Management of Pediatric Supraventricular Arrhythmias

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Background: Supraventricular tachycardia is the most common symptomatic arrhythmia in children.
Objective: To evaluate the incidence of supraventricular tachycardia in children, to identify the etiology and the predisposing factors and to propose an effective treatment strategy.
Method: Between January 2004 and December 2009, children with supraventricular arrhythmias treated in Pediatric Cardiology Clinic Tirgu-Mures, were included in this retrospective study. The arrhythmia was diagnosed with clinical examination, 12-leads ECG and/or 24 hours Holter monitoring, echocardiography for identification of associated cardiac malformations. In all cases the followed parameters were: age of onset, predisposing factors, underlying mechanism of arrhythmia, efficacy of treatment.
Results: 87 children with supraventricular arrhythmias with a median age of 9 years were included. Supraventricular tachycardias were the most frequent in children at school age and adolescents (70.1%); the incidence decreased in younger children and infants. Predisposing factors were cardiac malformations, cardiac surgery, dilatative cardiomyopathy, myocarditis. Trigger factors were physical exercises, infections, fever and emotions. The commonest underlying mechanism was atrioventricular nodal reentrant tachycardia (85.71%). The emergency treatment: vagal stimulation successful in 12 patients, medical treatment in 72 patients, electric cardioversion 3 patients. 90% of patients benefits of long-term treatment; the most used were betablockers and class III antiarrhythmics. Only 12% of patients present breakthrough episodes.
Conclusions: The incidence of supraventricular tachycardias in children is high, they are occurring frequently on structurally normal heart, but they have also many predisposing factors. The underlying mechanism is important in selection of effective medication. Class III antiarrhythmics were effective in cases refractory to other medications.

Keywords: supraventricular tachycardia, children, arrhythmia

Introduction

Cardiac arrhythmias in children may occur on structurally normal heart, can be associated with cardiac malformations or are the consequence of cardiac surgery. Supraventricular arrhythmia is the most common symptomatic arrhythmia in children [1]; the incidence is estimated to be one in 250 to 1000 children [2]. Different forms of tachycardia occur at different age of the child [3]. In contrast with adult cardiology, there are no controlled studies on treatment of children with supraventricular tachycardia, so the management of these, is based on clinical studies and individual experience of pediatric cardiologists. The objective of this study was to evaluate the incidence of supraventricular tachycardia in children, to identify the etiology and the predisposing factors and to propose an effective treatment strategy.

Material and method

Eighty-seven children with supraventricular arrhythmias, with age between 1 month and 18 years were included in the retrospective study since January 2004 until December 2009. The arrhythmia was diagnosed with clinical examination, 12-leads ECG and/or 24 hours Holter monitoring, echocardiography for identification of associated cardiac malformations and determination of hemodynamic parameters. If it was necessary, the exercising test was performed before and after the initiation of the antiarrhythmic treatment. In all cases the followed parameters were: age of onset of arrhythmia, predisposing and/or trigger factors, signs or symptoms present with the initial episode, underlying mechanism of arrhythmia, efficacy of treatment.

For the identification of the mechanism of arrhythmia were used the following definitions: supraventricular tachycardia if the origin of the abnormal mechanism was upper the bifurcation of Hiss fascicule. The origin or tachycardia was considered atrial if the heart rate was higher than 200 beats/min in new-born or higher than 100 beats/min in school children and adolescents. The origin was considered jonctional if the heart rate was higher than 100 beats in new-born or higher than 80 beats/min in school children.

