

CHEST SURGERY

A REVIEW OF ITS PRESENT STATUS*

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Chest surgery dates back to the days of Hippocrates who described empyema and its treatment. It is possible that the Chinese and Egyptians, previous to the days of Hippocrates, had drained empyema necessitates, but there is, however, no direct record in the literature of their work.

Hippocrates evidently understood the disease fairly well for he described it as a malady accompanied by high fever, cough, pain in the chest and distress when the patient lies on the well side. The treatment was to open with a knife or cautery. If there was a swelling, this point was selected as the place for opening, but if there was no swelling, the opening was made by the side of the ninth rib posterior to the midaxillary line. Hippocrates did not completely evacuate the chest at the time of opening, but closed the wound after some pus had been discharged and then each day the wound was opened and pus evacuated. On the tenth day he began the injection of oil and warm wine. After the discharge had become clear, he inserted a hollow metal tube drain. Much that Hippocrates wrote regarding empyema remains among the accepted facts today. In fact, for many centuries, chest surgery made but little advance. In the years preceding the World War, there was an increasing interest in this subject, but the profession as a whole was doing little more in chest surgery than Hippocrates.

In this paper it will be impossible to deal with all the various aspects of chest surgery, hence I shall discuss only some of the more important features, going into some detail with those conditions which the men in general practice treat for themselves and referring briefly to those which will need to be recognized, so that the patient may be re-

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ferred to a chest surgeon for such work before it is too late to secure relief.

Empyema. As a result of the influenza epidemic we have learned that empyema must not be treated as a single entity, but each case instead must be carefully studied and classified before outlining treatment. For general purposes empyema may be classified as acute, chronic and tuberculous. Acute empyema must again be classified as to its etiology, since the empyemas produced by different organisms require different treatment. Thus, while the time-honored method of Hippocrates is effective in a large portion of the empyemas, it is very frequently followed by death in the streptococcal infection. A practical classification of empyema from the standpoint of treatment is according to the general etiology.

1. Empyema accompanying influenza usually due to the streptococcus hemolyticus.
2. Empyema accompanying pneumonia.
3. Metastatic empyema.
4. Empyema by direct extension.
5. Empyema from penetrating wounds.

Graham has laid down the following principles to be followed in the treatment of empyema. First, the avoidance of an open pneumothorax in the acute stage of lung involvement; second, the early sterilization and obliteration of the cavity; and, third, the maintenance of the nutrition of the patient.

Empyema associated with influenza usually begins with an acute accumulation of thin serous serosanguinous fluid. The pleura is congested and the lung lies free with little or no attempt at formation of adhesions. The organism is usually a streptococcus and often of the hemolytic variety. The empyema develops at a time when the patient is in a more or less serious condition. The opening of the chest for drainage at this time permits the development of a pneumothorax, is accompanied by more or less shock even when done under local anesthetic and seems to increase the hemolytic activity of the organism.

Pneumothorax. Graham in his experimental work has shown that the mediastinum is not rigid, but when pneumothorax develops on one side, there

is pressure across the center through the mediastinum, decreasing the capacity of the other side of the chest. The vital capacity of these patients is already greatly reduced as a result of the disease. In such a case, if the chest is to be opened, a pneumothorax must of necessity result. The lung on the affected side collapses as there are usually no adhesions present and, because of the pressure across the midline, the capacity of the lung on the opposite side is decreased. The vital capacity of these patients is but little greater than the tidal air, so that the production of a pneumothorax may reduce the vital capacity below the tidal air volume previous to the operation. This is undoubtedly a frequent cause of death.

Shock. While under ordinary conditions there is not much shock in a simple thoracotomy under local anesthesia, when the patient is seriously ill with influenza and having respiration further hampered by an accumulation of fluid, the shock becomes of much greater import, so it may be an outstanding factor in producing death.

Increased hemolysis. A search of the literature fails to throw any scientific proof that there is an increase in the hemolytic action on the part of the infection, although it has been the observation in many of these cases that there is seemingly an apparent increase.

