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The Prognosis of Idiopathic Premature Ventricular Beats in Children with Structurally Normal Hearts

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What is already known on this topic?

- *In individuals without underlying heart disease, ventricular ectopy most commonly originates from the right ventricular outflow tract and typically shows a morphology of left bundle branch block.*[1–6]
- *Most pediatric patients with idiopathic PVBs remain asymptomatic.*[6–10]
- *In children with normal hearts, it is observed that idiopathic PVBs decrease significantly in follow-ups compared to the onset and have a good prognosis.*[2,4,6,7,10,11]

What this study adds on this topic?

- *This study showed that idiopathic PVBs in children with structurally normal hearts are mostly of right ventricular origin.*
- *However, contrary to the literature, almost half of these children present with symptoms.*
- *The frequency of PVBs, distribution of PVBs during sleep/wake periods, presence of complex PVBs, and ventricular origins of PVBs did not affect prognosis, and regression or complete recovery of PVBs occurred in two-thirds of these patients.*

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ABSTRACT

Objective: The objective of this study is to evaluate the prognosis of idiopathic premature ventricular beats (PVBs) in children.

Materials and Methods: We retrospectively evaluated 73 children (<18 years old) with idiopathic PVBs and structurally normal hearts. All patients were evaluated by 24-hour Holter electrocardiography (ECG) and echocardiography at the first admission and followed with a mean of 27 ± 7.6 months after diagnosis. Baseline Holter ECG and echocardiographic findings were compared to the last visit.

Results: The mean age of the patients was 11.1 ± 4.8 years, and half were symptomatic at initial examination. Baseline Holter showed complex beats in 35 cases, non-sustained ventricular tachycardia in 7 cases, and frequent PVBs in 19 cases. Complete recovery (CR) of PVBs was observed in 37 cases (50.7%) at a median of 15 (minimum: 5, maximum: 33) months after diagnosis. There were no significant differences in CR rates between patient groups with left bundle branch block (LBBB) vs. right bundle branch block (RBBB) morphology of PVBs, simple vs. complex PVBs, and daytime vs. nighttime dominance of PVBs ($P > .05$ for all parameters). The CR rate of PVBs was different among patients with infrequent, moderate, and frequent PVBs (62.8%, 36.4%, and 31.6%, respectively). Premature ventricular beats disappeared more often during follow-up in patients with infrequent PVBs ($P = .045$). However, the absolute decrease and disappearance rates of PVBs were similar across all groups (72.1%, 81.8%, and 89.5%, respectively; $P = .319$). The resolution rates of PVBs were not statistically different between the patient group who received pharmacological treatment and the group who followed up without treatment ($P = .070$). No myocardial dysfunction was observed in any patient during follow-up. No cases experienced major cardiac events.

Conclusion: Idiopathic PVBs usually regress in childhood regardless of frequency and complexity or receiving antiarrhythmic medication. The risk of ventricular dysfunction is low during childhood; however, they require careful evaluation and follow-up.

Keywords: Ventricular premature beats, structurally normal heart, children, 24-hour ambulatory Holter electrocardiography, prognosis

INTRODUCTION

Premature ventricular beats (PVBs) are a type of dysrhythmia that can originate from any point of ventricular myocardial tissue below the node of His. Premature ventricular beats are characterized by the early onset of an abnormal QRS complex, typically lasting 120 ms or longer. The corresponding T-wave is broad and oriented opposite to the main QRS deviation, and there is no preceding P-wave.[12,13] Idiopathic PVBs occur in 40% of healthy children on Holter monitoring.[1,14] These patients are mostly asymptomatic;[2,7–9] however, PVBs can cause palpitations, dizziness, and syncope.

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The most significant concern regarding PVBs is their potential to progress into malignant dysrhythmias and lead to sudden cardiac death.[10] Furthermore, reversible cardiomyopathy has been reported in cases of PVBs occurring at a frequency as low as 5%.[12] So, there is still concern about whether frequent PVBs in children are likely to cause left ventricular dysfunction as in adults.[15-18] In addition, PVBs detected before participation in sports activities cause concern in physicians due to the potential for malignant arrhythmia or death.

The prognosis of simple (isolated and uniform morphology) and infrequent ventricular beats is found to be good in most children with a completely normal heart.[1,2,6,7] The prognosis for children with frequent ventricular beats is not well defined, and the effectiveness of the drug therapy is not based on prospective studies.

In this study, we aimed to evaluate the electrocardiographic characteristics and outcomes of idiopathic PVBs in children with structurally normal hearts. We examined the effects of patients' demographic characteristics, PVBs origin, character, and frequency on prognosis. We also analyzed the disappearance rate of the ventricular beats in patients using antiarrhythmic drugs or not.

