Clinical Profile and Outcomes of Adult Patients with Echocardiographic Evidence of Cardiac Tamponade at the Philippine General Hospital: A 5-year Study (The CAPTIVE- Heart Study)

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ABSTRACT

Background. Cardiac tamponade is a life-threatening hemodynamic condition from pericardial effusions that increase intrapericardial pressure sufficiently to externally compress and restrict cardiac chamber filling, constrain cardiac output, and induce backward failure. The number of pericardial effusions arising from cardiothoracic post-surgical and catheter-based procedures accounts for 70% of all the cases in one series. In the Philippines, tuberculous infection remains as one of the most common etiologies of pericarditis, and accounts for 25.1% of the 438 cases of pericardial effusion in a local review.

Methods. This is a retrospective cross-sectional study. The in-patient adult echocardiography database of the Philippine General Hospital-Section of Cardiology from June 2007 to June 2012 was reviewed, and all confirmed studies with evidence of cardiac tamponade on echocardiography were included.

Results. A total of 58 patients were included in this review. The age ranged from 18-75 years, with mean of 43 ± 15 years. Thirty-eight (66%) patients were diagnosed cases of malignancy, with lung cancer as the most common type. The other concomitant conditions included pulmonary tuberculosis (12%), presence of pulmonary mass of undetermined etiology (7%), systemic lupus erythematosus (3%), endocrine disorder (3%), renal failure (3%), and post cardiac surgery status (2%). The most common clinical findings were tachycardia (84%) and elevated jugular venous pressure (57%). Hemodynamic compromise was seen in 8 patients (14%), and Beck's triad was present in only 5 (9%) of the cases. The pericardial effusions were moderate to large in size in 95% of the cases. All effusions were circumferential, and 100% had right-sided chamber collapse, 38 (66%) of which had both right atrial and right ventricular diastolic collapse.

Conclusions. Malignancy and TB pericarditis account for most cases of cardiac tamponade in our setting. There should be a high index of suspicion for cardiac tamponade among patients presenting with difficulty of breathing and tachycardia, especially on a background of malignancy or TB infection. Cardiac tamponade carries a high in-hospital mortality rate and prompt recognition and intervention is warranted. There was a higher rate of intervention among those who survived their hospitalization, a finding that is similarly reflected by a previous study.

Key Words: cardiac tamponade, pericardial effusion, malignancy, TB pericarditis, Philippines.

Poster presented at the 44th Annual Convention of the Philippine Heart Association - Philippine College of Cardiology, May 29-31, 2013, EDSA Shangri-La Plaza Hotel, Mandaluyong City; and at the 43rd Annual Convention of the Philippine College of Physicians, May 5-8, 2013, SMX Convention Center, MOA Complex, Pasay City.

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Introduction

Cardiac tamponade is a life-threatening hemodynamic condition from pericardial effusions that increase intrapericardial pressure sufficiently to externally compress and restrict cardiac chamber filling, constrain cardiac output, and induce backward failure. The volume of the effusion, the rapidity of fluid accumulation, compliance of the pericardium, and the etiology are the factors that determine if an effusion proceeds to tamponade. Thus, even relatively modest volumes of effusion accumulating acutely may result in severe diastolic chamber compression and hemodynamic embarrassment. Conversely, even a large effusion may accumulate over time without increments in intrapericardial pressure.[1]

Pericardial effusion may result from infectious processes, inflammation, malignancy, metabolic disorders and anatomic leaks. Malignancy, idiopathic pericarditis, post- infarction pericarditis or cardiac rupture, and post-cardiac vascular and surgical interventions remain to be the most common causes of cardiac tamponade[1,2]. In more recent data, there is increase in the number of pericardial effusions necessitating drainage arising from cardiothoracic post-surgical and catheter-based procedures, accounting for 70% of all the cases in one series.[3] In a Spanish Prevalence data,

the etiologies of pericardial effusions were neoplastic in 32.1%, idiopathic in 27.4% and rheumatologic in 10.4%.[4] A Turkish study showed that the common etiologies of cardiac tamponade were neoplastic in 28%, idiopathic in 28%, and tuberculosis in 14%.[5] In the Philippines, tuberculous infection remains to be one of the most common etiologies of pericarditis, and accounts for 25.1% of the 438 cases of pericardial effusion in a local review.[6,7]

This study was conducted to describe the clinical profile and presentation of patients with echocardiographic evidence of cardiac tamponade, as well as determine the in-hospital outcomes of patients admitted at the Philippine General Hospital.

