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RESEARCH ARTICLE

Evaluation of the Clinical Phenotype and Follow-up of Children with 'Non-sustained' Ventricular Tachycardia Detected on 24-hour Rhythm Holter

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ABSTRACT

Objective: Non-sustained ventricular tachycardia (NSVT) is an important arrhythmic finding in pediatric patients, with varying clinical implications based on the presence of structural heart disease. This study aimed to evaluate the clinical characteristics, follow-up, and management of children diagnosed with NSVT detected on 24-hour Holter monitoring.

Methods: A retrospective analysis was conducted on 22 pediatric patients (9 males, 13 females) aged 2.5–17 years, who were diagnosed with NSVT between 2015 and 2023. Patients with sustained VT, channelopathies, or electrolyte-related prolonged QTc were excluded. Echocardiography, electrocardiography, and Holter monitoring were performed for all patients. Statistical analyses were conducted using SPSS 26.0, with significance set at $p<0.05$.

Results: Monomorphic NSVT was observed in 14 patients (64%), while polymorphic NSVT was found in 8 patients (36%). The mean VT rate was 161.2±18.7 bpm, with polymorphic VT demonstrating a significantly higher rate (175.3±4.4 bpm) than monomorphic VT (153.3±4.6 bpm) ($p=0.003$). The prematurity index was significantly lower in polymorphic VT (0.75±0.03) than in monomorphic VT (1.1±0.03) ($p<0.001$). Additionally, QTc was longer in polymorphic VT (463.5±5.1 ms vs. 425.4±6.5 ms, $p=0.004$). Structural heart disease was present in 50% of cases, with polymorphic VT being predominantly associated with cardiomyopathies (dilated, hypertrophic, and non-compaction). Only three patients (14%) were symptomatic, and all symptomatic patients had structural heart disease. All patients with underlying cardiac abnormalities were treated with beta-blockers, primarily propranolol, while those with normal echocardiography were followed without medication. No adverse effects, syncope, or mortality were observed during follow-up.

Conclusion: NSVT in pediatric patients should be carefully evaluated, particularly in the presence of structural heart disease. While monomorphic NSVT in structurally normal hearts appears benign, polymorphic NSVT is strongly associated with cardiomyopathies, necessitating medical therapy and close monitoring. Individualized management based on echocardiographic findings and arrhythmic characteristics is essential for optimizing patient outcomes.

Keywords: Non-sustained ventricular tachycardia, Holter monitoring, beta-blockers

INTRODUCTION

Ventricular tachycardia (VT) is an arrhythmia that arises from the working ventricular myocardium (1). When a child presents with wide QRS complex tachyarrhythmia, it is always important to first consider the diagnosis of VT. We know that children present with late-related aberrancy associated with supraventricular tachycardia, but VT accounts for an estimated 80% of all wide complex rhythms across all ages (2). Most children with clinically significant ventricular arrhythmias have structural or functional cardiac disease. However, pediatric patients with chronic ventricular arrhythmias without organic heart disease or other predisposing factors are also being identified today (3).

It is important to determine the characteristics and clinical findings of ventricular tachycardia because the follow-up and treatment indications of ventricular tachycardia that develops in patients with structurally normal hearts and in the presence of underlying organic heart disease may vary depending on these criteria.

MATERIALS AND METHODS

In our retrospective study, 22 (9 boy, 13 girl) patients aged between 2.5 and 17 years were evaluated. Patients with non-sustained VT detected on 24-hour rhythm holter during follow-up in the pediatric cardiology department between 2015 and 2023 were included. All patients underwent echocardiographic and electrocardiographic evaluation during follow-up.

Each patient underwent ambulatory ECG recording. A Schiller medico AR was used to record a 3-channel ECG. For all episodes of VT, the following values were measured by manual analysis of the rhythm strips: average rate and consecutive number of

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episodes, heart rate prior to episode, the R-R interval before the episode, QT interval of the preceding sinus rhythm, and coupling interval (R-R'). The prematurity index of the initiating beat of VT was defined as (R-R')/QT.

Each patient had at least one 24-hour rhythm Holter recording containing episodes of non-sustained VT. Ventricular tachycardia should be diagnosed whenever three or more QRS complexes, which have a morphology different from that of the normal QRS complexes, occur at a rate greater than 120 beats/rain or 25% greater than the average normal sinus rate. Non-sustained VT is a ventricular tachycardia that lasts less than 30 seconds and terminates spontaneously.