MATERIALS AND METHODS

This study was conducted between April 2017 and August 2020. We retrospectively evaluated patients who were admitted to our outpatient clinic and found to have rhythm irregularity during auscultation or PVBs on 12-lead surface electrocardiograms.

The Study Population was Selected Based on the Following Criteria Among These Patients (Figure 1)

1. Who was under 18 years old at the first evaluation
2. Who had normal echocardiographic findings
3. Who had more than 50 PVBs per day during 24-hour ambulatory Holter ECG monitoring.[12]
4. Who were followed up for more than 2 years in our hospital.

Exclusion Criterion

Patients who had a history of congenital cardiac abnormalities, genetic arrhythmias (long and short QT interval or atrioventricular block other than first degree in ECG), chronic disease, and chest deformity were excluded from this study. The patients receiving arrhythmogenic medication at baseline evaluation were also excluded. Lastly, the patients who didn't have adequate medical records were also excluded from the study (Figure 1).

Our study has been prepared in accordance with the Helsinki Declaration and approved by the Akdeniz University Faculty of Medicine Clinical Research Ethics Committee. (approval no: KAEK-276, date:08 April 2020)

Clinical and Laboratory Examinations at the Initial Examination and Follow-up

After taking a detailed anamnesis of patients and family history, physical examination, surface, and 24-hour Holter ambulatory electrocardiography (ECG), and conventional echocardiography were performed in all cases at the initial and follow-up examinations. The decision on the other tests (including treadmill exercise tests, genetic tests, or cardiac magnetic resonance imaging), the antiarrhythmic treatment, or catheter ablation procedures was made according to the Pediatrics Expert Consensus statement on the evaluation and management of ventricular arrhythmias in the child with a structurally normal heart published by the Pediatric and Congenital Electrophysiology Society and the Heart Rhythm Society.[12]

The Surface Electrocardiography Evaluations

GE Healthcare MAC 2000 (General Electric Company, USA, 2013) electrocardiography device was used for ECG recordings. During rest, in the supine position, 12-lead ECG recordings were taken at 25 mm/s velocity and 1 mV, 10 mm amplitude calibrations. We examined the superficial ECGs utilizing heart rate, P-wave morphology, PR interval, QRS and QTc duration, QRS axis, morphology, characters, and axes of PVBs. Ventricular origins of PVBs were identified based on surface electrocardiography. Premature ventricular beats with left bundle branch block (LBBB) were defined as originating from the right ventricle, and PVBs with right bundle branch block (RBBB) were defined as originating from the left ventricle.[12]

24-Hour Ambulatory Holter Electrocardiography

NorthEast Monitoring (Nemon-2009, Canada, Ontario) DR200 device and software program were used for 24-hour ambulatory Holter ECG monitoring. Evaluated parameters with 24-hour ambulatory Holter ECG are listed below:

- Average, lowest, and highest heart rate.
- Total number of PVBs in 24 hours.
- The ratio of the number of ventricular beats to the total number of beats.
- Morphologies of ventricular beats (uniform or multiform).
- Presence of couplets, bigeminy or trigeminy beats, or ventricular tachycardia (VT).
- The character of ventricular beats (simple/complex).
- The distribution of the frequency of PVBs during the day (sleep/wake periods) was examined.

Uniform, multiform ventricular beats, sustained or non-sustained VT, and couplets beats were defined according to PACES and HRS reports.[12] Multiform and/or couplet PVBs or the "R-on-T" phenomenon or VT (VT) were defined as complex PVBs.

Frequency of Ventricular Extra Beats

The frequency of ventricular extra beats was analyzed into 3 groups according to the rate of PVBs per day (PVBs number/total number of beats) in 24-hour ambulatory Holter electrocardiography evaluations.[2,6,7,12,13]

1. If the frequency of PVBs is equal to or less than 5% per day, they are described as infrequent ventricular extra beats.
2. If the frequency of PVBs is between 5% and 10% per day, they are described as moderate-frequency ventricular extra beats.
3. If the frequency of PVBs is equal to or more than 10% per day, they are described as frequent ventricular extra beats.

