CASE REPORT

Catheter ablation of an epicardial accessory pathway via the middle cardiac vein guided by monophasic action potential recordings

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This report describes a case of permanent junctional reciprocating tachycardia (PJRT) that was ablated via the middle cardiac vein, guided by monophasic action potential recording. The patient was a 63-year-old woman who had been suffering from palpitation for 10 years. ECG during palpitation showed a narrow QRS tachycardia with a long RP interval. Electrophysiological study revealed that this tachycardia was an orthodromic reciprocating tachycardia, via an accessory pathway with a decremental property and a long ventriculoatrial interval (130 ms): PJRT. The earliest atrial activation during tachycardia was detected at the junction of the middle cardiac vein with the coronary sinus. Monophasic action potentials were recorded to confirm that the ablation catheter was in contact with the epicardium.

Key Words: Middle cardiac vein, catheter ablation, permanent form of junctional reciprocating tachycardia, epicardial accessory pathway.

Introduction

Endocardial catheter ablation of accessory pathways is now a common non-pharmacological therapy for patients with supraventricular arrhythmias[1,2]. Despite the high success rate, ablation failure may occur due to epicardial insertion of an accessory pathway[3]. Although the feasibility and relative safety of epicardial catheter ablation through the coronary sinus (CS) has been demonstrated[4,5], there is a risk of cardiac tamponade from current delivery into a small tributary of the coronary sinus (e.g. the middle cardiac vein)[6]. To minimize the risk of perforation, confirmation of catheter contact with the epicardium is important. This report describes a case of a permanent form of junctional reciprocating tachycardia (PJRT) with an epicardial accessory pathway, that was successfully ablated at the junction of the middle cardiac vein with the CS. In this patient, the position of the catheter tip was guided by recording monophasic action potentials (MAP) to confirm that the catheter was in contact with the epicardium.

Case report

A 63-year-old woman had been suffering from palpitation attacks for 10 years. When she was admitted to a hospital 10 years ago, she was diagnosed as having supraventricular tachycardia with sick sinus syndrome, and she underwent implantation of an antibradyarrhythmia pacemaker. During the follow-up period, she experienced pharmacologically refractory repetitive tachyarrhythmia, and she was referred to the authors' hospital. On admission, blood chemistry data and chest X-ray were normal. A 12-lead ECG during sinus rhythm showed no pre-excitation wave and normal QRS configuration. ECG recording during palpitation showed narrow QRS tachycardia with a long RP interval (Fig. 1). Most of this tachycardia was of the repetitive form and occurred from sinus rhythm.
Electrophysiological findings

After obtaining informed consent, an electrophysiological study was performed. All drugs were discontinued over a period of 48 h. Four quadripolar electrode catheters (7-French), with a distance of 2–5 mm between electrodes, were inserted percutaneously and positioned in the right atrial appendage, in the region of the His bundle and in the right ventricular apex. A decapolar 6-French catheter was placed in the CS through the right jugular vein.

Baseline studies during sinus rhythm revealed a sinus cycle length of 893 ms, atrio-His (AH) interval of 156 ms, and His-ventricle (HV) interval of 37 ms. Sinus node recovery time (SNRT) was markedly prolonged (9300 ms). Maximal antegrade one-to-one conduction via the atrioventricular (AV) node was 160 bpm.

Supraventricular tachycardia could be easily induced by programmed electrical stimulation both from the right atrium and ventricle. The cycle length of this tachycardia was 430 ms. The atrial activation sequence during tachycardia was identical to that of right ventricular pacing. When a premature ventricular stimulus was delivered during tachycardia at a time when the His bundle was refractory, the atrial activation time changed (Fig. 2). A diagnosis of orthodromic AV reciprocating tachycardia via an accessory pathway was made. The accessory pathway was characterized by slow retrograde conduction (130 ms), a decremental property, and conduction being blocked by adenosine (ATP) injection (20 mg bolus intravenously). Electrophysiological characteristics were compatible with PJRT.

