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Empyema thoracis

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E M P Y E M A T H O R A C I S

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EMPYEMA THORACIS

Empyema is defined as an accumulation of pus in a cavity of the body, but through common usage, has come to be limited to such accumulations within the pleural cavity, unless otherwise specified.

The chest, or thoracic cage, is composed of the muscular and bony wall and diaphragm, which surround the lungs, heart, great blood vessels, esophagus, trachea, thymus gland, several nerves, thoracic duct, and a few lymph nodes. The cavity is lined with two serous membranes, the pleurae, which invest each lung separately and are reflected upon the thoracic wall and diaphragm forming bilateral closed sacs. The parietal and visceral layers are normally practically in contact, being separated only by a small amount of serous fluid, which serves as a lubricant. The area between the two pleural cavities is known as the mediastinum and contains the various organs mentioned above, with the exception of the lungs. It interests us most particularly because of its position as a partitian. The significant facts concerning it seem to be that the structures within it are, in the most part, not firmly fixed, but held by attachments in such a way that considerable mobility is allowable, together with the fact that, in the ventral mediastinum

which is that portion directly ventral and superior to the base of the heart, the pleural surfaces of the two cavities are directly in contact.

In considering the pleura more particularly, histologically it is composed of a thin connective-tissue stratum in which the bundles of fibers cross each other in various directions,and, intermixed with which, there is a considerable quantity of elastic tissue. On the internal surface of this there is a continuous coating of thin endothelial cells placed edge to edge--simple squamous epithelium. The pleura so formed is attached to the parts which it lines and invests by a small amount of areolar tissue termed the subserous layer. In the case of the pulmonary pleura the subserous tissue is continuous with the areolar tissue in the substance of the lung, and this accounts for the tight manner in which the membrane is bound down.

The pleura is plentifully supplied with blood. This is conveyed to it by minute twigs from intercostal arteries, the internal mammary artery, and the bronchial arteries. Lymph vessels are also particularly abundant in the pleura and in the subserous layer, and it is by these that an excess of fluid is conveyed from its cavity. Stomata, which have been described, are artificial apertures in the epithelium and are not

connected with lymphatic vessels.

Grossly the lines of pleural reflection are of interest. They are three in number, the sternal, vertebral and diaphragmatic--the sternal and diaphragmatic being subject to considerable variation. The vertebral lines extend along the bodies of the vertebrae, at the top being placed well apart from each other and about equidistant from the median plane. As they are traced downwards, they approach more closely to each other and deviate to the left, so that while the reflection on the right side takes place from the ventral aspect of the vertebral bodies, on the left side it takes place from the left aspect of the vertebral column, this is due to the position of the thoracic aorta.

The sternal lines of pleural reflection differ on the two sides but in both show a tendency to deviate to the left. In the vicinity of the manubrium sterni the two sacs are separated from each other by an angular interval. The lines of reflection, at the superior thoracic aperture or inlet correspond to the sterno-clavicular joints. From those points the lines, as they are traced downwards, converge behind the manubrium, until at last they meet at its inferior border. There the sacs come in contact and the lines of reflection coincide. From there they proceed

downward, on the back of the body of the sternum, with a slight deviation to the left of the median plane, until a point immediately above the level of the sternal attachments of the fourth costal cartilages is reached, and there the two sacs part company. The line of reflection of the right pleura is continued downwards in a straight line to the xiphoid process, where the sternal reflection-line passes into the right diaphragmatic reflection-line opposite the sternal attachment of the fourth costal cartilage the reflection-line of the left pleura deviates laterally, and is continued downwards at a variable distance from the right pleura. A small triangular area of pericardium is thus left uncovered by pleura, and, therefore, in direct contact with the ventral chest wall. Leaving the sternum, the reflection-line of the left margin of the pleura passes downwards, parallel to and close to the left margin of the sternum, dorsal to the fourth intercostal space, the fifth costal and the fifth intercostal space, to the sixth costal cartilage. There it turns laterally and downwards, and passes into the diaphragmatic reflection-line of the left side.

