PNEUMOPYOPERICARDIUM: THE RADIOLOGICAL DIAGNOSIS.

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(With Special Plate.)

THE conditions of pneumohydropericardium and pneumopyopericardium are rarely diagnosed. They may exist, yet their presence may be unsuspected owing to their insidious development during the progress of a grave lesion, or to the physical signs and symptoms of the primary lesion masking those of these conditions.

Pneumopyopericardium may arise from any lesion which leads to perforation of the pericardium from within or without; thus it may be associated with:

1. Rupture of the pericardium by a foreign body in the oesophagus or stomach or by a puncture wound.
2. Paracentesis.
3. Direct violence—with or without a definite fracture of a rib or the sternum.
4. Artificial pneumothorax.
5. The breaking down of a tuberculous lesion which is in close proximity to the pericardium.
6. The rupture of inflammatory lesions near the pericardium—abscess (lung, liver, subdiaphragmatic), empyema, etc.
7. Carcinomatous ulceration of oesophagus, bronchi, or stomach.

The perforation of the pericardium by foreign bodies is rare in man, but in cattle it is fairly common. One has seen a number of cases at the public abattoir due to the swallowing of long strips of sharp metal or wire, which have torn through the viscera into the pericardium and infected it with organisms from the alimentary canal. The animals have become obviously so seriously ill that they have been sent to the abattoir for the purpose of "saving their lives"—or, in other words, to get early slaughter with the idea of being able to sell the meat. Infection of the pericardium by organisms of the *B. welchii* group readily leads to the development of pneumopyopericardium. Imperatori¹ records a case of pericardial oesophageal fistula following impaction of a foreign body in the oesophagus.

During the needling of the thoracic cavity the pericardium may be ruptured and infected, and the condition so produced. Rigler² records such a case. Ljungdahl³ has described a case of pneumopericardium occurring in a lad, eighteen years of age, who, whilst running, suddenly experienced a severe pain in the chest, with breathlessness and a feeling of obstruction in the bronchi, followed by a loss of strength. Peterson described a case in which he said that the alveoli were ruptured and air collected between the pericardial pleura and the pericardium. Saupe⁴ has emphasized the possibility of confusing this with pneumopericardium. That pneumopericardium can arise as the result of an artificial pneumothorax is shown by the history of the case recorded by Saupe.

Wenckebach¹² has described a case of pericarditis with effusion associated with phthisis treated by repeated withdrawal of the effusion and replacement by air. On one occasion as much as 1,400 c.cm. of fluid was withdrawn and 600 c.cm. of air introduced. It was found that the introduction of air considerably reduced the rate of exudate production, and altered its character from haemorrhagic to clear serous fluid, and consequently greatly improved the condition of the patient. His radiograph of the artificial pneumopericardium shows that the pericardium is very considerably dilated to the left, and to a much less extent on the right. On the left it reached to the level of the fourth space posteriorly and to the first costochondral junction anteriorly, and on the right from the diaphragm to the sixth rib posteriorly and the second space anteriorly. It has been shown at post-mortem examination that pneumopyopericardium has arisen as a result of rupture of the pericardium secondary to tuberculous cavitation, empyema, abscess or gangrene of the lung, or carcinomatous ulceration of the oesophagus, bronchi, or stomach.

DIAGNOSIS.

The diagnosis of pneumopericardium can only be definitely established by an *x*-ray examination. In the case to be described, the reason for the *x*-ray examination was the gravity of the dyspnoea, which appeared to have developed rapidly. The physical signs for several years suggested the diagnosis of phthisis. No additional physical signs were detected to account for this marked dyspnoea, and its onset had been insidious. The suspicion of pericarditis had not been aroused by any of the physical signs. Normally the pericardium invests the heart so closely that it cannot be seen on the radiograph (except perhaps at the left cardiophrenic angle), even if pericarditis exists, unless this has been present over a long period and calcification of the pericardium has occurred. Even when a pericardial effusion is present the radiograph may not determine its presence, though Schultze,⁹ Schwaer,¹⁰ Amelung,¹ and others have demonstrated radiographs which show a double contour to the heart shadow—the inner shadow being interpreted as the heart shadow and the outer shadow that of the fluid in the pericardium. It may be possible to demonstrate this in a few selected cases where the respective densities of the heart and fluid permit, but it is by no means a common finding. Definite cases of pericarditis with effusion occur in which no such radiographic shadows can be obtained. Moreover, such appearances may be shown on antero-posterior radiographs where no pericarditis is present; such lesions as a pleuritis mediastinalis or dilated oesophagus or paravertebral abscess or aneurysm of the abdominal aorta³ may give such a picture.

