

Successful catheter ablation of premature ventricular contractions triggering torsade de pointes in a small infant with histiocytoid cardiomyopathy: a case report

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Received 8 November 2018; first decision 6 January 2019; accepted 19 May 2019; online publish-ahead-of-print 10 June 2019

Background

A short-coupled variant of torsade de pointes (ScTdP) is rare and resistant to medical treatment. There has not been a reported catheter ablation (CA) of a short-coupled premature ventricular contraction (PVC) triggering ScTdP in an infant.

Case summary

A neonate was referred to our hospital on the day of birth for Wolff–Parkinson–White syndrome, repeated episodes of supraventricular tachycardia, and a left ventricular non-compaction. She underwent CA of an accessory pathway at 72 days of age. On the 5th day after ablation, she had recurrent TdP episodes resistant to various anti-arrhythmic drugs and received extracorporeal membrane oxygenation at 86 days of age. She underwent CA of PVCs triggering TdP at 122 days of age and a weight of 3.4 kg. Two types of PVCs triggering TdP were successfully ablated, which originated from the right ventricle (RV). Pre-potentials were recorded at the earliest ventricular activation sites of the targeted PVCs. After the ablation, she had no TdP episodes and the cardiac assist device was removed. However, she died of uncontrolled heart failure at 6 months of age. The histological findings were compatible with histiocytoid cardiomyopathy and abnormal cells were distributed throughout both ventricles. At the ablation site, fibrotic transmural lesions were noted in the RV wall.

Discussion

The PVCs triggering TdP were successfully ablated in a 4-month-old girl with histiocytoid cardiomyopathy. The PVCs were likely caused by triggered activity and associated with abnormal Purkinje cells.

Keywords

Catheter ablation • Premature ventricular contraction • Torsade de pointes • Histiocytoid cardiomyopathy • Infant • Case report

Learning points

- Premature ventricular contractions triggering torsade de pointes are able to be ablated even in small infants.
- Histiocytoid cardiomyopathy can cause Wolff–Parkinson–White syndrome, fatal arrhythmias, or severe heart failure from the neonatal period.

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Handling Editor: Borislav Dinov

Peer-reviewers: Philipp Sommer and Giulio Conte

Compliance Editor: Anastasia Vamvakidou

Supplementary Material Editor: Peregrine Green

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Introduction

The outcome and complications of catheter ablation (CA) in children have improved with the long-term results exceeding 90% and the complication rate \sim 1%.¹ Supraventricular tachycardias (SVTs) are targeted in the majority and ablation of ventricular tachycardia (VT) is rare, especially in infants. The efficacy of CA of premature ventricular contractions (PVCs) triggering VT or a ventricular fibrillation (VF) storm in idiopathic VF or a channelopathy has recently been reported.^{2,3} Here, we report the CA of PVCs triggering torsade de pointes (TdP) in an infant with histiocytoid cardiomyopathy requiring a ventricular assist device (VAD) and refractory to medical therapy.

Timeline

The day of birth (admission)		Transferred to our hospital due to recurrent supraventricular tachycardias
2 months	72 days	Radiofrequency catheter ablation (CA) of a left anterolateral accessory pathway (body weight of 3.8 kg)
	77 days	Torsade de pointes (TdP) developed
	86 days	Received extracorporeal membrane oxygenation and was transferred to a certified heart transplant facility and received a ventricular assist device (VAD)
4 months	122 days	Radiofrequency CA for the premature ventricular contractions triggering TdP (body weight of 3.4 kg)
	132 days	Removed the VAD
6 months		Died of severe heart failure

Case presentation

A neonatal girl was born with a normal delivery, full term as the second child to healthy, non-consanguineous parents. Mild growth retardation was detected during the foetal period and no cardiac abnormalities were pointed out. She was referred on the day of birth for a recurrent SVT. In the physical examination, her weight was 2720 g, height 46.7 cm, blood pressure 63/32 mm Hg, pulse 255 b.p.m., respiratory rate 67/min, and oxygen saturation 96%. She was alert, her heart sounds were clear without a gallop rhythm, her breath sounds were normal, her liver was not palpable, and her extremities were cold. She had no external malformations.

