Health Sciences & Disease
The Journal of Medicine and Biomedical Sciences

Article Original

Atrial Septal Defects Repair in Central Africa: Early and Intermediate-term Results

La Fermeture de la Communication Inter-Auriculaire en Afrique Centrale : Résultats Précoces et à Moyen Terme

[1,3,4]Mve Mvondo Charles, [3]Kobe Folkabo Zephanie, [3,4]Ngo Yon Laurence Carole, [3,4]Tsague Kengni Hermann Nestor, [5]Banga Nkomo Douglas, [4,5]Metogo Junette, [3]Lowe Kuissu Sepolin, [3,2]Ela Bella Amos, [3]Yepmo Yannick, [4,5]Ngatchou Djomo William, [4]Ngowe Ngowe Marcelin

Affiliations
[1]St Elizabeth Catholic General Hospital Shisong, Cardiac Centre Shisong, Kumbo, Cameroon
[2]Faculty of Medicine and Biomedical Sciences, Yaoundé, Cameroon
[3]Department of Cardiothoracic and Vascular Surgery, Yaoundé General Hospital, Yaoundé, Cameroon
[4]Department of Surgery, Faculty of Medicine and Pharmaceutical Sciences, Douala, Cameroon
[5]Department of Surgery, Douala General Hospital, Douala, Cameroon

Corresponding author: Charles Mve Mvondo, MD
mmvondocarlo@yahoo.fr; +237-655633474

Key words: atrial septal defects; cardiac surgery; Central Africa

Mots clés: communication interatriale, chirurgie cardiaque, Afrique Centrale

ABSTRACT

Background. Surgical or transcatheter techniques have been the mainstay therapy for atrial septal defects (ASDs) over the past decades. Few data with regard to ASDs management have been published to date in Sub-Saharan Africa. This paper reviews the early and intermediate results following surgical repair of ASDs in a Central African institution. **Patients and methods.** Between December 2009 and November 2022, a total of 46 patients underwent surgical closure for ASDs in our unit. Their files were retrospectively reviewed, and clinical data were analysed. **Results.** The mean age was 23.9 ± 17.8 years (range: 1.4–55 years). Female sex was predominant with a sex-ratio (M/F) of 0.76. Patients aged > 18 years were the majority (n = 27/46, 58.6%). The main symptoms were dyspnea (16/46, 34.7%) and palpitations (20/46, 43.4%) or both (10/46, 21.7%). Ostium secundum (OS) was the commonest type of ASD (93.5%, 43/46). The mean ASD size was 3.2 ± 1.8 mm. Moderate pulmonary hypertension was found in 6.5% (3/46) of the patients. Associated procedures were Patent Ductus Arteriosus (PDA) ligation (2/46, 4.3%) and tricuspid valve annuloplasty (6/46, 13.0%). Operative mortality was 2.1% (1/46). Postoperative complications were cardiac arrythmias (10.8%, 5/46) and bleeding requiring chest re-exploration (2.1%, 1/46). The mean intensive care unit length of stay was 3.2 ± 1.2 days. The six-year overall survival was 89.4 ± 7.3%. **Conclusion.** The early and intermediate outcomes of surgical closure of ASDs in our context seem to be associated with low rates of mortality and morbidity.

