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Outcomes of Atrioventricular Septal Defects Surgery in Senegal

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Abstract: *Introduction:* The incidence of atrioventricular septal defect (AVSD) varies between 0.24 to 0.31 per 1000 births and represents 4% of congenital heart disease. AVSD surgery has known a fast evolution with better results due to a better perioperative management of these patients and an earlier complete cure in the first 3 to 6 months. In Senegal, AVSD surgery represents a real challenge because a diagnosis is most often late. These patients are operated on at a later age. It is in this context that this work was carried out to see the results of the surgery of these patients and compared them with those of the literature. The aims of this work were to study the epidemiological profile as well as the clinical specificities of AVSD; to evaluate the results of surgery in terms of morbidity and mortality. *Materials and Methods:* This is a retrospective, descriptive and analytical study carried out from the chart of patients followed at the CUOMO cardio-pediatric center in Dakar over a period from January 2017 to May 2021. *Results:* The average age of patients is 77 months. The average duration of cardiopulmonary bypass (CPB) was 151 ± 78 min (62–375min), the average duration of aortic cross clamping was 113 ± 63.8 min (41-271min). Morbidity was dominated by heart rhythm disorders (13%) and hemodynamic instability (13%). The early mortality rate was 13% (3 patients), late mortality was nil. The mortality risk factors that were found in our study are patients with a diagnosis of complete AVSD, a CPB duration greater than 150 min, an intubation duration greater than 45 hours and an inotropic support duration greater than 136 hours. *Conclusion:* Our long-term results are satisfactory and encouraging in terms of survival and quality of life. Even though they were operated late most often beyond the indicated period, we have had good results in the follow-up of these patients after surgery. The recommendations go to the earlier management of these patients in our countries with an awareness in early diagnosis and more appropriate care to further reduce morbidity and mortality.

Keywords: Atrioventricular Septal Defect, Surgery, Senegal

1. Introduction

The incidence of atrioventricular septal defects (AVSD) varies between 0.24 [1] to 0.31 [2] per 1000 births and represents 4% of congenital heart disease [3]. In 50% of cases, AVSD is associated with Down syndrome [4]. AVSD surgery in the 1950s was associated with heavy mortality. However, since the 1980s, mortality and the rate of reoperation have greatly decreased thanks to a better knowledge of anatomy, progress in myocardial protection, improvement in surgical techniques and progress in postoperative management [5]. Improvements in neonatal and infant techniques of cardiopulmonary bypass, anesthesia, and postoperative intensive care unit medical management have allowed earlier repair of atrioventricular canal defects with, in nearly all instances, improvement in outcome by earlier date of operation. Most centers currently recommend complete repair of atrioventricular canal defects at the age of 3-5 months. In Senegal, AVSD surgery represents a real challenge because diagnosis is most often late. These patients are operated on at a later age most often outside the period indicated in the literature. It is in this context that this work was undertaken to see the results of the surgery of these patients most often operated late and compared them with those of the literature. The aim of this work was to study the

epidemiological profile as well as the clinical specificities of AVSD; to evaluate the results of surgery in terms of morbidity and mortality in our context.

2. Materials and Methods

This is a retrospective, descriptive and analytical study. It's carried out from the charts of patients followed at the CUOMO cardio-pediatric center in Dakar and who have undergone surgery for AVSD. It took place over a period from January 2017 to May 2021, i. e. a duration of 52 months (04 years). The data was collected from the charts of patients operated for AVSD. Statistical analysis of the data was performed with Excel and SPSS version 18 software. The total number of our study was 23 patients. Among these 23 patients, 11 were male (48%) and 12 were female (52%). The sex ratio was 0.91. The median age was 56 months (9-216 months). The average age of patients operated for complete AVSD was 21 ± 10 months, that of patients operated for intermediate AVSD was 73 ± 22 months and that of patients operated for partial AVSD was 125 ± 73 months. All diagnoses were postnatal. The mean age at diagnosis was 46 ± 71.05 months (1-207 months). The average time between the first consultation and surgery was 35 months (5-107 months). The most common reason for consultation was dyspnea on exertion (96%), hypotrophy (35%), eating difficulties and repeated episodes of bronchitis (30%). Down syndrome was found in 5 patients or 22%. In our study, only one patient (4%) had a pulmonary artery banding preoperatively. The concept of parental consanguinity was found in 9 patients or 39%.