Follow-Up Evaluations

If the absolute difference between the frequency of PVBs in the first and last Holter evaluations was equal to or less than 10% of

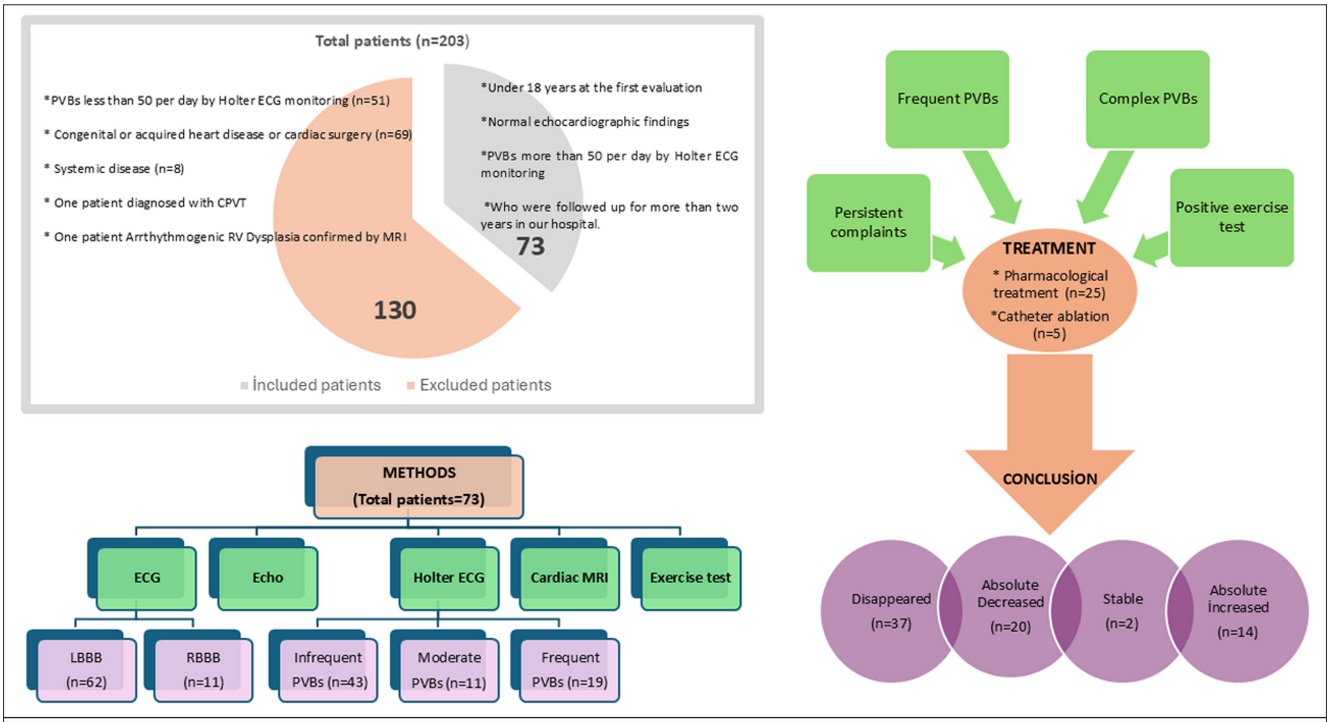

Figure 1. The selection of the study population based on the inclusion and exclusion criteria, method of study, treatment algorithm, and conclusions of the study was presented.

the first value, the frequency of PVBs was defined as stable. If this difference was more than 10% of the first value, we defined these patients as having a decrease or increase in the frequency of PVBs (according to the absolute increase or decrease). If the PVBs were less than 50 per day by 24-hour ambulatory Holter ECG monitoring at the last 2 examinations, it was accepted as a complete recovery of the PVBs.[18] If more than 50% of total ventricular beats were detected during the daytime, they were classified as daytime dominant, and if more than 50% were detected at night, they were classified as night dominant.[14,19]

Lastly, the patients who started any medical treatment or performed invasive catheter ablation at follow-up were determined, and changes in the frequency of premature beats were evaluated in terms of the prognosis of these patients.

Echocardiographic Examination

The left ventricular ejection fractions and fractional shortening ratio, and the left ventricular dimensions were measured in the parasternal long axis by using M-mode echocardiography.[20]

All measurements were made during the patient's electrocardiographic recordings in sinus beat. Philips Affinity 70G and Vivid 7 pro (General Electric Medical) echocardiography devices (4S or 3S probes) were used during the study period. Left ventricular systolic dysfunction was defined as an ejection fraction equal to or less than 57%. Left ventricular dilatation was defined as a left ventricular end-diastolic diameter z-score equal to or more than +2.

Statistical Analysis

The analyses were made with the IBM SPSS 23.0 package program (IBM Corp, Armonk, NY). Descriptive statistics were presented with n (%) or mean ± SD or minimum and maximum or median values. Pearson chi-square test and Fisher's exact test were used to analyze the relationships between categorical variables, and Bonferroni correction was made for pairwise comparisons. The Shapiro–Wilk test was used in the analysis of the assumption of normality. In the analysis of the difference between the measurement values of the 2 groups, the Mann–Whitney *U*-test was used when it did not comply with the normal distribution, and the Student's *t*-test was used when it complied with the normal distribution. The ANOVA test was used in the comparison of 3 or more groups when the assumption of normal distribution was provided, and the Dunnett T3 test was used when the homogeneity of variance was provided for pairwise comparisons and the Tukey HSD test was not provided. The Wilcoxon signed rank test and paired samples *t*-test were used to analyze the difference between the first and last measurements. *P*-values less than .05 were considered statistically significant.

