

Research Article

Evaluating Pericardiectomy Outcomes and Determinants; an 8-Year Retrospective Study at Tertiary Teaching Hospitals in Ethiopia

Mekonnen F. Senbu^{1,*} , Admikew Bekele Desalegn², Demu Tesfaye Mideksa³

¹Department of Surgery, Adama Hospital Medical College, Adama, Ethiopia

²Department of Surgery, Jijiga University, Jijiga, Ethiopia

³Department of Internal Medicine, Adama Hospital Medical College, Adama, Ethiopia

Abstract

Background: Constrictive pericarditis has a variety of etiologies which leads to severe symptoms and heart failure which affects the quality of life. So far the main modality of treatment is pericardiectomy. **Objective:** The aim of this research was to know pericardiectomy outcomes and determinants among constrictive pericarditis patients who were operated at Tikur Anbessa Specialized Hospital from 2014 - 2022. **Methods:** A retrospective study was done among 65 patients. Data was presented using frequencies with percentages, mean (\pm standard deviation) and/ or median (interquartile range) as required. Perioperative mortality and complications were summarized using incidence density with 95% confidence interval (CI). **Result:** Most patients were in their 20s (53.8%) and where male are (84.6%). The commonest presenting symptom was shortness of breath (100%), fatiguability (96.9%), and coughs (66.2%). The median time of presentation was 12.3 months (IQR, 7.0-25.5). There were also cases with clinical symptoms of tuberculosis (13.8%). The etiology of constrictive pericarditis was infectious in 83.1% of cases. The mean length of surgery was 3.3 ± 0.6 hours. The median duration of hospital stay is 9.0 days (IQR, 7.0-12.0). The incidence rate (IR) of perioperative death was 7.9 per 1000 person-days (PD) of observation (94% CI = 3.3 – 19.2) and the incidence rate of complication was 4.8 per 1000 PD (95% CI = 1.5 -14.9). **Conclusion:** Pericardiectomy is the best treatment for patients with constrictive pericarditis. The majority of patients had a good outcome, with an improvement in symptoms and functional status. The mortality rate was low, and the complication rate was acceptable. However, this study is based on relatively small sample size, and it is a retrospective study from a single center. Hence, further prospective studies are needed to confirm the findings of this study.

Keywords

Pericardiectomy, Constrictive Pericarditis, Out Come

*Corresponding author: mekananfs@gmail.com (Mekonnen F. Senbu)

Received: 31 May 2024; **Accepted:** 3 September 2024; **Published:** 26 September 2024



Copyright: © The Author(s), 2024. Published by Science Publishing Group. This is an **Open Access** article, distributed under the terms of the Creative Commons Attribution 4.0 License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

1. Introduction

1.1. Background

In patients with constrictive pericarditis (CP), a chronic inflammatory condition marked by fibrotic lesions and serous effusions, adherent parietal and visceral pericardium limits ventricular filling and impedes ventricular output. Ventricular compression is brought on by pericardial thickening, adhesions, and sporadic calcifications [1-5, 13], resulting to restrictive heart failure in the end [10], which may be life-threatening for the patient [1-6].

Constriction has an intricate pathophysiology [10]. It is characterized by a reduce in stroke volume and an increase in ventricular diastolic pressures because of the pericardial thickness [6]. It causes the intrathoracic and intracardiac pressures to diverge and increases the dependency of the ventricles. Since the right heart is the circuit with the lowest pressure, it is the one that is most restricted. The mean central venous pressure increases, a and v waves become more pronounced, and the x and y-descents become steeper due to the rigidity of the pericardium. Systemic venous congestion is the initial cause of several clinical features such as pedal edema, hepatomegaly, and ascites. Periodically, recurrent, inexplicable pleural effusions may be the first sign to appear. Afterwards, evidence of decreased cardiac output occur [14].

The diagnosis of constrictive pericarditis is established using typical clinical presentation, which includes abnormal ECG readings and symptoms like pulsus paradoxus, jugular venous pulse, pericardial knock (sometimes called a fast filling sound), and pericardial rub. Echocardiography is the main diagnostic method used to detect constriction, effusion, or effusion with constriction, and to confirm the diagnosis. It also displays floating flakes in the pericardial sac and provides information about vein flow in the liver and inferior vena cava (IVC). Additionally, echocardiography assesses the ejection fraction and eliminates other associated issues. In the modern era, heart CT and MRI have become the standard for diagnosis. Chronic constrictive pericarditis may be more likely to be diagnosed if there are observable clinical signs and calcification in the cardio-pericardial area on imaging. The presence of a normal pericardial picture rules out constrictive pericarditis, while calcification of the pericardium rules out restrictive cardiomyopathy. Computed tomography and magnetic resonance imaging are considered more effective in evaluating pericardial anatomy. Invasive cardiac catheterization and pressure measurements can reveal predominant ventricular filling in the first third of diastole. During mid- and late diastole, when the pericardial sac becomes fixed and stiff, it can no longer stretch, causing the abrupt cessation of heart chamber filling. This restriction equalizes the pressures in the right atrium, right ventricle, and pulmonary wedge pressure during diastole, with the pulmonary wedge pressure reflecting the left heart's diastolic pressure. A pericardium thickness of 7 mm or more is a strong indicator of

constrictive features, but a thickness exceeding 4 mm does not necessarily indicate constriction [10, 13].