The ECG diagnosis of supraventricular arrhythmias was made following the definitions:

1. Supraventricular tachycardia with accessory atrioventricular connection, orthodromic type: the most frequent type in infants and new-born. Heart rate 150–300 beats/min, regular beats, narrow QRS complex, retrograde P waves, RP>PR;
2. Supraventricular tachycardia with accessory atrioventricular connection, antidromic type: prolonged QRS duration with conduction anterograde over an accessory connection and retrograde via AV node or an additional accessory connection [4];

Table I. Type of supraventricular tachycardia

Type of supraventricular tachycardia	Number of patients
AVNRT	72
Jonctional ectopic tachycardia	9
Atrial flutter	2
Atrial fibrillation	3
Atrial ectopic tachycardia	1

3. Atrioventricular nodal reentrant tachycardia (AVNRT), type slow-fast: regular beats, narrow QRS, P wave invisible or inscribed in QRS, PR <RP;
4. Jonctional ectopic tachycardia (JET): frequent after cardiac surgery for Fallot tertalogy, Fontan procedure. Abnormal P wave axis, normal QRS axis and significant variability of overall rate;
5. Atrial flutter: heart rate 250–480 beats/min, variable atrioventricular conduction, usually 2:1, f waves;
6. Atrial fibrillation: heart rate 350/min, F waves, variable atrioventricular conduction.

The treatment was introduced after the identification of underlying mechanism of supraventricular tachycardia. The acute phase was treated either with vagal stimulation or if this was ineffective, medications such as Fosfobion, Verapamil or Amiodarone or electrical cardioversion were used. For the long-term therapy betablockers, digoxin, verapamil, sotalol or amiodarone were applied.

Results

Eighty seven children with supraventricular arrhythmias, with a median age of 9 years range (1 month and 18 years) were included in the retrospective study since January 2004 until December 2009.

Supraventricular tachycardias were the most frequent in children at school age and adolescents (61 patients – 70.1%); the incidence decreased in younger children and infants 29.9% (4 new-borns, 6 infants and 16 children younger than 6 years of age).

Predisposing factors were found in 41.3% of patients (36 patients) and they were underlying cardiac malformations (6 patients), cardiac surgery (18 patients), dilatative cardiomyopathy (4 patients), myocarditis (8 patients).

The trigger factors were physical exercises, infections, fever and emotions and there were present in 28 patients (32.18%). Forty-eight children presented symptoms such as: palpitations (56%) and less frequent transpiration, chest pain, dizziness.

The echocardiography identified alteration of hemodynamic parameters in only 6 cases (6.89%), four new-born and two patients with atrial fibrillation. The most common underlying mechanism was atrioventricular nodal reentrant tachycardia (85.71% – 72 patients).

The emergency treatment: vagal stimulation was successful in 12 patients (13.79%) and was effective in school age children and adolescents. Antiarrhythmic treatment was used for cardioversion in 72 patients

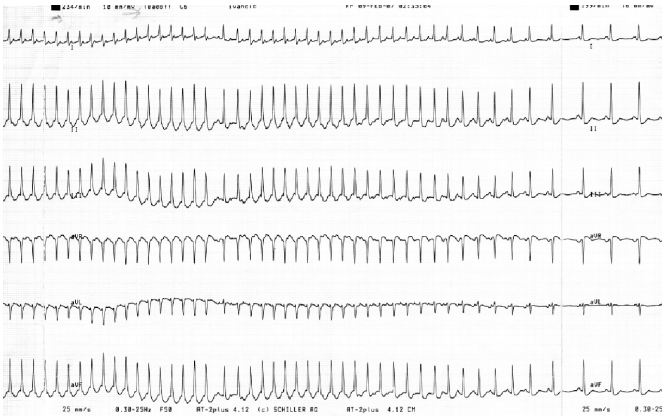

Fig. 1. Atrial ectopic tachycardia with heart rate 250 beats/min

(82.75%), electrical cardioversion in 3 cases (3.44%). The used antiarrhythmic agents were Fosfobion (Adenosine), Verapamil or Amiodarone (5 mg/kg IV). Eight patients (9.19%) had spontaneous cessation of their supraventricular tachycardia after the first treated episode, 79 patients (90.81%) were put on long-term treatment; the most used were betablockers 23 cases (29.11%), mostly in AVNRT, and class III antiarrhythmics. Sotalol was introduced in 21 cases (26.58%) and was effective in AVNRT, jonctional ectopic tachycardia, atrial ectopic tachycardia and atrial flutter. In 4 cases of Sotalol treatment occurre adverse events such as hypotension and conduction disturbances (III AV block). Verapamil was used with success only in four patients with AVNRT. Digoxin (10 mc/kg) was effective in 12 patients (15.18%). The most frequently used antiarrhythmic for long-term therapy was amiodarone (2–5 mg/kg) in 27 patients (34.17%), which was effective in cases of AVNRT, jonctional ectopic tachycardias, atrial ectopic tachycardias, atrial flutters and atrial fibrillations refractory for other antiarrhythmics. Thyroid adverse reactions (hypothyreosis) occurred in 3 cases of treatment with amiodarone.