RESULTS

According to inclusion criteria, 73 patients were evaluated in this study (Figure 1). The mean age of the patients was 11.1 ± 4.8 years (range: 0.9 to 17.8 years old) at the first admission, and the male/female ratio was 1.28. Thirty-three patients (45.2%) were asymptomatic, but 40 patients (54.8%) had cardiac complaints at the first admission. Among them, 18 cases (24.7%) had complaints of chest pain (Table 1).

Physical Examination Findings

Irregular rhythm was detected in 21 (28.8%) cases, and an innocent murmur was detected in 7 (9.6%) cases.

The surface ECGs showed that ventricular beats were of LBBB morphology in 62 cases (84.9%) and RBBB morphology in 11

Table 1. Characteristics of the Patients Included in the Study

Characteristics	n (%)
Mean age (years) (SD)	11.1 ± 4.8
Male	41 (56.2)
Mean follow-up duration (years)	27 ± 7.6
Symptoms	
Asymptomatic	33 (45.2)
Palpitation	8 (11.0)
Chest pain	18 (24.7)
Syncope	8 (11.0)
Others	6 (8.2)
PVB features	
Mean percentage	6.7 ± 8.2
Couplet	31 (42.5)
Bigemine	24 (32.9)
ns-VT	7 (9.6)
Simple	38 (52.1)
Complex	35 (47.9)
PVB morphology	
Monomorphic	61 (83.6)
Inferior axis	65 (89.0)
LBBB	62 (84.9)
RBBB	11 (15.1)
PVB frequency	
Infrequent (<5%)	43 (58.9)
Moderate (5-10%)	11 (15.1)
Frequent (>10%)	19 (26.0)
PVB frequency is higher during sleep/wake	
Awake dominant	54 (74.0)
Sleep dominant	19 (26.0)
Echocardiography findings	
PVB-induced cardiomyopathy	0 (0.0)
Left ventricle ejection	70.0 ± 3.2
Changes in percentage of PVB	
Disappearance of PVBs	37 (50.7)
Absolute decreased	20 (27.4)
Stable	2 (2.7)
Absolute increased	14 (19.2)
Medical therapy	25 (34.2)
Catheter ablation	5 (6.8)

Findings were expressed as number of cases (%), mean ± SD.LBBB, left bundle branch block; ns-VT, non-sustained ventricular tachycardia; PVBs, premature ventricular beats; RBBB, right bundle branch block.

cases (15.1%). Among the 62 patients with LBBB morphology, the ventricular beats had an inferior axis in 54 cases (87.1%) and a superior-oriented axis in 8 cases (12.9%). All patients with RBBB morphology of ventricular beats had an inferior axis of ventricular beats (Table 1).

24-Hour Ambulatory Holter Electrocardiography at the First Admission

Thirty-eight patients (52.1%) had simple PVBs and 35 patients (47.9%) had complex PVBs. Thirty-one patients (42.5%) had couplet ventricular beats, 12 patients (16.4%) had multiform morphology of ventricular beats, 24 patients (32.9%) had bigeminy ventricular beats, and 8 cases (11%) had trigeminy ventricular beats. Seven patients (9.6%) had non-sustained VT. Six of them (85.7%) were female, and only 1 (14.3%) was male (P = .039).

Forty-three patients (58.9%) had infrequent PVBs, 11 cases (15.1%) had moderate frequency PVBs, and 19 cases (26%) had frequent PVBs (Table 1).

Considering the percentage distribution of PVBs according to sleep/wake periods, 54 (74%) patients had more PVBs during the awake period, while 19 (26%) patients had a higher percentage of ventricular beats during sleep. Although symptoms were more frequently reported in patients with a higher percentage of PVBs during the awake period than in patients with a higher percentage of ventricular beats during sleep, the differences were not statistically significant (33/54 cases, 61.1% vs. 7/19 cases, 36.8%, P = .609).