Previously, tuberculosis (TB) played a significant role, but nowadays, the majority of cases are of unknown origin or stem from past radiation therapy or surgery. Nonetheless, TB remains a significant cause of pericarditis in many developing countries, particularly in regions like sub-Saharan Africa where HIV infection has become widespread [24]. The natural progression of this condition is not well understood. Typically, without undergoing surgery, CP leads to worsening symptoms and often premature death, as indicated by observational studies and case studies. Furthermore, most patients who have undergone surgery experience an enhancement in their functional abilities and overall quality of life. As a result, the recommended treatment for symptomatic CP is almost always pericardiectomy [9]. In the majority of instances, pericardiectomy proves to be a beneficial intervention. After the diagnosis has been established, the most effective treatment for symptomatic CP remains pericardiectomy, which should be performed promptly [5, 6].

Various surgical methods, including left anterior thoracotomy, bilateral thoracotomies, and median sternotomies, have been employed. Typically, the latter provides the most comprehensive exposure. Pericardiectomy is generally coupled with early hemodynamic stabilization [13, 24].

1.2. Statement of the Problem

In the general population the true incidence of constrictive pericarditis is not well understood due to its potentially subtle and painless nature, making detection challenging. However, traditional estimates indicate that around 6% of autopsies indicate signs of pericarditis, which represents approximately 1/1000 of patients admitted to hospital [3]. Up to 5% of individuals experiencing chest pain are diagnosed with this condition, where only a small percentage develops chronic symptoms. It is believed that 20% of individuals diagnosed with pericarditis may eventually require pericardiectomy. While a history of viral infections, previous heart surgeries, and mediastinal radiation are considered underlying factors in developed countries, the precise cause of pericarditis remains unknown [1]. Between 0.2% and 0.4% of heart surgical procedures lead to CP within the initial two years. TB is the primary cause of pericarditis in underdeveloped countries, often occurring alongside HIV infection and accounting for 22% to 91% of cases [1]. In developed nations, idiopathic factors account for 46.4% of CP cases, while post-cardiac surgery contributes to 19.6%, post-mediastinal radiation to 9.3%, and other causes (such as autoimmune, TB, rheumatic, or mixed) make up the remaining 24.7% of cases [2].

Treatment for constrictive pericarditis involves medical therapy and surgical procedures. Drugs like diuretics are useful for individuals with mild or no symptoms to avoid the

risks of surgery. However, surgical pericardiectomy is the recommended approach for all other cases and provides relief from symptoms. Nevertheless, the operational risk and long-term mortality can vary depending on different factors, with a range of 5 to 10% and 15 to 70%, respectively [10]. In the United States, 21% of hospitalized individuals with constrictive pericarditis finally will undergo surgery [1]. The perioperative mortality rates for Pericardiectomy have varied, resulting in 2 to 15% [1, 2], with different long-term outcomes. Surgical mortality rates for pericardial effusion and constriction were 4.2% and 5.6%, respectively [4]. Many patients undergoing surgery have also associated comorbidities, making it difficult to interpret the findings. Only a few studies have identified the risk factors for unsuccessful outcomes after constrictive pericarditis surgery. Investigations frequently recognize end-organ dysfunction, especially in the liver, kidney, and lungs, as a separate risk factor for death [11].

1.3. Significant of the Study

The result found from this research may contribute to the scientific findings on pericardiectomy outcome especially in resource limited set up.

2. Literature Review

Surgical removal of the pericardium is an effective treatment for pericarditis that does not respond to standard treatments, although it is relatively rare. Despite improving symptoms and the NYHA Class, a successful pericardiectomy carries a moderate to high risk of intermediate and long-term mortality, especially in patients with significant underlying medical conditions [1]. The high risk of death during surgery remains a characteristic of the outcomes of pericardiectomy for constrictive pericarditis. However, surgical intervention can elevate the functional class for most patients who survive long-term. Undergoing surgery early seems to be the most favorable choice. Preoperative clinical factors and concurrent health conditions are crucial in determining the risk of mortality. If a valvular procedure is performed concurrently, the optimal surgical approach is still to be determined [4, 5, 15].

The mainstay of managing constrictive pericarditis remains pericardiectomy. An analysis of current retrospective data shows that most patients who undergo total pericardiectomy see a significant improvement in survival, symptoms, quality of life, hemodynamics, and cardiac function. Following pericardiectomy for constrictive pericarditis, long-term survival is influenced by the original cause, left ventricular systolic function, renal function, serum sodium levels, and pulmonary artery pressure. The safety of pericardiectomy in this group is demonstrated by the relatively high survival rate in idiopathic constrictive pericarditis cases [7, 9, 10].

In summary, pericardiectomy remains a safe option for constrictive pericarditis, even though survival rates vary

significantly depending on the cause. Hypoalbuminemia, hyperbilirubinemia, and post-radiation pericarditis are important risk factors for decreased long-term survival. Lastly, despite changes in the etiologic spectrum over time, outcomes have not been altered. The spectrum has changed over time, but the outcomes have remained consistent. Compared to sub-total pericardiectomy, radical pericardiectomy has shown improved clinical performance and 10-year survival rates in patients with chronic constrictive pericarditis [2, 17].

