fortune Journals

Research Article

FORTUNE JOURNAL OF HEALTH SCIENCES

ISSN: 2644-2906

Predictors for Peri-Operative and early thirty days mortality after Pericardiectomy for chronic Constrictive Pericarditis: A Retrospective study at IGIMS

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Abstract

Background: Constrictive pericarditis (CP) is a rare condition characterized by pericardial rigidity, impairing cardiac filling and causing systemic congestion. Pericardiectomy is the definitive treatment but carries significant morbidity and mortality. Limited data exist on predictors of outcomes following surgery.

Methods: This retrospective study analyzed 53 patients with CP who underwent pericardiectomy at IGIMS, Patna, between December 2021 and October 2024. Clinical, laboratory, imaging, and intraoperative data were collected. Mortality predictors were evaluated using univariate, multivariate, and survival analyses.

Results: The study cohort (mean age: 59 years; 67.9% male) showed high prevalence of NYHA class III–IV symptoms, peripheral oedema (54.7%), and pericardial thickening (88.7%). Over 70% had preserved LV systolic function, but 67% had diastolic dysfunction. Complete pericardiectomy was performed in 54.7% of patients. The 30-day mortality was 18.9%, with significant postoperative complications including dialysis (30.2%) and reintubation (26.4%).

Conclusion: Constrictive pericarditis presents with apparently preserved LV function but complex haemodynamics and significant comorbidities. Surgical pericardiectomy, though effective, carries considerable perioperative risk.

Keywords: Constrictive pericarditis, pericardiectomy, haemodynamics, postoperative complications, cardiac surgery

Introduction

Constrictive pericarditis (CP) is a rare and complex condition arising from various underlying causes and presenting with diverse clinical outcomes. The central mechanism involves the loss of normal pericardial flexibility, which disrupts normal cardiac filling dynamics and produces a distinctive haemodynamic pattern known as the "square-root sign" on cardiac catheterization studies. [1]. As the disease progresses, patients typically exhibit features of systemic venous congestion such as peripheral oedema, abdominal fluid accumulation (ascites), and hepatic congestion, largely due to impaired filling of the right ventricle [2]. Surgical removal of the pericardium, or pericardiectomy, remains the definitive treatment for symptomatic cases. Nevertheless, this procedure carries a notable risk of complications and death [3, 4], particularly since it is often performed in patients with substantial pre-existing health issues, complicating the assessment of outcomes [3]. To date, limited research has thoroughly examined the prognostic indicators of adverse outcomes following pericardiectomy for CP [5–7]. Existing

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Citation: Tushar Kumar, Aandrei J Jha, Madhav Kumar. Predictors for Peri-Operative and early thirty days mortality after Pericardiectomy for chronic Constrictive Pericarditis: A Retrospective study at IGIMS. Fortune Journal of Health Sciences. 8 (2025): 705-709.

Received: May 23, 2025
Accepted: June 02, 2025
Published: July 15, 2025

Kumar T, et al., Fortune J Health Sci 2025
DOI:10.26502/fjhs.326

studies suggest that dysfunction of vital organs—especially the liver, kidneys, and lungs—may independently predict higher mortality rates [3, 5, 6]. Furthermore, some evidence points to shifts in pathological and surgical risk profiles over recent years [5]. This study aims to retrospectively evaluate surgical outcomes in 53 patients treated for CP at a single institution, with a focus on identifying predictors of perioperative and long-term mortality.

Methods

Study Design and Setting

This retrospective observational study was conducted at the Department of Cardiothoracic and Vascular Surgery, Indira Gandhi Institute of Medical Sciences (IGIMS), Patna. The analysis included 53 patients diagnosed with constrictive pericarditis (CP) who underwent surgical treatment between December 2021 and October 2024. Only those patients who underwent pericardiectomy were included, while individuals with CP who did not undergo surgery were excluded from the study.