Follow-up 24-Hour Holter Electrocardiography Findings

The mean follow-up period in our study group was 27 ± 7.6 months. The ratio of PVBs to total beats was 6.74 at admission and 2.88 at the last examination (P < .001). Premature ventricular beat load decreased and/or disappeared in 57 patients (78.1%) and increased in 14 patients (19.2%). Premature ventricular beat load did not change in 2 patients (2.7%). Full recovery was detected in 37 cases (50.7%) at the last Holter electrocardiography (Table 1). There were no significant differences in the disappearance rate of PVBs between the patient groups with LBBB morphology of PVBs (31/62 cases, 50%) and RBBB morphology of PVBs (6/11 cases, 54.5%) (P = .757). There were no significant differences in the disappearance rate of PVBs between the patient groups with nighttime-dominant PVBs (9/19 cases, 47.4%) and daytime-dominant PVBs (28/54 cases, 51.9%) (P = .737). Premature ventricular beats disappeared in 22 of 38 cases (57.9%) with simple form PVBs and 15 of 35 cases (42.9%) with complex form PVBs (P = .199). Complete recovery was observed in PVBs at the earliest in the first month and the longest in the 34th month. The mean (SD) and the median time for the disappearance of ventricular premature beats were 16.9 (SD = 7.4) and 15 (minimum: 5, maximum: 33) months, respectively.

The demographic, clinical, and electrocardiographic features of patients at baseline were not statistically different between the patient groups with an infrequent, moderate, and frequent rate of PVBs (Table 2).

The absolute decrease and disappearance rates of PVBs were similar in patients with infrequent, moderate, and frequent rates of ventricular beat loads (72.1%, 81.8%, and 89.5%, respectively, P = .319). The disappearance rates of PVBs were different among patients with infrequent, moderate, and frequent PVBs (62.8%, 36.4%, and 31.6%, respectively). Premature ventricular beats disappeared more often during follow-up in patients with infrequent PVBs (P = .045) (Table 2) (Figure 2).

Echocardiogram

The mean ejection fraction of our study patients at the first admission was 70.0% ± 3.2, while it was 69.8% ± 3.7 at the final admission. There was no significant change in the mean of the ejection fraction at the first and follow-up echocardiography of the study population (P = .359). There were no significant differences between the patient groups with infrequent,

Table 2. Demographic, Clinical, and Electrocardiographic Characteristics of the Patients According to the Frequency of PVBs in the First Holter Electrocardiography and Their Prognosis in the Follow-up were Compared

	Infrequent PVBs, n (%)	Moderate PVBs, n (%)	Frequent PVBs, n (%)	*P*
Characteristics				
Mean age (years) ± SD (minimum-maximum)	11.0 ± 4.4 (1.6-17.8)	8.6 ± 6.2 (0.9-16.8)	12.6 ± 4.4 (2.8-17.8)	0.090***
Male	23 (53.5)	8 (72.7)	10 (52.6)	0.485*
Symptomatic cases	27 (62.8)	3 (27.3)	10 (52.6)	0.105*
Multiform PVBs	7 (16.3)	1 (9.1)	4 (21.1)	0.823**
Couplet	17 (39.5)	3 (27.3)	11 (57.9)	0.219*
ns-VT	5 (11.6)	0 (0.0)	2 (18.2)	0.734**
LBBB morphology	34 (79.1)	10 (90.9)	18 (94.7)	0.276**
Changes in percentage of PVBs				
Decreased and disappeared of PVBs	31 (72.1)	9 (81.8)	17 (89.5)	0.319**
Disappearance of PVBs	27 (62.8)	4 (36.4)	6 (31.6)	0.045*
Absolute decreased	4 (9.3)	5 (45.5)	11 (57.9)	
Stable	1 (2.3)	0 (0.0)	1 (5.3)	
Absolute increased	11 (25.6)	2 (18.2)	1 (5.3)	0.178**
Echocardiography at the last examination				
Left ventricle ejection fraction (%), mean ± SD	69.8 ± 3.2	70.4 ± 3.6	70.3 ± 3.3	0.851***
Depressed left ventricular function	0 (0.0)	0 (0.0)	0 (0.0)	
Medical treatment	7 (16.3)	6 (54.5)	12 (63.2)	<0.001*
Catheter ablation	0 (0.0)	0 (0.0)	5 (26.3)	<0.001**

LBBB, left bundle branch block; ns-VT, non-sustained ventricular tachycardia; PVBs, premature ventricular beats. *Pearson chi-square test, **Fisher's exact test, ***ANOVA.

moderate, and frequent premature ventricular beat loads in terms of the mean ejection fraction of the left ventricle at the follow-up echocardiography (*P* = .851). In 7 patients with non-sustained VT, the mean ejection fraction of the left ventricle was 68.4% at the first admission and 68.3% in their last follow-up (*P* > .05).

Cardiac magnetic resonance imaging (CMRI) was performed in 9 cases. Among them, 2 patients had abnormal findings. A mild increase in trabeculation in the right ventricular wall was reported in one of these patients, and mild adiposity in the right ventricular myocardium in another patient.