Long-term clinical outcomes following pericardiectomy in a Japanese population were found to be associated with the underlying cause and the patient's preoperative clinical status. A study conducted in China at a single center indicated that total pericardiectomy is associated with reduced postoperative and late mortality. The extent of pericardial resection should be determined based on the specific circumstances of the patient. Proper preoperative care and complete relaxation of the left ventricle's thickened pericardium can help avoid postoperative issues. The Korean population experienced greater improvement in right ventricular systolic pressure and reduced tricuspid regurgitation over time with radical pericardiectomy compared to the traditional technique [17-19].

For individuals with chronic constrictive pericarditis, poor outcomes after pericardiectomy were associated with preoperative high early diastolic mitral input velocity and diabetes mellitus [20]. This suggests that preoperative Doppler echocardiographic examination may help predict prognosis after pericardiectomy, in addition to diagnosing constrictive pericarditis. Chronic constrictive pericarditis can be surgically addressed to treat diastolic heart failure. This disease is most prevalent in nations where tuberculosis is endemic, such as Nepal. For individuals with tuberculous constrictive pericarditis, undergoing complete pericardiectomy was associated with a heightened risk of postoperative complications. Research has shown that elevated preoperative CVP and a lower preoperative NYHA functional class can forecast the outcome [22, 23]. Based on previous cases at Tikur Anbessa Hospital, pericardiectomy can be performed without the use of CPB and with minimal mortality, ultimately enhancing the functional ability of most patients [24].

3. Objectives

3.1. General Objective

To evaluate pericardiectomy outcomes and its determinants among patients who were operated at TASH from 2014 to 2022.

3.2. Specific Objective

- 1) To determine pericardiectomy outcomes among patients who were operated at Tikur Anbessa specialized Hospital.
- 2) To identify determinants of pericardiectomy outcomes

among patients who were operated at Tikur Anbessa specialized Hospital.

4. Methods

4.1. Study Setting and Period

The study was conducted from February 15/2023 to March 30/ 2023 at Tikur Anbessa specialized Hospital (TASH), a tertiary teaching hospital in Addis Ababa, Ethiopia. The hospital was established in 1972 as the teaching hospital of Addis Ababa University, College of Health Sciences. It is the largest referral hospital in the country with 700 in-patient beds. The Cardiothoracic surgery unit has a total of 15-20 in-patient beds and performs with an average of 288 cases annually.

4.2. Study Design

A retrospective study design employed among constrictive pericarditis patients that were operated in the hospital from 2014 to 2022.

4.3. Eligibility Criteria

4.3.1. Inclusion Criteria

All Patients who underwent pericardiectomy in the hospital during the study period were included.

4.3.2. Exclusion Criteria

Patients with incomplete data on the outcome or major exposure variables on their records were excluded.

4.4. Sampling Technique

A total of 69 cases were operated during the study period. All who fulfill the eligibility criteria were found to be 65 and all of them included.

4.5. Study Variables

4.5.1. Outcome Variable

- 1) NYHA clinical Improvement
- 2) Post-operative outcome
- 3) Recovery
- 4) complication
- 5) Death
 - a. mortality (at 30days)
 - b. mortality (at 1 year)

4.5.2. Exposure Variables

- 1) Age
- 2) sex,
- 3) place of residence

- 4) educational status ...
- 5) Baseline clinical characteristics
 - a. Presenting symptom
 - b. Physical examination findings
- 6) Laboratory parameters
- 7) Radiologic findings
- 8) Intraoperative monitoring
- 9) Operative status
- 10) types of pericardiectomy
- 11) Duration of surgery
- 12) Rhythm
- 13) Etiologic causes
- 14) Prolonged intubation
- 15) Postop hemorrhage
- 16) Post-op follow-up duration
- 17) Rhythm status
- 18) Complications
- 19) Postop NYHA class functional status
- 20) Etiologic evidence of pericarditis

4.6. Operational Definitions

- 1) *Pericardiectomy types*
 - a. Total: the removal of all anterior pericardium between the phrenic nerve and from the great vessels superiorly down to and includes the diaphragm surface [2]
 - b. Subtotal: removal of less than the total [2]
 - c. Completion: completion of the incomplete pericardiectomy for recurrent CP [2]
- 2) Delayed extubation: defined as a postoperative mechanical ventilation lasting >48hours [2]
- 3) Perioperative mortality/ Hospital mortality: death during the initial hospitalization or within 30 days following surgery [9].

4.7. Data Collection and Quality Assurance

Data were collected from the patients' medical record using a data abstraction tool that consists of all the variables. Data on the following variables was recorded; socio-demographic characteristics, preoperative characteristics and intraoperative characteristics that will be retrieved from the medical records (charts and electronic database). The post-operative endpoints will be recorded from follow-up progress notes. A pretest on 5% of randomly selected medical charts was made and the necessary revision on the data collection tool was made based on the test result.

Training on the basics of the data abstraction form and on how to use the form appropriately was given by the principal investigator for four General practitioners and one supervisor for one day. Data was collected from February 15/2023 to March 30/2023. The collected data was checked for its consistency and completeness before any attempt to enter code and analyze it. Data management and analysis were performed using STATA software V 14.0.

