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Surgical Treatment of Chronic Constrictive Pericarditis in a Developing Country

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Abstract

Background: Chronic constrictive pericarditis is a rare but serious clinical entity with a poor prognosis in the absence of surgical treatment. The purpose of this study was to report on our experience of subtotal anterior pericardectomy and analyze our surgical results. **Results:** We included 74 patients operated on for chronic constrictive pericarditis in our institution during the period from January 1985 to December 2020. There were 29 female and 45 male patients, with an average age of 28 years (range: 8 - 64 years). 36.5% of patients were in NYHA class III or IV. Physical signs were dominated by peripheral signs of right heart failure in 93.2% of cases. The surgical procedure was a subtotal anterior pericardectomy from the left to the right phrenic nerve, freeing the heart chambers and the large vessels. The surgical results were marked by a functional improvement in 82.4% of the cases. The postoperative complications were marked by a low cardiac output in 8.1% of the cases, a atrial fibrillation in 4.1% of the cases, a haemorrhage in 1.4% of the cases, a haemothorax in 2.7% of the cases. Perioperative mortality was 5.4% patients. The causes of death were low cardiac output in 50% of cases, hemorrhage in 25% of cases, and hepatocellular insufficiency in 25% of cases. We observed a mortality of 2.9% after an average follow-up of 5.17 years ± 4.76 years. All other survivors were asymptomatic and no re-intervention for recurrence was performed. **Conclusions:** Subtotal anterior pericardectomy was the technique we used for the treatment of chronic constrictive pericarditis. It allowed having satisfactory surgical results with a functional improvement and an acceptable morbidity.

Keywords

Constrictive Pericarditis, Subtotal Pericardectomy, Result

1. Introduction

Chronic constrictive pericarditis (CCP) or pericardial constriction is a rare clinical entity (0.5% - 2% of all heart diseases), but serious with a poor prognosis in the absence of surgical treatment [1]. It is a chronic inflammatory disease of the pericardium resulting from the transformation of the latter into a fibrous, rigid and inextensible shell hindering the diastolic expansion of the heart [1]. Pericardectomy remains the sole curative treatment for chronic constrictive pericarditis [2]. Pericardectomy is a surgical technique which consists in surgically removing the pathological pericardium. The purpose of this surgical procedure is to free the heart from the extrinsic compression of the pericardial constriction. Pericardectomy can be subtotal (or partial) or total. Subtotal anterior pericardectomy consists of a resection of the anterior pericardium, extending from the left phrenic nerve to the right phrenic nerve, which allows the heart chambers and the large vascular trunks (aorta, pulmonary artery, superior vena cava and inferior vena cava) to be freed [3] [4]. In the literature, few data on the treatment and results of chronic constrictive pericarditis in Africa [5] are listed compared to a large number of articles on chronic constrictive pericarditis in developed countries [6] [7]. We therefore conducted a study, whose general objective is to report our experience with subtotal anterior pericardectomy in the management of chronic constrictive pericarditis in our institution.

2. Methods

We conducted a retrospective monocentric study, including all patients underwent pericardectomy for Constrictive Pericarditis during the period from January 1985 to December 2020 in our Institution. The data were collected from medical records by referring to an operating sheet that we established at the start of the study. Epidemiological data, functional signs, data from physical examination, data from additional tests (electrocardiogram, radiography thoracic and cardiac imaging data) Informations about the surgical intervention were collected. Patient's clinical and paraclinical data during in-hospital period and during follow-up were noted. (the last control was performed in December 2020).

2.1. Surgical Procedure

The patients were operated on under general anesthesia. An arterial catheter for blood pressure monitoring was placed. A venous catheter for central venous pressure monitoring was also in place. Two peripheral venous lines were in place for infusions. A Cardio Pulmonary bypass (CPB) was provided, as well as a femoral approach, so as to be able to cannulate through this route in case of major prob-

lems during pericardial decortication. However, CPB was not used in our context. The approach was a vertical median sternotomy. The sternum was opened with a circular electric saw, with great care. The pericardium was opened (Figure 1) along a vertical and median line, *i.e.*, opposite the anterior aspect of the right ventricle, to avoid a "blind" start of this dissection in the region of the left coronary vessels. The dissection was continued bi-laterally, from the ends of the initial incision, Pericardectomy was performed with round-tipped scissors, held closed, convex side against the myocardium. On the left, the dissection passed anterior to the anterior aspect of both ventricles and then over the lateral wall of the left ventricle. The pericardium was then excised approximately 1 cm anterior to the left phrenic nerve. Dissection was continued posterior to the left phrenic nerve in the plane between the myocardium and epicardium until the left ventricle was freed, and inferiorly above the diaphragm to free the tip of the heart. Release of the basal vessels, including the trunk of the pulmonary artery, is necessary to avoid postoperative gradients. On the right, the dissection was passed carefully over the right atrioventricular groove and the coronary vessels running through it, as well as the anterior and lateral walls of the right atrium. The pericardium was then excised approximately 2 cm anterior to the right phrenic nerve. The cava orifices were freed from any stricture without touching the posterior aspect of these vessels, since it is sufficient to break the cerclage effect sufficiently to achieve the desired result. The effectiveness of this release was monitored by intraoperative pressure measurement. Some calcified plaques, adherent to the myocardium, were sometimes left in place, their removal involving too great a risk of lesions on the coronary vessels, particularly at the level of the anterior interventricular groove.

