleura, the sharp definition of the cavity all lead to a diagnosis of possible lung cyst. The history of repeated lung infections was confirmatory. Comparison with the films made in February showed practically no change which tended to further fortify the diagnosis.

*Diagrammatic drawings of the lantern slides made from the original roentgenograms are used for illustrations thruout. The heart and subdiaphragmatic structures are shown by cross-hatching, the superior portion of the thoracic spine and superior meadistinum, and the clavicles by longitudinal hatching.

On October 23, Dr. John Paine resected the 12th rib and inserted a drainage tube with rapid and complete evacuation of the pus which was present. A thin shell of lung around a large cavity was found. At the same time he removed a section of the wall of the cavity for microscopic examination which was done by Dr. Robert Hebbel. Typical stratified epithelium characteristic of bronchial mucosa was found. This established beyond doubt that this was a lung cyst, as a bronchiectasis could readily be ruled out from the size and singleness of the cavity.

After the drainage had been established, the cough and pain ceased, the slight fever disappeared. Suction was instituted and there was some tendency toward collapse of the wall from the expanding lung. The patient was sent home to get rid of all infection whereupon a lobectomy will be done to permanently cure the condition.

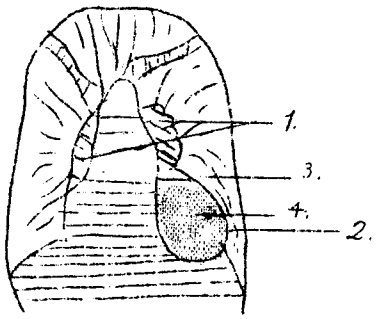


Fig. 1

Postero-anterior roentgenogram

1. Hilum of lung.
2. Cyst wall.
3. Gas bubble in cyst.
4. Fluid with fluid level.

Note the low position of the pocket of fluid and air, the sharp demarcation from the surrounding normal lung, the absence of thickened pleura, the rounded character of the pocket.

Comment

The practical importance of the roentgen diagnosis of lung cyst lay in the stimulus to the surgeon to make a biopsy and establish clearly that this was not an encapsulated empyema or lung abscess. It is evident from the history that this patient has been suffering from recurrent infections of the cyst and that repeated drainages would only be temporary in their effect. Maier and Haight have recently directed attention to the importance of biopsy in cases thought to be chronic empyema; cysts of the lung, that have become infected, will rarely be cured without either complete removal or destruction of the secreting lining of the cavity. An earlier diagnosis of cyst in this patient might have saved her a long period of suffering and the possible deleterious systemic effects of prolonged pulmonary suppuration. Elocsser has also emphasized the likelihood of mistaking infected cysts of the lung for encapsulated empyema.

The congenital or acquired origin of this cyst comes next to mind as an important question. Much of the recent literature on this subject has dealt with this problem. The difficulty in making such a decision is well illustrated in the following case.

Case 2

., a male of 19 years, came into the Out-Patient Department on 3-21-39 complaining of shortness of breath on exertion, pain over the precordium and palpitation. The blood pressure was 175/120.

During routine fluoroscopy, some changes were found in the right lower lobe, which, on roentgenography (Fig. 2), showed multiple areas of rarefaction confined to a small area of the lower lobe. Most of these were small cavities, having much the appearance of bronchiectasis but there were in addition several much larger, more sharply defined cavities suggesting lung cysts. In addition there was found an area of calcification which was thought to be due to the

chronic inflammatory process. Bronchography with iodized oil was done and the large cavities were filled sufficiently to determine their close relationship to the posterior pleura and their close resemblance to multiple cysts.

On closer questioning, the patient later admitted a cough with moderate expectoration, which came on every winter and had been present for a number of years.

Bronchoscopy on 5-17-39 showed inflammation of the bronchial mucosa and mucopurulent pus from the right main bronchus. Two of the lower lobe branches appeared stenotic.

He left the service for a time and returned 10-22-39 with a history of blood spitting which had occurred one month earlier, followed by purulent expectoration, attended by bouts of fever. A diagnosis of localized bronchiectasis with lung cysts was made.

On 10-24-39 a right lower lobectomy was done by Dr. O. H. Wangensteen; he found the remaining lobes on the right side to be normal. The excised lobe was found to contain a foreign body, fully calcified, which on close examination proved to be a timothy head. This lay in a bronchiectatic cavity and about it were a number of similar bronchiectases with a moderate degree of fibrosis, patchy atelectasis and secondary inflammatory changes in the parenchyma of the lung. The bronchiectatic cavities were lined with squamous metaplasia. Far removed from the foreign body there were two large cavities, lined with bronchial epithelium, having all the characteristics of congenital lung cysts. Their walls were sharply demarcated, smooth and trabeculated. Communication with the bronchi was clear but these cysts appeared independent of the stenosed bronchi.

It is of interest to note that a history suggesting aspiration of this foreign body during childhood was obtained from the mother altho it had been denied by the patient.

Reexamination of the roentgenograms indicated that the area of calcification originally observed represented the foreign body.

He has since made a full recovery and is now symptom-free.

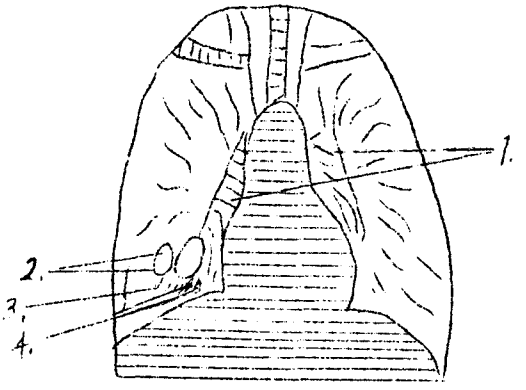


Fig. 2

Postero-anterior roentgenogram

1. Hila of lungs.
2. Cysts of lower lobes.
3. Calcified structure later proved to be foreign body.
4. Bronchiectatic cavity.

Note the sharply demarcated, rounded, air-filled cysts compared to the smaller, thicker-walled bronchiectases. The density here seen proved to be a timothy head which had become calcified.

Comment

The causative factor for a localized bronchiectasis was well established here, yet on pathological examination we are unable to rule out congenital cysts as well. The differentiation between congenital and acquired cysts has been based largely upon the demonstration of a secreting bronchial epithelium lining the cavity of the congenital cyst in contrast to the alveolar epithelium, squamous metaplasia or inflammatory tissue which lines bronchiectatic cavities or acquired cysts. Unfortunately, it has been demonstrated that bronchial epithelium may grow down through a fistulous orifice to a cavity and come to form a lining of that cavity. This is not a metaplasia but

rather a direct growth and if this may occur there is no possible way to distinguish such a process from a genuinely congenital cyst. In this case, for example, even with the lobe available for microscopic examination it is difficult to state categorically whether the cysts found in this lobe were congenital in origin or the result of the foreign body and its attendant inflammation.

Prior to a few years ago, it was generally believed that all lung cysts were congenital in origin, although it was recognized that bronchiectasis, chronic pulmonary abscess and other inflammatory processes might simulate the condition. That lung cysts may be acquired is illustrated by the following case which has already been reported in the literature.

