DIRECT DRAINAGE OF LUNG CAVITIES IN PULMONARY TUBERCULOSIS

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(WITH SPECIAL PLATE)

The direct drainage of lung cavities, introduced by Prof. Monaldi of the Forlanini Institute in Rome, would appear to offer interesting possibilities in the treatment of lung tuberculosis. Despite the constant improvement in the technique of the different methods of collapse therapy there remain many cases to which these methods cannot be applied. The direct drainage of a pulmonary cavity would seem to be a logical proposition, yet at first the idea of the transpulmonary drainage of a tuberculous cavity must cause some hesitation. The method and the theory on which it is based are founded on conclusions drawn from the work of Prof. Morelli on the mechanism of respiration.

Development of a Cavity

Two factors enter into the development of a lung cavity. The initial process is in the fine bronchioles or alveoli. Tubercles form which coalesce into consolidated areas. If the process is not arrested, caseation and softening, with involvement of the interstitial tissue, lead to the formation of a cavity. This is the first or biological factor. If it remains unchecked by the patient's resistance it will continue to predominate, leading to an extensive caseous process. However, in the great majority of cases the biological factor is modified and signs of defence are observed. Here the mechanical factor comes into play. Cavities, the dimensions of which may vary considerably from time to time, will often be observed in patients whose general condition is good and in whom there are but limited signs of activity. In these cases, in which the importance or variation in dimensions of the cavity would appear to be unaccompanied by proportionate signs of activity, the mechanical and not the biological factor seems to predominate. Poix and Vincent (1938) have studied these variations. The distinction is drawn between these cases and those in which the enlargement of the cavity is accompanied by signs of activity such as fever, increased cough, and sputum. The fluctuation due to the mechanical factor will be discovered radiologically and not clinically.

The traumatism to which a lung cavity is subjected during respiration has been studied by many. During the act of respiration the pressure exerted on the pulmonary parenchyma varies with inspiration and expiration. The lung is also in a state of constant distension. If there is a large drainage bronchus allowing free entrance and outlet the air pressure in a cavity will not be appreciably modified. If there is no drainage bronchus, or if the lumen is small or obstructed, the intracavernous pressure will be influenced during respiration. According to Monaldi, quoted by Arnould (1939), the partly obstructed bronchus will be found in the majority of cases. Even in the case of the large bronchus the passage of secretions can bring about intermittent obstruction. During inspiration the endocavernous pressure is diminished, whereas during expiration it is increased. The tissue surrounding the cavity is subjected to the opposing forces exercised by the expiratory process and the increased pressure in the cavity. The result is the development of atelectasis. The cavity is now less well protected from the traumatism caused by the thoracic traction and pressure during inspiration and

expiration than if it were surrounded by healthy air-containing and elastic lung tissue. The increased traumatism leads to increased pressure on the pericavernous tissue, and so the atelectasis becomes still more pronounced. Monaldi has also drawn attention to the diminished circulation in atelectatic tissue. Reduced blood supply to the cavity hinders the patient's resistance and so facilitates the inflammatory factor.

The "fibrous ring" surrounding a cavity in relatively healthy lung tissue, sometimes alluded to in the interpretation of the pulmonary radiograph, would appear to represent atelectatic tissue and not fibrosis. It would seem clear that the permeability of the drainage bronchus plays a very important part. Some writers claim that it is an essential condition to the closing of the cavity. In fact, radiological observation shows that spontaneous closure is often preceded by the formation of an endocavernous fluid level. According to Corryllos, quoted by Arnould, the occlusion of the bronchus is followed by absorption of the air in the cavity, bringing about its diminution and closure. Nevertheless it cannot be readily accepted that the occlusion of the bronchus is essential. X-ray observation in a case of spontaneous healing will generally show that sputum diminishes in proportion to the diminution in the size of a cavity, and does not disappear until the cavity has finally closed.

A cavity must be possessed of a retractile quality if it is to close. The presence of atelectasis in surrounding tissue would appear to answer this need best. Post-mortem examination has proved the presence of pericavernous atelectasis. It may also be recognized in the radiograph. The rapid spontaneous closing of some large cavities would seem to be best explained by re-expansion of atelectatic tissue. The theory according to which the closing of a cavity is brought about by the contraction of fibrotic tissue has not been borne out by post-mortem findings. Rist and Rolland, quoted by Poix and Vincent, have described their post-mortem findings in the case of a large cavity which had completely closed. They found no evidence of fibrosis and no trace of the cavity. Similar observations have been presented by many others. Where fibrosis is observed it is usually star-shaped and does not correspond to the contraction of a fibrotic ring.