RÉSUMÉ

Introduction. Au cours des dernières décennies, les techniques chirurgicales ou de transcathéter ont constitué le traitement de base des communications interauriculaires (CIA). Peu de données concernant la prise en charge des CIA ont été publiées à ce jour en Afrique subsaharienne. Cet article passe en revue les résultats précoces et intermédiaires de la réparation chirurgicale des CIA dans une institution d'Afrique centrale. **Patients et méthodes**. Entre décembre 2009 et novembre 2022, 46 patients au total ont subi une fermeture chirurgicale pour des CIA dans notre unité. Leurs dossiers ont été revus rétrospectivement et les données cliniques ont été analysées. **Résultats**. L'âge moyen était de 23,9 ± 17,8 ans (intervalle : 1,4-55 ans). Le sexe féminin était prédominant avec un sex-ratio (M/F) de 0,76. Les patients âgés de plus de 18 ans étaient majoritaires (n = 27/46, 58,6 %). Les principaux symptômes étaient la dyspnée (16/46, 34,7 %) et les palpitations (20/46, 43,4 %) ou les deux (10/46, 21,7 %). L'ostium secundum (OS) était le type de CIA le plus fréquent (93,5 %, 43/46). La taille moyenne de la CIA était de 3,2 ± 1,8 mm. Une hypertension pulmonaire modérée a été constatée chez 6,5 % (3/46) des patients. Les interventions associées étaient la ligature du canal artériel (2/46, 4,3 %) et l'annuloplastie de la valve tricuspide (6/46, 13,0 %). La mortalité opératoire était de 2,1 % (1/46). Les complications postopératoires ont été des arythmies cardiaques (10,8 %, 5/46) et des hémorragies nécessitant une ré exploration thoracique (2,1 %, 1/46). La durée moyenne du séjour en unité de soins intensifs était de 3,2 ± 1,2 jours. La survie globale à six ans était de 89,4 ± 7,3 %. **Conclusion**. Dans notre contexte, les résultats précoces et intermédiaires de la fermeture chirurgicale des CIA semblent être associés à de faibles taux de mortalité et de morbidité.

INTRODUCTION

Atrial septal defects (ASDs) are a variety of interatrial septum (IAS) congenital abnormalities characterized by a left-to-right shunting at the atrial level. ASDs are approximately 35–40% [1] of all congenital heart diseases (CHD), with an estimated prevalence at birth of approximately 1.65/1000 [2], the incidence being higher in women. Four types of ASDs are generally described, ostium secundum (75%), ostium primum (15–20%), sinus venosus (5–10%) and, rarely, a coronary sinus type (< 5%) [3]. These variants mainly differ by their relation to or position within the IAS components.

The onset and the severity of clinical manifestations are variable and related to various features, such as the size of the defect, age, and the presence of associated lesions [3, 4], a great majority of cases being clinically silent until the onset of symptoms in adulthood (> third decade) [5, 6]. Closure of the defect is recommended for clinically significant shunts with signs of right cavities overload regardless of the presence of symptoms [3].

While percutaneous closure has become the preferred therapy [7–9], mainly in ostium secundum and superior sinus venous types [10], surgical repair remains a valuable alternative for large defects (> 3cm), multiple defects, or in those with unfavorable anatomy and associated lesions. Moreover, surgical treatment has remained the main option when the percutaneous option is not available, such as in developing countries, for lack of expertise and financial constraints.

The current paper reviews the early and intermediate results following ASD repair in a Central African institute.

PATIENTS AND METHODS

We retrospectively reviewed the clinical files of all the patients who had surgical repair of ASDs from December 2009 to November 2022 in our institution. Their socio-demographics and clinical data were analyzed, as well as their follow-up outcomes.

Patients with an associated ventricular defect or pulmonary stenosis were excluded, whereas those with functional tricuspid regurgitation (secondary to right ventricle volume overload) or patent ductus arteriosus (PDA) were included in the series. Both procedures performed in children and adults were included. Patients' socio-demographic and preoperative data are summarized in Table 1. Data during follow-up were obtained by direct contact with the patients and relatives or by consulting the postoperative records of the operated patients in the outpatient department.

The institutional review board approved the study.

