



ORIGINAL ARTICLE

Referral patterns and Outcome of Children with Perceived Arrhythmia to a Tertiary Cardiac Service

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Abstract

Background & Objectives: Arrhythmias are common in pediatric population and is suspected in patients presenting with palpitations and/or syncope. These patients are commonly referred to Pediatric Cardiology for further evaluation either after identifying rhythm abnormality or based on clinical suspicion only. The objective of this study was to assess the yield of pediatric cardiology referrals for arrhythmia evaluation.

Methods: This is a single-center retrospective observational descriptive study. A total of 486 patients referred to the pediatric cardiology department from the year 1998 to 2020 were included. Patients were grouped based on referral, Group 1 consisted of patients referred with documented arrhythmia and Group 2 had patients referred on clinical suspicion. Patient's age at presentation, gender, reason for referral, type of arrhythmias, any associated structural heart disease, interventions, and outcomes were analysed.

Results: Group 1 had 156 (32.1%) patients and group 2 had 330 (67.9%) patients. The most common diagnosis in group 1 was atrioventricular re-entry tachycardia and in group 2 was premature ventricular contractions. There was no variability for the type of arrhythmia between the two groups. Among patients in group 2, 315 (95.4%) had no evidence of electrophysiological abnormalities. Positivity rates for arrhythmia were only 3.2% for palpitations and 9% for syncope. 28 (5.8 %) patients required interventions; all from group 1.

Conclusion: Clinically significant arrhythmias were mostly diagnosed at the point of first contact. Patients referred on clinical suspicion were mostly normal electro-physiologically. Inappropriate referrals increase the workload on pediatric cardiology services. There is an urgent need to regularise referrals.

Keywords: Cardiac arrhythmia, Heart diseases, Referral and consultation, Syncope, Tachycardia

Introduction

Palpitations and syncopal attacks are among the commonest referrals to pediatric cardiology services after cardiac murmurs and atypical chest pain.¹ The role of the cardiologist is to establish whether the palpitations and syncope are due to any significant or life-threatening arrhythmias. Arrhythmias are defined as variations from the normal sequence of electrical impulses traveling through the myocardium that is not sinus and does not follow normal atrioventricular conduction. Arrhythmias can be classified as tachyarrhythmia, bradyarrhythmia, and premature electrical activations. Tachyarrhythmias include supraventricular tachycardia (SVT), junctional ectopic tachycardia, and ventricular tachycardia (VT). Bradyarrhythmias include lesions of the sinus node, atrioventricular node, His-Purkinje system, and intra-atrial propagation.² Isolated premature beats can be atrial or ventricular.

Arrhythmias can occur in isolation or with associated congenital heart disease (CHD). Arrhythmias in patients with CHD can lead to significant morbidity and mortality. Assessment and workup of patients with suspected arrhythmias consist of a detailed history and physical examination, 12-lead electrocardiography (ECG), Holter monitoring, and echocardiography. Electrophysiological (EP) study, cardiac catheterization, cardiac magnetic resonance imaging and computed tomographic scans for functional and anatomical assessment may also be considered.³ Laboratory studies play a role in excluding inflammation, hormonal abnormalities, and electrolyte abnormalities as a probable cause. The objective of this study was to assess the yield of pediatric cardiology referrals from other departments for arrhythmia evaluation.

Methods

This single-center retrospective observational descriptive study analyzed a computerized database to identify all patients referred to the pediatric cardiology department from 1998 to 2020 with a documented arrhythmia, or with a clinical suspicion of arrhythmia. Subjects with incomplete data, sinus tachycardia, sinus bradycardia, and sinus arrhythmia were excluded. All patients had an initial diagnosis based on workup by ECG, echocardiography, and/or 24-hour Holter monitoring when indicated. Additional workup was done according to clinical suspicion and on an individualized basis. Parameters analyzed were patient's age at presentation, gender, reason for referral, type of arrhythmias, associated structural heart disease, interventions, and outcomes. In patients having more than one type of electrical abnormality, the most severe lesion was considered as the final diagnosis. Diagnosis of atrioventricular nodal re-entry tachycardia (AVNRT) was established only after confirmation on EP Study. Patients were grouped as those referred with documented arrhythmia (Group 1) and those referred based on clinical suspicion only (Group 2). For group 2, data was further subdivided according to the type of predominant symptom i.e., palpitations or syncope. Patients were also analysed for any associated CHD (defined by their most severe lesion).

Statistical Methods

Shapiro-Wilk test was applied to analyze the normality of quantitative data. Normal data is described as mean with standard deviations (SD) and non-normal data is represented as median and range and analysed with Kruskal-Wallis test or Mann-Whitney U test, as and when appropriate. Categorical variables were summarized as frequencies and percentages and analysed with

the Chi-square test and $p \leq 0.05$ was considered statistically significant. Statistical analyses were facilitated with the help of SPSS statistical software (SPSS Inc.).

