Pneumolysis

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TO the general practitioner as well as to the average medical student of a few years back the subject of thoracic surgery was something only to be dreamed of. They thought of it perhaps as a field that would some day be explored—and into which they themselves might possibly enter, but not one of them had any certain knowledge of what might be accomplished there.

But today in spite of the fact that comparatively few men in the medical world realize it thoracic surgery has emerged from its hiding place in darkness and ignorance and is now a brightly gleaming shrine to which many may come for succour, and indeed it can give not only hope but often definite assurance of cure to a great number of cases needing operative measures, that only a short time ago could not be attempted. Particularly in the fight against pulmonary tuberculosis has thoracic surgery proven itself a formidable warrior. Indeed it has been said and by indisputable authorities too, that surgery of the 20th century can boast of no more important advance than that being made in the operative management of this dreaded disease. These statements are ably backed up by some figures collected and published by John Alexander of Michigan. He made a survey of all cases of pulmonary tuberculosis treated surgically up to 1924 in every country and the results of his survey are represented by these figures. That of all these surgically treated cases 37% were actually cured, 24% were greatly improved, 5% were unimproved or made worse, 1.5% was the actual operative mortality while 12% died within 6 weeks as an indirect result of the operation. The remaining 20.5% included deaths that had no connection with the operation but were clearly due to some other cause for the most part extension of the disease to the other lung.

These figures were compiled as far back as 1924 and with the advance in knowledge and improvement in technique and with the lessons from experience that have been learned since then it is reasonable to assume that if such a set were compiled today the results would be even more impressive.

The importance that surgery demands in the treatment of pulmonary tuberculosis can be partially understood when it is realized that in the year 1926 Alexander estimated that in the United States alone there were 30,000 cases suitable for surgical measures that would certainly die if they were not operated upon.

It should not be thought, however, that surgery is indicated in very many cases of pulmonary tuberculosis. In most cases it is definitely not indicated and the surgery of this disease when undertaken is a branch of surgery requiring expert knowledge, considerable study, and above all things, a sound and conservative judgment.

Most operations used in treating tuberculosis of the lung do not actually attack the diseased organ itself but act by causing relaxation and rest of the lung as a whole by means of pulmonary compression. Now it does seem strange that while the medical profession as a whole is familiar with artificial pneumo-thorax, which might be called the medical branch of pulmonary compression, and while the profession realizes the soundness of collapse therapy, the nature of surgical compression is only partially if at all appreciated.

Most men working on pulmonary tuberculosis will agree that where it is decided to collapse a lung and where it is practicable artificial pneumothorax is the most efficient and satisfactory method of pulmonary collapse. But it will also be granted that there are frequent hindrances to collapse by this method which make adequate compression impossible. One of the commonest and perhaps the most exasperating hindrance is the presence of pleural adhesions, holding the lung out to the chest wall, and preventing proper collapse, perhaps holding open a pulmonic cavity that is the source of a profuse infective expectoration or of a severe haemoptysis,—leaving the patient open to such dangers as extension of the disease to the other lung, tuberculous enteritis, tuberculous laryngitis or to any of the other complications. But perhaps the greatest harm which an adhesion may do by holding open a cavity is to keep the sputum present and positive. The patient is then a true infective agent—wherever he goes, he leaves a trail of contacts and unless he is shut up in a sanatorium or kept under constant supervision he is a public enemy and his fellow citizens run great risks in being associated with him.

Unless those adhesions can be done away with the patient remains stationary, at least as regards cure, and it is more than likely that extension of the disease will take place either by further involvement of the already infected lung or by extension into the good one. There is continually present as well the danger of spontaneous pneumothorax due to one of these adhesions rupturing at the point where it joins the lung. Should communication into an infected area of lung be made in this way this will in all probability be further complicated by a tuberculous empyema of which the prognosis as regards cure is at the best only fair. Many an empyema has resulted in this way during the course of an ordinary pneumothorax and this in itself is an indication for the removal of adhesions if it is at all possible to do so.

