Original Article

Clinical and Echocardiographic Characteristics of Patients with Significant Pericardial Effusion requiring Pericardiocentesis

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Abstract

Objective: Clinical and echocardiographic features of significant pericardial effusion (PE) have been reported from the west. Currently there is lack of published data from this part of the world, we reviewed all consecutive cases of significant PE requiring echocardiographic assisted pericardiocentesis to analyze the clinical and echocardiographic features of these patients.

Methods: Forty four consecutive patients who underwent echocardiography assisted pericardiocentesis at the Aga Khan University Hospital (AKUH) between January 1988 and May 2001 are included in this review.

Results: Most common presenting symptoms were dyspnea (89%) and fever (36%). Elevated JVP and pulsus paradoxus were documented in 59% and 41% of patients respectively. Sinus tachycardia (75%) and low voltage (34%) were the most common ECG findings. Malignancy (45-51%) and tuberculosis (27%) were among the most frequent causes of PE. One patient died during echocardiography-assisted pericardiocentesis.

Conclusion: The symptoms and physical findings of haemodynamically significant PE are frequently nonspecific. Transthoracic echocardiography is the gold standard for rapid and confirmatory diagnosis of PE and cardiac tamponade. The most common cause of PE was malignancy followed by tuberculosis. Pericardiocentesis under echocardiographic guidance is a safe and effective treatment for significant PE (JPMA 55:66;2005).

Introduction

Pericardial effusion is an uncommon clinical entity. It may be asymptomatic or present as a life threatening cardiac tamponade, which is characterized by elevated intracardiac pressure, progressive limitation of ventricular diastolic filling and reduction of cardiac output.[1] Longer survival of patients with malignant disease, treatment of chronic renal disease with dialysis, the common use of anticoagulant drugs, irradiation in tumor therapy, are largely responsible for increased incidence of significant PE in recent years.[2] Cardiac tamponade may be acute or chronic and should be viewed hemodynamically as a continuum ranging from mild (pericardial pressure lower than 10mmHg) to severe (pericardial pressure higher than 15 to 20mmHg). Tamponade can be so sudden that the patient may succumb without any symptoms. In less drastic circumstances, patients with acute cardiac tamponade may

complain of severe shortness of breath accompanied by chest tightness and dizziness.[3] Echocardiography assisted Pericardiocentesis is simple, safe and effective primary management of significant PE.[4,5]

There is very little published data on clinical characteristics and echocardiographic features in patients with significant PE from this part of the world. We reviewed the records of all consecutive patients who underwent pericardiocentesis either because of therapeutic or diagnostic reasons at the Aga Khan University Hospital Karachi since the beginning of 1988. This study emphasizes on clinical characteristics, electrocardiographic and echocardiographic features of patients with significant PE.

Patients and Methods

Data collection

The records of patients who underwent Pericardiocentesis at the Aga Khan University Hospital between January 1988 and May 2001were reviewed and data on demographics, medical history, hospital course, laboratory results and echocardiographic characteristics was collected on a pre-designed questionnaire.

All patients with significant PE had a standard transthoracic echocardiogram. Echocardiographic features of cardiac tamponade include right atrial and right Ventricular collapse during diastole. Other features included dilated inferior venacava with lack of inspiratory collapse and swinging heart. Doppler hemodynamic findings of tamponade included decrease left ventricular filling with inspiration leading to delay of mitral valve opening, increase isovolumic relaxation time and decrease mitral E velocity and opposite changes occurring on expiration and reciprocal changes occurring on the right side.

Pericardiocentesis was performed under echocardiographic guidance, using a sub-xiphoid approach in all the cases.

Data analysis

Data was entered and analyzed using SPSS statistical software package version 11.0. All categorical variables are described as percentages and all continuous variables are mentioned as mean with standard deviation.

