Cardiovascular Topics

First Malian series of surgery for rheumatic valve disease: opening of the centre, clinical features and peri-operative realities

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Abstract

Introduction: Over the past two decades, the incidence of acute rheumatic fever (ARF) and chronic rheumatic heart disease (RHD) have dramatically declined in wealthier regions of the world as a result of preventative programmes, improved living standards and access to cardiac surgery. Nevertheless, ARF and RHD are still public health problems in less-developed regions of the world such as Oceania, south Asia and sub-Saharan Africa.

Aim: We report on clinical, therapeutic and prognostic aspects as well as the difficulties encountered during this first series of surgery for rheumatic valve disease in Mali.

Methods: This was a prospective, descriptive study conducted at the Andre Festoc Cardiac Surgery Centre from September 2018 to August 2019.

Results: The frequency of patients having been operated on for rheumatic valve disease was 44.73% (68 patients). The mean age of the patients was 18 ± 10 years with extremes of five and 60 years. The gender ratio was 0.7. The delay to treatment was between one and three years for 39.7% of the patients. The main diagnoses found were: mitral regurgitation in 50% of patients, mitral stenosis in 16.2% and aortic regurgitation in 10.3%. Pulmonary artery systolic pressure was 35–50 mmHg in 19.1% of patients and more than 50 mmHg in 25%. The median cardiopulmonary bypass time was 132 minutes (60–276) and median extubation time was three hours (0–96). The main complications were cardiac, renal, neurological, respiratory, gastrointestinal and infectious. In the immediate postoperative period, we recorded three deaths, which is a mortality rate of 4.4%.

Conclusion: Humanitarian efforts have led non-governmental organisations (NGOs) to launch surgical programmes in low- and middle-income countries in an attempt to fill the gap in these fragile healthcare systems. Cardiac surgery requires much expertise from the medical staff, as well as many material and financial resources. Empowerment of the local team is a challenge that is being realised since taking these essential steps of companionship with the NGO la Chaine de l’Espoir.
Keywords: rheumatic heart disease, cardiac surgery, pulmonary hypertension, la Chaîne de l’Espoir

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Rheumatic heart disease (RHD) is a chronic disease affecting the heart valves, secondary to group A streptococcal infection and subsequent acute rheumatic fever (ARF). However, preventative measures and cure of RHD are inextricably linked with socio-economic development, as the disease mainly affects children and young adults living in poverty.\(^1\)

In developed countries, ARF has become a virtual disease but in developing countries it is still a major public health problem.\(^2\) It is thought that as many as 39\% of patients with ARF may develop varying degrees of pancarditis with associated valve regurgitation and heart failure, and in some cases death.\(^3\) The incidence of ARF has slowly but steadily decreased since 1900, even before the use of antibiotics, and its current frequency of occurrence is low, with an incidence of 0.5 per 100 000 children on average. Along with the decrease in ARF cases, the prevalence of RHD is increasing. It is estimated that the rate varies between 0.1 and one per 1 000 schoolchildren in developing countries.\(^4\)

There is a significant burden of surgically correctable cardiovascular disease in Africa.\(^5\) Some 75\% of the world does not have access to cardiac surgery when needed because of lack of infrastructure, and human and financial resources.\(^6\) Large disparities exist between regions, ranging from 0.12 adult cardiac surgeons and 0.08 paediatric cardiac surgeons per million population in sub-Saharan Africa to 11.12 adult cardiac surgeons and 2.08 paediatric cardiac surgeons in North America. Low-income countries possess 0.04 adult cardiac surgeons and 0.03 paediatric cardiac surgeons per million population.\(^7\)

Humanitarian efforts have led non-governmental organisations (NGOs) to launch surgical programmes in low- and middle-income countries, in an attempt to fill the gap in these fragile healthcare systems.\(^8\) The methods of these NGOs vary, with some providing overseas treatment, while others carry out fly-in fly-out missions with varying levels of capacity building.\(^9\) The opening of the new heart surgery centre Andre Festoc at the Luxembourg Mother-Child Teaching Hospital in Bamako is the result of a solid co-operation with the NGO la Chaine de l’Espoir.

