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ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA

Speckle tracking derived left and right ventricular strain, strain rate and left ventricular rotation in children after slow pathway ablation

Çocuklarda yavaş yol ablasyonu sonrası "Speckle tracking" ile elde edilen sol ve sağ ventriküler "strain"

Rima Sileikiene[1], Jolanta Vaskelyte[2], Vaida Mizariene[2], Irena Nedzelskiene[2], Renaldas Jurkevicius[2], Viktorija Sileikyte[2], Rimantas Kevalas[1]

[1]Lithuanian University of Health Sciences, Department of Children Diseases, [2]Lithuanian University of Health Sciences Kaunas-Lithuania

ABSTRACT

Objectives: Aim of the study was to assess left and right ventricular strain, strain rate and left ventricular rotation in children at late follow-up after atrioventricular node slow pathway radiofrequency ablation.

Materials and methods: Left and right ventricular strain, strain rate, left ventricular rotation, rotational velocity and twist were assessed using the speckle tracking echocardiography in 22 children who underwent radiofrequency ablation of slow pathway and in 15 healthy control children.

Results: There were no significant differences in conventional echocardiographic left and right ventricular parameters between the two groups (p>0.05), except left atrial volume (28.0±8.7 ml in control group vs. 37.3±13.9 ml in radiofrequency ablation group, p=0.024) and right atrial volume (16.0±6.7 ml vs. 21.5±8.5 ml, respectively, p=0.047) and their left (16.7±6.0 ml/m^2 vs. 26.3± 9.8 ml/m^2, p=0.002, respectively) and right (16.0± 6.6 ml/m^2 vs. 21.5±8.5 ml/m^2, respectively, p=0.05) indices that were significantly higher in radiofrequency ablation group. Speckle tracking imaging derived regional and global strain, systolic and diastolic left and right ventricular strain rate as well as left ventricular rotation, rotational rate did not differ between the radiofrequency ablation group and controls (p>0.05). Left ventricular twist was comparable between the radiofrequency ablation group and controls (p>0.05).

Conclusions: Speckle tracking echocardiography did not revealed any deterioration of regional and global axis function of the left and right ventricles in children, who underwent atrioventricular node slow pathway radiofrequency ablation. *J Clin Exp Invest 2011; 2(1): 1 -10*

Key words: Speckle tracking, radiofrequency ablation, children, echocardiography

ÖZET

Amaç: Bu çalışmanın amacı, çocuklarda atriyoventriküler yavaş iletim yolu radyofrekans ablasyonu sonrası geç takip döneminde sol ve sağ ventiküler gerilme (strain), strain hızı ve sol ventrikül rotasyonunu değerlendirmektir.

Gereç ve yöntemler: Radyofrekans ablasyonu uygulanan 22 çocuk ve sağlıklı 15 çocukta sol ve sağ ventriküler strain, strain hızı, sol ventrikül rotasyonu, rotasyonal hız ve burkulma (twist) "Specle tracking" ekokardiyografi ile değerlendirildi.

Bulgular: Konvansiyonel ekokradiyografi ile iki grup arasında sol ve sağ ventrikül parametreleri bakımından; sol atriyal hacim (28.0±8.7 ml kontrol grubunda ve 37.3±13.9 ml radyofrekans ablasyon grubunda, p=0.024) ve sağ atriyal hacim (sırasıyla, 16.0±6.7 ml ve 21.5±8.5 ml, p=0.047) ve bunların sol (16.7±6.0 ml/m^2 ve 26.3± 9.8 ml/m^2, p=0.002) ve sağ (16.0± 6.6 ml/m^2 ve 21.5±8.5 ml/m^2, p=0.05) indekslerinin radyofrekans ablasyonu grubunda daha yüksek olması (p=0.023) dışında, anlamlı farklılık yoktu (p>0.05). Bölgesel ve global strain'den elde edilen "Spackle tracking" sistolik ve diyastolik sol ve sağ ventriküler strain hızı, sol ventriküler rotasyon ve rotasyonal hız radyofrekans ablasyon grubu ile kontrol grubu arasında anlamlı farklılık göstermedi (p>0.05).

