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Surgical Myocardial Revascularization in a Sub-Saharan African Country: Indications and Results

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Abstract

Introduction: Despite the advances of interventional catheterization, surgery remains the treatment of choice for some coronary lesions. **Objective:** To report the indications and results of surgical revascularization of the myocardium at the Abidjan Heart Institute. **Patient and Methods:** This is a retrospective study of patients with coronary insufficiency who underwent surgical myocardial revascularization between March 2014 and May 2020 in the Cardiovascular Surgery Department of the Abidjan Heart Institute. There were 17 patients, 11 of whom were men (64.7%) and 6 women (35.3%), The mean age of the patients was 57.5 years ± 8.8. All patients were symptomatic with disabling angina in class III of the Canadian Cardiac Society (CCS). This symptomatology had been evolving on average for 5 years and 6 patients had a history of acute coronary syndrome, 2 of whom had undergone prior angioplasty. Coronary angiography revealed mono-truncated (17.6%), bi-truncated (23.5%) and tri-truncated (58.8%) lesions. **Results:** The patients were operated under cardiopulmonary bypass (CPB) 15 cases (88.2%) and off pump in 2 cases (11.8%). They underwent a single bypass in 23.5% of cases, a double bypass in 47.1% of cases and a triple bypass in 29.4% of cases. We observed 3 cases of complications (17.6%), namely transient acute renal failure, mediastinitis and postoperative bleeding. The operative and hospital mortality was nil. After a mean follow-up of 3 ± 1.8 years, all patients were asymptomatic with a negative stress test at last check-up. **Conclusion:** Our experience has allowed us to demonstrate the safe performance of surgical myocardial revascularization in our patients with satisfactory and encouraging results.

Keywords

Myocardial Revascularization, Coronary Surgery, Bypass

1. Introduction

Coronary insufficiency is a pathology leading to hypo-perfusion of the myocardium [1]. It is characterized by an alteration of the coronary vascular network. This leads to an imbalance between myocardial oxygen supply and demand due to inadequate coronary perfusion. The main etiology of this coronary insufficiency is atherosclerosis. Its manifestations range from simple angina to myocardial necrosis [1].

In 2015, worldwide, more than 110 million people had coronary artery disease with 7.3 million new cases observed [2]. In Africa, coronary heart disease has long been considered rare or even non-existent among black populations in sub-Saharan Africa. However, the CORONAFRIC 1 and 2 studies [3] [4] have refuted this assertion by estimating its incidence respectively at 3.17% in 1991 and 13.5% in 2016. This could indeed be explained by the epidemiological transition of the tropical world due to the westernization of the lifestyle and the influence of cardiovascular risk factors [5]. In Côte d'Ivoire, R. N'guetta and Coll [6] estimate the prevalence of acute coronary syndrome at 13.5%.

Therapeutically, coronary surgery has shown its effectiveness. It significantly improves the survival of patients in the short and long term [7]. Coronary surgery is currently the most common cardiac surgery procedure in France, with approximately 25,000 patients operated on each year [8].

In Côte d'Ivoire, the Abidjan Heart Institute, which used to perform only medical treatment, has recently started the first surgical myocardial revascularizations as part of the management of patients with coronary artery disease.

The aim of our study is to report the indications and results of surgical myocardial revascularization at the Abidjan Heart Institute.

2. Patients and Methods

This is a retrospective study of patients with coronary insufficiency who underwent surgical myocardial revascularization between March 2014 and May 2020 in the Cardiovascular Surgery Department of the Abidjan Heart Institute.

All patients who underwent coronary artery bypass surgery exclusively at the Abidjan Heart Institute were included in this study.

Data were collected using a questionnaire from the patients' medical records. We were interested in:

- Data from the interrogation concerning civil status, history and antecedents.
- Data from the clinical examination.
- Paraclinical data brought by the thoracic radiography, the electrocardiogram, the echocardiography, the stress test, the coronarography.

- The operative report allowed us to find the data of the surgical intervention.
- The postoperative evolution.

The medical consultation files and the telephone calls allowed us to report the clinical and paraclinical follow-up data.

The questionnaire included variables selected on the basis of the study objectives and grouped according to the following chapters: epidemiological, clinical, paraclinical, operative, immediate postoperative and follow-up.

Data Analysis

Data entry and analysis were performed by WORD 2016, EXCEL, and SPSS 18.0 software. Using these software programs we performed a description of the different variables studied. The quantitative variables were described by the mean and standard deviations while the qualitative variables were described by the proportions.