La Chaine de l’Espoir is present in more than 30 countries in Africa, Asia and the Middle East.\(^10\) In 2018, it financed the construction and equipment of a centre, training of medical and paramedical staff, supply of consumables, and ensured surgical missions with experienced practitioners to allow the transfer of skills and ensure self-registration of the Malian team. We report on our clinical, therapeutic and prognostic particulars as well as the difficulties encountered during this first series of surgery for rheumatic valve disease in Mali.

Results

During the study period, 152 patients were operated on for heart disease. The frequency of patients having been operated on for rheumatic valve disease was 44.73\% (68 patients). These 68 patients represented our study population. The age group zero to 15 years represented 60.3\% of the population. The mean age of our patients was 18 ± 10 years, with extremes of five and 60 years. The female gender was the most representative with 40 cases (58.8\%) and the gender ratio was 0.7. Of the patient group, 22.1\% resided between 100 and 300 km from Bamako and 17.6\% were more than 300 km from Bamako.

The delay to treatment was between one and three years for 39.7\% of patients and was greater than three years for 39.7\%. Many of the patients (67.6\%) were undernourished, with a body mass index less than 18.5 kg/m\(^2\). A history of recurrent angina was found in 52.9\% of patients, 22 (32.4\%) had no cardiac decompensation before surgical management, while 33.8\% of patients presented with more than two decompensations. Sixty per cent of patients had no arrhythmia while 17.6\% had atrial fibrillation.

The main diagnoses found were: mitral regurgitation in 51.5\% of patients, mitral disease in 20.6\%, mitral stenosis in 16.2\%, aortic regurgitation in 10.3\% and aortic stenosis in 1.5\% of cases. Tricuspid insufficiency with pulmonary hypertension was associated with valve disease in nearly 45\% of patients. Pulmonary artery systolic pressure (PASP) was 35–50 mmHg in 19.1\% of patients and greater than 50 mmHg in 25\% of patients.

The surgical procedures performed were: 30 tricuspid plasty surgeries (44.1\%), one aortic plasty surgery, 33 mitral valve replacements (48.5\%), 33 mitral plasty surgeries (48.5\%), and eight replacements of the aortic valve (11.8\%). The type of valve used in our series was a bileaflet mechanical prostheses. All our patients were operated on CPB with aortic clamping with a crystalloid cardioplegia del Nido. The median CPB time

<table>
<thead>
<tr>
<th>Drugs</th>
<th>Number (%)</th>
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<tbody>
<tr>
<td>Noepinephrine</td>
<td>2 (2.9)</td>
</tr>
<tr>
<td>Dobutamine</td>
<td>16 (23.5)</td>
</tr>
<tr>
<td>Milrinone + epinephrine</td>
<td>9 (13.2)</td>
</tr>
<tr>
<td>Noepinephrine + dobutamine</td>
<td>17 (25)</td>
</tr>
<tr>
<td>Milrinone + epinephrine + noepinephrine</td>
<td>6 (8.8)</td>
</tr>
<tr>
<td>Milrinone</td>
<td>5 (7.4)</td>
</tr>
<tr>
<td>Milrinone + noepinephrine</td>
<td>7 (10.3)</td>
</tr>
<tr>
<td>Total</td>
<td>62 (91.2)</td>
</tr>
</tbody>
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was 132 minutes (60–276) and the median aortic clamping time was 93 minutes (32–225). The median of mean arterial pressure during CPB was 58 mmHg. Norepinephrine use during CPB was required in 19.1% of patients. Forty patients, or nearly 60% of the population, were transfused during the CPB. The target haematocrit per operation was 30%.

The main difficulties during withdrawal from CPB were low cardiac output with poor cardiac contractility in 35.2% of patients, acute pulmonary hypertension in 14.7%, and severe heart rhythm disorder in 10.3% of patients. Table 1 summarises the drugs used during CPB withdrawal. The median extubation time was three hours (0–96).

Revision surgery was performed in five patients (7.4%). Table 2 summarises the main indications for secondary surgical revision in our series. Fig. 1 shows the transfusion practice in our series; 58.1% of patients were transfused in the operating room during CPB and 33.8% in the intensive care unit (ICU). A curative anticoagulation protocol was initiated six hours postoperatively in the absence of contra-indications.