3. Results

The distribution of patients according to the type of AVSD is partial AVSD 10 patients (43%), intermediate AVSD 5 patients (26%) and complete AVSD 8 patients (35%) including 7 patients with type A AVSD according to Rastelli classification and a patient with type C AVSD. The percentage of atrioventricular valve leakage is noted in Table 1.

Table 1. *Percentage of Preoperative Atrioventricular Valve Insufficiencies.*

	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4
Left AV valve insufficiency	2 (9%)	6 (26%)	4 (18%)	4 (18%)	3 (14%)
Right AV valve insufficiency	1 (4%)	10 (44%)	5 (22%)	2 (9%)	1 (4%)

Mean systolic pulmonary arterial pressure (SPAP) was 44 ± 13.4 mmHg (25-68 mmHg). Four (18%) patients had supravalvular pulmonary stenosis. The stenosis was located at the level of the right pulmonary artery in 3 patients (14%) and one patient (4%) presented with stenosis of the trunk of the pulmonary artery associated with hypoplasia of the annulus and pulmonary infundibular stenosis (AVSD-Fallot). Two patients (9%) presented with a left superior vena cava draining into the coronary sinus. The surgical approach was a vertical median sternotomy. The approach to the heart was a right atriotomy. The cannulation was bicaval in all cases. We used a modified Del Nido cardioplegia in 17 patients (74%) and blood cold cardioplegia in 6 patients (26%). Most patients were operated on normothermia (21 patients or 91%). Moderate hypothermia was performed in 9% of cases (2 patients). Mean cardiopulmonary bypass (CPB) duration was 151 ± 78 min (62 – 375min), mean aortic cross clamping time was 113 ± 63.8 min (41-271min) and mean duration of cardiac support was 22 ±11.3 min (11-59 min). Sinus rhythm was observed in 22 patients (96%) and complete atrioventricular block (AVB) in 1 patient (4%) after completion of surgery. Two techniques were used in the complete AVSD: a two patches technique in 8 patients (35%) and a modified single patch technique (Nunn's technique) in 1 patient (4%). One patient (4%) benefited from a debanding of the pulmonary artery before the realization of the complete cure without widening plasty of the trunk of the pulmonary artery. In the intermediate AVSD, the plasty of the left atrioventricular valve was a closure of the mitral cleft in 5 patients (22%). For plasty of the right atrioventricular valve, the techniques used were postero-septal commissuroplasty with a Mac Vay point. Ventricular septal defect (VSD) closure was performed in 3 patients using pledgetted U stitches. A correction of the associated abnormalities was performed in 2 patients (9%): one patient (4%) for patent foramen ovalae (PFO) closure and one patient (4%) for a right branch enlargement patch of the pulmonary artery. In partial AVSD, left atrioventricular valve plasty techniques were mitral cleft closure in 10 patients (43%), posterior annuloplasty with an overlock in 2 patients (9%). Right atrioventricular valve plasty was performed in 4 patients (17%) and consisted of tricuspid annuloplasty by strip of autologous pericardium in 2 patients (9%) or by the De Vega technique in 1 patient (4%) and antero-septal commissuroplasty in 1 patient (4%). The mean length of stay in intensive care unit was 5 ± 3.5 days (2-18 days). The mean intubation time was 17.3 ± 22.9 hours (3-90 hours). The mean duration of inotropic support was 62 ± 58.3 hours (0-265 hours). A grade 3 mitral leak was observed in 5 patients, 7 patients presented with a grade 2 mitral leak, 8 patients (35%) with grade 1. The mitral leak was not specified in 2 patients (9%). Early complications were dominated by heart rhythm disorders (ventricular tachycardia in 4% of cases (n=1), supraventricular rhythm disorder in 4% of cases (n=1)), hemodynamic instability in 3 patients (13%), respiratory complications in 3 patients (13%), a pulmonary arterial hypertension crisis in 2 patients (9%), conduction disorders (transient complete AVB in 9% of cases (n=2)) without implantation of a permanent pacemaker, multi-organ failure in 1 patient (4%). Secondary complications were dominated by infectious complications such as pneumopathy in 8 patients (35%) and sepsis in 6 patients (26%). One

