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Original Article

Clinical and Echocardiographic Characteristics of Patients With Cardiac Tamponade and its Survival Prognostic Factors

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ABSTRACT

Background: Cardiac tamponade nearly always requires urgent intervention, but the optimal management of pericardial effusion is still controversial. The aim of our study was to introduce the profile and treatment results of patients with tamponade in our referral heart center.

Methods: From November 2010 to November 2014, our retrospective study was performed on 220 patients with tamponade. All the clinical and echocardiographic findings of the patients, as well as their operative and follow-up data, were recorded and analyzed.

Results: The overall prevalence of tamponade relative to the entire study population undergoing heart surgery was 8.5%. There were 106 men and 114 women at a mean age of 55.5 years (range = 5–99). The most common causes of tamponade were cardiac diseases (21%), malignancy (20.4%), unknown (20.4%), chronic renal failure (15%), and post-cardiac surgery complications (10.5%). The approaches for pericardial effusion drainage were the subxiphoid approach (97.7%), mini-thoracotomy (1.4%), and percutaneous pericardiocentesis (0.9%). The intraprocedural mortality rate was zero, the mortality rate during hospital stay was 4.5%, and the recurrence rate was 9.1%. Patients with primary sanguineous pericardial effusion, malignant etiologies of tamponade, and malignant pericardial effusion had significantly poor survival. The survival rates at 1 month, 1 year, 2 years, and 3 years were 87.1%, 67.7%, 64.5%, and57.2%, respectively.

Conclusions: We found an association between left pleural effusion and small amounts of pericardial effusion, hence the necessity of more attention in the echocardiographic evaluation of these patients. The subxiphoid approach for pericardial effusion drainage is a safe and simple procedure associated with relatively lower postoperative complications, mortality, and recurrence rate. Sanguineous pericardial effusion is concomitant with poor prognoses. ***(Iranian Heart Journal 2020; 21(1): 17-26)***

KEYWORDS: Cardiac tamponade, Subxiphoid pericardial window, Pericardial effusion, Pericardial drainage

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Pericardial effusion is pathological fluid accumulation in the pericardial cavity. It is usually due to an imbalance in fluid formation and absorption. If this accumulation occurs quickly or gradually, it can lead to the collapse of the heart chambers and tamponade, which is a life-threatening condition. [1]

The clinical presentations of pericardial effusion at the time of diagnosis vary, [2] with the most common causes of large pericardial effusion being malignancies, uremia, infections, collagen vascular disease, and chest radiation. [1, 3]

Cardiac tamponade nearly always requires urgent intervention, but the optimal management of pericardial effusion is still controversial. There are several pericardial drainage approaches: the percutaneous approach or pericardiocentesis and the surgical approach such as the subxiphoid pericardial window, left mini-thoracotomy, and the left paraxiphoidian approach, each of which has its own advantages and disadvantages. [4- 6]

Pericardiocentesis is a less invasive procedure than surgical procedures; it, however, has a higher recurrence rate and is sometimes associated with such complications as severe bleeding. [6] The subxiphoid approach is a more invasive technique but has lower recurrence rates. [1]

Optimal urgent decompression targets are sufficient fluid drainage and sampling, resection of the pericardial sample for pathological evaluation, and prevention of recurrence with minimal morbidity and mortality. Given that the existing literature contains conflicting data about various intervention options, we sought to introduce the profile and treatment results of patients with tamponade in our referral heart center.

METHODS

From November 2010 to November 2014, our retrospective study was performed on 261 patients who were admitted and treated at Seyed-al-Shohada Heart Center in Urmia, Iran, for pericardial effusion with cardiac tamponade. Our study protocol was approved by the Ethics Committee of Urmia University of Medical Sciences. Cardiac tamponade diagnosis and decision for surgery consultation in all cases were made by a cardiology specialist based on clinical evaluations and echocardiography. Postoperative patients requiring re-sternotomy and chest re-exploration during several days after open-heart surgery were excluded from the study.

