

Early Result of Atrial Septal Defects Repair at Soavinandriana Hospital

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Abstract

Introduction: The surgical closure of an atrial septal defect (ASD) using cardiopulmonary bypass (CPB) was the first surgical repair of congenital heart disease (CHD) performed at Soavinandriana Hospital (Cenhosoa) in Antananarivo. This study aimed to report the initial results of our series of surgical closures of isolated ASDs performed at Soavinandriana Hospital. **Materials and Methods:** This retrospective case series reports early outcomes of surgical closure of isolated ostium secundum atrial septal defects (ASD) at Soavinandriana Hospital (Cehosoa), Madagascar, during 2024-2026. The authors analyze patient demographics, clinical presentation, echocardiography results, surgical techniques involving cardiopulmonary bypass time and immediate postoperative outcomes. **Results:** Eleven children and young adults who underwent surgical repair of ASD are reported in this study, including five males (45%) and six females (54%). The average age was 12.18 years. The mean weight was 31.36 kg. The main symptoms were a cardiac murmur (81%), recurrent lung infections (54%), and failure to thrive (27%). Echocardiography revealed an isolated ostium secundum ASDs (100%), large in 100% of cases with a mean diameter of 17.91 mm and associated with moderate pulmonary hypertension (81%). All ASD repairs were performed using conventional surgery and cardiopulmonary bypass (CPB). The ASDs were closed by using dacron patch (54%), autologous pericardial patch (36%) and direct suturing (9%). The mean CPB time was 77 minutes. The mean aortic cross-clamping time was 36 minutes. The postoperative success rate was 100%. **Conclusion:**

Eleven patients underwent conventional repair on cardiopulmonary bypass with no mortality and one reported reoperation for postoperative bleeding. The manuscript positions this program as an important step toward local congenital heart surgery capacity and describes perioperative timings and short-term clinical outcomes.

Keywords

Atrial Septal Defects, Congenital Heart Disease, Surgery, Paediatrics

1. Introduction

An atrial septal defect (ASD) is a congenital heart disease (CHD) characterised by the presence of a hole in the septum that divides the upper chambers (atria) of the heart. In Africa, the prevalence of ASD varies by region, ranging from 10.36% in East Africa [1] to 8.86% in West Africa [2]. In Madagascar, ASD accounted for around 4% of CHDs in Antananarivo [3]. Access to surgical repair of ASD remains challenging in sub-Saharan African countries such as Madagascar. Children with ASD are usually sent to French hospitals for ASD closure due to collaboration with Chain of Hope, a French humanitarian organisation. However, surgical closure of simple ASDs can now be performed at Soavinandriana Hospital (Cenhosoa) in Antananarivo, thanks to a partnership with Chain of Hope and some French missionaries. The Malagasy team performs surgical closures of ASD with the assistance of French missionaries. This study aimed to report on the first series of cases of ASD repair performed at Soavinandriana Hospital.

2. Patients and Methods

Soavinandriana Hospital (Cenhosoa) is a military hospital in Antananarivo, Madagascar. It is the only hospital in Madagascar to perform congenital heart disease (CHD) surgery on children. Since 2024, Cenhosoa has periodically performed surgical closures of an isolated atrial septal defect (ASD) due to its collaboration with Chain of Hope and French Missionaries. This retrospective descriptive study looks at cases of atrial septal defect (ASD) repair in children and young adults at the Cardiac Surgery Unit of Cenhosoa from May 1st 2024 to January 31th 2026. This study included all children and young adults weighing at least 15 kg who underwent surgical repair for isolated atrial septal defects (ASDs). The study analysed the demographic data, symptoms, imaging diagnosis results, surgical procedures, outcomes, and hospital stays.