Results

A total of 486 patients were included in our study, 156 (32.1%) patients were referred with documented arrhythmias (Group 1) and 330 (67.9%) were referred with clinical suspicion only (Group 2). In group 2, predominant symptom on presentation was palpitations in 76.3% (n=252) and syncope in 23.7% (n=78) of patients. Description of patients according to their reason for referral to pediatric cardiology and type of arrhythmia is shown in Tables 1 and 2. Group 1 had a male predominance and group 2 had female predominance ($p < 0.001$). The most common category of arrhythmias in group 1 was tachyarrhythmia (44.2%) and in group 2 was premature electrical activation (2.4%). Statistical analysis showed no significant variability for arrhythmia types between the two groups and among subgroups ($p = 0.5828$).

The most common diagnosis in group 1 was AVRT and in group 2 was premature ventricular contractions (PVCs). None of the patients with long QT syndrome (LQTS) had any documented arrhythmia, they were diagnosed either during evaluation for non-cardiac reasons or while routine family screening. Of 330 patients in group 2, 315 (95.4%) had no evidence of EP abnormalities. Positivity rates for arrhythmia in 2 clinical subgroups i.e., palpitations and syncope were 3.2% and 9% respectively.

In Group 1, there were 18 (25.3%) patients with SVT who required ablation, 10 (58.8%) patients with complete heart block (CHB) required surgical pacemaker insertion. About 22 patients had an associated undiagnosed CHD. The most common CHD was patent ductus arteriosus (n=13) followed by atrial septal defect (n=5), ventricular septal defect (n=3), and peripheral pulmonary stenosis (n=1). All lesions were mild without any hemodynamic significance and did not require surgical or catheter intervention.

Discussion

Arrhythmias are responsible for 5% of pediatric emergency hospital admissions.⁴ The incidence

is 24.4 per 100,000 live births if postoperative arrhythmias, pre-excitations, LQTS, premature beats, and other non-sustained arrhythmias are excluded.⁵

AVRT is the most common pediatric arrhythmia. The proportion of AVRT among pediatric arrhythmias is 20 – 80% of which about one-third are attributed to WPW syndrome.^{1,5-10} Similar findings were found in this study, which showed AVRT as the most common arrhythmia (38.6%) and WPW responsible for 29.5% of AVRT. Other tachyarrhythmias are less common in the pediatric population with an incidence ranging around 5%.^{1,5-7,11,12} This study also described similar incidences of AVNRT, atrial flutter, and VT.

Premature electrical activations are common in children and are mostly benign with the majority resolving spontaneously.¹³ In this study also PVC and PAC were a common finding, and all were benign. CHB is the most common cause of significant bradyarrhythmia in the pediatric population. In this study, CHB represented 77% of bradyarrhythmias and 9.9% of total arrhythmias.

Previous studies analyzing the cause of palpitation and syncope had shown presence of cardiac cause in only 2-15% of patients.^{1,7,14,15} In this study also, arrhythmia was found only in 3.2% of cases presenting with palpitation and in 9% of cases presenting with syncope. Group 2 had a positivity rate of only 4.6% which reduced further to 1.8% if only clinically significant arrhythmias were considered i.e., tachyarrhythmia, CHB, and LQTS. Such a low incidence of positive results demonstrates a high index of suspicion and a low threshold for pediatric cardiology referrals among primary caregivers.¹⁶

Among patients with arrhythmia, 91.2% were diagnosed before referral, at the point of first contact (Group 1) and only 8.8% of patients were diagnosed during cardiology workup (Group 2). All patients that required interventions were from group 1 and none from group 2. This suggests that the arrhythmias that were missed by primary caregivers may not be severe enough to compromise patient safety. However, longitudinal follow-up studies are required to reach a definitive conclusion.

Rarely undiagnosed arrhythmias can lead to congestive cardiac failure secondary or sudden cardiac death. Therefore, primary caregivers are reluctant to label patients as normal and often refer them to pediatric cardiology for evaluation even with minimal clinical suspicion.^{17,18} Generalists and specialist trainees in Pediatrics, receive zero or little training in pediatric cardiology resulting in inappropriate referrals for cardiovascular evaluation.⁷ Also, a referral might be demanded by anxious parents unsatisfied with reassurance by a non-specialist. This results in an increased workload on pediatric cardiology services, a longer waiting list, and delayed patient care. Studies have described an increase in referrals to pediatric cardiology, with a rise in the proportion of patients without any cardiac pathology.^{16,18-21} This proportion is higher for general practitioners when compared to pediatricians.^{16,18,21} Studies show that detailed history, physical examination, and ECG are often sufficient in diagnosing aetiologies in most cases of syncope and palpitations.^{15,22} Echocardiogram does not contribute to the abnormal yield if there is no history of exercise-induced syncope, positive family history, abnormal physical examination, or abnormal ECG.¹⁵

