

Reversibility of Heart Failure after Catheter Ablation in Patients with Ventricular Pre-Excitation-Induced Cardiomyopathy

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Introduction

Ventricular pre-excitation is characterized by the presence of an atrioventricular accessory pathway, predisposing patients to cardiac arrhythmias that may lead to syncope, palpitations, or sudden death.¹ Although rare, a possible complication is the development of heart failure (HF), referred to as pre-excitation-induced cardiomyopathy. It has been suggested that the eccentric ventricular activation caused by the accessory pathway leads to mechanical ventricular dyssynchrony, resulting in structural alterations and ventricular dysfunction.² Case reports have described improvement of HF after catheter ablation of the accessory pathway. It is important to alert the medical community to this rare entity, which should be considered in patients with ventricular pre-excitation and reduced ejection fraction, as it represents a potentially reversible cause of HF following ablation.³

Methods

This was an ambispective observational study conducted at a university hospital. Seven patients with ventricular pre-excitation and cardiac dysfunction who underwent radiofrequency catheter ablation of the atrioventricular accessory pathway were included. The inclusion criteria were: (1) pre-excitation on electrocardiogram (ECG), defined by a short PR interval (<120 ms in adults and <90 ms in children), delta wave, and QRS duration >120 ms in adults and >90 ms in children; and (2) systolic dysfunction with left ventricular ejection fraction (LVEF) <50% on echocardiography (Simpson's method).¹ Patients with other evident causes of HF were excluded. None of the patients had incessant tachycardia, ruling out arrhythmia-induced cardiomyopathy.

The following variables were evaluated: New York Heart Association functional class, ECG, and echocardiography (LVEF, left ventricular systolic and diastolic diameters) before

and after ablation. Student's t-test was used to compare the mean values of the echocardiographic parameters. A p-value <0.05 was considered statistically significant.

The study was approved by the research ethics committee under protocol number 6.304.113.

Results

The seven patients were followed between January 2018 and March 2024, with a mean follow-up time of 28.1 ± 25.2 months. All were male, with a mean age of 28.3 ± 19.4 years. Five patients had a right anteroseptal accessory pathway, one had a right lateral pathway, and one had a left posterolateral pathway (Table 1). Catheter ablation was performed without complications. After the procedure, patients underwent periodic ECG and echocardiographic evaluations (Figure 1).

Regarding HF symptoms, patients 1 and 2 showed improvement in functional class after ablation, without the need for medication. Patient 3, a child (5 years old) who had growth restriction despite medical therapy for HF, became asymptomatic and medication-free after ablation. The remaining patients had occasional paroxysmal palpitations, which resolved after the procedure.

Following ablation, a significant increase in LVEF was observed in all patients, from $42.1 \pm 8.2\%$ to $60.4 \pm 9.9\%$ ($p = 0.0013$). There was also a reduction in left ventricular diameters, with a mean decrease of 7 ± 1.1 mm in systolic diameter and 1.2 ± 1.9 mm in diastolic diameter. Echocardiographic data before and after ablation are presented in Table 2.

Discussion

The association between ventricular pre-excitation and ventricular dysfunction was first described in 1998, with improvement in cardiac function observed after accessory pathway ablation.⁴ Pre-excitation-induced cardiomyopathy remains underdiagnosed and may be mistakenly identified as idiopathic dilated cardiomyopathy, depriving patients of early effective treatment.^{3,5,6} Arrhythmia-induced cardiomyopathy due to incessant tachycardia must also be excluded, and this was not observed in any of our cases.³

Pre-excitation-induced cardiomyopathy is related to early ventricular activation caused by conduction through the accessory pathway, leading to mechanical ventricular dyssynchrony – a phenomenon similar to left bundle branch block and artificial cardiac pacing. Over time, ventricular dyssynchrony may induce myocardial remodeling, resulting

Keywords

Cardiomyopathies; Heart Failure; Catheter Ablation

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Table 1 – Clinical characteristics and accessory pathway location

CASE	Age (years)	Sex	Accessory pathway location	Pre-ablation NYHA class	Post-ablation NYHA class	Follow-up duration (months)	Time between ablation and last echocardiogram (months)
1	65	M	Postero-lateral L	III	I	39	15.4
2	15	M	Antero-septal R	II	I	79	70.7
3	5	M	Antero-septal R	I	I	31	3.0
4	32	M	Antero-septal R	I	I	18	3.6
5	37	M	Lateral R	I	I	12	93.5
6	19	M	Antero-septal R	I	I	8	3.3
7	25	M	Antero-septal R	I	I	10	0.2

M: male; L: left; R: right; NYHA: New York Heart Association functional class for heart failure; Echo: echocardiogram.

