A

Thesis on Empyema

by

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Empyema

The term "Empyema" though originally confined to collections of pus in the pleural cavity, has recently been extended to any collections of fluid in this situation, and the term Pyothorax substituted for the former condition. I intend here to confine myself to the consideration of Empyema in its restricted sense, though it will be impossible to avoid making allusion from time to time, to cases of simple pleuritic effusion, since there is no sharp line of distinction, either clinical or pathological, between these two conditions.

The Causes of Empyema are many and variable; they may be conveniently divided into general and local.

The General or Predictors of Empyema.

Finally, some reference should be made to the influence of age, as this plays almost as important a part as in any other disease. I think it is generally admitted that the percentage of cases in children is considerably higher than that in adults.
and my own experience fully bear this out; further I find upon examining the statistics of the East London Children's Hospital that the majority of cases there recorded, were in children between two and six years of age. In adult life except from some local cause, the cases become rarer, and still further diminish as years advance. Sex has little influence in either direction, though males seem to be more liable to be attacked than females. This is probably due however to their running greater risks through exposure to cold or injury. If the side affected, once again it is impossible to say absolutely that the disease is more common upon one side than upon the other. It is asserted that it is more frequent upon the left side, in the proportion of 3 to 2 than upon the right. This however is contradicted by the statistics obtained from the Middlesex Hospital report between the years 1868 and 1892 in which I find that out of a total number of 41 cases, 23 occurred upon the right side, 17 upon the left and one was double.
A weak state of general health undoubtedly predisposes to this and any other similar morbid process and it is possible that this may throw some light upon the markedly greater frequency in children, since statistics are mainly drawn from cases occurring in hospital practice and consequently among the too often ill-nourished children of poor and neglectful parents.

It has often been traced to scarlet fever but the evidence is not very strong. Should this be the cause of an attack, it may be either primary, or secondary to kidney disease, nephritis, rheumatic fever, pleurisy, gout, or syphilis.

6. Syphilis.
7. Rheumatism.
8. Gout.
9. Other forms of disease.

Pleurisy and pericarditis may all give rise to Pleuritic effusion, which may or may not be prurulent, though in the last three cases it almost always is so.

The question as to whether an Effusion originates as such or is the result of an originally clear effusion becoming purulent, has been much disputed. In all probability, either statement may...
he correct, Trautzel states that in almost all cases it originates as a fibrinous-serous collection of fluid which afterwards becomes purulent. Wilson, too, on the other hand held that an empyema as a rule began as such, and this view is also taken by Ashley. Who says: "An empyema as a rule is an empyema from the first, at least the fluid effused is turbid looking at first" (Diseases of Children, Page 219 - Ashley, 1868). To turn now to the local causes.

There may arise from without, from within, or from the chest itself, themselves, including the elaborate.

The chief causes coming from without are punched wounds of the chest wall, including also exploratory puncture with unclean instrument or puncture accompanied by the production of excessive negative pressure in the pleural cavity, and consequent great emigration of causative.

Another cause of invasion from without is found in the lymphatics, as prevalence in cases of septic peritonitis, where the microorganisms may find their way from abdomen.
pleura through the lymph channels described by Recklinhausen as passing upwards through the diaphragm. Wounds or bruises of the chest wall especially if accompanied by fracture of ribs are well recognized causes as are also those conditions which lead to escape of air into the pleural cavity such as - laceration of spine or ribs, osteitis, pneumatis, rupture of an abscess - subdiaphragmatic or in the chest wall or of a pleural cavity. Again, a foreign body in the trachea or oesophagus may ulcerate its way over into the pleural cavity, set up an empyema or disease of the bronchial glands by extension may produce the same result.

Lastly pneumonitis especially broncho- bronchitis occurring in children after measles is one of the most frequent causes.
Pathology

Supposing the origin to be in a simple case of pleurisy or in other words that the disease is primary in its nature we have at the onset an inflammatory process involving first the pleural pleura but soon spreading to the visceral fluid then becomes formed out in which granular and multinucleated cells are found floating either freely or enmeshed in the meshes of clots of fibrin; these increase in number, staphylococci make their appearance, emigration of leukocytes occurs, and the result is a collection of pus.

In different cases the quantity, quality of the fluid vary within wide limits. There may be no more than an ounce or the quantity may reach 50 ounces. 30 or 40 ounces may be considered an average amount; 60 to 80 is exceptionally large though often exceeded. In this report a case in which from an empyema necessitatis he removed 20 pints of also one in which from a child of 5 years 6 pints were withdrawn (Spencer) as regards its physical character the fluid presents many variations. It may
The lining only slightly hemorrhaged, thick, lacerated pus, or there was a membrane, usually containing in addition, large flakes of lymph andpieces of false membrane.

The odour differs widely in different cases, nor can its nature always be foretold. It may be putrid and very foul, or on the other hand perfectly sweet. When air has entered the pleural cavity or an abscess has burst into it, it is usually foul, and it is observed that in cases in which the fluid has been serpiginous prior to the entrance of air, that fluid is even more liable to become putrid than in cases where the collection consists of lacerated pus. But even rapidly the odour of pus, the fluid does not necessarily become putrid, and again where no cause for its becoming so is found, it may be of the most foul character. The specific gravity does not exceed 1.032, and the reaction, unless decomposition has occurred, is alkaline.

There is usually no fever in children, a seldom when tuberculous pleurisy is the immediate cause.
Microscopically, one finds pus cells, fibrin, debris of broken down false membrane, leukocytes, and various organisms. Thus, in the whole prevalent fluids, may be found Staphylococcus aureus or albus, either alone or together with other microorganisms as tubercle bacilli.

Where pneumonia is present, the pneumococcus may be found as a complicating organism. Enteric fever - i.e., the bacillus Blood diseases may indicate a condition of scarring or arterial degeneration or perhaps tubercle or carcinomatous, but unless present in considerable quantity are of great importance. They may also result from tapping in which too much negative pressure has been used. Cholesterol, the result of degeneration of cell elements, or calcium or water derived from the fluid constitute.

The Pleural Membrane.

