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Structural Cardiac Abnormalities in Children with Congenital Malformations in Lagos

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Abstract

Background: Congenital heart disease has a great impact on a child's morbidity and mortality as well as on the health systems cost. They represent the main cause of death among children with congenital malformations.

Method: The study was prospective, cross-sectional involving consecutive subjects from two centers which were; a tertiary hospital, a private hospital and a major cardiology center. Children with congenital malformations had transthoracic echocardiography done by a cardiologist. Data was analyzed using Microsoft excel software supplemented with Statistical Package for Social Sciences (SPSS) version 20. Means of continuous variables were compared using the Student t test and proportions using Chi-square test. Level of significance set at $p<0.05$.

Results: A total of 366 children with obvious congenital malformation were recruited in the study. The age range of the patients was between 1 day to 12 years with a mean age of about 6 ± 508.03. Majority of the patients were neonates as shown in Table 1. Male to female ratio was 1.1:1. Up to 26.5% of the subjects had a structurally normal heart. The most common congenital heart defect observed observed was atrial septal defect (14.8%) followed by isolated ventricular septal defect (14.1%). Atrioventricular septal defect 13.7%, Patent ductus arteriosus 7.1%, tetralogy of Fallot 4.5%. Some of the patients had more than one cardiac defects.

Conclusion: The prevalence of congenital heart defects among children with congenital malformation is very high. Routine screening for cardiac defects in any patients with congenital malformation is advocated to improve quality of life, reduce morbidity and mortality in these subjects.

Keywords: Congenital malformations; Children; Echocardiography; Congenital; Heart; Disease

Introduction

Congenital heart diseases structural cardiac abnormalities present at birth. They represent abnormalities of the heart or intra-thoracic great vessels excluding abnormalities of systemic veins and arteries such as persistent left superior vena cava or inferior vena cava-azygous continuity and combined innominate-left carotid arterial trunk [1]. A malformation is a primary structural defect arising from a localized error in morphogenesis, resulting in the abnormal formation of a tissue or organ [2].

Congenital heart disease occurs in 0.5% to 0.8% live births; it is estimated that 2% to 5% of newborns have some recognizable congenital malformations at birth. In about half the cases, a single isolated malformation is found, while the others display multiple malformations [2]. Extra-cardiac congenital malformation may be noted in 20% to 45% of infants with congenital heart defect, cardiac abnormalities may be a manifestation of a known congenital malformation syndrome with typical physical findings [2]. Congenital heart disease has a great impact on a child's morbidity and mortality as well as on the health systems cost. They represent the main cause of death among children with congenital malformations [3].

Using cardiac diagnostic tools including echocardiography to detect associated congenital heart disease and screening all children with congenital malformation is necessary for detection and hence early surgical interventions. Congenital anomalies may have a genetic, infectious or environmental origin. Although in most of the cases it is difficult to identify their cause [4].

Risks factors associated with development of congenital anomalies in utero include; low socioeconomic status, advanced maternal age, intrauterine infections, exposure to pesticides, medicinal and recreational drugs, alcohol, tobacco, high doses of vitamin A, high doses of radiation and others [4].

Few studies have been done in the Nigerian population on cardiac abnormalities and congenital malformation. Pam and his colleagues in Jos in the North-central part of Nigeria studied the pattern of congenital anomalies and any association between the anomalies. Of the 200 cases of congenital anomalies, gastrointestinal system was found to be most involved (30.5%). Others systems involved include central nervous system, cardiovascular system and chromosomal anomalies. This study only identified the anomalies and found no association between them. Cardiac evaluation was not carried out for each anomaly including chromosomal anomalies. Moreover, the specific cardiovascular system anomalies identified were not stated [5].

Ekure et al., in Lagos identified congenital heart diseases associated with identified syndromes and other extra cardiac congenital malformations. Down syndrome was found as the most common congenital malformation in 53.5% with 77% of them having congenital heart defect, ventricular septal defect was the most frequent. Also, musculoskeletal defect was found to be the most common extra cardiac malformation. The most prevalent heart defects detected in each syndrome/malformations were documented; however, their

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associations were not statistically stated. Also, the study did not assess risk factors associated with congenital malformations [6].

The current study aims to document the structural cardiac abnormalities in children with congenital malformation in Lagos and some risk factors associated with congenital malformations.

Subjects and Methods

A cross-sectional and descriptive study carried out in two centers, Lagos State University Teaching Hospital (LASUTH) and a private specialist hospital in Lagos, between February 2008 and December 2014.

Lasuth is a 750 bedded tertiary institution in Southwestern Nigeria. It receives referral from within and outside the region. The Pediatric Department consists of an 83 bedded ward and general outpatients' unit where general Pediatric and subspecialty clinics hold every week day. Part of the outpatient clinic is the Paediatric cardiology clinic that runs weekly.

