Purulent pericardial effusion in children: Experience from a tertiary care center in North India

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ABSTRACT

Background : **Purulent pericarditis, if not recognized and managed timely, it can lead to significant morbidity and mortality. There are no guidelines for the management of purulent pericardial effusion in pediatric patients.**

Aim : **The study describes our experience with the management of 22 patients admitted with a primary diagnosis of purulent pericardial effusion seen over a 7-year period.**

Materials and Methods : **Hospital records of 22 children admitted to the pediatric intensive care unit with purulent pericardial effusion during January 2012–December 2018 were retrospectively analyzed.**

Results : **The mean age of presentation was 4.6 years. The most common presentation was fever. History of antecedent trauma was present in 27.27% of patients. Empyema was the most common associated infection. *Staphylococcus aureus* was the most commonly isolated organism. Out of 22, pericardial drainage was done in 13 patients (59%). Only one of these patients required pericardiectomy later on. Six (27.2%) patients responded to antibiotics alone. Three (13.6%) patients died before any intervention could be planned.**

Conclusion : **Echocardiography-guided percutaneous pericardiocentesis and pigtail catheter placement are a safe and effective treatment for purulent pericardial effusion. When pericardial drainage is not amenable, close monitoring of the size of effusion by serial echocardiography is required. Small residual pericardial effusion may be managed conservatively.**

Keywords : Echocardiography, pericardial effusion, pericardiocentesis, pyopericardium, tamponade

INTRODUCTION

Purulent pericardial effusion is a rapidly fatal disease if left untreated. Clinical diagnosis is often delayed, and a high index of suspicion is required. While in the presence of tamponade, the management unquestionably remains pericardial drainage, there are currently no treatment guidelines about the management of purulent pericardial effusion in the absence of tamponade. It is also a subject of discussion whether the best treatment includes surgical intervention or medical alone.[1] The role of intrapericardial thrombolytic treatment is also not clearly defined. There are very few studies in the literature on the management of purulent pericardial effusion in children.

This article describes our experience in the diagnosis and management of 22 patients with purulent pericardial

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effusion admitted in the pediatric intensive care unit at our center over a period of 7 years.

MATERIALS AND METHODS

Hospital records of 22 children (1 month–12 years) admitted to the pediatric intensive care unit of a tertiary care hospital with purulent pericardial effusion between January 2012 and December 2018 were retrospectively analyzed. Clinical presentation, examination findings, investigations including electrocardiogram (ECG), chest X-ray, echocardiography, and management findings were recorded and analyzed.

In echocardiography (subcostal four chamber view), "significant pericardial effusion" was defined as echo-free space approximately ≥1 cm in front of the right/left ventricle. Cardiac tamponade was clinically diagnosed by poor peripheral perfusion, poor peripheral pulses, and systolic blood pressure <5th percentile for age, which increased after pericardiocentesis along with a decrease in the heart rate. Echocardiographic evidence of tamponade was defined as the presence of right ventricular +/- right atrial diastolic collapse, dilation of inferior vena cava (IVC) and the absence of physiological collapsibility, increased ventricular interdependence, or the presence of septal bounce. The echocardiography-guided pericardial puncture was performed in patients with significant effusion, and a multiholed soft 7 F pigtail catheter was advanced into the pericardial sac, and the pericardial fluid was suctioned from the catheter tip. The pericardial fluid was sent for Gram staining, culture, and sensitivity. The catheter was left *in situ* for intermittent drainage (6–12 hourly) by syringe in a sterile manner till the drainage volume decreased to <20 ml/day for ≥48 h. Surgical intervention was not done in any patient initially. The outcome was measured as duration of hospital stay, mortality, development of constrictive pericarditis, and recurrence of effusion. A descriptive analysis was done.