In some cases there is a thick layer of false membrane, coating the pleural from the first attack, by its contracture may so bind down the lung so as prevent effective
its re-expansion is also re-absorption of the fluid. The pleura itself may be partly thickened, infiltrated with pus, and in parts adherent to the chest wall in such a manner as to completely shut off smaller collections from the general cavity. There are times said to be loculated: they may be single or multiple and are found in any citadel, but most usually at the base, except in children, where they are equally common at the apex, or in other cases they may be situated between lung and diaphragm, lung and pericardium, or between lobes of the same lung.

Besides these firmer adhesions, there are often found others, more friable, in the form of bands which pass from visceral to parietal pleura and are really offshoots from the false membrane lining the cavity.

At a later stage, after the pus has accumulated, the false membrane becomes frequently broken down to a greater or less extent, and foreign bodies may thus be set free, thereby producing a general from what was perhaps merely a localized empyema.
Other changes in the form of deposits may take place in the pleura of false membranes. Of these the deposit of calcareous matter is the most frequent and may occur to such an extent as to form almost a complete coat of the chest wall. The deposit of tubercle or melanin pigment has also been described by Walch (Diagnosis of the Lung, p. 253) but are uncommon, especially the latter.

The effects of pressure of the fluid upon neighboring organs deserve special consideration as it has important bearing upon diagnosis, treatment, and prognosis. In health, the resiliency and contractility of the lungs is sufficient to produce a negative pressure in the thorax equivalent to water's density, this being further increased by the thoracic elasticity. It follows that when the balance between the two sides is disturbed, the organs are in the first place drawn towards the side of greatest negativity of pressure and subsequently when the pressure on the affected side becomes positive, many difficulties, accumulation of fluid, an actual pushing over to the opposite side may take place.
The effect of pressure upon the heart are
most marked and of great diagnostic importance.
In all cases of pleural effusion, the displacement
being especially marked when that effusion is
frequent - probably owing to its higher specific
gravity (below).

Effects upon the lung of the same sides.
At first after the pressure has been continued
for some while, it becomes collapsed at the point where the pressure is applied,
and the part which is free, taking on
the extra work, becomes expanded to
its utmost capacity. As the fluid rises
however, this in turn becomes compressed
a then collapsed a the pressure (which
may now be -1/2 inch Mercury) being continued,
combined with the elasticity of the lung itself,
causes it to expand again perhaps merely
the eighth of its normal size and to be found
in the scapulo-vertebral space, where it
may be permanently fixed by fibrous
membrane contracting upon it and
causing the fluid pressure in emptying
it entirely of its air.

The opposite lung undergoes the same change.
so those seen in cases of ordinary simple effusion,
becoming at first hypertrophied and if the
pressure is great - edematous or congested.
The liver may be displaced forwards
when the thoracic pressure has become
sufficiently positive to overcome that of
the abdominæus cavity.
The diaphragm is similarly affected.
Contact effects of the pus upon neighbouring parts -
In some cases the thoracic wall may undergo
ulcerative changes affecting the ribs,
vertebrae, or soft parts, ultimately
leading to perforation or rupture externally.
This usually occurring at the point of
least resistance which is the 6th space
anteriorly - or the rib vertebral may
become cartilage or the area of interstitial
hypertrophy, or sub periosteal osteophyte
growth where the irritation has not been
sufficiently severe to cause death.
In other cases the pus instead of being
discharged externally, after penetrating
the chest wall - as far as the subcutaneous
connective tissue, these becomes widely
diffused, constituting what is known as
Empyema necessitatis; or a fair rupture may take place into the opposite pleura, pericardium, or peritoneal cavity, or entering the sheath of the great muscle the fascia may find its way along it and point in the front or even lower down the limb. Other cases are recorded in which the muscular strake of the abdominal wall have been separated by collection of pus derived from empyema. So that there seems to be no limit to the variety of courses, which an abscess may take. But, though the above means of exit are well recognised and not very rare, a more common termination is seen in rupture into the lung substance of the same side as the result of ulcerative changes which may either operate by the formation of a number of small openings into, general of the smaller bronchial tubes, or by one large one, frequently becoming less vascular into a larger tube, thus leading to the majority of cases to Pyoqueumothorax.
The complications found post mortem 
are well illustrated by the series of cases 
previously referred to.

Out of the 41 Autopsies. Grouping of the 
leptocc Cunningham occurred in two - Cerebral lesions.
in two (probably the result of septic 
embolism). It occurred after left leptomeningeal 
in each case in one was situated in 
the left temporo-sphenoidal lobe.
Pericarditis was found in less than 11 times, 
was attributed to direct spread of the 
infection. While in 5 cases Endocarditis 
ocurred, the latter being accounted for 
by the cases being mainly those, Monge 
following some general condition of 
blood poisoning.
The liver was reported as being cloudy 
in 1, fatty in 5, Amyloid in 2. 
Amyloid degeneration of other organs may 
of course occur in cases of long continued 
depression.
Parotitis has been occasionally seen 
but no satisfactory explanation of it is 
forthcoming. Pneumonia is not very uncommon.
Clinical Character.
The history in cases of empyema may be gathered from what has been said regarding evacuation to a great extent, though some addition is necessary.

There are two main types of empyema cases. The first includes only a small proportion, but is distinguished by its malignant character, rapid course, and almost invariably fatal termination in spite of operative treatment. In these cases the temperature runs up to 104°-5° or higher, pulse about 120, the tongue becomes dry and brown, there is extreme prostration, and perforation into the lung occurs at a very early period. They are usually of reptile origin, the pus extremely fetid.

The second group are included most of the more chronic cases. These may perhaps be a history of measles with broncho-pneumonia following, or of some other specific fever. Or again a chronic effusion of a simple nature may have been present for some time and at least become parenchymatous.
If such has been the case, it is usual to have a history of failing health, wasting, hectic, and possibly some dyspnœa and dry cough.

Where perforation into the lung has taken place by many small openings, there is a history of prolonged and insidious purulent expectoration, but if by one of the larger bronchial tubes, one of a sudden, profuse, often greenish, character, perhaps the acute symptoms of haemorrhagic effusions about as a rule tend to become prevalent.

