Scientific Research Publishing

World Journal of Cardiovascular Surgery, 2025, 15(2), 33-41
https://www.scirp.org/journal/wjcs
ISSN Online: 2164-3210
ISSN Print: 2164-3202

First Series of Ascending Aorta Surgery in a Sub-Saharan African Country (Benin)

Abdel Kémal Bori Bata[1,2], Yacoubou Imorou-Souaibou[3], Ahmad Ibrahim[1*], Désiré Nékoua[4], Ernest Ahounou[4], Arnaud Sonou[1], Léopold Codjo[1], Pierre Demondion[5]

[1]University Cardiology Clinic (CNHU-HKM), Faculty of Health Sciences, University of Abomey-Calavi, Cotonou, Benin
[2]University Visceral Surgery Clinic (CNHU-HKM), Faculty of Health Sciences, University of Abomey-Calavi, Cotonou, Benin
[3]University Hospital Center of the Abomey-Calavi/Sô-Ava Zone (CHUZ/AS), Faculty of Health Sciences, University of Abomey-Calavi, Cotonou, Benin
[4]Multipurpose University Clinic of Anesthesia and Resuscitation (CNHU-HKM), Faculty of Health Sciences, University of Abomey-Calavi, Cotonou, Benin
[5]Jacques Cartier Private Hospital, Paris, France
Email: *ahmedzaek14@yahoo.fr

How to cite this paper: Bori Bata, A.K., Imorou-Souaibou, Y., Ibrahim, A., Nékoua, D., Ahounou, E., Sonou, A., Codjo, L. and Demondion, P. (2025) First Series of Ascending Aorta Surgery in a Sub-Saharan African Country (Benin). *World Journal of Cardiovascular Surgery*, **15**, 33-41.
https://doi.org/10.4236/wjcs.2025.152004

Received: January 8, 2025
Accepted: February 9, 2025
Published: February 12, 2025

Abstract

Background: Pathologies of the ascending aorta, mainly aneurysms and dissections, represent a major challenge in cardiac surgery. The aim of this study is to report the short-term results of ascending aorta surgery in Benin. **Methods:** This is a prospective study of ascending aorta surgeries performed at Hubert Koutoukou Maga National University Hospital Center in Benin from March 2021 to October 2024. **Results:** Fifteen (15) patients were included, 11 with aneurysms and 4 with dissections of the ascending aorta, representing 11.7% of cardiac surgeries during the study period. The mean age was 50.4 ± 7.4 years, with a sex ratio (M/F) of 4. Dyspnea was the predominant symptom (66.7%). The mean left ventricular ejection fraction was 54.3% ± 9.9% and the mean left ventricular end-diastolic diameter was 68.3 ± 10.4 mm. The mean diameter of the ascending aorta was 55.0 ± 12.7 mm. The mean time of cardiopulmonary bypass was 124.5 ± 31.2 min, with a mean aortic cross-clamping time of 96.5 ± 14.4 min. Eight (8) patients underwent a Bentall procedure. A supracoronary ascending aortic replacement with aortic valve replacement was performed in 6 patients, and a Tirone David procedure in 1 patient. One patient died immediately after the operation, suffering from SARS-COV2 pneumonia. **Conclusion:** The indications for surgery on the ascending aorta in Benin are aneurysms and chronic type A aortic dissections. Bentall procedure is the most commonly used technique. Short-term results are relatively satisfactory.

Keywords

Ascending Aorta, Dissection, Aneurysm, Bentall Procedure, Benin

1. Introduction

Diseases of the thoracic aorta, notably thoracic aortic aneurysm (TAA) and acute aortic dissection (AAD), are of growing concern worldwide. In high-income countries, the incidence of TAAs is estimated to be at least 5.3 per 100,000 people per year, while AADs affect around 3 to 4 people per 100,000 person-years [1] [2]. In addition, thoracic aortic surgery already represents a significant proportion of cardiac activity, corresponding, for example, to 8% of the total volume of cardiac surgery in the United States [3].