Her electrocardiogram during the tachycardia revealed a ventricular rate of 255 b.p.m. and a narrow QRS wave with retrograde P waves just after the QRS wave. The tachycardia was temporarily responsive to more than 10 injections of an administration of adenosine triphosphate (0.3–0.5 mg/kg). The electrocardiogram during sinus rhythm revealed delta waves suggesting a left-sided accessory pathway, and Wolff–Parkinson–White (WPW) syndrome was diagnosed. Echocardiography revealed a left ventricular non-compaction with a

left ventricular ejection fraction (LVEF) of 59% and no other abnormalities. The condition was managed with a combination of flecainide (3 mg/kg), amiodarone (10 mg/kg), and digoxin (0.01 mg/kg).

The patient was discharged at 2 months of age but was readmitted for bradycardia caused by second-degree atrioventricular block. Deterioration of her LV function was due to a primary disease and antiarrhythmic drugs. At that time, no SVT occurred. We discontinued the administration of antiarrhythmic drugs and performed radiofrequency CA of a left anterolateral accessory pathway for recurring SVTs when she was 2 months of age. The accessory pathway was successfully ablated without any complications (Figure 1A).

Five days after the CA, she had recurrent TdP episodes (Figure 1B), which were resistant to a combination antiarrhythmic therapy with lidocaine (1.6 mg/kg/h), mexiletine (6 mg/kg), bisoprolol (0.02 mg/kg), and landiolol (1.8 μ g/kg/min), as well as a dual chamber pacemaker implantation (the DDD mode).

She received veno-atrial extracorporeal membrane oxygenation (ECMO) for cardiogenic shock (LVEF 15%) at 2 months of age. A short-coupled variant of TdP (ScTdP) was diagnosed based on the initiation of the TdP by a very short coupling interval of the PVCs (240 ms). The ECMO was switched to a temporary VAD using ROTAFLOW (MAQUET GmbH & CO. KG, Rastatt, Germany). The histological examination of the LV apex revealed histiocytoid cardiomyopathy. She did not meet the criteria for a heart transplantation due to a suspected systemic condition (agenesis of corpus callosum and a pale optic nerve). Although the TdP occurred sporadically on amiodarone, the VAD improved the cardiac function (LVEF, 53%). Because controlling the TdP would help remove the VAD, we performed CA of the PVCs under general anaesthesia when she was at 4 months of age and weighed 3.4 kg.

Two types of PVCs, which were a left bundle branch block and superior axis morphology, triggering the TdP were observed (Figure 1C and D). The coupling interval of the triggering PVC was 265 and 237 ms during atrial burst pacing at 150 and 190 b.p.m., respectively, which suggested that triggered activity was the mechanism of the PVCs (Figure 1E). After right ventricle (RV) angiography (Figure 2A), the earliest ventricular activation site was identified for each PVC, where the pre-potentials were recorded. The earliest ventricular potentials preceded the onset of the surface QRS complex by 22 ms for PVC1 and 26 ms for PVC2, respectively (Figure 1F and G). Nine radiofrequency applications were delivered for PVC1 and five for PVC2 using a 5-Fr ablation catheter (Ablaze 5F, Japan Lifeline) (Figure 2B and C). Each delivery lasted for 60 s with the temperature control set below 55°C with a power limit of 30 W. Disappearance of the PVCs was confirmed. After the ablation, the patient's cardiac performance was well maintained (LVEF of 55% and antiarrhythmic therapy with amiodarone and bisoprolol). At 4 months of age, VAD was removed. She lived for another 2 months without the VAD but died of uncontrolled heart failure at 6 months of age.

The genetic testing revealed a pathogenic mutation in the MHC6 gene (p.V274M) in the proband but not in the other three family members, which is associated with familial sick sinus syndrome and cardiomyopathy. No other mutations were detected in the PRKAG2, NDUFB11, and LAMP2 genes.