It is essential in the radiography of the heart that the best technique be adopted, and the chief factor is undoubtedly shortness of exposure. As in gall-bladder radiography, important features may be entirely missed if the duration of the exposure is not sufficiently short to give a sharp outline. I have drawn a resemblance between such radiography and photography of crowded thoroughfares.³ If the exposure of the latter is long enough only a clear photograph of the buildings and fixed objects will be obtained, whereas with a reduction in the time of the exposure the moving objects begin to be portrayed until with very short exposures even the detail of the fast moving cars will be shown.

Similarly with radiography of the thorax. If the exposure is so long that movement of the heart can occur—not only on account of pulsation but also of breathing—it is possible to produce a radiograph which shows the detail of the spine but little or no heart shadow. As this radiograph appears to have been "accurately" exposed it may be regarded as satisfactory. Indeed, I have seen such a radiograph exhibited and the suggestion seriously put forward that the absence of the heart shadow might be due to diminished density of the heart in phthisis.

With the very short exposures from a distance which are possible when using the big modern transformer sets and time switches, it is possible to obtain radiographs on which the outline of the heart is as sharp as if it had been drawn. With such exposures it only needs slight difference in the density of different structures to get an outline of their form, and it is with such radiographs that the greatest help in diagnosis can be obtained.

Description of Case.

A man, aged 40, had complained of a cough for some years. His sputum had been examined on several occasions for the tubercle bacillus with negative results. After an operation for appendicitis a fistula had developed in the right iliac fossa and persisted for nearly two years. This healed, but broke down again after four years, and during the past two years has widened considerably, and is now most offensive. Five months ago he developed dyspnoea. Dr. Benjamin Dale of Birmingham—to whom I am indebted for the history, clinical details, and permission to record the case—had attended him for several years. He re-examined the thorax with the development of the dyspnoea, but could find no new physical signs, and on this account requested an *x*-ray examination. On screening the chest, the lung fields, particularly in the upper half, showed much of the mottling which suggests chronic fibrotic changes. It had the appearance seen in cases of chronic phthisis, though no definite cavity formation could be detected. Marked emphysema of the lower lobes was suggested by the lighting up of these areas and the depression of the diaphragm and its small excursion.

A large localized collection of fluid with gas above was seen in the middle of the thorax, and when the patient was rotated it became obvious that the fluid and gas were contained in the

pericardial sac. The surface of the fluid could be seen to move with each pulsation, and when the patient was rotated lying down the gas bubble could always be seen lying above the fluid which flowed into the dependent parts. A further x-ray examination of the patient after he had been resting for one month showed no change in the appearance of the pericardium. About the same quantity of fluid and gas appeared to be present. His dyspnoea was perhaps a little less marked, and he was able to walk about without much distress.

After a further two months' rest another x-ray examination was made, and to our astonishment the whole appearance had changed. There is now no evidence of gas or fluid in the pericardium, and the heart shadow appears to be of normal shape and dimensions. His dyspnoea has practically disappeared and, excepting for his fistula, he feels much better. He stated that he had "vomited" a large quantity of foul-smelling matter since the previous examination, but it is impossible to say if this had any relation to the disappearance of the fluid from the pericardium. It would be remarkable to get such a complete evacuation and apparent healing and improvement in the patient's general condition if the fluid in the pericardium had been fetid pus containing gas-producing organisms, and I am inclined to the opinion that it was rather of the nature of a pericardial effusion following rupture of the pericardium and pleura, with entrance of air which was later absorbed. The appearance of the lung fields suggests that the underlying cause is tubercle, but no tubercle bacilli have been found in the sputum on any occasion.

Description of Radiographs.

The radiographs are instructive in showing the form which the pericardium may assume when dilated by a large collection of gas and fluid. It is generally taught that in pericarditis with effusion the area of precordial dullness becomes pear-shaped—the stalk of the pear reaching up to the level of the left sterno-clavicular articulation. It will be seen from the postero-anterior radiograph, Fig. 1 (and Fig. 1A, which is a tracing of Fig. 1), that the widest part of the pericardial sac in this case is at the level of the fluid surface,

FIG. 1A.—Tracing of outline of pericardium and fluid level from antero-posterior radiograph (Fig. 1).

which is three interspaces above the level of the diaphragm, the base of the pericardium being narrower. The general shape of the pericardial sac is ovoid, excepting for the notch due to its attachment to the aorta and pulmonary artery.