Case 3

., a male aged 30, came into the University Hospitals on 8-18-31 with a history of chills, fever, cough, sputum and pain in the left chest for 13 days. Rusty sputum had appeared the day before. He had physical findings and the roentgen picture (Fig. 3A) of a large consolidation in the left upper lobe. The sputum, on repeated examination by Dr. Hobart Reimann, showed a pure culture of hemolytic staphylococci and this case has been included in Dr. Reimann's report on staphylococcis pneumonia. Some evidence of cavitation developing within the left upper lobe consolidation was already present at this time. Meanwhile he developed other areas of consolidation with eventual cavity formation in the right upper lobe and in the left lower lobe. All of these cleared over a period of time except for the very large cavity in the left upper. This was originally multilocular but became unilocular after a time. Eventually all the fluid disappeared, the symptoms all cleared up, there was no further cough or expectoration. He was discharged from the hospital. Later he was reexamined and the roentgenograms revealed a very large, structureless, air-containing cavity, occupying most of the left upper lobe (Fig. 3B). There was no fluid within it, it was sharply ancapsulated and was obviously an air cyst remaining as a residue of the previous cavitation in the lung. An attempt to introduce lipiodol through the trachea was made but was unsuccessful, only displacement of the bronchi about the cavity being shown. Reexamination in 1934 indicated that the air sac had diminished in size but otherwise the condition was unchanged.

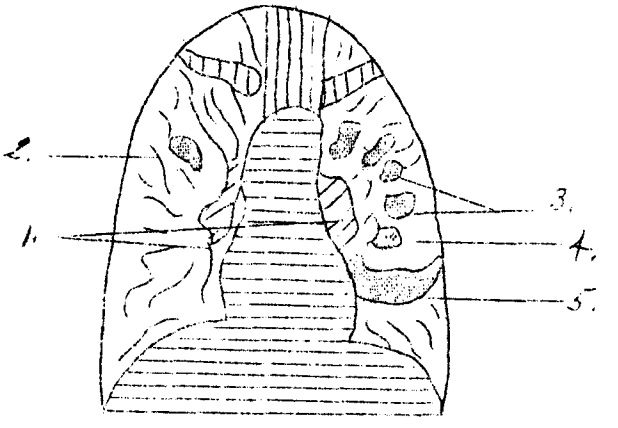


Fig. 3A

Postero-anterior roentgenogram made 9-4-31.

1. Hila of lungs.
2. Consolidation in right upper lobe.
3. Multiple areas of consolidation in left upper.
4. Air in lung cavity.
5. Fluid with fluid level in cavity in lung.

This roentgenogram shows the massive abscess with multiple areas of consolidation seen about a month after the onset of the staphylococcic pneumonia.

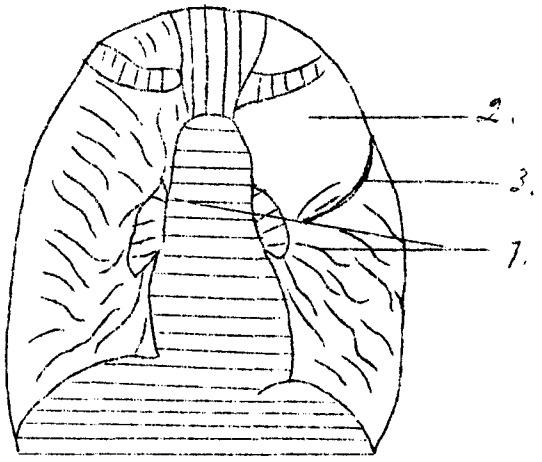


Fig. 3B

Postero-anterior roentgenogram made 12-5-32

1. Hila of lungs.
2. Air in cyst cavity.
3. Lower wall of cyst with atelectatic compressed lung alongside of it.

The large air cyst replacing the area of cavitation previously observed is well shown. There was no apparent gross bronchial communication. Reexamination two years later showed this cyst to be definitely smaller at this time, but otherwise it was the same. No fluid was observed.

Comment

There is here shown the development of an acquired air cyst of the lung following a massive cavitation. Peirce and Dirkse have reported recently the demonstration of the development of such cysts in infants following bronchopneumonia. Their report clarifies the problem of acquired lung cysts and is interesting in view of the previous general acceptance of the congenital origin of all cysts. There is no doubt that some cysts, particularly the air cysts, may be acquired. It is not always possible to make the distinction but, in any event, the term congenital should certainly not be applied unless there is some reasonable certainty that the cyst was not acquired.

In some instances, obviously, the congenital origin of a cyst may readily be determined from the history. An illustration of this is afforded by the case already reported in the literature by Swanson, Platou and Sadler.

Case 4

, a female, showed some cyanosis at birth and dyspnea and cyanosis every 4 days thereafter. She was examined within the first few days of life and showed dullness over the right lung. Roentgen examination at the age of 7 weeks revealed a dense opacity of the entire right lung. Fluid was then withdrawn by paracentesis and air was injected into the pleural cavity. This procedure made it obvious that the fluid was within the visceral pleura, the right lung being represented by a sac, filled with fluid, which could be partially collapsed by pneumothorax. At the age of $3\frac{1}{2}$ months the infant was admitted to the University Hospitals. A dilute solution of sodium iodide (this was before the development of the organic iodine compounds) was injected thru a paracentesis needle directly into the lung. Roentgenograms (Fig. 4) then demonstrated the outline of the lobes, all of which were filled with the opaque contrast medium.

Surgical drainage was instituted with very satisfactory results. The cavity became rapidly smaller as demonstrated on roentgen examination and normal lung began to appear on this side, apparently from expansion of previously atelectatic, compressed areas. The cyst was reduced to 4 cm. in diameter. It should be noted that no bronchial communication was ever demonstrated and there was no air in the cyst except when it was injected from without. This is in sharp contrast to the previous cases described.

Bronchoscopy was then done with the

injection of lipiodol through the bronchoscope in order to determine whether or not there was a true agenesis of the bronchi. None of the oil enteres the cyst, only the bronchi about it being filled. 36 hours later, exitus occurred; the exact cause has never been ascertained. At autopsy, the remains of the cyst were found together with the atelectatic lung about it. The cyst was lined with epithelium containing mucous glands.

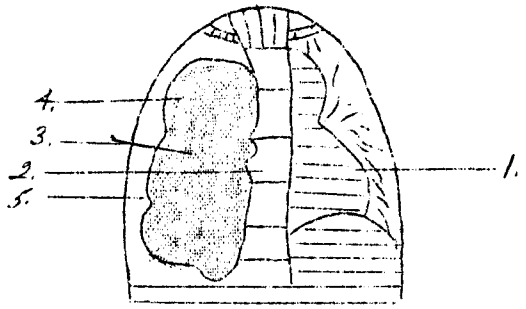


Fig. 4

Postero-anterior roentgenogram

1. Heart displaced to the left.
2. Thoracic spine.
3. Needle within the visceral pleura.
4. Sodium iodide injected into the lung showing the lung to be nothing but a very large cyst cavity into which fluid could be injected from without.
5. Pneumothorax demonstrating the separation of the lung cyst from the pleural cavity.

