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Evaluation of patients undergoing 24-hour rhythm Holter monitoring in the pediatric cardiology unit

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Abstract

Aim: This study aims to determine the value of 24-hour Rhythm Holter monitoring (HM) in diagnosing and treating pediatric patients. Somebody reviewed our clinic's indications and results of 24-hour rhythm Holter monitoring.

Materials and Methods: The files of 1670 patients who applied to our clinic between January 1, 2015 and December 31, 2022, were scanned retrospectively. Somebody retrospectively evaluated and recorded age, gender, reason for admission, presence of cardiac disease, presence of cardiac disease in the family, treatment histories, family consanguineous marriages, Electrocardiography (ECG) findings, Echocardiography (ECHO) findings, and HM findings were from the hospital computer archive files.

Results: Found to be expected in 1,005 (60.2%) of the patients who underwent Holter monitoring (HM). Detected tachyarrhythmia in 408 (24.4%) patients, bradyarrhythmia in 85 (5.1%) patients, preexcitation syndrome in 73 (4.4%) patients, right bundle branch block in 27 (1.6%) patients, atrial-derived arrhythmia in 27 (1.6%) patients, genetic-related arrhythmia in 12 (0.7%) patients, pace rhythm in 12 (0.7%) patients, and other different Holter findings in 21 (1.3%) patients.

Conclusion: Since arrhythmic symptoms often occur intermittently in childhood, detecting them at presentation may not be possible. A missed ECG taken at rest provides information for a short period of cardiac rhythm and many arrhythmias, so the 24-hour Holter method (HM) is helpful for diagnosis. Our study has supported that HM is used increasingly frequently and is beneficial as an easy-to-apply, noninvasive method in diagnosing arrhythmia and in monitoring and treatment planning of cases with arrhythmia.

Introduction

Rhythm Holter Monitoring (HM), or Ambulatory Electrocardiographic Monitoring, is a 24-hour recording of the heart's electrical activity. Holter monitoring (HM) is a diagnostic tool used to record the rate and rhythm of the heart. They noted irregularities such as tachycardia, bradycardia, and abnormal heart rhythms. Because somebody cannot always detect many irregularities in heart rate or rhythm, they may miss a standard electrocardiogram (ECG). By continuously recording a child's heart rate and rhythm throughout the day, 24 hours a day, there is a better chance of detecting abnormalities [1]. Holter monitoring (HM) is a standard test performed in the clinical practice of pediatric cardiology. Nowadays, the number of children with HM indication is increasing. The most common indications in this patient group include chest pain, palpitations, syncope, presyncope, and heart diseases before and after cardiac surgery, cardiomyopathies, evaluation of antiarrhythmic treatment, and atrioventricular block [2].

Arrhythmia is a challenging finding frequently encountered by pediatric cardiologists. Complicating factors include pathological findings often occurring together with symptoms and that symptoms disappear in most patients by the time of hospital admission. Baseline ECG is insufficient to detect pathology and usually shows normal findings. The typical findings observed in the first evaluation should be clear to the physician, and further examinations should perform carefully, considering that the patient may be experiencing an arrhythmia [3].

Effective identification of potential cardiac arrhythmias in symptomatic children is difficult due to the infrequency, short duration, and variability of subjective complaints. However, the fact that somebody can capture short symp-

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tomatic attacks of conduction system disorders with HM during the 24-hour recording period is related to the frequent enough occurrence of arrhythmias. Despite its wide application area in adult patients, studies in the pediatric age group are limited [4].

The present study aims to determine the value of Holter monitoring (HM) in diagnosing and treating pediatric patients and reviews its indications.

Materials and Methods

In the present study, a total of 2,823 HM examinations of 1741 patients who underwent 24-hour HM between January 1, 2015, and December 31, 2022, at İnönü University Turgut Özal Faculty of Medicine, Department of Child Health and Diseases, Department of Pediatric Cardiology, were evaluated. Seventy-one patients were excluded from the study because they could not access their records. As a result, they have included a patient group that evaluated 2769 HM records of 1670 patients in the present study. The present study is a retrospective, cross-sectional, descriptive observational study. Age, gender, reason for admission, retrospectively were evaluated presence of cardiac disease for presence of cardiac disease in the family, treatment histories, family consanguineous marriages, ECG findings, ECHO findings, and Holter findings and recorded from the hospital computer archive files. The groups were divided patients into groups of 0-1 year old, 2-5 years old, 6-12 years old, and 13-18 years old.