Surgical technique

Preoperative transthoracic echocardiograms were performed in all the patients (Figure.1). Further analysis of the defects with transesophageal echocardiography was possible only in those weighing > 25 kg, as pediatric transesophageal probes were not available in our institution. A right cardiac catheterization was indicated in patients who had suspicion of moderate to severe pulmonary arterial hypertension (PAH) during echocardiography evaluation. The majority of the cases were approached through a full median sternotomy. A lower mini-sternotomy was planned in cases with suitable anatomy following chest computed tomography scan assessment. Cardiopulmonary bypass (CPB) was established through aortic and bicaval cannulation. The cardioplegia type was selected according to the surgeon's preference or the availability of a solution. A standard right transatrial atriotomy and defect closure with heterologous pericardial patch was the commonest technique. When present, associated PDAs were closed before aortic clamping, and all the tricuspid annuloplasty was performed after ASD defect closure, preferably on a beating heart. Figure 2 shows an intraoperative view of a ASD repair with pericardial patch.

Statistical analysis

Statistical analysis was performed with R software version 4.1.1 (10). Variables were expressed as mean values ±1 standard deviation. Freedom from cardiac adverse events and survival at follow-up were computed using the Kaplan–Meier method.

RESULTS

The mean age at surgery was 23.9 ± 17.8 years (range: 1.4–55 years). Patients aged > 18 years were the majority (n = 27/46, 58.6%) versus 41.2% (n = 19/46) for those < 18 years. Age distribution in the pediatric group was as follows: < 5 years 19.5%; 6 to 10 years (15.2%); 11 to 17 years (6.5%). The sex-ratio (M/F) was 0.76. No genetic syndrome characters were found.

Table 1. Patients' characteristics

Variables	Frequency
Age, mean ±SD	23.9±17.8
Sex-ratio (M/F),	0,76
Body surface area (m2), mean ±SD*	1.28 ± 0.5
Dyspnea, n (%)	16 (34.7)
Palpitations, n (%)	20 (43.4)
Type of atrial defect, n (%)	
-Ostium Secundum	44 (93.5)
-Sinus venosus	2 (6.5)
Associated lesions, n (%)	
-Patent Ductus Arteriosus	2 (6.5)
-Functional tricuspid regurgitation	6 (13.0)
Size of the defect (mm), mean ±SD	3.2 ± 1.8 mm
Moderate to severe PHTN**	3 (6.5)
SD=standard deviation; **PHTN=pulmonary hypertension	

The main clinical signs at admission were: exertional dyspnea (16/46, 34.7%) and tachy-arrythmias (20/46, 43.4%) or both (10/46, 21.7%); history of repeated upper respiratory tract infections were reported in 23.9% (11/46), especially children who had concomitant PDA. Diagnosed ASDs were ostium secundum (OS) in 93.5% (43/46) and sinus venosus (SV) in 6.5% (3/46), respectively. The mean diameter of the defect determined by echocardiography was 3.2 ± 1.8 mm. Associated lesions were PDA (2/46, 4.3%) and functional tricuspid valve regurgitation (6/46, 13.0%). Moderate to severe

pulmonary hypertension was found in 6.5% (3/46) of the patients.

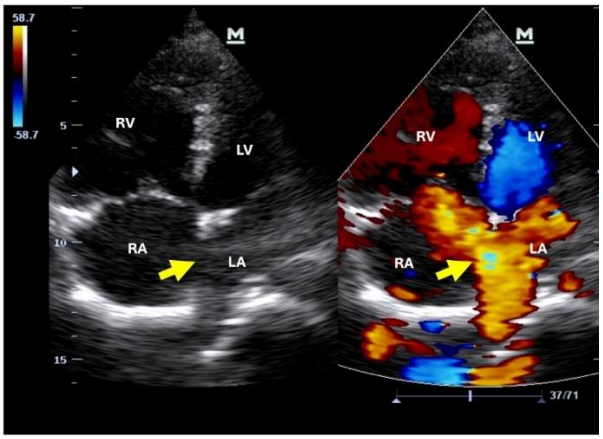

Figure 1. Four chambers' view on transthoracic echocardiogram showing a large OS defect with left-to-right shunt and dilated right side cavities (the yellow arrows indicate the location of the defect and the left-to-right shunt).