Results

Clinical presentations

Between January 1988 and May 2001, 44 patients (19 male and 25 females) underwent echocardiography assisted pericardiocentesis for diagnostic or therapeutic reasons. The baseline characteristics of patients and clinical presentation spanned a wide spectrum. The mean age was 42 years (range 15 years to 80 years). Common presenting symptoms were dyspnea (89%), fever (36%) and chest pain (20.5%) (Table 1). Hypotension (SBP < 90mmHg), pulsus paradoxus and elevated JVP were documented in 11%, 41%

Definitions

No.	Etiology	Definition
1.	Significant pericardial effusion	Pericardial effusion causing cardiac tamponade or requiring drainage for diagnostic reasons
2.	Tuberculosis	Probable: Radiological clinical and circumstantial diagnosis considered as probable diagnosis Definite: Microbiological or histopathological diagnosis considered as definite
3.	Malignant	A histologically confirmed cancer finding of malignant cells in cytological examination of the effusion
4.	Bacterial	Positive culture of fluid
5.	Uremic	A patient on hemodialysis or serum creatinine >3mg/dl and no other cause found
6.	Traumatic	Chest trauma within the preceding 24 hours
7.	Anticoagulation	INR >3.5 or day of admission with no other attributable etiology of bloody PE
8.	Post pericardiotomy	>1 week and <3 months after cardiac surgery
9.	Hemmorhagic effusion	Non-clotting red fluid that did not clear after the withdrawal of the first 20-ml of effusion
10.	Sinus tachycardia	Heart rate >100/min
11.	Low voltage	QSR amplitude of ≤5 mm in limb leads and ≤10mm in precordial leads
12.	Electrical alternans	Alternating amplitude of QRS complexes
13.	T-wave inversion	>1mm T-wave inversion

Table 1. Symptoms of patients with significant PE (n = 44).

Symptoms	No.	%
Dyspnea	39	88.6
Fever	16	36.4
Fatigue/Malaise	10	22.7
Chest pain	9	20.5
Cough	6	13.6
Weight loss	3	6.8
Palpitations	1	2.3
Abdominal pain	1	2.8

and 59% respectively. Only 11% had documented pericardial rub (Table 2).

Table 2. Sings in patient with significant PE (n=44).

Signs	Present		Absent	
	No.	%	No.	%
Tachycardia	39	88.6	5	11.4
Elevated JVP	26	59.1	15	40.9
Pulsus paradoxus	18	40.9	26	59.1
Hypotension (SBP < 90mmHg)	5	11.4	39	88.6
Pericardial Rub	4	9.1	37	90.9
Hepatomegaly	5	11.4	36	88.6

Electrocardiographic and radiological findings

Common ECG findings were sinus tachycardia (75%), low voltage (34%) and electrical alternans (9%). Radiographic evidence of cardiomegaly and pleural effusion were present in only 36% and 14% respectively.

Etiology of significant PE

The most common causes of PE in this cohort were malignancy (45.5%) and tuberculosis (27%) (Table 3). Seven out of eleven cases of tuberculosis were associated with hemorrhagic PE. Three cases of tuberculosis were diagnosed either by histopathology or microbiology while 8 patients had a presumptive diagnosis of tuberculosis based on radiological, clinical and circumstantial evidences.

Table 3. Causes of significant PE (n = 44).

Cause	No.	%
Malignancy	22	50
TB	11	25
Chronic renal failure	3	6.8
Auto-immune Disease	2	4.5
Trauma	1	2.3
Post cardiac surgery	1	2.3
Non Tuberculosis infection	1	2.3
Myxedema	1	2.3
Unknown	2	4.5

A wide variety of malignancies were responsible for the development of significant PE, these included carcinoma of the breast (n = 4/22), non Hodgkin's lymphoma (n=3/22), metastatic tumors with unknown primaries (n=3/22), carcinoma of the bronchus (n=2/22) and others.

Pericardial fluid was hemorrhagic in 68%, serous in 14%, serosanguinous in 11% and purulent in 2.3%. Most common causes of hemorrhagic PE were malignancy (47%) and Tuberculosis (19%).