Sonuç: Speckle tracking ekokardiyografi atriyoventriküler düğüm yavaş yoluna radyofrekans ablasyonu uygulanmış çocuklarda sol ve sağ ventriküler bölgesel ve global uzun ve kısa eksen fonksiyonlarında herhangi bir bozulmayı göstermedi. *Klin Deney Ar Derg 2011; 2(1): 1 -10*

Anahtar kelimeler: "Specle tracking" ekokardiyografi, radyofrekans ablasyon, çocuklar, ekokardiyografi

Yazışma Adresi /Correspondence: Rima Sileikiene, Lithuanian University of Health Sciences, Department of Children Diseases, Eiveniu 2, Kaunas, LT 50009. Lithuania. E-mail: rima.sileikiene@ kmuk.lt

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INTRODUCTION

The supraventricular tachycardias - atrioventricular reentrant tachycardia due to accesory pathways and atrioventricular nodal reentrant tachycardia are common in children. Reentry mechanism through the atrioventricular node or a bypass tract accounts for ~ 90 percent of all paroxysmal supraventricular tachycardias in children. The electrophysiologic – morphologic substrates responsible for tachycardia are thought to be present from birth, in 88 percent - in structurally normal heart. During the last decade transcatheter radiofrequency ablation of supraventricular tachycardias in children became a method of choice due to it's safety and effectiveness.[1]

However, the lesions in myocardium are created by radiofrequency current itself and by the thermal effect, in the case of atrioventricular nodal reentrant tachycardia – in the zone of tricuspid valve. Does it influence the systolic and diastolic function of the heart late after radiofrequency ablation remains unclear. There is no data on subclinical changes of the systolic and diastolic function of the heart in children who underwent transcatheter radiofrequency ablation.

However, current conventional echocardiographic parameters assess only global left ventricular function that are not always sensitive and even in patients with symptoms of heart failure they may remain within normal limits. The assessment of regional function may provide important diagnostic information. The development of new echocardiographic techniques allows assessment of the complex left ventricular motion pattern, enables regional quantitative analysis of left and right ventricular function.[2-5] Speckle tracking echocardiography represents a simplified and angle - independed modality for quantification of regional myocardial deformation: radial, circumferential and longitudinal strain, strain rate, apical and basal short axis rotation, that are more sensitive in assessment of subclinical systolic and diastolic dysfunction of the heart .[4]

In the present study, we aimed to investigate conventional echocardiographic left and right ventricular parameters, left and right ventricular strain, strain rate, left ventricular rotation, rotational velocity and twist using the speckle tracking echocardiography method in children at late follow-up after atrioventricular node slow pathway radiofrequency ablation and in healthy children. Echocardiography remains the method of clinical value as non-invasive procedure to evaluate hemodynamics, atrial and ventricular function in pediatric rhythm disorders.

MATERIALS AND METHODS

Study populations

The study group consisted of 37 subjects: 15 healthy children (control group), mean age 16.23±1.58 years (7 boys) and 22 children, mean age 16.59±2.44 years (11 boys), who underwent atrioventricular node slow pathway radiofrequency ablation, 5.52±2.25 years ago (radiofrequency ablation group). During the 1999-2005 year period radiofrequency ablation of slow pathway was performed in 48 children. At late follow up 22 children were investigated, the remaining (18 persons) refused to participate in the study, 8 patients were older than 18 years of age. Before treatment of radiofrequency ablation, children suffered from paroxysms of tachycardia.

At the study time (late follow up after radiofrequency ablation) all children were free of paroxysms, they did not use any medications. Physical examination, electrocardiogram, transthoracic conventional echocardiography did not reveal the signs of heart disease. Healthy children had no complains, no symptoms of heart failure, no history of cardiac rhythm disturbance, no evidence of heart disease by physical examination, electrocardiography, transthoracic echocardiography (no signs of left and right ventricle hypertrophy, valvular disease and wall motion abnormalities), they did not use any medications.

The study protocol was approved by the Ethic Committee of the Kaunas University of Medicine. Informed consent was obtained before the study from all patients and/or their parents.

Conventional echocardiography

Echocardiographic technique and calculations of morphometric parameters were performed in accordance with the recommendations of The American Society of Echocardiography 2005.[6] The biplane Simpson's rule was used for calculation of left ventricular ejection fraction.

