

THE FREQUENCY OF ARRHYTHMIAS AMONG CHILDREN WITH CONGENITAL HEART DISEASE PRESENTING AT A TERTIARY CARE HOSPITAL OF LAHORE, PAKISTAN

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Abstract

Objective: "To determine the frequency of arrhythmias among children with congenital heart disease presenting at a tertiary care hospital"

Study Design: Cross sectional study

Study place and duration: The Children's Hospital and the Institute of Child Health, Lahore from December 2017 to June 2020.

Methodology: Two hundred and eighty children who fulfilled selection criteria were included. Then children underwent ECG to determine the presence of cardiac arrhythmia and its type. Reports were assessed and type of cardiac arrhythmia was noted. All data was noted on proforma.

Results: The mean age of patients was 7 ± 4 years. There were 166 (76.15%) males and 52 (23.85%) females. Among 218 patients 62 (28.4%) were having VSD, 55 (25.2%) had TOF, 42 (19.3%) were suffering from ASD while 37 (17.0%) had Ebstein anomaly and 22 (10.1%) had PDA. Among studied patients 32 out of 218(14.7%) patients had cardiac arrhythmias while 186 (85.3%) had no rhythm abnormality. In 32 patients with cardiac arrhythmias, 14 (43.8%) had ventricular arrhythmias, 10 (31.3%) had supraventricular tachycardia, 8 (25.0%) had bradyarrhythmias.

Conclusion: Thus the frequency of cardiac arrhythmias is not rare in children with congenital heart disease.

INTRODUCTION

Heart arrhythmia, often referred to as arrhythmia, dysrhythmia, or irregular heartbeat, is a collection of disorders characterized by an irregular, excessively rapid, or sluggish heartbeat.¹ Adults with an excessively high heart rate (above 100 beats per minute) are said

to have tachycardia, whereas those with an excessively slow heart rate (below 60 beats per minute) are said to have bradycardia.²

Cardiac arrhythmias are any abnormality in the normal activation sequence of the myocardium. The underlying rhythm issue and the child's age

upon presentation determine the symptomatology of arrhythmias. Congestive heart failure is the most common presenting condition in neonates and babies with arrhythmias. In older children, palpitations and/or syncope are the modality of presentation. Arrhythmias seldom cause abrupt cardiac mortality, especially when they originate in the ventricles.^{3,4}

Documentation of electrocardiographic rhythm during the symptoms or tachycardia is the cornerstone of diagnosis. Twenty four hour Holter monitoring may be required in some cases.⁵ Traditionally, cardiac arrhythmia have been divided into non reentrant and reentrant activity. Arrhythmia may be classified broadly by rate (tachyarrhythmia, bradyarrhythmias) or accordingly to the site of origin (atrial, junctional, ventricular).^{6,7}

There were 24.4 arrhythmias for per 100,000 live births. With an incidence of 16.3 per 100,000, atrioventricular re-entry tachycardia was the most prevalent arrhythmia. There were only 2.1 incidences of atrial flutter and complete atrioventricular block for per 100,000 live births, and other arrhythmias were uncommon.^{8,9} The most prevalent persistent arrhythmia in children is SVT. According to estimates, 1 in 250 normally healthy youngsters will experience it. Among contrast, ventricular tachycardia is a rare arrhythmia among individuals under the age of eighteen. Its reported incidence is 1.1 per 100,000 patient-years, which decreases to 0.6 per 100,000 patient-years when patients with concomitant structural heart disease are excluded. Consequently, when children experience ventricular tachycardia, a thorough assessment for possible causes is often conducted.¹⁰

The incidence of different arrhythmias seems to be higher in our population for many reasons. There is an increased incidence of Rheumatic heart disease and post infectious myocarditis due to poor hygienic conditions, overcrowding and lack of access to health care. Moreover, the delayed surgical treatment of severe valvular disease leads to massive dilatation of cardiac chambers especially atria and the onset of arrhythmias. Lack of proper antenatal care and diagnosis also leads to an increased incidence of congenital heart disease as well as rhythm abnormalities. The aim of the study is to

determine the magnitude of different dysrhythmias in children in our population in comparison to the international data available and to determine the predisposing factors in different types of arrhythmias so as to enable ourselves to ascertain the burden of rhythm disturbances in different underlying conditions and work towards the prevention of arrhythmias.