All the clinical findings of the patients at the time of admission such as age, gender, dyspnea, hypotension, pulse paradox, elevation of jugular pressure, heartbeat mutations, and tachycardia were recorded. Echocardiographic findings such as right and left atrial collapse, right ventricular collapse, the ejection fraction, and findings compatible with fluid accumulation in the pericardial space were also recorded.

Local anesthesia and intravenous sedation or general anesthesia were used. The surgical procedure for most of the patients was the subxiphoid pericardial window. A 4 to 6-cm incision was made in the midline and the upper abdominal region approximately over the xiphoid process. In the thoracotomy approach, anterior mini-thoracotomy was done with a 4 to 6-cm incision beneath the left nipple and through the fifth intercostal interspace. After the identification and incision of the pericardium, pericardial fluid suction was performed. A chest tube (28 or 32 F) was placed into the pericardial space through a separate stab wound. Percutaneous drainage was performed with an 8-cm

18-gauge angiocatheter, guide wire, dilator, and a pigtail catheter.

The pericardial fluid was sent for culture and cytological, bacteriological, and histological analyses. A biopsy specimen (a piece of pericardium 1 to 2 cm in diameter) was resected for pathological evaluation. The fluid volume and its appearance were also recorded.

When the amount of the mediastinal drainage was less than 100 cc in 24 hours and control echocardiography showed no significant residual effusion, the tube drain was withdrawn.

Echocardiography was done after 1 month and 1 year for asymptomatic patients in the follow-up period and for all symptomatic patients.

Operative and follow-up data of the patients such as the drainage technique, the anesthesia technique, the amount of fluid drained, the nature of the pericardial fluid, cytological and pathological findings, hospital mortality, mortality in the follow-up period, and the mean survival rate were recorded.

The data analyses were conducted with version 20 of SPSS software. The quantitative data were shown as the mean ± the standard deviation (SD), and the qualitative data were presented as frequencies and percentages. The overall survival was calculated from the date of surgery until death or the last follow-up. For the univariate analysis, both the independent *t*-test and the ANOVA test were used to report any difference in the survival rates during the follow-up period. Differences were considered significant if the *P* value was < 0.05.

RESULTS

Within a study period of 48 months, 261 patients were diagnosed with tamponade. Forty-one patients were excluded due to incomplete medical records. The evaluations were performed on 106 men and 114 women at a mean age of 55.57 ± 18.28 years (range = 5–99). Two patients did not accept surgical or percutaneous intervention. Two patients underwent percutaneous drainage with echocardiography-guided pericardiocentesis. In the 4-year period, the overall prevalence of tamponade relative to the entire study population undergoing heart surgery was 8.5% (257/3010). The patients' demographics and clinical characteristics are described in Table 1. The most prevalent clinical problem was dyspnea (91.8%).

Table 1. demographic and clinical characteristics of the patients with tamponade (N=220)

Characteristic	No %
Age(y)	55.57±18.28 (5-99)
Gender: male female	114(51.8%) 106(48.2%)
BMI(kg/m^2)	25.92±4.82 (14.7-38.6)
Diabetes	39(17.7%)
Hypertension	86(39.1%)
Smoking	42(19.1%)
Familial history of tamponade	3(1.4%)
History of any previous surgery	75(34.1%)
History of tamponade drainage	20(9.1%)
Habitation location: urban rural	 155(70.5%) 65(29.5%)
Signs: Dyspnea Elevated jugular venous pressure Pulse paradox Hypotension (SBP < 90 mm Hg) Muffled heart sounds	202(91.8%) 64(29.1%) 22(10%) 29(13.2%) 62(28.2%)

Common ECG findings were sinus tachycardia 154 (70%), low voltage 78 (35.5%), and electrical alternans 35 (15.9%). Radiographic evidence of pleural effusion was present in 38 (17.3%) patients. The echocardiographic and laboratory findings are depicted in Table 2.