Automated speckle tracking imaging

For 2D speckle tracking echocardiography analysis we used Vivid 7 (GE Vingmed Ultrasound AS, Horten, Norway) equipment. Tissue harmonic images were scanned at 2 short-axis levels of left ventricle (mitral valve level and apical level) and at long-axis apical four and two chamber view with the M3S probe. For analysis of right ventricular long axis function apical four chamber view was used. The mean frame rate was 50 frames per second (range 40-70). Digital loops were stored on the hard disc of the echocardiographic machine, and transferred to a workstation (Echo PAC PC, GE Vingmed) for offline analysis. A line was traced along the endocardiumof left and right ventricles at the frame where it was best defined. On the basis of this line, the computer automatically created a region of interest, and the software selected natural acoustic markers moving with the tissue. Automatic frame-by-frame tracking of these markers during the heart cycle (2D speckle tracking echocardiography method) yielded a measure of rotation, rotational velocity, strain and strain rate at any point of myocardium. The left ventricle was divided into 6 short-axis segments at each level and into 6 long-axis segments in each view. The right ventricle was divided into basal and midventricular segments of the lateral wall long-axis segments.

Analysis of regional left and right ventricular longitudinal function – strain and strain rate

The apical two and four chamber view of the heart was analysed offline using Echo Pac software for the assessment strain and strain rate of left ventricle inferior, anterior, lateral wall, ventricular septum and the right ventricle lateral wall segments with the speckle tracking echocardiography method. The strain rate is equivalent to the spatial gradient of pixel movements. It is characterised by the equation strain rate = $d[r]-d[r + \Delta r]/\Delta r*t$ (d-distance in movement, r- location in space, t- time and expressed 1/s).[2] The time integral of incremental strain rate yields strain, defined as the fractional change from the original dimension the percentage shortening or lengthening of myocardium.[2,4,7] Strain = $L-L0/L0$, where L and L0 are the length of an infinitesimal material line segment at end diastole and end systole, respectively. 3 cardiac cycles were averaged. Measurements were performed at left ventricle basal, midventricular and apical segments and right ventricle basal and midventricular segments. The system calculates mean global strain and strain rate values for whole predefined left ventricle and right ventricle segments, lengthening is positive and shortening is negative in this description.

Analysis of left ventricular rotation, rotational rate and twist

Left ventricular rotation was defined as angular displacement and rotational velocity was defined as velocity of angular displacement of left ventricle about its central axis in the short-axis image. They were represented in units of degree and degrees per second, respectively. Measuring left ventricular rotation and rotational velocity by using speckle tracking echocardiography on the workstation was performed as described previously. Clockwise left ventricle rotation as viewed from the apex was expressed as a negative value and counterclockwise rotation as positive value.[2,4,8] Results were subdivided to six segments for regional analysis at each ventricular level and averaged at basal and apical level for analysis of global rotational motion. Data from at least 3 consecutive beats were averaged for the calculation of left ventricular rotation, rotational velocity and twist. Left ventricular twist was defined as a net- difference of „global left ventricular rotation" between apical and basal short-axis planes at each time point (i.e. twist (t) = apical left ventricular rotation (t)- basal left ventricular rotation (t).[9-11]

Statistical analysis

All of the statistical analyses were performed with software SPPS version 14.0 (SPSS, Inc., Chicago, Il., USA). A p-value less than or equal to 0.05 was considered significant. $\chi 2$ test was used for comparing frequencies of qualitative variables.

All parametric data were expressed as the mean (standard deviation), M (SD). To determine whether the differences in the quantitative values between two groups were statistically significant, Student t test was performed. Continues variables with abnormal distribution were compared using Mann-Whitney (U) test. As for all continues variables with abnormal distribution the level of the significance of Student's test and Mann-Whitney (U) test coincided, the results were provided as parametric variables. Spearman correlation coefficients were obtained to describe relations for parameters of different methods to evaluate systolic and diastolic function of the heart.

Intra-observer variability was determined by one observer repeating the measurements of speckle tracking echocardiography in five randomly selected subjects one month later. Agreement between the measurements was evaluated by linear regression analysis with correlation coefficient. In addition, Bland-Altman analysis was used to determine the bias and limits of agreement between the corresponding measurements. The significance of inter-technique biases was tested using paired t-tests.

RESULTS

Conventional parameters

Before treatment of radiofrequency ablation children suffered from paroxysms of tachycardia, which mean duration was 57.0±41.04 minutes, the mean heart rate during the paroxysm was 196.6±33.1 beats per minute and the mean rate of paroxysms was 3.25±1.56 per months. There was no signifficant differences in age and body surface area between the groups (p>0.05).