METHODOLOGY

After approval from Institutional review board (IRB letter number with date), this Observational Cross sectional study was conducted at The Children's Hospital and the Institute of Child Health, Lahore from December 2017 to June 2020. Sample size of 218 children is calculated with 95% confidence level, 3.5% margin of error and taking expected percentage of arrhythmias i.e. 7.5% among children. Childfree fulfilling following criteria were enrolled by applying Non-probability consecutive sampling technique.

Inclusion Criteria: Children aged 1-15 years, either gender presenting with congenital heart disease were enrolled in the study.

Exclusion Criteria: Post cardiac surgery patient with arrhythmia were excluded from the sample.

Children were included through OPD as well as from in-patient department. Informed consent was obtained from parents. Demographic details (name, age, gender, duration of cardiac problem) were recorded. Then children underwent ECG to determine the presence of cardiac arrhythmias and its types. All ECGs were reviewed by a pediatric cardiologist. Reports were assessed and type of cardiac arrhythmia was noted. Cardiac arrhythmia was defined as abnormal rhythm of heart detected on ECG other than the sinus rhythm. Sinus rhythm is every P wave followed by QRS complex of normal and similar morphology at a regular interval. Any one of these: **Ventricular arrhythmias:** in terms of premature ventricular contractions (preceding p-wave absent), ventricular tachycardia >200bpm, or ventricular fibrillation (>300bpm), **Supraventricular tachycardias:** narrow QRS complex (<120ms) with absent p-waves with heart rate >220bpm.¹¹ It was determined as atrial fibrillation (shape and

amplitude varies) and atrial flutter (shaper and amplitude remains same), and **Bradyarrhythmias:** in terms of sinus bradycardia (<60bpm), first-degree AV block (PR interval $\geq 0.2s$), second degree AV block (prolong PR interval and missed QRS) or third degree AV block also known as complete heart block (complete AV disassociation fixed PP and RR interval but no relation of p-wave and QRS). All data was noted on proforma.

The data was entered and analyzed using SPSS version 20. Mean and Standard deviation were calculated for variables like age and duration of cardiac problem. Frequency and percentage were calculated for gender and presence of different types of arrhythmias and type of congenital heart disease. Data was stratified for age, gender and type of congenital heart disease. Post-stratification, stratified groups were compared for presence of cardiac arrhythmias. P-value ≤ 0.05 was taken as significant.

RESULTS

In this study mean age of patients was 7.21 ± 4.39 years. There were 166 (76.15%) males and 52 (23.85%) females. Among 218 patients 62 (28.4%) were having VSD, 55 (25.2%) had TOF, 42 (19.3%) were suffering from ASD while 37 (17.0%) had Ebstein anomaly and 22 (10.1%) had PDA. Table-I

In my study 32 (14.7%) patients out of 218 were documented to have cardiac arrhythmias while 186 patients (85.3%) had no rhythm abnormality. Figure-1

Among 32 patients with cardiac arrhythmias, 14 (43.8%) had ventricular arrhythmias, 10 (31.3%) had supraventricular tachycardia while 8 patients (25.0%) were documented to have

bradyarrhythmias. Among these 32 patients subtype of cardiac arrhythmias was documented and showed that 8 patients (25.0%) had Atrial fibrillation ,6 (18.8%) had Premature ventricular contractions, 6 (18.8%) had Ventricular fibrillation 2 (6.3%) had Ventricular tachycardia, 2 (6.3%) had atrial flutter, 1 (3.1%) had Sinus bradycardia, 3 (9.4%) had First degree AV block, 1 (3.1%) had second degree AV block and 1 (3.1%) had third degree AV block. Table-II

