Demographic characteristics, clinical findings, electrocardiographic changes and outcome in children admitted with diagnosis of supraventricular tachycardia

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Abstract
Background: Supraventricular tachycardia (SVT) is the most common symptomatic rhythm disorder in children with a prevalence of 1 in 250 to 1 in 1000 in healthy children. This study was conducted to determine demographic characteristics, clinical findings, electrocardiographic changes and outcome in hospitalized children diagnosed with SVT.
Materials and methods: This descriptive-cross-sectional study was conducted in Shahid Motahari Hospital of Urmia. In this study, the files of all patients hospitalized in the pediatric and neonatal departments of Shahid Motahari Hospital in Urmia from the beginning of 2008 to the end of 2020 with the diagnosis of supraventricular tachycardia were evaluated in terms of the demographic characteristics of the patients, clinical symptoms and electrocardiographic changes. Also, during a phone call with the parents of the discharged cases, the long-term outcome of the patients was measured.
Results: 56 hospitalized children diagnosed with SVT were examined in this study. In total, 60.7% were boys and 67.9% were under 2 years old. The most common hospitalization season was spring and they were hospitalized for an average of 6.64 days. In total, 10.7% died, 8.17% had spontaneous recovery, 4.46% experienced recovery with medication, and 25% needed electrophysiologic study (EPS). The most common clinical complaint was heart palpitations.
Conclusion: The results of the present study are in most cases consistent with other studies in different parts of the world. Spring has been proposed as a common season in the occurrence of arrhythmias in line with other studies. Palpitation is the most common clinical finding of patients in most age groups. Also, sweating in infants has been a common finding.

Keywords: Supraventricular tachycardia, outcome, demographic, clinical, children

Introduction

Cardiac arrhythmias are classified into two categories: benign and non-benign. Benign arrhythmias include sinus arrhythmia, premature atrial contractions (PACs) and premature ventricular contractions (PVCs). Benign arrhythmia means that there is nothing clinically serious and no additional treatment is needed. In addition, no follow-up is necessary for benign arrhythmia, because the prognosis is so good that this condition will practically never be associated with or develop into any health problems. Symptomatic non-benign arrhythmias include supraventricular tachycardia (SVT), atrial sinus node dysfunction, atrial conduction system disorders, ventricular tachycardia, long QT syndrome, ventricular fibrillation, and also rhythm disorders caused by electrical disturbances [1]. Supraventricular tachycardia is the most common symptomatic rhythm disorder in children with a prevalence of 1 in 250 to 1 in 1000 in healthy children. It mostly occurs as recurrent heart palpitations in children and rarely can be life-threatening [2].
Supraventricular tachycardia is defined as any tachycardia involving at least one supraventricular structure above the bifurcation of the His bundle, including the atrial myocardium, atrial node, proximal His bundle, coronary sinus, pulmonary veins, vena cava, or atrioventricular junction [3].

Although SVT is caused by different pathological mechanisms, it finally appears in all cases as tachycardia with a narrow QRS complex in the ECG. The origin of tachyarrhythmia is from the upper parts of the Hiss bundle in the heart. The three main mechanisms of supraventricular tachycardia include atrioventricular reentrant tachycardia, AV-nodal reentrant tachycardia and atrial tachycardia [2].

Atrioventricular reentrant tachycardia (AVRT) is the most common form of supraventricular tachycardia that occurs mostly in infants and is more common in boys. In AVRT, tachycardia occurs due to the presence of a communication channel between atria and ventricles, and it mostly has a genetic origin. These secondary communication ways exist in the fetal period and usually disappear after the 20th week. In case of lack of analysis in the fetal period, later in the infancy period, they appear in the form of supraventricular tachycardia. A common form of AVRT is the Wolf-Parkinson-White syndrome, in which the sinus rhythm of the delta waves and the widening of the QRS complex are seen in the ECG [1].

Another common form of supraventricular tachycardia is AVRT. This form is more common in older age and in girls. In AVRT, the pathology is in the atrioventricular node itself and due to the existence of physiological disorders in the cells of the atrioventricular node, it causes the phenomenon of re-entry and thereby causes SVT [4]. Atrial tachycardia is another form of supraventricular tachycardia and is less common than the other two types. In this form, tachycardia occurs due to the presence of fetal cells with the characteristics of abnormal automaticity in the atria [5].

The clinical symptoms of supraventricular tachycardia are different in different ages. In infants, most of the attacks start at the age of less than 6 months and appear in the form of restlessness, paleness, shortness of breath, lack of feeding and sweating, and if there is a delay in treatment, it can cause heart failure in the infant. In older children and adolescents, it also manifests as heart palpitations, chest pain, and rarely syncope [6].

