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ORIGINAL ARTICLE

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Clinical, echocardiographic, and therapeutic aspects of congenital heart diseases of children at Douala General Hospital: A cross-sectional study in sub-Saharan Africa

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Abstract

Introduction: Cardiovascular diseases in pediatric pathologies have emerged in the recent years in sub-Saharan Africa (SSA), with congenital heart diseases (CHDs) being the most frequent. Unfortunately, their diagnosis is usually delayed, thereby increasing childhood morbidity and mortality.

Objectives: Describe the clinical, echocardiographic, and therapeutic aspects of CHDs of children at Douala General Hospital.

Methods: We carried out a cross-sectional descriptive study over a 10-year period, from January 2006 to December 2015. Files and reports of cardiac ultrasounds of patients aged $\leq$ 15 years were reviewed.

Results: We reviewed the medical records of 1616 children, of which 370 (22.9%) had CHD. The age range was 1 day to 15 years, with a mean of 26 months. Heart murmur was the most frequent clinical sign, seen in 72.3% of the cases. CHD with left-to-right shunt was seen in 61.8%, with ventricular septal defect being the most common (29.8% of all cases). The second most common CHDs were those due to obstruction (20.4%), mainly pulmonary stenosis (19.6% of all cases). Cyanogenic CHDs accounted for 17.8% of cases, dominated by tetralogy of Fallot (7.4% of all cases). Indications for surgical treatment was found in 171 (46.2%) patients, but due to financial constraints, only 48 (28.1%) patients were operated. Among those who underwent surgery, 66.7% were operated abroad, and Humanitarian organizations financed the surgical management of 58.3% of those operated.

Conclusions: CHDs are seen in one out of five children seen in the pediatric cardiology unit of our Hospital for suspected heart disease. Most cases are diagnosed late in life as toddlers. The rate of surgical correction remains low due to financial constraints, with most cases operated abroad with the assistance of Humanitarian organizations.

KEYWORDS

children, congenital heart disease, Douala General Hospital, sub-Saharan Africa

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1 | INTRODUCTION

Congenital heart diseases (CHDs) are the most common human malformations and cardiac pathologies seen in children worldwide.[1,2] They are major causes of death during childhood. It is the cause of 3% of deaths in neonates born at term, and represents 46% of neonatal deaths due to malformations.[2] CHDs are defined as abnormalities that occur during intrauterine heart development.[3] In the last decade, non-communicable diseases have emerged in pediatric pathologies, with CHDs figuring among the most frequent.[4] Meanwhile, their diagnosis is delayed with only about half of the cases being diagnosed in the first year of life, and up to 10% in adulthood.[5] Late diagnoses made in the course of complications increase the morbidity and mortality of the affected children.[2] Studies have shown that surgical management of these congenital malformations still remain limited in our setting. The burden of CHDs in our unit has not been characterized. Such data are needed for informed decisions both at the local and national levels. We carried out this cross-sectional study to describe the clinical, echocardiographic, and therapeutic aspects of CHDs at the Douala General Hospital (DGH), a tertiary health institution in a low income setting in sub-Saharan Africa (SSA).

2 | METHODS

2.1 | Ethical statement

This study was approved by the ethical committee of the DGH. This study was carried out in accordance with the declarations of Helsinki. We report this work according to the Standards for Reporting Observational Studies (STROBE) checklist.

2.2 | Study design and setting

We carried out a cross-sectional descriptive study in the cardiology unit of the DGH over a 10-year period, from January 2006 to December 2015. The DGH is a tertiary institution located in the economic capital of Cameroon, SSA. Besides high level patient care, it also serves as a teaching Hospital. It has a catchment population of about three million inhabitants.

2.3 | Participants, sources of data, and variables

Participants were patients of both sexes, aged $\leq$ 15 years, seen at the DGH, who had an echocardiographic diagnosis of CHD. Participants were recruited based on their case records. We collected information on age, sex, medical history (low birth weight (LBW), prematurity, recurrent lower respiratory tract infections), presenting symptoms (heart failure and respiratory distress), physical examination findings (heart failure and respiratory distress), findings on cardiac ultrasound, and treatment. Incomplete case records with key information (echocardiography) were excluded.