The main complications were cardiac, renal, neurological, pulmonary, gastrointestinal and infectious (Table 3). The average length of stay in the ICU was four days (2–18). In the immediate postoperative period, we recorded three deaths, which is a mortality rate of 4.4%. The deaths were due to an extensive ischaemic stroke in two patients and severe left ventricular dysfunction in a third. Four patients were re-admitted to the ICU within two and six months of surgery: two cases of haemorrhagic stroke, which were both fatal, one case of ventricular dysfunction with persistent mitral gradient, and a case of third-degree atrioventricular block, requiring a fitting. The overall mortality rate at one year of follow up was 7.2%.

Discussion

Over the past two decades, the incidence of ARF and chronic RHD have dramatically declined in wealthier regions of the world as a result of preventative programmes, improved living standards and access to cardiac surgery. Nevertheless, ARF and RHD are still public health problems in less-developed regions of the world, such as Oceania, South Asia and sub-Saharan Africa.10

More than 33 million individuals are affected globally and Africa is an endemic region. RHD remains a public health priority in Africa, despite being nearly eliminated in high-income countries.11 The RHD prevalence has been estimated mainly from surveys of school-going children, and varies from 2.7/1 000 in Kenya to 14.3/1 000 in the Congo. While mortality rates of chronic valvular RHD have been estimated at 1.5% of patients per year, this may be largely under-estimated in sub-Saharan Africa.12

The VALVAFRIC22 study, a registry in western and central Africa (2004–2008), provided prospective and retrospective data on the clinical characteristics and treatment of 3 441 RHD patients. The study highlighted scarcity of cardiac surgery, which was afforded in only 27 individuals out of 1 200 who required surgery. This difficulty in accessing surgery is due to the requirement of a certain level of expertise and a well-equipped technical platform.
Several new paediatric cardiac centres are currently funded by NGOs and run on a permanent basis in African countries. Some examples are the Salam Centre for Cardiac Surgery in Sudan, the Walter Sisulu Paediatric Centre for Africa in South Africa, the Ghanaian National Cardiothoracic Centre and the CUOMO Cardio-Paediaic Centre in Dakar.10

The opening in September 2018 of the André Festoc Heart Surgery Centre at the Luxembourg Mother-Child University Hospital, Bamako, was greeted with great hope and enthusiasm. It is the result of a long and rich co-operation between Luxembourg and the NGO la Chaine de l’Espoir. Between 1994 and 2018, this co-operation allowed medical evacuation for cardiac surgery of more than 500 Malian children. In addition to the donation of an ultra-modern centre, la Chaine de l’Espoir supports the Malian team by providing materials and consumables, and organising expatriate missions to ensure a plan of empowerment of the local team, made up of three cardiovascular surgeons, four anaesthetists, two cardiologists and two perfusionists.

Difficulties in accessing surgery at an early stage of the disease was a general problem in our series and other African series. Kingué et al. reported that patients were seen late in the course of the disease, with 40% presenting with heart failure and in New York Heart Association class III or IV. Clinical complications were documented in 585 of 1 385 patients, including heart failure (62%), arrhythmia/atrial fibrillation (22%), thromboembolic events (4%) and infective endocarditis (4%).

In our series, 39.7% of patients were operated on within one and three years of diagnosis and 39.7% after a period of three years. Our epidemiological characteristics are superimposed on the realities of low- and middle-income countries. We recorded a female predominance of 58.8%, the predominant valve disease was mitral regurgitation in 50%, 17.6% had arrhythmia, and pulmonary hypertension was present in almost 45% of patients.

Patients with RHD from low- and middle-income countries were young (median age 28 years), largely female (66.2%), and had a high unemployment rate (75.3%). The majority had moderate-to-severe valvular heart disease that was associated with pulmonary hypertension and up to a quarter of patients had left ventricular dysfunction.14

The choice between valve replacement or repair (plasty) was made according to several criteria: the degree of valve disease and its recovery, the age and gender of the patient (we prefer plasty in children and young girls), and the ability to monitor anticoagulation. Valve surgery is associated with a significant mortality rate. Complications such as cardiac, pulmonary, renal and neurological disorders, infections such as pneumonia or sepsis, and prolonged stay in the intensive care unit and hospital are indicators of not only quality of care but also quality of life after cardiac surgery.15-18

Postoperative acute kidney injury is a serious complication of cardiac surgical procedures that carries a high mortality rate. Renal failure was found in 11.8% of our patients, it was functional and transient in seven patients, and one patient presented with acute tubular necrosis with anuria for 12 days. A total of 10 haemodialysis sessions were performed and the outcome was favourable.

