ELECTRONICS AND ELECTRICAL ENGINEERING
ISSN 1392 – 1215 *2011. No. 3(109)*
ELEKTRONIKA IR ELEKTROTECHNIKA

T 121 *SIGNAL TECHNOLOGY*
SIGNALŲ TECHNOLOGIJA

Speckle Tracking Derived Left and Right Atrial, Left and Right Ventricular Strain, Strain Rate After Atrioventricular Node Slow Pathway Radiofrequency Ablation

R. Sileikiene
Lithuanian University of Health Sciences,
A. Mickevičiaus 8, LT 44312, Kaunas, Lithuania, e-mail: rima.sileikiene@kmuk.lt
J. Vaskelyte, V. Mizariene, R. Jurkevicius
Institute of Cardiology Lithuanian University of Health Sciences,
Sukileliu Av. 17, LT-3007 Kaunas, Lithuania
I. Bluzaite
Division of Cardiology, Department of Internal Medicine, Kantonsspital St.Gallen,
CH-9007 St.Gallen, Switzerland, e-mail: ina.bluzaite@kssg.ch,
Institute of Cardiology Lithuanian University of Health Sciences,
Sukileliu Av. 17, LT-3007 Kaunas, Lithuania

Introduction

The supraventricular tachycardias – atrioventricular reentrant tachycardia due to accesory pathways and atrioventricular nodal reentrant tachycardia are common in children. During the last decade transcatheter radiofrequency ablation (RFA) 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 (500 kHz) and by the thermal effect (t^0 - 50^0) , in the case of atrioventricular nodal reentrant tachycardia – in the zone of tricuspid valve. Previous clinical and experimental studies have provided evidence that postprocedural expansion of myocardial radiofrequency lesions can occurr. 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 RFA [2]. Moreover, the postinjury remodeling process includes compensatoty myocyte hypertrophy in the myocardium remote to the scar [3]. Does it influence the systolic and diastolic function of the heart late after RFA remains unclear. There is no data on subclinical changes of the systolic and diastolic function of the heart in children who underwent transcatheter RFA. 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, such as 2D speckle tracking echocardiography (2D STE) allows to assess regional systolic and diastolic function of the heart, atrial and ventricular deformation parameters - speckle tracking derived strain (ε) and strain rate (SR) [4–7].

SR, which reflects the rate of myocardial deformation, has been developed by estimating the spatial gradients in myocardial velocities, whereas ε, its integral, determines the total amount of of local deformation of a tissue [8, 9]. Both are independent of overall heart motion, cardiac rotation, or motion induced by contraction in adjacent myocardial segments, and are the true measure of local deformation. Speckle tracking echocardiography represents a simplified and angle - independed modality for quantification of regional atrial and ventricular myocardial deformation: longitudinal strain, strain rate, that are more sensitive in assessment of subclinical systolic and diastolic dysfunction of the heart [2, 4, 7].

This study was designed to assess atrial and ventricular function using conventional echocardiographic parameters, as well as left and right atrial and left and right ventricular strain, strain rate using 2D STE in children at late follow–up after RFA of the atrioventricular (AV) node slow pathway and in healthy children.

Materials and methods (study populations)

The study group consisted of 42 subjects: 20 healthy

children (control group), mean age 16.27 (1.58) (10 boys) and 22 children, mean age 16.59 (2.44) (11 boys), who underwent successful AV node slow pathway RFA 2-5 years ago (RFA group). During the 2000-2005 year period RFA of AV node slow pathway was performed in 40 children due to typical AV nodal reentrant tachycardia. At late follow-up 22 children were investigated, the remaining (18 persons) refused to participate in the study or were older than 18 years of age. Before RFA treatment children suffered from paroxysms of tachycardia.

At the study time (late follow up after RFA) 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: Abnormalities by physical examination, electrocardiography, transthoracic echocardiography (no signs of left and right ventricle hypertrophy, valvular disease and wall motion), they did not use any medications.

The study protocol was approved by the Ethic Commitee 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 [10]. The biplane Simpson's rule was used for calculation of left ventricle ejection fraction. Maximum left (LA) and right atria (RA) volumes were obtained from 2D frame just before mitral valve opening; minimal LA and RA volumes were obtained from the smallest volumes seen after atrial contraction.

