Idiopathic ventricular tachycardia in children: curative therapy with radiofrequency ablation

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Key words: *idiopathic ventricular tachycardia; children; ablation.*

Summary. *Idiopathic ventricular tachycardia is a rare condition, and there is a lack of clear guidelines for the necessity and indications for prophylactic antiarrhythmic or curative treatment.*

The aim of this study was to review the clinical picture of idiopathic ventricular tachycardia and evaluate the efficacy and safety of radiofrequency ablation therapy in children.

Material and methods. The subjects of this study were 16 children with idiopathic ventricular tachycardia. The mean age at onset of idiopathic ventricular tachycardia was 12 years. All patients underwent electrophysiological examination. Nonfluoroscopic mapping technology (Carto™) was used in one case. Radiofrequency ablation was performed in all children (mean duration of follow-up was 46 months).

Results. Six children with idiopathic ventricular tachycardia were free of symptoms. Palpitation was the only complain in four patients, and six patients presented with symptoms of circulatory disorder (the tendency of the higher rate of ventricular tachycardia and more premature contractions and episodes of ventricular tachycardia in one day were noticed in five of them). All children after radiofrequency ablation were alive, and only one complication (complete right bundle branch block) occurred. Success at last follow-up included five children with left and six with right idiopathic ventricular tachycardia.

Conclusions. Catheter ablation seems a promising therapeutic option with the outlook possible of the idiopathic ventricular tachycardia in children. It is safe enough and should be considered as the therapy of choice even in children without of symptoms if they wish to live active social and physical life.

Introduction

Ventricular tachycardia (VT) in childhood is an uncommon entity. The incidence of VT at this age is low (0.2–0.8 per 10 000 children in school-based heart screening) compared to that in adults (1). The most pediatric cases are idiopathic (IVT) without underlying heart disease. Clinical course of IVT varies from asymptomatic to the miscellaneous symptoms, range from palpitations only to more severe manifestations as syncope. There are different opinions on the management and prognosis of children's IVT. The aim of the present study was to review the clinical picture of idiopathic tachycardia and evaluate the efficacy and safety of radiofrequency ablation (RF) therapy in children.

Materials and methods

The subjects of the present study were 16 patients (13 males and 3 females) with idiopathic monomorphic ventricular tachycardia treated in our clinic during 10-year period. The mean age at onset of tachycardia was 12 years (range 5–17 years). Sustained tachycardia (lasted more than 30 s) was observed in five children. All patients were without evidence of structural heart disease.

All patients underwent electrophysiological examination, and RF was performed in all of them. One to three electrodes were introduced via the right femoral vein and/or artery and positioned by choice at the high right atrium (HRA), His bundle-recording site (His), coronary sinus (CS), right ventricle (RV), left ventricle (LV). Registration was performed by "CardioLab" (GE Medical Systems or Prucka Engineering, Inc.).

Nonfluoroscopic mapping technology (2) was used for the ablation of ventricular tachycardias and premature ventricular beats in re-do cases. Location of the ablation catheter using magnetic fields (electroanatomic mapping, Carto™, Biosense Webster) reduced radiation exposure. This technology allowed the construction of a three-dimensional geometry to

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guide catheter navigation and ablation lesion placement.

The earliest endocardial activation during premature ventricular contractions or ventricular tachycardia, pacemapping and entrainment methods were used to define the ablation target.

VT was originating from the left ventricle in seven and from the right in nine children.

4 mm tip Cordis Webster ablation catheter electrodes were used. RF energy was delivered using a maximum power of 30 W and a maximum electrode-tissue interface temperature of 55°C.

