A CASE OF PURULENT PERICARDITIS FOLLOWING ACUTE OSTEOMYELITIS.

BY

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The condition of purulent pericarditis is one of considerable interest to the clinician owing to its high mortality, to the difficulty in diagnosis which often attends it, and to the question of treatment, particularly the route of surgical approach.

Frequency. Though not frequently met with clinically, the condition is not a rare one if the comparatively large group of cases which are demonstrated only in the post-mortem room is included. Thus Alexander² found only three cases of suppurative pericarditis in 31,016 hospital cases, though Stone⁴ noted 15-5 per cent. in 300 patients dead of pneumonia. Allbutt and Rolleston⁶ also stressed the frequency with which purulent pericarditis is overlooked in childhood until the post-mortem examination. Poynton⁴ investigating 100 autopsies on cases of purulent pericarditis found that only six of these had been diagnosed during life, and considered few conditions more difficult to detect. It is probable, however, that Osler⁵, in referring to it as the most commonly overlooked serious disease, had in mind the terminal pericarditis of chronic diseases such as cirrhosis of the liver, diabetes, chronic nephritis, etc.

ETIOLOGY. Purulent pericarditis is, with the single exception of direct trauma (penetrating wounds) with infection, always secondary to some other infective condition. The most frequent causes are pneumonia, empyema, acute specific fevers (measles, scarlet fever, typhoid fever) osteomyelitis, tuberculosis, rheumatism (very rarely, if ever, suppurative).

Coutts⁶ distinguishes the commonest types by his statement that a limited number of cases occur in osteomyelitis, whilst practically all the rest have a causal origin in the presence of the pneumococcus.

DIAGNOSIS. Owing to the frequently insidious onset, the diagnosis is often difficult even to one on the look out for the condition, though it is overlooked on occasions owing to the severity of the associated disease. In the majority of cases, however, most, if not all, of the following symptoms and signs will be found to be present.

(1) Pericardial friction rub, it must be admitted, is not an uniformly reliable sign in the suppurative cases. It is frequently absent (Coutts⁶, Poynton⁴) or it may be very transitory. In one of the cases reported by Brooke⁷ the friction had disappeared within six hours of its appearance.
(2) Increased pericardial dullness, this area being pear-shaped and the increase showing itself chiefly in an upward direction so as to occupy the second left intercostal space (as exemplified by the present case), also extending to the
right beyond the right border of the sternum especially in the fifth space (Bottoh's sign) and to the left beyond the apex beat. An area of dullness and bronchial breathing at the angle of the left scapula, which is often found in young patients, is due to compression of the lung (Bamberger's sign). (3) Feeble or absent apex beat. (4) Muffled or absent heart sounds. (5) Precordial bulging in children. (6) Precordial or epigastric pain. (7) Attacks of dyspnea. (8) Cyanosis, but also frequently marked pallor. (9) Enlarged heart shadow on X-ray examination. (10) Fluctuating temperature. (11) Leucocytosis. (12) Signs of heart failure (edema of legs, etc.).

Of these signs the most reliable are (a) increased pericardial dullness (b) feeble or absent apex beat and heart sounds, and (c) enlarged globular heart shadow on X-ray examination.

Considerable difficulty may be met with in differentiating pericardial effusion from cardiac dilatation, though this difficulty will arise less often when the effusion is purulent, as the fluctuating temperature and leucocytosis may be significant.

The points to be kept in mind are the sharp and clear heat sounds in dilatation contrasted with their muffled character in pericarditis, and the fact that compression of the lung is rare in dilatation. The convex right border of the dull area of effusion, as distinct from the straight border in dilatation, which is often described, is of doubtful value.

The question of paracentesis of the pericardium as a diagnostic measure is discussed below.

Prognosis. Purulent pericarditis is a very serious condition, the mortality rate of all types of cases being about 60 per cent. (Appel states gives a death-rate of 65 per cent., and Alexander 56 per cent.). The published figures, however, include all cases of purulent effusion and make no distinction between their various causes. There is no doubt that the mortality rate of the cases secondary to acute osteomyelitis is very much higher than that of pneumococcal cases, which, a search of the literature shows, formed a large proportion of the cases which recovered. This group (osteomyelitis) is variously described as being 'desperately dangerous,' 'invariably fatal,' 'usually fatal' (Osler and McCrae), etc.