3. Results

There were 17 patients, 11 of whom were men (64.7%) and 6 women (35.3%), with a sex ratio of 1.83. The mean age of the patients was 57.53 years with a standard deviation of 8.86 and extremes of 44 to 72 years. All patients had one or more risk factors (see Table 1). All patients were symptomatic with disabling angina in class III of the Canadian Cardiac Society (CCS). Six patients had exertional dyspnea (35.3%), NYHA class III and IV, which had evolved for an average of 5 years, and 6 patients had a history of acute coronary syndrome. Two patients had undergone angioplasty before surgery. The various clinical and paraclinical characteristics are summarized in the following table (see Table 2).

Fifteen patients were operated on under cardiopulmonary bypass (CPB) with aortic clamping and two patients underwent beating heart surgery. The mean duration of CPB was 106, min (55 - 310 min) and that of the aortic clamping was 62 min (32 - 107 min). The patients had an average of two bypasses (1 - 3 bypass). A single bypass in 4 patients (23.5%), a double bypass in 8 patients (47.1%) and triple bypass in 5 patients (29.4%). The grafts used were arterial (right and left internal thoracic arteries) and/or venous (long saphenous vein). These different venous and arterial grafts were used to revascularize different coronary territories (see Table 3).

Table 1. Distribution of risk factors according to their frequency.

Risk factors	N (%)
Hypertension	14 (82.4)
Dyslipidemia	8 (47.1)
Diabetes type 2	8 (47.1)
Smoking	6 (35.3)
Obesity and overweight	5 (29.4)
Menopause	3 (17.6)

Table 2. Preoperative clinical and paraclinical characteristics of patients.

Characteristics	Values
Sex n (%)	
Female	11 (64.7)
Male	6 (35.3)
Age	57.5 years+/− 8.86 (extrem 44 and 72 years)
Functional signs n (%)	
Stress dyspnea NYHA III-IV	6 (35.3)
Typical angina	15 (88.2)
Atypical angina	2 (11.8)
Radiography (CTI)	0.52 (extrem 0.47 and 0.63).
Electrocardiogram n (%)	
Sinus rhythm	17 (100)
Repolarization disorder	11 (64.7)
Positive stress test n (%)	15 (88.2)
Echocardiographic signs	
Left Ventricular Ejection fraction (LVEF)	53.7% (extrem 40% and 74%)
Contractility disorder n (%)	
Segmental hypokinesia	9 (52.9)
Segmental akinesia	1 (5.9)
Coronary angiography n (%)	
mono-truncular lesions	3 (18)
bi-truncular lesions	4 (23)
tri-truncular lesions	10 (59)

NYHA: New York Heart Association; CTI: cardio thoracic index.

Table 3. Graft used for each coronary territory.

Territory / Graft	LAD N = 17	MARGINAL N = 15	PD N = 02	LAD N = 17
ITA	17(100%)	8(53.3%)	0(0%)	ITA
ISV	0(0%)	7(46.7%)	2(100%)	ISV

ITA: Internal thoracic artery; ISV: Internal saphenous vein; LAD: Left anterior descending artery; PD: Posterior descending artery.

Morbidity was 17.6%. There was one case of bleeding, which was treated with surgical removal and hemostasis. One patient presented an acute renal insufficiency by tubular necrosis which evolved favorably after a few dialysis sessions. Finally, a parietal suppuration was observed in one patient and was irrigated and drained at 15th postoperative day.

The two patients operated off pump stayed on average 2 days with 1 day for

one and 3 days for the other in intensive care. For the 15 patients operated on pump, the average length of stay in intensive care was 4 days (3 - 6 days). The patients operated off pump stayed 6 days in hospital after intensive care. Patients operated on pump had a mean length of stay after intensive care of 10.2 days (7 - 26 days).

After a mean follow-up of 3 years ± 1.8 (0.6 and 5.8 years), there were no lost to follow-up. No complications or deaths were observed during this post-operative follow-up period. All patients were functionally asymptomatic. No patient developed angina. All systematically performed stress tests were negative.

4. Discussion

Indications for myocardial surgical revascularization have evolved significantly. Currently, the "gold standard" in terms of scores for indications for coronary surgery is the SYNTAX score [7] [9]. The therapeutic decision will depend on the level of risk. This score suggests that surgery remains the reference method for patients with a complex lesion (intermediate or high Syntax score). This is because the secondary revascularization rate remains low with surgery. Therefore, our patients who underwent surgical myocardial revascularization were mostly tri-truncular.

They were operated on according to two main modalities. These were on-pump and off-pump coronary artery surgery. However, we performed more on-pump procedures. Some teams performing this surgery have operated most of the patients on-pump with a proportion of 66% to 90% [7] [10] [11]. On-pump coronary artery surgery allows for a more complete revascularization. It has other advantages such as:

- Maintenance of hemodynamic stability and in particular perfusion flow during the surgical procedure.
- Precision of the surgical gestures by maintaining an immobile and almost bloodless operating field.
- Myocardial protection during ischemia by cardioplegia. [12] [13].