A full median sternotomy was performed in 95.6% (44/46) of the cases and a lower mini-sternotomy in 4.3% (2/46) of the cases. Closure with a pericardial patch was used in all the patients. Two patients had a unidirectional valved patch owing to a moderate grade of pulmonary hypertension. Associated procedures were PDA ligation (2/46, 4.3%) in two patients and tricuspid valve annuloplasty in six (6/46, 13.0%). The mean cardiopulmonary bypass and aortic cross clamp times were 80.4 ± 47.2 and 44.6 ± 33.02 minutes, respectively. Operative mortality was 2.1% (1/46). The cause of death was respiratory distress, which occurred on the fifth postoperative day in a patient who underwent both ASD and PDA closure. Postoperative complications were cardiac arrythmias (10.8%, 5/46) and bleeding requiring chest re-exploration (2.1%, 1/46). The mean intensive care unit length of stay was 3.2 ± 1.2 days. Operative data are displayed in Table 2.

Table 1. Patients' characteristics

Variables	Frequency
Age, mean ±SD	23.9±17.8
Sex-ratio (M/F),	0,76
Body surface area (m2), mean ±SD*	1.28 ± 0.5
Dyspnea, n (%)	16 (34.7)
Palpitations, n (%)	20 (43.4)
Type of atrial defect, n (%)	
-Ostium Secundum	44 (93.5)
-Sinus venosus	2 (6.5)
Associated lesions, n (%)	
-Patent Ductus Arteriosus	2 (6.5)
-Functional tricuspid regurgitation	6 (13.0)
Size of the defect (mm), mean ±SD	3.2 ± 1.8 mm
Moderate to severe PHTN**	3 (6.5)

SD=standard deviation; **PHTN=pulmonary hypertension

At follow-up (8.6 ± 3.8 years), the overall six-year estimated survival of the whole cohort was 89.4 ± 7.3% (Figure 3a). The six-year combined freedom from New York Heart Association class ≥ III dyspnea and palpitations was 87.5 ± 4.6% (Figure 3b).

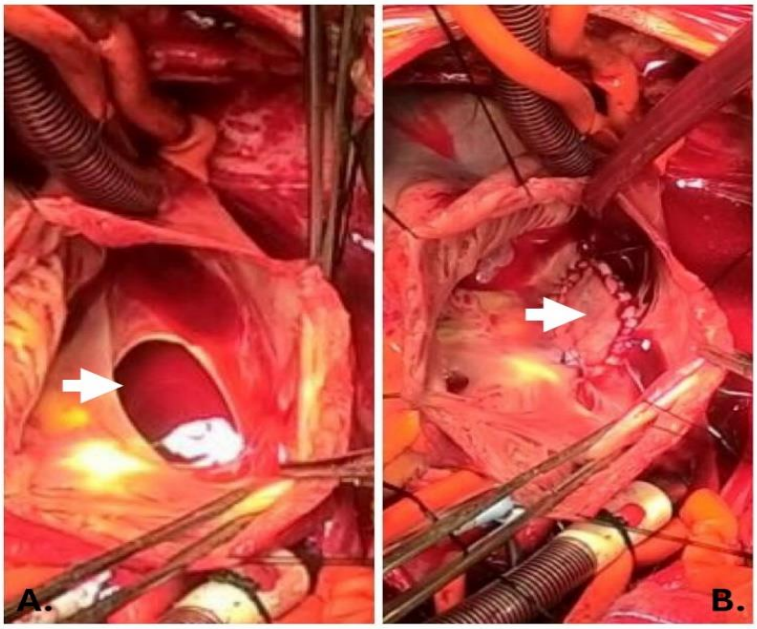

Figure. 2. Intraoperative view: A) white arrow indicating a large OS ASD –; B) closure of the defect – white arrow shows the pericardial patch in situ.