Methods

This was a retrospective cross-sectional study. The in-patient adult echocardiography database of the Philippine General Hospital-Section of Cardiology from June 2007 to June 2012 was reviewed, and all confirmed studies with evidence of cardiac tamponade on echocardiography were included. All the echocardiographic studies were done using the GE Vivid 4 Cardiovascular Ultrasound (General Electric, Connecticut, USA) and interpreted by consultants from the Section of Cardiology. Echocardiographic cardiac tamponade was defined as presence of pericardial effusion with any one of the following: (1) right atrial (RA) late diastolic collapse, (2) right ventricular (RV) early diastolic collapse, (3) both RA and RV collapse, or (4) exaggerated respiratory variations of the inflow velocities across the mitral and tricuspid valves. Pericardial effusions were classified into small, moderate or large effusions depending on the measurement of an echo-free pericardial space in either the anterior or posterior pericardium during diastole using the M-mode echocardiography. Small, moderate or large pericardial effusions were defined as <10mm, 10-20mm, and >20mm echo-free pericardial space, respectively. Loculated effusion was defined as an echo-free space confined to either the anterior or posterior pericardial space, while circumferential effusion involved both the anterior and posterior pericardial space. Mitral inflow velocity is a measure of blood flow as it passes the mitral valve from the left atrium to the left ventricle while the tricuspid inflow velocity is a measure of blood flow as it passes the tricuspid valve from the right atrium to the right ventricle during diastole using Spectral Doppler during echocardiography. Normally, respiration affects both measurements in the same manner. For example inspiration increases both the tricuspid inflow velocity and mitral inflow velocity. In cardiac tamponade, the increased intrapericardial pressure prevents expansion of the cardiac chambers so that an increase in tricuspid inflow velocity is accompanied by a decrease in the mitral inflow velocity. Exaggerated respiratory variations of inflow velocities were defined as >25% decrease of the inflow velocity across the mitral valve, and >40% increase of the inflow velocity across the tricuspid valve during inspiration. Inferior vena cava (IVC) plethora was defined as <50% decrease in IVC diameter with inspiration. A swinging heart was defined by the free swinging movement of the heart within the pericardial cavity.

A review of patient's medical record was also done to obtain demographics and clinical data. The etiology of the pericardial effusion based on the clinical, serologic and surgical findings, the interventions provided, and in-hospital mortality data were also obtained. The clinical signs that were sought in this study were tachycardia (heart rate of more than 100 beats per minute), hypotension (systolic blood pressure of less than 90 mmHg), muffled heart sounds on cardiac auscultation, and pulsus paradoxus (a difference of more than 10 mmHg from the first Korotkoff sound to the start of regular Korotkoff sound heard during blood pressure taking). The presence of tachycardia, hypotension, and muffled heart sounds is known as Beck's triad. The 12-lead electrocardiogram on presentation and the chest X-ray results were also noted. Electrocardiographic low voltage complex was defined as maximum QRS amplitude of <5mm in the limb leads, or <10mm in the chest leads. Electrocardiographic electrical alternans was defined as beat to beat variation in the QRS complexes.

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

A total of 58 patients were included in this review, 28 (48%) were males and 30 (52%) were females. The age ranged from 18-75 years, with mean of 43 ± 15 years. Thirty-eight (66%) patients were diagnosed cases of malignancy, with lung cancer as the most common type followed by lymphoma and breast CA. The other concomitant conditions included pulmonary tuberculosis (12%), presence of pulmonary mass of undetermined etiology (7%), systemic lupus erythematosus (3%), renal failure (3%), hypothyroidism (2%), Graves' disease (2%) and post cardiac surgery status (2%).