At autopsy, the heart weight was 63 g (normal value, 27.4 \pm 6.4 g). Endocardial fibroelastosis was noted in both ventricles. The luminal

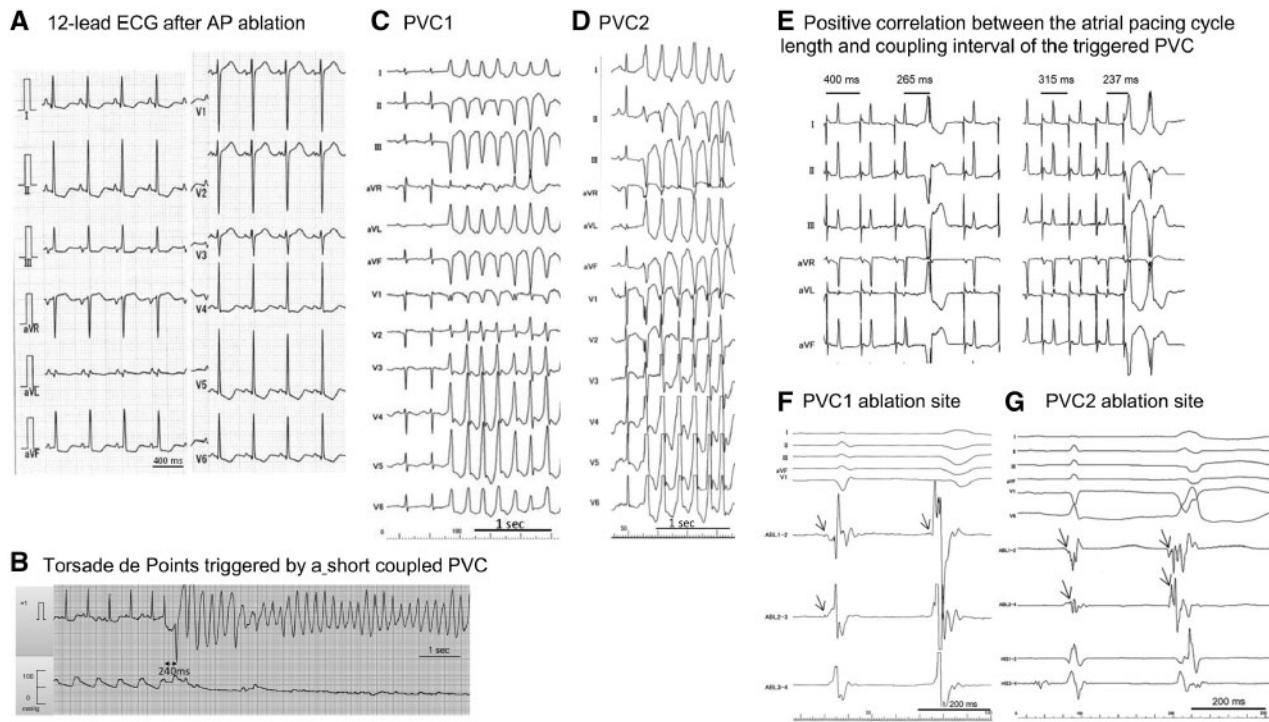


Figure 1 Electrocardiograms taken for the diagnosis and during ablation. (A) Twelve lead electrocardiograms after the accessory pathway ablation. (B) Torsade de pointes triggered by a short-coupled premature ventricular contraction (240 ms). (C and D) Two premature ventricular contractions (premature ventricular contraction 1 and premature ventricular contraction 2) that were triggering torsade de pointes. (E) Positive correlation between atrial pacing cycle length and coupling interval of the triggering premature ventricular contractions. The coupling interval of the triggering premature ventricular contraction was 265 and 237 ms during atrial burst pacing of 150 and 190 b.p.m., respectively. (F and G) Successful ablation of each premature ventricular contraction. The pre-potentials preceding the ventricular electrograms were recorded during both sinus rhythm and premature ventricular contractions. The arrows indicate the pre-potentials.

