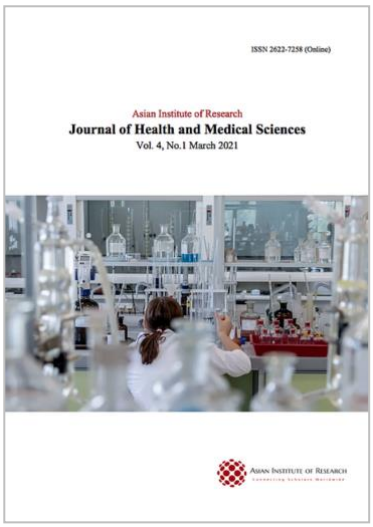

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Arrhythmias in Children with Normal Heart in Albaha, Saudi Arabia

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Abstract
Introduction: Arrhythmias in children with structurally normal hearts are common and reported as the causes of many hospital admissions. Generally, the risk of death is low. Physical examination is important in children with arrhythmias. Objectives: This study aimed to review the common types and clinical presentations of arrhythmias in children with normal heart structures in Albaha, Saudi Arabia. Methodology: In this hospital-based retrospective cross-sectional study, the medical records of children were reviewed from January 2010 to December 2020. Results: Overall, 214 children were included in this study. The prevalence of arrhythmias was 27.10% in children aged 5-8 years; 18.7%, 8-12 years; 16.82%, 3-5 years; 16.35%, 1-3 years; 13.55%, 12-14 years; and 7.48%, <1 year. Arrhythmias were more frequent in females aged <5 years and in males aged >5 years; however, overall, there was no significant difference between females (47.20%) and males (52.80%). Supraventricular arrhythmias were the commonest and found in 85% of the children and ventricular arrhythmias were found in 15%. Sinus tachycardia was the most common type of arrhythmia, reported in 25% of the children. Conclusion: In general, arrhythmias in the children are asymptomatic. History, clinical examination, and electrocardiography are important for the diagnosis. Supraventricular arrhythmias are the most common. There is no significant difference between females and males with respect to the prevalence of arrhythmias.

Keywords: Children, Arrhythmias, Normal Heart Structure

Abbreviations:
ECG: electrocardiography. PACs: premature atrial contractions. PVCs: premature ventricular contraction. SVT: supra ventricular tachycardia. VT: ventricular tachycardia. WPW: Wolff Parkinson white syndrome. LQT: long QT interval. AV: atrioventricular. SVT: Supraventricular tachycardia. CXR: chest x-ray. P value: probability of chance.