Clinical and conventional echocardiographic parameters are presented in Table 1. There were no significant differences in left ventricle dimensions, left ventricular ejection fraction, left ventricular fractional shortening, left and right ventricular inflow indices between the radiofrequency ablation group and controls, except of left atrial and right atrial volumes and their indices, which were significantly higher in radiofrequency ablation group (Table 1). In order to reveal the causes of left atrium and right atrium dilatation, the relations with age, weight, duration of the disease, characteristics of the paroxysms of atrioventricular tachycardia, left and right ventricular dimensions and function were sought. A reasonable correlation of left atrial volume index and right atrial volume index with heart rate during paroxysm (r=0.6, p<0.001; r=0.5, p<0.001, respectively) and a high with duration of paroxysm (r=0.7, p<0.001; r=0.6, p<0.001, respectively) was revealed.

Table 1. Conventional echocardiographic parameters of study and the control groups

Variable	Control group	Study group	p
Number	15	22	
Male/female	7/8	11/11	NS
Age (years)	16.3±1.6	16.6±2.4	NS
Body surface area (m^2)	1.6±0.14	1.6±1.86	NS
Heart rate (beats per min)	78.9±13.8	80.5±14.58	NS
Left ventricular end-diastolic volume (ml)	103.5±21.6	104.5±20.63	NS
Left ventricular end-systolic volume (ml)	23.0±6.8	24.4±8.7	NS
Left ventricular ejection fraction (%)	56.5±3.9	54.5±3.97	NS
Left ventricle fractional shortening (%)	45.3±4.6	46.4±5.62	NS
Left ventricular myocardial mass index (g/m^2)	86.2±3.6	90.3±4.5	NS
Left ventricular early filling velocity (cm/s)	82.0±12.1	88.1±7.2	NS
Left ventricular filling velocity during atrial contraction (cm/s)	50.4±8.0	55.2±2.2	NS
Left ventricular early filling deceleration time (ms)	162.8±31.9	161.4±35.8	NS
Right ventricular basal diameter (mm)	28.3± 2.3	29.1±3.2	NS
Right ventricular early filling velocity (cm/s)	61.4±12.3	58.8±11.0	NS
Tricuspid annulus motion amplitude (mm)	19.5±0.6	21.4±0.4	NS
Left atrial volume (ml)	28.0±8.7	37.3±13.9	**0.024**
Left atrial volume index (ml/m^2)	16.7±6.0	26.3±9.8	**0.002**
Right atrial volume (ml)	16.0±6.7	21.5±8.5	**0.047**
Right atrial volume index (ml/m^2)	16.0±6.6	21.5±8.5	**0.05**

NS: not significant

Table 2. Global and regional longitudinal peak systolic strain, strain rate of the left and right ventricular walls

		Peak systolic strain (percent) M(SD)		P	Systolic strain rate (1/s) M(SD)		p
		Control Group	Study Group		Control Group	Study Group	
LV inferior	Basal	-17.1±4.7	-21.6±6.3	0.4	-1.9±0.7	-1.4±0.6	0.1
	Midventricular	-20.3±5.6	-19.8±3.7	0.8	-1.4±0.4	-1.1±0.7	0.3
	Apical	-20.3±5.4	-17.2±4.5	0.2	-1.5±0.7	-1.1±0.3	0.08
	Global	*-19.2±8.5*	*-19.6±4.8*	*0.4*	*-1.1±0.6*	*-1.2±0.7*	*0.1*
LV anterior	Basal	-20.3±4.8	-23.2±6.6	0.1	-1.5±0.4	-1.5±0.4	0.8
	Midventricular	-20.5±3.5	-21.9±6.0	0.3	-1.3±0.1	-1.4±0.3	0.6
	Apical	-18.4±4.8	-17.5±6.6	0.8	-1.5±0.5	-1.2±0.5	0.3
	Global	*-19.7±4.4*	*-20.9±6.4*	*0.4*	*-1.4±0.4*	*-1.4±0.4*	*0.8*
LV lateral	Basal	-10.8±8.4	-14.8±5.6	0.2	-1.8±0.8	-1.3±0.4	0.08
	Midventricular	-17.3±4.3	-13.0±5.6	0.06	-1.2±0.3	-1.0±0.4	0.08
	Apical	-18.0±5.2	-11.3±8.9	0.06	-1.1±0.4	-1.1±0.3	0.9
	Global	*-14.1±5.6*	*-13.9±5.6*	*0.08*	*-1.4±0.6*	*-1.2±0.4*	*0.1*
LV septum	Basal	-19.6±2.4	-17.4±9.9	0.5	-1.2±0.3	-1.2±0.5	0.7
	Midventricular	-20.8±3.4	-17.0±7.1	0.1	-1.2±0.3	-1.1±0.3	0.4
	Apical	-14.5±9.10	-15.8±5.4	0.7	-1.1±0.3	-1.1±0.3	0.8
	Global	*-18.3±5.0*	*-16.7±7.5*	*0.5*	*-1.2±0.3*	*-1.1±0.4*	*0.6*
RV lateral	Basal	-16.5±10.3	-16.6±11.4	0.9	-1.2 ±1.7	-1.5±0.7	0.7
	Midventricular	-24.7±10.5	-20.4±9.9	0.4	-1.4±0.5	-1.3±0.6	0.8
	Global	*-20.8±0.0*	*-19.2±11.6*	*0.7*	*-1.3±1.0*	*-1.4± 0.6*	*0.8*