The size of ASD was defined as medium when the size of defect was between 6 and 9 mm and large from 10 mm. Pulmonary hypertension (PH) was defined with as moderate when the mean pulmonary arterial pressure, as measured by echocardiography, was between 20 and 40 mmHg. For the primary outcomes, surgical repair was considered successful when echocardiography showed complete closure of the defect with no residual shunt, and when the patient did not experience

any early complications such as arrhythmia, pericardial effusion or heart block within 30 days of the operation. The postoperative success criteria included the survival of the patient after surgery and complete closure of the defects, confirmed by echocardiography. The data were collected, analysed and managed using KoboToolbox® software.

3. Results

Eleven patients underwent surgical repair of ASD were recorded, including 5 males (45%) and 6 females (54%), giving sex ratio of 0.83. The average age was 12.18 ± 4.33 years, ranging from 6 to 21 years (Table 1). The average body weight was 31.36 ± 12.36 kg, ranging from 18 to 57 kg. The average height was 140.09 ± 17.95 cm, ranging from 113 to 171 cm. Nine patients (81%) presented symptoms of left-right shunt. The main symptoms were a cardiac murmur (81%), recurrent lung infections (54.54%), and failure to thrive (27.27%).

Table 1. Demographic data and symptomatology.

Patients (No.)	Age (years)	Gender	Weight (kg)	Height (cm)	Existence of symptoms
1	13	F	38	148	Yes
2	8	M	25	126	Yes
3	16	M	48	171	Yes
4	8	F	23	126	Yes
5	11	M	22	132	Yes
6	10	M	20	120	No
7	13	F	34	155	Yes
8	6	F	18	113	Yes
9	21	F	34	151	Yes
10	16	F	57	156	No
11	12	M	26	143	Yes

Chest X-rays showed cardiomegaly in 72.73% of cases and increased pulmonary vascularity in all cases (100%) (Figure 1).



Figure 1. Chest x-ray showing cardiomegaly with an increased pulmonary vascularity.

The diagnosis of ASD was made by using echocardiography with colour Doppler. Echocardiography revealed moderate pulmonary hypertension in 81% of cases (**Table 2**). All ASDs were ostium secundum type (100%). The ASDs were large in 100% of cases, with a mean diameter of 17.91 ± 3.91 mm. Two patients had a patent foramen ovale.

Table 2. Echocardiography results.

Patients (No.)	Type of ASD	Diameter (mm)	Size	Associated malformation	Pulmonary Hypertension
1	Ostium secundum	20	Large	None	Moderate
2	Ostium secundum	10	Large	None	Moderate
3	Ostium secundum	20	Large	PFO	Moderate
4	Ostium secundum	18	Large	None	Moderate
5	Ostium secundum	20	Large	None	Moderate
6	Ostium secundum	20	Large	None	Moderate
7	Ostium secundum	25	Large	None	None
8	Ostium secundum	14	Large	PFO	Moderate
9	Ostium secundum	16	Large	None	Moderate
10	Ostium secundum	16	Large	None	None
11	Ostium secundum	18	Large	None	Moderate

All ASDs were closed by conventional surgery with using cardiopulmonary bypass (CPB) and normothermic blood cardioplegia. The surgical procedures were performed by sternotomy following by aortic cross-clamping and cardioplegia. A right atriotomy was performed to expose the atrial defect, after which a patch was used to repair it (**Figure 2**). The defects were closed by using dacron patches (54.55%), autologous pericardial patches (36.36%) and direct suturing (9.09%) (**Table 3**). The patch was sutured with a running stitch at the edge of the defect using non-absorbable Prolene 5/0 thread (**Figure 3**). The associated PFO were closed by suturing. The mean CPB time was 77.36 ± 17.60 minutes (range 47 - 110 minutes). The mean aortic cross-clamping time was 36.55 ± 8.20 minutes (from 19 to 47 minutes). The mean operative time was 203.21 ± 36.70 minutes (range 160 - 291 minutes). The average length of hospital stay was 8.45 ± 2.25 days (range 5 - 12 days). There were no deaths among the 11 ASD repairs. However, one patient experienced a haemorrhagic complication after the surgery that required a further operation. The postoperative success rate was 100%.

