



Original Research

Indications and Early Surgical Outcomes of Bioprosthetic Heart Valve Replacement in an African population

Indications et résultats précoces de remplacement valvulaire par bioprothèses dans une population africaine

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ABSTRACT

Introduction. Although bioprostheses are recommended over mechanical valves in poorly compliant patients to limit the risks of valve related complications, their use in the young Africans is still limited due to early structural deterioration. We review the indications and early surgical outcomes following bioprosthetic replacement (BPR) in our institute over a 12-year period. **Patients and methods.** The clinical data of 29 patients who underwent BPR in our institute between August 2010 and September 2022 were retrospectively reviewed. Clinical profiles and early post-surgical outcomes were analyzed. **Results.** Females were predominant with a ratio of 0.70. The median age and the interquartile range (IQR) at surgery were 59.4 years (IQR 56-67). 65.5% of the patients were in New York Heart Association functional class \geq III. Twenty-five patients (86.2%) were in sinus rhythm. Degenerative and rheumatic etiologies were reported in 13 (44.8%) and 14 (48.3%) cases, respectively, followed by endocarditis in 2 (6.9%). Among the 29 patients, 14 (48.3%) had aortic replacement, 9 (31.1%) mitral replacement, 4 (13.8%) mitro-aortic replacement, 1 (3.4%) mitro-tricuspid replacement and 1 (3.4%) tricuspid replacement. The median cardiopulmonary bypass and cross-clamping times were 137 minutes (IQR 102.8-160.8) and 98 minutes (IQR 69.5-121.5) respectively. The operative mortality was 3.4% (1/29). Major postoperative complications were atrial fibrillation in 5 (17.2%) and reoperation for bleeding in 2 (6.9%). The intensive care unit length of stay was 2 days (IQR 2-3). **Conclusion.** Bioprosthetic valves were mainly implanted in older patients with similar rates of degenerative and rheumatic lesions. Early mortality is comparable to data from western series.

RÉSUMÉ

Introduction. L'utilisation des bioprothèses dans la population jeune africaine reste limitée malgré leur caractère peu thrombogène. Nous revisitons les indications et résultats précoces de remplacement valvulaire (RV) par bioprothèse dans notre institut. **Patients et méthodes.** Une analyse rétrospective des données cliniques, opératoires et postopératoires a été réalisée entre Août 2010 et Septembre 2022 sur 29 patients opérés de RV par bioprothèse au Centre Cardiaque de Shisong-Cameroun. **Résultats.** L'âge médian et l'intervalle interquartile (IIQ) étaient de 59,4 ans (IIQ 56-67), un sex-ratio de 0,70. Dix-neuf (65,5 %) de patients avaient une dyspnée en classe NYHA $>$ III. Vingt-cinq patients (86,2 %) étaient en rythme sinusal. Les étiologies dégénératives et rhumatismales représentaient 13 (44,8 %) et 14 (48,3 %) des cas respectivement, l'endocardite 2 (6,9 %) cas. Quatorze (48,3 %) avaient subi un remplacement aortique, 9 (31,1 %) un mitral, 4 (13,8 %) un mitro-aortique, 1 (3,4 %) un mitro-tricuspide et 1 (3,4 %) un tricuspide. La durée médiane de la circulation extracorporelle et du clampage aortique était respectivement 137 min (IIQ 102,8-160,8) et 98 min (IIQ 69,5-121,5). La mortalité opératoire de 3,4 %. Les complications postopératoires étaient la fibrillation auriculaire dans 5 cas (17,2 %) et la réintervention pour hémorragie dans 2 cas (6,9 %). La durée de séjour en soins intensifs était de 2 jours (IIQ 2-3). **Conclusion.** Les bioprothèses sont implantées chez les patients âgés comparé à ceux recevant les prothèses mécaniques dans notre institution. Le résultat chirurgical, mortalité précoce y compris, sont comparables à ceux des pays occidentaux.

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HIGHLIGHTS OF THE STUDY**What is already known on this topic**

Sporadic series have suggested a major use of MHV over BPV in SSA because of the high risk of reoperation after BPV implantation

What question this study addressed

Indications and early surgical outcomes of bioprosthetic heart valve replacement in an African population

What this study adds to our knowledge

Bioprosthetic valves were mainly implanted in older patients with similar rates of degenerative and rheumatic lesions. Early mortality was comparable to data from western series.