The initial complaints were difficulty of breathing (93%) and cough (62%), with duration of symptoms for more than two weeks in 71% of the cases. The most common clinical findings were tachycardia (84%) and elevated jugular venous pressure (57%). Hemodynamic compromise was seen in 8 patients (14%), and Beck's triad was present in only 5 (9%) of the cases. Prior to the echocardiographic study, the clinical diagnosis of cardiac tamponade was made in only 18 patients (31%). The maneuver to elicit pulsus paradoxus, which correlates with exaggerated respiratory variations across the right and left heart chambers and often precedes chamber collapse, was done in only 14 of the patients (24%) in this study, with 4 out of the 14 (28%) yielding a positive

result. The clinical characteristics of the patients are listed in Table 1.

Table 1. Clinical Characteristics of Patients with Echocardiographic Cardiac Tamponade

	N=58 (%)
Age in years (mean ± standard deviation)	43 ±15
Male Sex	28 (48%)
Co-morbid Conditions	
Malignancy	37 (64%)
Lung CA	11 (19%)
Lymphoma	8 (14%)
Breast CA	8 (14%)
Malignant mediastinal mass	5(9%)
Leukemia	2 (3%)
Primary cardiac angiosarcoma	1 (2%)
Renal cell CA	1 (2%)
Colon CA	1 (2%)
Pulmonary mass of unknown etiology	3 (7%)
Pulmonary tuberculosis	7 (12%)
Connective tissue disease (SLE)	2 (3%)
Renal failure	2 (3%)
Hypothyroidism	1 (2%)
Grave's Disease	1 (2%)
Post cardiac surgery	1 (2%)
Pregnancy	1 (2%)
Symptoms on Presentation	
Difficulty of breathing	54 (93%)
Cough	36 (62%)
Chest discomfort	33 (57%)
Orthopnea	32 (55%)
Clinical Signs	
Tachycardia	49 (84%)
Neck vein distension	33 (57%)
Muffled heart sounds	13 (22%)
Hypotension	8 (14%)
Beck's Triad	5 (9%)
Duration of symptoms	
<2 weeks	17 (29%)
>2 weeks	41 (71%)

The pericardial effusions were moderate to large in size in 95% of the cases. All effusions were circumferential with either a late diastolic right atrial inversion or early diastolic right ventricular collapse. Both diastolic right atrial inversion and right ventricular collapse were seen in 38 (66%) patients. Abnormal flow dynamics with inspiration was recorded in 10%, swinging heart in 14% and IVC plethora in 9%. Table 2 describes the echocardiographic findings.

The initial electrocardiograms (ECG) were available for review in 55 patients (95%). All were in sinus rhythm and have tachycardia. Low voltage complexes were present in 62% and electrical alternans in only 13%. Acute atrial fibrillation occurred in 9%, and one patient had premature ventricular contractions (Table 3).

The most common etiology of pericardial effusion was malignancy, accounting for 68% of all the cases. Lung cancer was the most prevalent type, followed equally by breast cancer and lymphoma. Tuberculous infection was the second most common cause, and accounted for 12% of the cases. There were four cases with undetermined etiology (Table 4 and Figure 1).

Table 2. Echocardiographic Features of Patients with Cardiac Tamponade

	N=58 (%)
Size of pericardial effusion	
Small	3 (5%)
Moderate	19 (33%)
Large	36 (62%)
Circumferential	58 (100%)
Right chamber diastolic collapse	58 (100%)
Right atrial collapse	8 (14%)
Right ventricular collapse	12 (21%)
Both right atrial and ventricular collapse	38 (66%)
Exaggerated inspiratory velocity variation across the valves	6 (10%)
Swinging heart sign	8 (14%)
IVC plethora	5 (9%)