4.8. Data Management and Analysis

Data was summarized using frequencies and percentages for categorical variables. For numerical variables, after testing for the assumption of normality using Kolmogorov Smirnov test of normality where p-value of <0.05 indicates skewed distribution, data was summarized with a mean \pm standard deviation (SD) or median with Inter Quartile range (IQR) values for variables with normal or skewed distribution, respectively.

The incidence rate of perioperative mortality and complications were measured using incidence density where person time was calculated using the total number of days of hospital from post-operation to discharge/complication/death for each group and was finally reported as incidence per 1000 person-days (PD) of observation. Furthermore, the 95% CI for the calculated incidence density was reported.

4.9. Ethical Clearance

Ethical clearance was obtained from Department of Surgery Research committee and IRB of the College of Health Sciences, Addis Ababa University. Access to the collected information was limited to the principal investigator and confidentiality was maintained throughout the study.

5. Result

From the 65 patients, majority were in their 20s (53.8%) and were male (84.6%). A large proportion of patients were from Oromia (40.0%), Amhara (26.2%), and Addis Ababa (18.5%). The most common presenting symptom was shortness of breath (SOB) (100%), followed by fatigability (96.9%), and cough (66.2%). The median duration symptom upon admission was 12.3 months (IQR, 7.0-25.5). Clinically active symptoms complex for tuberculosis (TB) were found in 9 (13.8%), and none of the patients has a history of past or current smoking. In terms of etiology, 54 (83.1%) cases were due to infectious conditions and the remaining 11 (16.9%) were idiopathic.

Elevated JVP was present in 38 (58.5%) cases. Pericardial friction rub and pulsus paradoxus were recorded in 6 (9.2%) and 2 (3.1%) patients, respectively. Preoperative cardiac rhythm was normal in all patients. The mean systemic systolic and diastolic blood pressures were 105.8 ± 10.8 mmHg and 69.5 ± 8.7 mmHg, respectively. LVEF and RV function as-

sessments showed a median of 60.0% (IQR=55.0-65.0%) and 19.0 mm (IQR=18.0-20.0), respectively.

The most frequently reported abnormal finding on ECG and CXR were left atrial enlargement in 5 (7.7%) and cardiomegaly in 28 (43.1%) cases, respectively. Echocardiography showed features of effusive and calcified constrictive pericarditis in 7 and 4 patients, respectively and Chest CT scan showed disseminated tuberculosis in 3 patients.

The preoperative functional status of the patients showed that majority of the patients were classified as Class 3 (64.6%) and 100% were Stage C.

During the intraoperative period, invasive monitoring was used in 61 (93.8%) of the patients, and chest surface ECG was used in 100% of patients for non-invasive monitoring. Sternotomy was used in 100% of patients for surgical approach and in all of the cases the surgery was elective. Total pericardiectomy was performed in 64 (98.5%) of the patients, and subtotal pericardiectomy was performed in 1 (1.5%) of the patients. The mean duration of operation was 3.3 ± 0.6 hours. Intraoperative rhythm status was abnormal in only one patient, who had atrial fibrillation. The majority of the patients (83.1%) had etiologic evidence of pericarditis, and 41 patients were treated for tuberculosis. Of these 41 patients, 13 had evidence of TB pericarditis on biopsy.

In 16 (24.6%) patients extubation was delayed. Postoperative abnormal rhythm status was recorded for one patient, who had atrial fibrillation. Postoperative CXR and Echo showed an improvement in the majority of cases, 46 (70.8%) and 60 (92.3%), respectively.

The postoperative functional status of the patients showed that the majority of the patients were classified as Class 1 (47.7%) and 2 (43.1%). In addition, 52 (80.0%) were classified as Stage B. There was no major post-operative bleeding in any of the patients.

Among the 65 patients, 57 recovered and discharged alive, 3 complicated and 5 died. Of the 57 recovered cases, as compared to their preoperative status, 47 recovered with improvement in both NYHA Class and Stage, 6 recovered with improvement in their NYHA Class only, 2 recovered with improvement in their NYHA stage only, and 2 were discharged in same condition as their preoperative status (with Class 2 and Stage C state). The three complicated cases were due to hypocalcemia, atrial fibrillation, and acute kidney injury. The 5 deaths were mainly due to cardiac and respiratory arrest and intractable cardiac shock. (Figure 1)