The diaphragmatic line of reflection does not correspond to the reflection of the diaphragm from the thoracic wall. It differs somewhat on the two

sides and is a curved line. On the left if follows the sixth costal cartilage downward, crosses the ventral part of the sixth intercostal space and reaches the junction of the eighth costal cartilage and the eighth rib at the mid-clavicular line; reaches the lowest point, the tenth rib or intercostal space at the mid-axillary line;; then curves slightly upward usually reaching the vertebral line of reflection slightly below the origin of the twelfth rib almost reaching the tip of the transverse process of the first lumbar vertebra. On the right the reflection line differs chiefly on the ventral surface following the seventh rather than the sixth costal cartilage, but being about the same as the left from the mid-clavicular line posteriorly. The pleurae follow closely the fissures of the lings reaching entirely to the bottom of them. Briefly, the lower border of the right lung is usually at the level of the sixth costal cartilage in the mid-clavicular line, then in a curved direction to the eighth rib in the mid-axillary line, the tenth rib in the scapular line, and the tenth thoracic spine posteriorly. The left corresponds roughly to this. The oblique fissure extends in a line drawn from the second thoracic spine around to the end of the sixth costal cartilage a little medial to the mid-clavicular

line. It crosses the fourth rib in the mid-axillary line and corresponds almost exactly to the position of the vertebral margin of the scapula when the hand is placed behind the head. The transverse fissure of the right ling extends from the origin of the fourth costal cartilage laterally and slightly superiorly along the fourth rib to meet the oblique fissure at the mid-axillary line. At the fourth to fifth interspaces on the left a deviation to the left of an inch or two occurs--the superficial area of cardiac dulness. The apex of the lung extends upwards to a position of one to two inches above the level of the first rib. (These positions should be kept in mind because of the possibility of empyemata altering normal relations, the ability to recognize such depending on the knowledge of the normal.))

Of the etiology of this condition several things can be said. It occurs in people of all ages, being especially common in small children. It is practically never primary and thus depends upon some other pathological process. The etiology is virtually that of the original condition coupled with a train of conditions which permit the infection of the pleura. The specific organism was usually the (hemolytic)) streptococcus or the pneumococcus in the army series.[10] This probably represents the average condition when consid-

ering any large number of cases in private life. The staphlococcus, typhoid bacillus, and influenze bacillus have also been found. When these organisms were present they were usually associated with the streptococcus and appear to have little influence.

These organisms probably reach the pleurae:

1. from the bronchial tree into the pulmonary alveoli and there excite an inflammatory exudate and an edema which extend into the areolar tissue underlying the pleural endothelium. The damage to the tissues, together with the production of serous exudate, offers an opportunity for the extension of the infecting organisms into these tissues and into the pleural cavity. This may be designated as the alveolar route.
2. The organisms may gain entrance to the interstitial tissues of the lungs through lesions in the bronchial lining and be carried along the spaces in the areolar tissue or through lymphatic channels directly to the pleural structures. The infection of the pulmonary alveoli would then be a less conspicuous consequence of the invasion. This mode of extension may be named the interstitial route.
3. The organisms may gain entrance to the circulatory blood and be disseminated to different and widely separated parts of the body with local foci of infection

where ever they find lodgement with conditions favorable for their development. This is the blood-stream route of dissemination. Other than these,

4. Extension through the chest wall or, direct extension from disease in the abdominal cavity, and,

5. The rupture of a pulmonary abscess must be considered as a possible route. (This last condition is virtually a much more severe type of Class 1.)