The disappearance of a cavity treated by an artificial pneumothorax maintained at negative pressures may be attributed to the re-expansion of collapsed alveoli. Collapse treatment has as one of its principal objects the elimination of respiratory traumatism, which, as has been seen, plays an important part in pericavernous atelectasis.

The cavity in which the mechanical factor has predominated is possessed of a retractile quality represented by atelectatic tissue. The cavity in which the biological element has been preponderant has not this quality. Such is the case in excavations in large caseous processes. The cavity in the advanced fibrotic lung also lacks this retractile quality, although the application of Monaldi's method to such cases will often show that there still remains a surprising possibility of retraction. The direct drainage of a tuberculous pulmonary cavity aims at combating the mechanical factor in the formation and maintenance of a cavity by producing a negative endocavernous pressure, facilitating the re-expansion of the peripheral atelectatic tissue, and so neutralizing respiratory traumatism. It seeks to overcome the biological factor by giving free outlet to inflammatory matter and debris and so deterring the surfaces of the cavity.

Drainage Technique

The instrument used consists of a trocar and cannula. The trocar is so constructed as to allow of the passage of

air between it and the cannula. The cannula has a lateral arm permitting its connexion to the manometer of a pneumothorax apparatus. The point of the trocar is but slightly bevelled.

If the technique of the method would appear simple, a strict attention to detail is essential. In the first place, it is of paramount importance to make sure that the lung is adherent to the parietal pleura in the region of the cavity. Only in the presence of adherent pleura may the method be applied. The extent of the adhesions must be such as to preclude all possibility of communication with an area where the lung is not adherent. Were this precaution not observed a pleuro-pulmonary fistula with all its consequences would be the result. The position of the cavity must be carefully studied by screen examination, as also on the radiograph. Tomographic plates will help towards a very precise location. The patient is placed preferably on an x-ray table permitting radiological control at each stage of the operation. The point of entry chosen will be between the anterior axillary line and the sternum, as this will best facilitate adoption of the recumbent position in the after-treatment. Most often the cavity is situated posteriorly, which is an advantage, as the drain will thus be introduced through healthy and elastic lung tissue. This will help to avoid the possibility of fistula and the escape of air around the drain. With the entry point decided on, the intercostal space is anaesthetized. The depth and position of the cavity are now controlled by the introduction of a long fine needle connected to a syringe. The syringe should be filled with fluid so as to avoid the possibility of introducing air into a blood vessel. As the needle is pushed gradually towards the cavity traction is made on the piston of the syringe. The free entry of blood into the syringe would indicate the presence of an important vessel. In this event the needle must be withdrawn and the entry point changed with a view to finding a less dangerous route. When the cavity is reached air can be drawn freely into the syringe. The direction of the needle is controlled by screen examination. If during the introduction of the needle no important blood vessel has been encountered the cannula may be pushed into the cavity. The direction and degree of penetration of the fine needle should be carefully noted before it is withdrawn. The track of the fine needle must be meticulously followed during the introduction of the cannula. While the cannula is being introduced the manometer is kept under observation. Small movements will be caused by the passage through alveoli. When the cavity is reached well-marked oscillations will be noted on the manometer. The correct penetration of the instrument may be controlled by the fluorescent screen. The trocar is now withdrawn. A suitable Nélaton catheter, No. 12, is introduced and the cannula is withdrawn carefully so as to leave the drain in position. The catheter is fixed to the chest by means of two strands of silk, twisted round each other and between which the drain is passed. The ends of the silk strands are fixed to the skin by adhesive plaster. A dressing is now applied, and the end of the drain is enveloped in the dressing.