Introduction

Arrhythmias in children with structurally normal hearts are common and reported as the causes of many hospital admissions. Generally, the risk of death due to arrhythmias is low [John M Miller, Douglas P Zipes. Braunwald's Heart Disease 2015]. Physical examination is important in children with arrhythmias. Congestive heart failure is the typical presentation in neonates and infants, while chest pain, tachycardia, palpitations, and syncopal attacks are the common signs and symptoms in older children [Emily Anne Schlechte et al 2008]. Supraventricular tachyarrhythmias with aberrant pathways such as in Wolff-Parkinson-White (WPW) syndrome and junctional tachycardia are the most common arrhythmias [Niwa K. Warita N et al 2004]. Supraventricular arrhythmias are often asymptomatic, accidentally diagnosed in most children, and respond well to treatment [Reena M Ghosh et al 2014]. Delayed diagnosis of arrhythmias can lead to serious consequences necessitating treatment for a long time; ablation is needed to resolve them in some cases [Martial M Massin et al 2008]. Supraventricular tachycardia (SVT) is categorized into two types, non-sustained and sustained, and has an incidence of about 1 per 25000 [Schlechte EA, Boramanand N, et al 2008]. Sudden cardiac death has been reported in children and infants have arrhythmias with normal hearts, and 5% of the cases had findings of WPW syndrome on electrocardiography (ECG); ablation should be considered in such cases [Gregory Webster, Rachael Olson, et al 2019]. Hypertrophic obstructive cardiomyopathy and Ebstein's anomaly may be associated with WPW syndrome [Lu CW, Wu MH et al 2014]. Bradyarrhythmias are rare in children and generally asymptomatic. First-degree heart block, recorded on ECG as a PR interval prolongation 0.2 seconds and more, is considered a benign finding in children with a prevalence of about 1%; although uncommon, it can be complicated by atrial fibrillation [Cheng S, Keyes MJ et al 2009- Zhi Du, Liying Xing, et al 2019]. The incidence of sudden death in children is about 0.8-6.2 per 100000 live births and 65% of these deaths result from cardiac causes [Robert M. Kliegman, MD, Nelson Textbook of Pediatrics 20th edition 2016]. The incidence of long QT syndrome is about 1 per 10000 live births, with a genetic cause in 80% of the cases; it can also be present in children with hypertrophic cardiomyopathy, electrolytes disturbance, and due to some medications [Robert M. Kliegman, MD, Nelson Textbook of Pediatrics 20th edition 2016]. Long QT interval is always a serious finding, and sudden death can happen in some cases. Some children have a positive family history for such illnesses; therefore, it is important and necessary to record a detailed history [Nabil El-Sherif et al 2017]. A complete heart block is rare in children, with an incidence of 1 per 20000-25000 live births; autoimmune causes have been noted in 60-70% of the cases, and the mortality is high (3.5%) when the diagnosis is delayed [Friedman D, Rupel A2002]. Premature ventricular complexes (PVCs) reported on ECG in children frequently and may be asymptomatic in 2.2% of children with heart disease [Mitchell I Cohen 2019].

Objectives

The present study aimed to review the prevalence, common types, and clinical presentations of arrhythmias in children with normal heart structures in Albaha, Saudi Arabia.

Methodology

In this is hospital-based retrospective cross-sectional study, medical records of children were reviewed from January 2010 to December 2020. The study was conducted in the pediatric and neonatology department of King Fahad Hospital, Albaha, Saudi Arabia. The sample size was calculated using the Leslie Kish formula [Jon Wiley, Sons INC 2004]. Records of 214 children, aged 1 day to 14 years, reported to have arrhythmias with normal hearts were reviewed. All children had been evaluated by pediatric cardiologists and had undergone physical examination, ECG, and echocardiography. Children having arrhythmias with associated congenial heart diseases were excluded. Statistical analysis was performed using Microsoft Excel 2020. Prevalence, types of arrhythmias, the age, and sex of the children were evaluated as various factors of interest affecting the course and presentation of arrhythmias. Laboratory workup, mainly serum electrolytes level, was performed for all cases. In this study, we considered the average normal heart rate related to age as 94-180 beats/minute in children aged 1-30 days; 120-179 beats/minute, 1-3 months; 105-185 beats/minute, 3-6 months; 108-169 beats/minute, 6-12 months; 89-152 beats/minute, 1-3 years; 73-137 beats/minute, 3-5 years; 65-133 beats/minute, 5-8 years; 62-130 beats/minute, 8-12 years; and 60-120 beats/minute, 12-16 years. Arrhythmia was said to be present when the difference between the minimal and maximal duration of a heart rate was more than

10%, as mentioned in the literature [Allen, Hugh D.; Driscoll, David J.; Shaddy, Robert E, Moss, Adams2008]. Probability of chance (P value) was calculated as significant statistical value for our results,

