

The Utility of Rashkind Balloon Atrioseptostomy in Sub-Saharan Africa: Experience at the Abidjan Institute of Cardiology

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Abstract

Introduction: Rashkind balloon atrioseptostomy is a vital palliative procedure for cyanotic congenital heart defects. In sub-Saharan Africa, access to corrective surgery remains a major challenge, in contrast to developed countries where the rate of transition to curative treatment reaches 95 percent. **Objective:** To describe the clinical course of patients following Rashkind balloon atrioseptostomy at the Abidjan Institute of Cardiology (ICA). **Patients and Methods:** A descriptive, retrospective study (January 2023-March 2026) of seven cases of newborns who required atrioseptostomy under fluoroscopic guidance via the femoral approach at the ICA. **Results:** There were 7 patients with a mean age of 1 month and 9 days. Transposition of the great vessels (TGA) was the main indication (100 percent, n = 7). Technical success was achieved in 85 percent of cases (n = 6), with a mean interatrial communication of 5.3 mm. Mean arterial oxygen saturation rose from 64 percent pre-procedure to 87.8 percent post-procedure. The overall survival rate for our cohort was 85.7 percent (n = 6). We recorded one death (14.3 percent). **Conclusion:** Rashkind balloon atrioseptostomy is an essential therapeutic bridge for ICA, enabling immediate haemodynamic stabilisation. However, the long-term prognosis remains compromised by the difficulties in accessing paediatric open-heart surgery in our setting.

Keywords

Rashkind Atrioseptostomy, Congenital Heart Disease, Sub-Saharan Africa, Abidjan Institute of Cardiology

1. Introduction

Rashkind balloon atrioseptostomy (BAS) is an essential and life-saving palliative interventional cardiology procedure for critical cyanotic congenital heart defects in newborns [1]. By creating an interatrial shunt, it ensures adequate blood mixing, thereby correcting severe, life-threatening hypoxaemia [1]. Whilst its indications encompass several complex malformations, transposition of the great vessels (TGA) which accounts for approximately 6 percent of congenital heart defects, with an incidence of 1 in 3500 to 5000 births remains the most common emergency indication [1] [2]. In high-income countries, ASB serves as a simple temporary bridge prior to definitive surgical correction (arterial switch operation), resulting in a high cure rate [1]. Conversely, in sub-Saharan Africa, access to paediatric open-heart surgery remains severely limited [3]. In our context, atrioseptostomy is undergoing a paradigm shift: it no longer serves as a short-term stop-gap, but is becoming a long-term palliative procedure [3]. A Sudanese study illustrates this reality: only half of the infants with TGA were able to undergo surgery, exclusively abroad, with a high operative mortality rate [4]. Despite this pivotal role in resource-limited settings, published African data on the practice and outcomes of ASB remain scarce [4] [5]. The aim of this study is to describe patient outcomes following ASB at our centre. The threshold for statistical significance was set at $p < 0.05$.

2. Patients and Method

This is a descriptive, retrospective study conducted in the paediatric cardiology department in Abidjan. The study covered the period from January 2023 to March 2026. The study included all newborns and infants who underwent a Rashkind balloon atrioseptostomy during the study period. Incomplete medical records were excluded from the analysis. The Ethics Committee of the Abidjan Institute of Cardiology has approved the submitted protocol and authorised the telephone calls. The procedure was performed under general anaesthesia, with continuous fluoroscopic guidance in a SIEMENS® cardiac catheterisation laboratory. The femoral vein was used as the access route in all successful cases. Following venous puncture, a balloon catheter was inserted into the right atrium and then guided through the foramen ovale to the left atrium under fluoroscopic guidance. The balloon was inflated with saline solution diluted with iodinated contrast medium, then pulled sharply from the left atrium towards the right atrium through the foramen ovale, thereby creating an enlarged interatrial communication (IAC). The size of the resulting IAC was assessed by transthoracic echocardiography imme-

diately after the procedure. Technical success was defined as achieving a CIA ≥ 3 mm on echocardiography, combined with an improvement in arterial oxygen saturation (SaO₂). The variables recorded included: sex, weight, age at the time of the procedure, diagnosis, pre-ASB septal defect size, arterial oxygen saturation before and after the procedure, the size of the CIA achieved, technical success, complications and survival. Medium-term post-procedure follow-up was ensured through systematic telephone contact with parents. The telephone follow-up period ran from the time of the procedure until the patient reached the age of 6 months. Those lost to follow-up were parents who could not be contacted or who had not attended their appointments for more than 3 months. Continuous variables were expressed as mean $\pm$ standard deviation (SD) with ranges, and categorical variables as frequencies and percentages.