LV: Left ventricular, RV: Right ventricular, Global: mean of all segments of the wall.

Table 3. Global and regional diastolic strain rate of the left and right ventricular walls

		Early diastolic strain rate (1/s)		P value	Late diastolic strain rate (1/s)		p value
		Control Group group	Study Group		Control Group group	Study Group	
LV inferior	Basal	1.8±1.0	1.9±0.5	0.8	1.3±0.6	1.0±0.5	0.1
	Midventricular	1.8±0.5	1.6±0.4	0.2	0.8±0.4	0.7±0.4	0.5
	Apical	1.9±0.5	1.4±0.7	0.1	1.0±0.7	0.9±0.5	0.5
	Global	*1.8 0.7*	*1.6±0.5*	*0.8*	*1.1±0.6*	*0.9±0.5*	*0.5*
LV anterior	Basal	1.7±0.5	2.1±0.5	0.4	1.5±0.5	1.3±0.5	0.5
	Midventricular	1.7±0.4	1.9±0.5	0.3	1.0±0.4	1.0±0.4	0.8
	Apical	1.9±0.3	1.6±0.7	0.3	1.0±0.6	0.8±0.5	0.3
	Global	*1.8±0.4*	*1.9±0.6*	*0.2*	*1.2±0.5*	*1.0±0.4*	*0.8*
LV lateral	Basal	1.7±1.0	1.8±0.6	0.9	1.0±0.4	0.9±0.7	0.6
	Midventricular	1.8±0.5	1.4±0.9	0.1	1.0±0.3	0.8±0.4	0.2
	Apical	1.9±0.8	1.7±0.8	0.5	0.9±0.4	1.0±0.7	0.8
	Global	*1.8± 0.8*	*1.6±0.8*	*0.7*	*1.0±0.40*	*0.9±0.6*	*0.8*
LV septum	Basal	1.8±0.4	1.9±0.6	0.7	0.9±0.4	1.0±0.4	0.8
	Midventricular	1.9±0.4	1.7±0.6	0.4	0.9±0.4	1.0±0.5	0.7
	Apical	2.2±0.7	1.6±0.7	0.07	1.2±0.5	1.1±1.2	0.9
	Global	*2.0±0.5*	*1.7±0.7*	*0.2*	*1.0±0.5*	*1.0±0.7*	*0.9*
RV lateral	Basal	1.7±1.1	2.2±1.0	0.4	1.0±0.7	1.5±0.8	0.2
	Midventricular	1.8±0.8	1.8±0.8	0.9	1.0±0.5	1.1±0.7	0.7
	Global	*1.7± 0.8*	*2.0±0.9*	*0.7*	*1.0±0.5*	*1.2±0.7*	*0.3*

LV: Left ventricular, RV: Right ventricular, Global: mean of all segments of the wall.

Table 4. Left ventricular segmental and global peak rotation at two levels

Peak rotation (degree)		Anterior septum	Anterior	Lateral	Posterior	Inferior	Posterior septum	Global (degree)
Basal	Control group	-2.8±2.7	-2.5±3.6	-4.5±3.4	-7.7±2.4	-8.7±3.5	-7.3±3.4	-5.8±2.8
	Study group	-4.1±2.4	-5.8±5.6	-7.6±7.8	-9.0±5.0	-8.6±2.4	-6.8±2.1	-7.1±3.3
p value		0.1	0.1	0.2	0.4	1.0	0.6	0.2
Apical	Control group	7.8±2.9	8.7±4.6	7.0±4.2	4.4±3.1	3.8±2.6	5.3±1.7	6.2±2.4
	Study group	6.0±3.0	7.1±4.8	7.3±5.4	5.8±4.9	4.6±4.1	5.1±3.2	6.0±4.0
p value		0.4	0.4	0.9	0.4	0.5	0.9	0.9