Table 3. Surgical procedures and hospital stay.

Patients (No.)	Closures techniques	CPB time (min)	Cross clamp time (min)	Operative time (min)	Hospital stay (day)
1	Autologous pericardial patch	54	32	195	11
2	Autologous pericardial patch	47	19	170	8
3	Autologous pericardial patch	110	47	291	9

Continued

4	Dacron patch	71	37	207	8
5	Dacron patch	74	37	160	5
6	Dacron patch	68	35	202	5
7	Dacron patch	93	47	202	8
8	Direct suture	85	45	189	11
9	Autologous pericardial patch	84	42	170	8
10	Dacron patch	79	32	240	12
11	Dacron patch	86	31	210	8

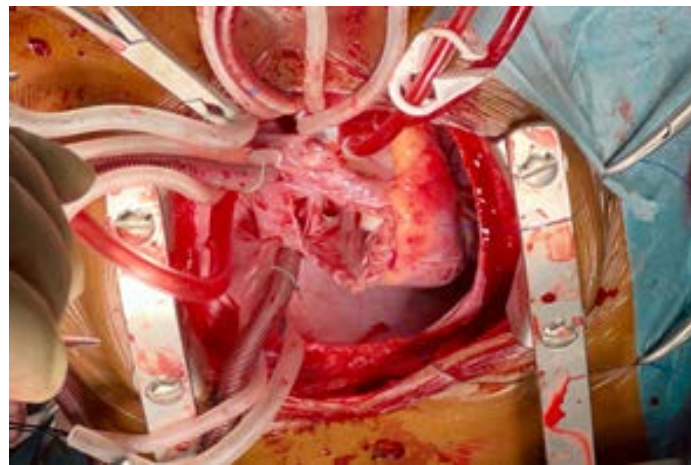


Figure 2. Peroperative atrial septal defect exposure after opening of right atrial.

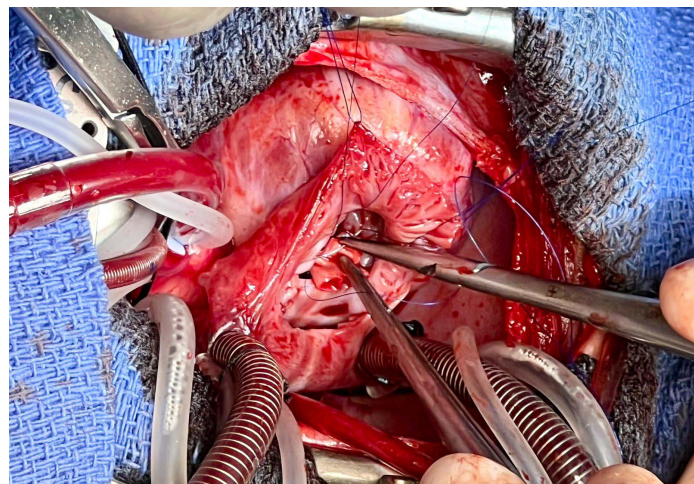


Figure 3. Surgical repair of atrial septal defect using autologous pericardial patch.

4. Discussion

Access to cardiac surgery remains limited in most Sub-Saharan countries. Barriers to accessing CHD surgery in low-income countries include delayed diagnosis of CHD, difficulty reaching treatment centres, institutional-level barriers to access, and financial constraints [4]. In Madagascar, poverty limits access to diagnosis

and surgery for children with CHD. The collaboration between Chain of Hope and Cenhosoa provided an opportunity for Malagasy children to undergo surgery to repair ASDs. This study reports on the first series of cases of ASD repair performed at the Cardiac Surgery Unit of Soavinandriana Hospital following the first repair in May 2024.