Symptoms.
These are generally somewhat indefinite. Yet, an earthy complexion, languid expression, wasting, loss of appetite and dyspnœa, especially if accompanied by vomiting, diarrhoea, red, fever, tongue, rigors; profuse perspiration; rapid pulse or hectic temperatures are very suggestive.

The patient usually lies on the affected side, his voice perhaps husky, a suffusion from a habitual cough.

Clubbing of the fingers is often seen, esp-
ease, in chronic cases, but disappear with recovery.

Physical Signs—
The physical signs are essentially those of fluid in the chest cavity, I shall consequently not describe them in detail except where they have some special significance for diagnosis. Perhaps the most obvious sign when present, is that of an elastic, fluctuating tumour situated anterior, over the 5th space or below the heart. Reducible on pressure, becoming less tense with inspiration and more so during expiration or cough and having a communication with the chest cavity which may sometimes be detected between the ribs. Occasionally more than one such swelling exists and cross fluctuation may be obtained between the two. When one is opened, the other collapses.

Lateral subcutaneous oedema is very suggestive if present, if the chest be very full, bulging of the side may be seen. Prepared movements or bulging of the inter-
Coughal spaces are common to all collections of fluid but the latter, which is more common, is better marked in emphysema owing to the softening action of the fluid upon the parts. Epigastric bulging due to a displaced diaphragm may be seen as a fulness, chiefly upon the right side, in some cases forming a distinctly palpable swelling. It is more often seen in females than in males and indicates, as before explained, that the pressure above is positive, greater than that in the abdomen. Consequently, the condition which opens the heart markedly in producing this sign, is one of a localized collection of fluid directed between the base of the lung and upper surface of the diaphragm.

The heart's apex point is displaced as in other effusions, only matter more to and in determining it, the same fallacies have to be avoided against i.e. distension, fluid in opposite pleura, pneumonic presence, the placement, retraction of lung etc.
Palpation

Fluctuation may be felt in the intercostal spaces.

Vocal fremitus is absent over the area occupied by fluid. This is one of the most important and reliable signs, especially in children, whereas others are often so misleading. It is not absolute however, for it may be present in part, even when the chest is fully filled with fluid, owing to the conduction of the vibrations by bands of adhesions, or on the other hand, may be absent, when no fluid is present, as a result of blocking of a bronchial tree, or great thickening of the pleural membrane.

Pulsion - Pulmocele empyema is a rare condition. It consists in pulsation in the fluid of the affected side and has been accounted for in various ways by different observers. De Leeu believes that "the action of the heart may produce a sort of succussion or fluctuation movement in the fluid, which, if that organ be hypertrophous, is very perceptible at the opposite surface of the chest." (De Leeu. Of the Lungs, p 256-7.)
This seems the most rational explanation but is not generally accepted as it stands. Some states that it is seen in left-sided empyema or any fluid effusion if sufficiently tense, rarely also in pneumonia. Clifford Allison says that the lung must be indwelled and bound down to the structures about the heart. From this that it is due to softening of the coriaceous pleura, the presence of fluid in the pericardium transmitting pressure. Whichever the explanation may be, it is an important sign when present and must be carefully distinguished from pneumonia.

Besides this, which is the true pleural empyema, there are cases in which a pointing empyema, situated upon the left side, near the heart may produce the fluid wave in the case being undoubtedly directly transmitted.
Percussion

Dullness and freely increased resonance are the chief sign of periscyphosis. The level of the fluid may follow Ellis' curve but may alter with changes of position of the patient.

Palpation: Dullness may be present with other signs of effusion and yet be caused by the sound of fluid resonance only, or by the placed finger, in which latter case it may be distinguished by the alteration of hepatic dullness with inspiration and by its being situated more anteriorly than posteriorly.

Kotze's Resonance is common to all collections of fluid. It is described by Powell as a peculiar form of tympanitic resonance of high pitch and great clearness. It is found beneath the clavicle when the under thoracic resonance has neared to zero or become positive and is regarded as a relaxed being note or by breathing as being near to diminution in the area of the chest wall which vibrates.
Acusultation.

Absence of breath sounds or marked diminution, is the rule. These are cases however in which they are electrically audible or even bronchial. There are seen chiefly in children and are in all probability due to compressed lung.

There may be absence of sounds without presence of fluid, as a result of collapse of lung or blocking of a bronchial tube.

Absence of Vocal Resonance is also found in typical cases, but here again, especially in children, the exceptions are numerous and apoplexy, bronchophony or even stethoscope may be heard over the whole side.

Absence therefore is an unreliable means of diagnosis when taken alone, but when harmonizing with other signs may supply very strong corroborative evidence of the presence of fluid.

It is said that impending pulmonary fistula may be detected by the presence of liquid rales in the upper third of the affected side but there are few who would wait for the appearance of such rales before operating.
and consequently their existence has not been confirmed.
I have previously had to special reference to the clinical phenomena of localized empyema
and indeed there is little to add. The same general signs are observed except that
they are confined to a smaller area, the limits of which follows no rule, and they
are often more painless and transitory than
in the diffuse variety. Children seem to be
especially prone to this form of the disease
when it commonly affects the apex and in
many cases arises from tubercular
infection.
The condition of the opposite lung requires
mention. Usually the percussion note over it
is low and the breath sounds compensatory.
In extreme cases there may be congestion
and edema, and the possibility of there being
a second empyema on the side least
always be born in mind.
I best pass to what of all the physical
signs is the most important and
reliable, though dependent on others for its
successful application. I refer to
Exploratory Paracentesis

In spite of every effort to arrive at a definite diagnosis by the usual means of physical examination, doubt may still remain, and here in almost all cases the presence or absence of pus may be at once decided by means of the exploring syringe. The needle used should not be too coarse, the patient should be gentle, aspirated beforehand (so as to stir up pus which may have settled at the bottom of the cavity) and antisepptic precautions should be used. The puncture should be made near the lower limit of the fluid, at a point where the lungs are well marked and where there is no suspicion of an adherent pleura. If nothing is found at first, the needle should be slowly withdrawn as it is possible that it may have passed through a thin layer of fluid and penetrated the lung beyond; a negative result may also be accounted for by blocking of the needle, adherent pleura or of course, absence of fluid, but if the lungs are well marked a second or third puncture in a slightly different situation should be made.
If pus or clear fluid be found, the nature of the case is decided, but should there be any doubt as to the composition of the fluid, it should be subjected to microscopic examination, when the presence of free cells or epithelium or both, makes things clear.