Basal: measurements at the mitral valve level; Apical: measurements at the apical level

Table 5. Left ventricular global peak systolic and diastolic rotational rate at two levels (mean±SD)

		Global peak systolic rotational rate (degree/s)	Global peak early diastolic rotational rate (degree/s)
Basal	Control group	-88.0 ±24.8	71.5±25.3
	Study group	-91.5 ±32.2	74.0±34.4
p value		0.7	0.8
Apical	Control group	77.1±22.2	-74.9±24.0
	Study group	71.7 ±29.2	-63.0±29.8
p value		0.6	0.2

Basal: measurements at the mitral valve level; Apical: measurements at the apical level

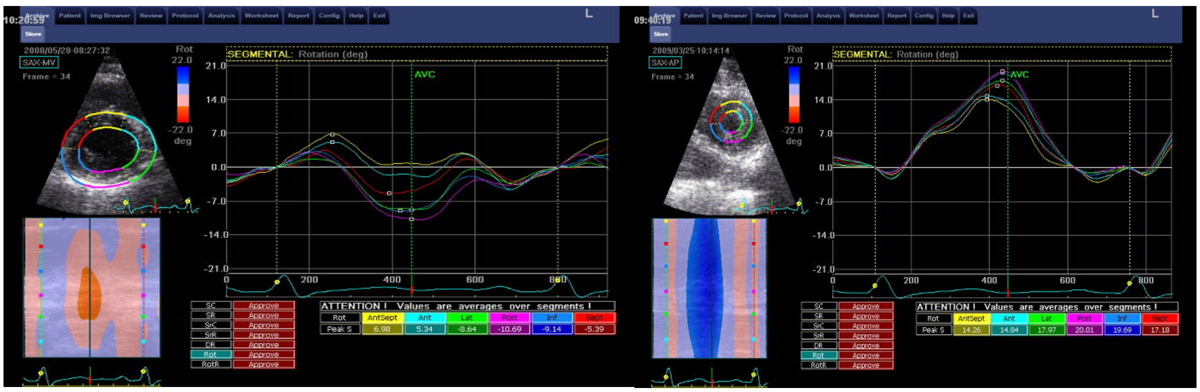

Figure 1. Profile of the segmental left ventricular basal and apical rotation of a 16 year boy after slow pathway radiofrequency ablation. Basal rotation was counter- clockwise positive at early systole and clockwise negative at the rest of systole, apical rotation was counter clockwise positive during systole except short clockwise negative rotation at early systole

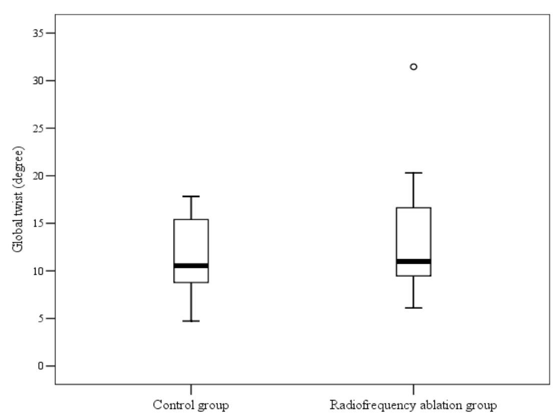

Figure 2. Comparison of peak global twist of the left ventricle in subjects after radiofrequency ablation in radiofrequency ablation group and controls. Solid horizontal line indicates median, hatched box, quartiles; and vertical line, highest and lowest values (p>0.05)

Longitudinal strain, strain rate parameters of LV and RV

Left and right ventricular longitudinal strain, systolic strain rate are presented in Table 2. Left and right ventricular global and segmental peak systolic strain, global and segmental peak systolic strain rate did not differ between the groups. Left and right ventricular diastolic strain rate (early and late) also did not differ between the radiofrequency ablation group and controls (Table 3).

Left ventricular rotation, rotational rate and twist

In all subjects of the radiofrequency ablation group and controls basal rotation was clockwise (negative) during systole, except early systole, apical rotation was counter clockwise (positive) during systole, except a short clockwise (negative) rotation at early systole (Figure 1). Mean values of segmental basal clockwise rotation and segmental apical counter clockwise rotation are shown in Table 4. No significant differences were found between the two groups in segmental and global apical and basal rotation and global peak systolic, early diastolic rotational rate (Table 5).