patient presented with a major mitral leak postoperatively and received medical treatment based on diuretics and Antagonist Conversing Enzyme inhibitors. Early mortality was 13% (3 patients). The relationship between a long CPB (greater than 150 min) and the occurrence of complications is summarized in Table 2.

Table 2. *Correlation Between a Long CPB and the Occurrence of Postoperative Complications.*

	Hemodynamic instability	Multiorgan failure	Cardiac failure	Rhythm disorders	PAH Crisis
CPB duration >150 min	p=0.047	p=0.391	p=0.391	p=0.391	p=0.142

A duration of intubation greater than 45 hours was correlated with hemodynamic instability, cardiac arrest, pneumopathy and postoperative hypoxia (respectively p=0.018; p=0.018; p= 0.044 and p=0.014). A length of stay in intensive care unit greater than 11 days was correlated with postoperative hypoxia p=0.001. A duration of inotropic support greater than 136 hours was correlated with hemodynamic instability, cardiac arrest, pneumopathy and postoperative hypoxia (respectively p=0.018; p=0.018; p=0.044 and p=0.014). The risk factors for mortality that were found in our study are patients with a diagnosis of complete AVSD (p=0.047), duration of CPB greater than 150 min (p=0.047), duration of intubation greater than 45 hours (p=0.018) and a duration of inotropic support greater than 136 hours (p=0.015). The mean duration of follow-up of our patients was 25 ± 13 months (3-46 months). At follow-up, 10 patients (43%) had stage 1 dyspnea (NYHA) and 2 patients had stage 2 dyspnea (NYHA). Mitral leakage was mild in 2 patients (9%), moderate in 2 patients (9%), and trivial in 3 patients (13%). Tricuspid leakage was trivial in 8 patients (35%). Late mortality was nil. At the end of our study 20 of the patients (86%) were still alive. However, 3 patients (13%) were lost to follow-up.