Table 2. Echocardiographic characteristics of the patients with tamponade (N=220)

Characteristic		No %
EF (%):	< 30	34(15.5%)
	30-45	47(21.4%)
	45-55	59(26.8%)
	> 55	80(36.4%)
RV collapse		99(45%)
LA collapse		2(0.9%)
RA collapse		85(38.6%)
Respiratory variation:	Mitral valve	32(14.5%)
	Tricuspid valve	17(7.7%)
IVC dilation		54(24.5%)
Swimming heart		10(4.5%)
Fluid amount:	Mild(< 5mm)	5(2.3%)
	Moderate(5-15mm)	40(18.2%)
	Sever(> 15mm)	175(79.5%)
Fluid type:	Localized	23(10.5%)
	Generalized	197(89.5%)
Hb(gr/dL)		11.54±2.08 (5-19)
ESR(mm/h)		29.67±28 (1-125)
CRP(mg/lit)		29.1±27.57 (0.1-97)
WBC		9356±4429 (4900-30300)
PLT		137067±24169(35000-1654000)
Cr(mg/dL)		1.46±1.3 (0.5-8.5)

EF, Ejection fraction; RV, Right ventricle; LA, Left atrium; IVC, Inferior vena cava; Hb, Hemoglobin; ESR, Erythrocyte sedimentation rate; CRP, C-reactive protein; PLT, Platelet; Cr, Creatinine

The most common causes of effusion were cardiac diseases, malignancy, renal failure, and post-cardiac surgery complications. The etiology was malignant in 45 (20.5%) patients and benign in 175 (79.5%) patients. Unknown etiology accounted for 45 patients. The causes of tamponade are presented in Table 3.

Table 3. Causes of tamponade (N=220)

Cause	No %
Cardiac	46(21%)
Malignancy:	45(20.4%)
Lung cancer	13(29%)
Hematological malignancy	12(26.7%)
Gastrointestinal	9(19.9%)
Breast cancer	8(17.8%)
Ovarian	1(2.2%)
Squamous cell carcinoma (neck)	1(2.2%)
Osteosarcoma	1(2.2%)
Chronic renal failure	33(15%)
Post cardiac surgery	23(10.5%)
Autoimmune disease	7(3.2%)
TB	6(2.7%)
Pericarditis	6(2.7%)
Myxedema	5(2.3%)
Liver disease	4(1.8%)
Unknown	45(20.4%)

Pericardial effusion drainage was performed on 218 patients. Two patients underwent percutaneous drainage with echocardiography-guided pericardiocentesis. The most common drainage procedure was surgery via the subxiphoid approach and general anesthesia. The appearance of effusion was serous and yellowish in most patients. The operative and postoperative data of the patients are shown in Table 4.

Table 4. Operative and postoperative data of the patients (N=218)

Characteristic	No %
Operative procedure n (%):	
Subxiphoid approach	213(97.7%)
Mini-thoracotomy	3(1.4%)
Percutaneous	2(0.9%)
Anesthesia:	
General	202(92.7%)
Local	16(7.3%)
Volume of drainage fluid, mL	600±391 (10-3000)
Nature of pericardial fluid:	
Serous	128(58.2%)
Sanguineous	85(38.6%)
Purulent	5(2.3%)
Operative complication:	
Renal	3(1.4%)
Pulmonary	1(0.5%)
Arrhythmia	2(0.9%)
None	212(97.2%)
Hospital mortality	10(4.5%)
Follow-up (mon)	0-78

There was no intraprocedural mortality. The mortality rate during hospital stay was 10(4.5%). The fluid samples and pericardial biopsy samples were sent for evaluation for 81(36.8%) patients. The cytological findings included malignancy in 20 (24.7%), normal in 21 (25.9%), inflammatory in 28 (34.6%), and bloody in 12 (14.8%) patients. Additionally, the pericardial biopsy reports of 81 patients included malignancy in 16 (19.8%), normal in 28 (34.5%), acute pericardial inflammation in 22 (27.2%), chronic fibrotic inflammation in 12 (14.8%), tuberculosis (TB) presentation in 2 (2.5%), and non-pericardial tissue in 1 (1.2%).

The median follow-up period for all the study participants was 35.5 (range = 0–78 mon). The survival rates at 1 month (108/124), 1 year (84/124), 2 years (80/124), and 3 years (71/124) were 87.1%, 67.7%, 64.5%, and 57.2%, respectively.