Results

Clinical, electrocardiographic, and echocardiographic characteristics of the patients are presented in Table. The lowest age at the onset of tachycardia

Table. **Clinical and electroechocardiographic characteristics of patients with idiopathic ventricular tachycardia**

Patient	Age, years		Gender	ECG		Symptom	Echocardiographic findings
	Onset VT	RF		Heart rate, beats per min	Pattern		
G.R.	11	14	F	140	LBBB nonsustained	No	Normal
K.M.	9	9	M	175	LBBB incessant	Weakness, fatigue, chest pain	Arrhythmogenic dilated cardiomyopathy
B.A	9	15	M	200	LBBB sustained	Palpitation	Normal
K.D.	13	13	M	150	RBBB nonsustained	No	Normal
B.V.	14	14	F	140	LBBB nonsustained	Syncope	Normal
M.E.	9	13	M	200	LBBB nonsustained	Weakness, palpitation	Mild enlargement of both atria and right ventricle
L.K.	17	17	M	138	LBBB sustained	Palpitation	Normal
B.R.	10	11	F	220	RBBB nonsustained	Fatigue, weakness, dizziness	Normal
S.V.	12	12	M	125	RBBB nonsustained	No	Mild enlargement of left ventricle
G.U.	13	13	M	170	RBBB nonsustained	No	Normal
M.D.	14	14	M	200	RBBB sustained	Palpitation, dizziness	Foramen ovale No enlargement
L.D.	14	15	M	140	RBBB sustained	Palpitation	Normal
J.G.	10	12	M	126	LBBB nonsustained	No	Normal
B.A.	15	17	M	131	RBBB nonsustained	No	Mild enlargement of left ventricle
G.V.	16	17	M	139	LBBB nonsustained	Dizziness, weakness, fatigue chest pain	Two leaflet aortic valve Mild enlargement of both atria
N.J.	5	18	M	120	LBBB nonsustained	Palpitation, lower physical activity	Normal

ECG – electrocardiogram; RBBB – right bundle branch block;
LBBB – left bundle branch block; RF – radiofrequency ablation; VT – ventricular tachycardia.

was 5 years. In six children, ventricular tachycardia was found by electrocardiogram only performed as part of routine examination in outpatient clinic. Palpitation was the only complain in four children. Symptoms of the circulatory disorder (fatigue, weakness, dizziness, syncope) had six children. The high heart rate (175–220 beats per minute) was in four, sustained VT in two (in one – incessant) of them.

The origin of the ventricular ectopy is presented in Fig 1.

Indications for RF were arrhythmogenic cardiomyopathy in two patients, circulatory disorder during VT in three, medically refractory arrhythmia in three, patient preference (wish to live active social and physical life) in eight (half of the all children).

All patients after RF were alive, and none was lost to follow-up after a mean of 46 months (range 2 to 118). Success at last follow-up included five children with left VT. In one boy (K.D.), IVT from the anterobasal region of left ventricle disappeared, but premature ventricular contractions remained. In patient L.D., procedure was not successful because of the anatomical singularities. Atenolol was prescribed for the treatment of his arrhythmia. Six children with right IVT underwent successful RF (patient L.K. after the second time when Carto system was employed). Immediate ablation success was achieved in other three patients with right IVT (focus in His zone – one, midseptum – one, anterobasal surface of right ventricle – one), but arrhythmia recurred after a short time. One complication occurred in patient L.K. after RF: complete right bundle branch block (RBBB) followed the procedure. This 17-year-old athlete boy has sustained IVT (Fig. 2), which trigger was physical activity. Electrophysiological study revealed that origin of tachycardia was septum of the right ventricle, near His bundle.

Discussion

Idiopathic ventricular tachycardia was defined as a VT without structural heart disease or any identifiable predisposing causes (3–5). The IVT diagnosis was based on accepted criteria (6) in any child showing at least three consecutive ventricular complexes at a rate clearly faster than the child's sinus rhythm, and documented on surface electrocardiogram (ECG) or a Holter monitor. Episodes of VT were defined as sustained when lasted more than 30 s; otherwise, they were defined as nonsustained. Clinical symptoms of IVT in our patients as in another studies (7, 8) varied from palpitation only to the mild circulatory disorders (weakness, fatigue, dizziness). Only in one girl's history syncope three times repeated was noted. However, heart rate in this case during IVT was not high (140 beats per minute), and tachycardia was nonsustained. No changes in echocardiogram were found. It might