As for off-coronary surgery [11] [14], it is less practiced than On-pump surgery. This technique avoids the deleterious effects of cardiopulmonary bypass surgery, limits perioperative myocardial ischemia, and minimizes damage to the aortic wall. It ensures a shortening of the hospitalization time and of the extubation delay. It is less costly in the absence of consumables related to the cardiopulmonary bypass. This makes it an interesting technique for developing countries where resources are limited. However, the beating heart presents difficulties that the surgeon must face: obtaining a good exposure of the vessel to be bypassed, locally decreasing the cardiac movements, protecting the myocardium during the time of ischemia caused by the interruption of the flow in the coronary. Contraindications to beating heart revascularization are the presence of intracavitary thrombus, intramyocardial vessels, massive ventricular dilatation, major ventricular arrhythmias, and procedures combined with valve replacement. In terms

of morbidity and mortality, these two revascularization modalities are almost identical [15].

We used the internal thoracic artery (ITA) and the long saphenous vein as grafts. ITA was used in all patients of our cohort. We performed single, double and triple bypasses with a higher proportion of double and triple bypasses. The same observation is made in some studies [16] [17] [18].

All single bypasses were performed with the left ITA and involved the territory of the anterior inter-ventricular artery.

The benefit to patients of anterior inter-ventricular artery revascularization with ITA compared to saphenous vein has been demonstrated [19]. ITA has an excellent longevity with a patency rate of 90% at 10 years [20]. Indeed, with ITA at 10 years, the risk of death is reduced by 1.6 times. The risk of infarction is reduced by 1.4 times. The risk of reoperations is reduced by 2 times and that of any postoperative cardiac event by 1.3 times. All-arterial bypass surgery should therefore be preferred [18] [19].

Almost half of the patients underwent coronary artery bypass surgery using both ITAs with or without additional venous grafts. In the remaining patients, ITA was used alone or in combination with saphenous vein grafts. Moreover, the use of 2 ITAs compared to the use of a single ITA resulted in a significantly higher rate of postoperative mediastinitis [20] [21]. None of our patients who benefited from the use of 2 ITAs in bypass surgery presented this complication. Another advantage of using 2 ITAs instead of one in myocardial revascularization is the improved survival at 5, 10 and 15 years. When using the 2 ITAs [10]. The average number of bypass operations was 2 in our study. Other African series [12] [22] show an almost identical mean number of bypasses (2.3 - 2.5). In Europe [16] [23] [24], the average number of bridges was higher (2.6 - 3.2). Concerning the skeletonization of grafts, a study [25] published in 2004 identified a spectacular increase in free sternal blood flow associated with good sternal vascularization during skeletonization. Skeletonization therefore reduces the rate of sternal infections from 10% to 2% and ensures good graft longevity [26]. In view of these studies, skeletonization should be adopted as the technique of choice.

Immediate operative mortality in our series was zero.Studies [27] have reported a mortality rate of 4% to 10% mainly due to refractory cardiogenic shock, myocardial infarction and acute renal failure. Postoperative complications were mediastinitis in one patient and acute renal failure in another. In the literature [12] [22] [28], we note a little more postoperative complications, notably mediastinitis (1.3% to 3.9%), MI (1.3% - 2.8%), stroke (0.9% - 3%) and renal failure (1.9% to 4.6%).

In the long term the evolution can be marked by: recurrence of acute coronary syndrome with surgical revision, ischemic cardiomyopathy, stroke and death [7]. These different complications are possible in both monovascular and polyvascular patients [7]. The average delay in the onset of these complications is identical for patients operated on with a beating heart and in bypass surgery. However, a

shorter delay is observed in patients with severe left ventricular dysfunction. Long-term survival is closely related to the patency of the grafts used. Several authors have confirmed the superiority of the ITA graft over the venous graft on long-term results [20] [21]. In all studies, the use of ITA on the anterior inter-ventricular artery during myocardial revascularization results in greater resistance to atheromatous disease progression and better long-term bypass patency compared with venous grafts [18] [19].

5. Conclusion

Surgical myocardial revascularization is a practice that is more than five decades old. It has undergone considerable growth and today it still elicits numerous studies. Advances in angioplasty have led to significant changes in the indications for revascularization. Nevertheless, coronary bypass surgery remains an essential technique for the optimal treatment of coronary artery disease with well identified indications. Our experience has allowed us to demonstrate the realization of surgical myocardial revascularization in our patients with satisfactory and encouraging results. At the end of our study, we note that this experience has allowed us to take an important step in the optimal management of coronary artery disease at the Abidjan Heart Institute.

Limitations of the Study

Sample size (small sample size). A larger cohort might have allowed us to refine some of our results.

The follow-up period is short for a better assessment of the long-term results.

Conflicts of Interest

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

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