These factors absolutely contraindicate a thoracotomy during the acute stage of an influenza complicated by an empyema. However, the constant increasing pressure due to the increased fluid must be relieved. This can be accomplished by careful aspiration which may be repeated from time to time as indicated, until the condition has either cleared up as sometimes happens, or the patient's condition is improved so that a thoracotomy can be safely done. In aspirating it must be remembered that air can enter through a needle as well as through an incision in the chest wall, consequently the needle must be kept closed at all times, and must be of such caliber that an opening will not be left in the chest wall through which air can be aspirated after the withdrawal of the needle. In patients having an extensive amount of fluid the entire

amount should not be withdrawn at one time. In aspirating it is well to use the Potain aspirator or some similar device, by which a steady flow may be maintained. Following the removal of the needle, the opening may be closed with collodion, but if this is done it should be watched, as occasionally there will be an infection in the chest wall by organisms left as the needle is withdrawn.

Empyema accompanying pneumonia. Empyema accompanying pneumonia is produced either by the pneumococcus or staphylococcus as a rule, but sometimes by the streptococcus. The same careful study of the patient's general condition should be made before deciding on the treatment, as with a patient with empyema complicating influenza. The reason that thoracotomy has given better results in the empyema following pneumonia than that following influenza is that empyema developed later in pneumonia or is not recognized until later. In the patients who are acutely ill because of lung involvement, the opening of the chest would carry with it great hazard, providing the lung had not become adherent to the chest wall. Fortunately for a large number of patients this occurs early, so that in opening the pleura there is not a complete collapse of the lungs and filling of the chest with air. This is the reason why the empyemas with pneumonia have done so well. However, it must be borne in mind that this is not always the case and it must be further borne in mind that the shock accompanying the rib resection may be the last straw that will determine the fatal outcome of the lesion.

In cases of empyema developing early in pneumonia, aspiration should be the procedure and not thoracotomy, but late in the disease, after the patient's lung has begun to resolve, drainage is indicated. In the early cases as in the early cases with influenza, aspiration may need to be repeated but it is better to aspirate a chest repeatedly until the patient's condition is such that a thoracotomy can be performed safely, than to run the risk of death.

The treatment of empyema due to a metastatic infection, by direct extension or by introduction through a penetrating wound from without, de-

pends entirely upon the patient's condition. If this is at all precarious, aspiration should be done at first, and then later when the patient's condition warrants it, thoracotomy under the same precaution used in the empyemas of influenza or pneumonia should be done. In penetrating wounds, infected foreign bodies should be removed immediately if possible. If still present after the empyema has developed, they should be removed as soon as the patient's condition will warrant it.

Chest drainage. Much was learned during the influenza epidemic about chest drainage. Formerly the usual method followed was to make a wide opening, put in a drain to insure that it would not close and trust to nature to do the rest. This method, as pointed out by Graham, is accompanied by great danger. It has been our experience, which is limited as compared to that of those who treated empyema in the military hospitals in the late war, that if early attention is given to the expansion of the lungs, healing is just as rapid without irrigation as with it, so with this in mind we have divided Graham's principles into four heads in place of three.

1. Open pneumothorax must be avoided.
2. The lung must be made to expand early so that it does not become fixed and thus produce a cavity.
3. In cases that do not clear up readily, irrigation may be used.
4. Maintain the nutrition of the patient.