2.4 | Working definitions

Children were defined as those $\leq$ 15 years, neonates as those between 0 to 28 days, infants as those between 29 days and 2 years, toddler as those between 2 and 6 years, preadolescents as those between 6 and 13 years, and adolescents as those between 13 and 15 years. Premature babies were neonates born before 37 weeks of gestation, and LBW were neonates born with less than 2500 g of body weight. Symptoms and signs of left heart failure were the presence of; dyspnea, orthopnea, palpitation, lung crackles, tachycardia, and gallop. Symptoms and signs of right heart failure were the presence of lower limb edema, hepatomegaly, hepato-jugular reflux, and distended neck veins. Signs of respiratory distress were the presence of; tachypnea, nasal flaring, thoraco-abdominal asynchrony, xyphoid retraction, intercostal retraction, and expiratory grunting. We also looked for Dysmorphic features noted in their case records.

2.5 | Sample size and power

This was a descriptive study of all cases seen thus, a convenient sample was considered.

2.6 | Statistical analysis

Data was analyzed using the software SPSS 20 (IBM, Chicago, Illinois). Age of the participants is presented as mean $\pm$ standard deviation (SD), while qualitative data are presented as frequencies and percentages. We used the physiologic classification to present the main CHDs encountered. We used chi-square test to compare the distribution of CHDs between males and females. A P value $<$ .05 was considered statistically significant for the observed differences.

3 | RESULTS

A total of 1616 children were seen in the cardiology unit of the DGH, amongst whom 370 (22.9%) were diagnosed with CHDs. Figure 1 shows the distribution of the participants by age range. The majority of

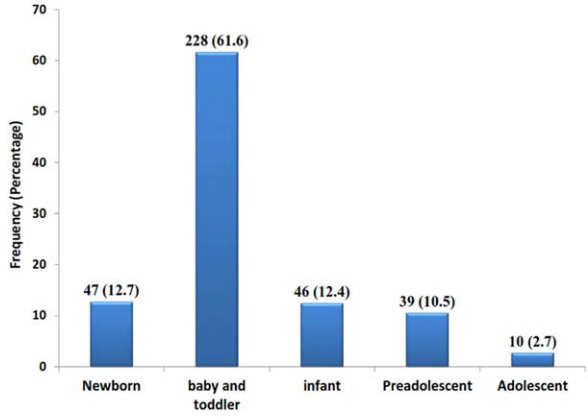

FIGURE 1 Distribution of the participants by age group

TABLE 1 Clinical characteristics of study participants

	Frequencies	Percentage (%)
Past history		
Prematurity	24	10.7
Low birth weight	30	13.4
Recurrent lung infections	28	12.5
Physical signs		
Heart murmur	162	72.3
Emaciation	50	22.3
Cyanosis	32	14.3
Dummy features	25	11.2
Ribs deflection	16	7.1
Respiratory distress syndrome	15	6.7
Lung crackles	8	3.6
Fever	8	3.6
Heart failure syndrome	7	3.1
Clubbing	6	2.7
Tachycardia	5	2.2
Splitting of P2	4	1.8
Functional signs		
None	177	79.0
Cough	17	7.6
Dyspnea	12	5.4
Difficulty of feeding	11	4.9
Asthenia	3	1.3
Chest pains	2	0.9
Convulsions	1	0.4
Faintness	1	0.4

them (228 participants, 61.6%) were babies and toddlers, while only 10 participants were adolescents.

Table 1 shows clinical characteristics (history, physical, and functional signs) of the study participants. The prevalence of LBW was 13.5%, prematurity was 10.7%, and recurrent lower respiratory tract infections was 12.5%. The most frequent physical finding was heart murmur (72.3%), while only four participants (1.8%) had splitting of second heart sound in the pulmonary area. Most of participants were asymptomatic (79%). Cough was present in 17 (7.6%) participants.

Table 2 shows the distribution of CHDs. Physiological classification was used to divide CHDs into three groups. The prevalence of CHDs with left-to-right shunt was 61.8%. This was significantly higher in females (67%) than in males, (57.1%), $P = .048$. Of those with left-to-right shunt, ventricular septal defect (VSD) was seen in 29.8%, with no significant sex difference ($P = .5$). Obstructive CHD was seen in 20.4% with no significant sex difference ($P = .8$). Pulmonary stenosis was the most frequent obstructive CHD seen in 77 (19.6%) participants, and only one participant had pulmonary atresia without VSD. The prevalence of cyanogenic CHD was 17.8%, and it was significantly higher in males than in females (22% vs 13.3%, $P = .034$). Tetralogy of Fallot was seen in 7.4%, and this was slightly higher in males than in female (9.8% vs 4.8%, $P = .053$). Only one participant had an abnormal pulmonary venous return.