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 long-axis apical four and two chamber view with the M3S probe. For analysis of left ventricle (LV), right ventricle (RV), LA and RA long axis function apical four and two 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 (EchoPAC PC, GE Vingmed) for offline analysis. A line was traced along the endocardium of LV and RV at the frame where it was best defined. For atrial analysis, a line was drawn along LA and RA endocardium when the atria were at their minimal volume after contraction. 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 STE method) yielded a measure ε and SR at any point of myocardium. LV was divided into 6 long axis segments in each view. RV was divided into basal and middle segments of the lateral wall. RA was divided into 2 (annular and middle) long axis segments of the lateral wall and LA was divided into 4 long axis segments (annular and middle) of the septum, lateral, anterior and inferior walls. The superior or „roof" region of the atria was excluded as this segment is rather stationary and makes no contribution to the atrial motion and active contraction.

Analysis of regional ventricular and atrial longitudinal function – strain and strain rate

The four chamber view of the heart was analysed offline using EchoPAC software for the assessment of ε and SR of LV lateral wall, ventricular septum, RV lateral wall segments, RA lateral wall segments, the atrial septum and LA lateral wall segments; the apical two chamber view- for the assessment of ε and SR of LV inferior, anterior wall segments and LA inferior and anterior wall segments with the 2D STE method. The SR is equivalent to the spatial gradient of pixel movements. It is characterised by the equation $SR = d[r]-d[r + \Delta r]/\Delta r * t$ (d- distance in movement, r- location in space, t- time and expressed s^{-1}) [7]. The time integral of incremental SR yields ε, defined as the fractional change from the original dimension, the percentage shortening or lengthening of myocardium [7, 8, 11]. $\varepsilon = L - L_0/L_0$, where L and L_0 are the length of an infinitesimal material line segment at end diastole and end systole, respectively. 3 cardiac cycles were averaged. The system calculates mean global ε and SR values for whole predefined LV and RV, LA and RA segments. Lengthening is positive and shortening is negative in this description. Atrial ε and SR values were measured during atrial contraction (time from the end of P -wave on ECG to mitral valve closure) and relaxation (time from mitral valve closure to aortic valve opening).

Statistical analysis

Statistical analysis was performed with software SPPS version 14.0 (SPSS, Inc., Chicago, Il., USA). A p-value less than or equal to 0.05 was considered

All parametric data were expressed as the mean (standard deviation), M (SD). Student's (t) test was used for comparison of quantitative sizes of two independent samples. χ^2 test was used for comparing frequencies of qualitative variables. Spearman correlation coefficients were obtained to describe relations for parameters of different methods to evaluate systolic and diastolic function of the heart.

Results

Clinical and conventional echocardiographic parameters are presented in Table 1. There were no significant differences in LV dimensions, LV ejection fraction, LV ventricular fractional shortening. LV and RV inflow indices were comparable between the RFA group and controls, except LV filling velocity during atrial contraction (it was decreased in RFA group). LA and RA volumes (minimal and maximal) and their indices were

significantly higher in RFA group. In order to reveal the causes of LA and RA dilatation, correlations between atria volume and clinical (age, weight, duration of the disease, characteristics of the paroxysms of atrioventricular tachycardia) variables were assessed. No correlations were found between echocardiographic and clinical parameters.

Table 1. Conventional echocardiographic parameters

Variable	Control group Mean (SD)	RFA group Mean (SD)	p value
Number	20	22	
Age (years)	16.3 (1.6)	16.6 (2.4)	NS
BSA (m^2)	1.6 (0.14)	1.6 (1.86)	NS
LVEDV (ml)	103.5 (21.6)	104.5 (20.63)	NS
LVESV (ml)	23.0 (6.8)	24.4 (8.7)	NS
LVEF (%)	56.5 (3.9)	54.5 (3.97)	NS
LVFS (%)	45.3 (4.6)	46.4 (5.62)	NS
LVMMI (g/m^2)	86.2 (3.6)	90.3 (4.5)	NS
E (cm /s)	82.0 (12.1)	88.1 (7.2)	NS
A (cm/s)	55.4 (8.0)	48.2 (2.2)	0.01
LV Edec (ms)	162.8 (31.9)	161.4 (35.8)	NS
RV (mm)	28.3 (2.3)	29.1(3.2)	NS
E_{RV} (cm/s)	61.4 (12.3)	58.8 (11.0)	NS
TAM A (mm)	19.5 (0.6)	21.4 (0.4)	NS
LAV max (ml)	28.0 (8.7)	37.3 (13.9)	0.024
LAVI max (ml/m2)	16.7 (6.0)	26.3 (9.8)	0.002
RAV max (ml)	16.0 (6.7)	21.5 (8.5)	0.047
RAVI max (ml/ m^2)	16.0 (6.6)	21.5 (8.5)	0.05
LAV min (ml)	11.65 (2.25)	13.64 (2.25)	0.007
LAVI min (ml/m^2)	7.16 (1.3)	8.36 (1.32)	0.005
RAV min (ml)	12.15 (4.5)	15.23 (5.01)	0.043
RAVI min (ml/ m^2)	7.41 (2.52)	9.36 (3.2)	0.035