Prevention of an open pneumothorax. There are two ways of draining the chest. First, by the insertion of a rubber tube through a canula that has been inserted between the ribs, the tube being immediately connected with a closed drainage system, and, second, by the classical rib resection, removing, however, but a small portion of rib and then inserting a Brewer tube (fig. 1) which is connected with a closed drainage apparatus. During the war much work was done upon the use of negative pressure for the purpose of aspirating the contents of the pleural cavity. It is still followed by some. However, we believe that the same results are obtained by carrying the drainage tube

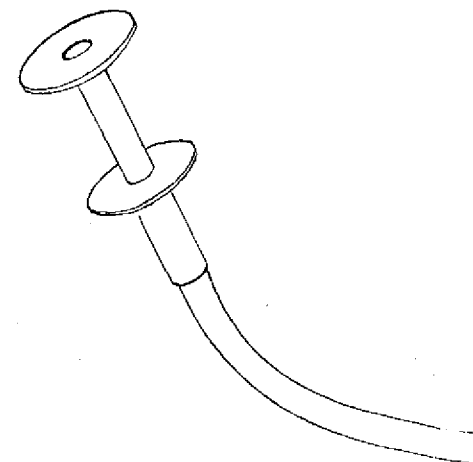


Fig. 1. The chest wall is compressed between the flanges, securing a fairly tight wound.

down the side of the bed into a bottle containing water in such manner that the end of the tube is always immersed (fig. 2). In this way, when the patient exhales, the fluid in the chest is forced out. When the patient inhales, it is impossible for air to enter the tube because it is immersed below the water and a limited negative pressure develops. In order to have this system work properly, the nurse must be carefully instructed not to empty the

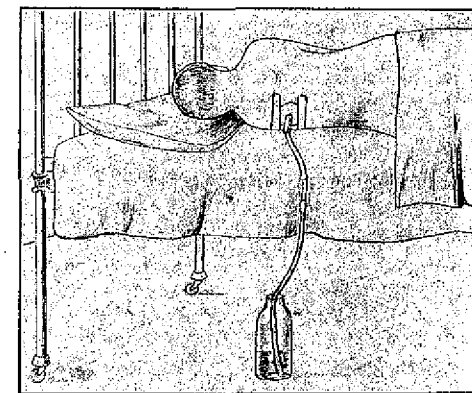


Fig. 2. End of tube must be kept under water in order to maintain a closed system. When the bottle is emptied the tube must be clamped.

bottle without previously having clamped the tube or otherwise air will enter the chest through the tube.

Securing expansion of the lungs. Blowing into a bottle has long been used as a method of securing lung expansion. This method necessitates the frequent filling of the bottle. Dr. Irvine, when associated with me some few years ago, devalued an ingenious method of causing the bottle to be refilled through a syphon and at the same time giving the patient a measure by which he could determine the effectiveness of his efforts. This method required

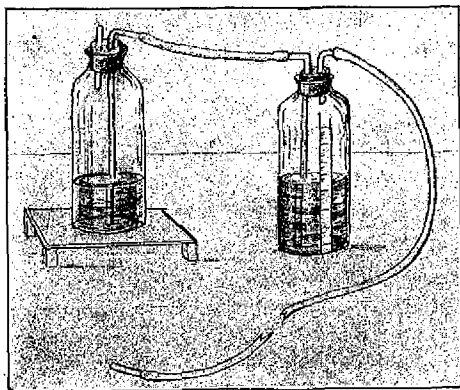


Fig. 3. Syphon bottle system for securing lung expansion.

two bottles, each having a rubber cork with two holes (fig. 3). In the first bottle a short glass tube, to which is attached a long rubber tube through which the patient blows, is placed in one hole. A long glass tube extending to the bottom of the bottle is passed through the other hole. This is connected by a rubber tube to a long glass tube extending to the bottom of the second bottle. In the other hole in the second bottle a short glass tube is placed. On the first bottle is placed a strip of adhesive, marked usually in inches to indicate the contents of the bottle. The first bottle is then filled with fluid and the second placed with its base two inches higher than the first. The patient in blowing blows the fluid from the first bottle into the second. When he ceases blowing, the fluid runs

back. The patient is instructed to blow into the bottle three or four times daily at first, but later more frequently. He is encouraged to observe the marks on the tape and determine how much can be blown out at a single blow and how many blows are required to empty the bottle. We have found that the patient usually takes considerable interest in the apparatus and it has been a great aid in securing lung expansion. We have never seen any harm result from blowing into the bottle.