Patients with sustained VT detected on 24-hour Rhythm Holter recording, patients with channelopathies such as long QT syndrome, arrhythmogenic right ventricular dysplasia (ARVD), Brugada syndrome, and patients with prolonged QTc values due to electrolyte disorders were excluded from the study.

Statistical Analysis

Statistical analysis of patient data was performed using SPSS (Statistical Package for Social Sciences) Windows 26.0 software. Kolmogorov-Smirnov test was applied to evaluate the suitability of the data for normal distribution. Normally distributed continuous variables are expressed as mean ± standard deviation (SD); Continuous variables that do not show normal distribution are presented as median and interquartile range (IQR). Categorical data are reported as frequencies (n) and percentages (%). In comparing the differences between groups, the independent-groups t-test was used for normally distributed data and Mann–Whitney U test was used for non-normally distributed data. The relationships between categorical variables were analyzed using the Pearson's chi-square test. The statistical significance level was set as $p<0.05$.

RESULTS

In our study, 22 patients (9 male %41,13 female %59) with non-sustained VT detected on 24-hour Rhythm Holter were included. The average age of the patients was 11,65±4,3 (min:2.5, max:17 years).

The number of beats of each episode ranged from 4 to 53 beats, and the average number of beats was 15,2±14. The rate of VT was 161,2±18,7 beats/min and ranged from 126 to 195 beats/min. The rate of VT was 153,3±4,6 in monomorphic VT group and it was 175,3±4,4 in polymorphic VT group; there was no statistically significant difference between them.

Heart rate before VT was 85,9±13,6 beats/min (range, 55 to 122 beats/min). In the monomorphic VT group it was 86,8±1,8 beats/min, and in the polymorphic VT group, the heart rate before VT was 84,4±7,6 beats/min. There was no significant difference between groups, and the majority of episodes were observed at a normal heart rate.

Monomorphic non-sustained ventricular tachycardia (VT) was detected in 14 of the 22 patients included in the study, and polymorphic non-sustained VT was observed in the remaining 8 patients. The average age of monomorphic and polymorphic VT patients was 11,5±1,1 and it was 11,9±1,7 for polymorphic VT patients.

The prematurity index was 0,98±0,2, in patients with polymorphic VT it was (0,75±0,03) significantly smaller than (1,1±0,03) in patients with monomorphic VT. Additionally, the number of beats (29,1±5,2) in patients with polymorphic VT was significantly higher than (7,2±1) in patients with monomorphic VT.

Polymorphic VT was detected in only 1 of 11 patients with normal echocardiography, whereas monomorphic VT was detected in 10 of these patients with a structurally normal heart. In other words, 10 of 11 patients with normal echocardiography had monomorphic VT. Four patients; 1 Operated ASD,1 operated DORV, 1 operated Fallot tetralogy

VARIABLES	TOTAL (n=22)	MONOMORPHIC VT (n=14)	POLYMORPHIC VT (n=8)	P value
Age	11,65±4,3	11,5±1,1	11,9±1,7	0,66
Male gender (n, %)	9, (%41)	6, (%42)	3, (%37)	0,8
Number of beats	15,2±14	7,2±1	29,1±5,2	<0,001
Heart rate before VT	85,9±13,6	86,8±1,8	84,4±7,6	0,76
Rate of VT	161,2±18,7	153,3±4,6	175,3±4,4	0,003
The coupling interval (msn)	665,6±151,4	728,7±37	555,3±37,6	0,008
QTc (msn)	439,2±28,1	425,4±6,5	463,5±5,1	0,004
Prematurity index (CI/RR)	0,98±0,2	1,1±0,03	0,75±0,03	<0,001
RR Interval(msn)	716,9±131,3	695,4±15,8	754,6±73	0,73
Symtom (n, %)	3	0	3, (%37)	0,014
Syncope	0	0	0	
Mortality	0	0	0	
Follow-up period (age)	3,3±1,8	2,8±0,4	4,2±0,7	0,11

VT: Ventricular tachycardia

and 1 patient with mitral valve prolapse had monomorphic VT. However, polymorphic VT was observed in all patients with cardiomyopathy (2 dilated cardiomyopathy, 2 hypertrophic cardiomyopathy, 2 non-compaction cardiomyopathy, 6 patients in total) and in 1 patient with a mass within the mitral papillary muscle. In summary, only one of the 8 patients with polymorphic VT in our study had a structurally normal heart.

Only 2 of the patients with non-sustained VT detected in Rhythm Holter had palpitations. One of these two patients had noncompaction cardiomyopathy and the other had dilated cardiomyopathy. The patient, who was followed up for a mass within the papillary muscle, could not describe any symptoms because he was young (2.5 years old), but he did complain of crying. The remaining patients were asymptomatic.