surface exhibited abnormally conspicuous, coarse trabeculations with a deep intertrabecular recesses but did not fulfil the criteria of a left ventricular non-compaction. Below the endocardium, there were clusters of vacuolated cells and histiocytoid cells, which had a characteristically large, round shape with a pale eosinophilic or foamy cytoplasm containing coarse granules and an irregular, centrally located round nucleus (Figure 3A). Those abnormal cells, stained by desmin, were distributed throughout both ventricles and in some parts of the atria. They were more prevalent in the subendocardium than subepicardium (Figure 3B). Hardly any fibrotic changes were observed except in the endocardium. At the ablation site, fibrotic transmural lesions were noted in the RV wall but not in the epicardium (Figure 3C and D).

Discussion

Histiocytoid cardiomyopathy is a rare genetic cardiac disorder of infancy and childhood, predominantly affecting girls below the age of 2 years. Clinically, it is characterized by severe cardiac arrhythmias including WPW syndrome, VT, and/or VF, dilated cardiomyopathy, cardiac arrest, and sudden death. Extra-cardiac features involving the nervous system and eyes have also been reported.⁴⁻⁷ DUFB11

variants have recently been independently proposed to cause histiocytoid cardiomyopathy. The efficacy of CA of PVCs triggering VF or polymorphic VT in idiopathic VF or channelopathies has been reported.^{2,3,8} Those PVCs could arise from the Purkinje system. Ablation therapy has also been reported in two cases of histiocytoid cardiomyopathy and VT, but the outcomes were far from satisfactory.^{9,10} The ablation target was the Purkinje tissue and anterior left bundle of His. One patient survived after a heart transplantation, and the other died of a cerebral haemorrhage after VAD therapy.^{9,10} Our case was a successful ablation of PVCs triggering TdP at the earliest ventricular sites. The patient died of uncontrolled heart failure due to cardiomyopathy 2 months later as a result.

The mechanism of ScTdP remains unclear, but it is assumed to be an unstable re-entry in the Purkinje network or triggered activity in the Purkinje cells. Histiocytoid cells are thought to correspond to abnormal Purkinje cells.¹¹ In the case presented here, abnormal cells were occupying the subendocardium areas in both ventricles, while no fibrotic tissues were observed in those areas. Based on the pathological and electrophysiological findings, the PVCs were likely caused by triggered activity and associated with abnormal Purkinje cells. The perpetuation of the VT could have been caused by re-entry in the injured Purkinje network, because ablation of the narrow area in the RV suppressed the TdP.

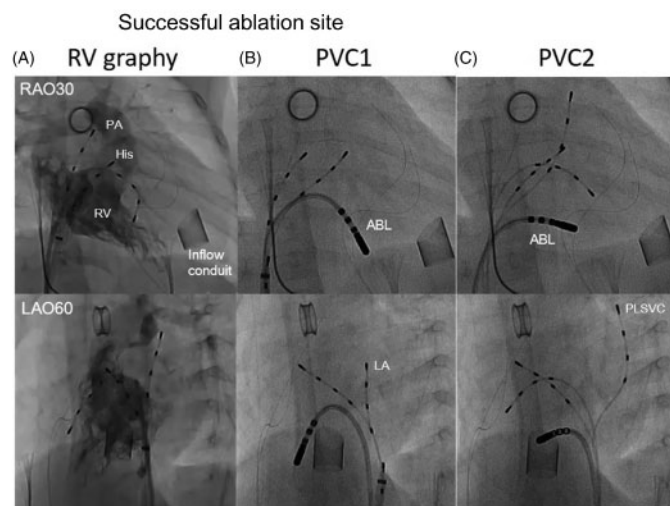


Figure 2 Fluoroscopy in the RAO and LAO views. (A) Right ventricular angiography. (B and C) Successful ablation of two premature ventricular contractions, premature ventricular contraction 1 and premature ventricular contraction 2. The origins of these two premature ventricular contractions were the apex and mid-level of the right ventricle. Electrode catheters were positioned at the bundle of His, right ventricle, left atrium, and persistent left superior vena cava. The inflow and outflow conduits of the left ventricular assist device were mounted in the left ventricular apex and aorta (A, B, and C).

