

Surgical management of staphylococcal pericarditis

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Cameron, E. W. J. (1975). *Thorax*, 30, 678–681. **Surgical management of staphylococcal pericarditis.** The surgical management of 10 patients with staphylococcal pericarditis is described. Of the 10, seven were children aged 12 years or under. A variety of procedures was used to drain the pericardium at open operation; these included left anterior thoracotomy, left anterolateral thoracotomy, median sternotomy, and the transdiaphragmatic approach to the pericardium. The pathological findings at operation are described. Two patients died; one of the deaths was related to operation, the other was not. The remaining eight patients were ultimately well although two required reoperation before recovery was achieved. After the initial diagnosis of pyopericardium, early consideration of operative drainage is advocated. An effective means of surgical management is dependent, open drainage of the pericardium approached by the transdiaphragmatic route.

In each patient purulent pericarditis caused by a *Staphylococcus aureus* was proven by culture of pus from the pericardial cavity and by histological examination of resected pericardium. Earlier conservative management had failed and the patients therefore had to be managed by operation.

THE PATIENTS

CASE 1 A 9-year-old boy presented with staphylococcal osteomyelitis of both tibiae. The lower limbs were immobilized and a course of benzylpenicillin and cloxacillin was begun. The infecting organism was sensitive *in vitro* to both antibiotics. The clinical course of the osteomyelitis was thereafter satisfactory. However, two weeks after admission the patient developed a pyopericardium. Despite repeated aspiration over three days the severity of cardiac tamponade increased. The pericardium was then approached through a median sternotomy and the pus was drained. Five weeks after operation the patient was well.

CASE 2 A 38-year-old man with a history of dysentery one month previously presented with a pericardial effusion. 'Anchovy-sauce' pus was aspirated from the pericardium. The pus was sterile on culture. The amoebic gel diffusion test was positive and the diagnosis of rupture into the pericardium of an amoebic abscess of the liver was made. A course of metronidazole was begun. Because of persistent reaccumulation of the effusion, repeated pericardial aspirations were performed. On the third occasion, seven days after the initial aspiration, yellow pus was obtained from which coagulase-positive *Staph.*

aureus was cultured. Despite intravenous cephalothin and oral cloxacillin the patient's clinical condition deteriorated. A left anterior subcostal incision was made with excision of the sixth and seventh costal cartilages. There was a left subphrenic abscess communicating inferiorly with a cavity in the left lobe of the liver and superiorly with the pericardium. The abscess was drained. Three weeks after operation the patient was well.

CASE 3 A 30-year-old woman presented with staphylococcal pericarditis and left empyema thoracis. She was apparently moribund. Initial management combined intravenous cephalothin with intramuscular methicillin and urgent drainage of the pleural and pericardial spaces through a left anterolateral thoracotomy. Postoperatively she developed haemolytic jaundice but thereafter made a slow recovery. The empyema cavity persisted and therefore, one month after the first operation, a rib was resected to allow open drainage of the empyema. The procedure was carried out while the patient was taking cloxacillin. Postoperatively she was well until the seventh day when she developed the clinical picture of bacteraemic shock and died. Blood cultured at this time was sterile. At necropsy there was no evidence of active pericardial infection, the empyema was satisfactorily drained, and no distant focus of infection was found.

CASE 4 A 12-year-old girl presented with staphylococcal pericarditis. Initially drainage was achieved through a left anterior thoracotomy with resection of the fifth costal cartilage. Cardiac tamponade

recurred, and on the ninth postoperative day the pericardium was re-explored through a transdiaphragmatic approach. Loculi of pus lay over the anterior and right surfaces of the heart. The rest of the pericardial cavity was obliterated by fragile adhesions. Four weeks after the first operation the patient was well.

CASE 5 A 9-year-old boy presented with staphylococcal pericarditis. A left anterior thoracotomy was made and the pericardium was drained through the bed of the resected fifth costal cartilage. The postoperative course was stormy with initial improvement and subsequent deterioration. Cardiac tamponade developed and on the seventeenth postoperative day the pericardium was re-explored through a median sternotomy. A loculus of pus which was under tension lay over the right surface of the heart. The pericardium was drained as at the first operation. Again clinical improvement was transitory and 15 days after the second operation the inferior end of the midline skin incision was reopened and the pericardium approached transdiaphragmatically. There were multiple loculi of pus within the pericardium. These were released and the pericardium was drained through the midline incision. Three weeks after the third operation the patient was well.

CASE 6 An 11-year-old boy presented with staphylococcal pericarditis. The pericardium was approached through a median sternotomy. The visceral cortex and parietal pericardium were fused and stripped easily from the anterior aspect of the heart between the phrenic nerves. Inflow and outflow tracts were cleared of cortex. In the process loculi of pus were entered. Cardiac action did not improve after pericardiectomy. Postoperatively the patient became shocked. *Staphylococcus aureus* was grown on culture of blood taken 12 hours after operation. Twenty-four hours after operation the patient died. Throughout the operative phase the patient was treated with cephalothin and intramuscular methicillin.

