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CASE REPORT
Electrophysiology

Transient conduction disturbances acutely after pulsed-field cavotricuspid isthmus ablation: a case report

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Background Cavotricuspid isthmus pulsed-field ablation has been recently described to be safely performed despite initial reports on coronary arterial spasm while conduction disturbances as a complication of cavotricuspid isthmus ablation are rare and have been reported exclusively for radiofrequency catheter ablation.

Case summary A 64-year-old female patient with mechanical prosthetic valves underwent atrial fibrillation ablation using the pentaspline pulsed-field ablation catheter. At the end of the uneventful pulmonary vein isolation, an atrial tachycardia depended to the cavotricuspid isthmus occurred. A single pulsed-field application at the cavotricuspid isthmus resulted in right bundle branch block combined with posterior fascicular hemiblock and PR prolongation that resolved spontaneously within 12 h.

Discussion This is the first report of transient conduction disturbances as a complication of cavotricuspid isthmus pulsed-field ablation. Although the underlying mechanism, either single or miscellaneous, was not verified, this case highlights that caution should be taken when the pentaspline pulsed-field ablation catheter is used for cavotricuspid isthmus ablation.

Keywords Pulsed-field ablation • Atrial flutter ablation • Cavotricuspid isthmus • Conduction disturbances • Trifascicular block • Case report

ESC curriculum 5.4 Atrial flutter • 6.3 Heart failure with preserved ejection fraction • 5.3 Atrial fibrillation

Learning points

(1) Transient conduction disturbances can complicate cavotricuspid isthmus pulsed-field ablation.
(2) This potential complication includes atrioventricular block and infranodal conduction disturbances as right bundle branch block and left posterior fascicular block.
(3) Possible mechanisms of this complication are direct injury to the atrioventricular node, conduction delay due to vagal response, and coronary artery vasospasm.

Introduction

Cavotricuspid isthmus (CTI) pulsed-field ablation (PFA) has been recently described to be safely performed despite initial reports on coronary arterial spasm.[1,2] Conduction disturbances as a complication of CTI ablation are rare and have been reported exclusively for radiofrequency (RF) catheter ablation.[3,4] In the present case, transient conduction disturbances occurred acutely after a single CTI pulsed-field

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application and firstly reported as a potential complication of this approach.

Summary figure

Medical history	Mechanical aortic and mitral valve implantation Persistent atrial fibrillation with functional capacity deterioration
Procedure	(1) Pulmonary vein isolation with pulsed-field ablation • Cavotricuspid-isthmus dependent atrial flutter presentation (2) Cavotricuspid isthmus pulsed-field single application • Acute right bundle branch block and left posterior fascicular block occurrence • No tachycardia termination (3) Electrical cardioversion • PR prolongation (334 ms) after cardioversion (in addition to right bundle branch block and left posterior fascicular block)
12 h after the procedure	Resolution of conduction disturbances (apart from a mildly prolonged PR interval of 220 ms)
Follow-up at 15 days	Sinus rhythm, normal QRS, mildly prolonged PR (220 ms) No recurrence of arrhythmias

Case presentation

A 64-year-old female patient was admitted for atrial fibrillation ablation (*Figure 1*). She had a history of mechanical mitral and aortic valve implantation, mild dilatation of left atrium (40 mm), normal systolic function of the left ventricle, and a recently deteriorated functional capacity attributed to persistent atrial fibrillation. Medical treatment before admission was including acenocoumarol, metoprolol (with adequate rate control), olmesartan, and amlodipine (with normal blood pressure on admission). Physical examination did not reveal signs of congestive heart failure. The patient underwent catheter ablation with the FARAPULSE PFA System (Boston Scientific, Marlborough, MA) using the 31 mm pentaspline PFA catheter (Farawave). At the end of the uneventful pulmonary vein isolation (PVI), an atrial tachycardia occurred that was entrained from the CTI. After administration of 2 mg of intravenous nitroglycerine, a single application (with a peak voltage of 2.0 kV), in flower configuration, was delivered at the lateral annular portion of the CTI (*Figure 2A*).

The patient acutely presented right bundle branch block (RBBB) and left posterior fascicular block (LPFB) without flutter termination (*Figure 2B*). The QRS complex in RBBB was particularly wide and a mild HV interval prolongation of 68 ms was revealed (*Figure 3A–C*). Cardioversion restored sinus rhythm uncovering an extremely prolonged PR interval of 344 ms in addition to RBBB (176 ms) and LPFB (*Figure 3B*). The patient remained under continuous electrocardiographic monitoring without any antiarrhythmic medication. Within 12 h, RBBB and LPFB resolved spontaneously and PR interval decreased to 220 ms (*Figure 3D*), as in previous ECG recordings. The following day, the patient was discharged in sinus rhythm. Fifteen days later, she was free of arrhythmias receiving sotalol 40 mg twice a day and the repeated ECG was identical to that of the day following the ablation procedure.