They have used The Spacelabs LC-12 Lifecard CF (Hertford, UK) device as HM for cardiac rhythm and heart rate variability examination. Data were analyzed using the Spacelabs application provided by the company, which is compatible with the device. The same pediatric cardiologists performed and reported Holter examinations.

Performed data were analyzed using the SPSS (Statistical Package for Social Sciences for Windows) 8.0 package program. Displayed data obtained by shown measurement as the arithmetic mean and standard deviation (arithmetic mean±SD), and data received by shown counting as numbers (%) and stated as a proportional quantity (% xx, y).

The present study is a retrospective, observational study aimed at determining prevalence. Since it was a retrospective study and the data obtained were not confidential, we did not obtain informed consent from the patients or their families.

Results

In the present study, each patient underwent HM at least once, and some underwent HM at most 50 times. Patients were administered HM for 24 or 72 hours.

While HM was performed once in 993 patients, HM was performed twice in 353 patients, three times in 125 patients, and more than three times in 199 patients.

Of the patients, 870 were male (52.1%) and 800 were female (47.9%). When we look at the age groups of the patients, there are 49 patients (2.9%) between the ages of 0-1, 120 patients (7.2%) between the ages of 2-5, 671 patients (40.2%) between the ages of 6-12 and 830 patients (830 patients (40.2%) between the ages of 13-18). It was determined as 49.7).

According to the complaint of 1670 patients who applied to the clinic with a symptom and complaint, 688 patients (41.2%) had palpitations, 370 patients (22.2%) had chest pain, 265 patients (15.9%) had palpitations+chest pain, 133 patients (8%) had syncope+presyncope (Table 1).

Table 1. Distribution of patients with complaints.

Complaints	Number of patients (n)	Percentage of patients (%)
Palpitations	688	41.2
Chest pain	370	22.2
Palpitations + Chest pain	265	15.9
Syncope + Presyncope	133	8
Other	214	12.7
Total	1670	100

Table 2. Distribution of patients' treatment needs.

Need for treatment	Number of patients (n)	Percentage of patients (%)
Not requiring treatment	1285	76.9
Treatment required	385	23.1
Total	1670	100

While 1285 (76.9%) of the patients who applied to our clinic did not need treatment, 385 (23.1%) did need treatment (Table 2).

Of the patients followed up with HM, 1005 (60.2%) were evaluated as usual, observed tachyarrhythmia in 408 (24.4%) patients, bradyarrhythmia in 85 (5.1%) patients, preexcitation syndrome in 73 (4.4%) patients, complete right bundle branch block secondary to previous congenital heart disease operation in 27 (1.6%) patients, atrial-derived arrhythmia in 27 (1.6%) patients, channelopathy in 12 (0.7%) patients, pacemaker rhythm in 12 (0.7%) patients, and other different Holter findings detected in 1.3%) patients (Table 3).

Table 3. Distribution of patients' HM findings.

HM findings	Number of patients (n)	Percentage of patients (%)
Normal	1005	60.2
Tachyarrhythmias	408	24.4
Bradyarrhythmias	85	5.1
Preexcitation syndrome	73	4.4
Right bundle branch block	27	1.6
Atrial-derived arrhythmias	27	1.6
Genetic arrhythmias	12	0.7
Pacemaker rhythm	12	0.7
Other*	21	1.3
Total	1670	100

*: Nodal rhythm, sinoatrial exit block, nodal escape beat, idioventricular rhythm, AIVR (accelerated idioventricular rhythm).

Of 85 patients with HM bradyarrhythmia, Mobitz Type 1

Block in 43 (50.6%), 1st AV block in 31 (36.5%), AV complete block in 5 (5.9%), 1 (1.2%) Mobitz Type 2 Block and other pathologies detected in 5 (5.9%) patients (Table 4).

Table 4. Distribution of patients with bradyarrhythmia in HM.

Bradyarrhythmia distribution	Number of patients (n)	Percentage of patients (%)
Mobitz Type 1 Block	43	50.6
1. AV block	31	36.5
Mobitz Tip 2 Block	1	1.2
AV complete Block	5	5.9
Other*	5	5.9
Total	85	100

*Sinus pause, Sick sinus syndrome.