CASE 7 A 10-year-old boy presented with ecthyma of the right ankle. *Staphylococcus aureus* was cultured from the lesion which was treated effectively without recourse to systemic antibiotics. Fourteen days after presentation the patient developed the signs of cardiac tamponade. *Staphylococcus aureus* was cultured from the pericardial pus. The pericardium was drained through a transdiaphragmatic approach and four weeks after operation the patient was well.

CASE 8 A 27-year-old man, who had had dysentery five weeks previously, presented with a pericardial

effusion. The progression of events was then similar to that in case 2. The pericardium was approached through a left anterior thoracotomy and drained through the bed of the resected fifth and sixth costal cartilages. At operation a defect in the central tendon of the diaphragm was demonstrated which led into a hepatic abscess. Two weeks later the patient was well.

CASE 9 An 8-year-old boy presented with staphylococcal osteomyelitis of the left tibia. Sixteen days after admission, despite successful treatment of the bone lesion and while he was under treatment with cloxacillin and lincomycin—antibiotics to which the pathogen was sensitive *in vitro*, the development of pericarditis was recognized. Over the succeeding five days the patient's condition deteriorated, the quantities of pericardial aspirate diminishing at each tap and the thickness of the pus increasing. Cardiac tamponade developed. The pericardium was drained through a transdiaphragmatic approach. The patient made a slow recovery with diminishing clinical evidence of heart failure and reduction of fever. However, the size of the cardiac shadow on serial chest radiographs did not diminish and the pace of recovery was felt to be too slow. On the twelfth postoperative day the pericardium was re-explored through the original incision. The parietal and visceral layers of the pericardium were lightly adherent. There was no pus. Three weeks after re-exploration the patient was well.

CASE 10 A 2-year-old male infant presented with staphylococcal pericarditis. A median sternotomy was made and the pericardium drained. Four weeks after operation the infant was well.

The clinical features are summarized in the Table.

SURGICAL MANAGEMENT

Before operation all patients had been treated with antibiotics to which the pathogen was sensitive *in vitro*, with drugs to counter heart failure, and by aspiration or repeated aspiration of the pericardium. The drug regimen was continued into the postoperative phase.

A variety of surgical procedures were employed depending on the preference of the operator.

LEFT ANTERIOR THORACOTOMY This was the route of approach in three cases (4, 5, 8). The standard anterior approach with resection of the fifth or sixth costal cartilage was employed (Gibbon, Sabiston, and Spencer, 1969). Closed drainage was used with Argyle intrathoracic catheters of gauge 28 or greater attached to a water seal. Two catheters were left in

TABLE
CLINICAL FEATURES

Case	Age (years)	Sex	Source of Infection	Cardiac Tamponade	Hb-10	Urea + 40
1	9	M	Osteomyelitis	+	+	
2	38	M	Aspiration of amoebic pericardial effusion	++	+	+
3	30	F	Empyema thoracis	++	+	+
4	12	F	?	++		
5	9	M	?	++		
6	11	M	?	++		
7	10	M	Ecthyma	++		
8	27	M	Aspiration of amoebic pericardial effusion	++	+	
9	8	M	Osteomyelitis	++	+	
10	2	M	?	+		

Hb-10 = haemoglobin level 10 g/dl (range 7.5 to 9.8 g/dl).

Urea + 40 = blood urea level greater than 40 mg/dl.

position, one on the anterior and one on the diaphragmatic surface of the heart. The drainage tubes were removed after significant discharge of pus had stopped and the patient's temperature had settled. In every case this occurred by the fifth postoperative day. There was no preliminary shortening of the drains.

In cases 4 and 5, reoperation was required and loculi of pus were found anteriorly and on the right (case 4), and on the right (case 5).

LEFT ANTEROLATERAL THORACOTOMY This was used in case 3 where an empyema thoracis had to be treated simultaneously. Drainage of the pericardium was through the left pleural space. The subsequent death of the patient was not related to pericarditis.

MEDIAN STERNOTOMY This was used in four cases (1, 5, 6, 10). With the exception of case 5, closed drainage was used as described for left anterior thoracotomy, the drainage tubes being brought out through stab wounds in the epigastrium. The post-operative course in cases 1 and 10 was uneventful. In case 5, where median sternotomy was used at a second operation, the site of previous resection of costal cartilage was used as the route for drainage. In this case a third operation was required. In case 6 pericardiectomy was also performed. Twenty-four hours after operation the patient died from bacteraemic shock. Sternal osteomyelitis did not develop in any of these cases.

