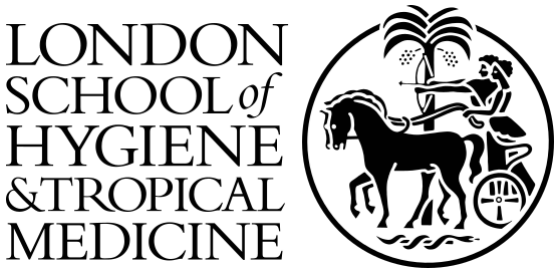

Cardiovascular Topics

The effects of HIV/AIDS on the clinical profile and outcomes post pericardiectomy of patients with constrictive pericarditis: a retrospective review

DP Naidoo, G Laurence, B Sartorius, S Ponnusamy

Abstract

Objective: The clinical profile and surgical outcomes of patients with constrictive pericarditis were compared in HIV-positive and -negative individuals.

Methods: This study was a retrospective analysis of patients diagnosed with constrictive pericarditis at Inkosi Albert Luthuli Central Hospital, Durban, over a 10-year period (2004–2014).

Results: Of 83 patients with constrictive pericarditis, 32 (38.1%) were HIV positive. Except for pericardial calcification, which was more common in HIV-negative subjects (n = 15, 29.4% vs n = 2, 6.3%; p = 0.011), the clinical profile was similar in the two groups. Fourteen patients died pre-operatively (16.9%) and three died peri-operatively (5.8%). On multivariable analysis, age (OR 1.17; 95% CI: 1.03–1.34; p = 0.02), serum albumin level (OR 0.63; 95% CI: 0.43–0.92; p = 0.016), gamma glutamyl transferase level (OR 0.97; 95% CI: 0.94–0.1.0; p = 0.034) and pulmonary artery pressure (OR 1.49; 95% CI: 1.07–2.08; p = 0.018) emerged as independent predictors of pre-operative mortality rate. Peri-operative complications occurred more frequently in HIV-positive patients [9 (45%) vs 6 (17.6%); p = 0.030].

Conclusions: Without surgery, tuberculous constrictive pericarditis was associated with a high mortality rate. Although peri-operative complications occurred more frequently, surgery was not associated with increased mortality rates in HIV-positive subjects.

Keywords: constrictive pericarditis, HIV, pericardiectomy

Submitted 16/5/18, accepted 5/3/19

Cardiovasc J Afr 2019; **30**: online publication www.cvja.co.za

DOI: 10.5830/CVJA-2019-015

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Constrictive pericarditis remains an uncommon yet treatable cause of heart failure.[1,2] The hallmark of constrictive pericarditis is impaired ventricular diastolic filling caused by a thickened, fibrosed pericardium, resulting in decreased stroke volume and varying degrees of systemic venous congestion.[2-5] The natural history of this disorder remains unknown.[6]

While medical therapy has been used to successfully treat patients with constriction in its early stages, surgical pericardiectomy remains the only treatment for chronic constrictive pericarditis.[7,8] The surgical mortality rate remains high and has been reported to be between five and 14% in multiple large series.[1,2,6,9-15]

Over the past two decades, there has been a changing spectrum of constrictive pericarditis in the developed world, with a declining incidence of infective aetiologies, in particular tuberculosis.[1,3] In sub-Saharan Africa, tuberculosis remains the dominant cause; about 30 to 60% of patients diagnosed with tuberculous pericarditis progress to constriction despite appropriate anti-tuberculous therapy and adjunctive corticosteroids.[16]

The effect of HIV on the incidence, natural history and surgical outcomes of patients with constrictive pericarditis has not been adequately documented.[2] Recent data suggest that co-existing HIV infection may modify the clinical manifestations and natural history of tuberculous pericarditis and resultant constriction.[17,18] Our study was designed to evaluate the clinical profile and surgical outcomes of HIV-positive and -negative patients with constrictive pericarditis.

Methods

This study was a retrospective chart review of all patients referred to Inkosi Albert Luthuli Central Hospital in Durban, KwaZulu-Natal, for evaluation and management of suspected constrictive pericarditis during the period 2004–2014. Patients eligible for inclusion in the study constituted those in whom the diagnosis of constrictive pericarditis was confirmed using a combination of clinical symptoms and signs associated with typical echocardiographic and computer tomography (CT) scan findings.

Clinical supporting features included peripheral oedema, ascites, pleural effusions, hepatomegaly, elevated jugular venous pressure and pericardial knock. Typical echocardiographic features of constriction were a thickened echogenic pericardium accompanied by paradoxical interventricular septal motion, and dilated non-compressible hepatic veins and inferior vena cava.