Strategies proposed to reduce the burden on pediatric cardiology services include employing a Pediatrician with a special interest in cardiology and basic understanding of echocardiography to work in peripheral general hospitals. This increases the positivity rate for referred cases and reduces demand on tertiary care services.^{18,20,23} Also institutions can employ appropriate use criteria for referrals, which will help in reducing the number of pediatric cardiology consultations.^{24,25}

Conclusion

Most patients referred to pediatric cardiology for diagnostic evaluation of palpitations with or without syncope were electrophysiologically normal. Most clinically significant arrhythmias can be diagnosed at the point of first contact. Referring patients with non-significant arrhythmias or on clinical suspicion for detailed evaluation results in an increased workload on pediatric cardiology services and financial burden on patients. There is an urgent

need to regularise cardiology referrals. This can be achieved by educating primary caregivers to differentiate innocent non-specific complaints from specific cardiac aetiologies and utilizing appropriate use criteria in daily practice.

Limitations

This is a single-centre study and findings may not reflect the true incidence in the community. Larger longitudinal studies are required to ascertain the true incidence. As with all retrospective study designs, there were challenges in data collection. The severity of symptoms was analysed subjectively which could cause interpersonal variations. Variable definitions of arrhythmias among different studies create inaccuracies during comparison.

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Nil

Conflicting Interest

Nil

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Table 1: Description of patients referred to paediatric cardiology categorised according to the reason for referral

Parameters	Total referred patients n = 486 (%)	Group 1: Referred with Documented Arrhythmia n = 156 (%)	Group 2: Referral Based on clinical suspicion	
			Palpitations n = 252 (%)	Syncope n = 78 (%)
Age in years (\pm SD)	8.7 (\pm 4.3)	6.9 (\pm 5.3)	9.1 (\pm 3.4)	10.2 (\pm 3.1)
Male: Female	0.99	1.64	0.84	0.86
Associated Congenital heart disease	22 (4.5)	20 (12.8)	2 (0.8)	0
Tachyarrhythmia	73 (15)	69 (44.2)	3 (1.2)	1 (1.3)
Bradyarrhythmia	29 (6.0)	26 (16.7)	1 (0.4)	2 (2.6)
Premature electrical activation	69 (14.2)	61 (39.1)	4 (1.6)	4 (5.1)
Required ablation or pacemaker insertion	28 (5.8)	28 (17.9)	0	0

SD, Standard deviation

Table 2: Description of type of arrhythmia among two groups

Parameters	Total n = 171 (%)	Group 1: Referred with Documented Arrhythmia n = 156 (%)	Group 2: Referral Based on clinical suspicion	
			Palpitations n = 8 (%)	Syncope n = 7 (%)
Tachyarrhythmia	73 (42.7)	69 (44.2)	3 (37.5)	1 (14.3)
Atrioventricular re-entry tachycardia with concealed pathway in ECG	43 (25.1)	39 (25.0)	3 (37.5)	1 (14.3)
Atrioventricular re-entry tachycardia with pre-excitation in ECG	16 (9.4)	16 (10.3)		
Atrioventricular nodal re-entry tachycardia	10 (5.8)	10 (6.4)		
Atrial flutter	2 (1.2)	2 (1.3)		
Ventricular tachycardia	2 (1.2)	2 (1.3)		
Bradyarrhythmia	29 (17.0)	26 (16.7)	1 (12.5)	2 (28.6)
1 st degree block	3 (1.8)	2 (1.3)		1 (14.3)
2 nd degree Block	2 (1.2)	2 (1.3)		
Complete heart block	17 (9.9)	16 (10.3)	1 (12.5)	
Long QT syndrome without documented ectopy	5 (2.9)	4 (2.6)		1 (14.3)
Sick Sinus Syndrome	2 (1.2)	2 (1.3)		
Premature electrical activation	69 (40.4)	61 (39.1)	4 (50.0)	4 (57.1)
Premature ventricular contraction	43 (25.1)	36 (23.1)	4 (50.0)	3 (42.9)
Premature Atrial contraction	23 (13.5)	22 (14.1)		1 (14.3)
Junctional ectopic beats	3 (1.8)	3 (1.9)		
Required ablation or pacemaker insertion	28 (16.4)	28 (17.9)	0	0

ECG, Electrocardiogram