The optional diagnostic procedure in SVT attacks is to take a standard twelve-lead ECG [1]. Characteristics of SVT in ECG are tachycardia (heart rate above 220-230 in infants and above 160 in children and adolescents) with a narrow QRS complex. Other symptoms include no change in heart rate with breathing and changes in sympathetic tone. Also, the P wave either does not exist or is negative in lead II [7]. The choice drug for the treatment of SVT in the acute stage is adenosine, which is injected intravenously. Due to the short half-life (less than 10 seconds) of adenosine, the injection of adenosine should be done quickly, and then immediately flush with normal saline. In cases where the patient is in a state of shock and does not respond to adenosine, in this case DC shock is given by cardioversion method. The first dose is 0.5-1 J per kilogram, and in the second stage, 2 J is given per kilogram [8].

Due to the high prevalence of supraventricular arrhythmias among all types of arrhythmias and the need for their accurate recognition and timely treatment, and on the other hand, the lack of similar studies in West Azerbaijan province, we decided to conduct a study in the children's referral center of the province to determine the demographic characteristics, clinical findings, electrocardiographic changes and outcomes in children hospitalized with a diagnosis of supraventricular tachycardia.

Methods and materials

This descriptive-cross-sectional study was conducted to determine clinical findings, demographic characteristics, electrocardiographic changes and outcome in children hospitalized with a diagnosis of supraventricular tachycardia in Shahid Motahari Hospital of Urmia from 2008 to the end of 2020. In this study, after approval in the ethics committee of Urmia University of Medical Sciences (IR.UMSU.REC 1400.269), the files of all patients hospitalized in the pediatric and neonatal departments was studied. The inclusion criteria were hospitalization for at least one day and age under 15 years. Children with incomplete information included in the file were excluded from the study.

Required information, including demographic characteristics (age, sex, hospitalization time), clinical findings like palpitation and ECG changes (heart rate, presence of delta wave, presence of a positive P wave in lead II) was extracted by the researcher from the patient files in the hospital archive and recorded in the prepared checklist. The patients were divided into 6 groups according to the age group, respectively, newborn (first 28 days), infancy (28 days to 2 years old), toddler (2 to 4 years old), preschool child (4 to 6 years old), school child (7 to 11 years old) and adolescent (12 to 15 years old). Interpretation of patients' ECG was done by a pediatric cardiologist collaborating in the project. The target changes in ECG include tachycardia, narrow QRS complex, absence of P wave, negativity of P wave in lead II and changes in PR interval size. Also, the final outcome of the patients was based on the duration of hospitalization, information obtained from EPS and hospital outcome (discharge/death) has been measured. Also, the long-term outcome of the patients was measured during the telephone call with the discharged cases.

Statistical analysis

The data were analyzed using SPSS version 21 software. In this regard, to show the results regarding quantitative variables, the central and dispersion indices (mean and standard deviation), and for qualitative variables, frequency and percentage were calculated. Also, statistical tables and graphs have been used to display the data.

Results

Out of 93 cases provided by medical records, 12 cases were repeated, 4 cases were over 15 years old, 10 cases had secondary cardiac diagnosis other than SVT and 8 cases had incomplete information in the file. Also, 3 cases were not found in the archive. Finally, 56 cases were subjected to the final analysis. According to the information shown in figure 1, 34 cases (60.7%) of all children were boys and 22 cases (39.3%) were girls. 22 cases (39.3%) were infants under 28 days old, 16 cases (28.6%) were infants, 12 cases (21.4%) were toddlers, 2 cases (3.6%) were school children, and 4 cases (1.7 %) were teenagers. Seventy-two percent of the babies under 28 days were boys. Besides, there were no hospitalized cases in both sexes in the teenage years (12-15 years) and there were 4 girls in the school age group (7-11 years).