Results

As shown in Table 1 and 2, the groups were categorized by age. The total number of children included in this study was 214. In a decreasing order, the prevalence of arrhythmias was 27.10% (58/214) in children aged 5-8 years; 18.7% (40/214), 8-12 years; 16.82% (36/214), 3-5 years; 16.35% (35/214), 1-3 years; 13.55% (29/214), 12-14 years; and 7.48% (16/214), <1 year. Arrhythmias were frequent in females (45/214) at <5 years of age and in males (71/214) at >5 years of age; however, overall, no significant difference was observed between females (101/214, 47.20%) and males (113/214, 52.80%) (overall P=0.12). Arrhythmias that originated above the atrioventricular node, supraventricular arrhythmias; sinus dysrhythmias, atrial arrhythmias, SVT, and premature atrial contractions (PACs) were more frequent than other types of rhythm disturbances and were found in 182/214 (85%) children, while ventricular arrhythmias were found in 32/214 (15%) children. Sinus tachycardia was the most common type of arrhythmia diagnosed in the study, accounting for 53 (25%) children, 33 (62%) males and 20 (38%) females. PAC was the second most common type of arrhythmia, reported in 34 (16%) children, 14 (41%) males and 20 (59%) females. Atrial tachyarrhythmias were confirmed in 29 children, 15 males and 14 females; sinus bradycardia in 26 children, 17 males and 9 females; SVT in 25 children, 11 males and 14 females; and first-degree heart block in 15 children, 7 males and 8 females. PVCs were seen in 14 children, 8 males and 6 females. Long QT interval was diagnosed in 9 children, 4 males and 5 females; genetic analysis was performed for them, and all patients were transferred to a higher center for further evaluation. WPW was diagnosed in 5 children, 2 males and 3 females. Ventricular tachycardia and second-degree heart block were diagnosed in 2 children each, 1 male and 1 female in each category. The presenting symptoms in children with SVT were chest pain (50%), shortness of breath (20%), and palpitations (20%). Heart failure and other signs were detected in 10% of cases. Majority of the children with PACs were asymptomatic. A total of 15 (7%) children had first-degree heart block, and 5 of them were on medications for no cardiac problems; no significant difference in occurrence of first degree heart block between males and females was observed (P=0.32). The outcome was excellent, and all children responded well to medical treatment. Children with WPW syndrome were transferred to a higher cardiac center for ablation. Chest x-rays were normal in 80% of the children, while mild cardiomegaly was noted in 20%.

Discussion

Tables 1 and 2 show the distribution of the reported cases of arrhythmias in the children included in this study. Medical records of 214 children were reviewed in this study. Mild differences were noted in the frequency of cardiac arrhythmias in all age groups. The prevalence of arrhythmias was higher in children aged 5-8 years (58/214, 27.10%). Sinus tachycardia had the highest prevalence in this study, and it was reported as the most common type of arrhythmia in all groups of children (P=0.05). A vegetative and immunological functional change in the sinus node and conductive tissues of the heart could explain that. This result was consistent with the results of other published national and international studies. Thus, we can call it a variant of cardiac rhythm and rate rather than dysrhythmias [Emily Anne Schlechte et al 2008, Niwa K. Warita N et al 2004]. Arrhythmias were more frequent in females under 5 years of age (45/214), while they were more frequent in males older than 5 years (71/214), with no overall significant difference between them (females 101/214, 47.20%; males 113/214, 52.80%; overall P=0.12). Arrhythmias that originated above the AV node, such as sinus tachycardia, sinus bradycardia, atrial arrhythmias, SVT, and PACs, were more frequent than other types of rhythm disturbances and were seen in 182/214 (85%) children, and dysrhythmias originating below the AV node were seen in 32/214 (15%) children. Sinus tachycardia was the most commonly diagnosed arrhythmia in this study, reported in 53 children (24.77%), 33 males (62%) and 20 females (38%). It was considered as a normal physiological response for many precipitating factors and associated diseases mentioned in the literature [Robert M. Kliegman, MD, Nelson Textbook of Pediatrics 2016]. Evaluation by clinical examination, ECG, and echocardiography was performed for all children to confirm the diagnosis. No medications were given and only the precipitating diseases were managed. PAC was the second most common type of arrhythmia, noted in 34 (16%) children, 14 (41%) males and 20 (59%) females. Most of children with PACs were asymptomatic. Atrial tachyarrhythmia was the third most common type of arrhythmia, noted in 29 (14%) children, 15 (52%) males and 14 (48%)