The question is this then—how may these adhesions be obliterated so that they are no longer obstacles to treatment? They may be dealt with in several ways, but one thing is certain, that in a vast number of cases they can be done away with surgically and in such cases the prognosis is materially brightened.

Adhesions may be dealt with by putting them on the stretch by using a high intrapleural pressure in artificial pneumothorax. This entails such obvious dangers, however, that it must be done with great caution. The great dangers are mediastinal displacement and spontaneous pneumothorax with all the complications and discomfort of which it is capable.

A more extensive and radical method of doing away with adhesions is by compression of the lung by thoracoplasty, preferably paravertebral thoracoplasty. But this is a serious extensive operation involving shock and all the hazards of a major surgical procedure. And in the end, even though the operation accomplishes its object and affords adequate compression, the patient is left deformed and mis-shapen,—a walking example of the terrible damage that can be attributed to pulmonary tuberculosis.

But, in many cases these adhesions may be dealt with by an operation involving no deformity, little shock, and causing the patient very little more discomfort than any one of the many minor operations carried on in surgery today. This is the operation of pneumolysis, particularly intrapleural pneumolysis. This consists of cutting or cauterising pulmonary adhesions, thus setting the lung free, paving the way for perfect compression by artificial pneumothorax and holding forth to the patient a chance to live a useful life; perhaps sending him back to work again for all intents and purposes a well man.

There are several types of pneumolysis practiced but the one receiving widespread attention today is closed intrapleural pneumolysis. However, brief mention will be made of the less common types before going on to a more detailed discussion of the better known method.

Extrapleural Pneumolysis

This operation consists of the freeing of a part of the lung from the chest wall together with its adherent parietal and visceral pleurae. Such a procedure would be indicated if there were present a thick-walled cavity with the surrounding lung tissue adherent to the chest wall, if for some reason the more radical operation of thoracoplasty could not be performed It has been the custom in cases of this character after the portion of lung has been freed to close the cavity by introducing some kind of filling into the pleural space over the cavitated area. Many materials have served for this purpose—paraffin and iodoform gauze, bone, muscle, and even fat from a lipoma having been used.

There are many dangers which must be avoided if the operation is to be successful. It is not practical to use more than 1,000 c.c of filling. There is a great danger of pleural effusion which may by itself cause elimination of the filling, or the effusion may become infected necessitating removal of all the foreign content of the pleural space. Cases have been reported, too, where pressure necrosis of the lung resulted from too great compression by the filling material.

On the whole the operation is of limited value and sufficiently good results have not been obtained to warrant its use as an independent procedure. It is of use only in compressing a circumscribed area of infected lung, usually when this area is cavitated and is the source of a severe and profuse haemoptysis. But even here it is thought inferior to a complete or even partial thoracoplasty, and its place is generally considered to be in compressing such an area of lung that has not been adequately treated by thoracoplasty.

Lesions requiring this type of operation are usually situated in the apical regions or in the regions of the upper lobes of the lungs. Incisions are therefore made in the axillary or in the paravertebral regions; sections of a rib or two are removed so that the lung may be approached and the adherent part separated.

This rib removal must not be confused with that performed in thoracoplasty, for in the latter the object is compression of the lung by allowing the thoracic wall to fall towards the midline. In the pneumolysis operation, however, the rib sections are removed only with the object of gaining access to the adherent part, and the rigid chest wall is used as a support for the filling that has been put in to maintain collapse of the cavity.

Open Intrapleural Pneumolysis

Only a few words need be said for this method of severing adhesions. It consists in exposure of the adhesions by removal of sections of two or three of the ribs and doing away with them either by breaking them down with the finger or by tying them off in two places and cutting between the ligatures. The perils of the procedure are those of resulting empyema due to opening into an infected area of lung tissue and of tearing away blood vessels, thus causing haemorrhage that could not be easily controlled.

Closed Intrapleural Pneumolysis

This is the method of dealing with adhesions that is most popular and that is most widely practiced today. It was devised by Jacobaeus of Stockholm in 1913. It is aimed at string, band and membrane types of adhesions, rather than at the short thick type or the type found where the lung surface is stuck fast to the inside of the thoracic wall.