RESULTS

Twenty-two children were admitted with purulent pericardial effusion during the period of study. The mean age of presentation was 4.6 years (6 months–12 years), with five children presenting in infancy. Of 22 children, 18 were males, and 4 were females. Fever was the most common presenting complaint. Other presenting complaints included breathlessness, cough, and chest pain [Table 1]. The median duration of illness from the point of onset of illness to presentation to hospital was 7.50 days (6–11 days). History of antecedent trauma leading to local infection (abscess, cellulitis, septic arthritis, or osteomyelitis) was present in 27.27% (6/22) patients. Indications for pediatric intensive care unit transfer included severe respiratory distress in 100% (22/22) and shock in 54.5% (12/22). Examination findings included tachycardia, tachypnea, muffled heart sounds, hepatomegaly, and increased jugular venous pressure. The pericardial rub was not appreciated in any patient. About 77.2% (17/22) of patients had some other associated pyogenic infection [Table 2], with empyema being the most common associated infection (59%).

Cardiomegaly on chest radiography was the most important finding seen in all patients. No significant abnormality was seen on ECG, except for ST-segment elevation in 9.09% (2/22) patients, both of which had significant pericardial effusion. The size of the pericardial effusion in the initial echocardiography was <0.5 cm in 4.5% (1/22), 0.5–1 cm in 13.6% (3/22), 1–2 cm in 50% (11/22), and >2 cm in 31.8% (7/22). The median size of pericardial effusion at presentation to the hospital was 1.65 cm (1.2–2.1 cm). The duration of symptoms and the size of pericardial effusion at presentation were not associated significantly ($P = 0.57$). Septae were present in echocardiography in 40.9% (9/22) patients, all of which were associated with significant pericardial effusion. Ejection fraction was normal in 90.9% (20/22). Echocardiographic evidence of tamponade was present in

Table 1: Signs and symptoms of patients with purulent pericardial effusion

Symptoms	Frequency (%)	Mean duration before hospitalization (days)
Fever	21 (95.4)	9.8
Breathlessness	17 (77.2)	6.2
Chest pain	5 (22.7)	7.4
Cough	4 (18.1)	8.5
Signs	**Frequency (%)**	
Tachycardia	22 (100)	
Tachypnea	22 (100)	
Muffled heart sounds	18 (81.8)	
Hepatomegaly	13 (59)	
Hypotension	12 (54.5)	
Increased jugular venous pressure	2 (9)	

Table 2: Associated infections/complications in patients with purulent pericardial effusion

Associated infections	Frequency (%)
Empyema	13 (59)
Subcutaneous abscess/cellulitis	5 (22.7)
Pneumonia	4 (18)
Septic arthritis	2 (9)
Pneumothorax	2 (9)
Paravertebral abscess	2 (9)
Infective endocarditis	2 (9)
Peritonitis	2 (9)
Liver abscess	1 (4.5)
Osteomyelitis	1 (4.5)
Deep vein thrombosis	1 (4.5)
Intestinal obstruction	1 (4.5)
Pancreatitis	1 (4.5)
Septic shock	1 (4.5)

27.3% (6/22). Underlying heart disease including ostium secundum atrial septal defect was found in 9.09% (2/22) patients. Infective endocarditis was an associated finding in 9.09% (2/22) patients.

The median duration of hospitalization was 31.5 days (21.7–45.2 days). Of 22 children, three died. Their median duration of hospitalization was 5 days. In all three cases, the cause of death was septic shock, and no surgical intervention for pericardial pus drainage could be undertaken as the collection when significant was organized or localized posteriorly. Two of the three patients had a history of trauma and evidence of infection at other sites, including paravertebral abscess, empyema, and thigh abscess ($P = 0.059$).

Of the 19 patients that survived, pericardial drainage was done in 13 patients. Of the 6 patients without pericardial drainage, three had minimal effusions (<1 cm), two had organized collection (1.4 cm, 1.1 cm), and one had laterally localized effusion (1.2 cm). All patients showed clinical and echocardiographic improvement to systemic antibiotic therapy alone. The median duration of hospitalization in these patients was 28 days (24–43 days).