Comment

In a case of this type there is no question as to the congenital origin of the cyst. Nevertheless, this does not contraindicate treatment which, even by the method of simple drainage, promised success in this case. The absence of a bronchial communication with the cyst is favorable because the opportunity for secondary infection is thus greatly diminished. It is conceivable that simple drainage if continued might have permitted a sufficient expansion of the normal lung and regeneration of alveolar buds to collapse the cavity completely. The presence of a secreting membrane lining the cavity makes this less probable. It seems more likely that eventually lobectomy or at least cauterization of the lining of the cyst would have had to be done.

The splendid effects of therapy are well illustrated in the next case which was treated by lobectomy.

Case 5

., a male aged 11, was admitted to the Out-Patient Department 7-18-39, because of pain in the chest for 2 years, coming on especially in attacks during the winter. Two months before admission he had expectorated blood for the first time. There were frequent colds from early life but no other history of a cardio-respiratory disorder.

Roentgen examination (Fig. 5) revealed a massive cavity in the right lung with a large amount of air within it and a small amount of fluid showing a level in the upright position. The cavity seemed to occupy the entire lower half of the right hemithorax, the heart was displaced to the left, the diaphragm downward. The cavity was sharply demarcated above. Within it were a number of dense, linear shadows representing tissue strands. These have been emphasized as good evidences of a lung cyst as they indicate residues of lung tissue. Bronchography with iodized oil was done and revealed the middle lobe bronchus to be almost closed. The upper and lower lobe bronchi could be readily made out. The lower lobe filled readily with the oil and was seen to be markedly compressed into the medial, posterior portion of the hemithorax, resting against the right border of the heart. None of the oil entered the cyst cavity. Bronchoscopy was done and showed only displacement of the bronchi to the left.

Dr. O. H. Wangensteen explored the thorax and found the anatomical situa-

tion to be substantially as described above. The middle lobe only was removed. It was composed essentially of a large cyst wall lined with stratified epithelium and showing practically no normal lung structure. The recovery was essentially uneventful. The lower lobe re-expanded and came to fill the right hemithorax along with the upper lobe. The boy has now regained a normal status.

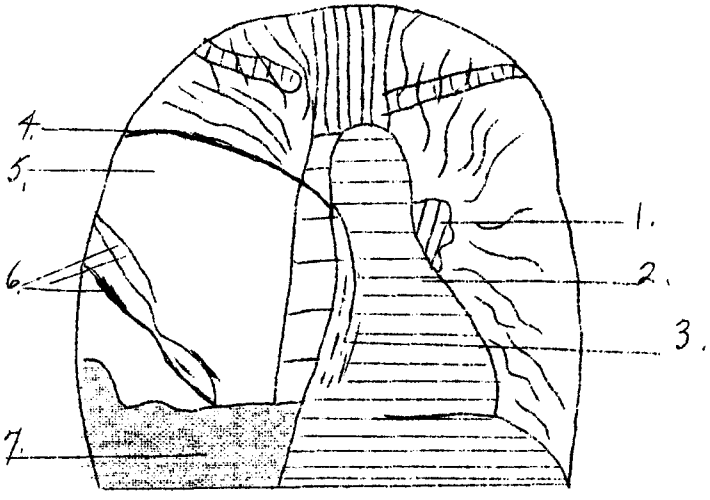


Fig. 5

Postero-anterior roentgenogram

1. Hilum of left lung.
2. Heart displaced to the left.
3. Compressed right lower lobe pushed to the left against the right border of the heart.
4. Edge of compressed upper lobe with atelectatic margin and wall of cyst.
5. Cyst cavity containing large quantity of air.
6. Strands of tissue representing residual, undeveloped lung tissue within the cyst.
7. Fluid at base of cyst with fluid level.

The characteristic picture of the massive, congenital cyst containing both fluid, air and residual of lung tissue is well shown. This cyst arose from the middle lobe and compressed both the upper and lower lobes, the latter being completely atelectatic. The findings were completely borne out at operation.

Comment

This was no doubt a congenital cyst although it is difficult to prove absolutely. There was bronchial epithelium lining the cyst cavity, and there was secretion of fluid in the cyst. Bronchial communication was not readily demonstrable but must have been present, otherwise the air in the sac could not be accounted for. In this case, again, the roentgen findings were of the utmost importance in the recognition of the condition which led to the proper treatment. The brilliant results of thoracic surgery are well illustrated. Repeated drainage would probably not have led to the permanent cure achieved by lobectomy.

Cysts of this kind, curiously enough, do not always produce prominent symptoms and occasionally may be borne for years without outstanding complaint on the part of the patient. The more or less accidental discovery of such a cyst is illustrated by the following case.

Case 6

. came in 5-15-37 because of a mass in the pelvis. This proved to be a cyst and a fibroma of the left ovary; salpingophorectomy was done. There was some evidence also to indicate the presence of a mitral stenosis.

During the course of the routine physical examination some evidences of hyper-resonance over the right chest were found, but they appeared to be of little significance.

Routine roentgen examination of the chest (Fig. 6), to exclude metastases, was made and a very large cyst was found. This showed a small amount of fluid at the base, but it largely contained air. It occupied the lower two-thirds of the right hemithorax. A strand of tissue similar to those described in Case 5 was

also present.

So far as could be determined after close questioning no symptoms were present at this time referable to the chest except some dyspnea. Further inquiry indicated that at Christmas of 1936 the patient had some pressure sensation in the chest and developed some dyspnea; apparently this was really an inability to catch her breath. She went to a doctor and he found the tumor in the pelvis but no other cardio-respiratory findings. She said she had lung fever at the age of six and on several occasions thereafter. There was no cough nor any expectoration.

Aspiration of the chest in the region of the cyst produced air and about 200 cc. of a brownish fluid. The measurement of the pressure showed a positive pressure in the right side; probably the needle was in the cyst. The vital capacity was only 1000 cc.

The sputum was negative. The fluid from the chest was also examined repeatedly and was entirely negative bacteriologically. It was thick, brown, homogeneous and showed no sedimentation. The fluid contained 25,000 white blood cells per cu. mm. and had a specific gravity of 1043. There were 22 grams of protein per liter of fluid. No tumor cells could be found within it.

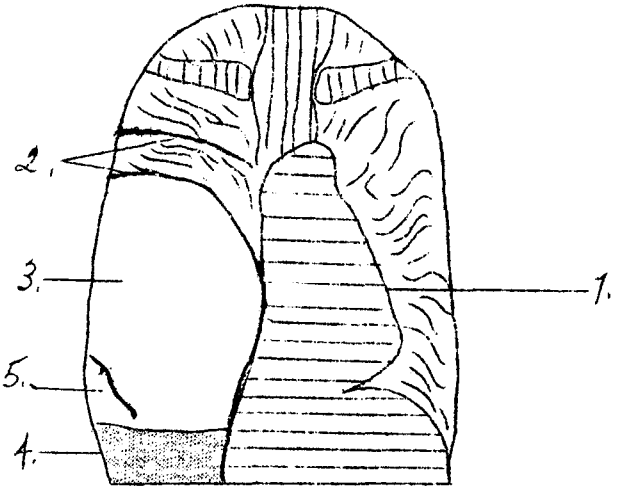


Fig. 6

Postero-anterior roentgenogram

1. Heart displaced to left.
2. Edges of compressed, somewhat atelectatic lung.
3. Air within massive lung cyst.
4. Fluid with fluid level at base of cyst.
5. Strand of lung tissue remaining within the cyst.