A total of 171 patients had indications for surgical treatment, but due to financial constraints only 28% (48) of these patients were operated. Among the operated cases, 32 (66.7%) were operated abroad—France, and 16 (33.3%) in Cameroon—2.08% at DGH, and 31.25% at the Shishong Cardiac Centre. Humanitarian organizations—the French NGO "Mecenat Chirurgie Cardiaque"—contributed for 58.3% of surgical intervention (28 participants), while 20 participants received no financial support. No case of death was registered. The post-surgical evolution was uneventful.

TABLE 2 Physiologic classification of congenital heart diseases

Physiological classification	All (%)	Female (%)	Male (%)	*P* value
CHD with left-right shunt				
VSD	117 (29.8)	60 (31.9)	57 (27.8)	.5
Patent ductus arteriosus	58 (14.8)	30 (15.9)	28 (13.7)	.093
Atrioventricular canal	45 (11.5)	25 (13.3)	20 (9.8)	.6
Atrial septal deflect	21 (5.4)	11 (5.9)	10 (4.9)	.8
Aortic-pulmonary window	2 (0.5)	0	2 (1.0)	.4
Total	243 (61.8)	126 (67.0)	117 (57.1)	.048
Obstructive CHD				
Pulmonary stenosis	77 (19.6)	36 (19.1)	41 (20)	.7
Cor triatriatum	2 (0.5)	0	2 (1.0)	.4
Pulmonary atresia without VSD	1 (0.3)	1 (0.5)	0	.9
Total	80 (20.4)	37 (19.7)	43 (21.0)	.8
Cyanogenic CHD				
Tetralogy of Fallot	29 (7.4)	9 (4.8)	20 (9.8)	.053
Pulmonary atresia with VSD	12 (3.1)	3 (1.6)	9 (4.4)	.1
Single ventricle	12 (3.1)	7 (3.7)	5 (2.4)	.5
Truncus arterious	4 (2.0)	2 (1.0)	3 (1.5)	.9
Tricuspid atresia	5 (2.7)	4 (2.0)	1 (0.5)	.074
Transposition of the great arteries	3 (0.8)	1 (0.5)	2 (1.0)	.9
Double outlet right ventricle	2 (0.5)	0	2 (1.0)	.4
Ebstein anomaly	2 (0.5)	0	2 (1.0)	.4
Abnormal pulmonary venous return	1 (0.3)	0	1 (0.5)	.9
Total	70 (17.8)	25 (13.3)	45 (22.0)	.034

Abbreviations: CHD, congenital heart disease; VSD, ventricular septal deflect.

4 | DISCUSSION

We carried out a cross-sectional study to describe the clinical, echocardiographic and therapeutic aspects of CHDs in children over a ten year period, at the DGH, a tertiary health institution in a low income setting in SSA.

During the period of study, 1616 children were seen at the cardiology unit of the DGH, of whom 370 (22.9%) were diagnosed with CHD. This prevalence is higher than that reported by other authors. Chelo et al. in Cameroun, Ibadin et al. in Nigeria, M'Pemba et al. in Congo, and Kinda et al. in Burkina Faso showed that the prevalence of CHD was, respectively, 0.46%, 0.46%, 0.5%, 0.98%.[6–9] The higher prevalence in our study could be explained by the fact that we carried out the study only in cardio-pediatric population, and in children referred for suspicion or with signs orientating to a cardiac pathology, while the other studies were carried out in a general pediatric population.

The age of our patients at the time of diagnosis varied from 1 day to15 years, with a mean age of 26 months. Infants were the most frequent age group encountered. The mean age of children at the time of diagnosis of CHD varies with different studies. Baragou et al. reported a mean of 29.2 months.[10] M'Pemba et al. reported a mean age of 6.3 years,[6] Kinda et al. reported a mean age of 3.65 years,[7] and Chelo et al. reported a mean age of 9 months.[9]

Prematurity was seen in 10.7% of patients. This is lower than that reported by other authors. Laas et al. reported 13.5%, Martinez-Oloron et al. reported 15.9%, and Hammami et al. reported 20.1% of prematurity in their series.[11–13] The rate of LBW in this study was higher than that reported by Kramer et al.[14] Recurrent broncho-pneumonia was lower than that reported by Salah et al. where recurrent pulmonary infections was present in 55,6% of patients.[15] Cardiac murmur was the most frequent sign recorded in our population. This can be explained by the fact that the majority of CHDs are associated with cardiac murmurs. This finding is similar to that reported by Chelo et al., Damorou et al., and Salah et al. who reported heart murmurs as the most frequent clinical sign seen in 81.4%, 82.48%, and 90.2% of patients, respectively.[4,6,15]