The private specialist hospital is located in the metropolis. It is a Paediatric based hospital with all sub-specialties including cardiology but with outpatient facilities only. Patients from various public and private hospitals within Lagos and outside Lagos are referred to the center for diagnosis in various sub-specialties in Paediatrics including cardiology and endocrinology.

The subjects were 366 children in all of which 210 of the subject with congenital malformations presented at the private specialist center. While, 156 of the children presented at the children emergency and outpatient unit of LASUTH. They had obvious extra cardiac congenital malformations and were referred to the cardiology clinic for evaluation.

Table 1: Distribution of subjects by age.

Age Group	Frequency	Percentage
Neonates	176	48.1
Infants	112	30.6
1-5years	52	14.2
>5years	26	7.1

Table 2: Frequencies of extra cardiac congenital malformations.

Congenital Malformations	Frequency	Percentage
Down Syndrome	195	53.3
Unclassified Syndrome	26	7.1
Cleft lip	22	6.0
Cleft lip/ palate	21	5.7
Multiple Congenital anomalies	19	5.2
Cleft Palate	14	3.8
Congenital hydrocephalus	6	1.6
Congenital Rubella Syndrome	12	3.3
Anorectal Malformations	8	2.2
Omphalocele	7	1.9
Limb Anomalies	5	1.4
Tracheoesophageal fistula	5	1.4
Edwards syndrome	4	1.1
Turner's syndrome	3	0.8
Skeletal anomalies	3	0.8
Cystic hygroma	3	0.8
Choana Atresia	2	0.5
Holt-Oram	2	0.5
*Others	7	1.5
Others include one case each of Prune-belly syndrome, DiGeorge Syndrome, Marfan's syndrome, Noonan syndrome, Biliary atresia, Vacterl association and a ranula cyst.		

A structured questionnaire that included biodata of the subjects and their clinical information, parents' biodata, socioeconomic status, drug history, lifestyle, exposure to environmental factors was administered by the researcher in LASUTH after obtaining consent from parent and caregivers of children with extra cardiac congenital malformations. They all had clinical evaluation and echocardiography using a GE Vivid E echocardiography machine with appropriate sized transducers.

Data was entered into a personal computer and analyzed using Microsoft Excel software supplemented with Statistical Package for Social Sciences (SPSS) version 20. Tables are used to depict variables. Means of continuous variables were compared using the Student t test and proportions using Chi-square test. Level of significance set at $p<0.05$.

Results

A total of 366 children with obvious congenital malformation were recruited in the study. The age range of the patients was between 1 day to 12 years with a mean age of 6 $\pm$ 508.03. Majority of the patients were neonates as shown in (Table 1). Male to female ratio was 1.1:1.

The most common congenital malformation was Down syndrome which accounted for 53.3% of the subjects followed by unclassified syndromes 7.1%, cleft lip 6%, cleft lip and palate 5.7%, multiple congenital anomalies 5.2%. The cases of unidentified syndromes were subjects with some dysmorphic features which do not fit into the documented identified syndromes. Other syndromes identified include Turner syndrome (3 cases), Edward syndrome (2 cases), Congenital Rubella Syndrome CRS (3 cases), Holt-Oram syndrome (1), Noonan syndrome (1), Marfan Syndrome (1). Incidence of other anomalies is as shown in (Table 2).

Up to 26.5% of the subjects had a structurally normal heart. These include those with Down syndrome (33), cleft lip (15), cleft lip and palate (13), cleft palate (8), unclassified syndrome (5), anorectal malformations (4), tracheoesophageal fistula (4), multiple congenital anomalies (4) Turner syndrome (1), Edward syndrome (1), limb abnormalities (1), Omphalocele (1).

Most common congenital heart defect observed was atrial septal defect (14.8%) followed by isolated ventricular septal defect (14.1%). Atrioventricular septal defect was found in 13.7% of the patients, Patent ductus arteriosus 7.1%, tetralogy of Fallot 4.5%. Some of the patients had more than one heart defects including ventricular septal defect and atrial septal defect in 6%, ventricular septal defect, pulmonary stenosis and aortic stenosis 4.5%, atrioventricular septal defect and patent ductus arteriosus 3.4%. There were five cases of pericardial effusion.

Table III shows the spectrum of congenital heart defect found in each congenital malformation. The most common cardiac defect in subjects with Down syndrome was atrioventricular septal defects (AVSD) which was documented in 35(18%) followed by ventricular septal defects in 22 (11.3%), atrial septal defect in 21(10.8%). Up to 16.9% of the subjects with Down syndrome had a structurally normal heart.