In sub-Saharan Africa, epidemiological data on these diseases remain limited. Restricted access to specialist care, lack of appropriate infrastructure, scarcity of cardiac surgeons and lack of early diagnosis often lead to lethal complications [4] [5]. In these regions, the true prevalence of TAA and AAD remains unknown, but between 1990 and 2019, morbidity and mortality linked to aortic disease rose by 67% worldwide, and by up to 150.55% in certain low- and middle-income countries [6]. In Sub-Saharan Africa, the hospital frequency of aortic dissection has been reported to vary between 0.24% and 0.6%, suggesting an emerging burden in the region [7] [8].

Historically, West Africa saw its first open-heart surgeries in the 1970s, with notable milestones including January 1974 in Enugu (Nigeria) and March 1978 in Abidjan (Côte d'Ivoire) [9]. In contrast, Benin's access to ascending aorta surgery has long been constrained by inadequate technical infrastructure and limited opportunities for medical evacuation to specialized centers. Recognizing these challenges, Benin introduced cardiac surgery in March 2021 with the aim of improving access to advanced cardiovascular care. This article reports the short-term results, over a 90-day period, of the first cases of ascending aorta pathology managed surgically in Benin.

2. Methods

This prospective, descriptive study was conducted from March 2021 to October 2024 at the Hubert Koutoukou Maga National University Hospital Center (CNHU-HKM). All patients who underwent surgical repair for an ascending aortic aneurysm or type A aortic dissection during the study period were included. The majority of patients were referred from other healthcare facilities or physicians after the discovery of ascending aortic disease. The diagnosis was confirmed by imaging (CT angiography and/or transthoracic echocardiography) and validated by a multidisciplinary consensus involving cardiac surgeons, cardiologists, and anesthesiologists. Free and informed consent was obtained from each patient and their family following a detailed explanation of the procedure's risks and benefits. We

collected sociodemographic, clinical, and surgical data, as well as postoperative outcomes. Data were collected and analysed using kobocollect. For the descriptive analysis, the quantitative variables were described in the form of mean ± standard deviation or median with the interquartile range after verification of normality using the Shapiro-Wilk test. Qualitative variables were described as proportions or frequencies. The various authorisations from the Hubert Koutoukou Maga National University Hospital Center were received.

3. Results

3.1. Preoperative Data

Fifteen patients (15) underwent ascending aortic surgery out of 128 open-heart surgeries performed during the study period, representing a frequency of 11.7%. Twelve patients (80%) were male, with a sex ratio of 4:1. The mean age was 50.4 ± 7.4 years (range 29 to 62 years). The mean body mass index was 22.7 ± 4.9 kg/m^2 with a mean body surface area of 1.8 ± 0.1 m^2. Dyspnea was present in 66.7% of patients. In 14 patients (93.3%), the chest X-ray revealed mediastinal widening. The electrocardiogram (ECG) showed left ventricular hypertrophy in 93.3%. Preoperative risk factors included hypertension in 10 patients (66.7%), a rheumatic etiology in 3 patients (20%), Marfan syndrome in 1 patient (6.7%), and Laubry-Pezzi syndrome in 1 patient (6.7%) (Table 1).

A total of 11 ascending aortic aneurysms (73.3%) and 4 chronic type A aortic dissections (26.7%) were noted. The mean left ventricular ejection fraction (LVEF) was 54.3% ± 9.9% with extremes of 35 and 68%. Mean left ventricular end-diastolic diameter (LVEDD) was 68.3 ± 10.4 mm with extremes ranging from 52 to 86 mm. Severe aortic regurgitation was noted in 13 patients (93.3%). The mean diameter of the ascending aorta was 55 ±12.7 mm, with extremes of 35 and 106 mm (Table 1).

Table 1. Preoperative data of patients who underwent ascending aortic surgery in Benin (N = 15).

	Values
Gender	
Male, n (%)	12 (80)
Female, n (%)	3 (20)
Average age, mean ± SD (range)	50.4 ± 7.4 years (29 - 62)
Average BMI, mean ± SD (range)	22.7 ± 4.9 kg/m^2
Average body surface area, mean ± SD (range)	1.8± 0.1 m^2
Symptoms	
Dyspnea, n (%)	10 (66.7)
Stage II, n (%)	5 (33.3)
Stage III, n (%)	2 (13.3)
Stage IV, n (%)	3 (20)
Chest pain, n (%)	8 (53.3)