Discussion

Currently available clinical data from a multi-national survey have shown that PFA is both efficacious and safe for PVI.[1] Atrial flutter was also treated in 1.1% of the patients in this registry. Mitral isthmus ablation and left atrial re-entrant tachycardias ablation have also been reported with the same pentaspline PFA catheter.[5] Moreover, despite initial reports on coronary arterial spasm, cavotricuspid isthmus ablation has been recently described to be safely performed using nitroglycerine administration.[2]

Conduction disturbances as a complication of CTI ablation are rare, although not negligible, and have been reported exclusively for RF catheter ablation.[3,4] Possible mechanisms of this complication include direct injury to the atrioventricular (AV) node, conduction delay due to increased vagal tone, and acute occlusion of the right coronary artery.[6,7] The main described conduction abnormality is AV block while data on the incidence of RBBB occurring during the procedure are scarce and mainly attributed to mechanical trauma during catheter manipulations.[3]

RF ablation is based on producing thermal tissue damage, and an increased risk of an AV block may be related to a septal approach during CTI ablation.[3] PFA lesions of tissues exposed to electric fields are wider and occupy a bigger volume than those obtained in RF ablation.[8] Obtained lesions are not necessarily through high catheter contact, but also in the proximity of the tissue–electrodes interface and may be unexpectedly wide occasionally.[9] Therefore, an effect of PFA on the conduction system cannot be excluded despite intracardiac electrograms (bipolar signals recorded in between third electrodes of each spline) did not include a His or a right bundle electrogram before application (*Figure 2B*). In a recent study, histology of swine ventricles demonstrated viable Purkinje fibres, despite ablation of adjacent cardiomyocytes.[10] However, histology was performed 4 weeks after ablation and thus, the sparing of conduction system seen, although suggests a lower susceptibility than cardiomyocytes, cannot exclude a transient effect of pulsed fields. On the other hand, the appearance of LPFB due to a direct electric field effect on the remote posterior fascicle of the left bundle branch (LBB) would be less likely in our case.

After sinus rhythm restoration, bifascicular block was combined with a markedly prolonged PR interval with a discordant slighter HV prolongation. Even in the absence of a markedly slow sinus heart rate, this finding could also indicate a vagally-mediated AV block.[11] Vagal response of pulsed-field application on sites of cardiac ganglionated plexi is common during PVI and has mainly been described as a transient effect.[12] Epicardial vagal fibres or ganglia are also dense in the CTI area and may be stimulated directly.[6]

The third possible underlying mechanism could be arterial spasm of the right coronary artery and AV nodal artery. Coronary vasospasm, even subclinical, was routinely provoked during PFA at locations adjacent to a coronary artery in a previous report, although this phenomenon was attenuated by nitroglycerine, administered either *post hoc* to treat spasm or as prophylaxis.[2] The AV nodal artery, more frequently as a branch of the right coronary artery, supplies arterial blood not only to the AV node but also to the proximal portion of the RBB and the posteromedial fascicle of the LBB.[13] Notably, the latter have a dual arterial blood supply receiving also blood from branches of LAD.[13] In this way, RBBB, alone or in combination with left anterior hemiblock or left posterior hemiblock rarely complicates a right coronary artery occlusion.[14] Moreover, RBBB does not usually interfere