First, endocardial radiofrequency (RF) ablation by the left ventricular endocardial or the left atrial transseptal approach was performed, but all attempts (up to 50 W) were unsuccessful because the site of atrial activation prior to P-wave onset could not be identified. Mapping within the CS, where the earliest local atrial activity was documented during the tachycardia, was then performed. The earliest atrial activity was detected at the junction of the middle cardiac vein and the CS, 2.5 cm from the CS ostium (Fig. 3). To avoid perforation of this small vein by RF energy delivery, MAP was recorded (0.5–400 Hz) to confirm that the catheter was in direct contact with the epicardium. A standard ablation catheter (distal 4 mm tip: EP Technology, USA) with bipolar mode was used to record MAP, but with reversed polarity (distal electrode to positive and proximal to negative). When the catheter tip was slightly deflected, there was increased dome elevation of MAP, suggesting that the catheter was in direct contact with the epicardial atrium [Fig. 4(a–c)]. Current delivery resulted in abrupt loss of ventriculo-atrial (VA) conduction within 7 s. The maximum tip temperature was 60°C, during a delivered power of 10 W and an impedance of 103 Ω. Repeated electrical stimulation was performed, but VA conduction was not observed even with isoprenaline infusion.

Discussion

An epicardial accessory pathway distant from the mitral valve annulus is relatively rare. An endocardial approach for RF ablation of such pathways is often unsuccessful. In such cases, an epicardial approach should be used. Although reports of complications from RF ablation inside the CS have been very rare, some complications (cardiac tamponade, AV block, and pericarditis) have been reported. Confirmation that the
catheter is in direct contact with the epicardium is important to minimize the risk of perforation. Haissaguerre et al. reported a unique technique using a unipolar configuration for a patient with a left lateral accessory pathway [7]. However, they did not mention contact of the catheter with the epicardium.

Monophasic action potential recordings, using a contact electrode technique, were first introduced by Franz et al. [8] and have since been used widely both experimentally and in clinical settings. It has been reported that MAP recordings are capable of reproducing the repolarization time course of the tissue [9] and that the magnitude of MAP might reflect electrical gradient due to injury current [10]. Therefore, this technique was used to confirm that the catheter was in contact with the myocardium. Interestingly, it was found that a difference in the intensity of catheter contact with the atrium can change the MAP amplitude [Fig. 4(c and d)]. Thus, it is considered that RF ablation in the epicardium guided by MAP at the same time is a useful method for confirming

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**Figure 2** Atrial reset by premature ventricular stimulation during PSVT. This demonstrated the tachycardia to be orthodromic atrioventricular reciprocating tachycardia via an accessory pathway. Note that the ventriculo-atrial interval was long at the site of the earliest atrial activation (CSp). CDd, distal coronary sinus; CSp, proximal coronary sinus; HBE, His-bundle electrogram; HRA, high right atrium; RVA, right ventricular apex; S, stimulus.

**Figure 3** (a) Left atrial and ventriculogram showing the mapping catheter (white arrow) placed at the epicardium. (b) Coronary sinus (CS) and middle cardiac vein (MCV) venography. (c) Site of the catheter ablation (white arrow). The earliest atrial activity was detected at the junction of the MCV and CS, 2·5 cm from the CS ostium. All of the images were obtained in the left anterior oblique view. A lead, pacemaker atrial lead; Ao, aortic root; Csos, ostium of coronary sinus; LA, left atrium; LV, left ventricle; V lead, pacemaker ventricular lead. Arrow in (b) shows ablation site via endocardial approach. Arrow in (c) shows successful ablation site.
that the catheter is in contact with the myocardium. Further experience is needed to demonstrate whether this technique is safer than the standard one.

We thank Kiyoshi Okano and Mineko Hatashima for their excellent technical assistance.

References