Comment

Here we have a very large cyst which apparently communicated with a bronchus in that there were large quantities of air, but did not produce any couth or expectoration and no symptoms at this time. The history of repeated attacks of lung fever in childhood is very significant as bearing on the problem of the congenital origin of this cyst. In many other respects it has the characteristics of a congenital cyst. It is astonishing that such a large cyst should have continued without symptoms and have been discovered more or less accidentally in this fashion. Yet this history has been obtained in a number of instances. The possibility of repeated infection of the cyst cavity in the future must be borne in mind. If this should occur, more radical efforts at extirpation would be made.

A further illustration of the fact that a lung cyst may have long periods of quiescence with absence of symptoms is illustrated in the next case.

Case 7

., a boy of 8, was first seen September 30, 1930. He had been apparently entirely well until a year previously when he developed a cold followed by cough and expectoration. This had improved but ever since that time he had had recurrent attacks of fever, cough and expectoration. In May of 1930 an attack of a similar kind was experienced. A rib resection was done for empyema and on injection of the cavity which was found, a bronchial fistula was demonstrated. He came into the hospital at this time with evidences of a bronchial fistula and it was thought that he had an

encapsulated empyema in the left upper lobe.

On x-ray examination (Fig. 7A) there was found a very large, dense, rounded mass which in the upright position showed a very small amount of gas at its upper surface indicating communication with the bronchus. We, too, on examination at that time considered this to be an encapsulated empyema. This error in diagnosis was largely due to unfamiliarity with the syndrome of infected lung cysts.

He was operated upon September 30 and again October 3 by Dr. Wangensteen with a drainage of the cavity. Both gas and pus were obtained and a drainage tube was put in. The cavity, however, persistently failed to close, and drainage continued over a period of years.

He was readmitted April 5, 1934 showing a large residual cavity. A catheter was introduced intercostally and suction was undertaken in order to re-expand the lung. There was a remarkable re-expansion during extreme suction, but the lung would collapse promptly when the suction was removed. The cavity was filled largely with air, and there was a relatively small amount of drainage.

Some time after this we came to realize that this was really an infected lung cyst. He was seen again October 10, 1938. At this time he was apparently entirely well. The roentgenogram (Fig. 7B) showed a very large cavity in the left upper lobe almost entirely filled with air. A very small amount of fluid was present at the base of the cyst.

He has had no further attacks of fever, cough, expectoration or any other symptoms. He occasionally gets a little drainage, however, through a small opening which is still communicating with the outside. He refused further operative procedure, and apparently is still getting along well.

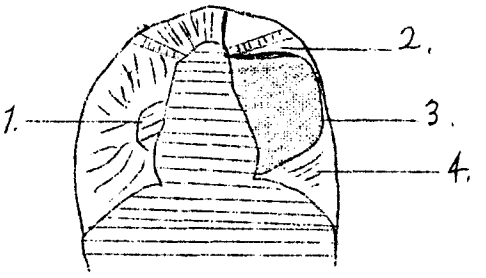


Fig. 7A

Postero-anterior roentgenogram made 10-1-30.

1. Hilum of right lung.
2. Air in superior portion of lung cyst.
3. Fluid within cyst.
4. Compressed, partially atelectatic lower lobe.

This is a typical picture of a massive lung cyst involving the entire left upper lobe containing both fluid and air. It was infected at this time giving the symptoms and signs of an encapsulated empyema.

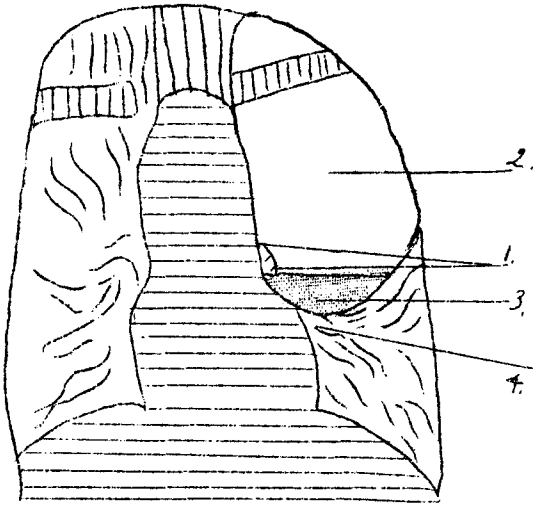


Fig. 7B

Postero-anterior roentgenogram made 10-10-38.

1. Hila of both lungs.
2. Air in cyst occupying most of cyst cavity.

3. Small amount of fluid at base of cyst.
4. Compressed, slightly atelectatic lower lobe.

The cyst now has relatively little fluid in it, and is not infected at this time so that the patient was symptom free, but the cyst cavity, communicating with the bronchus, still remained.

Comment

In this instance is again illustrated the error of mistaking an infected lung cyst for an encapsulated empyema. The failure to obliterate the cavity, the continued drainage, the alternate expansion and contraction of this large cavity should indicate that this is a cyst rather than an empyema. Here, too, is well illustrated the possibility for a lung cyst to have an infection, give marked symptoms and then spontaneously, or after drainage, improve greatly. The fact remains that in this boy there is still a large cavity communicating with a bronchus and with the outside, which may become infected again with serious results. In all probability, extirpation of the cyst by lobectomy would be the treatment of choice.

Not all cysts are single as shown in most of the cases so far illustrated. Many of them are multiloculated, occurring in either one lung alone, with multiple loculations or occasionally in both lungs. These are probably of a very similar origin to the very large fluid and air cysts previously described, but instead of developing from one bronchus they develop from a number of smaller bronchi. A case in point is illustrated below.

Case 8

a female aged 22, was first seen September 19, 1932. She was sent in from the Glen Lake Sanatorium Out-Patient Department with the following history. At the age of 10, in 1920, she had a tonsillectomy which was followed by a cold, temperature and expectoration. A diagnosis of abscess of the lung was made, but nothing was done. She was seen in 1923 in Lymanhurst Clinic where the diagnosis of lung abscess was also made. From that time until the present she has had repeated attacks of colds which occasioned a considerable amount of sputum but no other symptoms. She had had pneumonia prior to this tonsillectomy but there was nothing else of moment in the past history. She was sent to Glen Lake Sanatorium for observation in August of 1930. In October of 1932 a phrenic exeresis was done. Following this there was no particular change in her condition. She was last seen July 15, 1937 at which time she was still coughing and raising sputum from time to time but otherwise getting along fairly well.

On roentgen examination (Fig. 8) multiple areas of rarefaction with fluid levels were present throughout almost the entire right lung. Some of the cavities were very large containing a large amount of air and small amount of fluid at the bottom; others were much smaller. On bronchography the iodized oil could be introduced into these cavities and the communication with the bronchi thus clearly established.