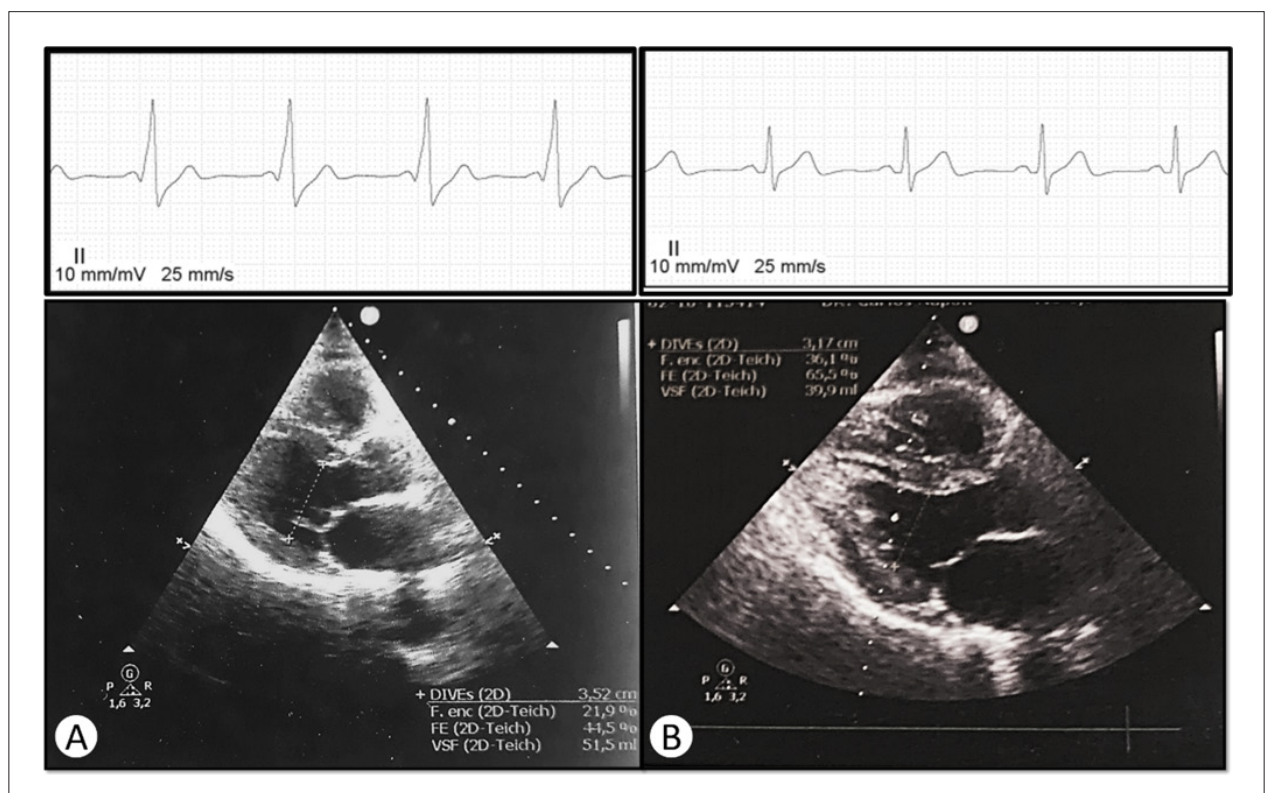


Figure 1 – A) Initial echocardiogram of patient 1 showing ventricular pre-excitation; echocardiogram demonstrating mild ventricular dysfunction. **B)** ECG after catheter ablation of the accessory pathway showing disappearance of ventricular pre-excitation; echocardiogram demonstrating recovery of ejection fraction (Teichholz) and reduction of end-systolic volume

in progressive dilation and ventricular dysfunction.^{3,6,7} Clinical manifestations may vary from asymptomatic cases to more severe presentations of HF, such as edema, dyspnea, and growth restriction in children,⁶ as observed in patient 3.