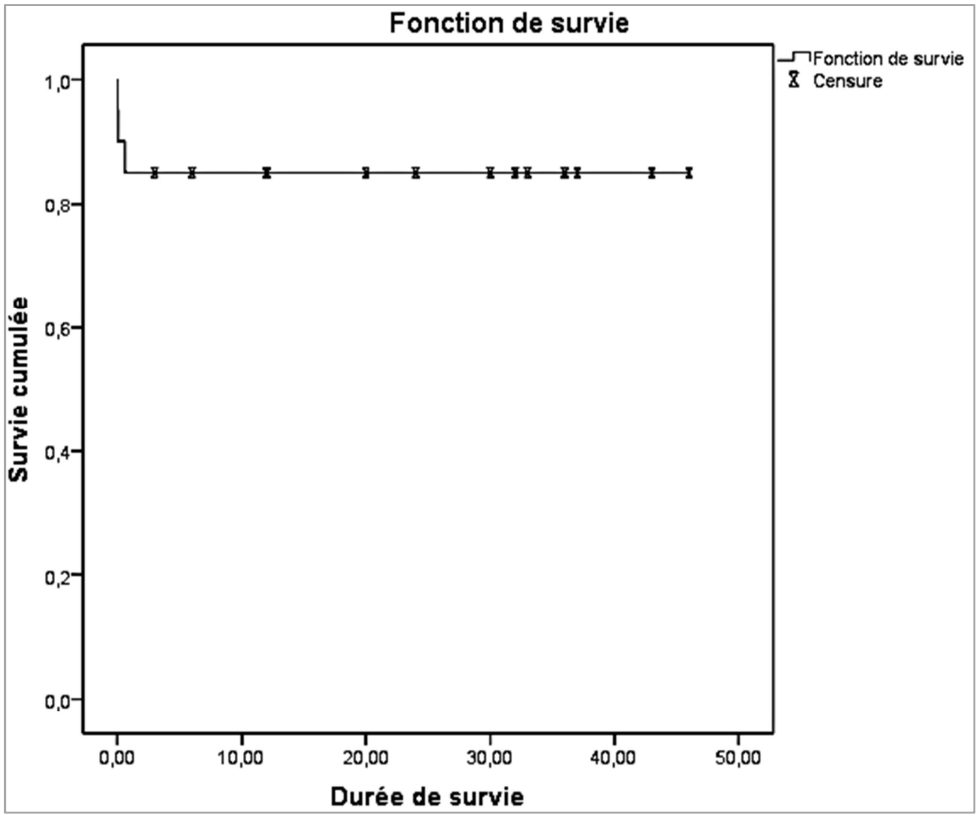

Figure 1. *Actuarial Survival Curve of Patients who Underwent AVSD Surgery.*

4. Discussion

In our series, we noted a female predominance with a sex ratio of 0.91 as in most series [6-8]. Our patients were operated late. The current trend is to perform surgery earlier and earlier to avoid complications related to pulmonary arterial hypertension (PAH) [7] especially in complete AVSD. Partial AVSD can be repaired at school age. In our study, only one patient (4%) had undergone pulmonary artery banding. In fact, in most recent studies, palliative surgery before the complete cure is performed less and less [5, 8]. In a study published in 1995 involving 203 patients, 44% of patients had undergone pulmonary artery banding before complete cure [9]. In our series, the CPB time is significantly longer than in the literature. This is explained by the technique used in our center (two-patch technique used in 88% of patients with complete AVSD). In fact, in the literature, it