Table 3. Electrocardiographic Characteristics on Presentation

	N= 55 (%)
Sinus rhythm	55 (100%)
Rate	
Tachycardia	49 (89%)
Normal	6 (11%)
Axis	
Normal	46 (84%)
Left axis deviation	2 (3%)
Right axis deviation	7 (13%)
Low voltage complexes	34 (62%)
Chest leads only	6 (11%)
Limb leads only	4 (7%)
Both chest and limb leads	24 (44%)
Electrical alternans	7 (13%)
ST elevation	1 (2%)
ST depression	2 (2%)
PR depression	0
Arrhythmias	
Acute atrial fibrillation	5 (9%)
Premature ventricular contractions	1 (2%)

Table 4. Etiology of Pericardial Effusion

Etiology	Number of Cases N= 58 (%)
Malignancy	39 (67%)
Lung CA	13 (22%)
Breast CA	8 (14%)
Lymphoma	8 (14%)
Mediastinal malignancy	5 (9%)
ALL	2 (3.5%)
Colon CA	1 (2%)
Renal CA	1 (2%)
Cardiac angiosarcoma	1 (2%)
Tuberculous Infection	7 (12%)
Renal Failure	2 (3.5%)
Thyroid	2 (3.5%)
SLE	2 (3%)
Purulent pericarditis	1 (2%)
Post op complication	1 (2%)
Undetermined	4 (7%)

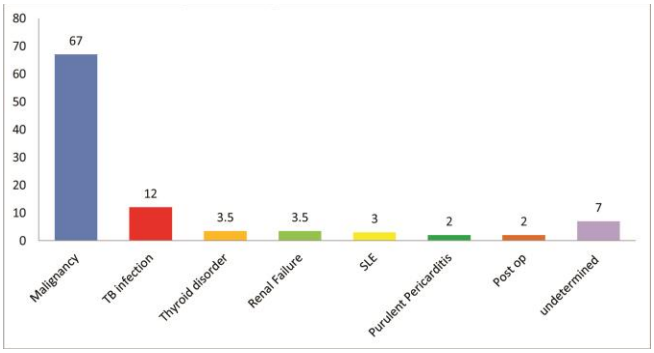

Figure 1. Etiology of Pericardial Effusion (%)

Out of the forty-eight patients who received invasive intervention, 38 had surgical decompression with tube pericardiostomy, 5 had pericardiocentesis, and 5 had pericardiocentesis followed by tube pericardiostomy. The ten patients who were managed conservatively included: 2 cases of renal failure who received medical management and underwent hemodialysis, 1 SLE patient who received steroid therapy, 1 patient with small pericardial effusion with planned close monitoring, 4 patients with malignancy who had no consent/ clearance for intervention and 2 patients (lymphoma and lung CA) who expired before the planned intervention could be given. Out of the 58 patients, 38 were discharged clinically improved, while the in-hospital mortality rate was high at 24%. The outcomes of 6 others could not be certainly ascertained because they went home against medical advice. (Table 5)

Table 5. Interventions and Clinical Outcomes of Patients with Cardiac Tamponade

	N=58 (%)
TYPE OF INTERVENTION	
Invasive Intervention	48 (83%)
Tube pericardiostomy ± window creation	38 (66%)
Pericardiocentesis and tube pericardiostomy	5 (9%)
Echo-guided pericardiocentesis	5(9%)
Conservative Management	10 (17%)
CLINICAL OUTCOMES	
Discharged improved	38 (66%)
In-hospital mortality	14 (24%)
Home against medical advise	6 (10%)

Of the 14 in-hospital mortality, 10 (17.2%) cases were attributed directly to the cardiac tamponade, 2 were from acute respiratory failure from nosocomial pneumonia, 1 was from acute respiratory distress syndrome, and 1 from pulmonary embolism. Only 9 had undergone invasive intervention, while the remaining 5 only had medical management.