Shipley and Winslow state that the cases following osteomyelitis are associated with a very bad prognosis, considerably worse than those due to pneumonia, empyema, and penetrating wounds. Brooke collected 36 cases of purulent pericarditis secondary to osteomyelitis in which drainage of the pericardium was performed, including three cases he himself records, with only two recoveries: a mortality of 94 per cent. The reason for this high death rate in the osteomyelitis cases probably depends upon the fact that the pyopericardium results from the rupture into the pericardial cavity of a small metastatic abscess in the heart muscle (i.e., the condition is a pyämic manifestation), whereas in pneumonia and empyema the infection of the pericardium is due to direct extension to the adjacent serous cavity.
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Paracentesis pericardi. The question of the advisability of aspiration of the pericardium as a diagnostic measure is an interesting one and has occasioned considerable discussion.

It must be admitted that as the diagnosis of pericardial effusion is often difficult, any accessory means of verification, both of the effusion and its nature, whether serous or purulent, would be justifiable provided it is free from danger. There is no doubt that tapping the pericardium carries with it a definite risk of puncture of the heart and of the pleura or lung (and thus carrying the infection to the latter structures).

Rowlands* confirmed the findings of Sick that the margin of the left pleura nearly always lies under cover of the left border of the sternum at the level of the 5th costal cartilage, and often also at the level of the 6th cartilage, so that in puncturing through the 5th or 6th left spaces, even close to the sternal margin, the pleura must in the majority of cases be traversed. Puncture through the 6th space has the additional disadvantage that the 6th and 7th costal cartilages are often so close together than the space is practically non-existent.

The danger of puncturing the pleura can be avoided by tapping through the left costo-xiphoid angle, the needle being directed inwards and slightly upwards.

Le Conte¹⁰ is of opinion that exploratory puncture is essential in making a diagnosis, whereas Rhodes¹¹ considers the procedure should be condemned. Coutts* was very much averse to paracentesis as he had known a left sided pleurisy result and also seven cases of puncture of the heart, though he admitted with no ill effects. Roberts¹² in 1897 preferred incision and exploration rather than aspiration, but in 1923 considered that the danger of injury to the heart was over-rated and disagreed with Ballance¹³ that 'aspiration of the pericardium should be banished as a surgical procedure.'

It would appear to be reasonable to sum up the question as follows:— At the present day, with the aid of good radiograms, the diagnosis of pericardial effusion should be possible with fair certainty; in the cases where the effusion is secondary to some pyogenic infection it is certain that the fluid will eventually become purulent, so that paracentesis is superfluous and should be replaced by immediate exploration of the pericardium and drainage.

Treatment. Whatever opinions are held about the question of paracentesis as a diagnostic measure, it must be admitted that aspiration has little place in the treatment of a purulent effusion. Free drainage is essential.

There are three main methods of surgical approach to the pericardium: (1) simple incision: (2) excision of costal cartilage; (3) the epigastric route.

(1) Simple incision through the 5th left intercostal space. The drainage is imperfect, and the pleura and internal mammary vessels difficult to define and avoid through the narrow space.

(2) Excision of two inches of the 5th left costal cartilage. The pleura and internal mammary vessels can be seen and displaced, but the drainage is anteriorly and not at the most dependent part of the pericardial sac. If
necessary, part of the 6th costal cartilage can be excised in addition, and even part of the sternum nibbled away (especially in children in whom it may still be cartilaginous) in order to gain better access.

The various flap operations, which consist of turning over like a trap-door flaps made up of the whole thickness of the chest wall including one or more costal cartilages, are more applicable to operations on the heart itself (e.g., suture of wounds or removal of foreign bodies) than to drainage of the pericardium.

(3) The epigastric route. This method was first devised by Allingham who, in a paper describing a case he had operated on by excising part of the 5th left costal cartilage, suggested a better method of approach through the diaphragm, an incision being made below the left costal margin and the interval between the costal and sternal fibres of the diaphragm defined and incised, and the pericardium then exposed and opened.

He considered that the advantages of this route would be, first, a sure way of entering the pericardium without injuring the pleura; and, secondly, drainage would be from the most dependent part of the sac if the patient were half propped up and would be through a large opening not bounded by cartilages or sternum. He considered that this method would be particularly applicable to children with flexible cartilages (so enabling the left costal margin to be retracted if necessary in order to improve the exposure). In adults with rigid cartilages it would be better to excise two inches of the 7th costal cartilage in addition.

