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Cardiomyopathy induced by incessant ventricular tachycardia originating in the vicinity of the His bundle

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ABSTRACT

A 04-year-old boy was referred to our institution with severe, progressive heart failure of 4-months duration associated with a persistent wide QRS tachycardia with left bundle branch block and severe left ventricular dysfunction. Because of incessant wide QRS tachycardia refractory to antiarrhythmic drugs, he was referred for electrophysiological study. The ECG was suggestive of VT arising from the right ventricle near the His area. Electrophysiological study revealed that origin of tachycardia was septum of the right ventricle, near His bundle, however the procedure was not successful and an inadvertent complete atrioventricular conduction block occurred. The same ventricular tachycardia recurred. A second procedure was performed with a retrograd aortic approach to map the left side of the interventricular septum. The earliest endocardial site for ablation was localized in the anterobasal region of left ventricle near His bundle. In this location, one radiofrequency pulse interrupted VT and rendered it not inducible. The echocardiographic evaluation showed partial reversal of left ventricular function in the first 3 months. The diagnosis was idiopathic parahisian left ventricular tachycardia leading to a tachycardia mediated cardiomyopathy, an extremely rare clinical picture in children.
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1. Case report

A 4-year-old boy was referred to our institution with severe, progressive heart failure of 4-months duration associated with a persistent rapid heart rate, ranging from 150 to 180 bpm, despite the use of amiodarone and bisoprolol. The electrocardiogram (ECG) performed during admission showed a regular tachycardia with left bundle-branch block (LBBB) QRS morphology with an atrioventricular dissociation. Echocardiographic evaluation showed left ventricle (LV) enlargement (LVDd: 45 mm; LVDs: 42 mm), and a reduced LV ejection fraction (LVEF: 23%). Idiopathic incessant ventricular tachycardia (VT) leading to tachycardia mediated cardiomyopathy was suggested. Because of incessant wide QRS tachycardia refractory to antiarrhythmic drugs, he was referred for electrophysiological study. Antiarrhythmic medications were discontinued one week prior to electrophysiological procedure. The ECG was suggestive of VT arising from the right ventricle near the His bundle (Fig. 1).

The patient was brought to the electrophysiological (EP) laboratory in a fasting state after informed consent was obtained.

During deep sedation with endotracheal intubation, the VT stopped and sinus rhythm was restored.

Catheters were placed in the right ventricle via femoral veins. A seven French 4 mm-tip radiofrequency (RF) mapping/ablation catheter (Mariner, Medtronic) was used for cardiac mapping and ablation. One additional 6 F decapolar electrode catheter was used. During normal atrioventricular (AV) conduction, AH and HV intervals were 100 and 38 ms, respectively. Programmed ventricular pacing during isoproterenol infusion easily induced the ventricular tachycardia.

The ablation site was selected using activation mapping during tachycardia. During VT, retrograde ventriculoatrial (VA) conduction was 1:1 with a heart rate of 140 bpm (RR: 420 ms), and the VA interval was 165 ms. The entire right ventricle endocardial surface, including the tricuspid annulus, was carefully mapped. The earliest

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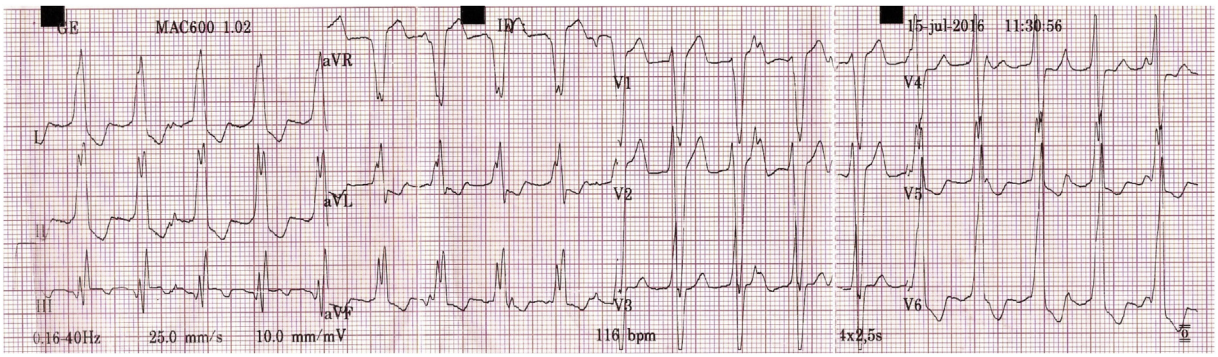

Fig. 1. Twelve-lead ECG showing wide-QRS tachycardia with a left bundle-branch block morphology.