The type of pathological process which is present preceding the pleural involvement differs greatly, with the alveolar route a pneumonic process exists before any pleural involvement. The first pleural manifestations are those of effusion. It gradually becomes purulent. In the early exudative stage considerable fibrin is deposited forming adhesions which delimit the subsequent empyema. The central fibrinous adhesions are absorbed and those peripheral become organized definitely walling in the pleural pathology. This may occur in one spot with a lobar pneumonia or in several, usually with a lobular pneumonia. Following the lobular form several empyematous cavities may form. The pneumococcus is usually the principal offender in this type of condition. Often in this condition the organisms subsequently die leaving a

sterile pus-filled cavity in which the bacteria gain entrance to the areolar tissues separating the lobules of the lung. It is quite easy for infection to spread in all directions in this tissue. The acts of coughing, the exaggerated respiratory movements, and the vomiting which accompany the infection aid materially in disseminating the infection. It follows both the intrapulmonary lymphatics and the areolar tissue spaces. In this way infection of pleural tissues could occur before signs of pulmonary consolidation were detected. Pleural pain would be one of the first symptoms and would be followed by an accumulation of fluid in the pleural cavity in sufficient quantity to veil the physical signs of a pneumonia. In other cases the effusion and consolidation would progress simultaneously so that the clinical picture would be that of a parapneumonic pleurisy. There is usually an abundant exudate. Some fibrin is formed, but agglutination of the pleural surfaces does not occur unless they are in contact, thus in the prone position the adhesions would occur anteriorly and the empyema cavity would be in the posterior part of the thorax. If he were in a semi-erect position, the adhesions would occur in the upper part of the chest.

The infection does not travel toward the pleura only, but can quite easily extend into the mediastinal

tissues through the hilum of the lung. Any lymphatic valves, if they do exist, or the normal direction of lymph flow need not serve as a serious impediment to this extension since the forces of coughing, respiration, etc., are sufficient to overcome these obstacles. They can quite easily follow normal lymphatic channels.

This type of process is usually caused by the streptococcus--very often the hemolytic type.

The blood-stream route of infection is not as important when considering a large group of cases as the other.[10] There seems to be little evidence that empyema is a result of a blood-borne infection itself. It is known that pneumococcic bacteremias are not uncommon and some empyemas have been known to follow this blood-stream infection, but whether or not the blood-borne organisms produced the empyema cannot be determined. The importance of the blood-stream and infection in empyema is the dissemination of infection to other portions of the body when an empyema is known to have been pre-existent. Some of this dissemination is through lymphatics or by direct extension. The pericardium, peritoneum, the joints, the middle ear, the nasal sinuses and the subcutaneous areolar tissue have all been found to be involved in empyema and

cultures showed the same organism as that in the empyema cavity. Surely the blood-stream must have played a part in joint infections, at least.

In traumatic conditions in which the chest wall is perforated after carrying into the pleural cavity bits of clothing, etc., a purulent pleuritis often results. This type of condition is seldom found, in private life, but occurred occasionally in the past war. Infection has also been introduced through aspirating needles as well undoubtedly but the effect of such introduction is hard to evaluate. The normal pleura can dispose of considerable infection and if an effusion were already present, it would be difficult to state just how much of the subsequent purulent condition was caused by outside infection and how much by the original process which caused the effusion. Purulent empyemata in tuberculous effusions following aspiration must often be infected in this manner. Rupture of the esophagus, etc., can produce empyema as well.

The rupture of a pulmonary abscess into the pleural cavity is undoubtedly a frequent cause of empyema. However, with an abscess existing near enough to the periphery of the lung to rupture into the pleura is

evidence of the existence of an inflammatory process peripherally, after an effusion exists prior to the rupture (explained in type 1) but has not become purulent. At the time of aspiration in this type of case occasionally fluid streaked with pus is found. It seems quite reasonable to suppose that the relief of intrapleural tension allowing some increased expansion of the lung had added the "straw" which was sufficient to cause the rupture of the abscess. This picture is frequently seen. There is another situation in which no pre-existing effusion has been noted and it is assumed that little pleuritis exists, in which the rupture of an abscess produces an empyema which is purulent from its onset.

The forms which an empyema may take are numerous. It may be single or multiple, unilateral or bilateral, peripheral, interlobar, supra perenic, or adjacent to the mediastinum. These may exist singly or any combination of these types may be found. In general it may be considered that the type of infection depends upon the location of the primary pathologic process and the modes of extension together with the type of reaction produced by the infecting organism. For example, a pneumococcic empyema following a lobar pneumonia

which was unilateral is usually a unilateral single empyema with considerable adhesions and the cavity filled with a thick pus. It has usually followed the alveolar route of extension or its modification, the rupture of a lung abscess. This must not be considered as axiomatic, however. The single cavity may be divided through the production of adhesions or many pockets may be formed. Blood-stream, lymphatic, or spread by direct extension may alter the picture.