has been shown that the CPB time and the aortic cross clamping time were significantly longer when the two-patch technique was used [7, 8, 10]. Among the patients who underwent a complete AVSD surgery, 88% (8 patients) benefited from the 2-patch closure technique and 12% (1 patient) from the modified one-patch closure technique. We preferably use the technique of two patches because it respects the geometry of the valve. Three techniques have been described in the literature for the cure of complete. Many centers have described their own experiences using these different techniques in the literature [11]. Several studies have come to different conclusions. Bando and al. divided their patients into 2 groups: one group who received closure with one patch and another group who received closure with two patches. Both techniques gave good results in terms of morbidity and mortality. However, their current preference tends towards the 2-patch technique because they believe that it is possible to avoid the splitting of the hemi-valves in type C AVSD when this is used [12]. The two-patch technique was originally described by Trusler and al. [13]. According to some authors, this would offer better postoperative results in terms of coaptation of the right and left atrioventricular valves [14, 15]. The advantage of the closure technique with a modified patch is that the CPB and aortic cross clamping time is shorter [16]. Jonas and al. [17] had excellent results, even during the learning phase, 33 patients were operated on, early mortality was 0% and only one patient (3%) was reoperated for severe mitral insufficiency. However, by critically reading the various publications, the superiority of one technique over the other has not been clearly demonstrated. The authors agree that both techniques provide excellent results [5, 11]. It is therefore up to the surgeons to choose the surgical technique according to their own experience and preference. Mitral cleft closure was performed in all our patients. Some authors say that the mitral cleft must be respected especially in the intermediate forms [18]. The mitral cleft should be closed as far as possible except in the double mitral orifice because this reduces the incidence of re-operations for major mitral leak [12, 19]. In the presence of a small mitral valve or of a single papillary muscle closing the cleft can lead to stenosis on the left AV valve [9]. Trisomy 21 syndrom is a protective factor against reoperation for a leak on the left AV valve [7]. St Louis and al. have shown that patients with Trisomy 21 have favorable anatomy for complete cure because their ventricles are balanced and we have more tissue valve, unlike patients with eusomic facies [20]. Early complications were noted in our study, in particular rhythm and cardiac conduction disorders, which represent one of the major complications of AVSD surgery. Their incidences are highly variable in the literature [6, 21]. The two mechanisms involved in the occurrence of these arrhythmias are jet lesions and scars secondary to right atriotomy for supraventricular arrhythmias and lesion inflammatory or organic damage of the atrioventricular node for conduction disorders. The placement of a permanent pacemaker probe varies from 0% to 3.5% [8, 9, 22]. There is no statistical difference in the occurrence of definitive complete AVB between patients who have benefited from the two-patch technique and those who have benefited from the one-patch technique. A PAH crisis was noted in 2 patients (9%). Bando and al. have shown that the survival time of patients who presented with a PAH crisis postoperatively is less than in patients who did not have a PAH crisis. A pulmonary arterial hypertension crisis is associated with an increase in postoperative morbidity and mortality [12, 14, 15]. In our study, the risk factors for the occurrence of these various complications are patients with a diagnosis of complete AVSD, duration of CPB greater than 150 min, duration of intubation greater than 45 hours, duration stay in intensive care unit greater than 11 days, a duration of inotropic support greater than 136 hours. In addition to the risk factors previously cited in the literature, the other factors that have been found are the presence of left superior vena cava, the presence of other VSD, coarctation of the aorta, valvular dysplasia, postoperative PAH, the presence other cardiac abnormalities associated with severe left AV valve leakage preoperatively [7, 15, 23]. Secondary complications were dominated by infectious complications such as pneumopathy in 8 patients (35%) and sepsis in 6 patients (26%). Infectious complications such as sepsis and pneumopathy are found at a lower rate in the Atz series with a percentage of 5% and a percentage of pneumopathy of 0.8% [24]. In Yahia's series [25] the percentage of sepsis was 1.8% and the percentage of pneumopathy was 14%. In one case we note major mitral leak postoperatively and a patient received medical treatment. We did not find any correlation between the degree of severity of mitral insufficiency and the occurrence of postoperative complications. In Twedell's study, it was also demonstrated that there was no relationship between the severity of mitral leakage and the occurrence of complications [14]. However, some authors have shown that severe left atrioventricular leakage preoperatively represents a risk factor for early mortality (p=0.01) [12]. Some teams have also demonstrated that a moderate or severe preoperative leak is a risk factor for revision [9, 26]. Early mortality in our series was 13% (n=3). In the 1950s operative mortality was 50% [27]. Since the 1980s, mortality has drastically decreased, reaching rates of 1 to 8% in the most recent series with a 15-year survival rate of 95% [7, 28]. This is due to a better understanding of surgical anatomy in complete AVSD and advances in postoperative management. Mortality is higher in complete AVSD than in other forms [28]. In our study, the mortality rate of patients operated for intermediate and partial AVSD was nil. In the literature there is no statistical difference in terms of mortality depending on the operative technique used for the cure of complete AVSD [16]. In our study, the mortality factors are patients with a diagnosis of complete AVSD, a CPB duration greater than 150 min, an intubation duration greater than 45 hours (p=0.018) and a duration of inotropic support greater at 136 hours (p=0.015). In the literature, the factors linked to the increased mortality rate found are an association with coarctation of the aorta, the presence of a left superior vena cava, a genetic anomaly other than trisomy 21 [7],

postoperative PAH [12, 14, 15], atrioventricular valve dysplasia [15], moderate to severe leakage of the left AV valve preoperatively [28], hemodynamic instability [15] and reoperation after complete AVSD surgery [22].

5. Conclusion

Our long-term results are satisfactory and encouraging in terms of survival and quality of life. Even though they were operated late most often beyond the indicated period, we have had good results in the follow-up of these patients after surgery. The recommendations go to the earlier management of these patients in our countries with an awareness in early diagnosis and more appropriate care to further reduce morbidity and mortality. This study shows us the importance of early management, especially patients with a diagnosis of complete AVSD, to limit morbidity and mortality. The limits of this work are constituted by the retrospective nature and the small sample. This is explained by the recent activity of this surgery in our center.

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