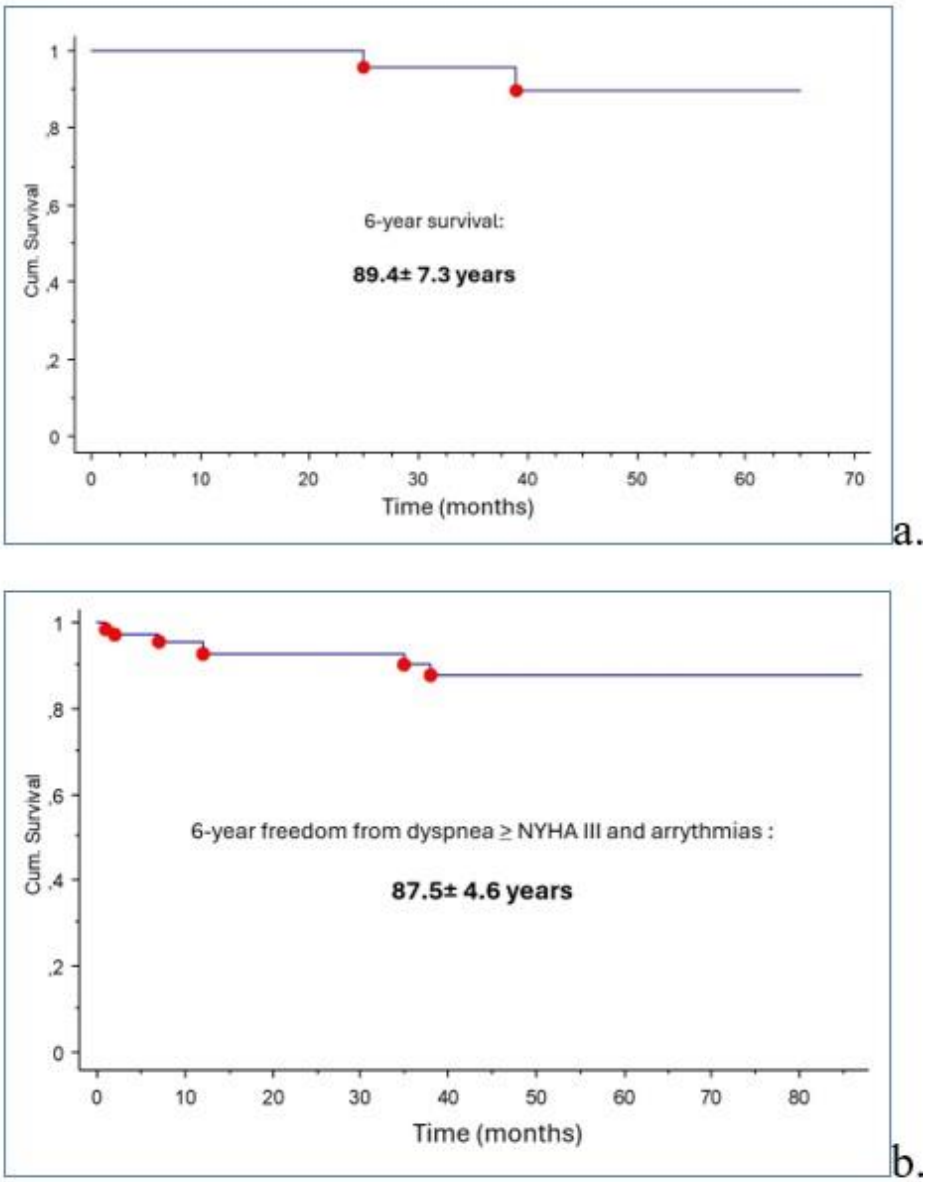

Figure 3. 6-year mid-term survival (a) and freedom from symptoms (b) after ASD repair.