The diagnosis depends upon the history, the symptomatology and the physical signs noted upon examination together with X-Ray findings and aspiration. That the diagnosis may be difficult and the clinical picture varied is obvious. In many of the cases the history is that of a lung affection, the crisis passed and convalescence apparently satisfactory when the temperature gradually begins to rise. It may reach 104° F. in a few days. The patient becomes acutely ill and added to the picture of sepsis shows signs of mechanical interference with breathing. There may be cyanosis, but rarely great respiratory acceleration. If present, it is due to some other cause. Cough is absent or slight and is unproductive. If cough is harassing or spasmodic it is due to a complication and

often signifies the presence of bronchial irritation by pressure or that the pus is progressing toward evacuation by way of the bronchial tree. Some consider it an animous sign and advise operation very soon. Others feel that the evacuation through the bronchial tree is desirable and should not be interfered with.

Another picture is that of a severe lung affection which seems to be accompanied from the outset with mechanical interference to breathing and is quite toxic,--the streptococcus type which spreads by the interstitial route. A ruptured gastric ulcer, subphrenic abscess and subsequent supraphrenic empyema is an example of the history found in the extremely varied case.

In the typical simple case the physical signs are clear. They are more striking to one who sees the patient for the first time when the process is well under way than to the individual who has followed the case continually. Upon inspection with the patient sitting or standing and viewed from behind, there is seen a distinct flattening of the affected side, even when the empyema is comparatively full. The shoulder is depressed. The spine is scoliotic, being convex toward the well side. Respiration of affected side is limited. The intercostal spaces are narrow and the

affected side is flattened.

The vocal fremitus is increased when the exudate is very cellular.

Percussion is considered by some to be the most important single physical sign in diagnosis. It brings out flatness over the area which directly overlies the fluid, and changes in dulness or modified resonance when a layer of aerated lung is between the chest wall and the fluid. A mesial pus chamber, one below the lower lobe or an interlobar pocket may be entirely missed. Groccos sign may be present when the empyema is large and occupies the lower chest, but is far less common than it is in pleurisy with effusion.

The auscultatory signs vary with the cellular concentration of the fluid. Conduction may be so well that the sounds of the breath and voice resemble those found in lung consolidation, but the areas are usually not typical of the pulmonary lobes. Good voice conduction with hyperresonance, especially in the upper anterior chest, indicates compression of the lung.

Auscultation of the heart tones may be very deceiving, so much so that no significance should be placed upon a diagnosis of cardiac displacement based upon auscultation unless verified by the X-Ray.

All the signs are altered when air or gas occupies

part of the pus cavity and they change with the patient's posture. Egophony at the liquid surface is often demonstrable. Splashing and tinkling sounds may be produced by quick motion. A free opening from the empyema into an open bronchus may in certain positions cause bubbling rales resembling those heard in some lung abscesses.

If the diagnosis of empyema in one portion of the chest is made, a very thorough search of the rest of the thorax should be made to discover any sacculations or other cavities.

The X-Ray shows an area of increased density--the density depending upon the cellular content of the fluid. The salient point in interpreting X-Ray films is the determingin of the presence of a clear rounded edge of the shadow not blending with the lung structure and obliterating normal intrathoracic markings in that area. In the interlobar condition the appearance at first is that of an elongated oval shadow in the region of one of the fissures. It has a tendency to develop into a triangle with its base toward the chest wall or even in contact with it. The line of demarcation at the lobe limits is very sharp. On the right side it may be impossible to differentiate between empyema and suppurative conditions of the middle lobe. The presence

of tumors, hydatids, dermoids, teratomata, or other sharply outlined dense masses should always be kept in mind as possibilities.

Before considering the treatment, a brief investigation into the normal mechanism of thoracic action should be made.