endocardial site for ablation was localized adjacent to the His bundle (Fig. 2, Panel A). Local activation times preceded in 38 ms at QRS beginning (Fig. 2, Panel B). No cryo energy was available to prevent injury to the bundle. Radiofrequency ablation was indicated because the tachycardia mediated cardiomyopathy despite the risk of atrioventricular block (AVB). The VT stopped after 7–13 s after the beginning of each RF application but remained inducible during isoproterenol infusion. Unfortunately, a complete AV conduction block (AVB) was induced and the procedure was stopped. A single chamber pacemaker was implanted. Two weeks later the same VT recurred and the child underwent an additional session of RF catheter ablation. A retrograd aortic approach via the left femoral artery was performed to map the left side of the interventricular septum. Intravenous (IV) heparin bolus of 50 U/kg and infusion of 1000 U/h were administered during the procedure. A local activation time preceding the surface QRS complex by 58 ms, with a QS morphology with steep negative deflection was observed in the unipolar recording from the catheter tip in the left parahisian area (Fig. 2, Panel C and D). One RF application stopped the VT and remained non-inducible immediately and 30 min after the last energy application, despite isoproterenol infusion (Fig. 3). The child remained free of VT during 7 months of follow-up. The echocardiographic evaluation showed partial reversal of left ventricular function in the first 3 months with LVEF of 38% despite right ventricle pacing.

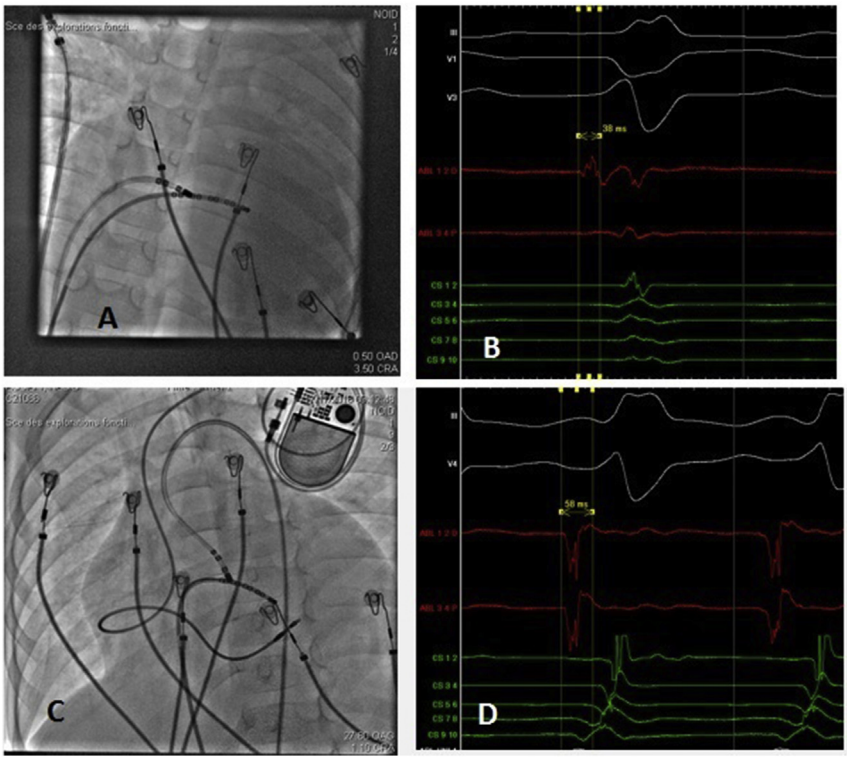

Fig. 2. Panel A: Anteroposterior fluoroscopic view showing the electrophysiological catheter positions during the first procedure. The earliest endocardial site for ablation was localized adjacent to the His bundle. Panel B: Corresponding intracardiac recordings during ventricular tachycardia from the right side of the parahisian area. Local activation times preceded in 38 ms at QRS beginning. Panel C: Rx image in left anterior oblique position, showing the catheter location where the earliest endocardial potential was recorded and where radiofrequency energy was successfully applied in the left parahisian region. Panel D: Corresponding intracardiac recordings during ventricular tachycardia from the left side of the interventricular septum. A local activation time preceding the surface QRS complex by 58 ms. Top to bottom: III, V1 and V3 (Panel B) and III and V4 (Panel D) are reference ECG leads. ABLp and ABLd proximal and distal electrogram obtained at the target spot. CS1-2 to CS 9-10: distal to proximal electrograms recorded from a decapolar mapping catheter positioned in the right ventricle.