The mean survival rate of the patients was not different significantly in terms of age (P = 0.15), sex (P = 0.258), smoking (P = 0.6), diabetes (P = 0.594), hypertension (P = 0.5), the body mass index (P = 0.71), dyspnea (P = 0.3), elevated jugular venous pressure (P = 0.293), hypotension (P = 0.45), the ejection fraction (P = 0.998), fluid amounts (P = 0.549), right atrial collapse (P = 0.068), respiratory variation (P = 0.356), and anesthesia type (P = 0.256). Nonetheless, the etiology of tamponade and cytological and pathological findings significantly affected the mean survival rate. The risk factors affecting survival are presented in Table 5.

Table 5. Risk factors affecting survival (N=124) (follow-up of 0–78 months and mean survival of 35.5 months)

Characteristic	Mean survival (months)	*P* value
Demographic Findings	32.67-42.28	>0.05
Clinical findings: Pulse paradox Others	 48.58 versus 34.10 31.26-43.1	 0.05 >0.05
Echocardiographic Findings	27.3-50.33	>0.05
Operative procedure n (%): Subxiphoid approach Mini-thoracotomy Percutaneous	 36.15 11 6	0.614
Etiology of Tamponade: Cardiac Malignancy Chronic renal failure Post cardiac surgery Autoimmune disease TB Pericarditis Myxedema Liver disease Unknown	 41.81±24.73 14.93±17.92 33.54±28.37 37.15±17.89 55.40±11.33 47±4.64 35±30.51 58.50±2.12 63.66±9.29 41.46±20.13	0.001
Cytological Findings: Malignancy Normal Inflammatory Bloody	 15.55±19.51 45.93±28.88 45.75±27.35 20.50±21.61	0.002
Pathological Evaluation of Pericardium Biopsy: Malignancy Normal Acute inflammation Chronic inflammation TB Non-pericardial tissue	 15.45±19.49 44.85±25.85 44.14±30.02 18.28±25.99 47±4.64 11	0.009

DISCUSSION

Pericardial effusion is rarely symptomatic, and often it is an incidental finding. However, with rapid or massive fluid accumulation, signs and consequences of a dangerous status of life may be created. [7]

The diagnosis of significant pericardial effusion based on clinical signs alone is usually difficult. One study revealed that the prevalence rates of hypotension, pulse paradox, and elevated jugular venous pressure in patients with echocardiography-based tamponade were 70%, 60%, and 50%, correspondingly. Puls paradox (> 10 mm Hg drop in systolic blood pressure during normal breathing) underscores the diagnosis of cardiac tamponade, but it has a low specificity. [2] In our study, most of the patients were symptomatic and dyspnea was the most common symptom (in 91.8%); nevertheless, the prevalence of hypotension, puls paradox, and elevated jugular venous pressure was lower than that reported by other studies.

Wang et al [8] showed sinus tachycardia in 72%, low voltage in 35% and electrical alternans in 15.9% of their patients with tamponade, which is similar to our common ECG findings.

Transthoracic echocardiography is a reliable, simple, and noninvasive method for the diagnosis of tamponade. It diagnoses as small as 20–50 mL of pericardial fluid. Hamid et al [9] showed atrial collapse in all their patients with large pericardial effusion

and 50% of their patients with moderate effusion presenting with tamponade. The increased respiratory variation in the tricuspid and mitral inflow velocities in patients with pericardial effusion reveals tamponade regardless of the amount of effusion. [2] In our study, cardiac chambers collapse, respiratory variation, and other echocardiographic parameters were close to similar studies, but the number of patients with low left ventricular ejection fractions was high because our hospital is the only referral heart center in West Azerbaijan province and most heart failure patients are admitted to this center.

Ekim et al [10] showed left pleural effusion in 26.7% of their patients with purulent pericarditis. We found radiographical evidence of left pleural effusion in 38 (17.3%) patients. Considering the association between left pleural effusion and small amounts of pericardial effusion and the possibility of the misdiagnosis of pericardial effusion, we recommend more attention in the echocardiographic evaluation of these patients and re-evaluation after left pleural effusion drainage.