Pneumothorax, both open and closed, are definitely linked with the surgery of empyema.

The lack of space between the normal lungs and thoracic wall or presence of a potential space only, results in an adhesive condition between the lung and chest wall, which is equal to external atmospheric pressure. This tends to keep the lungs expanded as much as the size of the chest cavity will allow. The intra-pulmonary elastic tissue tends to compress the lung. In the act of inspiration the ribs are raised from their position of obliquity to one more nearly approaching a 90° angle with the vertebral column. The diaphragm being depressed as well adds to the increase in the size of the chest cavity. Atmospheric pressure being many times greater than the force of the elastic tissue, the lung follows the thoracic wall, allowing air to flow in. Expiration is chiefly a relaxation of the inspiratory musculature and a cessation of inspiratory effort allows the ribs to fall

and the elastic tussue to contract the lung. Expiratory muscles can produce a forced expiration.

The normal intra-thoracic tension is always below that of atmospheric pressure except upon forced expiration. When the thorax is at rest, as it is immediately after death, the pressure is 6 mm. of Hg. below atmospheric pressure. Upon forced inspiration it may reach a pressure 30 mm. below atmospheric pressure. The terms residual, supplemental, tidal and complemental air are familiar to all. Since the residual air cannot be expressed and measured, the sum of the other three is the vital capacity. The vital capacity is greatest in the erect position. Upon ordinary breathing when an individual is quiet, only the tidal air is used. Increased activity or anything causing increased metabolic activity causes an excursion which calls into play some of the complemental and supplemental air.

A pneumothorax is "open" when air can pass in and out through a hole in the chest wall. It is "closed" when air is present in the pleural cavity but cannot pass in and out.

When a hole is made in the chest wall, air has the same tendency to enter the thoracic cavity through the artificial opening as through the trachea. It is therefore necessary for the inspiratory effort to be

greater to admit the normal amount of air into the lung through the trachea. Just as in a suction pump with a leaky valve, the suction chamber would contain air under a pressure equal to atmospheric pressure upon standing, but upon action some air will rush in through both the normal route and the leak, allowing some suction action, but requiring a greater excursion of the piston to permit the same efficacy of suction action. This assumes the unified action of the entire thorax in either unilateral or bilateral pneumo-thorax. It has been found that the normal resistance of the mediastinum is only equal to a pressure of 2-3 cm. of water or 1-2 mm. of Hg.[12] Recognizing these facts, it is evident that the ability on the part of an individual to withstand open pneumo-thorax is dependent upon the vital capacity principally. Closed pneumo-thorax is a slightly different problem. Its noxious action is that of lessening the negative (less than atmospheric) pressure in the pleural cavity so that inspiratory effort cannot produce sufficient suction action to allow the required amount of air to enter the lungs through the trachea. It is much less severe than open pneumo-thorax.

In disease a different situation exists. In any empyema in which the fluid in markedly purulent enough

stiffening of the mediastinum and adhesions have occurred to alter this normal picture and allow less collapse of lung both on the side of the opening and on the opposite side.

In operations which permit an open pneumo-thorax to exist the hazard is greatly increased if done early because this compensation has not been established and added to the effect of the pneumo-thorax there is often a coexisting pneumonitis which increased metabolism and decreases vital capacity. It is now considered utter folly to do an open operation before the fluid has become markedly purulent.

The method of treatment rests with the case and should be entirely a varied proposition suited to each individual case. Of course, the diagnosis must be definitely established first.

The principles involved are the same whatever method one employs. The removal of all the pus, the sterilization and obliteration of the cavity are the necessary conditions. This is not always easy especially in the chronic case with excessive adhesion formation and pleural thickening.

The removal of pus is secured through either aspiration or incision, the incision including in some cases the removal of portions of one or several ribs.

Considerable pus can be absorbed from the pleura unless thickening and fibrosis are sufficient to prevent it.

Cavities often become sterile even when no pus has been removed, they often become sterile with simple drainage of the cavity. At times it is necessary to introduce some antiseptic solution, Dakin's being employed most frequently.