2.2. Statistical Analysis

It was performed in a descriptive and analytical manner using EPI info software, version 6. Quantitative data were described by the mean and the standard deviation, while qualitative variables were described by the proportions. Statistical tests were performed with the same software and we used the Fisher exact test for qualitative variables and the student test for quantitative variables. The

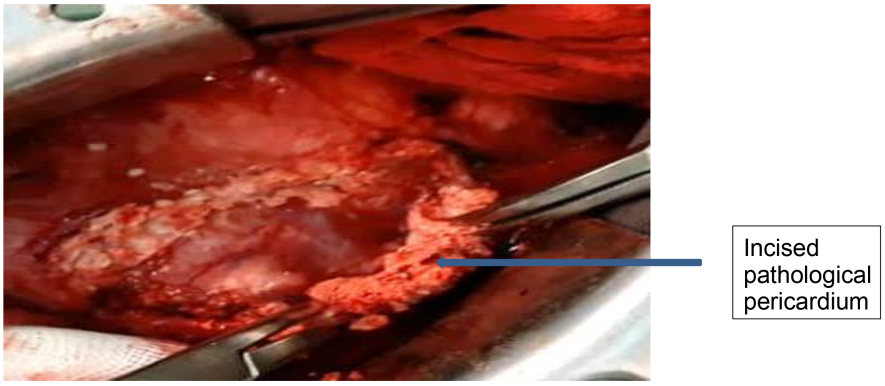

Figure 1. Beginning of pericardectomy after vertical median sternotomy.

threshold of significance was 0.05.

3. Results

We identified 74 patients, 29 of whom were female and 45 male, with a mean age of 28 years (extremes: 8 years and 64 years). A history of pericardial effusion was found in 45.9% of cases. Their main preoperative characteristics are reported in Table 1. Cardiac catheterization was performed in 56.7% of the patients, and allowed the diagnosis to be made by showing the appearance of a dip-flat, an increase in the pressures of the right chambers, and an equalization of the telescopic pressures of the heart chambers. Right adiastole was noted in 43.2% of cases and bilateral adiastole in 13.5% of cases. The thoracic scanner and magnetic resonance imaging were not performed in our context. The histopathological examination of the pericardium allowed us to evoke the diagnosis of tuberculous pericarditis in 25.7% of the cases and a non-specific inflammatory pericarditis in 74.3% of the cases.

3.1. Surgical Outcomes

The procedure allowed a good diastolic re-expansion of the heart, especially of the two ventricles, with a clear improvement of myocardial contractility. We also noted a significant decrease in the pressure at the level of the right atrium (Central Venous Pressure), on the monitor. We also observed an improvement in the hemodynamic state of the patients with an improvement in systolic blood pressure. The average length of stay in the intensive care unit was 3 days [extremes: 2 - 5 days]. The average length of hospitalization was 8 days [extremes: 6 - 18 days]. The postoperative course was simple in 62 cases. Regression of functional signs was noted in 61 cases (82.43%). We noted a regression of dyspnea from NYHA stages III and IV to NYHA stages I and II. The surgical results were also marked by a complete regression of physical signs in 66.2% of cases and partial in 29.7% of patients.

3.2. Morbidity and Mortality

Post-operative complications were marked by 1 case of hemorrhage following a injury of the right atrium, a right hemothorax was found in 2 cases, atrial fibrillation in 3 cases, and a low cardiac out put in 6 cases. The patient with bleeding was taken back to the operating room. Hemostatic stitches were placed on the right atrial injury. The hemothoraxes were treated by placing chest drains. The evolution was satisfactory after the thoracic drainage. We recorded 4 deaths (a mortality of 5.4%). The deaths were due to hemorrhage following a right atrium injury in one case. Two (2) patients died as a result of low cardiac output. And one 37-year-old patient died at 30 days postoperatively of hepatocellular failure in a context of hepatic cirrhosis (Table 2).

3.3. Risk Factors

The predictive factor of immediate postoperative mortality in our series was the

Table 1. Pre-operative characteristics of patients.