How this is relevant to practice, policy or further research.

Further prospective studies with more patients are needed.

INTRODUCTION

Prosthetic heart valve implantation is among the most common procedures in open-heart surgery worldwide [1]. Only in the United States, an estimate of 180,000 prosthetic heart valves procedures are performed each year [2]. In the sub-Saharan Africa (SSA), the access to valve surgery remains limited despite the large number of people suffering from advanced rheumatic valve lesions, as complications of the endemic rheumatic fever [3, 4]. Moreover, there are concerns related to the use of prosthetic valves in low middle income regions as the complex socio-cultural environment and the limited access to specialized cardiovascular care has been associated with increased rates of prosthetic related complications [5, 6]. While mechanical heart valves (MHV) are potentially associated to high risk of thrombo-haemorrhagic complications mainly due to a suboptimal anticoagulation intake, the early structural deterioration of bioprosthetic valves (BPV) in young patients is still a major concern [7, 8]. Data from sporadic series have suggested a major use of MHV over BPV in recent SSA experiences [9-11] as the risk of reoperation after BPV implantation have significantly affected the surgical policies in these settings with limited resources. The current paper aims to analyze BPR surgeries in our institute and the associated surgical outcomes.

MATERIALS AND METHODS

Between August 2010 and September 2022, a total of 29 patients underwent BPR at the division of cardiac surgery of Cardiac Centre Shisong, in Kumbo, Cameroon. Patients with mechanical valve replacement were excluded. However, patients with valve repair, and coronary disease were included in the study. Socio-demographic data as well as clinical information were reviewed and analyzed. The institutional review board approved the study and the consent forms were waived for this retrospective study.

Surgical technique

A routine trans-esophageal echocardiogram was performed in all the patients intraoperatively. A

conventional full median sternotomy was the preferred approach in all the cases. Cardiopulmonary bypass (CPB) was established through the cannulation of the ascending aorta and right atrium or both caval veins depending on the scheduled surgery. Myocardial protection was achieved with the administration of crystalloid or warm blood cardioplegic solutions according to the surgeon's preference.

The exposure of the mitral valve was obtained through a standard left atriotomy whereas a supracoronary "Hockey Stick" aortotomy was done in aortic procedures. When possible, we routinely maintained the annulo-ventricular continuity by preserving the posterior mitral leaflet during mitral replacement especially in the presence of impaired preoperative left ventricular function. Aortic root enlargement with Nick's technique was performed in patients with small annulus to avoid the risk of patient-prosthetic mismatch.

Statistical Analysis

Standard descriptive statistical analyses were used and performed with R software version 4.1.1. Continuous variables are presented as median with interquartile range (IQR), and categorical variables are presented as numbers and percentages in brackets.

RESULTS

Among the 29 patients, 17 were women with a sex ratio of 0.7. The median age at surgery of the whole cohort was 59.4 years (IQR: 56-67). Patients' demographics and clinical characteristics are reported in Table.1.

Table 1. Patient's characteristics and preoperative data

| Preoperative variables | Value |
|---|------------------|
| Age (years), median (IQR) | 59.4 (56-67) |
| Sex ratio H/F | 0.70 |
| Body surface area (m ²), median (IQR) | 1.80 (1.70-1.89) |
| Hypertension, n (%) | 10 (34.5) |
| Type 2 diabetes, n (%) | 4 (13.8) |
| Dyslipidemia, n (%) | 4 (13.8) |
| Smoking habit, n (%) | 2 (6.9) |
| Valve aetiology | |
| -Degenerative, n (%) | 13 (44.8) |
| -Rheumatic, n (%) | 14 (48.3) |
| -Endocarditic, n (%) | 2 (6.9) |
| Type of valvular lesion | |
| -Single valve regurgitation, n (%) | 9 (31.0) |
| -Single valve stenosis, n (%) | 3 (10.3) |
| -Mixed valve disease, n (%) | 17 (58.6) |
| NYHA functional class \geq III, n (%) | 19 (65.5) |
| Cardiac rhythm | |
| -Sinus rhythm n (%) | 25 (86.2) |
| -Atrial fibrillation n (%) | 4 (13.8) |
| IQR: interquartile range, NYHA: New York Heart Association | |

The main symptom at admission was dyspnea on exertion and 65.5% of the patients (n=19) were in New York Heart Association (NYHA) functional class III or IV. Sinus rhythm was present in 86.2% of the patients at admission. The valvular etiologies were degenerative (n=13, 44.8%), rheumatic (n=14, 48.3%) and endocarditis (n=2, 7.1%).