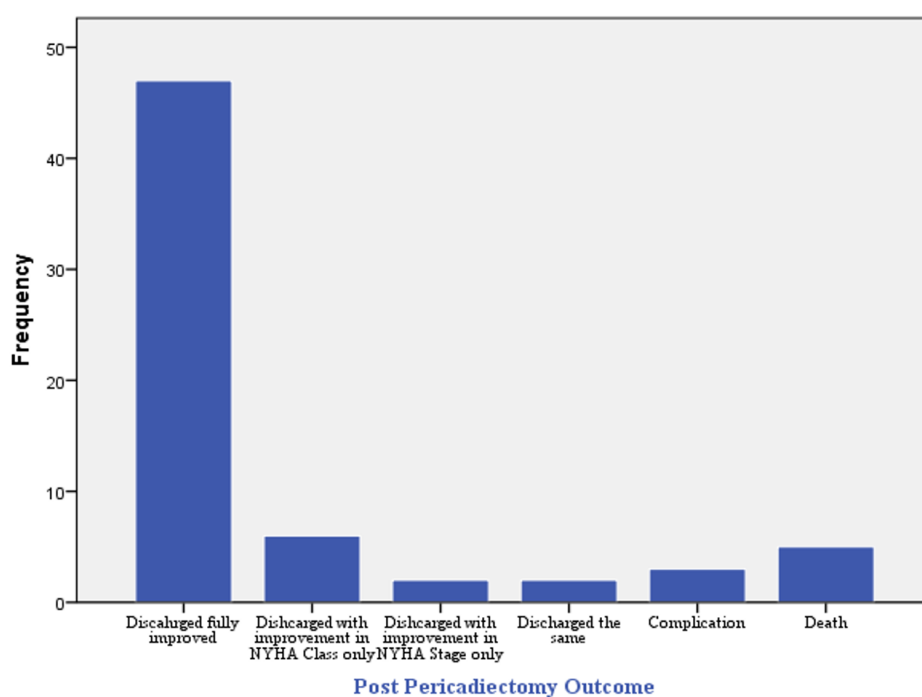


Figure 1. Post-operative outcomes of pericardiectomy among patients with constrictive pericarditis.

Table 1. Sociodemographic and preoperative parameters among constrictive pericardiectomy patients who underwent pericardiectomy (n=65).

Variable	Frequency (%) Median (IQR) Mean \pm SD	Variable	Frequency (%) Median (IQR) Mean \pm SD
Age		Cardiac rhythm status	
12-19	10 (15.4)	Normal	65 (100.0)
20-29	35 (53.8)	Systemic SBP	105.8 \pm 10.8
30-39	10 (15.4)	Systemic DBP	69.5 \pm 8.7
40-60	10 (15.4)	LVEF (in %)	60.0 (55.0-65.0)
Sex		RV function (in mm)	19.0 (18.0-20.0)
Male	55 (84.6)	Laboratory parameters	
Female	10 (15.4)	SGOT	38.0 (29.8-51.5)
Place of residence		SGPT	28.0 (13.0-40.0)
Addis Ababa	12 (18.5)	ALP	150.0 (99.0-223.5)
Oromia	25 (40.0)	BUN	24.0 (16.5-30.0)
Amhara	17 (26.2)	Cr	0.7 (0.5-0.9)
SNNPR	9 (13.8)	Serum K	3.9 (3.5-4.3)
Tigray	1 (1.5)	Serum Na	137.0 (135.0-140.5)
Presenting symptom		Serum Cl	103.0 (99.0-108.0)
Cough	43 (66.2)	ECG	
Chest pain	13 (20.0)	Sinus rhythm	47 (72.3)
SOB	65 (100.0)	Left atrial enlargement	5 (7.7)

Variable	Frequency (%) Median (IQR) Mean \pm SD	Variable	Frequency (%) Median (IQR) Mean \pm SD
Fatigability (body swelling)	63 (96.9)	Left ventricular hypertrophy	2 (3.1)
Weight loss	16 (24.6)	Atrial fibrillation and abnormal T-waves	2 (3.1)
Poor appetite	8 (12.3)	Sinus tachycardia	2 (3.1)
Night sweating	4 (6.2)	Inverted T-wave	2 (3.1)
Palpitation	2 (3.1)	Right atrial enlargement	1 (1.5)
Fever	1 (1.5)	Prolonged T-wave	1 (1.5)
Duration of symptom in months	12.3 (7.0-25.5)	CXR	
Etiology		Normal	11 (16.9)
Idiopathic	11 (16.9)	Cardiomegaly	28 (43.1)
Infectious	54 (83.1)	Others*	16 (24.6)
Comorbidities/ TB symptoms		Echo	
Clinically active symptoms for TB	9 (13.8)	Constrictive pericarditis	54 (83.1)
DVT	2 (3.1)	effusive constrictive pericarditis	7 (10.7)
T4-RVI	1 (1.5)	calcified constrictive pericarditis	4 (6.2)
AKI, SVC thrombosis	1 (1.5)	Chest CT	
Cigarette smoking		Constrictive pericarditis	24 (36.9)
No	65 (100.0)	Effusive constrictive pericarditis	6 (9.2)
JVP (CVP) status		Calcified constrictive pericarditis	4 (6.2)
Normal	27 (41.5)	Disseminated TB with constrictive physiology	2 (3.1)
Elevated	38 (58.5)	Pre-op NYHA functional status Class	
Pericardial friction rub		2	16 (24.6)
No	59 (90.8)	3	42 (64.6)
Yes	6 (9.2)	4	7 (10.8)
Pulsus paradoxus		Pre-op NYHA functional status Stage	
No	63 (96.9)	C	65 (100.0)
Yes	2 (3.1)		

N.B.: Others* include pulmonary edema, pleural effusion, pericardial calcification and lung fibrosis.

Table 2. Intraoperative and postoperative parameters among constrictive pericardiectomy patients who underwent pericardiectomy (n=65).