Data was stratified for age of children. In my study there was no arrhythmia documented among children aged 1-5yrs. In children aged 6-10years, 9 (15.8%) were having cardiac arrhythmias but 48 (84.2%) had no cardiac rhythm abnormality. In children aged 11-15years, 23 (39.0%) had cardiac arrhythmias but 36 (61.0%) had no cardiac arrhythmias. The difference was significant ($p < 0.05$). Data was stratified for gender of children. In males, 27 (16.3%) were having cardiac arrhythmias but 139 (83.7%) had no cardiac rhythm disturbance. In females, 5 (9.6%) had cardiac arrhythmias while 47 (90.4%) had no cardiac arrhythmias. The difference was insignificant ($p > 0.05$). Data was stratified for type of congenital heart disease. among patient with VSD, 12 (19.4%) were having cardiac arrhythmias, among TOF patients, 8 (14.5%) had cardiac arrhythmias.among patients with PDA.3(13.6%) had rhythm abnormality in children with EBstein anomaly, 5 (13.5%) had cardiac arrhythmias while in patients with ASD,4(9.5%) were found to have arrhythmias. The difference was insignificant ($p > 0.05$). Table-III

Table-I: Basic demographics and history of children (n = 218)

Parameters	Output
n	218
Age, in years	7.21 ± 4.39
Gender	
Male	166 (76.2%)
Female	52 (23.8%)
Type of congenital heart disease	
ASD	42 (19.3%)
VSD	62 (28.4%)
PDA	22 (10.1%)

TOF	55 (25.2%)
Ebstein anomaly	37 (17%)

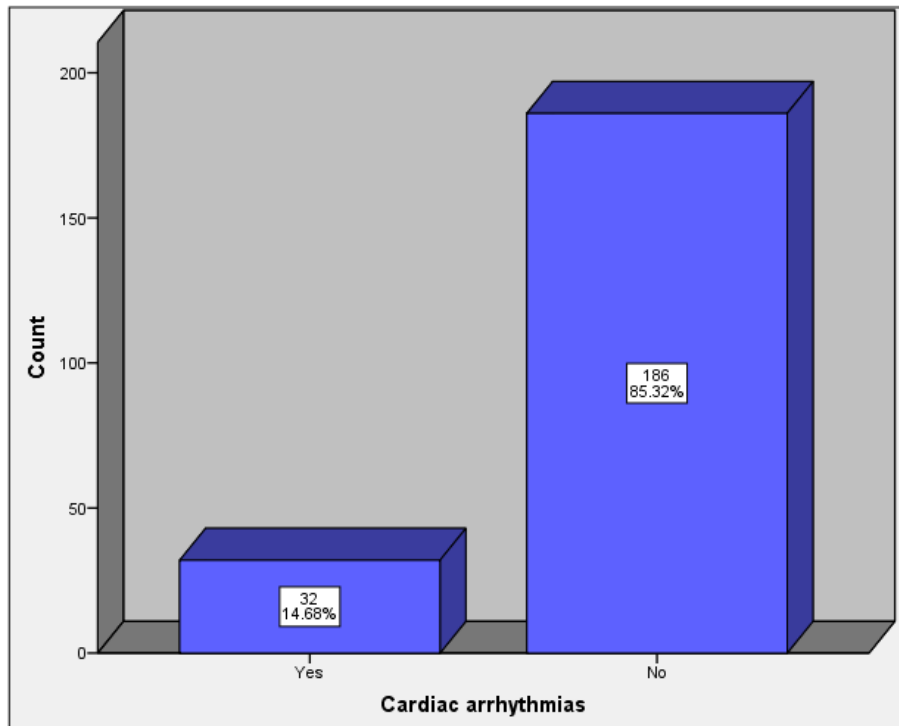


Fig-I: Cardiac arrhythmias (n = 218)

Table-II: Type and subtypes of cardiac arrhythmias observed (n = 32)