In our study, medical treatment was given to all patients with underlying structural heart disease for non-sustained ventricular tachycardia attacks, even if they were asymptomatic. Beta blockers are the first choice for medical treatment in our clinic. The most frequently used drugs in this group are propranolol and metoprolol. In our study, for treating 6 patients with cardiomyopathy; Only 1 patient with dilated cardiomyopathy was treated with metoprolol, and the other 5 patients were treated with propranolol. Propranolol was also used for the treatment of 1 patient with a mass within the mitral papillary muscle. No drug side effects were observed in patients who received medical treatment. Non-sustained VT detected by rhythm Holter in all asymptomatic patients without underlying heart disease was monitored clinically, and no drug treatment was given.There were no syncopes or deaths among the patients we followed.

DISCUSSION

Many researchers have found that unifocal ventricular extrasystoles seen in asymptomatic children with a structurally normal heart (4-6).

In a study conducted in children, sudden death, syncope, and ventricular tachycardia were not observed in patients with polymorphic PVCs and couplets and in those with a normal heart determined by echocardiography and cardiac catheterization during the 2.5-year follow-up period (6).

In an adult study by Yusuf et al., the relationship between heart rate in sinus rhythm and prematurity index and VT rate was examined. They demonstrated a significant inverse correlation between the prematurity index and ventricular arrhythmia rate. In this study, they also found that the incidence of couplets and triplets was higher in patients with ventricular tachycardia (75% and 50%, respectively) than in patients without ventricular tachycardia (43% and 25%), this was not statistically significant (7).

Infants with incessant or frequent paroxysmal ventricular tachycardia have a high risk of myocardial tumors (8, 9). In our study, one patient with a mass within the mitral papillary muscle had polymorphic non-sustainable VT episodes on 24-hour rhythm testing. This patient was under follow-up for 6 months, and after non-sustained VT episodes were detected, beta blocker treatment was started because of an underlying cardiac mass. In the literature, if arrhythmias are resistant to drug treatment in the presence of cardiac mass, surgical treatment is recommended. Our patient remained under medical monitoring because the arrhythmia was controlled with medication, and no increase in mass size was observed.

In many patients who are thought to have a structurally normal heart, if there is a life-threatening arrhythmia, an echo must be performed because sometimes the first clinical symptom in diseases such as cardiomyopathy or myocarditis may be arrhythmia (6, 10-12).

In almost all studies, patients with symptomatic arrhythmias had an underlying cause, whereas those with non-sustained, asymptomatic ventricular tachycardia often had normal hearts. It has been reported in the literature that cases with sudden death at long-term follow-up are patients with underlying cardiac pathology. In children, PVCs and VT occur mostly because of ventricular reentry and with underlying structural cardiac pathology (cardiomyopathies, cardiac mass, previous cardiac surgery), the presence of dilatation in the heart chambers or surgical scar due to the operation causes the arrhythmias to be resistant (5,10,11,13,14).It has also been observed that ventricular arrhythmias resolve spontaneously over time in some patients with structurally completely normal hearts (8).

All patients with symptomatic ventricular arrhythmia should be treated. The first choice of treatment in the literature is beta blockers (8).Studies show that non-sustained VTs seen in asymptomatic patients with normal hearts have a benign prognosis. For this reason, although the treatment options and exercise restriction issues are controversial, existing information does not remain valid (15, 16). The recommended follow-up method for symptomatic children with non-sustained ventricular tachycardia is ventricular couplets. Children with ventricular couplets and simple or multiform PVCs should have 24-hour Rhythm Holter and should be followed regularly by a pediatric cardiologist even if they have a structurally normal heart (17, 18). This is how we monitor ventricular couplets and non-sustained VTs at our clinic.

It is important to pay attention to the presenting symptoms and complexity of the arrhythmia when deciding on non-sustained VT and PVC management and treatment.

Cardiomyopathies, cardiac surgery, and heart tumors are also risk factors for VT. Because the heart is not normal in these situations, medical therapy or surgery for tumors may be necessary (4).

CONCLUSIONS

Patients with non-sustained VT detected in childhood should be evaluated by considering many factors. Each patient should be carefully evaluated with a detailed evaluation of the presence of underlying structural heart disease and ventricular tachycardia, and the treatment method and follow-up should be determined.

Ethics Committee Approval: This study was approved by the İstanbul Faculty of Medicine Clinical Research Ethics Committee (18/10/2024 - 20)

Informed Consent: Written consent was obtained from the participants.

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