The importance of cutting adhesions cannot be stressed too strongly as shown by the following figures. Under pneumothorax treatment approximately 70% of patients with pulmonary tuberculosis can work. With only a few adhesions present, this figure is reduced to 35% whereas with many present, the number is still further reduced to 11%.

The operation itself consists of the introduction of a trochar and cannula into the pneumothorax cavity through an intercostal space. The trochar is removed and a thoracoscope fitted into the cannula. This thoracoscope is nothing more than a modified cystoscope. Any adhesions present are sighted and examined through this instrument and if suitable for cutting are cauterized through by a cautery introduced in a similar way through another cannula in an adjacent part of the chest. The cauterization is under observation throughout the whole procedure by means of the thoracoscope.

All this sounds very simple and easy to do but the operation is really one requiring considerable skill. Even small errors in technique may expose the patient to the danger of grave complications.

Most adhesions, as stated before, are present over the upper part of the lungs usually over cavities or areas most needing compression. These adhesions undergo great modifications under pneumothorax treatment. The weak ones rupture, and the dense ones stretch and become quite tough

often taking the shape of heavy cords, strings, membranes and solid masses.

In the opinion of Jacobaeus, cord-like adhesions up to the thickness of one's thumb are suitable for cauterization, and membrane adhesions particularly call for treatment, for these often divide the pneumothorax up into pockets.

The great problems that must be dealt with in this type of pneumolysis are the extension of a pulmonic cavity or of lung tissue into the adhesion, or the presence in it of large blood vessels.

The special microscopic study of pulmonary adhesions has proven that nearly every one carries with it a certain amount of lung tissue in the region close to the lung itself. This pulmonary tissue rarely extends more than half way along the adhesion, but it is believed that even in bands no thicker than a pencil it is not at all uncommon to find at least some lung tissue being drawn out, this being altered and compressed by the stretching. It is less common to find extension of a cavity than it is to find this altered lung tissue.

As regards blood vessels it is practically impossible to decide whether a vessel is an artery or a vein simply by looking at it through the thoracoscope. The walls of both types of vessels are very thick and the lumina narrow. Whenever haemorrhage occurs when adhesions are cut, it does so from the parietal stump of the severed band. Jacobaeus believes that no severe haemorrhage occurs in this way, and that when much bleeding does take place it is due to injury to the intercostal vessels.

The patient upon whom pneumolysis is contemplated should be most carefully studied beforehand by stereoscopic Xray films and by fluoroscopy. Adhesions present may have their parietal attachments marked on the skin of the chest wall so that they may offer easy approach. But no matter how carefully the chest is inspected and no matter how keen the observation, the greater number of fine adhesions will not be shown up and when the thoracoscope is passed the operation will be found to be more intricate and more difficult than previous examination would indicate.

Actual preparation for the operation should include sedation by morphia or other sedatives. The skin should be prepared over the whole chest wall as for any surgical operation, but if iodine be used it should be removed with alcohol some hours before the operation, and sterile dressings applied, for the surgeon must work with his eye so close to the skin of the chest wall that the iodine may cause irritation resulting in impairment of his vision when accuracy and perfection are most needed. Metaphen is probably more suitable. The skin is anaesthetized with novocain and 10-20 c.c. are used to infiltrate the tissues right down to and including the parietal pleura. General anaesthesia by avertin may be used if the patient is nervous or apprehensive.

Technique

The position of the patient is very important. The object of this posturing is to open up the intercostal spaces widely on the side to be

operated upon, so that there is plenty of room for the insertion of the cannula. This is accomplished by having the patient lie on his good side on a pillow and having him raise the arm on the affected side high above his head.

A small incision is made through the skin over the intercostal space selected and the trochar and cannula pushed through into the pneumothorax cavity. The trochar is then withdrawn and the thoracoscope passed through the cannula. Now comes the time when skill and sound judgment are most needed, for, depending on the appearance of the pleura and of the adhesions, the cauterization of these may or may not be performed.