Sterilization of the cavity. It has been our experience that this is usually not necessary, if there is adequate drainage accompanied by lung expansion upon the apparatus described above. In some cases, however, there is delay. In these cases we think it advisable to irrigate with Dakin's solution.

Maintain nutrition. Careful attention must be given to the dietetic and hygienic requirements of the patient.

Chronic empyema. Failure of the healing of empyema and continued discharge are usually due to, first, a cavity within the chest; second, a foreign body within the chest; third, an open bronchus; and, fourth, an infected rib.

A cavity within the chest. This is usually the result of neglect, either because of (1) late operation, (2) the continued pneumothorax with fixation of the lung, (3) failure to secure lung expansion. In the presence of such a cavity it is best first to try to secure lung expansion through the use of the method described above. If this fails then operative procedure must be resorted to. Several operations have been advised for this purpose. (1) Extra pleura rib resection; (2) decortication of the lung; (3) epithelialization of the cavity through molding skin grafts into the cavity.

Extra pleural rib resection. Schede in 1890 described a method of raising an extensive skin and muscle flap and dissecting off the entire chest wall, allowing the skin and muscle fiber to fall against the collapsed lung. The mortality for this operation was fairly high. In recent years the principle has been modified by removing the rib subperiostally without disturbing the pleura. This also is a rather extensive operation. It is usually best to do it in

stages. After the ribs are removed the chest wall collapses, obliterating the space.

Decortication of the lung consists in the freeing of the adhesions and separation of the lung from the chest wall and the removal of the dense fibrous coat over the whole lung surface. This often proves to be a very formidable operation.

Epithelialization of the cavity. Beck of Chicago resected a portion of the chest wall and then turned the epithelial flaps into the cavity. From there this epithelium spreads over the surface of the cavity, resulting in cessation of discharge.

Foreign bodies. It not infrequently happens that a tube becomes displaced or lost in the chest or a portion of the tube breaks off. When this accident occurs, the pleural cavity should be immediately explored and the tube removed. The tube is not always easily found. We have recently had one patient in our clinic, in whom the tube had been in the chest wall for eleven weeks.

An open bronchus. This usually occurs in those cases in which there has been a lung abscess in conjunction with the empyema, but also occurs in some neglected cases in which the empyema has perforated into a bronchus before being opened. For a cure it is usually necessary for the chest wall to be opened and the open bronchus found and closed.

Infected rib. Occasionally an osteomyelitis of the rib follows drainage of an empyema. This requires the resection of the infected portion of the rib.

Tuberculous empyema. The fluid is usually of a serous character. This may be nature's way of producing lung immobilization.

Hedblom advises that in a closed pleural cavity with a sterile serous effusion, open drainage should not be done except in the presence of an impending perforation of the chest wall. Repeated aspiration of only a part of the fluid is indicated, if there is dyspnea on exertion or symptoms of circulatory embarrassment. In the presence of an active tuberculous process the replacing of the aspirated fluid by nitrogen or filtered air may be indicated. In cases where the lung is fixed so that it can not expand upon aspirating the fluid, he advises an extrapleural plastic operation to secure collapse of the cavity.

In the presence of a mixed infection, then, anti-septic irrigation with the Carrol-Dakin method or an open drainage is indicated. Open drainage is also indicated in the presence of bronchial fistula and, if the fistula fails to close spontaneously, operative procedure to produce its closure will be necessary. He advises care in the use of Dakin's solution in excessively diseased lungs, because the corroding action may result in hemorrhage or the production of a bronchial fistula. With small cavities a skin or a skin muscle plastic operation will produce obliteration, but in large cavities of long standing, so that there is a markedly thickened pleura, a more extensive operation will have to be done.

Lung abscesses. Etiology of lung abscesses is, first, aspiration of foreign bodies or infected material; second, necrosis and suppuration accompanying infection; third, infected emboli; fourth, penetrating wounds; fifth, direct extension.