Echocardiographic features

All the patients had a standard echocardiographic examination before Pericardiocentesis. Sixty four of patients had a large effusion (circumferential effusions with an arc width of >1cm) on echocardiography while 34% had a moderate effusion (circumferential effusion with an arc width of <1 cm at its greatest) and 2% had mild effusion (posteriorly loculated effusions of 1cm or less in width). Among patients with large effusion 54.5% and 50% had documented evidence of right atrial and right ventricular collapse respectively. On 2D echocardiography 95.5%patients had circumferential and 4.5% had loculated effusion (Table 4).

Table 4. Echocardiographic characteristics of Patients with significant PE (n=44).

Characteristic	No.	%
Mild effusion	1	2.9
Moderate effusion	15	34.1
Large effusion	28	63.6
Circumferential	42	95.5
Loculate	2	4.5
LV function normal	38	86.4
LV dysfunction	5	11.4
RA collapse	24	54.5
LA collapse	1	2.3
RV collapse	22	50
Tricuspid E/A >40%	15	34
Mitral E/A >25%	14	31.8

Outcome of Pericardiocentesis

Echo assisted pericardiocentesis as the initial management strategy was successful in 42 cases (95.45%) in this series. These results are comparable to those found in multiple series. Out of the two cases in the current study that could not be drained successfully by echo-assisted pericardiocentesis, one patient had SLE who died during the procedure because of RV rupture and other patient had tuberculosis, who later underwent open pericardial drainage. Both of these patients had circumferential PE. Only four patients had recurrence of effusion within thirty days of pericardiocentesis.

Discussion

Beck in 1935, described two triads for the diagnosis of cardiac compression.[6] One comprised of a decreasing arterial pressure, an increasing venous pressure and a small quiet heart and it occurred most commonly because of intrapericardial hemorrhage. The second cardiac compression triad consisted of a high venous pressure, ascites and a small quiet heart. Our study population at The Aga Khan University hospital comprised of patients who were acutely but not critically ill, a population somewhat similar to that described by Guberman et al. from Cincinnati[2], the difference being that, all our patients did not have cardiac tamponade. All of these patients were symptomatic and resting dyspnea was the most frequent symptom.

Diagnoses of significant PE on clinical grounds alone is often a challenge. In one series[7] hypotension, pulsus paradoxus and raised JVP were present in 70%, 60% and 50% respectively of the patients with echocardiographic evidence of tamponade. In another series[8] only 14% of patients presenting with late posterior tamponade had pulsus paradoxus and increased JVP. In our study Hypotension (SBP <90mmHg) was relatively uncommon considering the fact that about 55% of our patients had cardiac tamponade, but sinus tachycardia, raised JVP and pulsus paradoxus were frequent findings. The presence of pulsus paradoxus (>10mmHg drop in systolic pressure during normal breathing) supports the diagnosis of cardiac tamponade but it has a low specificity. Pulsus paradoxus can also be demonstrated in patients with acute or chronic obstructive airway disease[9,10], shock[11], pulmonary embolism[12], constrictive pericarditis[13], extreme obesity, tense ascites[14] and right ventricular infarction.[13] Inspiratory decline of systolic BP of up to 10mmHg may occur in normal individuals too.[15] On the other hand pulsus paradoxus may be absent even in the presence of tamponade among patients with atrial septal defect[16], aortic regurgitation, severe aortic stenosis[17] or uremia with left ventricular dysfunction.[2] In addition, with severe hypotension accompanying advanced tamponade, the pulsus paradoxus may be difficult to detect but is present in nearly every patient and the diagnosis of cardiac tamponade is to be strongly suspected in every patient who has symptoms and findings suggestive of myocardial failure, but who also has a significant paradoxic arterial pulse.[2]

Malignancy and tuberculosis account for three fourth cases and were found to be the predominant causes of hemorrhagic PE which corresponds with the published literature.[18-21]

Significant PE as a result of myxedema was first reported, by Martin and Spanthis[22] and Ivy.[23] In one series significant PE was reported in 30% of 33 patients studied by echocardiography in a hypothyroid population.[24] In our series only one patient had significant PE as a result of myxedema.