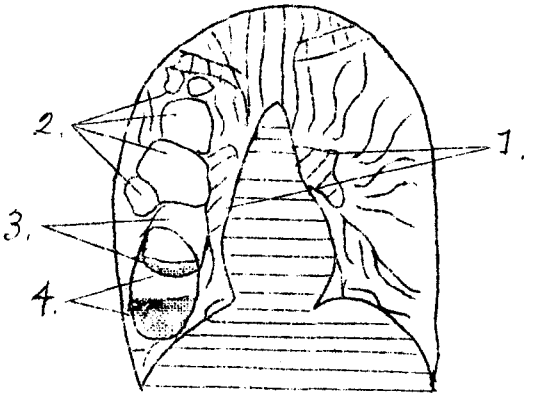


Fig. 8

1. Hila of both lungs.
2. Multiple air-filled cavities in upper portion of right lung.
3. Air in superior portion of multiple cysts.
4. Fluid with fluid levels shown in inferior por-

tion of these same cysts.

The multiple cystic loculated areas in the right lung are well shown, some of which contain fluid and air, others air alone. The absence of any thickening of the pleura or evidences of inflammatory process is notable. The walls are sharply defined, but thin, the whole appearance being characteristic of multiple lung cysts.

Comment

This type of case presents an extremely interesting problem. Are these multiple congenital lung cysts which happened to have become infected following the tonsillectomy at the age of 10 or do they represent the end result of multiple abscesses occurring at that time with possibly some secondary bronchostenoses? The multiple character of the lesions and their extensive distribution involving almost an entire lung makes the latter rather improbable. If the lesions had involved one lobe, the possibility of multiple lung abscesses would have to be strongly considered. It seems unlikely, however, that such an extensive pathologic process involving the entire right lung could have followed the tonsillectomy. The absence of any extensive secondary inflammatory changes in the remainder of the lung or in the pleura also speaks against a simple abscess formation. It is virtually impossible to prove this without biopsy of the cyst wall. Even if biopsy had been obtained, final proof might not be available. The possibilities are, however, that these represent multiple congenital loculated lung cysts involving the right lung with intermittent infection.

An entirely different picture may be presented in some instances in which there are multiple, very small rarefactions throughout one entire lung. These have all the appearances of a bronchiectasis but are different from the ordinary bronchiectasis in two respects. First, there is little or no evidence of pneumonitis or other inflammatory process in the lung; second, the entire lung is involved from apex to base. These are generally considered to be due to infection, very early in childhood, with a bronchostenosis and secondary changes arising from that. The possibility of a congenital bronchiectasis is not excluded. Such a case is reported below.

Case 9

, a male of 17, was first seen July 12, 1940. He had a history of a chronic cough since the age of 1 year with recurring pleurisy and pneumonia every winter since that time. He has had asthma each summer for the past nine years. On admission he was expectorating large quantities of greenish sputum, was nauseated and had lost some 11 pounds in the past three weeks.

On physical examination there were some coarse rales throughout the right chest with decreased resonance. He was bringing up about one cup of sputum each day. A leucocytosis of 20,000 was present, but there was no particular anemia. The sputum was repeatedly examined and was negative for tuberculosis.

On routine fluoroscopic examination what appeared to be an emphysema on the right side with multiple cavities was found. Bronchoscopy was done on 7-12-40 and pus could be observed coming from the right main bronchus, apparently chiefly from the upper and middle lobes. No signs of bronchostenosis could be made out. The left bronchus appeared normal.

Roentgen examination (Fig. 9) was done at this time and showed multiple small cavities extending through the right lung field but largely, if not entirely, in the lower lobe. The middle and upper lobes had expanded considerably with emphysema; there was relatively little atelectasis. The left lung also appeared emphysematous. There was no thickening of the pleura and no other evidences of inflammatory process. Bronchography was done and

the cavities could be well demonstrated on filling with the iodized oil. The appearance suggested a generalized bron chiectasis with, however, striking absence of secondary inflammatory changes and with an unusually wide distribution of the cavities.

On September 27, 1940 right lower lobectomy was done by Dr. Wangensteen. The middle lobe appeared on gross examination to be normal; the upper was not examined. The lower lobe was resected and weighed 120 grams. The pleura was normal and the lobe appeared crepitant. Practically all the bronchi were dilated to variable degrees. Some of these cavities measured 5 to 6 millimeters in diameter; in one the diameter was 2 centimeters; all of them communicated with the bronchi. The walls of the cysts were relatively thick, but there was very little secondary inflammation.

Recovery was uneventful and his symptoms have largely disappeared.

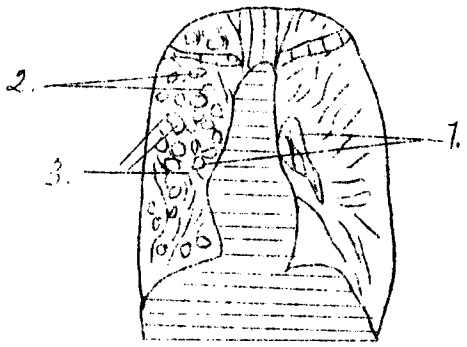


Fig. 9

Postero-anterior roentgenogram

1. Hila of lungs.
2. Air in cavities in right lung.
3. Fluid with fluid levels in right lung.

Multiple small rounded pockets containing both fluid and air are seen widely distributed. These were confined fairly well, however, to the lower lobe as shown in the lateral view. The appearance is characteristic of multiple bronchiectasis of a cystic type, the walls being relatively thin, there being little or no pleural thickening or other evidences of inflammatory process. There is some fibrosis shown at the right base, but it is minimal in degree in proportion to the tremendous number of cavities.

Comment

The origin of these cysts in all probability was a bronchiectasis arising from a pneumonic process early in childhood. The confinement to the lower lobe, the small size of the lesions, the fact that they represent actual dilatations of what appear to be otherwise normal bronchi, all lend credence to this theory. Many such cases have been reported in the literature as congenital bronchiectasis, but in all probability they represent an acquired lesion. The extirpation of the lobe had a very favorable effect. The patient was seen again several months later, and said he never felt better in his life, altho he still had some slight cough. The possibility that other bronchiectatic areas are still present on the right side in the middle or upper lobes has not yet been excluded.

That multiple small bronchiectatic cavities, resembling closely multiple lung cysts, can be developed as a result of pneumonia is well illustrated by the next case.

Case 10

., a male aged 73, was admitted June 18, 1938. He had been seen previously because of some abdominal difficulty which appeared to be due to cirrhosis of the liver. On June 12, 1938 he had a severe chill, cough, pain in the right chest, with fever. Cyanosis and dyspnea followed; the typical symptoms of pneumonia were present. The temperature was 103° to 104°; the leucocyte count was 19,800; the sputum showed

type is pneumococci.

On roentgen examination June 18, (Fig. 10A) a characteristic consolidation of the middle and upper lobes was found.

The temperature came down to normal on June 23, 1938 and the patient appeared to be recovering. Some cough with sputum, however, persisted. Repeated reexamination with roentgenograms revealed complete resolution of the middle lobe but the upper lobe continued to show some consolidation. This was followed by gradual shrinkage with atelectasis, and eventually a typical multiple bronchiectasis of the upper lobe.