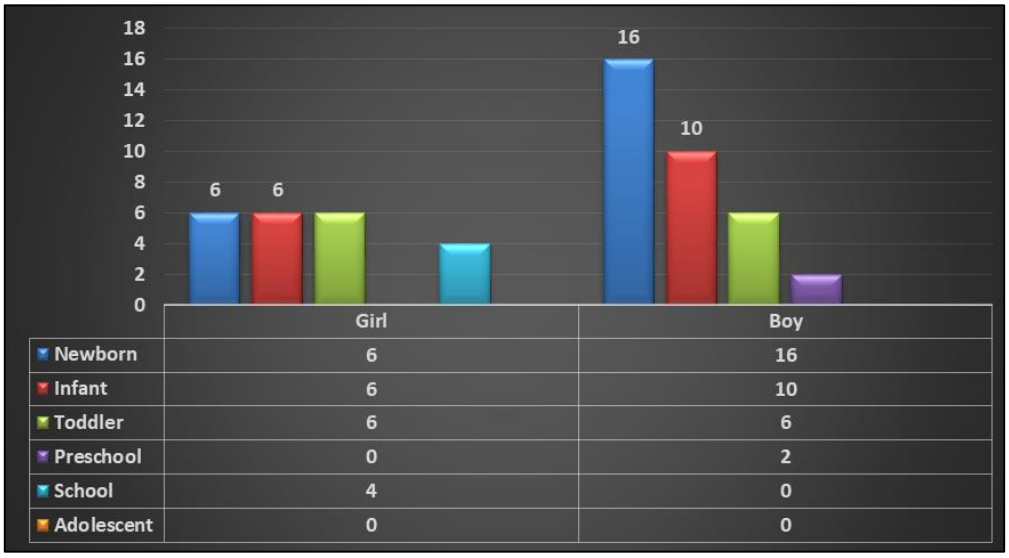

Fig 1: Age group distribution based on gender of children hospitalized with SVT

Spring with 20 cases (35.7%) was the most common season of hospitalization in the hospital and other seasons were equally (12 cases each) not different from each other. On average, children were hospitalized in hospital wards for 6.64 (1-42) days. In 44 cases (78.6 %) of all the investigated patients, there was no previous history of cardiac or non-cardiac disease, in 6 cases (10.7 %) there was a history of cardiac disease and in 6 cases (10.7 %) there was a history of non-cardiac disease. Out of 6 cases of heart disease, 4 cases were PDA, 1 case was PSVT and 1 case was ASD. Also, out of 6 cases with a history of non-cardiac disease, 4 cases had neonatal pathological jaundice, 1 case had bronchitis that led to hospitalization, and 1 case had a history of epilepsy. In echocardiography findings, 52 cases (92.8%) were normal without pathological findings, PDA was recorded in 2 cases, ASD in 1 case and Small VSD in 1 case. The results of the EKG examination of the patients by the pediatric cardiologist are presented in Table 1. Commonly, QRS complex was narrow in 96.4%, P wave was absent in 39.3%, and long RP was present in 28.6%. WPW pattern was recorded in only 8 cases (14.3%).

Table 1: EKG findings in hospitalized patints with SVT

Variable	N	%
Narrow QRS complex	54	96.4
Absence of P wave	22	39.3
Negativity of P wave in lead II	2	3.8
Long PR interval	16	28.6
Short PR interval	8	14.3
WPW pattern	8	14.3

In the age group of newborns, the average recorded heart rate was 203.14±71.54 with a range of 100-289 beats per minute, in the infant group, it was 199.50±54.27 with a range of 116-260. and in the toddlers, the average heart rate was 208.00±30.71 with a range of 88-300, preschool with an average of 200 and school with an average of 220±41.18 with a range of 180-260 beats per minute. The clinical symptoms of the patients based on the history given and the main complaint mentioned by the child or the parents are shown in Figure 2. Heart palpitations were commonly reported in 52 cases (92.8%), restlessness in 12 cases (21.4%), and sweating in 11 cases (19.7%). In most cases, the amount of reported clinical symptoms between both sexes was close to each other, but 91% of sweating cases were reported in boys (10 out of 11).

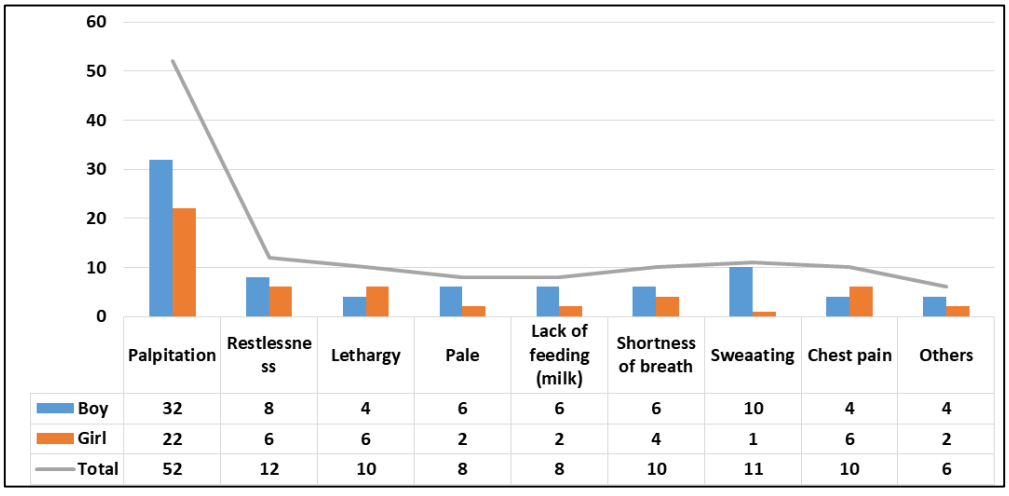

Fig 2: Clinical symptoms of hospitalized patients with SVT

Regarding hospital outcome as reported in table 2, 40 cases (4.71%) were discharged after administration of adenosine and 2 cases (5.3%) after administration of verapamil. In addition to adenosine, 10 patients (8.17%) needed amiodarone and then were discharged. Four cases (7.14%) of death occurred in the hospital.