Thoracic CT scans were used to confirm pericardial thickening and calcification, and to demonstrate lymph node enlargement.

Tuberculosis (TB) as the cause for constrictive pericarditis was inferred from a history of previous diagnosis of tuberculosis (pulmonary or extrapulmonary), or previous treatment for tuberculosis. Proven tuberculosis was defined by isolation of the organism or typical histological findings. Patients in whom the diagnosis of constrictive pericarditis was incorrect were excluded from the study population.

Informed consent for HIV testing was obtained from all patients with suspected constriction who were referred to Inkosi Albert Luthuli Hospital with a view to surgical pericardiectomy. Relevant data (demographics, HIV status, clinical symptoms, signs and symptoms, and laboratory, echocardiographic, radiological and operative data) and follow-up findings were extracted.

In the subset that underwent pericardiectomy, constrictive pericarditis was confirmed intra-operatively by identifying constrictive features with pericardial thickening and fibrosis. Surgery was performed by median sternotomy without cardiopulmonary bypass in all but one patient. At operation the entire ventricular epicardium, apex and diaphragmatic surface of the heart was freed. The pericardium was removed anteriorly extending laterally to the phrenic nerves and the posterior pericardium was left *in situ* after being freed from the epicardium. Any resection less than this was deemed a partial pericardiectomy. Immediate peri-operative mortality was defined as any death occurring during the index hospitalisation.

The study was approved by the Biomedical Research Ethics Committee of the University of KwaZulu-Natal (BE 324/15).

Statistical analysis

Data were analysed using Stata 13.0 (StataCorp 2013, Stata Statistical Software: Release 13, College Station, TX: StataCorp LP). Continuous variables were summarised using mean and standard deviation or median and interquartile range. Differences in means of continuous predictors by HIV status (two groups) were assessed using the student's *t*-test. If the data were not normally distributed then the Kruskal–Wallis equality-of-populations rank test was employed instead. Association between HIV status and categorised explanatory variables/risk factors were assessed using a Pearson chi-squared (χ^2) test. Multivariate logistic regression was employed to estimate the