3. Results

Our series comprised 7 patients (**Table 1**), including 3 boys (42.9 percent) and 4 girls (57.1 percent), giving a sex ratio of 0.75 in favour of females. Three patients were excluded as they could not be contacted after the procedure. The mean weight at the time of the procedure was 3.2 ± 0.28 kg (range: 2.9 - 3.7 kg). The mean age at the time of the procedure was 1 month and 9 days (range: 1 month 4 days - 1 month 18 days). TGA was the sole and exclusive indication for ASB in our series (100 percent, $n = 7$). Six cases (85.7 percent) involved a D-TGA and one case (14.3 percent) involved an L-TGA. L-TGA was associated with severe pulmonary stenosis. The mean pre-ASB septal defect was 1.89 ± 0.57 mm (range: 1.0 - 2.7 mm). The mean pre-procedure SaO₂ was $64.0\% \pm 7.0\%$ (range: 50% - 70%), indicating severe hypoxaemia on presentation in all cases. Technical success of the ASB was achieved in 6 out of 7 cases (85.7%). The sole technical failure involved an infant who presented with severe haemodynamic instability on admission, for whom the procedure could not be completed via the femoral route. She died within 24 hours of the attempted procedure whilst suffering from pre-existing refractory cardiogenic shock. The immediate overall survival rate for our cohort was therefore 85.7 percent (6/7). In the 6 patients in whom the procedure was technically successful, the mean post-ASB CIA measured by echocardiography was 5.3 ± 2.3 mm (range: 3.0 - 9.0 mm). All successful procedures were performed via the femoral vein, with no major mechanical complications (parietal perforation, pericardial tamponade, gas embolism) observed. For these patients, the mean post-procedural SaO₂ was $87.8\% \pm 4.8\%$ (range: 80% - 92%), compared with $64.0\% \pm 7.0\%$ pre-procedure, representing a clinically significant mean increase of +21.5%, and based on the individual data for the six patients, the p-value calculated using a Student's t-test for paired samples is 0.000081 ($p < 0.001$). Medium-term follow-up of the six patients who underwent the procedure revealed varied clinical trajectories. Three patients underwent definitive surgical correction via arterial switch. This procedure was carried out abroad, as no local open-heart corrective surgery was available during the study period. Two female patients remained in

the exclusive prolonged palliative care stage due to a lack of financial resources for their transfer. One patient was classified as lost to follow-up following discharge, as the parents could not be contacted during the follow-up period.

Table 1. General characteristics and results of the cohort (n = 7).

ID Patient	Sex	Weight (kg)	Age at the time of the offence	Diagnosis	Pre-ASB septal defect (mm)	SaO ₂ Pre (%)	SaO ₂ Post (%)	ASD Post-ASB (mm)	Immediate Survival	Evolution/Becoming
P1	F	2.9	1 month, 12 days	D-TGA	1.7	50	-	-	DEATH (24 h)	Not operated on (refractory shock)
P2	M	3.3	1 month, 9 days	D-TGA	2.7	67	80	9.0	YES	Operated on (Evacuation)
P3	M	3.7	1 month, 4 days	D-TGA	2.4	60	84	7.0	YES	Lost touch
P4	M	3.0	1 month, 8 days	D-TGA	1.0	70	92	3.0	YES	Operated on (Evacuation)
P5	F	3.1	1 month, 7 days	L-TGA+ Pulmonary stenosis	2.1	65	91	4.0	YES	No surgery (palliative care only)
P6	F	3.0	1 month, 5 days	D-TGA	1.8	69	90	3.8	YES	Operated on (Evacuation)
P7	F	3.4	1 month, 18 days	D-TGA	1.5	67	90	5.0	YES	No surgery (palliative care only)

4. Discussion

Our study presents our centre's most recent series on Rashkind ASB. Despite the small sample size (n = 7), our results demonstrate the feasibility and immediate efficacy of this procedure in our setting (85.7 percent technical success rate), whilst providing new insights into the medium-term outcomes for these children in sub-Saharan Africa. The mean age at the time of the procedure in our series (1 month and 9 days) is comparatively high by the standards of developed countries, where the diagnosis is made in the immediate neonatal period [1]. This delay is, however, consistent with current African data: in Sudan, the median age at the time of the procedure was 28 days, and in the historical Abidjan series (1990), late presentation had already been identified as a major challenge [4] [5]. This delay is due to multiple factors and is specific to low-income settings: inadequate screening programmes, limited access to specialist paediatric cardiology, a shortage of neonatal intensive care, and the frequent unavailability of prostaglandin E1 [3] [6]. However, the survival of our patients to one month of age indicates the initial presence of a spontaneous restrictive shunt (patent foramen ovale or patent ductus arteriosus) maintaining minimal but precarious oxygenation. Our technical success rate of 86 percent (Figure 1) represents an improvement on the pioneering series from Abidjan in 1990, which reported a success rate of 72 percent