Pulmonary hypertension is a classic pathophysiological consequence of left-sided valvular heart disease (VHD), which may result from multiple mechanisms such as an increase in pulmonary vascular resistance, pulmonary blood flow or pulmonary venous pressure.19 Pulmonary hypertension is found in 15 to 60% of patients with VHD and is more frequent among symptomatic patients. Pulmonary hypertension is associated with higher risk of cardiac events under conservative management, during valve replacement or repair procedures, and even following successful corrective procedures.20

Of our patients, 19.1% had PASP between 35 and 50 mmHg and 25% had PASP > 50 mmHg. Failure to have inhaled nitric oxide is a problem because it is used to cause a selective reduction in high blood pressure of the pulmonary vessels without decreasing blood pressure in the rest of the body.21 All our patients with pulmonary hypertension were managed during the peri-operative period as follows: during pre-operative preparation they were put on furosemide, captopril and sildenafil at 40 mg/day until the morning of the operation. Thirty to 45 minutes before weaning from CPB, a continuous infusion of milrinone at 0.5 µg/kg/min was given; 14.7% of all patients, or 58.8% of patients with PASP > 50 mmHg presented a surge in pulmonary hypertension during withdrawal from CPB. The milrinone infusion was continued for approximately 48 to 72 hours, associated with furosemide, captopril and sildenafil, depending on the cardiac condition. After leaving ICU, there was a persistence of pulmonary hypertension in eight patients (26.6% of patients with pulmonary hypertension).

Cardiac surgery is associated with increased rates and volumes of peri-operative blood transfusions. Packed red blood cell and fresh frozen plasma transfusion in cardiac surgery is associated with an increase in early and late mortality rate, hospital length of stay, multi-organ failure, infection, thrombosis and cost.22

Postoperative anticoagulation management is a problematic feature of valve surgery in low- and middle-income countries, the majority of patients having low health literacy and socioeconomic levels. This management requires special monitoring and careful patient education by cardiologists, especially in young women of childbearing age. At two and four months of surgery, we recorded two cases of accidents with vitamin K antagonists, with lethal haemorrhagic events. A report by Zühike et al. states that while the overall use of oral anticoagulants in patients with appropriate indications was relatively high (69.5%), it was low in patients with mitral stenosis in sinus rhythm at high risk for cardiac embolism.13 The quality of anticoagulation control at study enrolment was poor, with only a quarter of patients having international normalised ratios in the therapeutic range.

There are variations between low-, lower-middle and upper-middle-income countries in the detection and prevalence of cardiovascular complications. Rheumatic heart disease increases the risk of pregnancy and is one of the major non-obstetric causes of maternal deaths in Africa.23 Peri-operative mortality varies from series to series; a previous cardiac condition as well as the expertise of the care team vary from one centre to another.

Chauvaud et al.24 report the overall 30-day hospital mortality rate was 2%. The main cause of hospital death was myocardial failure, air embolism, mediastinitis and aortic dissection. A report by Mirabel et al. in low- and middle-income countries states that among the subset of patients who followed up, a further 50/518 (9.6%) died at a median of 23 months in Mozambique, and a further 34/591 (5.75%) died at a median of 11.5 months in Cambodia.4

The risk and mortality factors after rheumatic heart valve surgery were identified by Ibrahim et al.16 in a cohort of 346 patients. They reported a peri-operative mortality rate of 5.8%.
Age, emergency valve surgery, use of a biological valve, use of beta-blockers for less than one month before surgery, type of surgery, ejection fraction < 35%, and pump and cross-clamp time were all found to be independent predictors of mortality in patients undergoing valve surgery.

**Conclusion**

RHD remains a public health problem in Africa. Under-diagnosis of RHD, the cost of cardiac surgery, difficulty accessing this surgery, and time taken for treatment are factors that cause our patients to arrive at surgery with co-morbidities such as pulmonary hypertension, left ventricular failure and atrial fibrillation. Pulmonary hypertension is a real problem in our patients and the milrinone + sildenafil protocol has yielded good results. Co-operation with NGOs for the promotion of cardiac surgery, ejection fraction beta-blockers for less than one month before surgery, type of surgery, ejection fraction beta-blockers for less than one month before surgery, time were all found to be independent predictors of mortality in patients undergoing valve surgery.

**References**