There is a higher risk of developing cardiac tamponade with anticoagulant therapy in-patients with known or suspected pericardial disease.[25,26] In our series we did not find a single case of PE associated with anticoagulant therapy.

Pericarditis, PE and cardiac tamponade have been associated with several different ECG signs.[27] Low voltage ECG and electrical alternans have been proposed as being diagnostic of significant PE or cardiac tamponade.[28] Low voltage ECG is caused by large PE because of increase in the distance between heart and the chest wall however normal voltage electrocardiogram doesn't necessarily rule out significant PE.[29,30] We found low voltage ECG in 34% of patients however electrical alternans occurred less commonly.

In contrast with reports in literature, we did not find a strong association between electrical alternans and the presence of large PE. It has been suggested that electrical alternans is a sensitive and relatively specific sign for PE and cardiac tamponade.[27] However we found that this sign could not distinguish between patients with large or moderate effusion or between patients with cardiac tamponade and those without cardiac tamponade. In addition, electrical alternans has been reported in a number of different clinical settings besides PE and cardiac tamponade, including supraventricular tachycardia, and ventricular tachycardia, electrolytes imbalance, drugs, hypothermia, prolong QT syndromes and bradycardia.[29]

Enlarged cardiac silhouette on chest X-ray was a relatively uncommon finding in our group of patients (36%). This is in contrast to earlier reports from Guberman et al.[2] and Eisenberg et al.[31] which suggested that cardiomegaly on Chest X-ray is an important and frequently present (95%) diagnostic finding in patients with significant PEs. Our study suggest that enlarged cardiac silhouette on Chest X-ray if present is a helpful diagnostic finding in patients with PE but its absence does not rule out the diagnosis.

It has been suggested that the presence of increased respiratory variation in tricuspid and mitral inflow velocities in patients with PE represents significant hemodynamic compromise regardless of the amount of PE on two dimensional echocardiography findings.[32-34] Reduction in intra pericardial pressure through drainage of pericardial fluid favorably modifies the disturbed balance between production and re-absorption of pericardial fluid, thus facilitating its resolution. Percutaneous echocardiography assisted Pericardiocentesis has an excellent profile in terms of simplicity, safety and efficiency.[4,5] Loculated effusions appeared to be less amenable to echocardiography assisted

excellent profile in terms of simplicity, safety and efficiency.[4,5] Loculated effusions appeared to be less amenable to echocardiography assisted Pericardiocentesis. However in our review two cases with anterior loculated effusion were successfully drained. Echocardiography assisted pericardiocentesis may be considered as the primary management strategy for loculated effusions as is for circumferential effusions.

Only one death occurred as a result of the Pericardiocentesis and two patients had vasovagal syncope which was treated with intravenous fluids and atropine. This suggests that echocardiography assisted pericardiocentesis is a safe and effective procedure for the treatment of clinically significant PEs.

Limitations of Study

Although the prospective registry encompasses detailed records of echocardiography assisted pericardiocentesis procedures, data acquired from a retrospective review needs verification and is subject to bias. Referral bias may be another potential limitation of our analysis. Although this limitation can not be eliminated, it can be analyzed, based on the sample area of our hospital. Our hospital is a tertiary care hospital, in an urban area and serves a heterogeneous population of patients. It has active infectious diseases, oncology, and rheumatology and nephrology services. It also serves as a referral center for invasive percutaneous cardiac procedures and cardiac surgery. We also treat a large population of patients who are at risk for TB, namely immunocompromised chronically ill and elderly patients. Thus, we believe that our patient population is representative of an urban community in our part of the world.

In summary, in a patient population that is reasonably representative of that in most tertiary care hospitals in Pakistan, the most common causes of significant PE requiring pericardiocentesis are malignancy and tuberculosis. Although the clinical presentation may provide clues to the presence of a hemodynamically significant effusion, it alone is often inadequate for decision making regarding intervention. Two dimensional echocardiography allows rapid confirmation and hemodynamic assessment of an effusion. Echocardiography assisted pericardiocentesis is sample safe and effective for primary treatment of clinically significant PE.

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