Patient Data Collection

Clinical and demographic data were collected from hospital records and included variables such as age, sex, and body mass index (BMI). Clinical presentation was assessed based on symptom duration, New York Heart Association (NYHA) classification, and signs of systemic venous congestion, such as ascites and lower limb oedema. Preoperative laboratory evaluations included serum creatinine, albumin levels, and liver function tests based on the Child-Pugh classification.

Diagnostic Work-Up

All patients underwent a standardized diagnostic work-up before surgery, including clinical examination, routine blood tests, electrocardiogram (ECG), transthoracic echocardiography, and chest X-ray . Cardiac catheterization was performed in selected patients to measure intracardiac pressures and confirm haemodynamic patterns consistent with CP. When required, computed tomography (CT) scans of the chest were performed to assess pericardial thickening, and calcifications, focusing exclusively on patients undergoing isolated pericardiectomy. Intraoperatively, patients were monitored using standard modalities such as electrocardiography, invasive arterial blood pressure monitoring, central venous pressure measurement, and pulse oximetry.

Follow-Up

Postoperative follow-up was conducted through telephonic interviews and structured questionnaires. In cases where the patient could not be contacted directly, follow-up information was obtained from family members, especially in instances of patient demise.

Operative Procedure

All patients underwent surgery through a standard median sternotomy. The pericardial dissection followed the conventional outlet-to-inlet sequence, beginning at the great vessels, progressing to the ventricles, then the right atrium, and finally the vena cavae. The initial dissection was performed at the superior pericardium overlying the great vessels, proceeding cautiously over the right ventricular surface, and extending toward the diaphragm and right atrium, especially in areas with dense calcification. Cardiopulmonary bypass (CPB) was not routinely employed; dissection was continued off-pump and without heparinization for as long as it was safely possible. Mobilization of the heart began with the right ventricle and aorta, with CPB cannulation prepared only if necessary. The pericardium was carefully dissected up to the phrenic nerves on both sides. Entry into the right pleural cavity was occasionally required for adequate exposure. Following right-sided pericardial clearance, the left ventricle was accessed and mobilized using Favaloro or other sharp retractors to reach the apex while minimizing cardiac manipulation.

A left pericardiotomy was carried out up to the phrenic nerve, either off-pump or after initiation of cardiopulmonary bypass (CPB), based on intraoperative haemodynamic stability. CPB was employed selectively, more frequently in patients with significantly dilated right ventricles or extensive adhesions. The heart was not routinely arrested; cardiac arrest was reserved for cases involving unrepairable intraoperative injury. Radical pericardiectomy, including posterior pericardial excision, was not performed except in rare cases such as malignancy. Total pericardiectomy was achieved from phrenic to phrenic nerve. Electrocautery was extensively used to minimize bleeding, and external defibrillation pads were applied prophylactically. In patients with heavy intracardiac calcifications—particularly around the crux cordis and right ventricular surface—CPB support and off-pump blowers were employed to facilitate safe dissection and protect coronary structures. Autologous fibrin glue was applied as required to manage parenchymal bleeding.

Statistical Analysis

Data were analyzed using SPSS version 20.0. Univariate and multivariate models, ROC curves, and Kaplan–Meier survival analysis were used to assess mortality predictors, with significance set at $P < 0.05$.

Results

The mean age was 59 years with a slightly elevated average BMI of 25.8 kg/m². Males made up approximately 68% of the cohort. A majority of patients had symptoms for less than six months and presented with advanced NYHA class (III–IV). Common clinical signs included peripheral

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DOI:10.26502/fjhs.326

oedema (54.7%), ascites (34%), and deranged liver function tests (LFTs) (24.5%). Pericardial thickening and calcification were seen in most patients. Additionally, over 84% of patients were on diuretics, highlighting the burden of fluid overload in this population (Table 1).