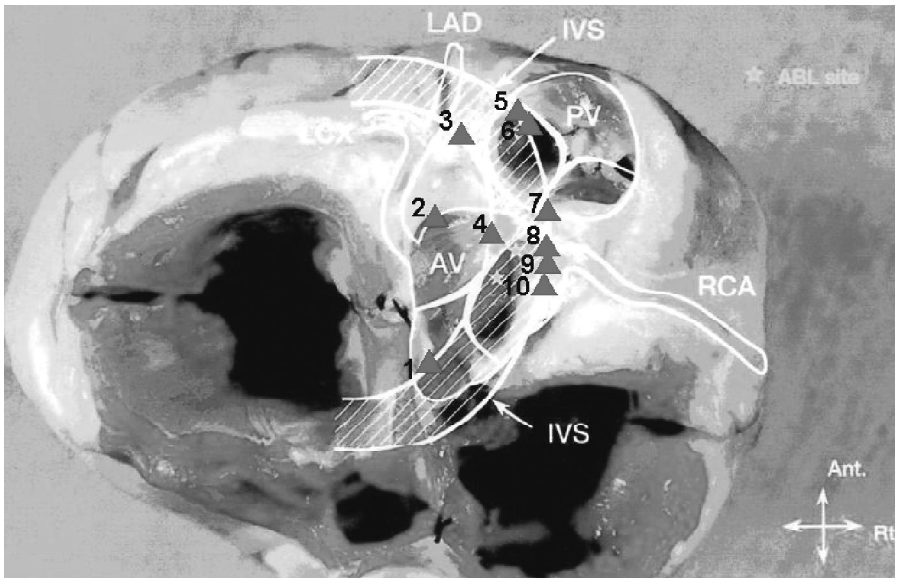

Fig 1. **Origin of ventricular ectopy**

1. Posterior surface of left ventricular septum (patients 1, 14). 2. Closeness to the aortic leaflets near the left main coronary artery (patient 2). 3. Anterior surface of left ventricular septum (patients 3, 11). 4. Anterobasal region of left ventricle (patient 4, 12). 5–6. Outflow tract of right ventricle (patients 5, 6, 15, 16). 7. Anterobasal surface of rightventricle (patient 13). 8–9. His zone (patients 7, 8, 9). 10. Midseptum of right ventricle (patient 10).