Discussion

The concept of cardiac tamponade as a continuum of severity rather than as an "all or none phenomenon" has been supported by recent studies and experiments. At one end of the spectrum, the increase in pericardial pressure may only be apparent through invasive cardiac catheterization techniques, with absence of clinically apparent signs and symptoms. Echocardiographic tamponade occurs before the onset of overt hemodynamic effects, and is recognized by the presence of cardiac chamber collapses and characteristic alterations in respiratory variations of mitral and tricuspid flow on echocardiography. Clinical cardiac tamponade represents the most extreme manifestation, causing severe hemodynamic perturbations readily recognized through the classic findings of dyspnea, tachycardia, jugular venous distension, pulsus paradoxus and hypotension.[8,9]

In our study, there was no sex predilection for cardiac tamponade with 48% male and 52% female prevalence. Difficulty of breathing was the predominant symptom, and tachycardia was the most common clinical sign. Fourteen percent (14%) of the patients presented with hypotension, and only 9% presented with the classic Beck's triad of muffled heart sounds, hypotension and distended neck veins. This finding was consistent with studies that showed low frequency of overt hemodynamic compromise at 8-14%, which may be attributed to a more gradual accumulation of fluid in the pericardial space. [10,11,12]

The under recognition for the presence of the pulsus paradoxus may be secondary to the low index of suspicion for cardiac tamponade during initial presentation, and may partly explain why cardiac tamponade was considered in only 18 of the patients (31%) prior to the echocardiographic study. Although this physical examination finding is a classic in cardiac tamponade, its predictive value is limited.[12,13,14] It is affected by the presence of other hemodynamic factors such as LV dysfunction or intravascular volume.[14,15] It has a sensitivity of 79% and specificity of 40%.[13] Echocardiogram was done in the majority of these patients to detect other cardiac causes that can explain the clinical presentation. The more prevalent use of echocardiography increases the identification of the subset of patients with only subtle evidence of hemodynamic compromise.[16]

In this series, malignancy and tuberculous infection accounted for 79% of all the cases. Lung cancer, lymphoma and breast CA were the most frequent tumor types, consistent with published literature.[2,3,5] Infectious pericarditis from tuberculous infection was the second most common cause, which accounted for 12% of all the cases. Out of the 7 cases of tamponade from TB pericarditis, 4 were previously diagnosed and treated for pulmonary tuberculosis, 1 had +3 AFB on the pericardial fluid analysis, and 2 had chronic inflammatory changes on biopsy. In one study in Africa where TB is also endemic, majority of the effusion among the 15 patients with cardiac tamponade was secondary to TB infection.[17] In another study in Turkey with 100 patients, 14% of patients had TB pericarditis, ranking it

as the third most common cause, next to malignancy and idiopathic conditions.[5] Although more recent studies point to the increasing incidence of post cardiac intervention complications as the cause of cardiac tamponade, this was not reflected in this series, maybe due to the relatively lower number of cardiac interventional procedures done in our center.[3,18]

Sinus tachycardia was the most common rhythm. Low voltage complexes were noted in 62%, and electrical alternans pattern in 13%, depicting the low sensitivity of these parameters in the detection of patients with cardiac tamponade. Electrical alternans ECG pattern has a very low sensitivity but relatively high specificity and positive predictive value among patients with pericardial effusion and tamponade as shown in some studies.[19] Acute arrhythmias like atrial fibrillation and premature ventricular contractions occur very infrequently, and malignant tachyarrhythmias or heart blocks were not documented.

These findings reiterate the need for a high index of suspicion among patients who have predisposing conditions for tamponade. Cardiac tamponade needs to be ruled out with timely echocardiographic study, among patients who present with difficulty of breathing and tachycardia, on a background of malignancy or tuberculous infection even in the absence of hemodynamic embarrassment.

Cardiac tamponade is a potentially life-threatening emergency that responds dramatically to properly performed and optimally-timed pericardial damage and decompensation. Echocardiographically- guided pericardiocentesis is the initialdrainage procedure of choice, providing lifesaving prompt relief of symptoms and hemodynamic compromise.[1] If pericardial tissue is required for diagnosis, in cases of purulent pericarditis or recurrent effusions like malignant effusions, surgical drainage may be the preferred treatment.[8] Temporizing measures include intravascular volume expansion, and inotropic support.[1] Majority of the patients in this series underwent tube pericardiostomy because of the predominance of malignancy as the cause.