The dangers of the operation are practically nil, though I have seen a case in a child, in which serious haemorrhage followed. So it cannot be regarded as absolutely free from risk.

The exploratory sympahectomy should be used:

1. If two or three weeks after an attack of pleurisy, the chest remains full of fluid.
2. Always in cases of chronic effusion occurring in children.
3. Always before operating for empyema.
4. When in doubt.
Differential Diagnosis

1. Serosal Fluid

The only certain means of differentiating between collection of serous fluid and of pus, is the exploratory pericyst, though other signs may lead one to infer that pus most probably is or is not present.

When, for instance, after some acute disease a weakly child becomes the subject of heavy acute pleurisy with effusion, or in the more chronic cases an effusion persists, accompanied by sweats, cyanosis, hiccough, tachyppnea, with severe fever and great prostration, the diagnosis of empyema is almost a certainty.

It must however be remembered that marked hiccough may exist when the contents of the thorax are aerocelebrinious and on the other hand that a prevalent effusion may be completely appreciated though the latter exception is on the whole exceedingly rare.

It is the case that a persistent elevation of temperature on the affected side is in favour of the fluid being pus.

(Observer of the Lung, and Pleura - konig, Fo)

Page 1037.
If after tapping a serous effusion, the temperature runs up a remaining, or if there is much pain in the side, pus is to be suspected.

Oedema of the side, intercostal bulging and displacement of the diaphragm are more common in empyema than in simple effusions. And again any loculated collection of fluid is much more probably of a purulent than of a simple character, especially if it has persisted for some time.

The sign "Pectorilogique Aphonique" has been considered of great importance as an aid to diagnosis between different kinds of fluid. It is said (Diseases of the Lungs & Powell page 67) that provided the fluid be of an homogeneous character, in placing the ear over the back of the affected side and making the patient repeat in a whisper some rough word - the sound is conducted to the ear with great distinctness, the articulation being perfectly recognized. In cases of purulent effusion or the other hand, in such conduction is to
be obtained—Against this Bowditch states that the phenomena vary, not with the density of the fluid but with plate of the lung, and other writers agree with him that it is at least an uncertain sign.

2. From Parapleural Abscess.

This may arise spontaneously or from injury by punctured wound, or in connection with pleurisy. In which case, it is due either to extension directly of the inflammatory process or local neuritis thrombosis.

This condition is distinguished from Empyema (which if large it may closely simulate) by marked localisation, bulging of the intercostal spaces, which however is not uniform, the spaces above, being often narrowed while those below are expanded. Second by fluctuation being more apparent, again by the very occurrence of pain, the there being no displacement of neighbouring organs and by the tissue of the resorbing varying with the respiratory heaves, even the dullness is less profound in its extent, as not corresponding to those of fluid which
is free in the pleural cavity, nor is there any alteration in level on change of position. If tapped, the rapidity of the flow, varies from the first with expiration, being greater during expiration than during inspiration. Whereas in Empyema, the flow is at first continuous.

Barclay states that the specific gravity of the fluid is higher in pleural effusion, where it may reach 1041 than in Empyema, in which case it never exceeds 1032.

3. From new growths, consolidation, abscess, pleurisy or a combination of fluid, with one or other of these.

Encysted Empyema, not large enough to elevate the intercostal spaces and causing no cardiac displacement, gives at times signs almost indistinguishable from those of Chronic Consolidation, or abscess of lung. If however a permanent large pleural area remains after an acute pleurisy or pleural pneumonia, this most probably corresponded to an encysted Empyema (Barclay, Smith, Thedman) to 277.
Variations in the intensity and distribution of the dulness and breath sounds, favour a diagnosis of fluid.

In some cases cæsarean pneumonias there are diminished breath sounds and very marked dulness, making the diagnosis of fluid an exceedingly probable one, or a petechial pneumatic lung covered with a thick layer of lymph, or a sudden lung covered with fibrin tissue and adherent to the chest wall may give a wooden dulness and resistance, closely resembling that of fluid. On the other hand, when fluid is present the bronchial breathing is sometimes loud and even intense.

A good rule to follow is whenever there is a patch of dulness that does not clear up, especially where there is a hectic or high temperature, always to explore (Disease of Children p. 221).

The differential diagnosis between a large pulmonary cavity and an appreciated empyema with bronchial fistula, turn upon the history of the case and upon the condition of the opposite and different part of
the same lung

A Case of intrathoracic tumor (Sarcoma of pleura) may at first sight closely resemble one of empyema. I have seen in such a case in a child, the usual characteristic marks, complexion, testify of general languor with at the same time physical signs pointing mainly to a collection of fluid but not harmonizing well together. On tapping the chest, slightly blood colored fluid was withdrawn, the heart which had been very markedly displaced, returning to its normal position. The fluid reaccumulated again repeatedly tapped in order to relieve dyspnea, but on each occasion the apex beat returned rather less towards its normal position. Death occurred and post mortem had been a diffuse sarcoma affecting the left pulmonary pleura. In other cases of the fluid, there may be precious signs, inequality of pupils, diplopia, conjugal paralysis, delayed pulse or engorged veins or enlarged glands, all of which are very rare in effusion above. Moreover in cases of
Effusion the hydrostatic displacement of organs is regular, whereas in tumors it is usually not so. The level of decline, produced by tumors does not vary on change of position and extreme tenderness with peculiar heightened pitch and strong resonance, as said by Galeshe (p. 67) to be almost conclusive in favor of new growth.