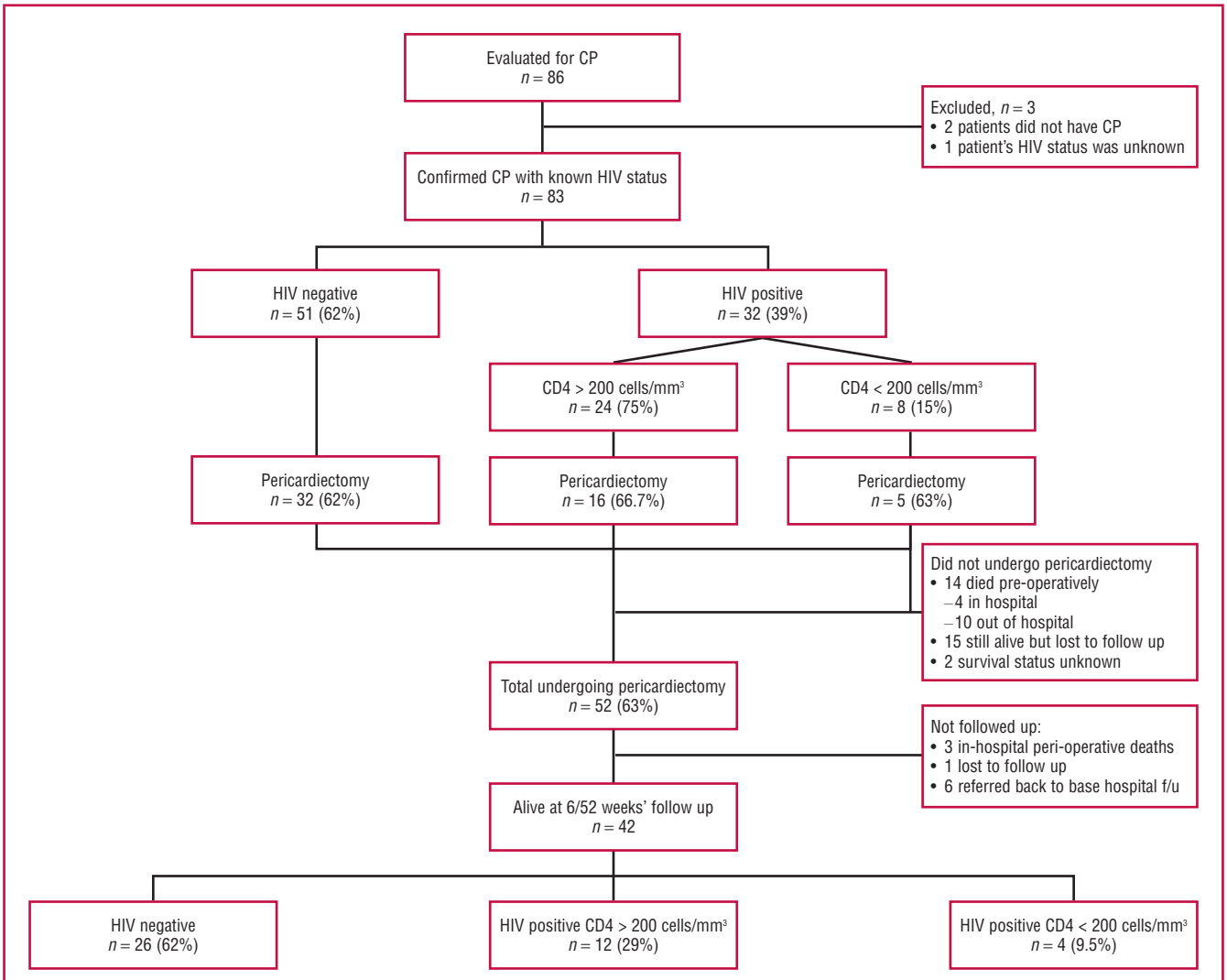

Fig. 1. Early outcome of patients with constrictive pericarditis (CP).

strength of association (odds ratios) between the explanatory predictors and HIV status. A *p*-value of < 0.05 was considered statistically significant.

Results

Pre-operative clinical profile

A total of 86 patients were eligible for inclusion during the study period (Fig. 1). Three patients were excluded, (incorrect diagnosis: $n = 2$, HIV status unknown: $n = 1$) leaving 83 (43 male, 40 female) for analysis. The mean age of the total sample was 37.98 ± 12.91 years (range 19–69). Of these patients, 32 (38.6%) were HIV positive, of whom 21 (65.6%) were on antiretroviral therapy, and of these, 19 (59%) patients were virally suppressed (viral load < 1 000 copies/ml). Three patients who were not on antiretroviral therapy had viral loads < 1 000 copies/ml. In total 8/32 (25.0%) patients had a CD4 count of less than 200 cells/mm^3. The baseline characteristics stratified by HIV status are shown in Table 1.

The aetiology of constriction was tuberculosis in 80/83 (96.3%) patients. Constriction was deemed to have followed viral pericarditis in two patients and the third developed constriction following repeated radio-ablation procedures for tachyarrhythmias. Tuberculosis was proven in 22 (26.5%) patients and was considered the probable aetiology in a further 58 (69.5%) patients. Although proven tuberculosis was identified more frequently in HIV-positive (40%) compared to HIV-negative patients (17.6%), this finding was not statistically significant.

The mean body weight of HIV-positive patients was 5 kg less those who were HIV negative (62.77 ± 12.01 vs 67.69 ± 13.05 kg; $p = 0.09$) but this finding was also not statistically significant. Moderate dyspnoea (NYHA class II) was present in almost two-thirds (63.9%) of the patients and severe symptoms were present in 32.5% (NYHA class III and IV) of patients. Similarly, two-thirds ($n = 57$; 68.7%) of patients had ascites. There was no difference in the clinical characteristics between HIV-positive and -negative patients except for peripheral oedema, which was significantly more frequent in HIV-negative patients (86.2 vs 65.6%; $p = 0.026$). Atrial fibrillation was documented in five patients (all HIV negative), four of whom had extensive pericardial calcification on chest radiography.

All patients (n=83) had chest radiographs and echocardiograms and 77 (94%) had thoracic CT scans. A total of 17 patients (20.5%) had pericardial calcification on the chest radiograph and one additional patient had pericardial calcification identified on CT scan only. Extensive pericardial calcification was more common on the chest radiograph in HIV-negative compared to HIV-positive patients ($n = 15$, 29.4 vs $n = 2$, 6.3%; $p = 0.011$). Mediastinal lymphadenopathy was identified in 47 (61%) patients and there was no difference between HIV-positive and -negative patients ($p = 0.642$)

On echocardiography, effusive constrictive pericarditis was found in seven (8.4%) patients, of whom four were HIV negative and three HIV positive. There was no significant difference in the ejection fraction (51.88 ± 7.5 vs 52.69 ± 4.96%; $p = 0.593$) and pulmonary arterial pressure (33.88 ± 8.86 vs 34.96 ± 7.76 mmHg; $p = 0.571$) between HIV-negative and -positive patients, respectively.