Parameters	values
Fonctionnal Signs **n (%)**	
NYHA class	
II	47 (63.5)
III	24 (32.4)
IV	3 (4.1)
chest pain	8 (10.8)
exertional hepatalgia,	19 (25.7)
cough	16 (21.6)
Physical signs **n (%)**	
Hepatomegaly	69 (93.2)
Hepato jugular reflux	68 (91.9)
Edema of the lower limbs	67 (83.8)
Ascites	64 (86.5)
Spontaneous turgidity of the jugular veins	51 (68.9)
Collateral venous circulation	47 (63.5)
Pleural effusion	46 (62.2)
Splenomegaly	3 (4.1)
Fever	3 (4.1)
Facial puffiness	2 (2.7)
Alteration of general condition	2 (2.7)
Jaundice	2 (2.7)
chest radiograph	
mean cardiothoracic ratio mean (extreme)	0.51 (0.45 - 0.57).
Pericardial calcifications n (%)	42 (56.7)
pleural effusions n (%)	25 (33.8)
electrocardiogram	
sinus rhythm n (%)	47 (63.5)
atrial fibrillation n (%)	14 (19)
peripheral micro-voltage n (%)	29 (39.2)
Doppler echocardiography	
Pericardial effusion n(%)	21 (28.4)
The mean ejection fraction mean(extreme)	0.58 (0.49 to 0.68)

Table 2. Surgical outcomes of pericardectomy.

Complications	Number (n)	Percentage (%)
Low cardiac output	06	8.10
Atrial fibrillation	03	4.05
Hemothorax	02	2.70
Hemorrhage	01	1.35

preoperative NYHA functional stage III-IV (p = 0.022) (Table 3).

3.4. Follow-Up

After an average follow-up of 5.17 years ± 4.76 (Extreme 0.5 and 25 years) we observed 2 deaths. That is a mortality of 2.9%. One patient in atrial fibrillation died of thrombo-embolic complications following poor compliance with the anticoagulant treatment. The second patient died following refractory right heart failure one year after pericardectomy. All other survivors were asymptomatic and no re-intervention for recurrence was performed.

Table 3. Risk factors.

Risk Factor	Alive (n = 70)	Deceased (n = 4)	P
Age (in years)	29 (11 - 43)	30 (8 - 64)	0.09
Female gender n (%)	29 (41.4)	3 (75)	0.299
Functional stage III-IV n (%)	20 (28.6)	4 (100)	0.022
chest pain n (%)	7 (10)	1 (25)	0.21
exertional hepatalgia n (%)	17 (2.4)	2 (50)	0.16
cough n (%)	15 (2.1)	1 (25)	0.41
Hepatomegaly n (%)	65 (92.8)	4 (100)	0.35
Hepato jugular reflux n (%)	64 (91.4)	4 (100)	0.35
Edema of the lower limbs n (%)	63 (90)	4 (100)	0.33
Ascites n (%)	60 (85.7)	4 (100)	0.27
Spontaneous turgidity of the jugular veins n (%)	47 (67.1)	4 (100)	0.35
Collateral venous circulation n (%)	43 (61.4)	4 (100)	0.07
Pleural effusion n (%)	44 (62.8)	2 (50)	0.31
Splenomegaly n (%)	2 (2.9)	1 (25)	0.08
Fever n (%)	2 (2.9)	1 (25)	0.08
Facial puffiness n (%)	1 (1.4)	1 (25)	0.054
Alteration of general condition n (%)	1 (1.4)	1 (25)	0.054
Jaundice n (%)	1 (1.4)	1 (25)	0.054
mean cardiothoracic ratio (*mean*)	0.51 ± 0.033	0.50 ± 0.012	0.119
Pericardial calcifications n (%)	39 (55.7)	3 (75)	0.256
atrial fibrillation n (%)	12 (17.1)	2 (50)	0.089
peripheral micro-voltage n (%)	28 (40)	1 (25)	0.308
Pericardial effusion n (%)	21 (30)	0 (0)	0.127
The mean ejection fraction (*mean*)	0.58 ± 0.07	0.54 ± 0.04	0.138
RVEDP (*mean*)	19.6 (8 - 34)	16.8 (15 - 37)	0.12

RVEDP: Right Ventricle End Diastolic Pressure.