If the pus is evacuated completely at a time before excessive thickening of the pleura has occurred preventing expansion of the lung, the cavity obliterates itself. Dakin's solution dissolves fibrin and aids materially in preventing and relieving this thickening. Operations are done in which the thickened pleura is stripped off or scored in such a way that the lung can expand. When these have failed, rib resections can be done, which collapse the chest wall down to meet the partially collapsed lung, thus obliterating the cavity.

All modes of treatment, of course, come under one of three types, namely, 1. simple aspiration, 2. closed drainage with rib resection, and after rib resection, and, 3. open drainage.

In Hudson's[14] clinic the only two procedures used are, first, intercostal closed drainage, and second, rib resection with open drainage. The first procedure is used on those patients who are so ill that the more

extensive rib resection is to be avoided because of trauma and shock, it is used also in infants under one year, as a primary procedure, and in those patients with a very thin exudate and with a culture showing an organism other than the pneumococcus. The procedure followed in his clinic for the performance of intercostal closed drainage follows: The approach is made in the seventh or eighth interspace in the mid-axillary line following infiltration with 1% novocaine. A one-half inch skin incision is made, and a trocar is plunged into the cavity after aspiration has verified the localization of the cavity. The stylet of the trocar is replaced by a fenestrated rubber catheter, following which the trocar cylinder is removed, and the catheter clamped. Gauze and imbricated adhesive are applied, and the catheter is led into a vessel below the level of the fluid contained therein. The catheter is then unfastened, and the closed system is established.

Rib resection, with concomitant inspection and palpation of the empyema cavity, is the other method used in Hudson's clinic, and it seems altogether satisfactory. The post-operative hospitilization is shorter in this type of operation and the proposition of secondary operations is less, also the mortality is

lower, 18% to 9%. Ultraviolet therapy, as an adjunct to this type of operation has more value, apparently, than it has in the other type.

Roeder[21] advocates a gauze pack as another method of treatment. In defense of his innovation, he says, "One of the principal reasons for the origin of the closed method was the thought that air in an infected pleural cavity was detrimental, mainly through preventing an expansion of the lung. The presence of air in an infected pleural cavity has never been proved to be harmful, and the average application of the closed method of drainage rarely prevents the ingress of air." By means of his gauze pack he is able to cause the obliteration of a cavity in from ten to thirty days if the visceral wall of the cavity is not too thick. The advantages of the gauze pack method are enumerated by Roeder as follows:- first, it holds the lung steady following the operation, which of itself is most comforting to the patient; second, it clears the exudate rapidly from the walls of the cavity; third, it breaks up the numerous small abscesses in the periphery of the lung; fourth, it eradicates external purulent drainage almost completely, after 48 hours; and, fifth, it obliterates the cavity at least as rapidly as does

any other method. He notes, on the other hand, certain disadvantages; first, that the pack must be changed daily by some one experienced; second, that the first change post operative is distressful without light anaesthesia. For the average case it is necessary to pack the cavity for from seven to ten days with gauze impregnated with bismuth sub-iodide.

Foster[12] uses a method on acute empyema cases consisting of thoracentesis, delayed partial costectomy and constant suction tube drainage.

Singleton[22] has a method of inserting a trocar and cannula in the eighth interspace in the mid-scapular line, and of allowing the cannula to remain in place, stitched to the skin. A tube connection, filled with sterile water is led to a large bottle beside the bed, and the end placed under water, thus retaining a vacuum with siphon effect. The cannula is allowed to remain about ten days, and is then replaced by a rubber tube.

Among the advantages of local anesthesia, according to Lilienthal[19], is the fact that the patient is fully conscious and can often be of great assistance to the operator. In intra-thoracic work he can cough or strain, distending the lungs at will. He can change his position, at request, for the convenience of the operator, avoiding the break in asepsis and the other

annoyances of changing the posture of a narcotized patient. There having been no narcosis, food and drink may be taken soon after the operation. The aspiration of septic matter or blood from the mouth possibly coughed up from a diseased lung, is practically avoided. Some of the disadvantages of local anesthesia are that, in certain operations on the pleura, as, for example, acute and subacute empyema, an unavoidable cough reflex may be embarassing. Vomiting may appear, and be as troublesome as it is after general anesthesia. Local is contra-indicated in extremely nervous patients.