Willy Meyer classified lung abscesses, first, as the typical lung abscesses which occur subsequent to an attack of influenza or pneumonia and due to a simple necrotic process of suppuration; second, typical bronchiectasis (most authors place this under a separate heading), and; third, bronchiectatic lung abscess. Bronchiectatic abscess is descriptive of the pathologic appearance and not of the origin of the process. It results either from the aspiration of the infected material or by infected emboli, and presents a somewhat multiloculated appearance.

The diagnosis of lung abscess may or may not be difficult. With the history of aspiration of a foreign body or infected material or a recent inflammatory process in the lung which has failed to clear up, accompanied by dullness, or if the abscess be superficial and containing air, the presence of tympany, variation in the voice sounds, variable rales, purulent sputum containing elastic fibers and x-ray findings showing a more or less localized process, abscess of the lung should always be considered. Fluoroscopic examination and the exploratory needle are often of value. Stereoscopic plates should always be made, but even with the most careful examination the diagnosis will often be in doubt. Under such conditions, in a patient who is

gradually losing ground, exploratory thoracotomy is indicated, but in general, however, exploratory thoracotomy is looked upon with suspicion.

TREATMENT

As a considerable portion of the lung abscesses result from aspiration, prophylaxis is important. Following an operative procedure requiring a general anesthetic, the patient should be carefully watched and the head kept on the side until thoroughly awake in order to prevent the aspiration of the vomitus. In nose and throat operations under general anesthesia, the patient's head must always be so lowered that the blood and secretion will gravitate to the upper pharynx, from whence it must be frequently removed by aspiration or sponging. Lung abscesses follow tonsillectomies under a local anesthetic, so that it is necessary for the surgeon to watch and see that no blood accumulates about the epiglottis to be suddenly aspirated, if the patient should gasp. Patients who are advised to use local treatment about the nose should be cautioned. The author saw one case of lung abscess, due to a patient's aspirating a swab with which he was swabbing his nose. He accidentally passed the swab back through the nose, touching the pharynx and gasping suddenly, drew the swab into the right lung.

The treatment of lung abscess consists either in compressing the lung by pneumothorax or, when this is impossible due to adhesions, in opening and draining. Whether this be done in one or two stages depends upon the presence or absence of adhesions and the patient's general condition. The chest is opened usually by an incision between the seventh and eighth ribs, unless the location of the abscess indicates another location. If upon opening the chest the lung lies free, gauze should be packed about the wound and the wound closed. After forty-eight hours the gauze is removed under gas and a couple of days later, unless the patient's condition demands immediate action, the abscess is opened by cautery. Immediate operation would result in an empyema or lung collapse or both. In the extensive bronchiectatic lung abscesses a lobectomy will often have to be done. If the lobe can be easily brought out, this may be done in one stage.

Lillenthal is of the opinion that a lobectomy requiring more than forty-five minutes is practically always followed by death and advises, in cases where the operation can not be rapidly done, that it be done in two stages.

Bronchiectasis. The diagnosis of bronchiectasis is made comparatively easy, if the patient is carefully observed, noting his ability to evacuate considerable quantities of pus, usually having a foul odor when in certain posture. X-ray findings are often of value, but sometimes are deceiving. In extensive cases of bronchiectasis involving a single lobe, lobectomy is indicated. This should be done usually in two stages. The best anesthesia for a lung operation is the gas-oxygen anesthesia, given with one of the better types of apparatus, so that differential pressure can be used, provided the lung collapses.

Tuberculosis of the lung. Although therapeutic pneumothorax was developed and popularized by the surgeon, it is a procedure that should be carried out only by the specialist in pulmonary tuberculosis. When properly used it is of inestimable value, but when improperly used it may be productive of great harm. In cases which fail to yield to pneumothorax, extrapleural rib resection, producing a collapse of one side of the chest, is often of great value. This may be done by resecting a comparatively small portion of the rib near the angle posteriorly or the resection of a portion posteriorly and a resection of a portion anteriorly or the resection of a long portion of the ribs laterally. If the operation is to be done, a sufficient number and a sufficient portion of the ribs must be resected to produce the necessary compression. As the patients requiring this type of operation are often seriously ill, the operation must frequently be done in stages. This type of operation has practically replaced the extensive operations described by Schede and others at the close of the last century.