Type of cardiac arrhythmias	Frequency (%)
Ventricular arrhythmias	14 (43.8%)
Supraventricular tachycardia	10 (31.3%)
Bradyarrhythmias	8 (25.0%)
Subtype	
Premature ventricular contractions	6 (18.8%)
Ventricular tachycardia	2 (6.3%)
Ventricular fibrillation	6 (18.8%)
Atrial fibrillation	8 (25.0%)
Atrial flutter	2 (6.3%)
Sinus bradycardia	1 (3.1%)
First degree AV block	3 (9.4%)
Second-degree, Mobitz II AV block	1 (3.1%)
Third-degree AV block	1 (3.1%)

Table-III: Comparison of cardiac arrhythmias with different characteristics of children (n = 218)

		Cardiac arrhythmias		p-value
		Yes (n = 32)	No (n = 186)	
Age (years)	1-5	0 (0%)	102 (100%)	0.000
	6-10	9 (15.8%)	48 (84.2%)	
	11-15	23 (39%)	36 (61%)	

Gender	Male	27 (16.3%)	139 (83.7%)	0.237
	Female	5 (9.6%)	47 (90.4%)	
Type of congenital heart disease	ASD	4 (9.5%)	38 (90.5%)	0.730
	VSD	12 (19.4%)	50 (80.6%)	
	PDA	3 (13.6%)	19 (86.4%)	
	TOF	8 (14.5%)	47 (85.5%)	
	Ebstein anomaly	5 (13.5%)	32 (86.5%)	

DISCUSSION

The most prevalent birth abnormality is a heart issue.¹² They affected 48.9 million individuals worldwide in 2015.¹³ They impact 4 to 75 out of every 1,000 live newborns, depending on the diagnosis.^{14, 15} Congenital heart disease is becoming more common in the community. Arrhythmias can occur in children with congenital cardiac conditions. These children's arrhythmias increase morbidity and death if they are not detected early and treated properly. Either congenital anomalies of the specialized conduction system or hemodynamic impacts on chamber size, muscle mass, and cardiac tissue hypoxia cause the arrhythmias.¹⁶ We carried out this investigation to ascertain the extent of arrhythmia among patients with congenital heart disease in the local community because there is no evidence regarding the frequency of cardiac arrhythmias in children with this condition in the local data.

In my study 218 patients with congenital heart disease were included, among those 32 (14.7%) had cardiac arrhythmias while 186 (85.3%) had no arrhythmias. But another study conducted in Uganda that included children with underlying congenital heart defects, 53/194 (27.3 %, 95 % CI 21.0 - 33.6) children had arrhythmias. Of these children with congenital heart disease, 44/194 (22.7 percent, 95 percent CI 16.8-28.6) had first degree AV block, and 9/194 (4.6 percent, 95 percent CI 1.7-7.6) had either premature ventricular contractions, ectopic atrial rhythm, junctional rhythm, complete atrioventricular (AV) dissociation, or premature atrial rhythm. Digoxin-using children had a higher risk of first-degree AV block (OR 3.75, 95% CI 1.60-8.86), but children under the age of five had a lower risk (OR 0.16, 95% CI 0.07-0.37). Children with CHD who were evaluated from Mulago Hospital had a high prevalence of arrhythmias

(27%). Digoxin usage and older children who had long survived without correcting surgery for their congenital deformities because of a lack of resources were linked to these.¹⁶

Spectrum of arrhythmia in my study was different among 32 patients with cardiac arrhythmias, 14 (43.8%) had ventricular arrhythmias, 10 (31.3%) had supraventricular tachycardia, 8 (25.0%) had bradyarrhythmias. Among these 32 patients subtype of cardiac arrhythmias was documented and showed that 8 patients (25.0%) had Atrial fibrillation, 6 (18.8%) had Premature ventricular contractions, 6 (18.8%) had Ventricular fibrillation 2 (6.3%) had Ventricular tachycardia, 2 (6.3%) had atrial flutter, 1 (3.1%) had Sinus bradycardia, 3 (9.4%) had First degree AV block, 1 (3.1%) had second degree AV block and 1 (3.1%) had third degree AV block. Complete AV dissociation has been described in children with L-TGA and in children with CAVC.¹⁶ However, a youngster with TOF had this arrhythmia in our research. The incidence of total AV dissociation in kids with TOF is not well documented in the literature.