Tumors from pathological conditions situated below the diaphragm, such as subdiaphragmatic, external oblique or new growth in this situation, is often difficult to distinguish from that near to the apiece of the base. Especially as it may invade the thoracic region. The chief points of distinction are (a) there is always a tumor below the diaphragm. The decline is displaced downward on deep inspiration, and (b) should the decline be fluid, its pressure is increased by inspiration, as may be seen when a trocar connected with a manometer is introduced into it. The opposite is the case in effusions.
Prognosis

This turns chiefly upon the cause, the general condition of the patient, the age of the patient. 2-20 mile cases in children are very much more hopeful than in adults owing to the greater adaptability of the chest walls whereby the ribs are enabled to fall in and close the cavity. Experience however teaches that the outlook is not equally hopeful in children of all ages, for below that of 2 years a fatal result is only too common. Taking the cases which occurred in the East London Children's Hospital during the years 1893 & 1894 the following table will serve to illustrate the point.

<table>
<thead>
<tr>
<th>Year</th>
<th>Under 2 years</th>
<th>2-6 years</th>
<th>Over 6 years</th>
<th>Total</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1893</td>
<td>Cases</td>
<td>Recovered</td>
<td>Died</td>
<td>Cases</td>
<td>Recovered</td>
</tr>
<tr>
<td>1893</td>
<td>1</td>
<td>0</td>
<td>9</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>1894</td>
<td>7</td>
<td>1</td>
<td>8</td>
<td>11</td>
<td>3</td>
</tr>
</tbody>
</table>

After the age of 20, the results again show a falling off, the recovery from the wound becoming fewer.

The condition of the opposite side materially affects the prognosis. If there is a second empyema present here, or the lung itself...
is occasionally a hypersensitive and especially
if the case is acute with rapidity, the outlook is bad.
The duration of illness - There is much
less hope of a cure in long standing
than in recent cases, the lungs never
fully being able to recover from the
prolonged compression to which it has been
subjected.
Complications, according to their nature
and extent, manifestly reduce the prospect
of recovery to a greater or less extent.
The presence of pneumococci in the pus is
said to be of good omen, but why is not
manifest unless it be that these are
acute cases in which one would naturally
hope for a speedy recovery.
Sudden death may occur from Syncope;
Thrombosis in the head and Pulmonary Artery
or Emphysema close to rupture into a bronchus
or a fatal respiratory failure more slowly
from Emaciation, Angioid Anemia, Chronic
Sphincteritis, Secondary Abscess (of brain)
or Phrenicopleurisy.
The question as to whether an empyema, may become absorbed or not when left to nature is a much vexed one; but the weight of evidence seems to me to be in favour of it under certain conditions, as when the fluid is zero-poculent, or rare in amount, and the general state of health good. I cannot do better than quote a passage on the subject from "Diseases of the Lungs and Pleura" by Milne. On page 1014 he there says: "There is a considerable body of evidence showing the possibility of the absorption of abscesses in other parts, and further a certain number of cases exist in which a partial removal or a perforating fluid by aspiration has been followed by the absorption of the remainder or where the reaccumulation of fluid, probably of a similar nature after aspiration, has been followed by cure without a repetition of the operation... Further, encapsulated chronic collections of matter are not uncommonly found at the base of the lung and in the hilum or hilar fissures. Where the effusion has been in a great measure
absorbed, leaving only a small solid residue behind. Further evidence exists that the free cells in some cases break down, leaving only a milky fluid which is to a considerable extent capable of absorption.

Vieussens states that the free macrophages, when transformed into a milky fluid where the free corpuscles break down and a liquefied granular debris remains, the liquid part of which becomes absorbed while the solid remains as an imbibed material containing chorionic free cells, crystals of the fatty acids, and cholesterol or may calcify. He cannot say that I have ever seen a case in which absorption had occurred and since all cases with any exception are now operated upon as soon as the diagnosis is established, the evidence of absorption must be gathered more from accidental cases seen in the post-mortem room, in which death has resulted from some other cause than from the bed side.
Treatment.
The general principle underlying all treatment is the early evacuation of the pus. Detail of method are numerous. Occasionally nature works her own cure by rupture into the air passages or externally through the skin. This, however, is not always the case. Even such cases may completely recover, without operative treatment.

M. Malcolm (British Medical Journal 1866) relates such a case in which after the formation of a pulmonary fistula, a cure was brought about by inversion of the patient. In the great majority of cases, some form of operation is necessary, and its performance is attended by much less risk to life than when lungs are left to nature. The most simple method is that of tapping with trocas and cannula either with or without aspiration. When without aspiration, a slight suction action may be obtained by leaving a tube attached and allowing it to dip under source antiseptic solution about 3 feet below the level of the patient. Tapping may be employed to relieve expectoration.
Symptomes, to reduce the shock of operation or, in the case of double empyema where it is well only to operate upon one side at a time, to relieve the other side until the patient is well enough for a second operation: or again, it may be utilized with a view to a permanent cure, though the chance of such a result are not very good except in cases of double recent empyema where the pus is not localized or does not contain masses of lymph or cancerous material and where the lung is not bound down by adhesions. The best site at which to puncture within a disputed point - Marshall advised the 5th space in the nipple line but this has been practically abandoned for either the 6th space in the mid axillary, the patient lying on his back so as to allow the fleshy tissue away from the carina or the 7th space (6th or 8th costal) in the line of the angle of the scapula or, others recommend the anterior axillary line though the 11th or 12th space on the right side or 6th or 7th on the left. Personally, I prefer the angle of the scapula -
In all cases the position of incision should be carefully ascertained, adherent pleura avoided and the apex or the selected spur definite and if there is distinct bulging of the intercostal spaces, this region should be selected.

The method of operation.

Having selected the point at which to puncture, with the patient, if possible, in the recumbent position, the skin is rendered aseptic and anesthetised either by the ether spray, sec naph or ethyl chloride.

The forefinger of the left hand is now placed upon the upper border of the lower rib bounding the selected space and, using this as a guide, the trocar is rapidly thrust into the thorax. Sir W. Jenner ordered to recommend that the skin should be first drawn up, so that on withdrawal of the canula a Valvula, opening would remain at the entrance of pure air and this plan may be adopted with advantage.