The types of lesions were single valve stenosis in 3 (10%), single valve regurgitation in 9 (32.1%), mixed valve disease in 4 (14.3%), double valve disease in 10 (35.7%) and triple valve disease in 2 (6.9%).

Among the 29 patients, we found 14 (48.3%) aortic replacement, 9 (31.1%) mitral replacement, 4 (13.8%) mitro-aortic replacement, 1 (3.4%) mitro-tricuspid

replacement, and 1 (3.4%) tricuspid replacement. In addition to BPR, 11 patients underwent concomitant procedures including tricuspid valve repair in 10 cases (34.4%) and a coronary artery bypass grafting in one (3.4%).

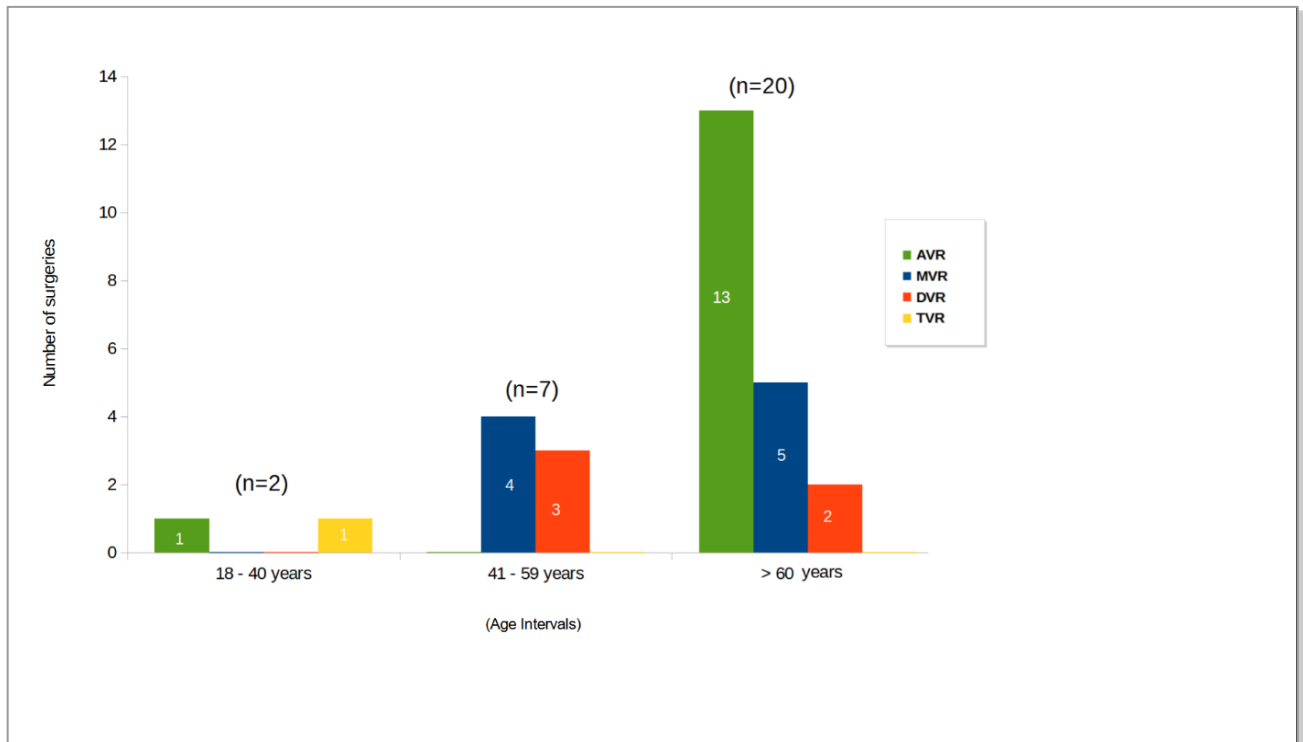


Figure.1: age distribution of according to the type of surgery
 AVR= aortic replacement; MVR= mitral replacement; TVR= tricuspid replacement; DVR= double replacement.