Rowlands brought forward the following criticisms:—(1) The little room available in adults with rigid or ossified cartilages. This objection is met by Allingham's suggestion of excising part of the 7th costal cartilage (and even of the 6th) when necessary. (2) The operation is necessarily performed somewhat in the dark and under cover of the sternum and 7th costal cartilage, and the operator may not be certain whether the exploring finger is above or below the diaphragm so that the peritoneum may be opened. (3) The pericardium may be separated by the finger from the parietes, and pus may leak into the loose connective tissue and set up a fatal mediastinitis. He admits that the operation would be easier in children, owing to the elasticity of the boundaries of the costo-xiphoïd angle.

In the case described below this method of exposure was used and the writer found no difficulty in defining and displacing the peritoneum downwards, and there appeared surprisingly little danger of opening it: moreover, the bulging pericardial wall could be easily felt after the costo-xiphoïd space had been opened, so that there was little likelihood of separating it from the parietes and so opening up the mediastinal space. It would, therefore, appear that the above criticisms are not entirely justified.

The drainage obtained in this patient, when she was propped up in a half-sitting position, was entirely satisfactory.
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To summarize, simple incision allows such imperfect drainage that it should be confined to desperate cases where very limited surgery only is justifiable. Excision of parts of the 5th and, if necessary, 6th costal cartilages gives good exposure, but the drainage is not entirely satisfactory. The epi-gastric route is the method of choice in children, but may be difficult and the exposure restricted, in adult patients.

It should be noted that local anaesthesia would allow of the performance of either of the two last operations, even in very ill patients, with comparatively little disturbance.

Case Report.

A female child, aged 4 years and 10 months, was admitted to St. Bartholomew's Hospital on October 7th, 1928, with the history that at 3 o'clock that morning she woke up with sudden agonizing pain in the left thigh, together with signs of septic intoxication—hctic flush, sweating and continuing delirium.

On admission, 3 p.m., October 7th (i.e., 12 hours after the onset of symptoms), her condition was as follows:


The left knee was held flexed and the child jumped in agony if the left thigh—especially the lower part—was touched. The general outline of the thigh was swollen and the skin a little reddened just above the internal condyle. No definite lump was palpable. There was no effusion in the knee joint.

Heart and lungs showed no abnormality. Urine, specimen not obtained (patient incontinent).

The diagnosis of acute osteomyelitis of the femur was made, and immediate operation carried out.

Operation (October 7th).—Under gas, oxygen, and ether an incision was made over the internal aspect of the lower end of the femur for 3 in. upwards from the adductor tubercle and deepened down to the periosteum which was found to be raised from the bone by a subperiosteal collection of thin, blood-stained pus, which was evacuated. No opening into the medulla was found. A gutter was made into the bone at the level of the epiphyseal line and drainage tubes inserted. Unfortunately the pus was not examined bacteriologically, but there can be little doubt that it was staphylococcal in origin.

Her condition remained about the same until the 4th day (October 12th) when the respiration rate shot up to 80, she became cyanosed, and signs of broncho-pneumonia, involving both lungs, became manifest. By the 18th October (12th day of illness) the temperature had fallen by lysis to normal but the pulse rate, which since admission had remained about 150 to 160, showed no diminution in rate, while the respiration rate had dropped to about 45. Her general condition had improved, she was quite rational and more amenable to treatment. During this time the wound had been discharging satisfactorily and the swelling of the thigh had subsided.

For the next nine days (October 18th—26th) the improvement in her condition was maintained, the temperature being about normal (with a rise to 100° on four occasions), the lung signs clearing up except for some scattered râles, and the patient less fretful and taking nourishment well, but the slight cyanosis persisted and the pulse and respiration rates still remained high (about 150 and 45 respectively) though the pulse was of good volume.

On October 26th (20th day of the illness) her temperature was 100°, pulse 150, and respirations 50. During the course of routine examination an area of impaired respiratory movement and of dullness appeared in the upper part of the front of the chest on the left side in the second intercostal space, but at this time this area of dullness was not demonstrated to be continuous with the cardiac dullness which was not increased to the right or to the left; there was no precordial bulge.
From this date the temperature became intermittent in character, varying between 97-4° and 102°, the pulse rate showing similar variations. This suggested the presence of suppuration, which was confirmed by a leucocyte count of 23,800 on November 1st. The local condition was quite satisfactory and did not appear to account for this temperature and leucocytosis.