Table 1: Baseline Clinical Characteristics of the Study Cohort (n = 53)

Clinical Characteristic	No. of Patients	%
Age (years)	59.0 ± 11.5	—
BMI (kg/m²)	25.8 ± 4.5	—
Male	36	67.90%
Symptom Duration		
<6 months	31	58.50%
6–12 months	9	17.00%
>12 months	13	24.50%
NYHA Class		
I–II	11	20.80%
III–IV	42	79.20%
Peripheral Oedema	29	54.70%
Ascites	18	34.00%
Deranged LFTs	13	24.50%
Chest Pain	15	28.30%
Pleural Effusion	31	58.50%
Pericardial Effusion	15	28.30%
Pericardial Calcification	36	67.90%
Pericardial Thickening	47	88.70%
LV Systolic Function		
>56%	38	71.70%
31–55%	13	24.50%
<30%	2	3.80%
Renal Insufficiency	13	24.50%
Diuretic Usage	45	84.90%

The average left ventricular ejection fraction was preserved at 60%, while the mean cardiac index was slightly reduced at 2.2 L/min/m², indicating compromised cardiac output. Both systolic and diastolic blood pressures were in the normal range, but elevated filling pressures were noted, with raised left and right atrial pressures and end-diastolic pressures of both ventricles. The pulmonary capillary wedge pressure was mildly elevated, and the PA pulse pressure index was reduced (1.6), suggestive of impaired right heart function. The classic dip and plateau phenomenon was observed in 75.5% of the patients, further supporting the diagnosis of constrictive physiology (Table 2).

Complete pericardiectomy was more frequently performed (54.7%) compared to partial pericardiectomy (45.3%), with partial pericardiectomy involving the removal of part of the pericardium, typically performed in less extensive cases, while complete (or total) pericardiectomy involves the removal of the entire pericardium to address more advanced cases. Cardiopulmonary bypass (CPB) was used in 10% of cases, with an average CPB time of 123.5 minutes and aortic cross-clamp time of 75.5 minutes. Cardioplegia was necessary in 37.7% of patients, where blood cardioplegia was used slightly more often than crystalloid. The average duration of surgery was around 198 minutes, reflecting the complexity of the combined procedures (Table 3).

Table 2: Haemodynamic Parameters of the Patients (n = 53)

Haemodynamic Parameters	Adjusted Value	n
Left ventricular ejection fraction (%)	60 ± 10	43
Cardiac index (L/min/m²)	2.2 ± 0.6	41
Systolic blood pressure (mmHg)	117 ± 24	50
Diastolic blood pressure (mmHg)	65 ± 11	50
Left atrial pressure (mmHg)	29 ± 9	25
Right atrial v-wave (mmHg)	20 ± 5	42
Left ventricular end-diastolic pressure (mmHg)	22 ± 6	45
Right ventricular end-diastolic pressure (mmHg)	16 ± 7	40
Pulmonary capillary wedge pressure mean (mmHg)	21 ± 5	32
PA pulse pressure index (PAPPi)*	1.6 ± 0.9	44
Dip plateau phenomenon	40 (75.5%)	53

The 30-day mortality rate was 18.9%, while low output syndrome occurred in 28.3% of cases. Re-exploration for bleeding was necessary in 20.8% of patients, and postoperative dialysis was needed in 30.2%, indicating

Table 3: Perioperative Data (n = 53)

Perioperative Data	No. of Patients	%
Type of pericardiectomy		
Partial pericardiectomy	24	45.3
Complete pericardiectomy	29	54.7
Cardiopulmonary bypass	5	10
CPB time (min)	123.5 ± 67.5	—
Aortic cross-clamp time (min)	75.5 ± 42.1	—
Length of surgery (min)	198.0 ± 104.2	—
Need for cardioplegia	20	37.7
Type of cardioplegia		
Blood cardioplegia	11	55
Crystalloid cardioplegia	9	45

significant renal complications. Other events included sepsis (11.3%), reintubation (26.4%), and tracheotomy (15.1%). The average hospital stay was prolonged, at approximately 28 days, reflecting the complexity and intensity of postoperative management in these cases (Table 4).