Continued

Radiographic signs	
Mediastinal widening, n (%)	14 (93.3)
Electrocardiographic signs	
Left ventricular hypertrophy, n (%)	14 (93.3)
Left atrial hypertrophy, n (%)	6 (40)
First-Degree Atrioventricular Block, n (%)	2 (13.3)
Atrial fibrillation, n (%)	1 (6.7)
Etiology	
Hypertension, n (%)	10 (66.7)
Rheumatic, n (%)	3 (20)
Marfan's disease, n (%)	1 (6.7)
Laubry-Pezzi syndrome, n (%)	1 (6.7)
Average LVEF, mean ± SD (range)	54.3 ± 9.9% (35 - 68)
Average diameter of the aorta, mean ± SD (range)	55 ± 12.7 mm (35 - 106)
Average LVEDD, mean ± SD (range)	68.3 ± 10.4 mm (52 - 86)
Associated valve disease	
Aortic regurgitation, n (%)	13 (86.7%)
Mitral regurgitation, n (%)	1 (6.7%)

3.2. Operating Data

The surgical approach was a total median sternotomy in all cases. Cannulation was aorto-bicaval in 10 patients, aorto-atriocaval in 4, and brachiocephalic artery–atriocaval in 1. Normothermic blood cardioplegia was used in all patients. The mean cardiopulmonary bypass time was 124.5 ± 31.2 minutes, and the mean cross-clamping time was 96.5 ± 14.4 minutes. Hypothermia with circulatory arrest and cerebral perfusion was performed in three patients (20%) using selective antegrade cerebral perfusion through the carotid arteries.

Eight (8) patients underwent a Bentall procedure with mechanical valve (**Figure 1** and **Figure 2**), while six (06) patients underwent a supracoronary ascending aortic replacement (SCAAR) with aortic valve (AV) replacement with mechanical prosthesis. Only one (01) Tirone David procedure was performed. Additionally, two patients underwent a hemiarch replacement of the aorta during the procedure. The associated procedures are listed in **Table 2**.

3.3. Surgical Outcomes

During the first 90 days post-operatively, functional improvement was observed in all patients (NYHA stage I-II). Postoperative complications included two cases of third-degree atrioventricular block, all of which required pacemaker implantation, as well as one stroke, one instance of acute kidney injury not requiring dialysis, and one reoperation for bleeding. One death occurred in the context of SARS-CoV-2 infection, corresponding to a hospital mortality rate of 6.6% (**Table 2**).

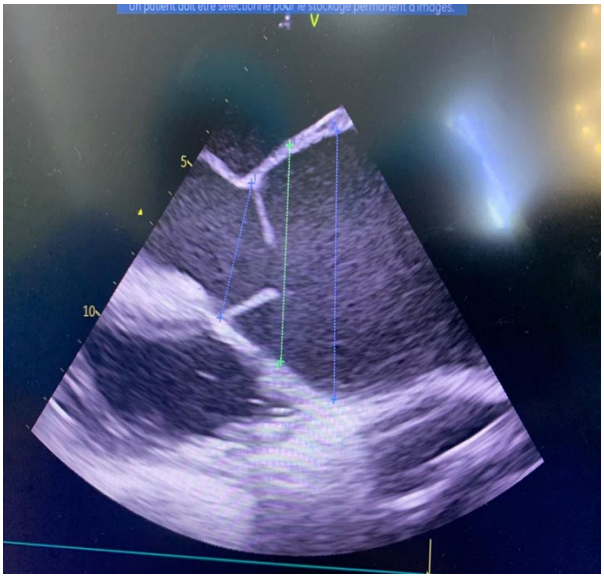
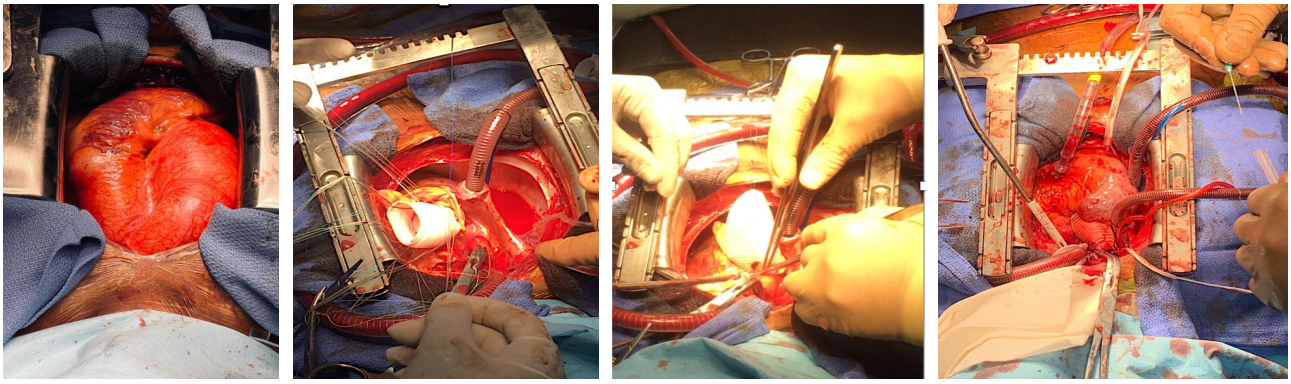