across 11 cases [5]. It remains slightly lower than the figures reported by Weeda *et al.* in the Netherlands (98 percent), which can be explained by the low annual volume of procedures performed at our centre [7]. The improvement in SaO₂ observed in our series (an average increase of 21.5 percent, rising from 64.0 percent to 87.8 percent) is clinically significant and comparable to the results of the Sudanese series by Ali Sulafa *et al.*, where the median final post-ASB saturation was similar (87 percent) [4]. The key finding of this study lies in the medium-term follow-up. Whilst the lack of local access to paediatric corrective cardiac surgery had raised fears of a rapid therapeutic impasse, our study shows that 50 percent of surviving patients ($n = 3/6$) were able to undergo definitive corrective surgery abroad. This rate of transition to curative treatment is higher than that reported in Nigeria by Animasahun *et al.*, where only 10 percent of children with TGA were able to undergo surgery abroad, with the remainder of their cohort dying rapidly due to a lack of access to local open-heart surgery [8]. Having local ASB capacity is therefore proving to be a crucial link: it fully fulfils its role as a therapeutic bridge, providing the time needed for families and practitioners to organise a medical evacuation for curative purposes.

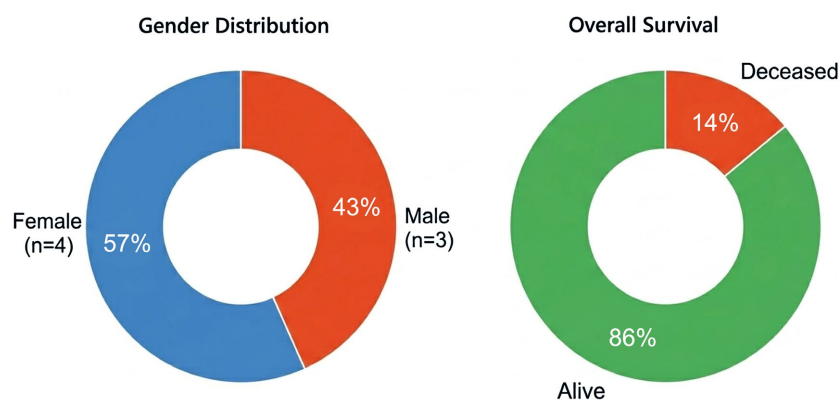


Figure 1. Gender distribution (left) and overall survival (right) in the cohort of 7 patients. 57 percent of patients were female; overall survival was 86 percent ($n = 6$ alive, $n = 1$ deceased).

However, the overall long-term prognosis remains severely compromised by disparities in access to care. For one third of survivors (33.3 percent, $n = 2$), ASB had to serve as the sole form of prolonged palliative care. Data from the African literature indicate that the median survival of patients with TGA who have not undergone surgery is only 6 months, with almost all dying before the age of one in the absence of correction [4]. Although referral to centres abroad enabled us to save half of our eligible patients, this strategy has its limitations due to prohibitive costs and long waiting times [3]. In developed countries, arterial switch surgery is performed within the first 2 to 3 weeks of life, with a low operative mortality rate and excellent long-term survival [9]. This difference highlights the persistent inequality in the management of critical congenital heart defects. The development of a regional centre of excellence in paediatric cardiac surgery in West Africa, ca-

pable of performing open-heart corrective surgery in the neonatal period, is an absolute priority [10].

5. Conclusion

Rashkind balloon atrioseptostomy is a vital, feasible and effective palliative procedure at our centre, with a technical success rate of 85.7 percent and an immediate and significant improvement in arterial oxygen saturation. B-AS is undeniably an essential therapeutic bridge, but it cannot, on its own, provide a lasting solution to TGA. Whilst it has enabled half of our survivors to wait and undergo an arterial switch operation abroad, the long-term prognosis at population level remains compromised by the lack of local access to corrective paediatric open-heart surgery. The establishment of a regional surgical network, the strengthening of early screening for congenital heart defects, and the ongoing training of interventional teams are the key priorities for improving the long-term outcomes for children with TGA and complex congenital heart defects in sub-Saharan Africa.

Ethical Considerations and Statements

Consent for the procedure was obtained from the parents or guardians. The study was conducted in accordance with the ethical principles of research, following authorisation from the ICA management and with a guarantee that the data would remain anonymous.

Author Contributions

N'goran Yves N'da Kouakou: Performance of the interventional procedure, drafting and revision of the manuscript. Akoun Oboe Ange-Marie Christopher, Tano-Akoto Micesse Kouamé Yves Wilfried: Analysis and literature review, drafting and revising the manuscript. Traoré Fatoumata (married name Diaby), Avoh Ami Echua Manzan: Clinical management and diagnosis. Camara Zenabou, Keita Massandjé Sara, Coulibaly Abdoul-Wahab Sydick: Clinical management and diagnosis. Degni Iris Jeanne Audrey, Arriko Sarra Dominique Anita Guillet, Assie Ahou Sarrah Carelle: Performance of the interventional procedure. Yoboua Aimé Kirioua-Kamenan: Performance of the interventional procedure, scientific responsibility for the study.

Conflicts of Interest

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

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