A good sized trocar should be used and if an operator is employed, forcible
suction should be avoided. This best safeguard against this is not to employ the bottle. Should the patient be attacked during the operation, with dry cough and pain over the costal cartilages, which are indicative of marked negative pressure in the thorax, the rule is to stop. The entrance of air at the bound on withdrawing the cannula must be avoided by the immediate application of collodion or adhesive plaster, and by directing the patient not to breathe. Subsequently the side should be strapped.

If the pus is grave and it is decided to treat the case by aspiration alone, this operation will probably have to be repeated on several occasions, being better to accumulate which almost invariably takes place but in the end a cure may sometimes be effected.

The best suitable cases are those of localized empyema in young children or infants, but it is at the best an uncertain method, much valuable tissue may be lost, during which the patient is always liable to the formation
of pulmonary fistula or septic abscess of the lung become more and more condenser. Moreover, it is impossible to completely empty the cavity, as the lung can never fully expand to take the place of the fluid. Dr. Parker, recognizing the difficulty, endeavored to overcome it by the injection of carbolic acid into the pleural cavity, but he now invariably performed the major operation (June 17, 1888-989) in cases of pulmonary fistula aspiration should never be employed as it would only lead to keep open the wound in the lung.

The difficulties and dangers of the operation require special consideration. Firstly, the difficulties which may be best dealt with sometimes owing to the patient's making a violent muscular effort at the moment when the trocar is being thrust into the skin, he strips the ribs into close opposition, thus the trocar fails to enter the chest. Again, pus may either not appear at all or its escape become suddenly arrested.
before any gravity has been withdrew.

This may be owing to blocking of the cannula by a false lymph, or to the peritoneum being made up of a number of small loculi, only one of which has been tapped so again to the pleura having been partially thickened and instead of being pointed become pushed in front of the end of the trocar.

The chief dangers are:

1. Wounds of viscera - the diaphragm has been often injured when the puncture has been made too low and even in other cases owing to its being drawn up above its normal level, it may be mistaken.

The following case illustrates this point - "Patient, in right posterior axillary border near 8th rib. Diaphragm and peritoneum wounded. Haemorrhage into peritoneum. Empyema at right base containing 50 oz of thick yellow pus. "Middlesex Hospital."

Wounds of the spleen and kidney are less likely to occur but may do so. The heart may be injured.

2. Sepsis - from too rapid withdrawal of fluid.

3. Haemorrhage - from intercostal arteries.
accident which should never occur; or from the pleura, the result of too forcible aspiration.
Pneumothorax may be produced when the aspiration is used in a case of phthisis, with cavities near the surface.

Operation by incision and drainage offers by far the most sure and rapid means of dealing with empyema, and should be employed in almost every instance, whether complicated by pulmonary fistula or not, but this does not apply to cases of pneumonia thoracis of phthisical origin, in which no operation should be undertaken except to relieve urgent symptoms. Details. The anaesthetic employed should be chloroform, but not sufficient to produce deep anaesthesia. In some extreme cases the risks are too great to warrant the use of a general anaesthetic at all, and in these cocaine may be used. During anaesthesia the patient should be allowed as far as possible to lie on hi,
back though this is not altogether practicable
where the lower latera incision is made.
The rise of the incision is not the same
with all operators, where the plex has
perforated the pleura and caused an
abscess in the subcutaneous cellular
tissue, this should be opened at its
most dependent point but if this is not
sufficient also to drain the pleura,
another should be made.
Where the empyema is localized, there it
must be opened and in doubtful, if not in
all cases, the incision should be made
without the presence of plex having been
first forced by means of the exploratory puncture.
The first object to remove is free
empyema and the rise which best
fulfills this need is over the 5th rib or
spine in a line with the angle of the
pectoral. Others are recommended
which correspond in the main to those
named when discussing aspiration.
Under advised the 5th space, one inch
in front of the brachial axillary line, as it
is here that the spaces are widest apart,
though this position also has the disadvantage of being that at which the approximation of the ribs is most marked after operation. He fully recognised the importance of free drainage and advised that a second opening should be made posteriorly. The 7th or 8th space in the posterior is the site recommended by Borsell and this, or one just posterior to it, below as to be interfered with by movement of the angle of the scapula. I believe to produce best results, and there is less risk of encountering an adherent or dislocated diaphragm.

Should there be pointing at any particular spot, this is no reason for operating there unless otherwise desirable.

Whether a rib should be resected or not is still an open question; while some surgeons assert that it is an unnecessary and needless some procedure, others practice it habitually, believing that it affords freer drainage and abolishes all risk of the tube being pressed upon by adjacent ribs. appropriated used a rib trochar, passing the trochar through the
hole in the rib and thus affording good support and effectively guarding against blockage from external pressure. The chief disadvantage of the plan would seem to be that it might not be possible to insert a sufficiently large tube, especially would this be the case in children, in whom it is necessary to use a large tube, as in the case of adults. The chief objection to simple visceral control seems to be that there may not be sufficient room between the ribs, for a large tube to be inserted and that the tube may subsequently be pressed upon by the falling together of the ribs. In several cases, also, I have experienced considerable difficulty in replacing the tube after having removed it for washing, this hewing being partly due to the skin and pleural viscera not exactly coexisting.