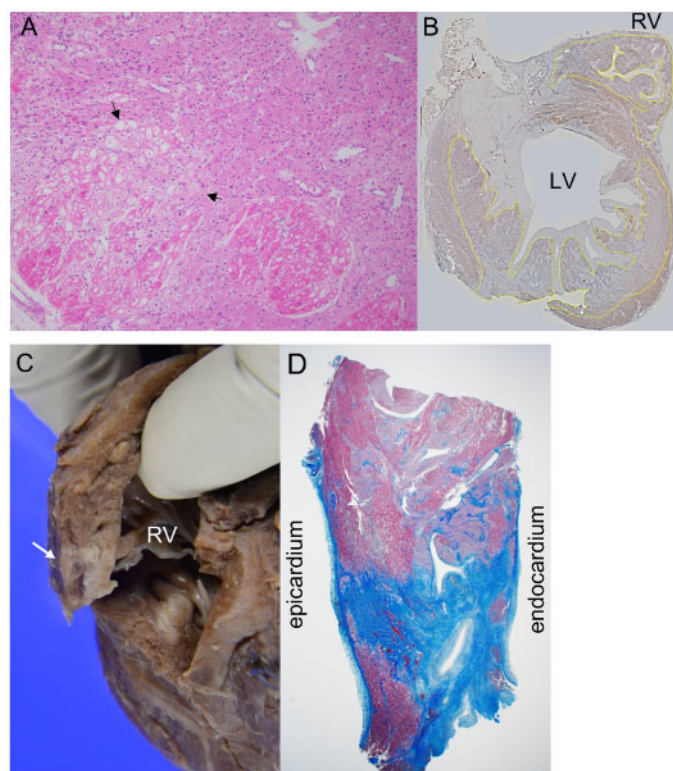


Figure 3 Histological findings. (A) Haematoxylin–Eosin stain. The arrows indicate the clusters of vacuolated cells. These cells were surrounded by histiocytoid cells characterized by their large, round shape, pale eosinophilic or foamy cytoplasm, and irregular, centrally located round nuclei. (B) Desmin stain. The enclosed spaces contain histiocytoid cells lightly stained in blue. These histiocytoid cells were found throughout both ventricles. Fibrotic changes were hardly noted except in the endocardium. (C) Macroscopic view of the ablation site in the right ventricle. The arrow indicates the ablation site where the tissue has turned white. (D) Masson's trichrome stain. Transmural lesions were replaced by fibrous tissues in the right ventricular wall but not in the epicardium.

Particular attention should be given to the safety of CA in small patients. The expert consensus for CA is that VT with a deteriorating ventricular function is a Class I indication, even in infants, if medical therapy is not effective.¹ We applied radiofrequency energy for 60 s for a total of 14 times at two different sites with the temperature control set below 55°C and a power limit of 30 W. Histopathology revealed the formation of transmural lesions replaced by fibrous tissue in the RV wall but not in the epicardium. This finding was quite satisfactory in terms of the adequacy of the depth of the ablation. At this level, abnormal cells associated with arrhythmias would have been eliminated without damaging the coronary arteries in the epicardium.

Conclusion

The PVCs triggering TdP were successfully ablated in a 4-month-old girl with histiocytoid cardiomyopathy. The PVCs were likely caused by triggered activity and associated with abnormal Purkinje cells.

Lead author biography



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Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

Acknowledgements

We thank Hidekazu Ishida and Kunihiko Takahashi for the evaluation of a heart transplantation and the management of the LVAD. We also thank Minoru Horie, Seiko Ohno, and Hidehito Kondo for their assistance with the genetic testing.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

Consent: The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: none declared.

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