Figure 1. Transthoracic ultrasound image showing an aneurysm of the ascending aorta.



(a) (b) (c) (d)

Figure 2. Operative view of Bentall procedure with mechanical valve. (a) Operative view of an ascending aortic aneurysm; (b) Attaching the valved tube to the aortic annulus; (c) Reimplantation of coronary arteries with a dacron prosthetic tube; (d) Result of Bentall procedure.

Table 2. Operative and outcome data for patients who underwent ascending aortic surgery in Benin (N = 15).

	Values
Cardioplegia	
Blood, n (%)	15 (100%)
Central temperature	
Normothermia, n (%)	15 (100)
Cardiopulmonary bypass time, mean ± SD (range)	124.5 ± 31.2 [86 - 207]
Cross-Clamping time, mean ± SD (range)	96.5 ± 14.4 [70 - 127]
Canulation	
Aorto-atriocaval, n (%)	10 (66.7)
Aorto-bicaval, n (%)	4 (26.7)
Brachiocephalic artery-atriocaval, n (%)	1 (6.7)

Continued

Hypothermia + Circulatory arrest + Cerebral perfusion (temperature-duration)	
30˚C - 1 min 30 s, n (%)	1 (6.7)
18˚C - 32 min, n (%)	1 (6.7)
20˚C - 37 min, n (%)	1 (6.7)
Surgical procedure performed	
Bentall procedure with mechanical valve, n (%)	7 (46.6)
SCAAR with AV replacement, n (%)	5 (33.3)
Tirone-David, n (%)	1 (6.7)
Bentall procedure with mechanical valve + Hemiarch replacement, n(%)	1 (6.7)
SCAAR with AV replacement + Hemiarch replacement, n (%)	1 (6.7)
Associated surgical procedure	
Tricuspid valve repair, n (%)	3 (20.0)
Mitral valve repair, n (%)	1 (6.7)
Ventricular septal defect closure, n (%)	1 (6.7)
Aortic graft diameter	
30 mm dacron aortic graft, n (%)	12 (80.0)
32 mm dacron aortic graft, n (%)	2 (13.3)
28 mm dacron aortic graft, n (%)	1 (6.7)
Average post-operative LVEF, mean ± SD (range)	48.1 ± 14.1 (15 - 62)
Post-operative complications	
Third-Degree Atrioventricular Block, n (%)	2 (13.3)
Stroke, n (%)	1 (6.7)
Acute renal failure without replacement therapy, n (%)	1 (6.7)
Bleeding, n (%)	1 (6.7)
90-day mortality	1 (6.7%)
Median time to death (days)	3

4. Discussion

The frequency of ascending aorta surgery was 11.5% compared with 2% reported by Majdoub *et al.* in Morocco [10]. This type of surgery accounts for a considerable proportion of cardiac surgery in developed countries, notably 8% in the United States [3]. This low proportion in sub-Saharan Africa reflects persistent difficulties in diagnosing and treating these diseases rather than any real rarity. Indeed, recent epidemiological and autopsy studies highlighting an increase in mortality from aortic aneurysms and dissections in sub-Saharan Africa reinforce this impression. The front-line involvement of nurses and General Practitioners, who are prone to misinterpretation, and the lack of local resources for advanced cardiovascular imaging, which is difficult to access, could also explain this observation [11] [12].