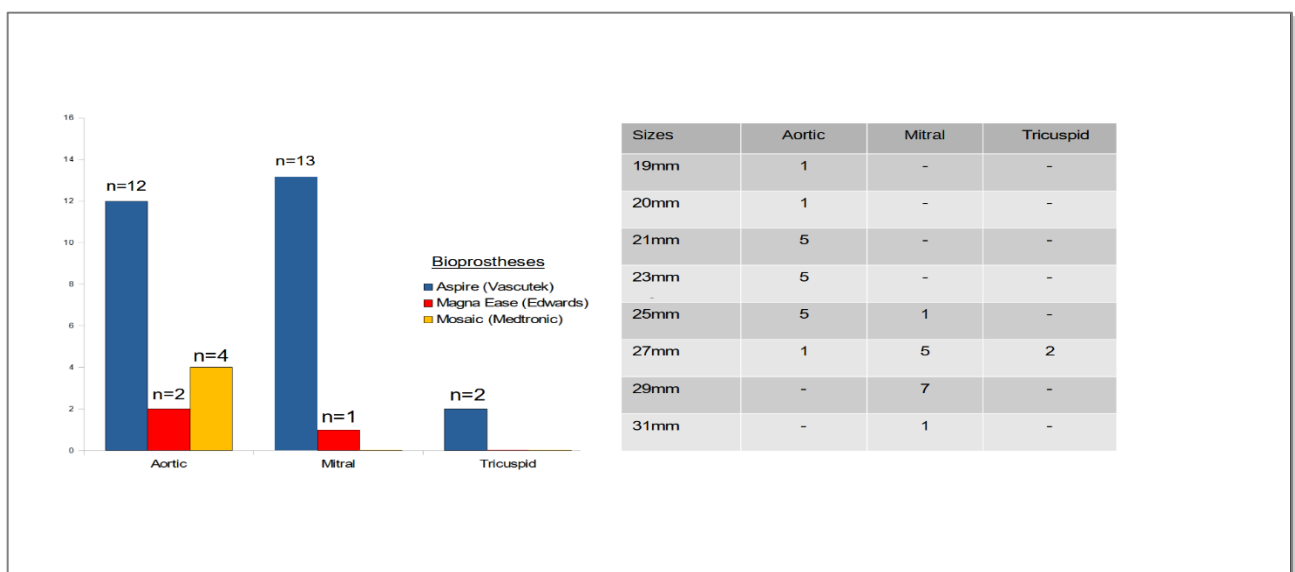


Figure.2: Types and sizes of implanted bioprosthetic valve

The median cardiopulmonary bypass (CPB) and aortic cross clamp time were 137 minutes (IQR 102.8-160.8) and 98 minutes (IQR 69.5-121.5) respectively. The majority of the patients were weaned from mechanical ventilation within the first day with a mean intubation time of 8 hours (IQR 5.75-15.25). The median intensive care unit length of stay was 2 days (IQR 2-3). Table 2 displays the operative and post-operative data.

Table 2: Operative and post-operative data

| Operative characteristic | Value |
|---|-------------------|
| Type of surgery | |
| - Aortic replacement n (%) | 14 (48.3) |
| - Mitral replacement n (%) | 9 (31.0) |
| - Mitro-aortic replacement n (%) | 4 (13.8) |
| - Mitro-tricuspid replacement n (%) | 1 (3.4) |
| - Tricuspid replacement n (%) | 1 (3.4) |
| Concomitant cardiac surgery | |
| - Tricuspid valve repair | 10 (34.5) |
| - Aortic root enlargement | 5 (17.2) |
| - CABG | 1 (3.4) |
| - Ascending aorta replacement | 1 (3.4) |
| - Septal myectomy | 1 (3.4) |
| Redo surgery | 1 (3.4) |
| Cardiopulmonary bypass time (minutes), median (IQR) | 137 (102.8-160.8) |
| Cross clamping time (minutes), median (IQR) | 98 (69.5-121.5) |
| Mechanical ventilation (hours), median (IQR) | 11 (6-19) |
| Hospital stay (days), median (IQR) | 7 (6-7) |

IQR: interquartile range, CABG: Coronary artery bypass grafting.