DISCUSSION

ASDs represent 11.5% (46/405) of all repaired CHDs in our unit. This ranges between 22% and 45% in previous sub-Saharan African (SSA) series [11–13]. Preferably, ASDs and PDAs were treated by percutaneous closure in our institution [14]. Although device closure remains the preferred option [15, 16], surgical repair is a valuable alternative in cases with less suitable anatomy (such as large OS defects > 38mm, absence of sufficient rims, or sinus venosus ASDs), associated lesions, and in cases where an attempt to use a device has failed. In our context, periodic shortages of percutaneous intervention consumables have also favored the referral to surgery in many cases.

Similar to previous reports [3], the OS type was the commonest type of ASD (93.5%) in our series, and the majority of the patients were adults (> 18 years). Although a late diagnosis of ASDs is common in adulthood, representing 25–30% of newly diagnosed defects [17], the limitations in cardiovascular diagnosis in our context could have compromised a timely detection in infants. Indeed, the mean age at surgery in the current series was 23.9 ± 17.8 years. Approximately 59% were adults (including 37% diagnosed in their third decade or above), and only 20% were less than five years of age.

The main symptoms during admission were exertional dyspnea, palpitations (arrythmias) or both. Adult patients were more likely to have both symptoms in addition to some degree of pulmonary hypertension (PAH) as compared to the pediatric group. Indeed, a preoperative right catheterization was performed in cases with a suspicion of ≥ moderate grade of PAH on echocardiography with specific medications (pulmonary vasodilators and diuretics) administered prior to surgery. Adult patients who presented with a mild or more degree

of PAH and associated lesions such as PDA experienced more adverse events in the post-surgical period (respiratory distress, prolonged ventilation and hospital stay).

All our patients underwent closure with a heterologous pericardial patch regardless of the defect size. A unidirectional valved patch technique was used in those presenting with a moderate grade of PAH (4.3%) [18]. Various valved patch techniques have been described in the literature [19–20]. They provide conditions for hemodynamic stability in the case of persistent elevation of pulmonary pressure by facilitating a right-to-left shunt in both atrial and ventricular repair defects. Although their real benefit remains controversial [21], valved patch techniques should be considered when pharmacological (phosphodiesterase inhibitors, nitric oxide) and cardiocirculatory (extracorporeal membrane oxygenation) options to manage severe postoperative PAH are not available. Following the valved patch principle, the use of fenestrated devices during interventional procedures has been equally reported in patients with severe PAH [22].

Mortality and morbidity rates following isolated ASD closure remain globally low [15, 16]. However, whether with percutaneous or surgical options, these procedures are not free from any risk. Indeed, several complications, including residual shunt, device embolization, cardiac perforation, and thromboembolism, have been reported after percutaneous procedures [23, 24]. Moreover, and despite the widespread use of minimal access techniques, surgical closure still carries a non-negligible risk of postoperative bleeding, arrythmias, and prolonged ventilation and hospital stay. Our operative mortality was 2.1%, resulting from a patient who underwent both ASD OS and PDA closure and developed severe pulmonary distress during the intensive care unit stay.

Limitations of the current study were potential biases associated with retrospective analysis (incomplete records, lost to follow-up, etc.).

Patients undergoing surgical closure of ASDs in our context were mostly adults. The early mortality and morbidity rates were low, and the rate of intermediate term survival was acceptable. Comparative studies between surgical repair and transcatheter closure are needed.