The average age at which patients undergo surgery to repair an ASD varies according to geography. In sub-Saharan African countries, most ASDs are repaired during adolescence, whereas in more developed countries, they are usually repaired within the first six months of life. In our study, the average age at which patients underwent ASD repair was 12.18 years. Some African sub-Saharan studies showed a later age for ASD repair, such as the studies by Sawadogo A *et al.* [5] and Tamatey MN *et al.* [6], in which the average age was 15.7 and 17.6 years, respectively. The advanced age of patients in patients underwent ASD repair in our study and other African sub-Saharan studies could be explained by delayed diagnosis and long waiting times for surgery.

Most studies have shown a female predominance among patients who underwent surgical repair of an ASD. Our study also showed a female predominance (54%). Some African authors found similar results, such as Sawadogo A *et al.* (53%) [5], Tamatey MN *et al.* (59%) [6], and Mvondo CM *et al.* (sex ratio of 0.76) [7]. Some non-African studies also showed a female predominance in populations undergoing ASD closures, such as the study by English KM *et al.* (65%) [8]. However, Xuan Tuan H *et al.* found a significantly higher prevalence of ASD among females (25.9%) than males (16.0%) ($p < 0.01$) [9].

The average body weight of infants undergoing surgical repair of ASD depends on the experience of the cardiac surgery team. In developed countries, ASD closures are usually performed earlier, despite patients having a lower weight. Our study showed an average body weight of 31.36 kg. But, some authors found lower average weights than in our study, such as Yoo BA *et al.* (7.1 kg) [10] and Pilard CM *et al.* (8.9 kg) [11]. The high average body weight in our study could be explained by our team's lack of experience.

The prevalence of symptomatic atrial septal defects (ASD) among patients who have undergone surgical repair is still being observed in sub-Saharan African countries. In Madagascar, parents usually come to the hospital for a consultation when their child exhibits symptoms related to a left-to-right shunt. In addition, the lack of systematic screening usually means that asymptomatic ASD goes undiagnosed in African people. Our study found a predominance of symptomatic ASD (81%). Some African authors have found similar results regarding the prevalence of symptomatic ASD, such as Sawadogo A *et al.* (60%) [5] and Nasir M *et al.* (75%) [12]. The high prevalence of symptomatic ASD in our study could be explained by the absence of systematic screening for CHD in the neonatal period among the Malagasy population. According to Nasir M *et al.*, the most common symptoms of ASD were recurrent respiratory tract infections in children and adolescents (≤ 18 years of age), and dyspnoea and easy fatigability in adults (≥ 18

years of age) [12]. In our study, the most common circumstances in which ASD was discovered were cardiac murmur (81%), recurrent lung infections (54%), and failure to thrive (27%). A similar result was found in the study by Sawadogo A *et al.*, with 86% of cases presenting with a cardiac murmur and 20% presenting with failure to thrive [5]. Bani Hani A *et al.* also found a predominance of symptomatic ASD (86%), with palpitations (45%), easy fatigability (42%), and chest pain (22%) being the main symptoms [13].

A chest X-ray is one of the routine imaging tests used to diagnose ASD. The chest X-ray in patients with atrial septal defect and sizable left-to-right shunts generally shows cardiac enlargement and increased pulmonary vascularity with a dilated pulmonary trunk and central branches [14]. Our study showed 72% cardiomegaly and 100% increased pulmonary vascularity. Nasir M *et al.* found a prevalence of 69% for cardiomegaly among 99 patients who underwent percutaneous closure of ASD in Ethiopia [12].

Echocardiography with Doppler colour is the gold standard imaging technique for diagnosis, evaluation of haemodynamics and preoperative decision-making for surgical or interventional closure of defects [15]. Pulmonary hypertension (PH) is the most common complication of a left-to-right shunt, which is related to the presence of atrial septal defects. Our study found moderate PH in 81% of cases. However, Sawadogo *et al.* found a lower rate of moderate PH (40%) than in our study [5]. Another study by Mvondo C *et al.* showed a very low rate of moderate to severe PH (6%) [7]. However, the study by Nasir M *et al.* showed a moderate PH rate of 60% and a severe PH rate of 12% [12]. The high rate of pulmonary hypertension in our study could be explained by delayed diagnosis in our patients.