Of 408 patients with tachyarrhythmia detected in Holter monitoring (HM), VES in 177 (43.4%), SVT in 113 (27.7%), SVE in 79 (19.4%), SVE+VES in 20 (4.9%), SVE+VES in 13 (3.2%) had VT and 6 (1.5%) had AF (Table 5).

Table 5. Distribution of patients with tachyarrhythmia in Holter monitoring (HM).

Tachyarrhythmia distribution	Number of patients (n)	Percentage of patients (%)
Ventricular Extrasystole (VES)	177	43.4
Supraventricular Tachycardia (SVT)	113	27.7
Supraventricular Extrasystole (SVE)	79	19.4
SVE + VES	20	4.9
Ventricular Tachycardia (VT)	13	3.2
Atrial Flutter (AF)	6	1.5
Total	408	100

Table 6. Distribution of applied treatments.

Applied Treatment	Number of patients (n)	Percentage of patients (%)
Atenolol	58	35.4
Propranolol	22	13.4
Metoprolol	10	6.1
Sotalol	9	5.5
Sotalol + Flecainide	9	5.5
Propranalol + Flecainide	9	5.5
Triple antiarrhythmic	8	4.9
Pacemaker	5	3.1
Digoksin	4	2.4
Flecainide	4	2.4
Propafenone + Propranolol	3	1.8
Propafenone	2	1.2
Amiodarone	1	0.6
Those whose medication stopped	20	12.2
Total	164	100

The distribution of treatments shown applied to our clinic in the table, with 58 (35.4%) receiving Atenolol, 22 (13.4%) receiving Propranolol, and 10 (6.1%) receiving metoprolol. While 5 of the patients using triple antiarrhythmics received digoxin+flecainide+metoprolol, 3 patients received digoxin+flecainide+sotalol (Table 6) .

Discussion

Holter monitoring (HM) is a practical, economical, and noninvasive method that is still widely used despite alternative diagnostic tools/methods developed with the thought that they are inadequate in evaluating heart rate changes [1,2]. Holter monitoring (HM) is the most specific and sensitive diagnostic tool in diagnosing and monitoring arrhythmias [3]. HM maintains its reliability in the diagnosis, treatment, and follow-up of arrhythmias from the day it was first discovered [5,6]. The clinical indications of HM are different in childhood and adulthood. The most typical indication in both groups is the investigation of symptoms such as palpitations, chest pain, and syncope [4,7,8]. Within the American Heart Association (AHA), class 1 HM indications in patients with symptoms include syncope, presyncope, dizziness attacks of unknown cause, and unexplained, recurrent palpitation attacks [9,10].

The most common symptom of significant cardiac arrhythmias and admission to pediatric cardiology clinics is palpitations [11,12]. The indication for Holter monitoring (HM) in 31-43% of patients is palpitations. Hegazy et al. [6] reported that palpitations were the most common indication for HM in their study, including 1319 pediatric patients. Present study, by examining additional complaints suggestive of cardiac arrhythmia, ECG and HM results of pediatric patients who applied to the clinic with palpitations, chest pain, and other symptoms, the type and distribution of arrhythmias, the place and importance of HM, which is a noninvasive method, in monitoring and planning treatment were evaluated.

The present study group found the rate of children with arrhythmia in HM records to be (39.8%). If the symptom occurs daily, the probability of detecting arrhythmia with HM is high. In rare arrhythmias, HM may be insufficient, and therefore, different diagnostic methods such as trans telephonic ECG, “event recorder," or electrophysiological study are needed [12].

The symptoms most commonly caused by temporary arrhythmias are syncope, presyncope, dizziness, and palpitations [11,13]. However, neurological symptoms such as shortness of breath, chest pain, weakness, sweating, transient ischemic attack, and stroke are less associated with arrhythmia in children. In the present study, the most common complaints reported in 402 patients who underwent Holter analysis were chest pain (33.6%), palpitations (22.9%), and syncope (7%) [12]. In the present study, at the time of admission, 41.2% (n=601) of the patients had isolated palpitations, 22.2% (n=324) had chest pain, 15.9% (n=231) had palpitations + chest pain, % 8 of them (n=116) had syncope + presyncope and 12.7% (n=185) had different other symptoms.

When we examined our patient files, we determined that 17.4% of the patients had a history of drug use at an external center or in our hospital before HM, and the most

frequently used drug among these drugs was beta blockers (56.5%). The other most commonly used drugs were CNS stimulants (5.8%) and antidepressants (4.1%).