November 1st.—Temp. 102°. Pulse 156. Resp. 60. Definite, impaired movement and dullness of the left chest anteriorly up to the level of the second rib.

Apex beat not palpable. No precordial bulge. Area of cardiac dullness: above, 2nd rib; to right, 3-in. to R. of sternum; to left, 1 in. outside mid-clavicular line. On auscultation: no heart sounds audible. No pericardial friction heard.

Dr. Graham saw the patient and diagnosed pericardial effusion, probably purulent. The presence of this effusion was confirmed by X-ray examination (see Fig. 1) X-ray report:

The heart shadow is enormously enlarged in all directions, especially upwards, and has assumed the typical rounded appearance associated with pericardial effusion. There is also some thickening of the pleura at the base of the left lung.

Operation (November 2nd).—Exploration of pericardium. Under gas and oxygen anaesthesia, and without previous aspiration, a vertical incision was made below the costal margin 3 in. to the left of the mid-line, separating the fibres of the left rectus muscle. The peritoneum was exposed and pushed downwards, the tissue between the sternal and costal fibres of the diaphragm separated and the pericardium incised. Immediately between 12 and 14 ounces of slightly turbid fluid gushed out under considerable tension. A specimen was taken for bacteriological investigation. The forefinger was inserted into the cavity and the heart felt beating strongly; no adhesions could be felt.

As the fluid was only slightly turbid it was not thought justifiable, owing to the risk of secondary infection, to insert a drainage tube into the pericardial cavity until the bacteriology of the fluid was known; the wound was accordingly closed without drainage.

Bacteriological report of pericardial fluid: A slightly turbid fluid,Gram-stained films of which showed large numbers of polymorph leucocytes but no organisms. Cultures on blood-agar-agar showed a fair growth of staphylococcus aureus.

Second Operation (November 3rd).—In view of the culture report (showing organisms to be present in the pericardial fluid) under ethyl chloride anaesthesia the wound was rapidly re-opened, an ounce of two of fluid, more turbid than on the previous day, was evacuated and a drainage tube inserted just into the pericardium through the opening previously made in it.

After the operation the wound drained freely, the discharge by the following day consisting of frank pus, while the patient's general condition improved slightly and the temperature fell gradually to normal by the fourth day.

The area of pericardial dullness diminished at once so as to reach upwards only as far as the third rib.

The pericardium was irrigated on the 2nd, 3rd, and 4th days, but as only a few flakes of fibrin came away this procedure was not repeated. The drainage tube was removed on the 10th day and the wound had almost healed up 6 days later.


About this time, however (November 7th) the region of the left axilla showed, on daily examination, an increasing impairment of movement and percussion note, with the appearance of pleural rub; and on aspiration in the 8th space in the posterior axillary line 3 to 4 c.c.m. of pus was withdrawn. Cultures of the pus showed a pure growth of staphylococcus aureus.

Operation (November 9th).—In view of this 13 in. of the 8th rib in the posterior axillary line was resected under local anaesthesia but no pus was found on opening the pleural cavity; the visceral layer was, however, thickened and adherent to the parietal layer. These recent adhesions were gently separated in an upward direction but no purulent collection was discovered. A needle was introduced into the lung substance for 14 in., but no pus was withdrawn. A drainage tube was inserted and the wound partially closed. The pleural thickening which was found at this operation had been noted in the X-ray report of November 2nd.

After this operation the temperature continued irregular for four days, but from then onwards remained about normal with occasional rises to 100°. The patient's general condition improved steadily for a time, but on November 20th signs of heart failure, oedema of legs, back
Fig. 1. Skiagram of chest before operation.

Fig. 2. Skiagram of chest after operation.
and abdominal wall with signs of ascites, appeared, the swelling of the abdomen being especially marked in the right flank where a definite tumour was felt.

On November 28th, the general condition of the patient not being satisfactory and the question of re-accumulation of pus in the pericardium being considered, exploration of the pericardium through the original wound was carried out but no purulent collection was found. At the same time the swelling in the right loin was investigated by aspiration, straw coloured ascitic fluid being withdrawn; and the second left intercostal space aspirated (there being in view of persistent dullness in this region the possibility of empyema) but no pus was found.