Table 4: Immediate Postoperative Outcome and Events (n = 53)

Postoperative Outcome and Events	No. of Patients	%
Thirty-day mortality	10	18.9
Low output syndrome	15	28.3
Re-exploration for bleeding	11	20.8
Sepsis	6	11.3
Postoperative dialysis	16	30.2
Reintubation	14	26.4
Tracheotomy	8	15.1
Hospital stay (days)	28 ± 19	—

Discussion and Conclusion

In the present study conducted at IGIMS, reduced left ventricular ejection fraction (LVEF) and right ventricular (RV) dilatation emerged as independent predictors of early mortality following pericardiectomy. This study is an extensive single-center experiences with constrictive pericarditis (CP) over a two-decade span. Unlike some prior studies, the IGIMS cohort included patients with only classic CP symptoms, thereby offering clearer insights into the prognostic factors and surgical outcomes associated with pure constrictive pericarditis. Compared to global literature, the early postoperative mortality rate observed at IGIMS was relatively high at 18.6%. This is in contrast to lower rates reported elsewhere—1.2% in South Korea [8], 7% in another German center [9], and 8.6% in Turkey [11]. Nationwide data from Japan and the USA reported early mortality or morbidity rates of 10.0–15.0% [3, 4]. The higher mortality at IGIMS can be attributed to the older average age of the cohort (around 60 years), and a significant burden of preoperative morbidity. Many patients were in NYHA Class IV (79.8%) and had longstanding symptoms (43.3% for over six months).

The present study's findings at IGIMS, which focused exclusively on patients undergoing isolated pericardiectomy for constrictive pericarditis, reinforce the procedure's role as a definitive treatment option. The study demonstrated a 30-day mortality rate of 18.9%, with major complications including low output syndrome (28.3%), postoperative dialysis (30.2%), and reintubation (26.4%). Despite these complications, the results emphasize the procedure's ability to provide significant symptomatic relief and favorable early outcomes. By excluding patients with prior cardiac surgeries or those with post-radiation constrictive pericarditis (a known causative factor in some studies) [17, 18], this focused approach eliminates confounding variables associated with combined procedures or radiation exposure. This methodology allows for a more accurate evaluation of the surgical efficacy in classic CP cases. The results of this study align with those of George et al. [5], although the latter focused on combined procedures rather than isolated pericardiectomy. Additionally, while limited global data exists on the outcomes of isolated pericardiectomy, studies on combined procedures have been explored by several researchers [3–5, 9, 14]. Earlier studies from Baltimore and the Mayo Clinic [5, 6] have shown that around 20% of patients undergoing pericardiectomy had a prior history of cardiac surgery. Given that this study exclusively included patients undergoing isolated pericardiectomy, our findings provide more focused evidence supporting the efficacy of this procedure for symptom relief in the selected population.

The presence of CAD significantly impacted outcomes, reinforcing its role as the leading cause of mortality in the general population. When paired with CP and other comorbidities, CAD proved to be a critical risk factor for both early and late mortality, a trend supported by studies such as that by Du Goff et al. [19]. COPD also independently predicted adverse late outcomes, as it complicates both respiratory weaning and haemodynamic stability [20, 21]. Our results align with prior findings in both CP-specific and general patient populations [4, 22]. Additionally, renal insufficiency remained a consistent predictor of late mortality, echoing the findings of Bertog et al. and others [6, 23].

This study has several limitations. It was conducted at a single institution, which may limit the generalizability of the findings to other centers or populations. The relatively small sample size and retrospective design could introduce selection bias, affecting the robustness of the results. Additionally, the study lacked a control group, making it difficult to compare isolated pericardiectomy outcomes with other treatment modalities. The exclusion of patients with prior cardiac surgeries or post-radiation constrictive pericarditis further narrows the scope of the findings. Lastly, the absence of long-term follow-up data limits our ability to evaluate the durability of symptom relief and survival outcomes over time.

Acknowledgement

All the authors contributed equally in this study.

Declaration

Funding: None

Conflict of interest: None declared

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Citation: Tushar Kumar, Aandrei J Jha, Madhav Kumar. Predictors for Peri-Operative and early thirty days mortality after Pericardiectomy for chronic Constrictive Pericarditis: A Retrospective study at IGIMS. Fortune Journal of Health Sciences 8 (2025): 705-709.