Heart lesions. Cardiac surgery is being developed at the present time. Within the past two years stenosed mitral valves have been cut by Graham, Allen, Cutler, Levine and Beck. It is too early yet to properly estimate the value of the pro-

cedure. Theoretically it offers relief to a certain class. In adherent pericarditis producing serious cardiac embarrassment, the freeing of the heart has been followed with beneficial results in some cases. The drainage of purulent pericarditis has saved lives, as has also the suturing of heart wounds and the removing of foreign bodies from the cardiac wall. Owing to the delicate nature of this type of surgery, it will probably always be more or less limited in its use.

Tumors of the chest wall and pleura. These can be easily removed whether benign or malignant, if seen early. The pleura will stand extensive operation for the removal of the tumors. The author has removed an osteochondrosarcoma approximately 10 cm. in diameter, to which the lung was adherent and which required not only the resection of a portion of the entire chest wall, but of the visceral pleura and a portion of the lung, with no apparent shock to the patient. Although the patient later developed a metastasis in the spinal canal which resulted in death, there was no evidence of any recurrence in the chest, when the patient was last seen. The patient was not seen during the last two months of life and a postmortem was not obtained, so it is not known whether there was a late recurrence in the chest.

Lung tumors are usually malignant and secondary to tumors elsewhere in the body, so that this field of surgery offers but little relief.

Esophagus. Strictures of the esophagus have long been treated by dilatation or when complete by gastrostomy, enabling the patient to be fed directly into the stomach. There has, however, been considerable work done on the reconstruction of the esophagus. Zaaiger, in 1913, reported operation for carcinoma of the esophagus. Previous to this time, Völker, Fummell, and Küttner had described methods of approach through the abdominal route and Wendel and Sauerbach had described a transpleural route of approach. More recently, Lillenthal, Willy Meyer and others have given the surgical treatment of carcinoma of the esophagus considerable attention.

Two principal methods of esophageal reconstruc-

tion have been tried. One, by bringing the esophagus out through the neck and constructing a skin tube anterior to the chest wall that connects with the gastrostomy opening in the epigastrium, and the other the reconstruction of the esophagus within the thorax. The stomach has been brought up through the diaphragm and anastomosed to the esophagus above the site of the tumor. Another method has been to make a tube from the greater curvature of the stomach and anastomose it with the esophagus in the chest. Recently Hueur and associates have devised a method of transplanting the diaphragm upward so that the lower portion of the esophagus becomes an intrapleural abdominal organ, so the removal of a portion of the esophagus and the anastomosis between the stomach and the esophagus may be done below the diaphragm.

We have been doing some work on dogs, following the method of transplanting the stomach upward. In this work anesthesia is a very important factor and our chief difficulty in the technic has been in securing a satisfactory anesthetic. In this work care must be taken to close the opening in the diaphragm. One of our dogs died from a strangulated diaphragmatic hernia taking place by the side of the stomach.

In concluding this brief review of the present status of chest surgery, I think we can safely state that this offers a field for careful study. As a result of study during the war, the treatment of empyema is better understood and can be carried out by the general practitioner in the more remote districts as well as in the metropolitan centers. A collapse of the chest wall offers relief to a certain group of tuberculous patients which have not been relieved by pneumothorax. Chest cavities resulting from neglected empyema can now be obliterated without the danger experienced from the former extensive operation. With the development of chest surgery as a specialty, relief is going to be offered to a considerable group of individuals suffering from lesions of the heart, esophagus and lungs. Lung abscesses while always serious will not result in the high mortality that they have in the past. Mediastinal abscesses may be opened and drained, where before it meant almost certain death.