The left ventricular twist had tendency to be higher in radiofrequency ablation group, although values did not differ significantly between the groups: - 11.6(4.1) vs.12.95(6.17), p-value equal 0.5 (Figure 2).

Reproducibility of measurements

As continues variables were distributed abnormally, parameters were transformed to logarithmic scale. The mean of differences of the study for basal rotation was 0.4[-0.01-0.82] (paired differences [95% confidence interval of difference], for apical rotation 0.17[-0.08-0.42], for basal rotation rate 1.57[-0.22-3.36], for apical rotation rate 1.0[-0.15-2.16], for systolic longitudinal strain -0.1[-0.91-0.7], for longitudinal strain rate -0.04[-0.11-0.03], respectively.

DISCUSSION

The effectiveness of the treatment of supraventricular tachyarrhythmias by radiofrequency ablation in children is high and rate of complications is low.[12] Usually after successfully performed radiofrequency ablation children have no complains for heart failure, they are considered as healthy and have sport activities. Do we need to perform echocardiography after uncomplicated catheter ablation in these children? Routine echocardiography is highly recommended when a retrograde aortic approach has been used.[13] However; previous clinical and experimental studies have provided evidence that postprocedural expansion of myocardial radiofrequency lesions can occurr.[14] For example, in an experimental study, using young lambs, myocardial scar dimensions were reported to increase in a time- dependent manner up to 9 months from 5.3(0.5) to 8.7(0.7) mm in the atrium tissue and from 5.9(0.8) to 10.1(0.7) mm in the ventricular tissue after radiofrequency ablation.[15] Moreover, the postinjury remodeling process includes compensatoty myocyte hypertrophy in the myocardium remote to the scar.[14-16] In our study conventional echocardiographic examination did not reveal any left or right ventricular injury as conventional echocardiographic parameters of left ventricle and right ventricle size, wall thickness and function did not differ between the radiofrequency ablation group and control group. However, atrial volume parameters and atrial volume indices were higher in children, who underwent radiofrequency ablation. Medial correlation between atria volume index and heart rate during paroxysm and strong correlation between atria volume and duration of paroxysm permit us to hypothesize, that dilatation of the atria are due to previous repetitive arrhythmias, but not due to negative effect of radiofrequency ablation.

As the lesions created on myocardium by radiofrequency energy were not detected by conventional echocardiography in our study (it did not reveal any systolic or diastolic ventricular dysfunction), we assessed functional parameters of left and right ventricles using speckle tracking echocardiography in order to sustain the possibility of subclinical dysfunction.[4,7,10,11,16,17]

During slow pathway radiofrequency ablation procedure, the lesions are created locally in the ventricular septum at subendocardial level. Application of speckle tracking echocardiography makes it possible to evaluate longitudinal left and right ventricular deformation which is more sensitive for subendocardial damage.[11,18-20] Moreover, speckle tracking echocardiography permits to evaluate not only global, but also regional function as well as rotational function of left ventricle, which is a very sensitive indicator of subclinical systolic and diastolic dysfunction.[4]

Our study did not reveal any differences in global and regional left ventricular function, also right ventricular function using speckle tracking echocardiography between the radiofrequency ablation group and healthy subjects. Left and right ventricular global and segmental peak systolic strain, global and segmental peak systolic and diastolic strain rate, as well as left ventricular rotational indices did not differ between the groups.

Though different patterns of apicobasal twisting are seen in pediatric age: counter clockwise apical rotation is almost constant during childhood, whereas basal rotation counter clockwise in infancy to neutral in early childhood and showing the adult clockwise pattern in adolescence[21-23], in the present study we have found an adult pattern of apicobasal twisting: counter clockwise apical rotation and clockwise basal rotation.

In conclusion, speckle tracking echocardiography has not revealed any deterioration of left and right ventricular regional and global long and short axis function in children, who underwent slow pathway radiofrequency ablation. Thus, it permits us to state, that no negative effect of radiofrequency ablation on left and right ventricle myocardium was revealed.

As data regarding normal 2D speckle tracking echocardiography in pediatric patients have been sparse, the parameters, obtained during this study in the subjects of the control group could be taken as reference values in pediatric age.

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