It would be futile to attempt to discuss the technique and application of all surgical procedures devised for empyema therapy. It does seem that simple aspiration is applicable to the general unilateral empyema in the child or possibly the single sacculated type with no pockets. Children do not stand pneumothorax as well as adults. If the cavity were extensive, the closed suction bottle method could be used. Modifications in which a catheter is inserted through a trocar and left, allowing removal of pus at will and introduction of any antiseptic desired have been suggested. Any method in which all the pus could be reached and drained with the minimum of embarrassment

to respiration and shock to the patient is best. Aspiration in the general empyema is usually done at the eighth interspace at the posterior axillary line. If sacculated over the cavity, drainage may be aided by posture.

When more fibrosis has occurred and possibly side pockets or several sacculated cavities exist, thoracotomy is best. This allows free drainage and free irrigation. It should be remembered that all pockets must be reached and drained.

When the process has become chronic and irrigation with Carrel-Dakin solution does not remove the pleural thickening, it may be treated surgically as mentioned above. In all these, efforts at lung expansion through forced expiration against resistance aids at times and should be tried.

In therapy, first an accurate diagnosis, then suit the type of treatment to the case. Aspiration alone is often enough in those under eight or ten years of age--or closed drainage may be substituted. In those older, a thoracotomy without section of ribs is best, unless such rib section is necessary for a complete drainage or obliteration of the cavity. As a final warning, never make any incision into a chest until aspiration shows frank pus.

CASE REPORTS

I

Patrick Cosgriff age 28 male

On February 5, 1932 patient had a chill and fever and a pain in the left chest. He became progressively worse and was admitted to the University Hospital on February 9. A diagnosis of lobar pneumonia was made with a complicating pleural effusion.

Feb. 11. X-Ray confirmed the diagnosis. Fever continued high.

Feb. 17. Temperature remained high and the patient looked toxic. In the morning his temperature would go as low as 101.5 and in the afternoon as high as 104 degrees. At this time empyema was thought of and an X-Ray was made. The X-Ray report confirmed the diagnosis of empyema.

Feb. 20. Thoracic paracentesis was done and revealed a very purulent but still thin liquid, verifying the diagnosis.

Feb. 25. Patient transferred to surgery; as yet the fluid in the chest was not thick. Temperature remaining about the same.

Mar. 2. At this time, about two weeks after the development of the empyema, the contents of the cavity was quite thick, so the patient was taken to the operating room.

Operating surgeon--Dr. John R. Nilssen
Under local anesthesia a needle was inserted into the seventh intercostal space in the posterior axillary line, and a few cc. of thick purulent material was aspirated. An incision, approximately six cm. long was made in the above space down to the intercostal muscles. By the use of a hemostat an opening was made into the pleural cavity and approximately 900 to 1000 cc. of very thick purulent material containing a cheesy like exudate, was expelled. The patient had a paroxysm of coughing at this time and became very dysponeic. Three penrose drains were inserted and the wound closed by retention sutures which had been placed before the thoracic cavity had been opened.

After the operation the temperature dropped from a high of 103 degrees average to a high of 101.5 degrees on the following day, and four days later to 100.5 degrees.

Mar. 6. There was still considerable discharge, but the patient feels better.

Mar. 14. For the past six days the temperature has been normal. Only one drain was retained and the patient feels very well.

Mar. 20. Last drain removed. Very little discharge.

Mar. 23. Patient discharged. Wound still open but practically no discharge.

II

Walter Schon age 4½ male

On December 20, 1931 the patient developed lobar pneumonia of the lower left lobe.

December 28. A thin yellowish fluid was aspirated from the left pleural cavity.

January 1, 1932. Two hundred and fifty cc. of a muddy colored fluid was aspirated from between the ribs in the sixth interspace.

January 2. Seventy five cc. of the same kind of fluid was aspirated.