Subjects with orofacial clefts were found to have more of atrial septal defects, ventricular septal defects or both. Up to 68% of subjects with cleft lip had structurally normal heart while 32% had cardiac defects. For subjects with cleft palate, 57% had a structurally normal heart while 43% had cardiac defect. For subjects with a combination of cleft lip and palate, about 62% of them had structurally normal heart while 38% had cardiac defects.

The parents of the subjects were in the upper and middle class level

Name of the Syndrome	Normal	VSD	ASD	PDA	PS	AVCD	TOF	TGA	DORV	Hyperdynamic Circulation	PFO	Pericardial Effusion	Cor Pumonale	Multiple Heart Defect	Total
Down	33	22	21	11	2	35	5	0	4	1	4	4	1	52	195
Turners	1	0	0	0	1	0	0	0	0	0	0	0	0	1	3
Edward	1	1	2	0	0	0	0	0	0	0	0	0	0	0	4
Congenital Rube LLA	2	1	1	3	1	0	0	0	0	0	0	0	0	4	12
Holt or AM	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2
Unclassified	5	3	3	3	1	0	1	2	3	0	0	0	0	5	26
Prune Belly	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Digeorge	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Marfan	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Noonan	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Total	42	27	28	17	5	35	7	2	7	1	5	4	1	65	246

Table 3: Syndromes and associated heart defects.

Deformity	Normal	VSD	ASD	PDA	PS	AVCD	TOF	TGA	DORV	Hyperdynamic Circulation	PFO	Pericardial Effusion	Cor Pumonale	Multiple Heart Defect	Total
Cleft Lip	15	1	0	0	1	0	1	0	0	0	1	0	0	3	22
Multiple Congenital Anomalies	4	2	3	1	1	1		0	0	0	0	0	0	6	19
Trachetoesophageal Fistula	4	0	0	0	0	0	0	0	0	0	0	0	0	1	5
Congenital Hydrocephalus	2	1	1	0	0	0	0	0	1	0	0	0	0	1	6
Vacter Association	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Cleft Palate	8	1	3	0	1	0	0	0	0	0	0	0	0	1	14
Billiary Atresia	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Skeletal Anomalies	1	1	0	0	0	0	0	0	0	0	1	0	0	0	3
Choanal Atresia	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Cleft Lip/Palate	13	3	1	1	1	0	0	0	0	0	0	0	0	2	21
Omphalocele	1	1	1	0	2	0	0	0	0	0	0	0	0	2	7
Anorectal Malformation	4	0	1	0	0	0	1	0	0	0	1	0	0	1	8
Limb Anomalies	1	0	1	0	0	0	2	0	0	0	0	0	0	1	5
Cystic Hygroma	0	0	0	0	0	1	0	0	0	0	0	1	0	1	3
Hemangioma	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2
Ranula Cyst	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Total	55	11	12	2	6	2	5	0	1	0	3	1	0	22	120

Table 4: Other anomalies and associated heart defects.

of socioeconomic status, there were none in the lower class. Age range of the mothers was from 19years to 47years with a mean age of 32 years and standard deviation of 6.037.

Table 4 shows association between maternal age and congenital malformations.16.2% of them were exposed to radiation mainly X-rays during early pregnancy (P=0.124). 16.4% were on routine antenatal medications only during pregnancy while others were on some other medications as shown in Tables 5 and 6. Most were exposed to hair relaxer 41.5% (P=.209), 2.5% took alcohol in pregnancy, 1.9% caffeine. Almost all of the subjects had no family history of congenital malformations

Discussion

This study was carried out to document structural cardiac abnormalities in children with congenital malformations. Most of the subjects were neonates, (48.1%) and infants (30.6%) which are comparable to a study done in Ibadan by Adeyemo et al. with a prevalence of 72.7%. This early presentation can be due to the congenital malformations affecting the quality of life of the patients including feeding difficulties, poor weight gain and cosmetic effects.

The prevalence of cardiac abnormalities was 73.5% which is similar to the study by Ekure et al., in Lagos who found a prevalence of 72.3%. [6,7]. This predicts the true prevalence of congenital heart defects in the southwestern zone of Nigeria as both studies were in same geopolitical zone and state. Cardiac abnormalities varied for each congenital malformation the commonest been Atrial Septal Defect (ASD) 10.9% followed by isolated Ventricular Septal Defect (VSD) 10.4%. In the current study, some of the subjects were found to have more than one heart defect, with VSD mostly co-existent with other defects. This could have accounted for ASD to be the commonest [8-11].