The mean age of our cohort is in line with the literature, ranging from 43.8 to 69 years [13]-[15]. Male predominance is the rule in several series [13] [16] [17]. Similarly, hypertension emerges as the main etiology, in line with the findings of

previous studies conducted in the sub-region [14]. Other studies have also highlighted a rheumatic etiology in their series [10].

The most frequently operated aortic pathology is ascending aortic aneurysm (73.3%). In the literature, a similar observation is found with a rate of 64.2% [14]. This could be explained by the high pre-hospital mortality of acute aortic lesions, which justifies the preponderance of chronic lesions.

The mean times for cardiopulmonary bypass (124 minutes) and cross-clamping (96 minutes) are within the ranges reported in other series, varying respectively between 115 and 179.7 minutes and between 78.5 and 120.7 minutes [17] [18]. Bentall procedure was the most frequently performed procedure, accounting for 53% of cases in our study. Authors in the sub-region have reported a higher preponderance of this procedure, ranging from 78% to 80% [10] [14]. Similar to many centers in our region, we favor the Bentall procedure for the majority of ascending aortic surgeries, particularly due to the prevalent valvular lesions and the fact that this technique generally requires less specialized valve-repair expertise.

Hospital mortality was 6.6%, which is lower than most series in the sub-region (9.2% to 20%) [10] [14] [18]. One key factor may be the lower proportion of acute aortic dissections, which often account for the majority of deaths in those cohorts. We therefore recommend focusing on prevention and early diagnosis (systematic hypertension screening, training of primary care practitioners, and enhancing imaging access), improving the rapidity of management for type A acute aortic dissections, further expanding cardiac surgery infrastructure, and creating a national or regional registry to standardize care and improve overall quality in aortic surgery.

Finally, the inherent limitations of our study are similar to those encountered in regional research on ascending aortic surgery, in particular the small number of participants [10] [14].

5. Conclusion

In Benin, the main indications for surgery on the ascending aorta are aneurysms and chronic type A aortic dissections. Bentall procedure remains the most commonly used surgical method for these procedures. Short-term results are generally satisfactory. This demonstrates the efficacy and viability of this therapeutic approach in the Beninese context. These initial data suggest that it would be worthwhile continuing to develop surgical capabilities. This will help optimise results and ascending aorta surgery in sub-Saharan Africa.

Conflicts of Interest

The authors report no conflicts of interest.

References

[1] LeMaire, S.A. and Russell, L. (2010) Epidemiology of Thoracic Aortic Dissection.

Nature Reviews Cardiology, **8**, 103-113. https://doi.org/10.1038/nrcardio.2010.187

[2] Gouveia e Melo, R., Silva Duarte, G., Lopes, A., Alves, M., Caldeira, D., Fernandes e Fernandes, R., *et al.* (2022) Incidence and Prevalence of Thoracic Aortic Aneurysms: A Systematic Review and Meta-Analysis of Population-Based Studies. *Seminars in Thoracic and Cardiovascular Surgery*, **34**, 1-16. https://doi.org/10.1053/j.semtcvs.2021.02.029

[3] Kim, K.M., Arghami, A., Habib, R., Daneshmand, M.A., Parsons, N., Elhalabi, Z., *et al.* (2023) The Society of Thoracic Surgeons Adult Cardiac Surgery Database: 2022 Update on Outcomes and Research. *The Annals of Thoracic Surgery*, **115**, 566-574. https://doi.org/10.1016/j.athoracsur.2022.12.033

[4] Vervoort, D., Lee, G., Lin, Y., Contreras Reyes, J.R., Kanyepi, K. and Tapaua, N. (2022) 6 Billion People Have No Access to Safe, Timely, and Affordable Cardiac Surgical Care. *JACC: Advances*, **1**, Article ID: 100061. https://doi.org/10.1016/j.jacadv.2022.100061

[5] Vervoort, D., Meuris, B., Meyns, B. and Verbrugghe, P. (2020) Global Cardiac Surgery: Access to Cardiac Surgical Care around the World. *The Journal of Thoracic and Cardiovascular Surgery*, **159**, 987-996.e6. https://doi.org/10.1016/j.jtcvs.2019.04.039

[6] Wang, Z., You, Y., Yin, Z., Bao, Q., Lei, S., Yu, J., *et al.* (2022) Burden of Aortic Aneurysm and Its Attributable Risk Factors from 1990 to 2019: An Analysis of the Global Burden of Disease Study 2019. *Frontiers in Cardiovascular Medicine*, **9**, Article 901225. https://doi.org/10.3389/fcvm.2022.901225