here SD, standard deviation; NS,not significant; BSA, body surface area; LVEDV, left ventricular end diastolic volume; LVESV, left ventricular end systolic volume; LVEF, left ventricular ejection fraction; LVFS, left ventricle fractional shortening; LVMMI, left ventricular myocardial mass index; E, left ventricular early filling velocity; A, left ventricular filling velocity during atrial contraction; LVEdec, left ventricular early filling deceleration time; RV, right ventricular basal diameter; E_{RV}, right ventricular early filling velocity; TAM A; tricuspid annulus motion amplitude; LAV max, maximal left atrial volume; LAVI max, maximal atrial volume index; ; LAV min, minimal left atrial volume LAVI min, minimal left atrial volume index; RAV min, minimal right atrial volume; RAVI min, minimal right atrial volume index

Longitudinal strain and strain rate parameters of the ventricles and atria

All ε and SR traicings were acceptable for the analysis of longitudinal atrial and ventricular ε and SR. LA and RA longitudinal strain, strain rate are presented in Table 2, Table 3. Table 4, Table 5. The ε values during atrial contraction were reduced in all LA and RA wall segments in RFA group. ε during relaxation was reduced in all LA and RA wall segments in RFA group, except LA middle segments of inferior and anterior wall. Longitudinal SR during atrial contraction was reduced in all LA and RA walls in RFA group, except middle segments of RA lateral wall and LA inferior wall. Longitudinal SR during relaxation was reduced only in annular segments of LA lateral, inferior walls and interatrial septum in RFA group.

There was a negative correlation between maximal LA volume and longitudinal SR during relaxation of LA walls (r=-0.476, p=0.03) and positive correlation between minimal LA volume and longitudinal SR and ε during contraction of LA walls (r=0.361, p=0.03; r=0.375, p=0.024, respectively).

LV and RV global and regional longitudinal deformation values (ε, SR during cardiac cycle) were homogenous for all LV and RV segments and there were no significant differences between the subjects of both groups (Table 5, Table 6, Table 7, Table 8, Table 9).

Table 2. Longitudinal strain of the atria during atrial contraction

	Strain (%) in contraction Mean (SD)		p value
	Control group n=20	RFA group n=22	
IAS annular seg	-5.54 (2.0)	-2,44 (1.09)	<0.001
IAS middle seg	-5.57 (2.94)	-2.58 (1.6)	0.001
	LA lateral wall		
Annular seg	-5.63 (2.8)	-2.82 (1.35)	<0.001
Middle seg	-4.32 (2.3)	-2.67 (1.24)	0.001
	RA lateral wall		
Annular seg	-6.67 (1.05)	-4.33 (1.6)	<0.001
Middle seg	-5.05 (1.96)	-3.55 (2.16)	0.04
	LA inferior wall		
Annular seg	-4.61 (3.07)	-2.04 (1.66)	0.005
Middle seg	-4.18 (1.2)	-2.79 (0.55)	<0.001
	LA anterior wall		
Annular seg	-4.67 (2.07)	-3.11 (1.2)	0.014
Middle seg	-4.37 (2.57)	-2.88 (1.02)	0.038

here SD, standard deviation; NS, not significant; seg, segment; IAS, interatrial septum; LA, left atrium; RA, right atrium