Out of the identified congenital malformations, congenital syndromes were most prevalent 67.3% which was higher than that of a study in Saudi Arabia with a prevalence of 37% [12]. The differences in the prevalence is accounted for by the difference in the methodology in which our study recruited patients who presented with congenital malformations and echocardiography done on them to identify cardiac anomalies, the Saudi Arabia study recruited patients with cardiac anomalies and screened for congenital malformations in them. Also they had a larger sample size. Amongst the subjects with congenital syndromes, Down syndrome was most common which is similar to the

Name of the Syndrome	%	Mother Age Group (years)			
		< 20	21 to 30 yrs	31 to 40 yrs	41 to 50 yrs
Down Syndrome	% Within Syndrome	1 (1.6%)	22 (34.9%)	37 (58.7%)	3 (4.8%)
Turners Syndrome	% Within Syndrome	0.0%	1 (33.3%)	1 (33.3%)	1 (33.3%)
Edward Syndrome	% Within Syndrome	0.0%	1 (50%)	1 (50%)	0.0%

Table 5: Association between congenital syndromes and maternal age.

Medications	Frequency	Percentage
None	60	16.4
Analgesics	20	5.5
Antimicrobials	5	1.4
CVS	3	0.8
Contraceptives	3	0.8
Herbal	3	0.8
Others	29	7.9
Analgesics, Others	2	0.5
Analgesics, Antimicrobials	3	0.8
Analgesics, Antimicrobials, Others	1	0.3
Analgesics, Antimicrobials, Others	1	0.3
Analgesics and Anti-Allergy	2	0.5
Analgesics, Anti-Allergy	1	0.3
Analgesic, Anti-Allergy, Contraceptive	1	0.3
Analgesic, Gait	1	0.3
Analgesic, Herbal	2	0.5
Antimicrobials, Anti-Allergy	2	0.5
Anti-Allergy, Herbal	1	0.3
Herbal, Others	1	0.3
Sum Total	141	38.5
Missing	225	61.5
Total	366	100.0

Table 6: Drugs used by mothers during pregnancy.

Saudi Arabian study. Atrioventricular Septal Defect (AVSD) has been reported to be most associated cardiac defect in patients with Down syndrome [2,13]. Atrioventricular Septal Defect was the most common cardiac defect in subjects with Down syndrome in the study.

The major congenital heart abnormality reported in patients with Turner syndrome is coarctation of the aorta [14], in one of the subjects in the current study had this cardiac anomaly. Patent Ductus Arteriosus (PDA) was identified in 6 out of the 12 subjects with Congenital Rubella Syndrome which is in keeping with the report of PDA established as the most common lesion in patients with CRS [15].

Up to 57 (15.6%) subjects had orofacial clefts cleft including cleft lip, cleft palate, cleft lip/palate. The prevalence of cardiac abnormalities in subjects with orofacial cleft in the current study was 36.8%. Up to 68% of subjects with cleft lip had structurally normal heart while 32% had cardiac defects. For subjects with cleft palate, 57% had a structurally normal heart while 43% had cardiac defect. For subjects with a combination of cleft lip and palate, about 62% of them had structurally normal heart while 38% had cardiac defects. Orofacial clefts contributed to about 7.8% of the total cardiac defects documented in all the subjects involved in the current study. The prevalence of cardiac abnormalities in subjects with orofacial cleft documented in this study is more than twice the prevalence reported by Otaigbe and her colleagues in the southern part of Nigeria. It is also higher than the prevalence of 20% documented by Asani and his colleagues in the northern part of Nigeria. The immediate reason for higher prevalence documented in the current study is unclear but may be attributed to the fact that both earlier studies not only involved very few subjects but were either retrospective in design or carried over a very short period when compared with the current study. Also, a study done in Lagos which is the commercial capital of Nigeria consisting of all ethnic groups in Nigeria will be more representative of the true prevalence of cardiac defects among Nigeria children with orofacial clefts compared with the earlier studies which involved subjects from either the Northern or Southern part of the country.

The risk factors assessed in this study include maternal age, socioeconomic status, family history, drug use in pregnancy, maternal lifestyle, exposure to radiation, chemicals, paints, hair relaxers. Increasing maternal age is associated with increased risk of Down syndrome [18,19]. In this study, a higher frequency was identified with increasing maternal age above 30years with a prevalence of 58.7%.

Low socioeconomic factor and family history were not identified as risk factors in this study probably due to inability of the parents to afford echocardiography screening. Other risk factors identified in this study include maternal alcohol consumption, ingestion of caffeine, exposure to radiation and hair relaxers which were common in subjects with syndromes and multiple congenital anomalies; however, this has been reported in another study [20] which also reported consanguineous marriage as a risk factor. This kind of marriages is not common in our environment due to sociocultural reasons, and therefore not identified in this study.

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