The operative mortality of the whole cohort was 3.4% (1/29). Major postoperative complications were postoperative atrial fibrillation in 5 (17.2%) and chest reexploration for bleeding in 2 (6.9%). Postoperative complications are reported in Table.3.

Table 3: Postoperative complications

| Complications | N(%) |
|----------------------------------|----------|
| Atrial fibrillation | 5 (17.2) |
| Chest reexploration for bleeding | 2 (6.9) |
| Right heart failure | 1 (3.4) |
| Renal failure | 1 (3.4) |

DISCUSSION

The current study demonstrates that BPV patients are older (59.4 ± 11 years) than those undergoing MHV in our institute (27.6 ± 13.4 years) [10]. Approximately, 69% of the patients who received BPV were at least 60 years of age and only 6.9% (2 patients) were younger than 40 years of age. However, the median age (59 years) in our cohort was lower than the current guidelines recommendations for BPV implantation (> 65years) [12, 13] as well as in several western series where ages of BPV patients range between 73 and 81 years [14-16]. These age differences could be due to the existing gap in life expectancy between SSA and western populations (Cameroon~62.3years vs Europe ~81.6 years) [17, 18]. As only 2.73% of the Cameroonian population is above > 64 years (vs 21.75% in Germany), patients with valve disease

in this age group are statistically less common. Furthermore, while the prevalence of valvular disease in western countries increases with age with a peak of degenerative aetiologies in the elderly, rheumatic disease remains the predominant valvular aetiology in SSA populations with major prevalence in children and young adults [19, 20].

Non-thrombogenic surgeries, whether with valve repair or BPV replacement, have been widely promoted in patients living in underserved regions such as the SSA [12, 13]. Indeed, the disadvantaged socio-economic conditions, the poor educational status and the limited access to cardiovascular care have been associated with major risks of cardiovascular events mainly due to inadequate oral anticoagulation therapy (OAT) intake after MHV replacement [21, 22]. In fact, valve repair techniques were encouraged in our institute over MHV when feasible, but this has not been the case for BPV. Indeed, no patient in the current series has received a BPV based on anticipated poor compliance to oral anticoagulation. The choice of a BPV in two patients aged < 40 years was a shared decision as both wished to avoid OAT for professional and planned pregnancy, respectively. It is possible that the accelerated structural deterioration of BPV in young patients [8, 23] along with considerations and uncertainties related to the financial burden of repeat surgery have both contributed to limit the use of BPV in our context. Indeed, the cost of surgeries are among the major challenges for our patients. No public healthcare coverage is currently available in our country and the great majority of our patients are supported by private funds through local and foreign NGO's. Last but not least, published data reporting less thrombotic events with the use of third generation MHV in similar populations have possibly contributed to increase their preference over BPV [24].

We have reported an operative mortality of 3.8% which is consistent with rates from international databases ranging between 2.9% and 6% [12, 13]. However, the current results were slightly better than our mechanical valve series with a mortality rate of 4.7% [10]. This might be explained by the higher rate of double and triple valve surgeries in MHV patients, in addition to advanced stages of heart failure (NYHA \geq III: 88.8% vs 65.5%; Left ejection fraction < 50%: 13.3% vs 0.0%) as compared to the current series.

Limitations of this study are both the small sample potentially affecting the statistical strength of the data, and the retrospective aspects of the analysis. Moreover, the long-term outcomes providing more reliable clinical data with the use of BPV were not considered in the current study as the main objectives were to review the indications for BPV implantation and the associated early outcomes. In conclusion, BPV are mainly implanted in older patients when compared to those receiving MHV. The well known risk of early structural deterioration and reoperation associated with BPV, especially in young patients, have significantly affected the use of BPV in our study group. Surprisingly, the lack of compliance of the patients did not seem to affect the choice of the prosthetic valves. The surgical outcomes including the early mortality are comparable with those of western countries.

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