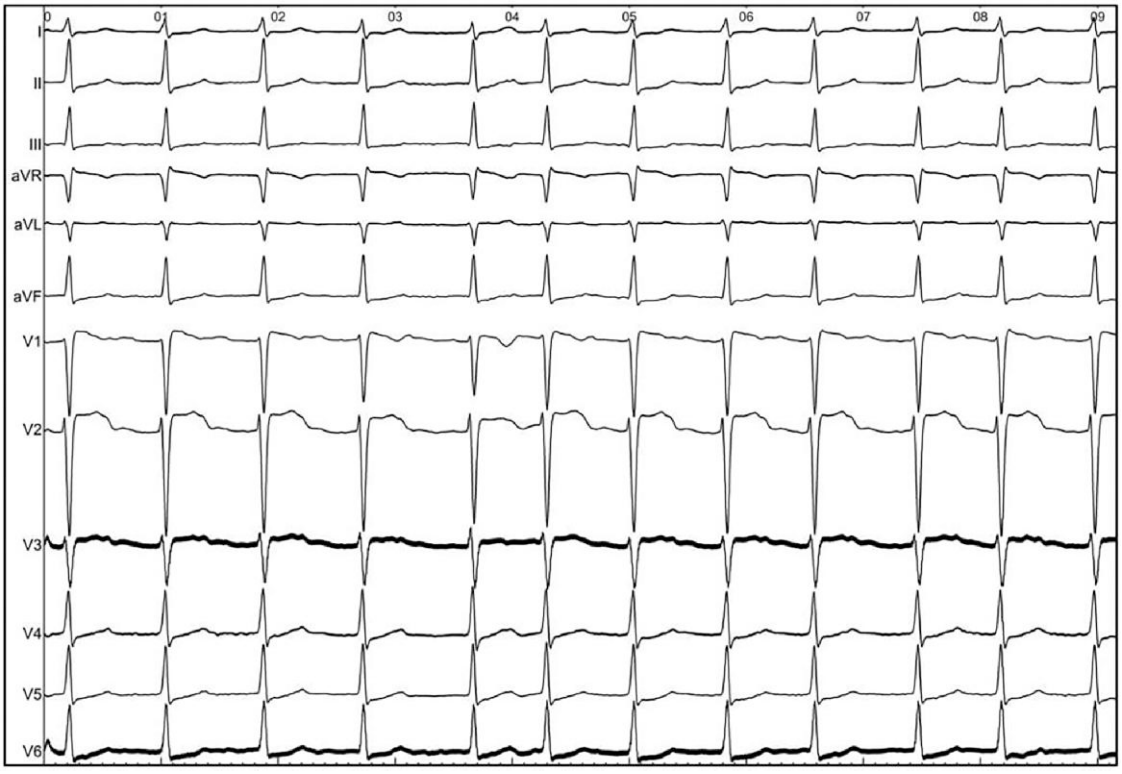

Figure 1 ECG on admission revealed atrial fibrillation with QRS of normal duration and normal axis.

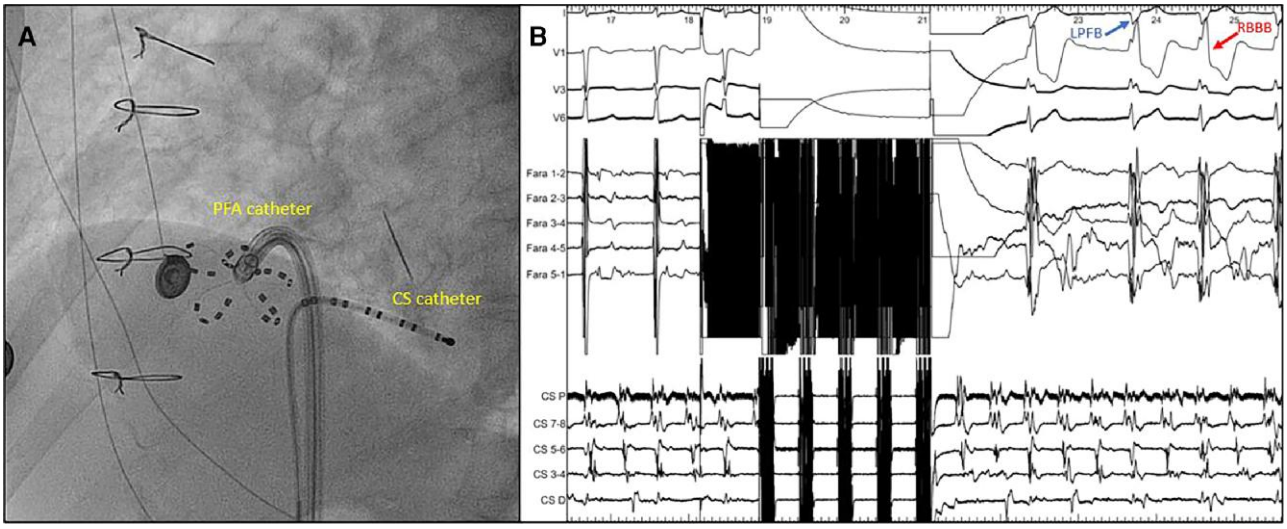

Figure 2 (*A*) After administration of 2 mg of intravenous nitroglycerine, a single pulsed-field application (with a peak voltage of 2.0 kV), in flower configuration, was delivered at the lateral annular portion of the cavotricuspid isthmus. (*B*) Acute occurrence of RBBB and LPFB without flutter termination. CS, coronary sinus; PFA, pulsed-field ablation; RBBB, right bundle branch block; LPFB, left posterior fascicular block.

with the diagnosis of an acute ST-elevation myocardial infarction, although ECG changes can often be subtle.[14] Apart from a 0.4 mV ST-segment discordant downsloping in right precordial leads (*Figure 3B*), no other possible signs of ischaemia were presented in our case. Taking into consideration the absence of ST-segment elevation and/or chest pain (after reversion of deep sedation) and the absence of wall motion abnormalities of the left ventricle, coronary angiography was not performed.