On November 30th paracentesis abdominis was performed and 36 oz. of ascitic fluid removed.

Following the paracentesis the oedema very rapidly disappeared and the patient's general condition improved steadily, the temperature during this time remaining about normal, the pulse rate gradually diminishing to 120 and the respiration rate to 30.

The patient was up for the first time on January 1st, 1929, and was discharged to a Convalescent home on January 15th.

Clinical examination just before discharge showed the apex beat to be in the 5th space in the nipple line. The area of cardiac dullness was above, 3rd rib: to right, at the right border of sternum, and to left at the apex beat. Heart sounds natural. Apex beat does not move on turning the patient. The pleural, pericardial, and thigh wounds had healed and there was no ascites or enlargement of the liver.

An X-ray examination of the chest (see Fig. 2) was reported on as follows:—A portion of the 8th left rib has been removed and has reformed. The heart shadow is still enlarged. This enlargement extends right up to the aorta. It has not, however, the typical globular appearance of pericardial effusion, which was previously seen, but is now pear-shaped. The width of the aorta suggests pericardial thickening or a little effusion.

**DISCUSSION.**

This case presented several interesting features. The onset of the purulent pericarditis was insidious, as is usual in these cases, and it is probable that the effusion had been present for some days before it was diagnosed. The area of dullness in the 2nd left intercostal space was noted six days before, but its significance was not at that time appreciated, the previous bronchopneumonia, which had not completely subsided, rather confusing the issue. No pericardial friction was heard but this sign, which is inconstant and often transitory, may easily have been overlooked.

With regard to the symptoms, these were certainly not classical.

The child did not look gravely ill; indeed, her condition was very different from that during the first week. She was only slightly cyanosed, and the pallor, anxious expression and precordial pain, which are often described as prominent features, were absent. She had for some days a short irritating cough which was considered to be due to the lung condition, whereas it was probably reflex.

The diagnosis was made on the following physical signs—increased pericardial dullness (confirmed by the radiogram); absent apex beat and heart sounds with a persistent rapid pulse, together with signs of suppuration, i.e., fluctuating temperature and leucocytosis.

In reference to the operation of pericardial exploration in this case there is no doubt that a drainage tube should have been inserted at once, and not delayed for 24 hours to await the result of bacteriological examination, as a pericardial effusion in cases of osteomyelitis always becomes purulent. For the same reason aspiration of an effusion in such a case while still serous or seropurulent should not be performed, but immediate and free drainage carried out.
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One point in the after treatment demands mention, namely, the question of irrigation of the pericardial cavity. In this case gentle lavage with saline solution was carried out on the second, third, and fourth days without any untoward result, but as little more than a few shreds came away and the drainage was satisfactory it was not continued. There is a danger, during lavage, if a free outlet for the irrigating fluid is not maintained, for the intra-pericardial pressure to increase so much as to embarrass the action of the heart with sudden fatal consequences.

Another of the more interesting points in the case is the question of the situation of the pus which was removed presumably from the left pleural cavity by aspiration in the 8th space, but which the subsequent operation for empyema failed to locate.

The possibilities are, first, that the 3 or 4 c.cm. of pus removed by needling represented the whole of the contents of a very small empyema which was completely evacuated by the aspiration. This is the most probable explanation, for the needle was only inserted far enough to enter the pleural cavity when pus was obtained; moreover, the thickening of both visceral and parietal pleura and their recent adhesions demonstrated at operation, afforded confirmatory evidence of this. Secondly, that a small lung abscess, and not a collection in the pleural cavity, had been tapped. Against this possibility is the fact that at the subsequent operation when no pus was found, the lung was needled to a depth of \( \frac{3}{4} \) -inch in several places. Thirdly, that the pus was aspirated from the pericardium. Though the pericardium, before it was drained, was enormously distended and might easily have been reached by needling from the lateral chest wall, yet after drainage it had collapsed and must have receded too far to be reached by a needle which was only inserted such a short distance.

The last point of interest which should be mentioned is the very marked and rapid improvement which resulted from paracentesis abdominis when ascites developed in the later stages of the illness.

My thanks are due to Mr. Geoffrey Keynes for allowing me to make use of the notes of this case:

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5. Osler, W., and McCrae, T., Principle and Practice of Medicine, 1920, 758.