Laboratory data showed no significant differences in haemoglobin, white cell count, urea, creatinine and albumin

Table 1. Baseline characteristics of study patients stratified by HIV status

Characteristics	*All (n = 83)*	*HIV negative (n = 51)*	*HIV positive (n = 32)*	p-*valve*
Age (years)	37.98 ± 12.91	38.82 ± 14.56	36.63 ± 14.56	0.454
Weight (kg)	65.75 ± 12.81	67.69 ± 13.05	62.77 ± 12.01	0.91
Gender				4.24
Male	43(51.8)	29 (56.9)	14 (43.75)	
Female	40 (78.2	22 (43.1)	18 (56.35)	
Aetiology of pericarditis				0.140
Probable tuberculosis	58 (69.9)	39 (76.5)	19 (59.4)	
Proven tuberculosis	22 (26.5)	9 (17.6)	13 (40.6)	
Other	3 (3.6)	3 (5.9)	0	
NYHA functional class				0.481
I	3 (3.6)	2 (3.9)	1 (3.1)	
II	53 (63.9)	33 (64.7)	20 (62.5)	
III	22 (26.5)	4 (7.8)	1 (3.1)	
IV	5 (6.0)	4 (7.8)	1 (3.1)	
Examination				
SBP (mmHg)	110.83 ± 11.85	110.78 ± 11.67	110.91 ± 12.32	0.963
DBP (mmHg)	70.57 ± 10.63	71.43 ± 9.86	69.19 ± 11.78	0.352
Pulse rate (beats/min)	88.76 ± 14.72	86.35 ± 14.74	92.59 ± 14.05	0.060
Jugular vv pressure	77 (92.8)	48 (94.1)	29 (90.6)	0.358
Pericardial knock	43 (51.8)	24 (47.1)	19 (59.4)	0.274
Hepatomegaly	76 (91.6)	46 (90.2)	30 (93.8)	0.767
Ascites	57 (68.7)	35 (68.3	22 (68.8)	0.991
Oedema	65 (78.3)	44 (86.2)	21 (65.6)	0.026
Chest X-ray				
Pericardial calcification	17 (20.5)	15 (29.2)	2 (6.3)	0.011
Pleural effusion	67 (80.7)	43 (84.3)	24 (75.0)	0.295
Echocardiography				
Ejection fraction (%)	52.19 ± 6.61	51.88 ± 7.50	52.69 ± 4.96	0.593
End-diastolic dimension	47.95 ± 7.793	47.4 ± 7.92	48.81 ± 8.01	0.435
Left atrial size (mm)	43.85 ± 8.57	44.86 ± 9.5	42.28 ± 6.70	0.185
Septal bounce	81 (97.6)	49 (96.1)	32 (100.0)	0.257
PA pressure (mmHg)	34.31 ± 8.41	33.88 ± 8.86	34.96 ± 7.76	0.571
Dilated IVC/hepatic vv	73 (97.3)	45 (100.0)	28 (93.3)	0.157
CT chest				
Pleural effusion	58 (75.3)	37 (80.4)	21 (67.7)	0.282
Pericardial thickening	73 (94.8)	45 (97.8)	28 (90.3)	0.297
Pericardial calcification	18 (23.4)	15 (32.6)	3 (9.7)	0.032
Lymphadenopathy	47 (61.0)	27 (58.7)	20 (64.5)	0.64
Laboratory results: mean ± SD				
Haemoglobin (g/dl)	12.78 ± 1.75	12.91 ± 1.76	12.58 ± 1.74	0.418
White cell count (10^9 cells/l)	5.15 ± 1.47	5.25 ± 1.48	4.99 ± 1.46	0.444
Platelets (10^{12} cells/l)	251.86 ± 84.37	244.20 ± 79.82	264.06 ± 91.11	0.299
Sodium (mmol/l)	136.96 ± 3.33	137.27 ± 3.50	136.47 ± 3.03	0.286
Urea (mmol/l)	60.58 ± 2.57	6.40 ± 2.79	6.86 ± 2.20	0.286
Creatinine (µmol/l)	81.70 ± 20.57	81.76 ± 20.05	81.59 ± 21.55	0.971
Albumin (g/l)	37.60 ± 6.33	38.04 ± 5.99	36.91 ± 6.89	0.431
AST (U/l)	39.35 ± 13.59	37.22 ± 10.51	42.28 ± 16.69	0.110
ALT (U/l)	25.21 ± 16.94	20.71 ± 10.70	32 ± 22.06	0.002
Alkaline PO_4 (U/l)	167.40 ± 89.50	146.02 ± 67.70	201 ± 108.82	0.005
Gamma GT (U/l)	249.16 ± 224.09	172.96 ± 104.76	370 ± 300.59	< 0.001