According to the literature, ASD ostium secundum is the most common anatomical type of ASD. Our study revealed a prevalence of 100% for ASD ostium secundum. Similar results have been published by other authors, such as Sawadogo *et al.* (100%) [5], Tamatey MN *et al.* (80%) [6] and Mvondo CM *et al.* (93%) [7]. In infancy, defects were classified as small (3 - 5 mm), medium (5 - 9 mm) or large (≥ 10 mm) [16]. The size of ASDs published in African studies is usually large. In our study, 100% of ASDs were large, with a median diameter of 17 mm. Some African authors have found similar results regarding the predominance of large ASDs, with a median diameter of 18 mm in the study by Nasir M *et al.* [12] and 16 mm in the study by Sawadogo A *et al.* [5]. However, Mvondo CM *et al.* showed a predominance of small ASDs with a median diameter of 3.2 mm [7].

Most of African countries closed the defects of ASD by conventional surgery while the percutaneous closure takes more and more place in closure of ASD in advanced countries. All ASDs in our study were closed by conventional surgery. Some African authors published the surgical repair of ASD [5] [6] while others published the percutaneous closures of ASD [12]. The materials used to close the defects varies according to the study. Most of defects were closed by using dacron patches (54%) following by using autologous pericardial patches (36%) in our

study. But, the study of Sawadogo A *et al.* showed a predominance of using biological patch (66%) following by using autologous pericardial patch (20%) [5]. Otherwise, the study of Mvondo CM *et al.* showed a using of pericardial patch for all ASD closures [7].

The duration of cardiopulmonary bypass (CPB) and aortic clamping usually depends on the experience of the surgeons and cardiac surgery team. Our study showed that the average CPB and aortic clamping times were 77 minutes and 36 minutes, respectively. A similar result was found in the study by Mvondo CM *et al.*, with an average CPB time and aortic cross-clamping time of 80 and 44 minutes, respectively [7]. Additionally, Sawadogo A *et al.* found a similar result: an average CPB time and aortic cross-clamping time of 76 and 39 minutes, respectively [5]. However, Baharestani B *et al.* found a shorter mean CPB time (49 minutes) and aortic cross-clamping time (22 minutes) than in our study [17]. The long CPB and aortic cross-clamping times in our study could be explained by the inexperience of the surgeons at Soavinandriana Hospital. The French missionaries helped the Malagasy team by providing companionship during surgery.

Surgical repair of ASDs usually yields good results, with a 30-day mortality rate of under 1% [18] [19]. In our study, no deaths recorded among the 11 ASD repairs. However, the study by Mvondo CM *et al.* showed a 2% mortality rate [7]. Sawadogo A *et al.* reported one case (0.6%) of mortality among 15 ASD repairs [5].

The length of hospital stay for ASD repair depends on the postoperative outcome and the type of procedure performed. Nowadays, the length of hospital stay for ASD closures is short in developed countries, thanks to the introduction of percutaneous closures. However, most African countries only use surgical repair, which results in a long hospital stay. The average length of hospital stay in our study was 8 days. This is shorter than the average length of stay reported in the studies of Sawadogo A *et al.* (11 days) [5] and Souaga KA *et al.* (14 days) [20].

5. Limitation

This study has several limitations. The sample size was small and does not accurately represent the Malagasy population. The fact that this study was conducted at the outset of open-heart surgery in Cenhosoa makes it difficult to compare with other studies.

6. Conclusion

This first case report of 11 ASD repair at Soavinandriana Hospital showed a predominance of symptomatic and large ASD with complications of moderate pulmonary hypertension. The study concludes that surgical closure of large ASDs is feasible in this setting, reporting a 100% success rate for the initial cohort.

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Ethical Approval

The study is exempt from ethical approval in our institution.

Conflicts of Interest

The authors declare no competing interests in the submitted work.

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