In reports among patients with malignant effusion, the 30-day mortality rates after drainage is high at 19.4% and 19.5%.[3,18] The difference in mortality rates of patients who had invasive intervention either by pericardiocentesis or tube pericardiostomy (19%) and those who received conservative management (50%) was statistically different, with $p<0.05$. The 24% overall mortality rate noted in our population may even be underestimated, because we were not able to account for the 10% who were discharged against medical advice and this was only an in-hospital mortality figure. Furthermore, no follow-up to determine long term outcomes was done in this study.

The patients who were discharged improved were compared to patients who were in-hospital mortality group in Table 6. Clinical characteristics on both groups appeared to be similar. The most prevalent cause of the cardiac tamponade on both groups was malignancy. The presence of malignancy was probably a major factor in the prognosis of the patients in this study. The percentage of the patients who had invasive intervention was higher among those who were discharged. The three patients who had only conservative management improved with hemodialysis (2 patients) and steroid therapy (1 patient with SLE) were not due to malignancy. In the in-hospital mortality group, all the patients who did not have invasive intervention were due to malignancy. Although, this study cannot conclude that invasive intervention was significantly associated with in-hospital survival, the comparison did show that it was probably a major factor in the survival of the patients in the discharged improved group. This trend was shown in a previous study. [3,15]

Table 6. Comparison of clinical characteristics of patients discharged improve versus in-hospital mortality

	Discharged Improved (N=38)	In-hospital Mortality (N=14)
Age	41±15 yrs	48±16 yrs
Gender	53% male	43% male
Tamponade physiology		
o RA Collapse only	14%	7%
o RV Collapse only	14%	43%
o RA and RV Collapse	72%	50%
o Respiratory variation	11%	0
Size of the pericardial effusion		
o Small	2.7%	14%
o Moderate	30.5%	36%
o Large	66.7%	50%
Location of the pericardial Effusion		
o Circumferential	100%	100%
o Anterior	0	0
o Posterior	0	0
Signs and Symptoms		
o Dyspnea	94.4%	92.8%
o Orthopnea	44.4%	71.4%
o Cough	58.3%	78.5%
o Chest pain	61.1%	57.1%
PE Findings		
o Neck vein engorgement	52.7%	71.4%
o Hypotension	5.5%	21.4%
o Muffled heart sounds	22.2%	14.2%
o Tachycardia	80.5%	85.7%
o Pulsus Paradoxus	8.3%	0
o Beck's Triad	2.7%	14.2%
ECG		
o Sinus rhythm	97%	100%
o Atrial Fibrillation	2.7%	0
o Electrical alternans	13.9%	14.2%
o Low-voltage complexes	52.7%	78.6%
Etiology		
o Malignancy	66.7%	78.5%
o TB	13.8%	0
o others	19.3%	21.5%
Intervention		
o Tube pericardiostomy	81.5%	57.1%
o Pericardiocentesis	7.9%	7.1%
o None	7.9%	35.7%
Duration of Hospitalization	18±9 days	9±6 days

Conclusion

Malignancy and TB pericarditis account for 79% of all cases of cardiac tamponade in our setting. There should be a high index of suspicion for cardiac tamponade among patients presenting with difficulty of breathing and tachycardia, especially on a background of malignancy or TB infection. Only 14% will present with hypotension and 9% with the classic Beck's triad, and presence of this overt hemodynamic embarrassment already represents the most severe and extreme manifestation of cardiac tamponade. Cardiac tamponade carries a high overall in-hospital mortality rate of 24% and prompt recognition and intervention is warranted. There was a higher rate of intervention among those who survived their hospitalization, a finding that is similarly reflected by a previous study.

Limitation of the Study

This was a retrospective study and may be subject to bias and loss of data. A prospective study that would enroll more patients and follow up patients even after hospital discharge is suggested.

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