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CORRESPONDENCE
Vascular and cardiac imaging

Effects of apical right ventricular pacing on right ventricular and left ventricular mechanics in patients with preserved systolic function: 2D speckle tracking assessment

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Introduction

Left ventricular (LV) function during right ventricular (RV) stimulation is well studied, while the effects on RV function are not well explored. We used speckle tracking echocardiography (STE) as it provides detailed information on LV and RV contractile performance, hence a more sensitive method to assess RV and LV function.

Methods

Fifty-three consecutive patients underwent echocardiography before implantation. LV and RV function was assessed with 2D echocardiography and STE. At a median follow-up of 8 months, the patients underwent control echocardiography and device interrogation. Patients were divided according to the percentage of cumulative ventricular pacing (CumVP) in Group 1 with <40% in dual chamber trigger/inhibition mode (DDD) mode or <80% in ventricular single chamber inhibition mode (VVI) mode ($n = 20$; 38%) and Group 2 with >40% in DDD or >80% in VVI mode ($n = 33$; 62%), based on the results of the mode selection trial study.[1] Standard echocardiography was performed. LV and RV quantifications were done according to current guidelines.[2]

Results

Patient characteristics and data are listed in *Table 1*. In Group 1, we observed a trend towards worsening all parameters. We registered a deterioration in RV systolic function measured by a significant decline in global right ventricular longitudinal strain (GLSRV) and right ventricular free wall strain (GLSRVFW) without a significant reduction in global longitudinal left ventricular strain (GLSLV). The systolic speed at the lateral tricuspid annulus (S't) and tricuspid annular plane systolic excursion (TAPSE) also decreased significantly without affecting the RV filling pressures measured indirectly by E/e't ratio. LVEF was not affected at all by this point. The systolic shortening speed at medial mitral annulus was significantly attenuated, which was not observed at the lateral mitral annulus. The altered activation leads to increased filling pressures in the LV assessed indirectly by E\e'm ratio. In Group 2, we measured a significant deterioration of RV systolic function assessed by GLSRV, GLSRVFW, S't, and TAPSE, but we also registered a significant worsening in LV function assessed by GLSLV, but almost no dynamics in the LVEF. The same pattern was observed in the systolic speed at the medial and lateral mitral annulus. LV and RV diastolic function worsened in both groups.

Discussion

The results from our study suggest that the altered activation induced subclinical systolic RV dysfunction in all patients and subclinical systolic LV dysfunction only with higher CumVP, based on STE and tissue Doppler imaging parameters. This was caused by the altered activation, leading to intraventricular preload redistribution.[2] LVEF was not affected at this point in all patients. LV filling pressures increased, but RV diastolic function remained normal. Apical stimulation may cause worsening of RV parameters irrespective of CumVP, or the threshold for RV dysfunction is lower than that for LV dysfunction.[3]

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Table 1 Patient characteristics, baseline, and follow-up data

Age, years	Gender	Pacing mode	
74 ± 2.7 (52–91)	Male ($n = 30$; 56.6%)	DDD $n = 48$(91%)	
	Female ($n = 23$; 43.4%)	VVI $n = 5$(9%)	
Group 1			
Parameter	Baseline	Follow-up	*P*-value
GLSRV, %	−22.00 ± 2.2	−18.58 ± 3.3	$P = 0.009$
GLSRVFW, %	−21.66 ± 2.3	−19.11 ± 1.2	$P = 0.034$
GLSLV, %	−20 ± 2.3	−19.3 ± 3.3	$P > 0.05$
LVEF, %	59 ± 8	59 ± 7.8	$P > 0.05$
E\e'm,	10.68 ± 1.5	14.31 ± 1.2	$P = 0.002$
S't, cm/s	17.88 ± 1.6	12.3 ± 3.3	$P = 0.007$
TAPSE, mm	21.65 ± 3.3	19.12 ± 2.9	$P = 0.001$
E\e't	4.35 ± 1.1	5.65 ± 2.6	$P > 0.05$
Group 2			
Parameter	Baseline	Follow-up	*P*-value
GLSRV, %	−21.4 ± 1.4	−17.34 ± 1.6	$P = 0.048$
GLSRVFW, %	−21.7 ± 1.9	−17.4 ± 1.8	$P = 0.049$
GLSLV, %	−20.37 ± 2.2	−17.49 ± 1.2	$P = 0.027$
LVEF, %	57 ± 4	55 ± 5	$P > 0.05$
E\e'm,	13.5 ± 1.3	16.6 ± 1.1	$P = 0.014$
S't, cm/s	17.6 ± 3.1	12.1 ± 2.5	$P = 0.039$
TAPSE, mm	21.7 ± 1.4	18.5 ± 1.2	$P = 0.044$
E\e't	5.3 ± 1.3	6.1 ± 2.3	$P > 0.05$

Conclusion

Short-term stimulation resulted in subclinical deterioration of RV function in all patients. It worsened LV function with higher CumVP. Based on our results and published data, we suggest that RV threshold for induced dysfunction is lower than LV threshold. Further studies are needed to understand the effects of RV apical pacing on RV function. The small cohort of the study needs to be acknowledged as a limitation of the study.

Authors' contributions

N.P. contributed to the design of the work, data acquisition, analysis, interpretation, and drafting of the work, approves the final version, and agrees to be accountable for all aspects of the work. E.K. was involved in data acquisition, analysis, and interpretation, revising the work, approves the final version, and agrees to be accountable for all aspects of the work. A.L. contributed to data acquisition, analysis, and drafting of the work, approves the final version, and agrees to be accountable for all aspects of the work. V.T. contributed to data analysis and interpretation, revising the work, and approves it to be published. A.G. contributed to the design of the work, data analysis, and interpretation, revising the work, approves the final version, and agrees to be accountable for all aspects of the work.

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Data availability

All data are incorporated into the article.

Statement of ethics

Ethics approval was not required. The patients signed an informed consent form for undergoing the procedure of implantation of the device.

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