The antiarrhytmic treatment was effective in 88% of the patients, only 12% of patients present breakthrough episodes under long-term therapy.

Discussions

Supraventricular tachycardia is a common arrhythmia in children, often also in infants under 4 months of age [5,6]. In some patients the supraventricular tachycardia has spontaneous cessation, so they can have no recurrences after the first episode [7].

In the literature are reports about 38% or 59% of supraventricular tachycardias in infants [5], in our study only 29.9% of patients were new-born and infants.

In our group predisposing factors were present in 41% of cases, trigger factors as fever, infections, emotions, physical exercises in 32.18%. These findings correlate with literature data (49%) [2].

Three main mechanisms of supraventricular tachycardia were identified: reentry, abnormal authomaticity and trig-

gered activity. The identification of mechanism causing the supraventricular tachycardia is based also on childs age, because it is generally accepted that in children younger than 12 years of age, supraventricular tachycardias are usually caused by an accessory atrioventricular connection [8,9]; in adolescents the common cause of supraventricular tachycardia is an atrioventricular nodal reentrant tachycardia (AVNRT). [10,11]; 90% of supraventricular tachycardias in infants are caused by an accessory atrioventricular connection.

Identification of mechanism as well as determination of predisposing and trigger factors of supraventricular tachycardia is essential to choose the most effective treatment for the patient.

In reentry supraventricular tachycardias the vagal stimulation can be effective for interruption of abnormal conduction. Treatment with adenosine is usually effective, but in case of hypotension or acidosis the electrical cardioversion is the most indicated alternative [2].

In our study fosfobion (adenosine) and intravenous amiodarone were the most frequent medications in acute cases, in literature intravenous digoxin was the most frequently used drug [2]. Digoxin must be avoided in patients with large QRS supraventricular tachycardias due to WPW syndrome because of risk of ventricular fibrillation, but can be used with success in AVNRT [12].

Verapamil, used very frequently a few years ago, is now avoided in infants and little children because of risk of cardiac arrest, due to severe hemodynamic deterioration and death [13]. In our study verapamil was used in only four cases of AVNRT in adolescents.

Cardioversion has been used in our group in only three cases, but is a treatment option which has been reported to be successful in 98% of cases [14].

Class III antiarrhythmics as sotalol and amiodarone must be used only in refractory cases of supraventricular arrhythmias, [15,16] prevention of atrial fibrillation and atrial flutter [17,18] and those with breakthrough episodes of arrhythmia [19,20,21,22]. In our group 3 of 27 patients (11.11%) treated with amiodarone presented thyroid adverse reactions, these data correlate with the literature, abnormal thyroid function tests 6% [23,24,25].

The antiarrhythmic treatment was effective in majority of the cases, only in 12% of the patients presented recurrences under long-term medication.

In patients younger than one year with supraventricular tachycardia is recommended to keep the maintenance therapy one year, and if after that no recurrence occurs and the infant has no WPW syndrome, the therapy can be interrupted; if WPW syndrome is associated, than the therapy will be continued one more year [26].

Conclusions

The incidence of supraventricular tachycardias in children is high, they are occurring frequently on structurally normal heart, but they have also many predisposing and triggering factors.

In some cases the supraventricular tachycardia can have spontaneous cessation.

The determination of underlying mechanism of arrhythmia is important in selection of effective medication.

The emergency treatment with vagal stimulation is effective in reentry tachycardias but usually ineffective in infants.

Class III antiarrhythmics are effective in supraventricular tachycardias refractory to other medications.

Recurrences of supraventricular tachycardia are rare under long-term therapy and occurs frequently in infants.

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