Another noticeable feature is that the pericardium is more dilated to the left than to the right. This feature I also observed in the radiograph illustrating the case of artificial pneumopericardium by Wenckebach. The dilatation in my case is also seen to be more above than below. Curschmann recommends paracentesis in or lateral to the left mammary line in the fifth or sixth left interspace, in view of the fact that the fluid tends to collect on either side or below the heart rather than in front of it. These radiographs show that the features described are not necessarily present, and little success would have attended efforts to drain the pericardium if these recommendations had been adopted.

No dullness to the right of the sternum was detected, and this is to be explained by the shape of the pericardium and the emphysema of the base of the right lung. The lateral radiograph (Fig. 2) and the tracing from it (Fig. 2A) show the outline of the pericardium. This I thought was due to some thickening and calcification of the pericardium, and it suggested that the lesion had been present for a considerable time, but from the last examination I believe it to be due solely to it being the limiting membrane of the large gas-containing cavity. Its outline resembles that shown in the drawing of the posterior wall of the pericardial sac (Fig. 616 in Gray's Anatomy).

FIG. 2A.—Tracing of outline of pericardium and fluid level from lateral radiograph.

The radiographs also illustrate the importance of taking radiographs in several planes and rotating the patient during screening. It would be impossible from the antero-posterior radiograph to state definitely that the fluid and gas were in the pericardium.

Differential Diagnosis.

Similar appearances shown on the postero-anterior radiograph I have seen in a case of empyema localized in the mediastinal area which had been partly drained by needling; an echinococcal cyst which had ruptured and partly drained; a mediastinal tumour the middle of which had disintegrated, liquefied, and partly drained; and a large oesophagus with cardiospasm.

Other conditions, such as paravertebral abscess, aneurysm of the heart and descending aorta, and mediastinal tumour, would have to be considered if no gas collection was present. By rotating the patient during screening or by taking radiographs in several planes these conditions could be excluded.

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A CASE OF PANCREATIC CALCULI.

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It is extremely rare for pancreatic calculi to be diagnosed during life, so that it is always of interest when such a diagnosis can be made with reasonable certainty.

The patient, an Indian, aged 37, was sent to me by Dr. G. Narunsky of Claremont, Cape, on February 19th, 1929. For the previous four to five months he had complained of pain in the epigastrium, which radiated to both sides of the abdomen. The pain seemed to come on five to ten minutes after food. For the past six weeks the pain was more severe, practically continuous, and was getting worse, so that for the last two weeks he had eaten very little. He had no attacks of colic, but only the dull continuous pain.

He had no appetite, no desire for food, had not vomited, and was not jaundiced. His tongue was furred and his breath very foul. The teeth were bad. His bowels were constipated, but latterly he had had a few loose, very small motions.

He had marked tenderness just above the umbilicus. The liver and spleen were not palpable. There was no glycosuria.

One of the stools was examined. It was very small in amount, contained little faeces, much mucus, and certainly was not a pancreatic "fat stool."

An Ewald-Boas test meal showed 50 per cent. free HCl and 66 per cent. total acidity. A barium meal x-ray examination was then made, and the four photographs reproduced in the special plate were among those taken (see Films A-D).

Film A (taken in the prone position) shows shadows in the loop of the duodenum and to the left of the first lumbar vertebra.

Film B (taken six and a half hours after the ingestion of the barium meal) shows the bulk of the meal in the ileum. A wire was placed on the abdomen to indicate the position of the abdominal tenderness. The shadows show quite plainly on the right of the body of the second lumbar vertebra, and across the body and to the left of the first lumbar vertebra.

Film C (taken twenty-six hours after barium meal) shows the ascending and transverse colon well filled and the shadows above the colon.

Film D was taken four days later, after the patient had had an enema and an aperient to clear the alimentary canal. The shadows show very clearly.

FIG. 1.—Postero-anterior radiograph of pneumopypericardium. Note that the dilatation is mostly to the left side and more dilated above than below. Marked mottling of the lung fields, particularly the upper halves; the bases show emphysema.

FIG. 2.—Lateral radiograph of the thorax, showing pneumopypericardium. The outline of the pericardium and its attachments to the diaphragm are clearly shown, also emphysema of the bases of the lungs and arthritic changes in the dorsal spine.

STANLEY N. SENNETT: PANCREATIC CALCULI.

FILM A.

FILM B.

FILM C.

FILM D.