Variable	Frequency Mean \pm SD	Variable	Frequency
Type of invasive Intra-op monitoring		Prolonged intubation	
Central/peripheral arterial line	61 (93.8)	No	49 (75.4)
Other	4 (6.2)	Yes	16 (24.6)
Type of non-invasive Intra-op monitoring		Postoperative rhythm status	
Chest surface ECG	65 (100.0)	Normal	64 (98.5)
Type of surgical approach		Abnormal (Atrial fibrillation)	1 (1.5)

Variable	Frequency Mean \pm SD	Variable	Frequency
Sternotomy	65 (100.0)	CXR	
Operative status		Normal	46 (70.8)
Elective	65 (100.0)	Pleural effusion	16 (24.6)
Type of pericardiectomy		Right lung fibrosis, right lung opacity, right lower lobe consolidation	3 (4.6)
Total	64 (98.5)	Echo	
Sub-total	1 (1.5)	Improved	60 (92.3)
Duration of operation (in hours)	3.3 \pm 0.6	residual constrictive pericarditis	4 (6.2)
Rhythm status		poor systolic function	1 (1.5)
Normal	64 (98.5)	Post-op NYHA functional status Class	
Abnormal (Atrial fibrillation)	1 (1.5)	1	31 (47.7)
Etiologic evidence of pericarditis		2	28 (43.1)
No	11 (16.9)	3	5 (7.7)
Yes	54 (83.1)	4	1 (1.5)
Treated for TB	41	Post-op NYHA functional status Stage	
Biopsy-TB pericarditis	13	B	52 (80.0)
		C	13 (20.0)

The 65 patients were followed for a median duration/ inpatient follow up/ of 9.0 days (IQR, 7.0-12.0). The incidence rate (IR) of perioperative mortality was 7.9 per 1000 person-days (PD) of observation (94% CI = 3.3 – 19.2). The incidence rate of complication was 4.8 per 1000 PD (95% CI = 1.5-14.9).

6. Discussion

This study investigated the outcomes of pericardiectomy for constrictive pericarditis. The study included 65 patients, with a median age of 27 years and a male predominance (84.6%). The most common presenting symptoms were shortness of breath (100%), fatigue (96.9%), and cough (66.2%). The median duration of symptoms before presentation was 12.3 days. The most common underlying etiology was infectious (83.1%), with tuberculosis being the most common specific diagnosis (13.8%). The presenting pattern in this study is in agreement with what is known so far except for age. The commonest age for constrictive pericarditis is reported in the 60s and there appears to be a male predominance, with some studies reporting a male-to-female ratio of 3:1. The most common presenting symptom is shortness of breath. Other symptoms include fatigue, cough, abdominal pain, and edema. In addition, literatures show that the most common underlying etiology is infectious, accounting for up to 80% of cases. Tuberculosis is the most common specific diagnosis, followed by cancer and autoimmune diseases [16-18]. There are a number of reasons why

pericarditis is more common in young people in developing countries. One reason is that these countries have higher rates of infectious diseases, such as tuberculosis and HIV, which can cause pericarditis. In addition, poor nutrition and exposure to environmental toxins, such as air pollution, can also increase the risk of developing pericarditis. This further is compounded by the lack of access to healthcare, which means that risk factors for pericarditis may not be diagnosed or treated on time to prevent complications [15-17].

In this study, the mean duration of surgery was 3.3 hours. This is in line with other studies conducted so far where a mean duration of pericardiectomy was reported to be around 2.8-3.2 hours (range 1.5-4.5 hours). In addition, the study found that the intraoperative and postoperative rhythm status was abnormal in only one patient (1.5%). The expected intraoperative and postoperative rhythm status during pericardiectomy is usually sinus rhythm. However, some patients may have atrial fibrillation or other arrhythmias. The finding from this study is lower than other studies which reported an intraoperative and postoperative atrial fibrillation in 13-14% of patients had atrial fibrillation and 1-2% of other types of arrhythmias [16-18].

Five patients (7.7%) died during the study period. The most common causes of death were cardiac arrest (3 patients) and respiratory arrest (2 patients). There were three complications (4.6%): hypocalcemia (1 patient), atrial fibrillation (1 patient), and acute kidney injury (1 patient). The overall incidence rate of perioperative mortality was 7.9 per 1000 person-days of

observation. The overall incidence rate of complications was 4.8 per 1000 person-days of observation. The study found that the majority of patients had a good outcome, with an improvement in symptoms and functional status. The mortality rate was low, and the complication rate was acceptable. These results are consistent with the findings of other studies on pericardiectomy for constrictive pericarditis. Three studies published between 2016 and 2018 which investigated the outcomes of pericardiectomy for constrictive pericarditis showed that pericardiectomy was associated with a low mortality rate (2.5-3.3%) and a moderate complication rate (10.7-13.6%). In the majority of patients, pericardiectomy led to an improvement in symptoms and functional status [19-21].

The study's findings are a valuable addition to the existing literature because it addressed a less-studied research question and was conducted in the largest national referral hospital. However, there are some limitations to the study that should be considered when interpreting the findings.

First, because the study was conducted retrospectively and there was insufficient chart recording with limited information on additional exposures, further relevant exposures were not studied. Second, due to the small sample size, further analysis to identify determinants of pericardiectomy outcomes was not possible and thus further generalization of the findings is impossible. Despite these limitations, the study's findings are still valuable and can be used to inform future research on pericardiectomy.

7. Conclusions

These results show that pericardiectomy is a safe and effective treatment for constrictive pericarditis. Most of patients had a good outcome, with an improvement in symptoms and functional status. The mortality rate was low, and the complication rate was acceptable.

However, it is important to note that the study is based on relatively small sample size, and it is a retrospective study from a single center. Hence, further prospective studies are needed to confirm the findings of this study.