Multiple diseases such as malignancies, uremia, hypothyroidism, infections, chest trauma, collagen vascular disease, and unknown causes may lead to pericardial effusion and tamponade.

The most common malignant tumors associated with tamponade are carcinoma of the breast, melanoma, and lymphoma. [11] Jeon et al [6] reported lung cancer, followed by breast cancer, in 65.5% and 10.9% of their cases, respectively. A study reported that 15%–20% of the autopsy specimens of patients with malignancy exhibited pericardial or cardiac metastasis. [12] We detected malignancy etiologies in 20.5% of all the cases, with the most common malignant tumors being lung cancer, hematological malignancy, gastrointestinal cancer, and breast cancer, respectively. This distribution of malignant tumors was also reported in other studies. [1]

The rate of pericardial effusion due to benign diseases in our study was 79.5%, which is higher than that reported by previous studies. [1, 2] The prevalence of patients with heart failure in our study was high, so that the prevalence of patients with left ventricular ejection fractions < 55% was 63.6%. Quraishi et al [2] showed normal left ventricular function in 86.4% of their patients.

We showed a history of pericardial effusion drainage in 20 (9.1%) patients, which is lower than the figure reported by Petcu et al [5] (32%–40% of the patients). A previous study reported that the recurrence of pericardial effusion after surgery in patients with cancer-related pericardial effusion was 27.3%. [6] The reason for the low incidence of recurrence in our study may be due to the low prevalence of malignant causes.

Unlike developed countries, TB is the most common cause of significant pericardial effusion in developing countries. [13, 14] In our study, TB was uncommon in that it was responsible for 2.7% (6 patients) of all the cases. In another study from Iran by Mirhosseini et al, [1] the prevalence of TB in symptomatic pericardial effusion was 6%–8.6%. In the study by Quraishi et al [2] from Pakistan, TB was detected in 27% of the patients with massive pericardial effusion. Cardiac tamponade is a rare manifestation of hypothyroidism, [15] and its prevalence in our patients was 2.3%. We had no traumatic cases because our patients were treated in a trauma referral center.

Treatment approaches for patients with tamponade are different in many centers, and there is controversy about the standard procedure. The subxiphoid pericardial drainage technique was first done by Larrey in 1829. [17] The advantages of the subxiphoid technique include simplicity and safety, [3]

inexpensiveness, [1] less postoperative pain, and earlier postoperative extubation [7] and its disadvantage is that it is associated with a high recurrence rate in comparison with the thoracotomy approach.[7]

The thoracotomy approach is more effective at preventing effusion recurrence. [7] However, it is a more invasive operation that is associated with greater potential for morbidity, higher ventilation time, more postoperative pain, [7] higher risk of sudden hypotension during the induction of general anesthesia, and difficulty in obese patients and women with large breasts. [16]

Pericardiocentesis is associated with advantages inasmuch as it is less invasive and it obviates the need for general anesthesia; nonetheless, its disadvantages include great risk of recurrence (as high as 60%) in comparison with window operations, [6, 7] no direct visualization for pericardial biopsy taking, [3] and active bleeding after pericardiocentesis. [6] In our center, in order to avoid cardiac penetrating trauma and subsequent sternotomy and exploration, we usually avoid pericardiocentesis.

At our center, the subxiphoid technique is the preferred option for the majority of patients with tamponade. The recurrence rate in our study was 9.1% (in 20 patients). Celik et al [16] reported a recurrence rate of 2.08% for the left mini-thoracotomy approach for tamponade. In all the recurrent cases, we chose the subxiphoid technique for the second drainage; however, for the third drainage, we opted for the thoracotomy approach. All 3 recurrent patients, who underwent the left mini-thoracotomy approach drainage, had malignancy.