Among the 13 children undergoing pericardial drainage, it was done within 48 h of hospitalization in nine patients (9/13, 69.2%), including two patients (2/13, 15.3%) who had tamponade at initial presentation. The mean size of effusion was 1.8 cm (1.2–2.5 cm) in these children. During hospitalization, 4/13 children showed increase in the size of effusion on repeat echocardiography, and two of the patients developed tamponade. Following this, pericardial drainage was done. The median time posthospitalization, when pericardial drainage was required in these four patients, was 9.7 days. All four patients came in the first 5 days of their illness and could have been in the early effusive phase. The median duration of hospitalization in all 13 patients requiring pericardial drainage was 36 days (27.5–49.5 days).

The median duration of the pigtail being *in situ* was 12 days (9–12.5 days). The median initial drainage was 1185 ml/kg/m^2 (821–1643 ml/kg/m^2). The median total drainage was 4965 ml/kg/m^2 (906–5892 ml/kg/m^2). In 9 out of 13 patients, minimal effusion persisted at the time of removal of pigtail and were discharged on oral diuretics. One patient, however, 48 h after the removal of pigtail rapidly progressed into obstructive shock on day 15 of hospitalization, with echocardiography was suggestive of an organized collection (2.3 cm) and dry pericardiocentesis, necessitating pericardiectomy. The patient had an uneventful postoperative period and was discharged on oral diuretics.

Intercostal tube drain was placed in eight patients for empyema. The average drainage was 3535 ml/kg/m^2, with a median duration of the intercostal tube being *in situ* 12.4 days. Other sites of pus drainage included liver abscess in one patient, intraarticular abscess in two patients, and superficial abscess in two patients.

With the emergence of community-acquired methicillin-resistant *Staphylococcal aureus* (MRSA), our empirical antimicrobial therapy for suspected purulent pericardial effusion was ceftriaxone and vancomycin to cover methicillin-sensitive *Staphylococcus aureus* (MSSA)/MRSA. Blood culture was positive in three patients for MRSA. The pus obtained by pericardiocentesis grew MRSA and MSSA in one patient each. The pleural aspirate was positive in two cases; growing *Acinetobacter* and *Klebsiella*. Four out of six cases of posttrauma sepsis were associated with the evidence of staphylococcal growth at the local site (thigh abscess, osteomyelitis, and septic arthritis).

On echocardiography at discharge, minimal pericardial effusion persisted in 13/19 patients, of whom nine patients had pericardiocentesis, and four received medical management alone. At discharge, 15 out of19 patients continued to show hepatomegaly and pedal edema (suggestive of effuso-constriction) and were discharged on oral diuretics (furosemide 1 mg/kg/day). Of these 15 patients, seven patients also had echocardiographic evidence of constriction like a distended IVC. Over a follow-up of 2–3 months, hepatomegaly and pedal edema were subsided, echocardiography findings of residual effusion and pericardial constriction were resolved, and diuretics could be successfully tapered and discontinued. There was no case with recurrent pericardial effusion.

DISCUSSION

A total of 22 cases of purulent pericardial effusion were admitted in the pediatric intensive care unit during the 7-year period of the study. The mean age of presentation was 4.6 years (6 months–12 years). These findings were similar to other studies by Cakir *et al.* and Rao *et al.*[1,2] However, in another study by Bagri *et al.* from India, the mean age of children with purulent pericardial effusion was 8.1 years (range: 2–17 years).[3]

The presentation included fever, breathlessness, cough, and chest pain. Examination findings included tachypnea, tachycardia, and hepatomegaly. Pericardial friction rub was not present in any patient. Other studies have also reported pericardial rub to be rare, while distant heart sounds were a common finding.[1,3]