Data presented as mean ± standard deviation for continuous variables and *n* (%) for categorical variables. NYHA, New York Heart Association; SBP, systolic blood pressure; DBP, diastolic blood pressure; PA pressure, pulmonary artery pressure; IVC, inferior vena cava; CT, computed tomography; AST, aspartate aminotransferase; ALT, alanine aminotransferase; alkaline PO_4, alkaline phosphatase; gamma GT, gamma glutamyl transferase.
CT scanning was not undertaken in six subjects (five HIV-negative and one HIV-positive subject).
No results for dilated IVC and hepatic veins for eight subjects (six HIV-negative and two HIV-positive subjects).

levels between HIV-negative and -positive patients. Of note, alkaline phosphatase (146.0 ± 67.7 vs 201.0 ± 108.8 U/l; p = 0.005) and gamma glutamyl transferase (172.96 ± 104.76 vs 370 ± 300 U/l; $p \leq 0.001$) levels were significantly elevated in HIV-positive patients.

Pre-operative mortality rate

Of the initial study cohort of 83 patients with constrictive pericarditis, 31 (37.3%) patients did not undergo immediate pericardiectomy. Of these 31 subjects, four died in hospital shortly after admission (all HIV negative) from a low-cardiac-output state, and the remaining 27 who were offered surgery did not return for the operation. Survival status of those lost to follow up was established telephonically as well as by checking the national registry of deaths. In this way it was established that a further 10 had died out of hospital (HIV positive: n = 4), yielding a total pre-operative mortality rate of 16.7% (14/83) (95% CI: 9.5–26.6%).

Bivariate logistic regression analysis identified seven predictors of pre-operative mortality (Table 2). These were age (OR 1.11; 95% CI: 1.04–1.18; $p \leq 0.001$), levels of haemoglobin (OR 0.67; 95% CI: 0.45–0.99; p = 0.031), albumin (OR 0.90; 95% CI: 0.82–0.99; p = 0.019) and aspartate aminotransferase (OR 0.91; 95% CI: 0.85–0.98; p = 0.003), and pulmonary artery pressure (OR 1.13; 95% CI: 1.05–1.22; $p \leq 0.001$). HIV status had no influence on the pre-operative mortality rate (p = 0.693).

On multivariable analysis, age (OR 1.17; 95% CI: 1.03–1.34; p = 0.02), serum albumin level (OR 0.63; 95% CI: 0.43–0.92; p = 0.016), gamma glutamyl transferase level (OR 0.97; 95% CI: 0.94–0.1.0; p = 0.034) and pulmonary artery pressure (OR 1.49; 95% CI: 1.07–2.08; p = 0.018) emerged as independent predictors of pre-operative mortality rate.

Table 2. Bivariate logistic regression model of associated pre-operative mortality

Characteristics	*Alive (n = 69)*	*Pre-operative death (n = 14)*	*Odds ratio (95% CI)*	p-*value*
Gender				
Female	33 (47.8)	7 (50.0)	0.92 (0.29–2.89)	0.882
Male	36 (52.2)	7 (50.0)		
HIV positive				0.693
CD4 > 200 cells/mm^3	21 (30.4)	3 (21.4)	0.59 (0.15–2.36)	
CD4 < 200 cells/mm^3	7 (10.1)	1 (7.1)	0.59 (0.65–5.32)	
NYHA class	69 (100)	14 (100)	1.50 (0.65–3.48)	0.351
Haemoglobin (g/dl)	12.96 ± 1.70	11.91 ± 1.78	0.67 (0.45–0.99)	0.031
White cell count (10^9 cells/l)	5.17 ± 1.45	4.99 ± 1.58	0.91 (0.61–1.37)	0.660
Platelets (10^{12} cells/l)	257 ± 89.01	224.64 ± 49.96	0.99 (0.99–1.00)	0.160
Sodium (mmol/l)	137 ± 3.33	136 ± 3.28	0.91 (0.77–1.07)	0.243
Urea (mmol/l)	6.37± 2.17	7.6 ± 3.96	1.17 (0.96–1.42)	0.131
Creatinine (umol/l)	80.37 ± 20.87	88.21 ± 17.94	1.02 (0.99–1.04)	0.192
Albumin (g/l)	38.35 ± 6.29	33.93 ± 5.37	0.90 (0.82–0.99)	0.019
AST (U/l)	41.16 ± 13.71	31.36 ± 9.97	0.91 (0.85–0.98)	0.003
ALT (U/l)	25.87 ± 16.88	22 ± 17.52	0.98 (0.94–1.03)	0.403
Alkaline PO_4 (U/l)	175.94 ± 93.06	125.29 ± 54.11	0.99 (0.98–1.00)	0.061
Gamma GT (U/l)	269.39 ± 235.30	149.43 ± 119.43	1.00 (0.99–1.00)	0.071
Ejection fraction (%)	51.97 ± 6.75	53.29 ± 6.06	1.03 (0.94–1.13)	0.491
PA pressure (mmHg)	32.80 ± 6.88	43 ± 11.19	1.13 (1.05–1.22)	< 0.001