Table 3. Longitudinal strain of the atria during atrial relaxation

	Strain (%) in relaxation Mean (SD)		p value
	Control group n=20	RFA group n=22	
IAS annular seg	21.55 (5.97)	12.75 (2.9)	<0.001
IAS middle seg	17.89 (5.12)	12.62 (3.7)	0.001
	LA lateral wall		
Annular seg	23.56 (17.01)	10.35 (4.4)	0.005
Middle seg	19.54 (11.32)	9.37 (4.10)	0.02
	RA lateral wall		
Annular seg	24.02 (10.88)	15.39 (5.3)	0.006
Middle seg	25.75 (14.23)	14.66 (5.6)	0.03
	LA inferior wall		
Annular seg	26.09 (17.05)	15.62 (3.7)	0.02
Middle seg	22.34 (6.08)	18.76 (5.4)	NS
	LA anterior wall		
Annular seg	24.14 (11.83)	15.08 (3.4)	0.005
Middle seg	19.22 (7.04)	15.37 (4.0)	NS

here SD, standard deviation; NS, not significant; seg, segment; IAS, interatrial septum; LA, left atrium; RA, right atrium

Table 4. Longitudinal strain rate of the atria during atrial contraction

	Strain rate (s^{-1}) in contraction Mean (SD)		p value
	Control group n=20	RFA group n=22	
IAS annular seg	-2.2 (1.25)	-1.05 (0.4)	0.001
IAS middle seg	-1.9 (0.75)	-1.25 (0.4)	0.003
	LA lateral wall		
Annular seg	-2.32 (0.83)	-1.48 (0.5)	0.001
Middle seg	-2.14 (0.9)	-1.28(0.3)	0.001
	RA lateral wall		
Annular seg	-2.22 (1.8)	-1.8 (0.29)	0.003
Middle seg	-2.21 (0.3)	-2.03 (0.4)	NS
	LA inferior wall		
Annular seg	-2.45 (0.5)	-1.9 (0.4)	0.001
Middle seg	-2.4 (0.12)	-2.12 (0.7)	NS
	LA anterior wall		
Annular seg	-2.26 (0.8)	-1.35 (0.2)	0.042
Middle seg	-2.21 (0.74)	-1.49 (0.4)	0.002

here SD, standard deviation; NS, not significant; seg, segment; IAS, interatrial septum; LA, left atrium; RA, right atrium

Table 5. Longitudinal strain rate of the atria during atrial relaxation

	Strain rate (s^{-1}) in relaxation Mean (SD)		p value
	Control group n=20	RFA group n=22	
IAS annular seg	1.43 (1.3)	1.08 (0.96)	0.02
IAS middle seg	1.86 (0.73)	1.66 (0.96)	NS
	LA lateral wall		
Annular seg	1.66 (0.44)	1.3 (0.58)	0.001
Middle seg	1.65 (0.32)	1.44 (0.5)	NS
	RA lateral wall		
Annular seg	1.37 (0.85	1.31 (0.1)	NS
Middle seg	1.27 (0.52)	1.08 (0.19)	NS
	LA inferior wall		
Annular seg	1.59 (0.1)	1.36 (0.26)	0.02
Middle seg	1.5 (0.15)	1.41 (0.27)	0.101
	LA anterior wall		
Annular seg	1.57 (0.1)	1.49 (0.35)	NS
Middle seg	1.5 (0.38)	1.51 (0.39)	NS

here SD, standard deviation; NS, not significant; seg, segment; IAS, interatrial septum; LA, left atrium; RA, right atrium

Table 6. Global and regional longitudinal peak systolic strain of the left and right ventricle

		Peak systolic strain (%) M (SD)		p value
		Control group n=20	RFA group n=22	
LV inferior	Basal	-17.1(4.7)	-21.6(6.3)	NS
	Mid	-20.3(5.6)	-19.8(3.7)	NS
	Apical	-20.3(5.4)	-17.2 (4.5)	NS
	Global	*-19.2(8.5)*	*-19.6(4.8)*	NS
LV anterior	Basal	-20.3(4.8)	-23.2(6.6)	NS
	Mid	-20.5(3.5)	-21.9(6.0)	NS
	Apical	-18.4(4.8)	-17.5(6.6)	NS
	Global	*-19.7(4.4)*	*-20.9(6.4)*	NS
LV lateral	Basal	-10.8(8.4)	-14.8(5.6)	NS
	Mid	-17.3(4.3)	-13.0(5.6)	NS
	Apical	-18.0(5.2)	-11.3(8.9)	NS
	Global	*-14.1(5.6)*	*-13.9(5.6)*	NS
LV septum	Basal	-19.6(2.4)	-17.4(9.9)	NS
	Mid	-20.8(3.4)	-17.09(7.1)	NS
	Apical	-14.5(9.1)	-15.8(5.4)	NS
	Global	*-18.3(5.2)*	*-16.7(7.5)*	NS
RV lateral	Basal	-16.5(10.3)	-16.6(11.4)	NS
	Mid	-24.7(10.5)	-20.4 (9.9)	NS
	Global	*-20.8(10.0)*	*-19.2(11.6)*	NS