TRANSDIAPHRAGMATIC APPROACH An extraperitoneal transdiaphragmatic approach to the pericardium was used in four cases (4, 5, 7, 9). This was an epigastric midline approach through the linea alba and bisected xiphoid process. The pericardium was opened through the central tendon of diaphragm. Drainage was achieved with 2 cm wide plastic corrugated drains placed over the anterior and inferior surfaces of the heart and draining through the unsutured approach incision. The time of removal of the drains depended on the criteria described for

left anterior thoracotomy. All drains were removed by the fifth postoperative day.

In two cases (7, 9) this approach was used at the first operation. For reoperation in case 9 the same approach was used: by hindsight this reoperation was unnecessary. In two cases (4, 5) this approach was used at reoperation where other approaches had failed. All four patients were well without recourse to further operative management.

PATHOLOGICAL FINDINGS

At operation the parietal pericardium was thickened; the maximum thickness noted was estimated to be 0.5 cm. With one exception (case 6) the visceral and parietal layers were separated by yellow pus. Either the pericardial cavity was distended with pus and fibrinous clot or the pus lay sequestered in loculi. Loculation occurred particularly where a first operation had failed as in cases 4 and 5. In these two patients loculi of pus under tension overlay the right aspect of the heart and the recurrence of tamponade was attributed to local right atrial compression. Since in both the approach was by a left anterior thoracotomy in the first instance, it is suggested that difficulty in reaching and draining the right part of the pericardial space is a defect in this surgical technique. The visceral pericardium, with the exception of that in case 6, was covered by a layer of granulation tissue to which fibrinous clot adhered. This layer was also present on the internal surface of the parietal pericardium.

In all cases the contained pus was under tension.

The granular epicardial cortex was removed in case 10 without consequent improvement in cardiac action. Only in this case and case 6 was any attempt at pericardiectomy made.

The findings at microscopy in cases 1, 3, 4, 5, 7, 9, and 10 were similar. The pericardium was covered with oedematous granulation tissue which showed heavy polymorphonuclear infiltrate. In case 6 there was an organizing fibrinous pericarditis with dense

collagen formation. In cases 2 and 8, in addition to the features of granulation, the pericardium contained areas of amorphous eosinophilic material with islands of mononuclear cells. No amoebae were seen in either case.

None of the 10 cases had any of the histopathological features of tuberculosis.

RESULTS

Three of the 10 patients underwent reoperation because of failure of the first operation to deal adequately with the pericarditis (cases 4, 5, 9). In case 9 reoperation was proven to have been unnecessary. In case 5 a third operation was required. Two patients died (cases 3 and 6) from bacteraemic shock. In case 6 this was directly related to operation at which pericardiectomy had been performed. In case 3 death could not be related to pericarditis. The eight surviving patients were all well in periods varying from two to six weeks after their only or last operation. In this context 'well' means that the patient was ambulant and afebrile, did not have cardiac failure, required no drugs, and had normal blood indices. Of this group, five have now been followed up for periods of between one and three years and these patients have remained well.

DISCUSSION

The presentation and diagnosis of purulent pericarditis has been discussed elsewhere (Sanyal *et al.*, 1970; Fowler and Manitsas, 1973).

An abscess is best managed by dependent, open drainage. There is no reason why pyopericardium should be treated differently. Dependent, open drainage is easily achieved by using the transdiaphragmatic approach to the pericardium. This route has several advantages; no tissue planes are opened up during dissection and the pleural and peritoneal cavities are not entered; the operation is simple and quick; and access is gained to the whole pericardium. In the present series surgical failure was associated with deviation from open to closed drainage and from dependent to non-dependent through the beds of the fifth or sixth left costal cartilages. The closed drainage systems (Gibbon *et al.*, 1969; d'Abreu, Collis, and Clarke, 1971) were not utilised to irrigate the pericardium.

Symbas, Ware, and DiOrio (1974) advised pericardiectomy as part of the surgical management of purulent pericarditis. Since there is no evidence in the literature (Deterling and Humphreys, 1955) or from follow-up of the present series that chronic pericardial constriction occurs as a result of staphylococcal pericarditis, and since pericardiectomy in the presence of infection is theoretically a further

potential cause of bacteraemia (as perhaps in case 6), pericardiectomy may be contraindicated in staphylococcal or other purulent pericarditis, tuberculous pericarditis excepted.

No patient was well earlier than two weeks after operation, most requiring four to six weeks. Equally slow recovery has been noted even where pericardiectomy has been performed (Perera, 1971).

In all patients there was initially globular enlargement of the cardiac shadow seen in the chest radiograph. This enlargement did not invariably diminish during convalescence, and failure of radiographic shrinkage alone is not an indication to re-explore the pericardial space. Indications for re-exploration are the signs of persisting infection and recurrence of cardiac tamponade.

Evidence from the present series supports the thesis (Hurst and Logue, 1970; Ikram, Banum, and Makey, 1974) that once purulent pericarditis is recognized at pericardiocentesis, drainage of the pericardium at open operation must be considered. Treatment by repeated pericardiocentesis may be ineffective.

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