Comparison of the Prognosis in Patient Groups Receiving Medical Treatment or Not

Pharmacological treatment was started in our clinic for patients who had frequent PVBs, showed complex PVB characteristics, had positive exercise test results, or had complaints. Pharmacological treatment was given to 25 patients (34.2%). We most commonly used beta blockers consisting of metoprolol

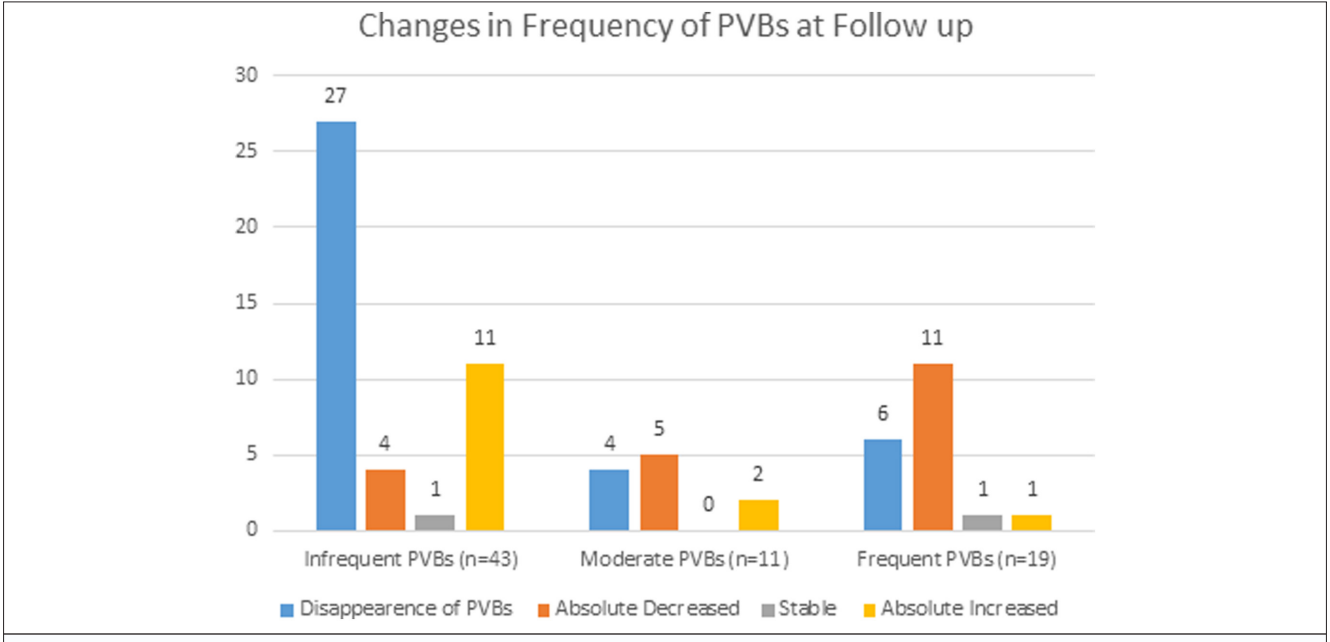

Figure 2. The column shows the changes in the frequency of premature ventricular beats from baseline to the follow-up.

Table 3. Comparison of the First and Follow-Up Holter Electrocardiography and Echocardiography Findings in the Patient Groups who were Given Antiarrhytmic Medication or Follow-Up Without Treatment

	Antiarrhythmic Medication, n (%)		
Characteristics	**Treated, n = 25**	**Untreated, n = 48**	***P***
Mean age ± SD (years)	9.5 ± 5.7	11.9 ± 4,1	.077***
Male	14 (56.0)	27 (56.2)	.984*
Symptomatic cases	16 (64.0)	24 (50.0)	.254*
Complex	16 (64.0)	19 (39.6)	**.048***
LBBB	22 (88.0)	40 (83.3)	.738**
Changes in percentage of PVBs n = 25 n = 48			
Decreased and disappeared	20 (80.0)	37 (77.1)	.775*
Disappeared	9 (36.0)	28 (58.3)	.070*
Absolute decreased	11 (44.0)	9 (18.8)	
Stable	1 (4.0)	1 (2.1)	
Absolute increased	4 (16.0)	10 (20.8)	.759**
Echocardiography at the last examination			
Left ventricle ejection fraction (%), mean ±SD	69.1 ± 3.6	70.5 ± 2.9	.079***
Catheter ablation	4 (16.0)	1 (2.1)	**.044****

Data were expressed as number of cases (%), mean ± SD. *Pearson chi-square test, **Fisher's exact test, ***Student's t-test. LBBB, left bundle branch block; PVBs, premature ventricular beats.