The aspiration is not begun until twenty-four hours later. It may be effected by means of a small electric pump or a filter pump. The aspiration obtained by the difference of level between two vessels connected together, one of them filled with water, may be employed. This is an inconvenient method, as constant manipulation is necessary in order to maintain the difference of level. The electric pump is also suitable, but the apparatus tends to heat when used continually. The filter pump is the most convenient method of aspiration. The drain is connected to the aspirating apparatus shown in the diagram. It

consists of a glass cylinder partially filled with water, approximately 75 cm. in length and 3 cm. in diameter. It is closed by a rubber stopper with two perforations, through which two glass tubes are passed. The short tube is connected to the closed aspirating circuit. The upper extremity of the long tube communicates freely with the atmosphere, whilst the lower extremity is plunged in the water of the cylinder. The degree of immersion determines the maximum depression desired. When the aspira-

FIG. A.—Diagram showing method of drainage. A: Glass bottle which receives the matter aspirated from the cavity. B: Manometer graduated in c.cm. of water. C: Pressure controller (Jeanneret and Joyet, 1939).

tion tends to become too strong atmospheric air is sucked through the long tube, thus limiting the negative pressure in the aspirating circuit.

During the first few days after the introduction of the drain a febrile reaction is generally observed. The matter aspirated, as also the sputum, is often blood-stained. It may be added, however, that often no trace of blood is seen.

The dressing must be changed daily, as strict asepsis is indispensable. The aspiration must be conducted very carefully and should be maintained night and day. It is usual to begin with a pressure of approximately -5 . It must not be increased so long as the sputum or aspirated matter is coloured red. Once all signs of haemorrhage have ceased the pressure may be raised so as to reach -15 at the end of ten days. The degree of aspiration must depend on the clinical and radiological findings. If the suction is too intense the lung surrounding the cavity will tend to become opaque. This opacity would appear to be due to alveolar secretion, and diminishes when the aspiration is reduced. Care must be taken to avoid this complication, which could become very serious in cases in which the respiratory surface is already inadequate or in which the treatment is bilateral. The sputum, if it had its sole origin in the cavity treated, usually disappears almost at once. If not, it must be seen whether the drain is placed in its proper position in the cavity.

Frequent radiological examinations are necessary in order to carry out the treatment. At first the aspirated matter will be thick and the drain often become blocked. It may usually be cleared by means of a syringe. After the first few days the secretions become gradually more fluid, and finally all sediment tends to disappear. The suction may be increased gradually. The possibility of reaching a very negative pressure will depend on the permeability of the drainage bronchus. If the drainage bronchus closes a maximal pressure of -50 may be reached. In practice it would seem that the optimum figure is in the region of -20 to -30 .

The decision to remove the drain requires careful consideration. It is not easy to decide whether the cavity has completely disappeared. Examination of the aspirated fluid will help in the decision. It will also be observed

that the drain may even hinder final disappearance of the cavity. When it is decided to withdraw the drain it is best to do so gradually.

Cases in which to apply Drainage

This method of drainage will be best applied to cases in which, as has been previously mentioned, the mechanical factor has predominated and in which there is pericavernous atelectasis. It may be employed to advantage in many cases in which the tissue surrounding the cavity appears to be fibrous. Its application in such cases has shown that there often remains a surprising possibility of retraction. In the case of some giant cavities, in which treatment by aspiration offers but slender hope of a complete result, drainage treatment can improve the patient's general condition and, by reducing the size of the cavity, render surgery more feasible.

In patients subject to frequent haemoptysis or in cases with marked dyspnoea the decision to apply the method must necessarily be a difficult one. A cavity of too small dimensions would make the introduction of the drain impossible. Cavities situated close to the hilus or to the mediastinum should generally be avoided, as their position renders the operation too dangerous. Provided that the details of the technique are carefully observed and that the respiratory balance is not too greatly compromised, the method may be applied to both lungs simultaneously. It may be added that in the case of a cavity with a free drainage bronchus a too rapid aspiration may lead to dyspnoea, sore throat, and dryness of the mouth. The dangers suggested by the puncture of the lung would appear to be attenuated by practice of the method. The risk of embolism is lessened by keeping the exploratory needle and syringe filled with fluid. Exploration by means of this needle will show whether there is an important vessel in the proposed course of the trocar and cannula. Haemorrhage would nevertheless appear to be the principal danger, and its possibility must be constantly borne in mind. The risk of a pleuro-pulmonary fistula is ruled out by making sure that the pleura is adherent. In practice the external fistula causes no trouble if the dressings are carried out often enough. This fistula tends to close round the drain rather than to increase in diameter.

It is as yet impossible to appreciate fully every aspect of Monaldi's method. The question of the complete and durable closure of the cavity can only be answered by fuller observation. That remarkable and rapid improvement may be obtained would appear to be certain. This result can render collapse treatment feasible, and therein would appear to be one of the chief indications for the use of this method.