Against resection may be said that it means a larger operation at the time with some though very slight risk of subsequent rib recurrence. Each case must however be judged on its own merits and whenever the intercostal space is not sufficiently wide to allow a large
An aneurism tube to be inserted, resection must be performed. From this rule it follows that in nearly all cases of children a rib must be excised, and practically this will usually be found necessary. Lining the difference in structure of the chest wall, the end shapes of the pleura are not the same in the two cases. Where it is not intended to resect a rib, a linear or T-shaped incision, some 2 or 3 inches long, is made over the middle of the selected space but before doing so it is necessary to see that the angle of the scapula will not interfere with it, in any position of the arm, and also to guard against any loss of correspondence between the pleural and skin incision, which is liable to occur through displacement of the latter. To overcome this, it is a good plan to place the arm in the position it is to occupy during the after treatment and then slightly to stretch the skin between the left fingers and thumb in the long axis of the tube, before making it. Care should also be taken not to run any risk of wounding the intercostal aery, consequently
it has been recommended to take the upper
border of the lower rib or the spine, though
as long as the knife keeps to the middle of the
space, there can be little chance of such
an accident. The direction above carried
down through the external and internal inter-
costal muscles and their fasciae, is the
pleura which is then penetrated at the
upper margin of the rib; a broad director
introduced before the incision enlarged
up to about 1/2 inch, that is, less than
the 3/4 of an inch, so that there may be no
risk of surgical emptying or perforation.
When it is decided to resect a rib, a similar
incision is made over the middle of that rib
down to the periosteum, which is then
completely divided and freed all round
the rib by means of a detacher, by which
means the intercostal nerves & vessels are
also completely separated from the bone.
Using the detacher as a lever, pianed beneath
the rib a resting on that beyond, the bone is
raised slightly from its bed and divided in two
places about 1 1/2 inches apart by means of
forceps or other arranged special for the purpose.
the pericardium and pleura are then removed together, and the wound enlarged as before. Several folds of inflammatory tissue have been placed over the wound. At first the pleura flows out in a continuous stream but later only with expiration aided by a dry cough which usually appears as soon as the chest is opened and is of great service both in clearing the pleural cavity, and also in helping the lung to expand. The forefinger must be now introduced in order to ascertain the size of the cavity, to break down adhesions between the pleura, where they exist, to clear out flakes of lymph and desquams of membrane and to examine the condition of the lung and the degree of reexpansion which is taking place. In favourable cases the lung may be felt to come up towards the thoracic, while in others it remains firmly broad down by leprous and false membranes. It is impossible completely to avoid the entrance of air into the pleural cavity when the flow of pus becomes interminable; nevertheless by means of a thin rod of gauze placed over the wound and acti-

...
as a rule, one can assume that what does enter is pure, in which case it is quite harmless.

The question now arises as to whether or not the pleural cavity should be washed out. As a routine practice I believe it to be wrong, if not actually harmful, but where the lung is Janet and there are many capsules and shreds of membrane which cannot otherwise be got rid of, it may be employed with advantage, provided always due care be taken to avoid any sudden alteration of fluid pressures within the thorax either by using a double tube, or inserting that, that was put loosely, and at the same time regulating the force of the flow by means of an irrigator held just above the level of the patient. If these precautions be not taken there is considerable risk.

1. Cerebral embolism caused by the sudden alteration of pressure, loosening any clot which may be present.
2. Syncope from these sudden alterations or from irritation of the cardiac nerves in the walls of the cavity.

Various fluids have been recommended.
for irrigation. Pearse full advises Common Sublimate 1-5000 and Careful Drying out of the cavity afterwards. Delicate Caudal fluid, Boracic Acid Lotion, Borphycard 1-40, etc., have also been employed.

The best stage in the operation is the introduction of a tube; these may be of various patterns and materials. The length should not exceed 3 inches the breadth about 3/4 to 1 inch, the end flat or not slanting as in ordinary drainage tubes and if there be any side holes at all, they should be at the end but not in a position to allow granulations from the wound to enter into them.

In many cases a double tube is desirable and a very convenient form is made by splitting a rubber tube longitudinally in two places close to the thing a little above line, passing the ends of two other tubes of equal calibers through these holes, then winding them so as to form a collar which prevents their slipping out. Thus —

Or a single rubber tube may be split into four
at one end for a distance of 2 inches and these four pieces turned outwards and stitched to a flat pericardial flange, the tube itself not covering the cavity for more than two inches. Another form is that of a vulcanite shield or short tube, through which a rubber tube is passed. It is especially useful where there is danger of pressure from the ribs and the same applies to all rigid tubes whether, rubber, vulcanite, or whatever other material, and in all cases the tube should be fixed in such a way as to make it impossible for it to slip into the chest cavity. The tube having been fixed in position, the wound pericardium be draped with a large quantity of adhesive absorbent gauze and gauze special care being taken in the application to avoid pressure on the end of the tube so to ensure that it is not slipping down, 

"trace"  

After Treatment. The temperature usually falls within the first twenty-four hours after operation in favorable cases, and the general condition begins to improve; this should be helped by generous diet & tonics. Consult
and iron, and by getting the patient up as soon as possible, if strong enough the temperature normal, this may lie on the 3rd or 4th day.

The after-treatment is referred to wound remnants, in keeping the discharge exact, frequent changing of the dressings during the first few days and the preservation as far as possible of the entrance of air, especially when the wound is exposed by keeping the latter continuously covered and at other times by the application of an elastic bandage applied around and below the edges of the dressings, thus preventing the entrance of any air at their edges. While that which may filter through there will be thoroughly filtered through in the third day the tube may be removed and washed, then replaced after being shortened if necessary by the expanding lung and contracting chest walls. Lastly, when the discharge has ceased and the cavity filled in, as ascertained by probing and the palpation region of an expanded lung, it may be removed altogether, the wound allowed to heal. This may come about very early if one removed a tube on the 5th day, but were usually, ten
days or a fortnight must elapse.

Daily washing out the pleura during the
first week or 20 after operation has been
always advised, but provided there is no
special reason for it, is prone to cause factor
of discharge, it is best avoided.

Various means have been devised to prevent
the entrance of air during the after-treatment.
A long tube may be used, reaching from the
chest cavity to an India rubber bag at a
lower level which has been previously emptied.
If a tube contains some antiseptic solution,
or the tube is near clip under a solution of
bromine, care so that on inspiration if any-
thing is drawn into the chest it will be the
solution. That is again discharged or aspirated
thus washing the cavity out and at the same
time producing a slightly negative pressure
encouraging expansion of lung; the latter
may be further increased provided the tube
fits tightly by placing a valve, preferably
in the dental end of the tube. pumps the
value from the end of a rubber syringe
placed, the reverse being but have found that
it is liable to become blocked, though successful
Up to a certain point, what is required is some apparatus which while permitting the free exit of discharge, prevents the entrance of air without the necessity of employing a longer tube than ordinarily fused.