REFERENCES

1. Geva T, Martins JD, Wald RM. Atrial septal defects. Lancet 383: 1921-1932, 2014
2. van der Linde D, Konings EE, Slager MA, et al. Birth prevalence of congenital heart disease worldwide. A systematic review and meta-analysis. J Am Coll Cardiol 2011;58:2241-7
3. Warnes CA, Williams RG, Bashore TM, et al. ACC/AHA 2008 guidelines for the management of adults with congenital heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (writing committee to develop guidelines on the management of adults with congenital heart disease). Developed in collaboration with the American Society of Echocardiography, Heart Rhythm Society, International Society for Adult Congenital Heart Disease, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *J Am Coll Cardiol.* 2008;52:e143–263
4. Le Gloan L, Legendre A, Iserin L, Ladouceur M. Pathophysiology and natural history of atrial septal defect. J Thorac Dis. 2018 Sep;10 (Suppl 24):S2854-S2863. doi: 10.21037/jtd.2018.02.80. PMID: 30305945; PMCID: PMC6174151.
5. Kuijpers JM, Mulder BJ, Bouma BJ. Secundum atrial septal defect in adults: a practical review and recent developments. Neth Heart J. 2015 Apr;23(4):205-11. doi: 10.1007/s12471-015-0663-z. PMID: 25884091; PMCID: PMC4368528.
6. Akagi T. Current concept of transcatheter closure of atrial septal defect in adults. J Cardiol. 2015 Jan;65(1):17-25. doi: 10.1016/j.jjcc.2014.09.002. Epub 2014 Oct 11. PMID: 25308548.
7. Tanaka S, Imamura T, Narang N, Fukuda N, Ueno H, Kinugawa K. Practical Therapeutic Management of Percutaneous Atrial Septal Defect Closure. Intern Med. 2022 Jan 1;61(1):15-22. doi: 10.2169/internalmedicine.5944-20. Epub 2021 Feb 15. PMID: 33583888; PMCID: PMC8810241.
8. Butera G, Biondi-Zoccai G, Sangiorgi G, Abella R, Giamberti A, Bussadori C, Sheiban I, Saliba Z, Santoro T, Pelissero G, Carminati M, Frigiola A. Percutaneous versus surgical closure of secundum atrial septal defects: a systematic review and meta-analysis of currently available clinical evidence. EuroIntervention. 2011 Jul;7(3):377-85. doi: 10.4244/EIJV7I3A63. PMID: 21729841.
9. Jalal Z, Hascoët S, Gronier C, Godart F, Mauri L, Dauphin C, Lefort B, Lachaud M, Piot D, Dinet ML, Levy Y, Fraisse A, Ovaert C, Pillois X, Lusson JR, Petit J, Baruteau AE, Thambo JB. Long-Term Outcomes After Percutaneous Closure of Ostium Secundum Atrial Septal Defect in the Young: A Nationwide Cohort Study. JACC Cardiovasc Interv. 2018 Apr 23;11(8):795-804. doi: 10.1016/j.jcin.2018.01.262. PMID: 29673513.
10. Hansen JH, Duong P, Jivanji SGM, Jones M, Kabir S, Butera G, Qureshi SA, Rosenthal E. Transcatheter Correction of Superior Sinus Venosus Atrial Septal Defects as an Alternative to Surgical Treatment. J Am Coll Cardiol. 2020 Mar 24;75(11):1266-1278. doi: 10.1016/j.jacc.2019.12.070. PMID: 32192652.
11. Kinda G, Millogo GR, Koueta F, Dao L, Talbousouma S, Cissé H, Djiguimdé A, Yé D, Sorgho CL. Cardiopathies congénitales: aspects épidémiologiques et échocardiographies à propos de 109 cas au centre hospitalier universitaire pédiatrique Charles de Gaulle (CHUP-CDG) de Ouagadougou, Burkina Faso [Congenital heart disease: epidemiological and echocardiography aspects about 109 cases in Pediatric Teaching Hospital Charles de Gaulle (CDG CHUP) in Ouagadougou, Burkina Faso]. Pan Afr Med J. 2015 Jan 29;20:81. French. doi: 10.11604/pamj.2015.20.81.5624. PMID: 26090039; PMCID: PMC4450055.
12. Yangni-Angate KH, Meneas C, Diby F, Diomande M, Adoubi A, Tanauh Y. Cardiac surgery in Africa: a thirty-five year experience on open heart surgery in Cote d'Ivoire. Cardiovasc Diagn Ther. 2016 Oct;6(Suppl 1):S44-S63. doi: 10.21037/cdt.2016.10.06. PMID: 27904843; PMCID: PMC5119994.
13. Agwar FD, Tekleab AM. Heart surgery by the locals in resource-limited settings: The experience from Ethiopia. JTCVS Open. 2022 Feb 3;9:98-105. doi: 10.1016/j.xjon.2022.01.004. PMID: 36003472; PMCID: PMC9390689.
14. Ambassa JC, Charles M, Jacques Cabral TT. Heart catheterization in adults in a sub-Saharan tertiary centre: 8