Data presented as mean ± standard deviation for continuous variables and n (%) for categorical variables. NYHA, New York Heart Association; CI, confidence interval; AST aspartate aminotransferase; ALT alanine aminotransferase; alkaline PO_4, alkaline phosphatase; gamma GT, gamma glutamyl transferase; PA pressure, pulmonary artery pressure.

Operative outcome of patients undergoing peri-cardiectomy

A total of 52 patients (62.7%) underwent pericardiectomy, which included 32 HIV-negative (61.54%) and 20 HIV-positive patients (38.5%). Of the 20 HIV-positive patients, 15 (75%) were on antiretroviral therapy with successful viral load suppression (< 1 000 copies/ml). Pericardial biopsy specimens taken at the time of surgery showed histological evidence of tuberculosis in the form of granulomas and/or acid-fast bacilli in 12/49 (24.5%) patients.

Complete pericardiectomy was achieved in 38 patients (73.1%) and there was no significant difference between HIV-positive and -negative patients (26%; 81.3 vs 12; 60%; p = 0.093). There were three in-hospital peri-operative deaths, yielding a peri-operative mortality rate of 5.7% (95% CI: 9.5–26.7%). One patient (HIV positive) died of intra-operative haemorrhage in theatre and two (HIV negative), who were both severely symptomatic pre-operatively (NYHA IV) with impaired ejection fraction, died in the intensive care unit (ICU) as a result of a low-cardiac-output state in the ICU. There was no significant difference in the length of ICU stay between HIV-negative and -positive patients (4.28 ± 2.74 vs 5.11 ± 2.84 days; p = 0.321).

Postoperative complications occurred in seven patients (9.6%), three of whom had also suffered intra-operative complications. These postoperative complications were: sternal wound sepsis (one), re-intubation for respiratory failure and tachyarrhythmia (one), thoracotomy for postoperative haemorrhage (one), postoperative renal impairment (one) and low-output cardiac failure (three). In total, peri-operative (intra- and post-operative) complications occurred more frequently in HIV-positive patients (HIV positive: 9, 45% vs HIV negative: 6, 17.6%; p = 0.030). The higher complication rate in HIV-positive patients could not be explained by left ventricular function since the left ventricular function was similarly preserved in both groups (HIV negative 53.33 ± 6.7% vs HIV positive 53.93 ± 6.79%; p = 0.783).

Of the 49 patients who were discharged (three died in hospital) after undergoing pericardiectomy, 41 (26 HIV positive) returned for the six-week postoperative follow up at our hospital. Six patients were followed up at their referral hospital and two were lost to follow up. Most patients improved their NYHA class by one or two levels (p < 0.001) (Fig. 2). The majority of patients had improved from NYHA class II to class I (n = 21, 50%) and NYHA class III to class I (n = 10, 23.8%). Eight patients showed no improvement in functional class. There was no significant difference in symptoms of dyspnoea (p = 1.000) or ejection fraction (p = 0.785) between HIV-positive and -negative patients.