The presence of very large or pulsating vessels would immediately contraindicate cauterization. Should there be present any large adhesion holding out the lung in the presence of many small ones, it is doubtful if the large one should be cut, for the added strain suddenly placed upon the smaller adhesions might cause rupture with artificial pneumothorax resulting, together with its complications.

Evidence of an active pleuritis or the presence of tubercles on the pleura or adhesions, would constitute objections to cauterization for fear of lighting up an already present infection or starting a tuberculous empyema.

In one case performed during July at the Halifax Tuperculosis Hospital, several large blood vessels running on a thick adhesion constituted sufficient danger of haemorrhage to warrant the adhesions being untouched and the operation was abandoned.

When the thoracic cavity and the adhesions have been carefully surveyed then, and it is decided to cauterize the adhesions, another trochar and cannula are introduced through some convenient nearby space and the cautery placed in the cannula. Sufficient distance must be allowed, however, for manipulation of the cautery within the thoracic cavity; e.g. if the thoracoscope is in the wide intercostal spaces in the anterior axilla, then the cannula carrying the cautery should be in the posterior axilla or thereabouts. With the instruments used today the thoracoscope and the cautery may be interchanged in position for the cannulae are made to fit both. By this means a more extensive survey of the thoracic cavity may be obtained.

The most difficult part of the operation and the part requiring most skill and experience is the manipulation of the cautery so that it is in contact with that part of the adhesion viewed through the thoracoscope. When this is accomplished the current to the cautery is turn on. Red heat is used rather than white, for any blood vessels present are then seared through rather than quickly severed. By this means chances of haemorrhage are greatly reduced.

Pain is frequently felt during the cauterization but this varies with the distance away from the parietal pleura that the cautery is applied. When the adhesion is of sufficient length to do the cauterization 2-3 c.m distant from the parietal pleura, pain is seldom experienced. If the ad-

hesion is short, however, it must be divided close to the thoracic wall to avoid cutting any extension of the lung tissue, and then pain is usually felt.

All adhesions present need not be cauterised to effect satisfactory collapse, for the smaller weaker adhesions will often disappear under pneumothorax if the larger stronger ones have been severed. But no very thick and short adhesion, nor any adhesion out of the range of vision of the thoracoscope should be cut, for then the patient is in danger of an empyema or of haemorrhage.

For severe haemorrhage, Jacobaeus recommends raising the intrapleural pressure by air or saline as high as the patient can endure.

When the operation is completed and the cannulae withdrawn, gauze pads should be tightly strapped over in the incisions to minimize the chances of subcutaneous emphysema. Pneumothorax should be restarted as soon as possible to prevent any re-expansion of the lung.

Complications:

Subcutaneous Emphysema. This is common and is rarely dangerous and only painful when it is extensive enough to involve the neck, when some pain may be felt on swallowing. The great danger in emphysema is that the patient, if he coughs much, may empty his whole pneumothorax into the subcutaneous tissue and thus lose his collapse.

Effusion and Empyema. In about 50% of cases scrous effusion appears in a few weeks from the operation. These are believed to be due to thermal and mechanical irritation of the pleura. Some of these become purulent from infection resulting from the tearing into an infected area and about 5% of cases die from empyema.

Closed intrapleural pneumolysis then, should be performed whenever adhesions are present preventing adequate collapse by pneumothorax providing that these adhesions, when examined by the thoracoscope, present indication for safe cauterization.

Results:

These vary of course, in the hands of different surgeons, but 10 years ago Jacobaeus reported 65% of his cases as being clinically successful. Two workers reporting their results in the American Review of Tuberculosis for February 1936, report 78% of their 96 cases done over a period of 7 years as being successful clinically. The cavities in these cases were closed as a result of artificial pneumothorax made possible by intrapleural pneumolysis.

It appears then that in a vast number of cases of pulmonary tuberculosis where adequate compression is prevented by adhesions intrapleural pneumolysis may permit proper collapse and the cure of the disease. It is important, however, that the operation be done only in skilled hands and only after all contraindications have been ruled out.

Bibliography

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