One June 16, 1939 reexamination with x-rays (Fig. 10B) showed multiple rarefactions in the upper lobe. Bronchography was done and these were demonstrated to fill with the iodized oil, having all the appearance of bronchoiectasis of the upper lobe. Bronchoscopy was done and showed some distortion of the right upper lobe bronchus which was displaced upward and somewhat angled. Purulent secretion could be seen coming from it. Aside from some cough and expectoration the patient was not having any serious symptoms.

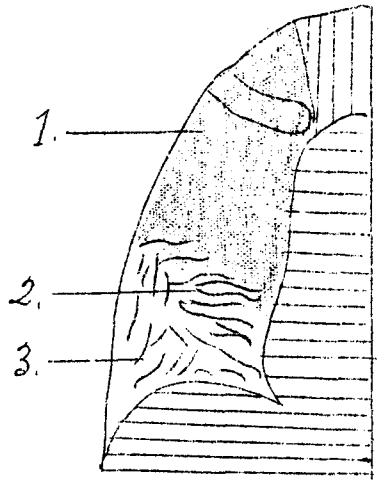


Fig. 10A

Right half of postero-anterior roentgenogram made 6-21-38.

1. Dense consolidation in right upper lobe.
2. Moderate consolidation in right middle lobe.
3. Normal lower lobe.

The characteristic appearance of lobar pneumonia is here shown.

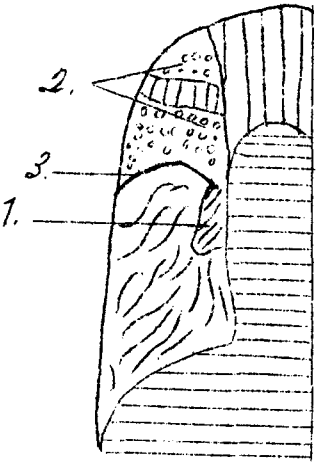


Fig. 10B

Right half of postero-anterior roentgenogram made 6-8-39.

1. Hilum of right lung.
2. Multiple bronchiectatic cavities.
3. Lower border of shrunken, atelectatic right upper lobe.

The resultant, typical cystic type of bronchiectasis in the upper lobe is well shown here coming from the unresolved lobar pneumonia.

Comment

Such a case demonstrates well the development of bronchiectasis from a partially unresolved pneumonia while under observation. No doubt this is illustrative of the type of process which was presented in Case 9 in which the phenomenon occurred very early in life.

A type of cyst occurs in association with emphysema which very likely is acquired and represents a breaking down

of alveolar walls due probably to some type of partial bronchial obstruction. This may well be called an air cyst although it has often been designated as subpleural emphysematous blebs in the lungs. These blebs may attain a very large size and become an important factor in the clinical symptomatology of the patient. They are almost always associated with emphysema, but may occasionally occur as a result of bronchostenosis. A case of this type is reported below.

Case 11

., aged 35, was first seen 2-18-37. The history was that of dyspnea of extreme grade beginning some two years before. He had had a cough for some 6 years, sometimes with sputum, but never with blood; there was no pain and no other evidence of abnormality. He developed an upper respiratory infection in 1935 following which he was unable to work because of dyspnea. The Mantoux was negative and the laboratory findings were essentially negative. The vital capacity was 2700 to 2900 cc. In July of 1936 x-ray examination made elsewhere showed an air cyst in the left upper lobe, but apparently there was none at that time on the right side.

On roentgen examination (Fig. 11) here, a large cyst filled with air occupying a large portion of the left upper lobe was shown. It was sharply demarcated by a capsule but there was no fluid within it. It was remarkably distended. The lungs on both sides showed a high grade of emphysema. The heart was long and narrow and the diaphragms extremely low. On the right side there were a number of subpleural exmphysematous blebs of characteristic fashion, especially in the upper lobe.

The cyst was needled and 600 cc. of air obtained, but it refilled very rapidly indicating a communication with a rather large bronchus.

This case, seen originally by Dr. Thomas Kinsella, who made the diagnosis, was studied for a time in the hospital. Dr. Kinsella's opinion was that some relief of his extreme dyspnea might be afforded by removal of this expanding air cyst in the upper lobe. Exploratory thoracotomy was undertaken. Approxmmately three-fourths of the left upper lobe was found to be occupied by a large multilocular, thin-walled air cyst. This was adherent to the chest wall and the mediastinum. Many smaller air cysts were also present in this lobe. The lower lobe was partially collapsed but no cysts were seen within it. Lobectomy of the left upper was done by the primary method without complications.

The patient recovered from the operation and was improved for a period of time, then he developed a sudden attack of dyspnea, was brought into the Minneapolis General Hospital a year and one-half later and died very suddenly. At autopsy complete bronchial obstruction with atelectasis of the right lung was found which, because of the reduced function of the remaining single lobe on the left, produced a reduction in vital capacity incompatible with life.

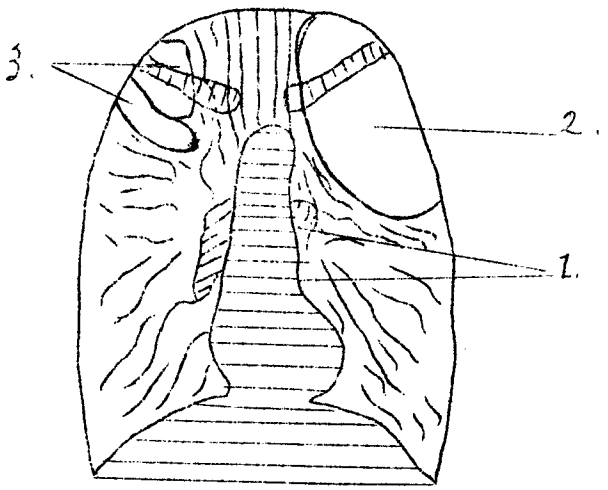


Fig. 11

Postero-anterior roentgenogram

1. Hila of lung.
2. Large air cyst in upper lobe, showing fairly thick, sharply defined walls due to compressed atelectatic lung about it.
3. Multiple air cysts in right upper lobe.

Note the marked emphysema, the low diaphragms and the long, narrow heart being characteristic. The large air cyst on the left side was compressing the remainder of the left lung which, added to the emphysema and the air cysts on the right, reduced the vital capacity to a very low point.

Comment

This is a typical case of air cyst associated with emphysema with the complications incident to it. The absence of infection and the absence of a secretory lining to the cyst wall indicates clearly the character of the cyst. It is an acquired, emphysematous destruction of the alveolar walls rather than a true bronchogenic cyst.

By contrast with cysts, the presence of an encapsulated tension pneumothorax must always be borne in mind. These may simulate very closely the appearance given above, yet their origin is entirely different and the treatment is of a different order. Such a case is illustrated below.

Case 12

.. a child of 8, was first admitted to the University Hospitals in 1931 for malnutriton. Her chest was negative at that time. The second admission was in 1936 for a fungus infection of the hand.

The third admission was March 24, 1938, at which time there was a sudden onset of acute illness with delirium, vomiting, and elevated temperature. A left lower lobar pneumonia was found on x-ray examination. On March 28 evidences of a beginning pleural effusion, probably an empyema, were seen on x-ray examination. The blood was cultured and Type 1, pneumococcus was obtained.