Predisposing factors include underlying congenital heart disease, rheumatic heart disease, cardiomyopathy, electrolyte disturbances, septic shock, systemic illness like chronic kidney disease, hepatic cirrhosis, thalassemia and drugs like digoxin.^{17, 18} Arrhythmias develop in about 7.5% patients in early post-operative period after cardiac surgery, the commonest being junctional ectopic tachycardia (46%) followed by supraventricular tachycardia (33%).¹⁹ Following surgery Although junctional ectopic tachycardia can happen following any type of surgery for congenital cardiac abnormalities, it is most commonly seen following ventricular septal

defect closure (4%), AV septal defect repair (2%), and full tetralogy of Fallot repair (22%).²⁰ One study showed that among children with cardiac arrhythmias with underlying cardiac myopathy, sinus bradycardia, first-degree AV block, & second-degree, mobitz II AV block in 0.5% cases each, third-degree AV block (complete heart block) in 1.1%, atrial fibrillation in 4%, atrial flutter and atrial tachycardia in 0.4% each, AVNRT in 0.2%, AVRT in 1.1%, premature ventricular contractions in 3.1%, monomorphic ventricular tachycardia in 11.8%, bidirectional ventricular tachycardia in 0.4%, polymorphic ventricular tachycardia in 1.4% and ventricular fibrillation in 0.9%.²¹

There were 662,698 live births throughout the course of 20 years. Of the 162 newly diagnosed arrhythmia patients we found, 22 had structural cardiovascular abnormalities linked to them. There were 24.4 arrhythmias for per 100,000 live births. With an incidence of 16.3 per 100,000, atrioventricular re-entry tachycardia was the most prevalent arrhythmia. Complete atrioventricular block and atrial flutter both occurred at 2.1 cases per 100,000 live births, and other arrhythmias were rare.²² But another study showed that first degree AV block was most common (22.7%) while Complete A-V block, Premature ventricular contractions, and Junctional rhythm being least (0.5%).¹⁶

In my study, the mean age of patients was 7 ± 4years. Data was stratified for age of children. there was no arrhythmia documented among children aged 1-5yrs. In children aged 6-10years, 9 (15.8%) were having cardiac arrhythmias but 48 (84.2%) had no cardiac rhythm abnormality. In children aged 11-15years, 23 (39.0%) had cardiac arrhythmias but 36 (61.0%) had no cardiac arrhythmias. The difference was significant (p<0.05).

Children who have live longer with congenital heart defects and have not undergone corrective surgery are more likely to have arrhythmias as compared to younger children.

In my study, there were 166 (76.15%) male and 52 (23.85%) females. Data was stratified for gender of children. among males, 27 (16.3%) were having cardiac arrhythmias but 139 (83.7%) had no cardiac rhythm disturbance. among females, 5 (9.6%) had cardiac

arrhythmias while 47 (90.4%) had no cardiac arrhythmias. The difference was insignificant (p>0.05). There are more males in our study population as more males as compared to females are brought to hospital due to increased concern in our society for male child. Data was stratified for type of congenital heart disease. among patient with VSD, 12 (19.4%) were having cardiac arrhythmias, among TOF patients, 8 (14.5%) had cardiac arrhythmias.among patients with PDA.3(13.6%) had rhythm abnormality in children with EBstein anomaly, 5 (13.5%) had cardiac arrhythmias while in patients with ASD,4(9.5%) were found to have arrhythmias. The difference was insignificant (p>0.05).

CONCLUSION

Thus the frequency of cardiac arrhythmias was not rare in children with congenital heart disease especially in older ages with no history of corrective surgery. Now we have got the local evidence and we implement the results of this study in local setting. In future, we recommend to screen the children of congenital heart disease for cardiac arrhythmias. So that children can also be managed for comorbidities.

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