here LV, left ventricular; RV, right ventricular; Mid, middle segment of the wall; Global, mean of all segments of the wall; NS, not significant

Table 7. Global and regional longitudinal peak systolic strain rate of the left and right ventricle

		Systolic strain rate (s^{-1}) M(SD)		p value
		Control group n=20	RFA group n=22	
LV inferior	Basal	-1.9(0.7)	-1.4(0.6)	NS
	Mid	-1.4(0.4)	-1.1(0.7)	NS
	Apical	-1.5(0.7)	-1.1(0.3)	NS
	Global	*-1.1(0.6)*	*-1.2(0.7)*	NS
LV anterior	Basal	-1.5(0.4)	-1.5(0.4)	NS
	Mid	-1.3(0.1)	-1.4(0.3)	NS
	Apical	-1.5(0.5)	-1.2(0.5)	NS
	Global	*-1.4(0.4)*	*-1.4(0.4)*	NS
LV lateral	Basal	-1.8(0.8)	-1.3(0.4)	NS
	Mid	-1.2(0.3)	-1.0(0.4)	NS
	Apical	-1.1(0.4)	-1.1(0.3)	NS
	Global	*-1.4(0.6)*	*-1.2(0.4)*	NS
LV septum	Basal	-1.2(0.3)	-1.2(0.5)	NS
	Mid	-1.2(0.3)	-1.1(0.3)	NS
	Apical	-1.1(0.3)	-1.1(0.3)	NS
	Global	*-1.2(0.3)*	*-1.1(0.4)*	NS
RV lateral	Basal	-1.2 (1.7)	-1.5(0.7)	NS
	Mid	-1.4(0.5)	-1.3(0.6)	NS
	Global	*-1.3(1.0)*	*-1.4(0.6)*	NS

here LV, left ventricular; RV, right ventricular; Mid, middle segment of the wall; Global, mean of all segments of the wall; NS, not significant

Table 8. Global and regional early diastolic strain rate of the left and right ventricle

		Early diastolic strain rate (s^{-1})		p value
		Control group n=20	RFA group n=22	
LV inferior	Basal	1.8(1.0)	1.9(0.5)	NS
	Mid	1.8(0.5)	1.6(0.4)	NS
	Apical	1.9(0.5)	1.4(0.7)	NS
	Global	*1.8 (0.7)*	*1.6(0.5)*	NS
LV anterior	Basal	1.7(0.5)	2.1(0.5)	NS
	Mid	1.7(0.4)	1.9(0.5)	NS
	Apical	1.9(0.3)	1.6(0.7)	NS
	Global	*1.8(0.4)*	*1.9(0.6)*	NS
LV lateral	Basal	1.7(1.0)	1.8(0.6)	NS
	Mid	1.8(0.5)	1.4(0.9)	NS
	Apical	1.9(0.8)	1.7(0.8)	NS
	Global	*1.8(0.8)*	*1.6(0.8)*	NS

		Early diastolic strain rate (s^{-1})		p value
		Control group n=20	RFA group n=22	
LV septum	Basal	1.8(0.4)	1.9(0.6)	NS
	Mid	1.9(0.4)	1.79(0.6)	NS
	Apical	2.2(0.7)	1.6(0.7)	NS
	Global	*2.0(0.5)*	*1.7(0.7)*	NS
RV lateral	Basal	1.7(1.1)	2.2(1.0)	NS
	Mid	1.8(0.8)	1.8(0.8)	NS
	Global	*1.7(0.8)*	*2.0(0.9)*	NS

here LV, left ventricular; RV, right ventricular; Mid, middle segment of the wall; Global, mean of all segments of the wall; NS, not significant

Table 9. Global and regional late diastolic strain rate of the left and right ventricle