In the present study, the SVT rate was 7.7% on ECG and 6.7% on HM. It is difficult to determine the frequency of supraventricular tachycardia attacks because they usually last short and end before an ECG recording can be obtained. The incidence of SVT in children varies between 1/250 and 1/25000. Those that occur through accessory pathways are common in childhood, while other types increase with age. In 50-60% of patients, SVT attacks occur within the first year of life.

Examining the cardiac rhythm in Holter monitoring (HM, SVT, VT, XXXiter bradycardia, sick liter syndrome, and other serious arrhythmias can be demonstrated. Seen arrhythmia can occur in 17-48% of healthy children [8]. In the present study, we found 39.8% of arrhythmia.

The present study investigated the frequency and distribution of arrhythmia in 1670 children who underwent HM. Reported in the literature that detected arrhythmia in 10.6-61% of HM records in children [14,15,16,17,18]. In our study, in order of frequency, VES (10.6%), SVT (6.7%), SVE (4.7%), Preexcitation syndrome (4.4%), Mobitz type 1 block (2.6%), 1. Degree AV block (1.9%), correct bundle branch block pattern (1.6%), atrial arrhythmias (1.6%).

In the present study, the most frequently detected arrhythmias with HM were VES (10.6%) and SVT (6.7%). Similar to the present study, Güven et al. [8], HM was most frequently associated with VES (25%), and Kılıç et al. [12] also found VES to be the most common (80%).

AV block is an uncommon conduction disorder that accounts for less than 2% of primary arrhythmias seen in childhood [19]. AV block in children usually occurs after cardiac surgery, but high-grade AV block seen in a healthy child is a condition that requires an urgent treatment approach [20]. It reported in the literature that congenital complete AV block in 1/15000-20000 live births [21]. The present study detected AV conduction disorder in children in 80 (4.8%) patients. At the same time, the most common mobile type 1 block (2.6%), first-degree AV block, was seen at 1.9%.

In the present study conducted in Switzerland, the frequency of spontaneous VT in the pediatric age group was 1.1/100000 children. We detected an underlying structural heart disease in 52% of children with ventricular tachycardia. In the present study investigating arrhythmia frequency by performing an exercise stress test in children, VT was 0.5% [22]. In the present study, the frequency of VT was 2.4%, while patients with VT constituted 0.4% of all patients with arrhythmia. Present research conducted in our country showed that the incidence of VT in children was 0.4%, and 50% of were accompanied these patients by structural heart disease [23]. In the present study, an incidence of 0.8% found VT. In the present study, the frequency of VT was 2.4%, while patients with VT constituted 0.4% of all patients with arrhythmia.

Present HM screening showed that patients needing treatment constituted 23.1%. Of these, the rate of patients receiving only pharmacological treatment was 42.5%, and the rate of patients receiving only ablation was 36.3%. In comparison, 21% of the patients received pharmacological and ablation treatments.

In the present study, beta-blockers were the most commonly used pharmacological agents in treating arrhythmia (54.9%), and atenolol was the most frequently used (35.4%). While 9.8% of patients used dual antiarrhythmic agents, 3.1% used triple antiarrhythmic agents. In addition, we planned medication discontinuation for 5.1% of the patients.

Conclusion

Since arrhythmic symptoms often occur intermittently in childhood, detecting them at presentation may not be possible. Electrocardiography taken at rest provides information for a short period of cardiac rhythm and can miss by many arrhythmias. Therefore, the Holter method is helpful for diagnosis. Thought that Holter monitoring (HM) should be used, even if asymptomatically, in patients with suspected arrhythmia and especially organic cardiac lesions or postoperative cases, as it has no complications and is a noninvasive technique based on electrophysiological studies. For this reason, the present research has supported the use of HM increasingly frequently, which is beneficial as a noninvasive method that is easy to apply in diagnosing arrhythmia and in the monitoring and treatment planning of cases with arrhythmia. The present study will attract great attention as it is one of the most comprehensive studies in the domestic literature and one with the most significant number of patients. Thanks to such studies and broad participation, handy databases will create in the world literature.

Ethical approval

They approved the study by the İnönü University Faculty of Medicine Scientific Research Evaluation Board with the decision numbered 2022/2542 in the 03th meeting session dated 08/02/2022.

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