CHDs with left-to-right shunts were the most frequent. This is similar to that reported by M'Pemba et al. where CHDs with left-to-right shunts were the most frequent, seen in 45% of patients.[6] This finding is consistent with that reported in the literature, where CHDs with left-to-right shunts are the most frequent CHD seen in children.[16] VSD was the most frequent CHD recorded in our study. This is also consistent with other studies carried out in Cameroon and other African countries.[4,7,8,10,15,17–22] We had few cases of transpositions in those with cyanogenic heart disease. This is because most children with CHD are referred late to our unit, often after one month of life. Ante natal diagnosis of CHD, especially transpositions are rarely made especially in the secondary hospitals. Most cases die shortly after birth. Infant mortality at birth still remains high in our setting. Some could be due to missed transpositions

Among the patients followed up at DGH, 171 had indication for surgical management and only 48 (28.1%) of them were operated. This rate was higher than that reported by Chelo et al. and Bazolo et al. where surgery was carried out, respectively, in 7.1% and 15.9% of patients.[9,23] It is equally higher than that reported by Diop et al. where 17.3% who had CHD were operated.[24] Among the patients who underwent surgery, most of them were operated abroad—France. This was similarly reported by Chelo et al.[9] This could be explained by the fact that there are only two functional cardiac surgery centers in our country. The Shisong cardiac centre, operational since 2009 and in the DGH, operational since 2012 where the technical platform permits the operation of only adults and bigger children. The cost of heart surgery remains largely nonaccessible for most Cameroonians, if they have to pay out of pocket. Most surgeries were financed by humanitarian organizations—the French NGO "Mecenat Chirurgie Cardiaque."[9] The postsurgical outcome was good, with no case of death.

5 | LIMITATIONS

This study has some limitations inherent with the retrospective collection of data. Missing information for some minor variables were missing from some case records. In 21.7% of cases, the referring physician was not recorded, and the gestational age and birth weight was omitted in 23.2% and 28.1% of files, respectively. This did not permit us to have a better view of the distribution of CHDs according to gestational age and birth weight. Information on the referring physician could help identify gaps in the referral chain. We did not collect data on the year of patient visit thus, we could not report on the trend of CHDs in this hospital. Our data could not capture other risk factors of CHDs such as maternal age, family history, consanguinity, maternal infection and other comorbidities in pregnancy, and substance use.

6 | CONCLUSIONS

CHDs are seen in one out of five children seen in the pediatric cardiology unit of our Hospital for suspected heart disease. Most cases are diagnosed late in life as toddlers. The rate of surgical correction remains low due to financial constraints, with most cases operated abroad with the assistance of humanitarian organizations. Prospective registries are needed, so as to capture the risk factors of CHDs in our setting. Need to improve on early detection and treatment of cases through education and empowering of health personnel. Surgery should be subsidized by the state.

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CONFLICT OF INTEREST

None to declare.

AUTHOR CONTRIBUTIONS

Conception: FK, DKK, BH. Design: FK, DKK, BH. Data collection: FK, DKK, BH, MY, DN, EB, AD, CA, HN, YM, SM. Data analysis: HL, AD, BH. Data interpretation: FK, DKK, BH, HL, SK, YM, MSD. Drafting of the manuscript: FK, DKK, BH, AD, MSD, YM, HL, SK. All the authors read and approved of the final version, and the decision to publish the work.

REFERENCES

[1] Langman J, Sadler TW. Appareil cardiovasculaire. In: Langman J, Sadler TW, eds. Embryologiemédicale. Paris: Pradel; 1996:196–248.

[2] Onuzo OC. How effectively can clinical examination pick up congenital heart disease at birth? *Arch Dis Child Fetal Neonatal Ed*. 2006;91(4):236–237.

[3] Batisse A. *Congenital Heart Diseases in Paris. Cardiologie pédiatrique pratique*. 2ème édition. Paris: Doin; 1995:100–103. [Article in French]

[4] Chelo D, Nguefack F, Menanga AP, et al. Spectrum of heart disease in children: an echocardiographic study of 1666 Subjects in a pediatric hospital, Yaoundé, Cameroon. *Cardiovasc Diagn Ther*. 2015; 6(1):10–19.

[5] Ekure EN, Adeyemo AA. Clinical epidemiology and management of heart defects in a developing country. In: Muenke M, Kruszka PS, Sable CA, Belmont JW, eds. Congenital Heart Disease: Molecular Genetics, Principles of Diagnosis and Treatment. Basel: Karger; 2015:46–56.