females. SVT was seen in 25 children, 11 (44%) males and 14 (56) females (P=0.09). A majority of the children responded well to medical treatment by intravenous adenosine as the treatment of choice. However, two children needed intensive care and DC shock. Children with PACs were asymptomatic. WPW syndrome was found in 5 (2.34%) children, 2 (40%) males and 3 (60%) females, and they presented with chest pain, palpitations, and SVT on ECG (P=0.36). Intravenous adenosine was administered as the treatment of choice with good response [Gregory Websteret al 2019, Lu CW, Wu MH et al 2014]. Patient with recurrent attacks were transferred to a higher cardiac center for ablation. Fifteen children (7%) were diagnosed with first-degree heat block, and 2 of these children were on digoxin and 5 on non-cardiac medications when the ECG findings were detected. There was no significant difference in occurrence of first-degree heart block between males and females (P=0.32). Second-degree heart block was reported in two children the study and completely investigated. PVC was diagnosed in 14 children, 8 (57%) males and 6 (43%) females. It was unifocal, and the children were stable and asymptomatic, fully investigated with normal laboratory results, and needed only parents' reassurance and observation (P=0.15). Long QT interval was diagnosed in 9 children, 4 (44%) males and 5 (56%) females. Genetic study was performed in all of them and the genetic cause was detected in 3 patients and considered as long QT syndrome. It was precipitated by some medications and electrolytes abnormalities in the other 6 children (P=0.72). Ventricular tachycardia was observed in 2 children with hyperkalemia, and it responded well to treatment. The results of the present study were consistent with other national and international studies on the same topic [John M Miller, Douglas P Zipes. Braunwald's Heart Disease 2015, Emily Anne Schlechte et al 2008].

Conclusion

Arrhythmias in children are frequently asymptomatic. They are a normal variation in a majority of cases. History, clinical examination, and ECG are important for the diagnosis. Supraventricular arrhythmias are the most common. Arrhythmias are more common in females under 5 year of age and in male children over 5 years of age, with no overall significant difference between the sexes.

Table1: Distribution of children with age group.

Age	Normal HR[19]	Pts No	percent	M	F	P Value
<12 m	95-180	16	7.48%	6	10	0.16
1-3 yr	89-152	35	16.35%	20	15	0.07
3-5 yr	73-137	36	16.82%	16	20	0.07
5-8 yr	65-133	58	27.10%	33	25	0.05
8-12 y	62-130	40	18.7%	24	16	0.06
12-14 yr	60-120	29	13.55%	14	15	0,34
total	bpm	214	100%	113	101	0.12
No: number of pts. P Value: probability of chance. M: male. F: female. HR; heart rate. Pbm; beat per minute.						

Table2: Distribution of arrhythmias type by group.

ECG findings	< 12 m	1-3 y	3-5 y	5-8 y	8-12 y	12-14y	total	M	F	P value
Sinus tachycardia	4	10	11	11	10	7	53	33	20	0.05
PACs	5	5	4	10	5	5	34	14	20	0.06
Atrial Tachyarrhythmias	2	6	4	7	7	3	29	15	14	0.12
Sinus bradycardia	2	4	5	8	3	4	26	17	9	0.07
SVT	1	3	7	6	5	3	25	11	14	0.09
Heart block 1st degree	0	1	2	6	2	4	15	7	8	0.32
PVCs	1	1	2	4	3	3	14	8	6	0.15

LQT	1	3	0	3	2	0	9	4	5	0.72
WPW	0	2	0	1	2	0	5	2	3	0.36
VT	0	0	1	1	0	0	2	1	1	0.43
Heart block 2nd degree	0	0	0	1	1	0	2	1	1	0.43
Total children	16	35	36	58	40	29	214	113	101	0.12

ECG: electrocardiography. PACs: premature atrial contractions. PVCs: premature ventricular contraction. SVT: supra ventricular tachycardia. VT: ventricular tachycardia. WPW: Wolff Parkinson white syndrome. LQT: long QT interval. P value: probability of chance. HR; heart rate.

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