Table 2: Hospital outcome in hospitalized patints with SVT

Variable	N	%
Discharge with only adenosine	40	71.4
Discharge with verapamil	2	3.5
Discharge with amiodarone	10	17.8
Death	4	14.7
Total	56	100

Discussion

In the present study, lots of hospitalized children diagnosed with SVT were under 28 days old (39.3%) and in general 67.9% of all cases were under 2 years old. Also, the results of the present study showed that the prevalence of male gender (60.7%) was higher among hospitalized patients. In a study by Malikian *et al*., 54% of the patients studied were boys (2). Also, in a study by Badrawi *et al*., in both study groups with benign and malignant arrhythmias, the frequency of boys was relatively higher [1]. In the multicenter study by Chu *et al*., the frequency of boys in cases with SVT was relatively higher (63%) than that of girls [9].

It is not possible to compare the age of the present study with other studies due to the lack of studies with the age range from newborn to 15 years old, and in most studies, a more limited age group has been addressed. But in general, studies have shown that almost 50% of children with SVT experience the first occurrence of their disease in the first year of life, and the age of 6-9 years is considered as the second peak age for the onset of symptoms of the disease. In the present study, 42.7% of children were under one-year-old and 67.9% were under 2 years old, which is in line with international studies [10].

In general, it is believed that changes in seasonal circadian rhythms, hormonal and biochemical changes inside the body play a role in the occurrence of supraventricular arrhythmia attacks. Identifying these seasonal and day-night rhythms can have an important practical application. Abbasnejad *et al*. showed that the highest incidence of arrhythmias is in the spring season [11]. In the present study, spring (35.7%) was the most common season for hospitalization of patients diagnosed with SVT in the hospital, and other seasons had the same frequency. Echocardiography findings in 92.8% were normal and without pathological findings, and it clearly shows that echocardiography has no place in the first line of diagnostic treatment for this disease. On the other hand, various studies have shown that arrhythmias, especially those with atrial origin, are related to congenital atrial abnormalities. In Chu *et al*.'s study, 12.5% of SVT cases were associated with congenital heart disease (9). In the present study, 10.7% of the cases had a history of heart disease. According to the results of this study, SVT was associated with WPW in 14.3% of cases. In a multicenter study by Chu *et al*., 16% of SVT cases were associated with WPW [9]. Arrhythmia documentation is an essential task to establish a clinical relationship with symptoms and correct diagnosis to guide patients in the right direction of treatment. Despite accurate diagnostic criteria, diagnosis and referral for treatment are not always easy. A recent report has shown that a significant part of patients suspected of paroxysmal tachycardia, but without ECG documentation, have induced SVTs and use electrophysiological methods. In cases of paroxysmal tachycardia without ECG documentation, clinical symptoms alone may lead to problems in diagnosis because studies have shown that the predominant clinical symptoms of SVT attacks are similar to panic attacks and even acute coronary syndromes [12]. Examining the clinical manifestations of supraventricular tachycardia in the present study showed that palpitation was the most common clinical complaint of patients and was mentioned in 92.8%. Restlessness and sweating were two clinical findings and the main complaints of other patients. Wood *et al*.'s study also showed that 20% of people with SVT experienced syncope at least once. Also, the most common reported symptoms included heart palpitations in 96% of cases, dizziness in 75% and shortness of breath in 47% [13]. The results of the present study showed that 17.8% of patients had spontaneous recovery in the long term, 46.4% experienced recovery with medication, 25% needed ablation by EPS, and only 10.7% died.

Conclusion

The results showed that the incidence of SVT is higher in boys than in girls, and in most cases, the initial symptoms appear until the age of 1-2 years. Also, spring has been proposed as a common season in the occurrence of arrhythmias consistent with other studies. Examining the clinical symptoms and main complaints of patients, especially at young ages, due to the inability to cooperate and express the main complaint, can have bias and deviation, but the results of the present study, like other studies, showed that palpitation is the most common clinical finding of patients in most age groups. Also, sweating in infants has been a common finding.

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