[6] M'Pemba Loufoua Lemay AB, Johnson EA, N'Zingoula S. Congenital heart diseases seen in the paediatric service of CHU of Brazzaville, a propos of 73 cases: epidemiologic aspects. *Med Afr Noire*. 2005; 5203:173–177. [Article in French].

[7] Kinda G, Milligo GRC, Koueta F, et al. Congenital heart diseases: epidemiologic and echocardiographic aspects of 109 cases seen at CHUP-CDG of Ouagadougou, Burkina Faso. *PAMJ*. 2015;(20):81 [Article in French].

[8] Ibadin MO, Sadoh WE, Osarogiogbon W, Ikkos D. Congenital heart disease at the University of Teaching Hospital. *Niger J Pediatr*. 2005;32:29

[9] Chelo D, Nguefack F, Koki Ndombo PO, Kingue S. Challenges of surgical management of childhood cardiac diseases in sub-Saharan Africa, experience of a pediatric cardiology unit in Yaoundé, Cameroon. *J Pediatr Neurol Med*. 2016;(1):103.

[10] Baragou S, Afassinou M, Atta B, Pio M, Goeh-Akue E, Damorou F. Epidemiologic and diagnostic aspects of congenital heart diseases in a paediatric echocardiography unit in Lomé (Togo): prospective study from July 2010 to December 2012. *J Rech Sci Univ Benin*. 2013;15(3):6–11. [Article in French].

[11] Martínez Olorón P, Romero Ibarra C, Aguilar de VA. Incidence of congenital heart diseases in Navarra (1989–1998). *Rev EspCardiol*. 2005;58(12):1428–1434. [Article in Spanish].

[12] Hammami O, Ben Salem K. Boujemaa Z, et al. Epidemiologic and clinical features of congenital heart diseases in children at the Bizerta Hospital. *Tunis Med*. 2007;85(10):829–833.

[13] Laas E, Lelong N, Thieulin A-C, et al. Preterm birth and congenital heart defects: a population-based study. *Pediatrics*. 2012;130(4): 829–837.

[14] Kramer HH, Trampisch HJ, Rammos S, Giese A. Birth weight of children with congenital heart disease. *Eur J Pediatr*. 1990;149(11): 752–757.

[15] Salah AI, Mohammed H, Osama HE. Pattern and diagnostic of congenital heart disease in patients attending Ahmed Gasim cardiac centre. *Sudan JMS*. 2012;7(4):249–254.

[16] Iselin M. Congenital heart diseases. Encycl Méd Chir (Elsevier, Paris), Radiodiagnostic - Cœur-poumon, 32–015-A-12.Pédiatrie, 4–070-A-05, 1999:6. [Article in French].

[17] Damorou F, Matey K, Douti N, et al. Congenital heart diseases in togo: epidemiologic, clinical, diagnostic, and therapeutic aspects of 141 cases seen at "colliges à terre des hommes (TDH)". *AJOL*. 2006;8(2):44–47. [Article in French].

[18] Kokou O, DisparidéAgbéré A-R, Balaka B, et al. Doppler echocardiography in the diagnosis of cardiopathies in the paediatric service of CHU-Tokoin, in Lomé (Togo). *Cahiers D'études Et De Recherche Francophone/Santé*. 1996;(6):161–164. [Article in French].

[19] Joly H, Dauphin C, Motreff P, Boeuf B. Luss. Ventricular septal defect at short term (prospective series). *Arch Mal Cœur Vaiss*. 2004;97(5):540–545. [Article in French].

[20] Sable CA. Ultrasound of congenital heart disease: a review of prenatal and postnatal echography. *Semin Roentgenol*. 2004;39(2): 215–233.

[21] Mua Fung H. Pediatric congenital heart disease surgery in Shisong: determinants of early post-operative outcome. *HSD*. 2013;14(Suppl): 26–29.

[22] Abena-Obama MT, Muna WFT, Leckpa JP, Kingue S, Kobello M, Bollo M. Cardiovascular disorders in sub-Saharan African children: a hospital based experience. *Cardiol Trop*. 1995;21(81):5–11.

[23] Bazalo B, Ngouala GA, Affangha DA, Leye M, Kane A. Prevalence of symptomatic infant cardiopathies at "Centre Hospitalier Régional" of Louga, Sénégal. *CVJA*. 2015;26(4):1–5.

[24] Diop IB, Ndiaye M, Ba SA, et al. Congenital heart disease surgery in Senegal. Indications, evaluation and perspectives. *Dakar Med*. 1996; 41(2):85–90.

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