An encapsulated pocket in the left upper lobe, very sharply outlined, was now demonstrated. Fluid and pus were removed from this.

Rib resection was done on April 1, with drainage, following which there was a rapid recovery.

No further films were made after the drainage of the cavity until the patient returned in July of 1938 at which time a large pocket containing air, sharply outlined, was discovered (Fig.12) The patient was observed for a period of time during which the pocket of air gradually increased in size. No procedure was undertaken because the patient had a variety of other complications including malnutrition, rheumatism, and congenital syphilis.

On November 28 the patient was readmitted with a high fever, dyspnea, cough and other evidences of pulmonary infection. She went steadily downhill, developing cyanosis and shallow irregular respiration. She died a respiratory death on November 29.

At autopsy both pleural cavities were obliterated. The left upper lobe was found to be completely collapsed by a pocket of air which lay in the pleural cavity anterior and lateral to the lung. There was no fistula into a bronchus demonstrable. Some pus was found in the left interlobar fissure and in all the bronchioles. Tuberculosis was also discovered at autopsy, a few small tubercles being present in the apex of the left lung and some of the mediastinal lymph nodes being completely replaced by caseous tuberculosis.

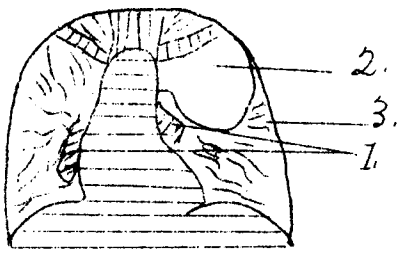


Fig. 12

1. Hila of lungs.
2. Air in pocket.
3. Wall of pneumothorax.

The encapsulated tension pneumothorax is well shown here simulating very closely the appearance of a large air cyst.

Comment

The close similarity in the roentgenographic appearance between this tension pneumothorax and the air cysts previously described is apparent. In this instance the development of the lesion under observation indicated clearly its origin. Under other circumstances the distinction might be extremely difficult as the anatomical difference between an intrapleural pocket of air and in intrapulmonary pocket of air, both of which compress the remaining lung, is certainly difficult to distinguish. Pressure readings with a manometer might, of course, make a sharp distinction. It seems probable that despite the failure to demonstrate a bronchial fistula at autopsy, some fistulous communication between the pleural cavity and the lung was present. It may, however, have been merely a communication with some of the alveoli and, thus, not demonstrable anatomically.

The development of multiple air cysts in the lung as a result of stenosis of the bronchus has been well authenticated in previous publications. In the case of partial stenosis, emphysematous blebs or air cysts may occur. It is, however, often difficult to demonstrate these stenotic areas in the bronchus itself. By means of bronchography with introduction of iodized oil this has been done. In recent years the procedure of planigraphy has become feasible and in this manner, likewise, it is possible to demonstrate stenosis of the bronchi under such circumstances. The final case here reported is shown to illustrate this procedure.

Case 13

..., a male aged 50, was first seen November 9, 1939. He was reasonably well until February 1, 1939, when he developed a pain in the left shoulder which was followed by a pain in the right shoulder. He saw a doctor at that time who told him he had lung trouble, probably tuberculosis Roentgen examination and sputum examination were done at that time.

The past history is of interest. He is said to have had pneumonia as a baby. He again had pneumonia in 1911 and once more in 1930. He has had a chronic productive cough as long as he can remember. There have been, however, no other symptoms and no dyspnea until the recent onset and even at this time he had very little dyspnea. Cough and purulent sputum were present, but there had never been any expectoration of blood.

Repeated examination of the sputum revealed no organisms. There was no fever and no other findings. On bronchoscopy 11-15-39 pus was seen coming from the right upper lobe bronchus, the meatus of which was open.

Roentgen examination at this time showed multiple rarefied areas involving essentially the upper lobe, with diffuse fibrosis of the middle and lower lobes. The areas of rarefaction were characteristic of air cysts, being surrounded by a sharp capsule. At no time was fluid observed in any of these cysts. Planigraphy was then undertaken (Fig. 13). Multiple air cysts throughout the upper lobe and involving also part of the middle lobe were shown. The right main stem bronchus was distorted somewhat from its normal position, but appeared entirely patent. The right upper lobe bronchus was normal at its orifice, but a short distance from its origin there was a very marked constriction due to a mass of inflammatory tissue around it. Some partial constriction of much lesser degree of the middle lobe bronchus could also be made out and the lower lobe bronchus was also somewhat narrowed. The right upper lobe bronchus was seen to open directly into the large series of air cysts which completely replaced the upper lobe.

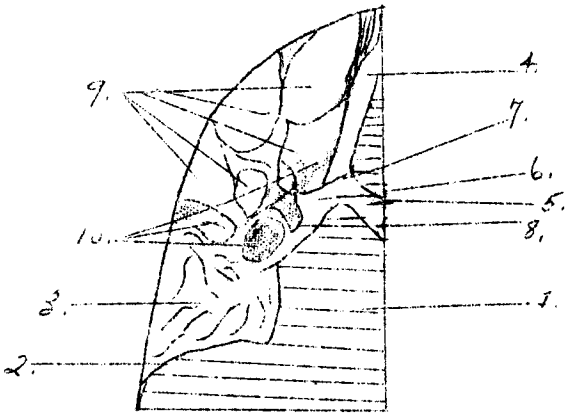


Fig. 13

Roentgenogram of right side of chest made by planigraphy.