Becit et al [18] reported a recurrence rate of 10% within 1 month following subxiphoid surgical pericardiostomy in 368 patients. Celik et al [16] reported that the nature of the pericardial fluid was hemorrhagic in 37.5%, serous in 60.4%, and purulent in 2.1% of their patients, [16] which is similar to our study.

Our surgical subxiphoid pericardiotomy was done under local anesthesia in 16 (7.3%) patients, which is less than the figure reported by other studies. Celik et al [16] reported surgery under local anesthesia in 77% of their 57 patients. In order to avoid severe hypotension and cardiac arrest in our hypotensive patients, we performed the surgical operations under local anesthesia.

Our postoperative complications were reported in 2.8% of the cases. Jeon et al [6] reported operative morbidity in 12.7% of their study patients, which included atrial fibrillation, prolonged mechanical ventilation, refractory hypotension, constrictive pericarditis, and acute renal failure.

In a study by Petcu et al, [5] hospital mortality was reported in 13.04% of the patients in the subxiphoid technique group and 20.37% in the pericardiocentesis group. In another study, the rate of hospital mortality in patients treated with left mini-thoracotomy was 8.33%. [16] In our study, there was no surgery-related mortality and the hospital mortality rate was 4.5%.

In most studies, the mean volume of the drainage fluid was 600–800 cc. [1, 8] In contrast to our results, Wagner et al [19] showed that the volume of the drained fluid was one of the predictors of poor survival after pericardial effusion drainage. Chiming in with our results, Celik et al [16] showed that there was no correlation between the survival time and the amount of effusion drained.

In our study, the mean survival rate of the patients was not significantly different in terms of demographic and clinical characteristics such as age, sex, and hypotension or echocardiographic characteristics such as the ejection fraction,

the fluid amount, and cardiac chamber collapse. Pulse paradox affected the mean survival rate of our patients (48.58 vs 34.10 mon) with unknown reasons. We found a significant difference between the mean survival rates of sanguineous (no postoperative cases) and serous pericardial effusions (20.5 vs 45 mon).

The underlying disease of patients with tamponade is an established risk factor for survival. [20] Patients with underlying malignancy and malignant pericardial effusion have poor survival in comparison with patients with benign pericardial effusion. [1, 16] Wagner et al, [19] in a review of 179 patients with pericardial window surgery, reported poor overall survival for the lung cancer group (median survival of 5 months). Nonetheless, in a study by Dosios et al, [21] in contrast to our study, there was no significant difference in the mean survival rate between patients with positive and negative cytological or histological results for malignant invasion to the pericardium. Whereas Wang et al [22] reported no significant difference in the survival rates between malignant and benign pericardial effusion cases, we found a significant difference between these groups in our study. The etiology of tamponade and cytological and pathological findings significantly affected the mean survival rate (15.5 vs 45 mon).

In a review of patients with cancer-related pericardial effusion, the mean survival rate was 4 months (range = 0–39 mon) and the 1-year survival rate was 21.8%. [6] In another study, the overall mean survival rate was 10.41 ± 1.79 months and the 1- and 2-year survival rates were 45 ± 7% and 18 ± 5%, respectively. [16] The mean survival time in hematological malignancies was reported to be 29.20 ± 7.59 months in a previous study. [21] In our study, the mean survival time in malignant etiologies was 15.5 months. The survival rates at 1 month (108/124), 1 year (84/124), 2 years (80/124), and 3 years (71/124) were 87.1%, 67.7%, 64.5%, and57.2%, respectively.

CONCLUSIONS

The most common cause of tamponade in our study was cardiac diseases (21%). Malignancy etiologies were responsible for 20.5% of the cases. The most common approach for pericardial effusion drainage was the subxiphoid approach (> 97%), which proved to be a safe and simple procedure. In the current study, the rate of intraoperative mortality was zero and the rates of postoperative complications, hospital mortality, and recurrence were relatively low. Our results revealed an association between left pleural effusion and small amounts of pericardial effusion, which underscores the significance of due attention in the echocardiographic evaluation of these patients. According to our results, patients with primary sanguineous pericardial effusion, malignant etiologies of tamponade, and malignant pericardial effusion had significantly poor survival.

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