Discussion

This study shows a relatively high rate of HIV infection (32/83, 38.6%) among patients with constrictive pericarditis compared to the 14.6% reported by Mutyaba *et al.*[2] in a recent South African study, but less than the 12/19 (63%) reported by Abubaker and colleagues[17] in a Nigerian study. These data for developing countries are in contrast to the very low rate reported by Gopaldas *et al.*[18] in the USA, who found only 10 HIV-positive

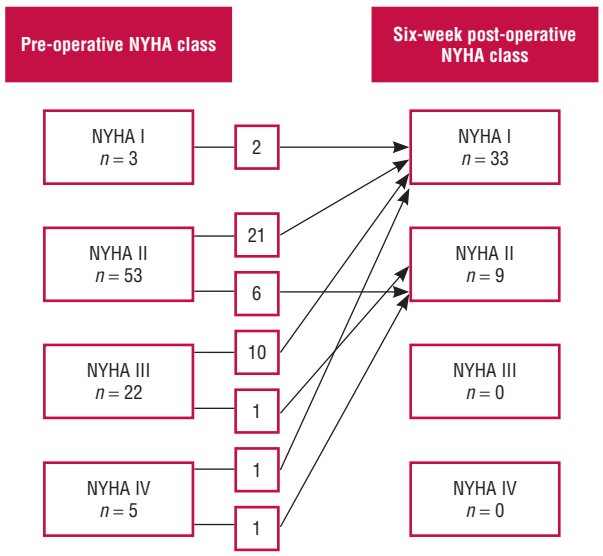

Fig. 2. Comparison of pre-operative and six-week postoperative New York Heart Association functional class status in 41 patients ($p < 0.0001$). Most subjects improved by at least one functional class. NYHA, New York Heart Association.

patients with constrictive pericarditis out of a sample size of 3 847 undergoing pericardiectomy.

In keeping with other studies from developing countries,[2,11,12,19-21] and in contrast to Western series,[22,23] tuberculosis was the major aetiology of constrictive pericarditis in our study and highlights the impact of the HIV/AIDS epidemic in refuelling a resurgence of tuberculosis infections.[24,25] Similar to other series,[2,15] proven tuberculosis (pericardial histology, culture of AFB from sputum, lymph nodes) was documented in 22 (26.5%) of the patients. In contrast to Reuter's findings in TB pericarditis,[26] we found histological evidence of definite tuberculosis in only nine operative pericardial biopsy specimens and could not determine from these small numbers whether histological evidence of tuberculosis is more common in HIV-positive subjects. The natural history of tuberculous pericarditis has been previously described, including treatment options to prevent progression to constriction.[16,27-30]

In this study we found few differences in the clinical profile between HIV-positive and -negative patients. The higher levels of alkaline phosphatase and gamma glutamyl transferase among HIV-positive patients might have been due to hepatic tuberculosis or more likely to more severe hepatic congestion in these subjects. Importantly, there was no difference in the pre-operative and follow-up ejection fraction between HIV-positive and -negative patients. This finding differs from studies in patients with tuberculous pericarditis co-infected with HIV who have been found to have a higher prevalence of myopericarditis.[27,31]

Preservation of ejection fraction might explain why we found no significant differences in peri-operative mortality rate observed between HIV-positive and -negative patients. It is also likely that antiretroviral therapy in our patients may have helped to preserve left ventricular function by preventing the development of opportunistic infections or HIV-associated myocardial dysfunction.

Pericardial calcification was identified on chest radiography in 17 (20.5%) of our study patients, which is much higher than the 5% reported by Strang *et al.* in the pre-HIV era.[19] While equivalent rates of pericardial calcification in HIV-positive and -negative patients (21.4 vs 20.7%; $p = 0.953$) have been described in the study by Mutyaba *et al.*,[2] we found that calcification was an uncommon finding in HIV-positive compared with HIV-negative patients (6.3 vs 29.4%; $p = 0.011$). Furthermore none of the eight patients with CD4 counts < 200 cells/mm^3 developed pericardial calcification.

We attributed the higher prevalence of pericardial calcification among HIV-negative patients to longer survival in these patients with a more prolonged duration of infection, progressing to fibrosis and calcification. Alternatively it could be explained by the suppression of CD4 helper by the HI virus, leading to less fibrogenesis and calcification in these subjects.[26]

Among the 31 subjects who did not undergo early surgery, 15 patients on telephonic contact were still alive, and of these, five reported improvement in their symptoms (survival status unknown in two) on anti-tuberculous therapy. Strang *et al.*[32] have shown that a significant number of patients diagnosed with tuberculous constrictive pericarditis may undergo resolution of their symptoms on anti-tuberculous therapy. The high pre-operative mortality rate of 16.78% in our study emphasises the importance of pericardiectomy in ensuring a successful outcome in subjects who do not respond to anti-tuberculous therapy.