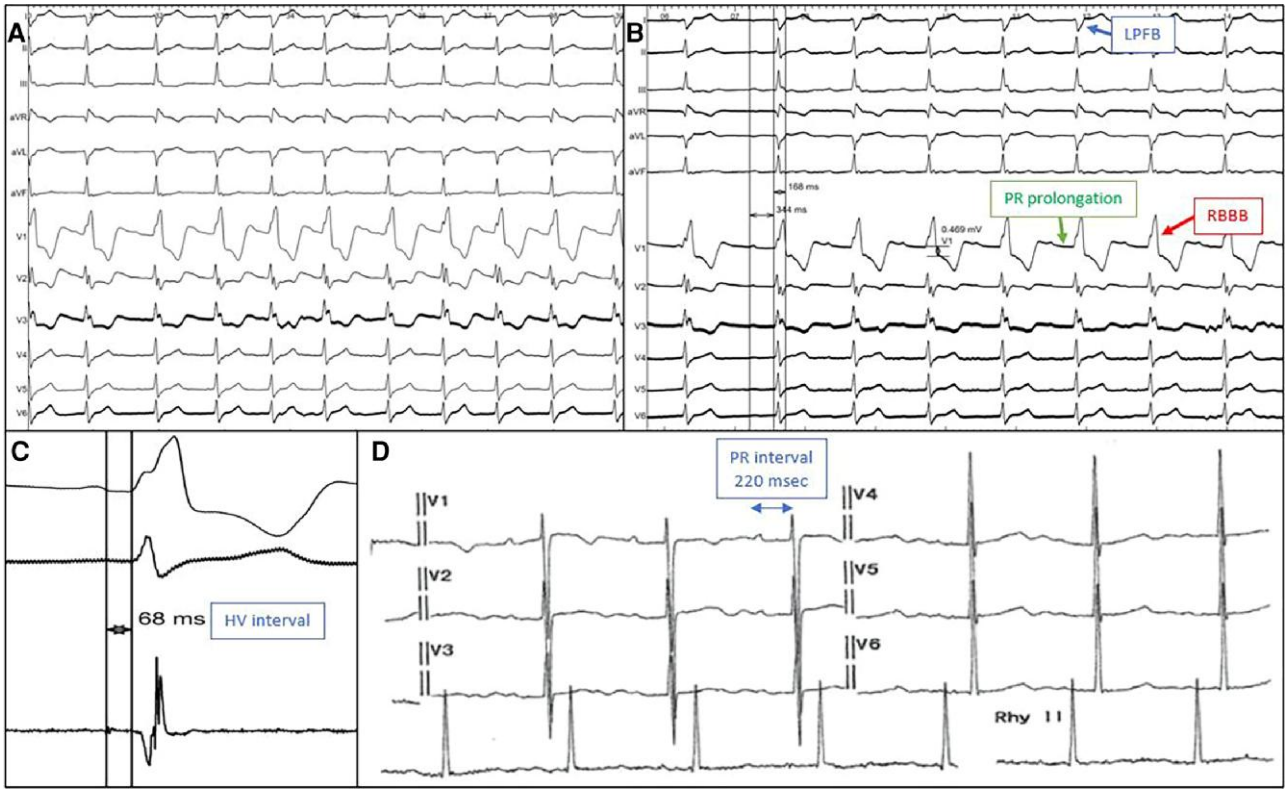

Figure 3 (*A*) Bifascicular block after cavotricuspid isthmus pulsed-field ablation. (*B*) Electrical cardioversion revealed a markedly prolonged PR interval (344 ms) in addition to RBBB and LPFB. (*C*) HV interval measurement revealed a mild prolongation. (*D*) Conduction disturbances resolved within 12 h after the procedure apart from a mildly prolonged PR interval (220 ms). RBBB, right bundle branch block; LPFB, left posterior fascicular block.

In conclusion, this is the first report of transient conduction disturbances as a complication of CTI PFA. Although the underlying mechanism, either single or miscellaneous, was not verified, this case highlights that caution should be taken when the pentaspline PFA catheter is used for CTI ablation, especially in the presence of pre-existing conduction abnormalities.

Lead author biography

Dr George Andrikopoulos graduated from the Medical School of Athens University (1990). He was a research fellow of the ESC at the Department of Biological Sciences, University of Warwick, UK (2000) and a Clinical Research Fellow at Walsgrave Hospital, Coventry, UK (1999). He received his PhD at Cardiovascular Genetics from the University of Athens (2004). He is president of the Hellenic Arrhythmia Institute, founding member of the Hellenic Cardiovascular Research society, and special scientific advisor of the board of the Hellenic Heart Foundation. He is director of the 1st Department of Cardiology and Electrophysiology at Henry Dunant Hospital Center in Athens.

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Conflict of interest: None declared.

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Data availability

The data underlying this case report are available in the manuscript and in its online supplementary material.

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