I have hitherto discussed merely cases in which there is reason to hope for a rapid and complete recovery; in these recent and uncomplicated cases, the whole of the cavity may be filled up by the expanded lung, but in many instances there is, at least, some retraction of the chest wall which may be extreme in others and accompanied by falling in of the ribs and shoulders, tilting out of the inferior angle of the scapula and marked lateral curvature of the spine in which the convexity is towards the sound side. The hickey may also be displaced to a greater or lesser extent.

To turn to the complicated cases requiring special treatment.

In cases of double emphysema it is not advisable to operate upon both sides at one time, but
to do the most extensive first and touch, in a few days if the patient is well except in cases of uncomplicated pulmonary fistula, operation should be performed as usual so as to allow the wounded lung to heal, but when the empyema is secondary to tubercle of the lung with pulmonary fistula possibly presence thoraces operation is to be avoided unless absolutely necessary from leanness of symptoms or threatened pyopneumonia, in which case the incision must be a very free one, drain the thorax, and care taken to avoid any cause of negative pressure in the thorax. If, after the pus has been evacuated and good drainage obtained, the discharge is of a persistently offensive character and the fever remains, either tuberculous or a second empyema on that or the opposite side may be the cause and should be sought for.

Unfortunately, Chronic Cases form a large group by themselves. They may be secondary to tubercle or simple cases in which, owing to rigidity of the chest wall or
bridgry down of the lung by adhesions and thickness of false membrane, a chronic abscess remains. Others are cases of chronic bronchial fistula or there may be simply an external sinus often long and sinuous which will not close. The cure from such chronic cases is often prompt and thin, or may be opaque a creamy and the corporules faltly degenerated where a chronic cavity exists. 

The great principle of treatment is to endeavour to bring it nearer in opposition, whether by resection of the lung (which is hardly to be hoped for), falling in of the chest wall, or by displacement.

1) increase and hypertrophy of the sound lung. To promote reexpansion of the lung - repeated tapping with the syphon toehar or other means such as Vaque tubes, if producing a slightly negative effect of thoracic pressure, may be tried, the patient at the same time taking respiratory gymnastics e.g. deep breathing, movement of the arms and artificial respiration, or inhalation of compressed air, manege or 

farradine.
To aid recovery by falling on the chest wall, stripping the chest in the inframammary region and the application of a compress may both help the lung to form adhesions and encourage the opposite lung to hypertrophy.

Various other means, short of operation have been tried recommended as injection with solution of sodaline tincture (3 i. aq.) or 10-15 grain of guaiac left in the pleura or the patient may be placed in a boracic bath and allowed to work his own chest out by deep respiration.

In some cases, owing to elevation of the diaphragm long climates remain, leading upwards from an old operation wound the azygos vein and in these a new opening at a higher level is indicated.

In others, though drainage by double opening may be tried: 'in the Lancet 1888 p 631 a case is reported of pyopneumothorax from bronchial fistula in which the method accompanied by daily injection of Carbidil's acid, resulted in recovery. The openings in these cases are made anterior and posterior, 1 as mile. Sailing other means, Ecklander's operation holds out the best prospect of success.
It consists in removal of part or the whole of the ribs forming the inner wall of the cavity, together with the thickened pleura. It is performed by making a long vertical incision over the cavity or by raising a flap of skin, and by subperitoneal resection of the ribs if sufficient length to allow the walls of the cavity to come together. The pleura may be cut away with scissors and bleeding arrested by ordinary means.

If necessary, though as a rule, owing to contracture of the thickened pleura, the intercostal vessels are more or less obliterated. Rarely found in an article by Leach (1888 p. 26), however, upon the operation only being under taken in order to save life but when done, to be performed thoroughly. He first explores the limits of the cavity by probing and with the fingers after enlarging the opening, and then proceeds to remove the ribs and thickened pleura to whatever extent they enter into the formation of the inner wall (with the exception of the 1st rib which, owing to its anatomical position, can never be interfered with). Where the length of rib involved is considerable,
It is often easier to remove it in pieces and if extending far back towards the spine it is more easily reached, and with less injury to soft parts, by attacking it from the thoracic pulmonary side, after division anteriorly.

Finally the wound is closed by sutures, a drainage tube inserted, and a good large pad of cotton wool placed over the site of the cavity.

Other operative measures have been recommended viz. resection of two and a half ribs with scraping out all the pyogenic membrane (Parke, Lancet 1858), but this involves great risk of pyaemia. Others have suggested exsanguination and division of the costal cartilages—a proceeding attended by great risk of wound in healthy pleura and little hope of closing any wound.

In spite of all efforts to effect a cure some cedema continue to discharge indefinitely. In some it is little more than a serous which remains and this may go on for years without causing much inconvenience or impairment of general health, as in the case of Dr. Candelstadt who continued for
13 years, daily drains of some pus from an old empyema case and yet preserved excellent health. Other instances are not so fortunate and become the subjects of local sepsis. Sometimes after operation, recrudescent rib felon or thoracic wound strung up if the peritoneum and pleura be dealt with in the usual way, or others, an ulcerative process may commence around the wound and extend to the muscles or ribs; or again, the integument may become infiltrated with pus over a considerable area. Scleroderma or leucoplasia is apt to occur during the first few days, but seldom of serious import. These sequelae may follow extra thoracic or secondary operations but their occurrence is unusual and the fear of them is no contraindication to doing what may be necessary for the condition.

Empyema then, is a condition very amenable to treatment if seen early and there are few operations which give more satisfactory results than the importance of early recognition and
Immediate Surgical Interference.

The operation may be placed in the same category as herniotomy and trachiotomy, or being one of urgency and one, which if not performed may cost the patient his life.

The above thesis is based largely upon personal experience of cases in children occurring in the East London Children Hospital during my tenure of office as Surgeon Superintendent, which have come under my care at the Brompton Hospital for Consumption, General Hospital Nottingham and East London Hospital. I have also obtained great assistance from the following books of reference, most of which have been referred to from time to time—

"Diseases of the Lung and Pleura" Boston, Fox & Thomas, Boston, 1844.

"Diseases of the Lungs" Powell

"Diseases of the Lungs" B. Skene, 1835.

"Diseases of the Lungs and Bronchial Glands" S. T. Bucy, 1835.

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Operative Surgery

Surgical Diagnosis

Paper in the Journal refers to