Empyema was the most common associated infection, present in 59% of patients. Once an established focus of infection is present, the pericardium may become infected either by septic emboli or by the contiguous spread.[1,3] Pneumonia, septic arthritis, osteomyelitis,

skin infections, and sepsis were the most frequent associated infections in other studies.[4-6] The presence of other sites of infections was associated with mortality significantly. Pyomyositis was reported to be the most common predisposing factor in series from Nigeria.[7]

Similar to other studies, cardiomegaly was present in all patients on the chest radiography, while ECG changes were infrequent.[1,3-5,8] Echocardiographic evidence of tamponade was present in 27.3% of patients. The incidence of tamponade was less compared to other studies.[3,4]

Ours being a tertiary care referral center, most children had received prereferral antibiotics, possibly affecting bacteriological results. In our study, no organism was isolated in most cases. The most common organism isolated was *S. aureus* (MSSA/MRSA) in 66% (4/6) of the positive cultures. Staphylococcus was the most common organism isolated in other studies as well.[1,3,4,8-10]

Pigtail catheter drainage was done successfully in all patients with significant effusions (>1.2 cm in our study) with or without tamponade. Pigtail catheter drainage was successful in spite of the presence of septae. Streptokinase or an attempt to break synechiae was not done in any patient. In patients having minimal effusions or dry pericardiocentesis, the effusion size was monitored by serial echocardiography, and systemic antibiotic therapy was continued. In our study, all patients who had an increase in pericardial effusion on serial echocardiography came in the first 5 days of their illness and could have been in the early effusive phase. With time, the minimal pericardial effusion detected initially may evolve to become a purulent or an organized collection, increase in size making the collection amenable to pericardiocentesis later on.

In our study, no patient required primary pericardiectomy, and only one patient required pericardiectomy later on. This was contrary to a retrospective study by Cakir *et al.*, in which 27.7% (5/18) patients required pericardiectomy. Pericardiectomy was done primarily in three patients and later, after 11 and 15 days of subxiphoid pericardial tube drainage in two cases. In addition, three patients received intrapericardial streptokinase.[1] In another study by Rao *et al.* 56.4% (22/39) cases had pericardiectomy.[2]

Echocardiography-guided pericardiocentesis remains the preferred diagnostic and therapeutic approach.[9,11] In patients with small pyogenic effusions (<1.2 cm in our study) when pericardiocentesis was unsuccessful, close monitoring of the size of effusion by serial echocardiography and systemic antibiotic therapy was done, and primary pericardiectomy was not tried. Minimal pericardial effusion may persist at the time of drainage removal and even at discharge. This may be managed by low-dose diuretics instead of considering pericardiectomy, even if signs of effuse-constriction are present clinically (hepatomegaly and pedal edema) or on echocardiography (distended IVC).

Purulent pericarditis is associated with significant morbidity and mortality, requiring prolonged antibiotic therapy and surgical intervention in some cases. The mortality rate in purulent pericarditis reduces to 20% or less when medical and surgical treatments are combined.[1] The mortality rate in our study was 13.6% (3/22), with all the deaths being unrelated to pericardial effusion. In another study by Weir and Joffe, the mortality rate was 31% (8/26), with pericardial effusion being the probable cause of death in two cases and contributory in six cases.[12]

Limitations of our study include its retrospective nature and being from a single center. The etiologic spectrum of organisms in this study was representative of one pediatric care center.

CONCLUSIONS

Clinical findings with cardiomegaly on the chest radiography are pointers to a diagnosis of pericardial effusion, and echocardiography is diagnostic. Purulent pericardial fluid and associated infections help to establish pyogenic etiology. Timely diagnosis and treatment can decrease the associated mortality and morbidity.

Pericardial drainage remains the treatment of choice in significant effusions and should be used even if septae are present. Small effusions in the absence of tamponade may be conservatively managed initially, but close monitoring of the size of effusion by serial echocardiography is required. Small residual pericardial effusion can be managed conservatively. Only in an occasional case if persistent constrictive pericarditis has developed, delayed pericardiectomy should be considered.

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Conflicts of interest

There are no conflicts of interest

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