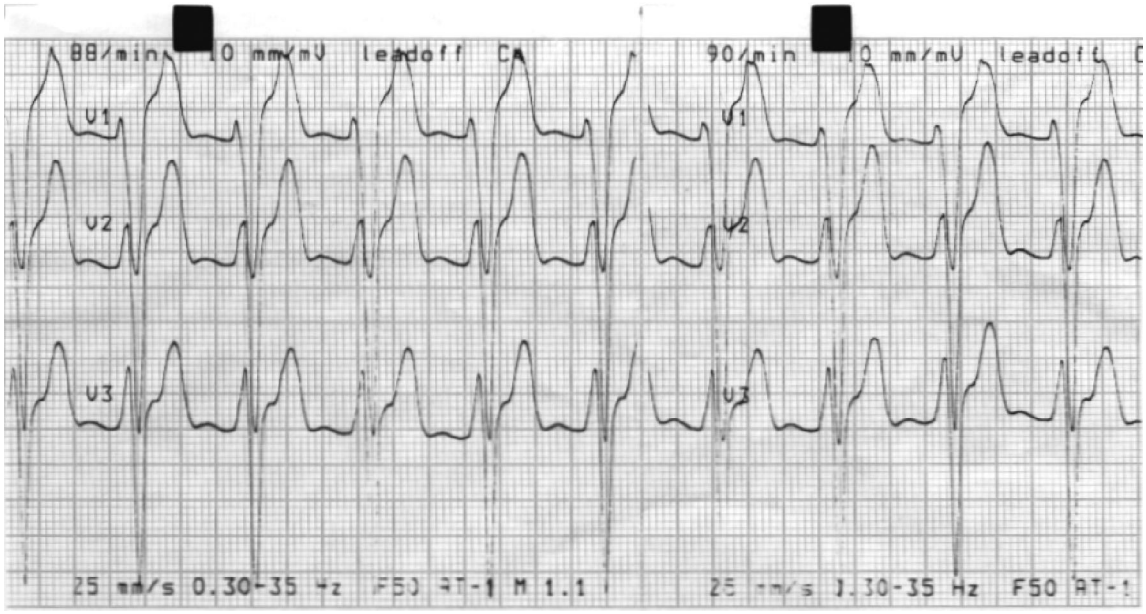

Fig. 2. **Sustained ventricular tachycardia (patient L.K.)**

be premise that those syncope were automatic (neurocardiac). In other patients with IVT and circulatory disorders, a tendency to the higher rate of VT (175–220 beats per minute) and more premature ventricular contractions and VT episodes in one day was noted. There were two children with sustained IVT (one with incessant IVT) among them. Resting ECGs were normal in all patients. Unquestioned arrhythmogenic dilated cardiomyopathy was diagnosed only in one 9-year-old boy with incessant IVT. All clinical findings defined in our patients fulfill diagnosis of benign (idiopathic VT) disease (6, 10–12).

There are different strategies of IVT treatment in children, and they have been changing during last 10 years. There was an opinion that VT in normal heart usually needed drug treatment only if it was symptomatic or sustained (13, 14). Variable success has been reported for different antiarrhythmic drugs (6, 8, 15, 16). However, the response to drugs of IVT is relatively ineffective against other forms of VT (1, 7, 16).

During the last several years, RF has become a promising procedure for the treatment of patients with symptomatic IVT (5, 7, 12, 17, 18). Success rates for ablation of either right or left ventricular tachycardia ranged from 83% to 88% (18, 19). Total success rate of RF in our patients with IVT was lower (about 69%), but in the last six years, the efficacy of the procedure became markedly more successful (83%). Possibility to define precise the anatomic arrhythmogenic substrate is essential for successful RF (2, 3, 19). The recurrence of clinical VT after ablation is associated with initially unsuccessful procedure (20). We as other authors had no major complications (complete RBBB in one child only) after RF of idiopathic VT. The follow-up study showed that no late proarrhythmic or cardiopressing impact of delivered radiofrequency energy was observed either on the right or on the left ventricular myocardium (20).

Conclusion

Catheter ablation seems a promising therapeutic option with the outlook possible cure of the idiopathic ventricular tachycardia. It is safe enough in children and should be considered as the therapy of choice. It can be performed even in children without symptoms if they wish to live active social and physical life.

Vaikų idiopatinė skilvelių tachikardija: gydymas radiodažnine abliacija

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Raktažodžiai: idiopatinė skilvelių tachikardija, vaikai, abliacija.

Santrauka. Idiopatinė skilvelių tachikardija vaikams pasitaiko retai, dėl to iki šiol nėra aiškių rekomendacijų dėl šių pacientų stebėsenos ir gydymo taktikos. Šio darbo tikslas buvo patikslinti idiopatinės skilvelių tachikardijos simptomus vaikams bei nustatyti jos gydymo radiodažnine perkateterine abliacija efektyvumą ir saugumą.

Ištirta 16 vaikų, kurių amžiaus vidurkis skilvelių tachikardijos atsiradimo metu buvo 12 metų.

Visiems pacientams atliktas elektrofiziologinis tyrimas (vienam – pakartotinai panaudojant *Carto*^{TM} metodiką) bei radiodažninė tachikardijos židinio abliacija.

Šeši vaikai neturėjo jokių skundų, keturi – jautė širdies plakimo epizodus, likusiems pacientams nustatėme nesunkius kraujotakos sutrikimus, kurių atsiradimą galėjo nulemti žymiai dažnesnis skilvelių tachikardijos dažnis bei dažni jos epizodai paros laikotarpiu (vienam – pastovi skilvelių tachikardija).

Tachikardijos židinys visiškai sunaikintas 11 vaikų (šešiems – dešiniajame, penkiems – kairiajame skilvelyje). Vienam pacientui po procedūros išsivystė visiška dešiniojo Hiso pluošto kojos blokada. Stebėsenos po procedūros vidurkis – 46 mėnesiai.

Radiodažninė abliacija yra pakankamai efektyvus ir saugus skilvelių tachikardijos gydymo metodas ir gali būti pasirinktas ir tada, kai vaikui nėra simptomų, bet vaikas nori gyventi be apribojimų.

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