Case Reports

Case 1.—Large cavity of right apex. Complete rest treatment extending over a period of sixteen months. A.P. impossible. Phrenic evulsion done without result. Surgical treatment impracticable. Fig. 1 on Plate shows size of cavity eight days before operation. Drain introduced July 12, 1939. Febrile reaction reaching 102° F.; temperature normal five days later. Aspirated matter slightly blood-stained during first three days. Immediate cessation of sputum. Fig. 2, taken December 6, 1939, shows that the cavity has almost completely disappeared. General condition now excellent; aspirated matter very fluid, and negative on repeated analysis; wound in good condition.

Case 2.—Giant cavity of upper third of left lung. Smaller cavity in right apex. A.P. impossible. Surgical treatment impracticable. Fig. 3 shows size of cavity seventeen days before operation. Drain introduced August 14, 1939. Slight febrile reaction lasting four days. Fig. 4 taken January 30, 1940; the cavity is still visible, but has greatly diminished in size; wound in good condition.

Case 3.—Giant cavity in upper portion of left lung. A.P. impossible. Surgical treatment impracticable. Drain introduced October 23, 1939. Febrile reaction reaching 103° F., lasting three days. Fig. 5 shows cavity eight days after drainage. There is a small cavity just below, and masked by, the cavity treated. Fig. 6, taken on January 30, 1940, shows that the cavity has almost disappeared; the smaller cavity, no longer masked, is more visible; and the wound is in good condition.

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FEMINISM

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(WITH SPECIAL PLATE)

In contrast to our series of cases of virilism in women which we have published at different times from Charing Cross Hospital we have for several years been observing the rarer and opposite condition of feminism in the male, a case of which is here described.

Case Report

The patient, who first presented himself in 1933, was so distressed about himself in 1939 that he threatened to take his life unless something was done. His plight may best be described in his own words:

"Since the age of 13 I have never developed; my voice has not broken, I am physically still a small boy, and in the present state have not a man's strength and can never hope to get married, although I do get sexual feelings at periods. I cannot associate with men because they think I am a lad and address me as 'Son,' 'Lad,' or 'Boy'; neither can I associate with youths, as I have got past their stage of life mentally and they are in fact too full of life for me. I have tried many treatments, but to no avail, and I think I have to go through life as another Peter Pan, the boy who never grew up. I have never shaved yet, and am practically hair-free on the body. I am beginning to dread the thought of going through life as a bachelor. I have seen other boys grow up, get married, and have children, and I would like to be the same as they."

When seen in 1933 he was 32 years old. His family history was normal, and his brother was the champion boxer of the Southern Command. At the age of 12 he had had diphtheria, and says that he had also had what was called mumps when 12, and again at 13 and 14, but it did not involve the testes. He never developed normally at puberty, and at the age of 22 began to grow a few hairs; he has never shaved, his voice has not dropped, and when 23 he grew five inches in height.

Physically his bodily contour was then distinctly feminine; he was 5 ft. 5 in. in height, his weight 8 st. 5 lb., and his pelvic girdle (31 in.) wider than the pectoral (30 in.). His external genitalia were small—the penis was about 2 in. long, his testes were descended and about the size of hazel-nuts—and he had a few sparse pubic hairs. In his manner this young man gave the impression that he was still psychologically at the age just previous to puberty. His sexuality was more or less neuter; he had an occasional erection but never any emissions. His mentality was good, but his temperament somewhat unstable; he was self-conscious, timid, and nervous in the dark. He was a house-painter and decorator by trade, and was keen on swimming. Although his skin was smooth there was no breast enlargement or that sleek adiposity of the eunuchoid type which we have observed in cases of bilateral torsion of the testes at an early age, so that it appeared improbable that he had suffered from orchitis as a result of mumps.

In 1933 he was admitted to hospital, and investigations gave the following results:

MICHAEL J. SMYTH: EXPLORATION OF THE COMMON BILE DUCT FOR STONE

FIG. 1.—Filling defect A-B, lower end of common bile duct. Obstruction incomplete, as opaque medium (per-abrodil) is in duodenum.

FIG. 2.—Per-abrodil in duodenum and common bile duct after removal of five stones and dilatation of sphincter of Oddi. T-tube in common bile duct also shown.

FIG. 3.—Ducts filled with uroselectan after removal of stones from common bile duct.

L. R. BROSTER: FEMINISM

FIG. 1.—Before operation.

FIG. 2.—Eight months after operation.