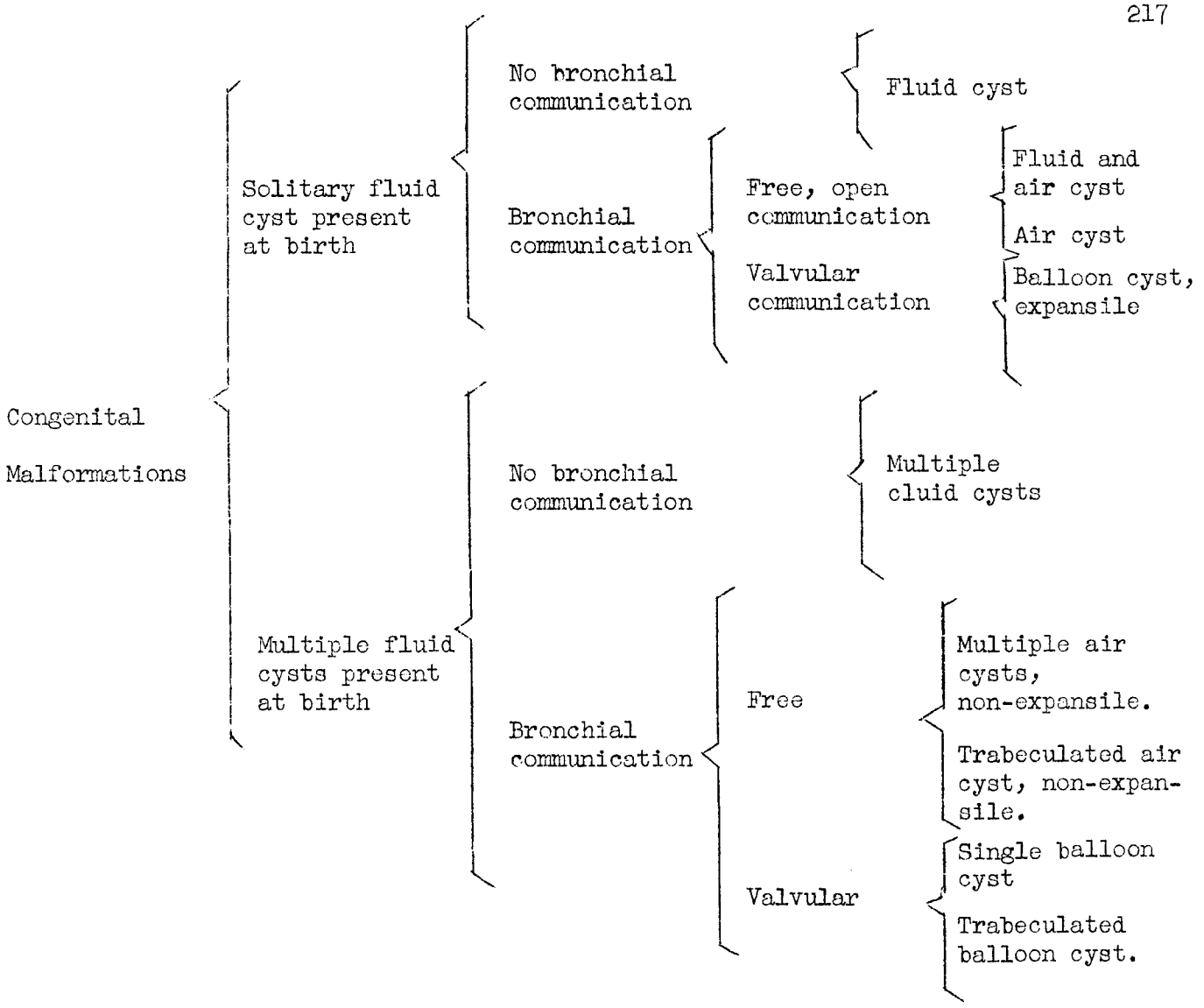
1. Heart.
2. Right diaphragm.
3. Remaining normal right lung.
4. Trachea.
5. Left main bronchus.
6. Right main bronchus.
7. Stenotic right upper lobe bronchus.
8. Stenotic right middle lobe bronchus.
9. Multiple air cysts in upper lobe.
10. Areas of consolidation or fibrosis in remaining portion of the lungs.

The planigraphic demonstration of stenosis of the bronchi is well shown here as well as the extensive multiple air cysts which are associated with such a process.

Comment

Here again we have the long standing history which is so commonly found in patients with this condition. Very likely the stenosis of the bronchus developed early in life and the repeated pneumonias later on represent infections associated with this partial stenosis. This type of air cyst with bronchial stenosis is clearly an acquired process. The demonstration of the stenosis by means of planigraphy is in some instances brilliantly accomplished and is extremely valuable for purposes of orientation.

Lung cysts have been classified in a number of ways. One commonly used is that of Anspach and Wolman. This concerns itself essentially with the congenital malformations and no provision is made in this classification for other types of cysts. This classification is as follows:



Peirce and Dirkse have recently suggested a much simpler, but more inclusive classification which includes the group of acquired lesions. This is as follows:

1. True congenital cysts--containing fluid, air, or both.

2. a. Chronic interstitial pneumonitis with emphysema.
   b. Chronic bullous emphysema.

3. Cystic bronchiectasis, either congenital or acquired.

4. Pulmonary pneumatocele--localized alveolar or lobular ectasia, acquired as a result of pneumonia or pulmonary abscess.

For practical clinical purposes the question of congenital or acquired lesions is of no great import. What concerns us essentially is the presence or absence of bronchial communication, which can usually be determined by the presence of air in the cyst. Injection of iodized oil or planigraphy may determine this same point conclusively. The size and extent of the cyst is also of grave importance in determining the question of therapy. The presence of a bilateral process obviously militates strongly against any radical surgery. It should be noted that in general the simple air cyst, such as has been reported in many of these cases above, does not require any radical treatment. It is the fluid secreting cyst, which is likely to become infected and to continue to have multiple infections, in which radical procedures seem desirable. This distinction between the simple air cyst and the fluid containing cyst, or the cyst which contains both fluid and air, is relatively easy to make on roentgen examination and

this is of the first importance.

It should be emphasized that the discovery of such cysts is to a large extent dependent upon adequate roentgen examination and the exact diagnosis can be accomplished if the condition is kept in mind. In any case of chronic draining abscess or empyema, the possibility of an infected lung cyst must always be considered and biopsy of the cavity wall is a very important procedure in making a final determination of the nature of the abnormality.

Summary

1. Cysts of the lung include a large group of heterogeneous processes, some of which are congenital and others acquired. They are more common than is generally supposed.

2. Cysts of the lung produce symptoms in two ways. They may compress the remaining lung to a point which reduces the vital capacity and disables the individual. This is true of both the balloon, expanding air cyst and the fluid secreting cyst. Or the cyst, by reason of a bronchial communication may become infected and produce all the sumptoms and signs of intrathoracic suppuration. In this manner a cyst may simulate encapsulated empyema or chronic lung abscess.

3. It is important to make a sharp distinction between chronic encapsulated empyema or pulmonary abscess and lung cyst because the latter is amenable to radical surgical therapy and will not clear up by ordinary means of drainage.

4. Biopsy of the wall in cases of chronic draining empyema which do not readily respond to therapy is a useful procedure in making the distinction from a lung cyst.

5. Cysts of the lung may be acquired. Most of these are air cysts and are due either to partial stenosis of the bronchus or interstitial emphysema developing after pneumonia or pulmonary abscess. They may result from the cavity formed by an abscess.

6. In many instances air cysts may occur as a result of generalized emphysema of the lung with bullous emphysematous blebs finally developing into air cysts.

7. Cysts containing fluid are most likely to be congenital in origin although not necessarily so. They are usually lined by bronchial epithelium, the fluid being secreted by this lining.

8. Encapsulated tension pneumothorax, simple pneumothorax, subpleural emphysematous blebs, extreme pulmonary emphysema must all be distinguished from pulmonary air cysts.

9. Encapsulated empyema, encapsulated pyopneumothorax, chronic pulmonary abscess, tuberculous cavities, fungus infections with cavitation must all be distinguished from the fluid containing cyst.

10. Multiloculated lung cysts and multiple lung cysts must be distinguished from multiple lung abscesses and bronchiectasis.

11. Multiple bronchiectases are often indistinguishable from multiple lung cysts. Bronchiectasis of this kind may be the result of unresolved pneumonia.

12. Symptom-producing cysts when confined to one lobe or lung, whether congenital or acquired, single or multiple, bronchiectatic or truly cystic, are amenable to radical surgical therapy. Extirpation of the portion of the lung containing the cyst should be considered as a possible procedure in each case.

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This program was arranged by the Department of Radiology for the meeting on November 22, 1940.