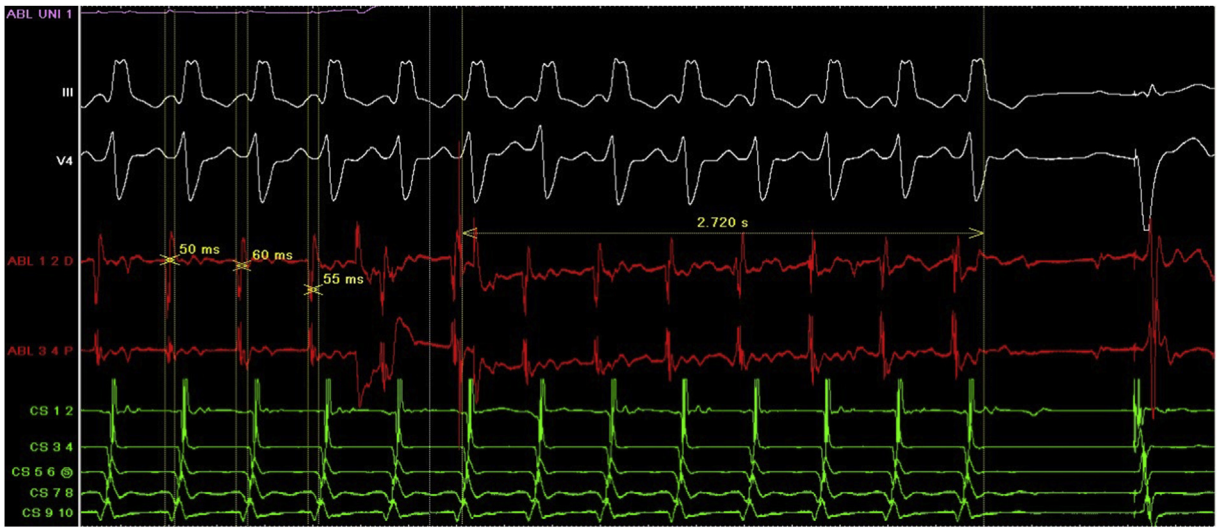

Fig. 3. Intracardiac recordings during ventricular tachycardia immediately before and during successful radiofrequency delivery. Top to bottom: III and V4 are reference ECG leads. ABLp and ABLd proximal and distal electrogram obtained at the target spot. ABLd shows the earliest activation potential during ventricular tachycardia with rapid interruption of ventricular tachycardia with radiofrequency application. CS1-2 to CS 9–10: distal to proximal electrograms recorded from a decapolar mapping catheter positioned in the right ventricle.

2. Discussion

This case describes an idiopathic incessant ventricular tachycardia arising from an unusual site in the left ventricle in a 4-year-old boy leading to a tachycardia mediated cardiomyopathy (TMC), which is an extremely rare and challenging clinical picture in children [1–3].

TMC is particularly apparent in children with specific types of incessant supraventricular tachycardia as focal atrial tachycardia and permanent junctional reciprocating tachycardia [1]. Idiopathic incessant VT leading to a tachycardia-mediated cardiomyopathy is a very rare form of clinical presentation, mostly related with idiopathic right ventricular outflow tract tachycardia. On the other hand, the most common tachyarrhythmia from the left His-Purkinje system are intra- or interfascicular reentries or focal Purkinje VTs and they generally have a good prognosis.

In this case, the electrocardiographic pattern of the ventricular tachycardia suggested a right parahisian origin and guided the initial approach with only right ventricular (RV) mapping. The first procedure failed and was complicated. A complete atrioventricular conduction block occurred.

Most of the data from the electrocardiographic and electrophysiological findings of idiopathic parahisian VA have been obtained from adult patients. Komatsu et al. [4] have proposed ECG criteria to identify parahisian VA and suggested the following technical practice to minimize procedural complications (specially inadvertent atrioventricular conduction block) in the stetting of these particular VA. The proposed technical tricks were (i) use of a long guiding sheath to assure the stability of the ablation catheter; (ii) use of cryoablation; (iii) mapping from both the right and left side; and (iv) knowledge of local electrogram characteristics at the successful ablation site.

In this case, a left-sided approach was considered, which was beneficial only after that right-sided RF catheter ablation failed. Regardless of age and weight, in the setting of parahisian VT, mapping both sides of the septum should be performed before any RF application to reduce procedure failure and complication (inadvertent atrioventricular conduction block).

Recently, Akdeniz et al. [5] reported the result of RV arrhythmias ablation in 35 children. Ablation failed in six patients. The location of VA was epicardial in 3 out of 6 (50%) failed procedures. In two patients, the origin of VA was adjacent to the His bundle and RF or irrigated RF ablation was not preferred to prevent injury to the bundle. In one patient, right ventricular outflow tract ablation failed and due to the age and weight (5 years, 20 kg respectively) retrograde approach via aorta was not done to assess the possibility of left ventricular outflow tract focus. Hence, the same authors described, the common feature of children with failed procedure, which were the presence of male gender, near the His bundle localization and epicardial origin.

3. Conclusion

This case demonstrates an unusual origin of VT in a child with a challenging RF catheter ablation. Regardless of age and weight, we emphasize the importance of mapping both sides of the septum in case of parahisian VT, before any RF application. Mapping the left side of the septum via a retrograde approach could avoid the inadvertent AVB. This observation shows also that left ventricular dysfunction induced by a persistent rapid ventricular rate (tachycardiomyopathy) is reversible after heart rate normalization despite AVB and pacemaker implantation.

Conflict of interest

None declared.

Author's contribution

SO, MB conceived this case report. All authors read and approved the final manuscript.

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