Our analysis of the pre-operative outcome showed that HIV status had no effect on the pre-operative mortality rate in constrictive pericarditis in subjects on antiretroviral therapy. Instead, our analysis showed that older age, unsuppressed viral load, lower serum haemoglobin and albumin levels, as well as

Table 3. Operative characteristics of study patients stratified by HIV status

Characteristic	*All* (n = *52*)	*HIV negative* (n = *32*)	*HIV positive* (n = *20*)	p-*value*
Pericardiectomy				0.093
Total	38 (73.1)	26 (81.3)	12 (60.0)	
Sub-total	9 (17.3)	2 (6.3)	7 (35.0)	
Not known	5 (9.6)	4 (12.5)	1 (5.0)	
Inotrope usage	48 (94.1)	31 (96.9)	17(85.0)	0.547
Days in ICU	4.59 ± 2.84	4.28 ± 2.74	5.11 ± 2.84	0.321
Postoperative complications	15 (28.9)	6 (18.8)	9 (45.0)	0.030
Pericardial histology				
Granulomas	9 (18.4)	4 (12.9)	5 (27.8)	0.259
Acid-fast bacilli	3 (6.1)	1 (3.2)	2 (11.1)	0.546
Calcification	12 (24.4)	10 (32.3)	2/18 (11.1)	0.168
Postoperative ejection fraction	53.55 ± 6.65	53.33 ± 6.70	53.93 ± 6.79	0.783
Postoperative six-week follow up				0.687
NYHA I	33 (80.4)	20 (76.9)	13 (86.7)	
NYHA II	9 (21.4)	6 (23.1)	2 (18.8)	
Ejection fraction	53 ± 9.16	52.44 ± 11.50	53.83 ± 4.67	0.785

Data presented as mean ± standard deviation for continuous variables and *n* (%) for categorical variables.
ICU, intensive care unit; NYHA, New York Heart Association.
Details of inotrope usage was not available for one subject; three subjects' histology results were not found (one HIV negative, two HIV positive); nine subjects did not have postoperative measurement of ejection fraction (four HIV-negative subjects and five HIV-positive subjects); 41 patients attended six-week follow up (26 HIV negative, 15 HIV positive). Follow up ejection fraction (10 HIV-negative, five HIV-positive patients).

elevated pulmonary pressure were shown to predict pre-operative mortality rate.

Similarly, we found no difference in the peri-operative and postoperative outcomes between HIV-positive and -negative patients. At the six-week follow-up visit, most patients in our series showed significant improvement in NYHA class ($p \leq 0.001$) (Table 3), with improvement of at least one functional class to NYHA I (78.6%) and II (21%). This finding is consistent with reports by Mutyaba *et al*.[2] and Tetty *et al*.[20] Furthermore, ejection fraction was preserved in both HIV-positive and -negative subjects.

Although our in-hospital peri-operative mortality rate of 5.7% is higher than the 3.7% reported by Fennel *et al*.[12] in the pre-HIV era, it is consistent with the majority of series worldwide.[6,9,11-14,18] It is much lower than the 14% mortality rate found by Mutyaba *et al*.[2] in their series, possibly because our HIV-positive patients were virally suppressed on treatment.

Peri-operative complications in our study appeared to be more common in HIV-positive patients undergoing pericardiectomy. Furthermore, complete pericardiectomy was less likely to be achieved in HIV-positive (n = 9, 50%) compared to -negative patients (n = 37, 71%). Whether this was due to the inflammatory process, with greater anatomical distortion making surgery more difficult, is not clear.

Study limitations

Our study has limitations related to its retrospective design, including a number of patients who were lost to follow up while awaiting surgical pericardiectomy. We were able to obtain survival status in most patients and were able to show that a number of subjects died while awaiting surgery. Furthermore, long-term patient follow up was often not possible because many patients were from rural areas and had difficulty in accessing the clinic. Based on the available patient records we could only accurately comment on in-patient peri-operative mortality rate and the early six-week follow-up visit after surgery. Furthermore, in this study the diagnosis of constriction was made clinically and supported by echocardiographic findings. Although Doppler echocardiographic parameters (restrictive pattern) to confirm pericardial constriction were not measured, the diagnosis was confirmed in all subjects who underwent surgery for pericardial constriction.

Conclusion

The findings of this study have important clinical implications. Without surgery, constrictive pericarditis is associated with a high mortality rate. Our study emphasises the benefits of surgery in patients who do not respond to anti-tuberculous therapy. Over a third of patients with constriction are HIV-positive in a developing country. Although HIV infection is associated with a higher in-hospital complication rate, peri-operative mortality rate is unaffected in subjects who are on antiretroviral treatment and are virologically suppressed.

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