There are reports of systolic dysfunction associated with accessory pathways in various locations along the fibrous annulus; however, right lateral and septal pathways are more frequently linked to the development of HF.⁸ Interestingly,

patient 1, an older adult, had a left posterolateral accessory pathway and showed improvement after ablation, supporting the association between left-sided anomalous pathways and dyssynchrony with ventricular dysfunction.⁹ Although pre-excitation-induced cardiomyopathy typically presents early in life, it has also been documented in adults.^{4,10} The effects of ventricular pre-excitation are likely cumulative over the years, depending on individual and genetic

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Table 2 – Clinical characteristics and accessory pathway location

CASE	Pre-ablation LVEF (%)	Post-ablation LVEF (%)	Pre-ablation (mm)	Post-ablation LVESD (mm)	Pre-ablation LVESD (mm)	Post-ablation LVEDD (mm)
1	45	74	35,2	31	45,1	54,5
2	33	65	43	32	51	50
3	28	41	40	36,9	46	46,1
4	48	64	46	37	61	57
5	49	60	44	35	59	52
6	47	59	38	33	50	48
7	45	60	38	30	49	45
Mean ± SD	42,1±8,2	60,4±9,9*	40,6±3,9	33,5±2,8**	51,6±6,1	50,4±4,4***

SD: standard deviation; LVEF: left ventricular ejection fraction; *p-value 0.0013; **p <0.001; ***p 0.56; LVESD: left ventricular end-systolic diameter; LVEDD: left ventricular end-diastolic diameter.

predisposition, as ventricular dysfunction occurs in only a minority of patients.

Our study demonstrated improvement in cardiac function after ablation in patients with pre-excitation, evidenced by improved functional class and increased ejection fraction—findings consistent with the literature.^{3,5,7} Although ablation is the treatment of choice, in exceptional cases (such as low-weight children or para-Hisian accessory pathways), antiarrhythmic therapy may be used temporarily to block conduction through the accessory pathway and reverse dyssynchrony¹⁰ until the patient can be referred to an experienced electrophysiology center. Another important aspect is the time required for systolic function recovery after ablation, which may range from weeks to years.³ We observed cases with acute improvement, within less than one month after ablation, as well as cases in which recovery occurred only after several months.

Limitations

The small sample size and the ambispective nature of the study may limit the generalizability of the results.

Conclusion

In patients with ventricular pre-excitation who present clinical and echocardiographic signs of HF, in the absence of incessant tachycardia, ventricular dyssynchrony-induced pre-excitation cardiomyopathy should be considered. In this study, catheter ablation of the accessory pathway was shown to be decisive for improving both clinical status and ventricular function. We emphasize the need for early referral for ablation in patients with suspected pre-excitation-induced cardiomyopathy, as it represents a reversible cause of HF, with a positive impact on quality of life and prognosis.

Author Contributions

Conception and design of the research: Morte SSB, Magalhães LP; Acquisition of data: Morte SSB, Magalhães LP,

Duarte JOP, Guabiru AT, Santos AS; Analysis and interpretation of the data: Morte SSB, Magalhães LP, Duarte JOP, Guabiru AT, Santos AS, Magalhães EFS; Statistical analysis: Morte SSB, Magalhães LP, Magalhães EFS; Writing of the manuscript: Morte SSB, Magalhães LP, Magalhães EFS, Aras Junior R; Critical revision of the manuscript for intellectual content: Morte SSB, Magalhães LP, Duarte JOP, Magalhães EFS, Aras Junior R.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the Hospital Universitário Professor Edgard Santos (CEP/HUPES-UFBA) under the protocol number 6.304.113. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

Use of Artificial Intelligence

The authors did not use any artificial intelligence tools in the development of this work.

Availability of Research Data

The underlying content of the research text is contained within the manuscript.

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