(6 patients) and propranolol (12 patients). Antiarrhythmic drugs consisting of sotalol (4 patients), amiodarone (2 patients), and verapamil (1 patient) were given to the other 7 patients. Monotherapy was given to all of them, and the duration of treatment varied between a minimum of 1 year and a maximum of 4 years. The changes in the frequency of PVBs in the follow-up were not statistically different between the patient group who received pharmacological treatment and follow-up without medical treatment ($P > .05$).(Table 3) (Figure 3). Due to insufficient response to pharmacotherapy, catheter ablation was performed in 5 (6.8%) patients with frequent PVBs. Success was achieved with the catheter ablation procedure in 4 patients (80%).

DISCUSSION

Our study showed that idiopathic PVBs in children with structurally normal hearts are mostly LBBB morphology. Almost half of the children presented with symptoms; however, regression or complete recovery of PVBs occurred in two-thirds of them.

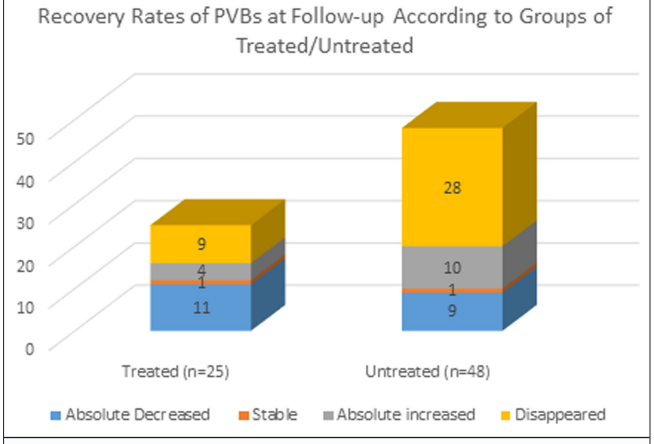

Figure 3. Recovery rates in premature ventricular beats between patients who received medical treatment and those who did not receive during follow-up of the patients.

No myocardial dysfunction was observed in any patient during follow-up (Table 1). The origin, complexity, and frequency of PVBs, as well as the use of medication, were not found to be predictive for prognosis in our study population.

Many studies indicate that most pediatric patients with PVBs and no structural cardiac anomalies are asymptomatic.[2,7,8,10] However, in our study, 54.8% of patients reported arrhythmia-related complaints upon their initial admission. This could be attributed to symptomatic PVB patients, with chronic complaints being more likely to seek care at tertiary care institutions at their own request or by clinician decision.

In 2000, Massin et al[14] showed that PVBs are affected by changes in heart rate according to the circadian rhythm. Like our study, almost two-thirds of their patients had more PVBs during the awake period. The suppression of sympathetic activity during sleep may cause a decrease in the heart rate and the frequency of PVBs.

The incidence of the couplet and VT has been reported as 11.5%-47% and 7.4%-20% of cases in children with a structurally normal heart, respectively.[2,3,15,21,22] In our study, couplet ventricular beats were observed in 42.5% of the patients and non-sustained VT was observed in 9.6% of them.

Paul et al[23] conducted a study on 22 pediatric patients with structurally normal hearts and frequent PVBs, with an average follow-up period of 2.5 years. They found that PVBs disappeared in 13 patients (59%), and no patients developed VT. Similarly, Ehara et al[24] followed 23 patients identified with couplet PVBs during a school screening program and found no cases of malignant arrhythmias (VT, VF). Tsuji et al[10] studied children with structurally normal hearts and frequent PVBs, reporting that PVBs completely disappeared in 28% of patients with isolated PVBs, 23% of those with couplet PVBs, and 37% of those with VT. In our study, consistent with these findings, we observed that PVBs completely disappeared in 1 of 2 patients with couplet PVBs and non-sustained VT after an average follow-up of 27 months. These findings suggest that patients with

couplet PVBs and non-sustained VT without underlying heart disease have a good prognosis.

Relationship Between the Frequency of Premature Ventricular Beats and Prognosis

Some studies show that no relationship is found between complete recovery in PVBs and the frequency of PVBs.[7,17,21] Uysal et al[2] reported a partial decrease in the frequency of PVBs in 42% of the patients and a complete recovery in 22%. They did not detect a significant difference in the decrease in PVBs frequency between the frequent and infrequent groups. In the study by Tosyalı et al,[6] frequent PVBs were observed in 21.6% of the patients. During follow-up, a partial reduction in PVBs frequency was observed in 31.7% of the patients, while complete recovery was seen in 16.7%.