years' experience. Cardiovasc Diagn Ther. 2019 Apr;9(2):173-178. doi: 10.21037/cdt.2018.11.07. PMID: 31143639; PMCID: PMC6511676..
15. Chambault AL, Olsen K, Brown LJ, Mellor SL, Sorathia N, Thomas AE, Kothari N, Harky A. Transcatheter versus surgical closure of atrial septal defects: a systematic review and meta-analysis of clinical outcomes. Cardiol Young. 2022 Jan;32(1):1-9. doi: 10.1017/S1047951121004583. Epub 2021 Nov 25. PMID: 34819196.
16. Rigatelli G, Zuin M, Roncon L, Nanjiundappa A. Secundum atrial septal defects transcatheter closure versus surgery in adulthood: a 2000-2020 systematic review and meta-analysis of intrahospital outcomes. Cardiol Young. 2021 Apr;31(4):541-546. doi: 10.1017/S1047951121001232. Epub 2021 Apr 8. PMID: 33827735.
17. Lindsey JB, Hillis LD. Clinical update: atrial septal defect in adults. Lancet. 2007 Apr 14;369(9569):1244-1246. doi: 10.1016/S0140-6736(07)60576-5. PMID: 17434386.
18. Zhou Q, Lai Y, Wei H, Song R, Wu Y, Zhang H. Uidirectional valve patch for repair of cardiac septal defects with pulmonary hypertension. Ann Thorac Surg. 1995;60:1245-9. 5.
19. Zhang B, Wu S, Liang J, Zhang G, Jiang G, Zhou M, et al. Unidirectional monovalve homologous aortic patch for repair of ventricular septal defect with pulmonary hypertension. Ann Thorac Surg. 2007;83: 2176-81
20. Novick WM,Sandoval N, Lazorhysynets VV, Castillo V, Baskevitch A, MoX,etal. Flap valve double patch closure of ventricular septal defects in children with increased pulmonary vascular resistance. Ann Thorac Surg. 2005;79:21-8. 4.
21. Hui-Li Gan, Jian-Qun Zhang, Zhao-Guang Zhang, Yi Luo, Qi-Wen Zhou, Ping Bo. The unidirectional valve patch provides no benefits to early and long-term survival in patients with ventricular septal defect and severe pulmonary artery hypertension. Volume 139, Issue 4, April 2010, Pages 950-955.
22. Wang JK, Chiu SN, Lin MT, Chen CA, Lu CW, Wu MH. Transcatheter Closure of Atrial Septal Defect Associated With Pulmonary Artery Hypertension using Fenestrated Devices. Am J Cardiol. 2021 May 15;147:122-128. doi: 10.1016/j.amjcard.2021.01.025. Epub 2021 Mar 3. PMID: 33667439.
23. Wu HC, Wang CC, Fu YC, Jan SL, Wei HJ, Lin YK, Chang Y. Surgical Management for Complications during Closure of Atrial Septal Defect with Amplatzer Device. Acta Cardiol Sin. 2013 Nov;29(6):557-61. PMID: 27122757; PMCID: PMC4805035.
24. Raghuram AR, Krishnan R, Kumar S, Balamurugan K. Complications in atrial septal defect device closure. Interact Cardiovasc Thorac Surg. 2008 Feb;7(1):167-9. doi: 10.1510/icvts.2007.165647. Epub 2007 Nov 5. PMID: 17984170.