		Late diastolic strain rate (1/s)		p value
		Control group n=20	RFA group n=22	
LV inferior	Basal	1.3(0.6)	1.0(0.5)	NS
	Mid	0.8(0.4)	0.7(0.4)	NS
	Apical	1.0(0.7)	0.9(0.5)	NS
	Global	*1.1(0.6)*	*0.9(0.5)*	NS
LV anterior	Basal	1.5(0.5)	1.3(0.5)	NS
	Mid	1.0(0.4)	1.0(0.4)	NS
	Apical	1.0(0.6)	0.8(0.5)	NS
	Global	*1.2(0.5)*	*1.0(0.4)*	NS
LV lateral	Basal	1.0(0.4)	0.9(0.7)	NS
	Mid	1.0(0.3)	0.8(0.4)	NS
	Apical	0.9(0.4)	1.0(0.7)	NS
	Global	*1.0(0.4)*	*0.9(0.6)*	NS
LV septum	Basal	0.9(0.4)	1.0(0.4)	NS
	Mid	0.9(0.4)	1.0(0.5)	NS
	Apical	1.2(0.5)	1.1(1.2)	NS
	Global	*1.0(0.5)*	*1.0(0.7)*	NS
RV lateral	Basal	1.0(0.7)	1.5(0.8)	NS
	Mid	1.0(0.5)	1.1(0.7)	NS
	Global	*1.0(0.5)*	*1.2(0.7)*	NS

here LV, left ventricular; RV, right ventricular; Mid, middle segment of the wall; Global, mean of all segments of the wall; NS, not significant

Conclusions

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 did not differ between the groups. But our study revealed increased atria volumes, reduced regional atrial myocardial deformation parameters - the ε and SR during atrial contraction and relaxation, especially at the annular segments of all walls of LA and RA during atrial contraction in children, who underwent ablation of AV node slow pathway. One of the possible cause of reduced atrial function may be negative effect of radiofrequency ablation.

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Received 2011 01 26

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Impairment of atria and ventricular function may occur after radiofrequency ablation (RFA) of AV node slow pathway in the case of tachycardia. The 2D speckle tracking imaging technique was used for quantification of global and regional function of the heart at late follow-up in children who underwent RFA of slow pathway. The study group consisted of 22 children who underwent RFA 5, 5 (2,5) years ago and 20 healthy children. The age was comparable between the groups. The study revealed no impairment of global and regional function of the ventricles and increased atria volumes, reduced regional atrial myocardial deformation parameters in children late after RFA. One of the possible cause of reduced atrial function may be negative effect of radiofrequency ablation. Bibl. 11, tabl. 9 (in English; abstracts in English and Lithuanian).

R. Šileikienė, J. Vaškelytė, V. Mizarienė, R. Jurkevičius, I. Blužaitė. Vaikų, kuriems buvo atlikta atrioventrikulinio mazgo lėtojo tako radiodažninė abliacija, kairiojo ir dešiniojo prieširdžio, kairiojo ir dešiniojo skilvelio įtampos ir įtampos kitimo greičio įvertinimas taškelių žymėjimo metodu // Elektronika ir elektrotechnika. – Kaunas: Technologija, 2011. – Nr. 3(109). – P. 57–62.

Po lėtojo tako radiodažninės abliacijos (RDA), esant tachikardijai, gali pablogėti prieširdžių ir skilvelių sistolinė ir diastolinė funkcijos. Vaikų, kuriems buvo atlikta atrioventrikulinio mazgo lėtojo tako RDA, segmentinei miokardo funkcijai įvertinti vėlyvuoju laikotarpiu taikytas taškelių žymėjimo metodas. Tiriamųjų grupė buvo sudaryta iš 22 vaikų, kuriems prieš 5,5 (2,5) metų atlikta RDA, ir 20 sveikų vaikų. Vaikų amžius grupėse nesiskyrė. Vaikų, gydytų RDA, skilvelių funkcija pagal ilgąją ašį vėlyvuoju laikotarpiu nepablogėjo. Tačiau padidėjo jų prieširdžių tūriai, sumažėjo prieširdžių deformacijos parametrai vėlyvuoju laikotarpiu. Tai galima paaiškinti neigiamu RDA poveikiu prieširdžių miokardui. Bibl. 11, lent. 9 (anglų kalba; santraukos anglų ir lietuvių k.).