Abbreviations

ANOVA	Analysis of Variance
ALP	Alkaline Phosphates
ARR	Absolute Relative Risk
BUN	Blood Urea Nitrogen
CBP	Cardiopulmonary Bypass
CVP	Central Venous Pressure
CXR	Chest x-ray
COPD	Chronic Obstructive Pulmonary Disease
CP	Constrictive Pericarditis
CT	Computed Tomography
Cr	Creatinine
CRR	Cumulative Relative Risk

DM	Diabetes Mellitus
ECG	Electrocardiogram
HIV	Human Immunodeficiency Virus
IRB	Institutional Review Board
HTN	Hypertension
MRI	Magnetic Resonance Imaging
NYHA	New York Heart Association

Acknowledgments

We would like thank you that assisted in data collection, typing the manuscript and also who advised us on statistical analysis of the result.

Funding

We disclose there is no conflict of interest, no funding.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Faiza Z, Prakash A, Namburi N, Johnson B, Timsina L, Lee LS. Fifteen-year experience with pericardiectomy at a tertiary referral center. *J Cardiothorac Surg*. 2021 Jun 22; 16(1): 180. <https://doi.org/10.1186/s13019-021-01561-4> PMID: 34158104; PMCID: PMC8220762.
- [2] George, T. J., Arnaoutakis, G. J., Beaty, C. A., Kilic, A., Baumgartner, W. A., & Conte, J. V. (2012). Contemporary etiologies, risk factors, and outcomes after pericardiectomy. *The Annals of thoracic surgery*, 94(2), 445–451. <https://doi.org/10.1016/j.athoracsur.2012.03.079>
- [3] Gillaspie EA, Stulak JM, Daly RC, Greason KL, Joyce LD, Oh J, Schaff HV, Dearani JA. A 20-year experience with isolated pericardiectomy: Analysis of indications and outcomes. *J Thorac Cardiovasc Surg*. 2016 Aug; 152(2): 448-58. <https://doi.org/10.1016/j.jtcvs.2016.03.098> Epub 2016 Apr 29. PMID: 27210468.
- [4] DeValeria PA, Baumgartner WA, Casale AS, Greene PS, Cameron DE, Gardner TJ, Gott VL, Watkins L Jr, Reitz BA. Current indications, risks, and outcome after pericardiectomy. *Ann Thorac Surg*. 1991 Aug; 52(2): 219-24. [https://doi.org/10.1016/0003-4975\(91\)91339-w](https://doi.org/10.1016/0003-4975(91)91339-w) PMID: 1863142.
- [5] Vistarini N, Chen C, Mazine A, Bouchard D, Hebert Y, Carrier M, Cartier R, Demers P, Pellerin M, Perrault LP. Pericardiectomy for Constrictive Pericarditis: 20 Years of Experience at the Montreal Heart Institute. *Ann Thorac Surg*. 2015 Jul; 100(1): 107-13. <https://doi.org/10.1016/j.athoracsur.2015.02.054> Epub 2015 May 13. PMID: 25979240.