4. Discussion

4.1. Surgical Data

Surgery for constrictive pericarditis remains the only effective treatment for this potentially curable disease [6] [8], with good medium and long term results, knowing that these results depend on the delay of the surgery initiation [9]. The treatment consists of freeing the heart from extrinsic compression. The approach to the heart was a vertical median sternotomy in all our operated patients (100%). Currently, pericardectomy is performed by median sternotomy or left anterolateral thoracotomy [8]. Median sternotomy is considered the classical route and is widely used by many surgical teams [5] [8] [10] [11]. This approach allows sufficient pericardial resection to decompress the myocardium and improve cardiac function. Therefore, it is clear that the teams that perform both approaches preferentially use it in 76% to 97.5% of patients [3] [12] [13] [14]. We performed subtotal anterior pericardectomy in all our patients. Like us, several teams [10] [15] had the same surgical approach. Until very recently, there was no series in the literature to confirm the interest of a total pericardial resection [16]. It seems reasonable to consider the widest possible exeresis to allow the re-expansion of the 2 ventricles [17] at the price of a longer surgery; of poorly tolerated manipulations and of cardiac injuries. Some authors think that one should not hesitate to use cardiopulmonary bypass (CPB) to widen the pericardectomy procedure because the risk inherent in CPB seems to be less than the benefit brought by the widening of the pericardectomy that it will allow [18]. Others only use it in case of technical problems or associated cardiac procedures because of the increased risk of bleeding that it entails [16]. Hemorrhage is the main danger of this procedure [19]. Tearing of the pellucid and fragile right atrium was the cause of one death in our early practice. It is therefore necessary to be more careful and meticulous during this pericardial decortication in order to limit or even avoid intraoperative accidents [20]. Furthermore, intraoperative incidents were represented by 3 right atrial injuries. These lesions were corrected by hemostatic stitches during the same operation.

4.2. Surgical Results

Pericardial decortication allowed the improvement of the functional status of our patients. The postoperative status was favorable; since more than 80% of the patients showed a clear improvement of their symptomatology [1]. Pericardectomy improves most of the patients very quickly since 80% to 90% of the patients are in class I or II of the NYHA (New York Heart Association), whereas 73% were in class III or IV preoperatively, whatever the etiology. The functional results in the short, medium and long term are satisfactory [21]. The functional improvement obtained is maintained on the long run, except in the rare cases of incomplete intervention with recurrence of the constriction [1] [22]. In terms of postoperative morbidity, low cardiac output was the most common complication in our series. Similarly, Zhu [23] in China reported that low cardiac output

represented more than half of the complications observed. Low cardiac output was the most common complication after total pericardectomy in China. The most common complication after pericardectomy is the occurrence of congestive heart failure in 10% - 35% of cases [21]. There is a relationship between preoperative functional class (class III and IV) and the occurrence of low cardiac output syndrome. Furthermore, the use of CEC increases the incidence of low cardiac output. Intraoperative mortality is considered to be low; less than 1% in the study by Ling *et al.* [4]. In-hospital mortality varies from 5.4% to 18.6% in the literature. [6] [10] [14] [23] [24] [25]. The most frequent cause of mortality in the perioperative period is of cardiovascular origin: massive hemorrhages in the intraoperative or immediate postoperative period and then episodes of low cardiac output [6]. Secondary death by myocardial decay is due to inflammatory phenomena secondary to epicardial injury [25]. The most common cause of early death was low cardiac output [26], which is consistent with our observation. Surgical removal of the pericardium is associated with an operative mortality rate of 5% to 20% in various large series. Myocardial atrophy after prolonged constriction, residual constriction, or concomitant myocardial process could lead to prolonged heart failure despite successful pericardectomy. [27]. Poor prognostic parameters have been reported by several authors. We have noted as a risk factor the functional stage III-IV of the NYHA in the preoperative period. This parameter has also been reported by several authors [10] [14] [15]. We did not find the involvement of other risk factors such as age, female gender, RVEDP, calcification and Atrial fibrillation. Indeed, operative mortality and episodes of low cardiac output correlated in McCaughan's study [16] with preoperative functional stage. Seifert *et al.* [21] demonstrated a correlation between functional class and operative mortality; and identified a relationship between right ventricular end-diastolic pressure (RVEDP) and risk of death after surgery. Age was the second independent prognostic factor also found in the series of Bertog *et al.* [12] and Ling *et al.* [5]. The role of calcifications in postoperative outcomes is controversial, with no influence in the series of Bertog [12], it is an independent predictor of postoperative mortality in the series of Ling *et al.* [28], but without influence on survival.

4.3. Study Limitations

- The retrospective nature of the study with data recruitment bias.
- The follow-up of patients was not complete.

5. Conclusion

Subtotal anterior pericardectomy by vertical median sternotomy was our therapeutic strategy for the surgical management of all chronic constrictive pericarditis in our institution with good short-term results. Low cardiac output was therefore the most frequent cause of morbidity and mortality. The predictive factor of mortality was the preoperative NYHA functional stage III-IV.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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List of Abbreviations

CPB: Cardiopulmonary Bypass
NYHA: New York Heart Association
RVEDP: Right Ventricle Enddiastolic Pressure
CCP: Chronic Constrictive Pericarditis