January 6. Thoracotomy was performed and an opening was made in the sixth interspace by incision, and then jabbing through with a hemostat considerable blood and pus came out. It was under considerable pressure. The patients condition was not good so a catheter was inserted and the would dressed and the patient returned to bed.

January 9. Another opening was made in the fourth interspace and the cavity irrigated with air tight drainage, using Dakin's solution.

The condition was only temporarily improved and on February 14, the temperature went up again from a former average of 100.5 degrees to 102 degrees on February 15. This septic temperature continued.

Mar. 9. Operating surgeon--Dr. John R. Nilssen
An intercostal opening was made in the tenth interspace and three penrose drains were inserted after the escape of considerable pus. The would was then dressed and the patient returned to bed.

Mar. 14. Temperature remained at about 101-102. However, the patient has a positive throat culture and a discharging ear, which may be the cause, as the new opening is draining nicely.

Mar. 31. Drainage has stopped and the chest has closed off and X-Ray shows the empyema to have healed, but the patient still has a septic temperature and this is probably due to a brain abscess as examination of the spinal fluid shows pressure and a cell count of 3000.

III

Wesley Freger age 7 male

Entered the University Hospital on March 22.

The patient had a broncho pneumonia which ended by lysis, the temperature however, remianed between 100 and 102 degrees.

March 27. Physical findings suggested fluid in the chest and X-Ray showed a resolving pneumonia, a partial collapse of the left lung, with a small amount of fluid in the left pleural space.

April 2. The chest was aspirated and 160 cc. of a thick greenish pus was removed. A smear proved this to be pneumococcus.

April 4. Dr. Roeder performed his operation in which, bismuth sub-iodide gauze was used to pack the cavity.

April 8. Temperature had returned to normal, and the patient feels fine, There is no discharge.

#IV

Mrs. Mildred Clayton age 28 female

February 4. The patient had a chill and a fever of 104 degrees. Her temperature remained high and she developed a pain in her left chest. Empyema was suspected and she was admitted to the hospital.

February 12. Her temperature had remained high, ranging from 101 to 103.6. X-ray donfirmed the diagnosis of empyema.

February 22. The chest was aspirated and a thick green pus was obtained.

February 26. 500 cc. of thick green pus was aspirated and 500 cc. of air injected.

February 27. It was decided to operate and so the patient was taken to the operating room.

Operating Surgeon:--Dr. Clyde Roeder.

Under local anesthetic about four inches of the eighth thoracic rib on the left side was removed and the empyema opened. About 200 cc. of thick pus and a large amount of fibrinous exudate was removed. There was also a small hole in the diaphragm which was sutured. The cavity was then packed with bismuth sub-iddide gauze and the wound was left open and dressed.

February 28. The cavity was repacked with the bismuth sub-iodide gauze, but only one-half of the original

amount could be replaced. The patient complained of abdominal pain.

March 4. The temperature had returned to normal and the patient was feeling fine. The cavity having been repacked each day. At this time the cavity was much smaller.

March 12. The temperature has remained normal and the patient was feeling fine. The cavity has not drained since the operation, and is still smaller.

March 22. Patient dismissed. The cavity being almost completely closed and there is no drainage.

#V

Douglas County Hospital #10819 male 53

Admitted January 6, 1932 with diagnosis of lobar pneumonia of the right side.

January 7. X-ray showed increased density in the right lower lung field. Breathing was labored. Some coughing and an expectoration of a prune juice sputum is present. Temperature remains high, and breathing is becoming more labored.

January 15. X-ray showed consolidation in the right upper and middle lobes and an elevation of the right diaphragm. The lower lobe and costo-phrenic angle were obscured.

January 16. Thoracentesis obtained 140 cc. of reddish fluid.

January 19. Under local anesthesia the sixth inter-space in the mid-axillary line was opened and the intercostal muscle removed. 1000 cc. of thin purulent material was removed and Dakin tubes inserted. Dakin's treatment was carried out methodically and by February 8 the patient was up and about.

February 27. Measurement of the cavity showed it reduced to 25 cc.

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