- [6] Murashita T, Schaff HV, Daly RC, Oh JK, Dearani JA, Stulak JM, King KS, Greason KL. Experience With Pericardiectomy for Constrictive Pericarditis Over Eight Decades. *Ann Thorac Surg.* 2017 Sep; 104(3): 742-750. <https://doi.org/10.1016/j.athoracsur.2017.05.063> Epub 2017 Jul 29. PMID: 28760468.
- [7] Avgerinos D, Rabinokov Y, Worku B, Neragi-Miandoab S, Girardi LN. Fifteen-year experience and outcomes of pericardiectomy for constrictive pericarditis. *J Card Surg.* 2014 Jul; 29(4): 434-8. <https://doi.org/10.1111/jocs.12344> Epub 2014 Apr 18. PMID: 24750218.
- [8] Miranda WR, Oh JK. Constrictive Pericarditis: A Practical Clinical Approach. *Prog Cardiovasc Dis.* 2017 Jan-Feb; 59(4): 369-379. <https://doi.org/10.1016/j.pcad.2016.12.008> Epub 2017 Jan 4. PMID: 28062267.
- [9] Bertog SC, Thambidorai SK, Parakh K, Schoenhagen P, Ozduran V, Houghtaling PL, Lytle BW, Blackstone EH, Lauer MS, Klein AL. Constrictive pericarditis: etiology and cause-specific survival after pericardiectomy. *J Am Coll Cardiol.* 2004 Apr 21; 43(8): 1445-52. <https://doi.org/10.1016/j.jacc.2003.11.048> PMID: 15093882.
- [10] Szabó G, Schmack B, Bulut C, Soós P, Weymann A, Stadtfeld S, Karck M. Constrictive pericarditis: risks, aetiologies, and outcomes after total pericardiectomy: 24 years of experience. *Eur J Cardiothorac Surg.* 2013 Dec; 44(6): 1023-8; discussion 1028. <https://doi.org/10.1093/ejcts/ezt138> Epub 2013 Jun 12. PMID: 23761416.
- [11] Busch C, Penov K, Amorim PA, Garbade J, Davierwala P, Schuler GC, Rastan AJ, Mohr FW. Risk factors for mortality after pericardiectomy for chronic constrictive pericarditis in a large single-centre cohort. *Eur J Cardiothorac Surg.* 2015 Dec; 48(6): e110-6. <https://doi.org/10.1093/ejcts/ezv322> Epub 2015 Sep 15. PMID: 26374871.
- [12] Mori M, Mullan CW, Bin Mahmood SU, Yousef S, Pelletier KJ, Mangi AA, Geirsson A. US National Trends in the Management and Outcomes of Constrictive Pericarditis: 2005-2014. *Can J Cardiol.* 2019 Oct; 35(10): 1394-1399. <https://doi.org/10.1016/j.cjca.2019.05.015> Epub 2019 May 20. PMID: 31493971.
- [13] Kumawat M, Lahiri TK, Agarwal D. Constrictive pericarditis: retrospective study of 109 patients. *Asian Cardiovasc Thorac Ann.* 2018 Jun; 26(5): 347-352. <https://doi.org/10.1177/0218492318771490> Epub 2018 Apr 27. PMID: 29703105.
- [14] Gatti G, Fiore A, Ternacle J, Porcari A, Fiorica I, Poletti A, Ecarnot F, Bussani R, Pappalardo A, Chocron S, Folliquet T, Perrotti A. Pericardiectomy for constrictive pericarditis: a risk factor analysis for early and late failure. *Heart Vessels.* 2020 Jan; 35(1): 92-103. <https://doi.org/10.1007/s00380-019-01464-4> Epub 2019 Jun 24. PMID: 31236676.
- [15] Biçer M, Özdemir B, Kan İ, Yüksel A, Tok M, Şenkaya I. Long-term outcomes of pericardiectomy for constrictive pericarditis. *J Cardiothorac Surg.* 2015 Nov 27; 10: 177. <https://doi.org/10.1186/s13019-015-0385-8> PMID: 26613929; PMCID: PMC4662820.
- [16] Nozohoor S, Johansson M, Koul B, Cunha-Goncalves D. Radical pericardiectomy for chronic constrictive pericarditis. *J Card Surg.* 2018 Jun; 33(6): 301-307. <https://doi.org/10.1111/jocs.13715> Epub 2018 May 14. PMID: 29761570.
- [17] Nishimura S, Izumi C, Amano M, Imamura S, Onishi N, Tamaki Y, Enomoto S, Miyake M, Tamura T, Kondo H, Kaitani K, Yamanaka K, Nakagawa Y. Long-Term Clinical Outcomes and Prognostic Factors After Pericardiectomy for Constrictive Pericarditis in a Japanese Population. *Circ J.* 2017 Jan 25; 81(2): 206-212. <https://doi.org/10.1253/circj.CJ-16-0633> Epub 2016 Dec 8. PMID: 27928144.
- [18] Zhu P, Mai M, Wu R, Lu C, Fan R, Zheng S. Pericardiectomy for constrictive pericarditis: single-center experience in China. *J Cardiothorac Surg.* 2015 Mar 19; 10: 34. <https://doi.org/10.1186/s13019-015-0237-6> PMID: 25887705; PMCID: PMC4367887.
- [19] Choi MS, Jeong DS, Oh JK, Chang SA, Park SJ, Chung S. Long-term results of radical pericardiectomy for constrictive pericarditis in Korean population. *J Cardiothorac Surg.* 2019 Feb 6; 14(1): 32. <https://doi.org/10.1186/s13019-019-0845-7> PMID: 30728044; PMCID: PMC6364466.
- [20] Kang SH, Song JM, Kim M, Choo SJ, Chung CH, Kang DH, Song JK. Prognostic predictors in pericardiectomy for chronic constrictive pericarditis. *J Thorac Cardiovasc Surg.* 2014 Feb; 147(2): 598-605. <https://doi.org/10.1016/j.jtcvs.2013.01.022> Epub 2013 Feb 4. PMID: 23380514.
- [21] Acharya A, Koirala R, Rajbhandari N, Sharma J, Rajbanshi B. Anterior Pericardiectomy for Postinfective Constrictive Pericarditis: Intermediate-Term Outcomes. *Ann Thorac Surg.* 2018 Oct; 106(4): 1178-1181. <https://doi.org/10.1016/j.athoracsur.2018.04.048> Epub 2018 May 16. PMID: 29777668.
- [22] Jaiswal LS, Pandit N, Sah B. Surgical treatment of tuberculous chronic constrictive pericarditis: A retrospective observational study from tertiary hospital of eastern Nepal. *Indian J Tuberc.* 2021 Apr; 68(2): 174-178. <https://doi.org/10.1016/j.ijtb.2020.08.002> Epub 2020 Aug 8. PMID: 33845948.
- [23] Fang L, Yu G, Huang J, Zhao W, Ye B. Predictors of postoperative complication and prolonged intensive care unit stay after complete pericardiectomy in tuberculous constrictive pericarditis. *J Cardiothorac Surg.* 2020 Jun 19; 15(1): 148. <https://doi.org/10.1186/s13019-020-01198-9> PMID: 32560663; PMCID: PMC7304169.
- [24] Adem Ali, H. Biluts, A. Bekele. Thoracic surgical unit, Tikur Anbessa Hospital, Department of Surgery, Medical Faculty, Addis Ababa University, Addis Ababa, Ethiopia Vol. 12 No. 1 (2007).