It has been reported that frequent PVBs affect ventricular function in adults; however, there is no consensus about the relationship between frequent PVBs and ventricular dysfunction in childhood. Some pediatric studies showed that a very high frequency of PVBs did not have a significant effect on left ventricular functions.[4,7,11,25] Porcedda et al[4] have evaluated the prognosis of frequent PVBs (≥ 500/24 h) in asymptomatic children during screening programs before non-competitive sports participation. They implicated that myocardial dysfunction developed in only 1 case after a mean of 9.5 ± 5.5 years of follow-up, and the persistence rate of PVBs was found to be 43.7%. They reported that the total reduction in PVBs was not correlated with sex, age at diagnosis, or morphology of the ventricular beats. They found that the disappearance rates in patients with moderately frequent PVBs (500-15 000/day) were not different from patients with very frequent PVBs (15 000-30 000 PVBs per day) and patients with more than 30 000 PVBs per day (66.6%, 57%, and 54.5%, respectively). In contrast to these studies, Delise et al[26] evaluated athletes with frequent PVBs; 14.5% of their patients had a mild reduction in ejection fraction at follow-up. Bogun et al[27] found a decrease in left ventricular ejection fraction in 37% of patients with frequent PVBs, and an improvement in systolic function after catheter ablation was also reported.

Some studies also showed that the development of left ventricular dysfunction is associated with a higher burden of PVBs, the presence of sustained VT, and couplets.[5,15,27] They also reported that left ventricular dysfunction appears to be reversible if the burden of PVBs is decreased by medication or ablation. In our study, there was no significant change in the mean ejection fraction between the initial and follow-up echocardiograms of the entire study population. No myocardial dysfunction was observed in any patient during follow-up. There were no significant differences between our patient groups with infrequent, moderate, and frequent premature ventricular beat loads in terms of the mean ejection fraction of the left ventricle at the follow-up echocardiography (P = .851). The mean ejection fraction of the left ventricle in our patients with non-sustained VT at the first admission was similar to those in their last follow-up.

Treatment

Up to two-thirds of pediatric patients with PVBs are given pharmacological treatment at follow-up;[6,10,28] however, the effectiveness of drug therapy is not based on prospective studies. In a retrospective study of 163 children with structurally normal hearts, no significant differences were found in terms of reduction or disappearance of PVBs between patients who received pharmacological treatment and those who did not after at least 2 years of follow-up.[10]

Uysal et al[2] reported that the complete disappearance of PVBs was seen in 25% of patients who received pharmacological treatment and 20.8% of patients who were followed up without treatment. In this study, cardiomyopathy did not develop in any of the patients during the follow-up period. Likewise, no increase in the frequency of VT was observed in Holter examinations, and cardiac death was not observed in any patient. Akihito Tsuji[10] and Bertels et al[15] reported that the efficacy of antiarrhythmic drug therapy on frequent PVBs or asymptomatic VT in children is very limited.

In our study, about one-third of the patients with moderate or frequent ventricular beats received pharmacological treatment. Like previous studies,[2,10,15] we didn't find any statistically significant difference in terms of the complete recovery rate of PVBs between the groups receiving antiarrhythmic drugs or not. Premature ventricular beats disappeared completely without catheter ablation in 3 (42.8%) of seven patients with VT, one with pharmacological treatment and the other two spontaneously.

Limitations of the Study

Firstly, this study was retrospective and reflected single-center experiences and consisted of a small-size study population. The criteria for defining the origin of PVBs in surface electrocardiograms were based on adult studies. There was a possibility that the duration of the follow-up period in our study was not sufficiently long to detect left ventricular impairment in patient subgroups with frequent PVBs. Lastly, due to the small number of patients, it could not be evaluated whether there was a difference in the effectiveness of the different drugs. We thought that if the efficacy of antiarrhythmic drugs were to be examined in patient groups with left ventricular dysfunction or severe malignant arrhythmias, their effects on prognosis could be seen.

CONCLUSION

This study showed that regression or complete recovery of the ventricular ectopic beats occurred in two-thirds of the children with idiopathic PVBs and structurally normal hearts. Our results indicate a favorable prognosis for patients with PVBs, including those with frequent occurrences and non-sustained VT. However, it is not known exactly which patients will develop cardiomyopathy, so echocardiographic examinations should be performed during follow-up. Drug therapy may provide symptomatic improvement but does not affect prognosis. Catheter ablation may yield successful outcomes in suitable cases. Overall, the prognosis of PVBs in children with structurally normal hearts is favorable, which should reassure patients' families.

Availability of Data and Materials: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: This study was prepared per the Declaration of Helsinki and was approved by the Akdeniz University Medical Faculty Clinical Research Ethics Committee (approval no: KAEK-276, date: 08 April 2020).

Informed Consent: Verbal and written informed consent was obtained from the patients' families who agreed to take part in the study.

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