[7] Bori Bata, K., Sonou, A., Dohou, H., Aïkpon, D., Agbo, M., Abatti, C., *et al.* (2023) Acute Aortic Dissection at the Cardiology Clinic to the University National Hospital Hubert Koutoukou Maga of Cotonou (Benin). *International Journal of Cardiovascular and Thoracic Surgery*, **9**, 71-76. https://doi.org/10.11648/j.ijcts.20230906.11

[8] Diao, M., Ndiaye, M.B., Kane, A.D., *et al.* (2010) Diagnostic, Therapeutic and Evolutionary Aspects of Dissection in Dakar. Retrospective Study of 19 Cases. *Médecine d'Afrique Noire*, **57**, 419-424.

[9] Yangni-Angate, K.H. (2016) Open Heart Surgery in Sub-Saharan Africa: Challenges and Promise. *Cardiovascular Diagnosis and Therapy*, **6**, S1-S4. https://doi.org/10.21037/cdt.2016.10.05

[10] Majdoub, A., Boulmakoul, S., Elhafidi, A., Moumna, A. and Messouak, M. (2020) Chirurgie De L'aorte Ascendante: A Propos De 20 Cas Opérés. *Journal Marocain des Sciences Médicales*, **22**, 15-22.

[11] Sampson, U.K.A., Norman, P.E., Fowkes, F.G.R., Aboyans, V., Song, Y., Harrell Jr., F.E., *et al.* (2014) Global and Regional Burden of Aortic Dissection and Aneurysms: Mortality Trends in 21 World Regions, 1990 to 2010. *Global Heart*, **9**, 171-180. https://doi.org/10.1016/j.gheart.2013.12.010

[12] Elefteriades, J.A. and Farkas, E.A. (2010) Thoracic Aortic Aneurysm: Clinically Pertinent Controversies and Uncertainties. *Journal of the American College of Cardiology*, **55**, 841-857. https://doi.org/10.1016/j.jacc.2009.08.084

[13] Kirioua-Kamenan, Y.A., Amani, K.A., Souaga, K.A., *et al.* (2023) Endovascular and Conventional Surgical Treatment of Aneurysms of the Aorta and Its Main Branches in Sub-Saharan Africa: The experience of the Côte d'Ivoire. *African Annals of Thoracic and Cardiovascular Surgery*, **5**, 1-6.

[14] Mvondo, C.M., Ngatchou, W., Kengni, H.N.T. and Ngowe, M.N. (2021) Surgical Repair of Thoracic Aortic Aneurysm and Dissection in the Sub-Saharan Africa: 30-Day Outcomes from a Cameroonian Center. *African Annals of Thoracic and Cardiovascular Surgery*, **13**, 1-6.

[15] Mourad, F., Srivastava, V. and Duncan, A. (2016) Aortic Arch Surgery Using Selective Antegrade Cerebral Perfusion and Mild Hypothermia. *Journal of the Egyptian Society of Cardio-Thoracic Surgery*, **24**, 116-122. https://doi.org/10.1016/j.jescts.2016.04.006

[16] Xydas, S., Mihos, C.G., Williams, R.F., LaPietra, A., Mawad, M., Wittels, S.H., *et al.* (2017) Hybrid Repair of Aortic Arch Aneurysms: A Comprehensive Review. *Journal of Thoracic Disease*, **9**, S629-S634. https://doi.org/10.21037/jtd.2017.06.47

[17] Panfilov, D., Saushkin, V., Sazonova, S. and Kozlov, B. (2024) Ascending Aortic Surgery for Small Aneurysms in Men and Women. *Brazilian Journal of Cardiovascular Surgery*, **39**, e20220179. https://doi.org/10.21470/1678-9741-2022-0179

[18] Minh, N.T., Thien, L.Q., Hien, N.S., Ha, N.H., Hung, N.D. and Phong, N.H. (2022) Outcomes of Surgical Treatment of Stanford Type of Aortic Dissection at Hanoi Heart Hospital in the Period 2015-2020. *The Vietnam Journal of Cardiovascular and Thoracic Surgery*, **35**, 138-149. https://doi.org/10.47972/vjcts.v35i.691