Journal of Arrhythmia 30 (2014) 515–518

Contents lists available at ScienceDirect

Journal of Arrhythmia

journal homepage: www.elsevier.com/locate/joa

Case Report

Intra-cardiac echocardiography guided catheter ablation of a right posterior accessory pathway in a patient with Ebstein's anomaly

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ARTICLE INFO

Article history:
Received 1 November 2013
Received in revised form
23 January 2014
Accepted 5 February 2014
Available online 20 March 2014

Keywords:
Intra-cardiac echocardiography
Catheter ablation
Ebstein's anomaly
Accessory pathway

ABSTRACT

We report a case of Ebstein's anomaly in which radiofrequency catheter ablation of an accessory pathway was successfully performed under intra-cardiac echocardiography. A 50-year-old woman was referred to our hospital for radiofrequency catheter ablation of a paroxysmal supraventricular tachycardia. A 12-lead surface electrocardiogram revealed ventricular pre-excitation associated with type B Wolff–Parkinson–White syndrome. In the baseline electrophysiological study, an orthodromic atrioventricular reciprocating tachycardia with a right posterior accessory pathway was induced. A phased-array intra-cardiac echo probe was positioned in the right atrium to visualize the atrioventricular junction. The key structures for catheter ablation, such as the atrialized right ventricle, atrioventricular junction, and tricuspid valve, were clearly visualized on intra-cardiac echocardiography. Radiofrequency current was successfully delivered at the atrioventricular junction, where a Kent potential was recorded. During a 6-month follow-up period, the patient was free from arrhythmias. The findings in this case suggest that phased-array intra-cardiac echocardiography is useful for ablation of right-sided accessory pathways in patients with Ebstein's anomaly.

1. Introduction

Ebstein's anomaly, characterized by apical displacement of the posterior and septal leaflets of the tricuspid valve, accounts for < 1% of all congenital heart diseases [1].

Approximately 20–30% of patients with Ebstein's anomaly have atrioventricular reciprocating tachycardia (AVRT) due to an atrioventricular accessory pathway [2,3]. Radiofrequency catheter ablation is a curable approach for symptomatic accessory pathways. However, in patients with Ebstein's anomaly, accessory pathway ablation is associated with a low success rate and increased risk of recurrence [4–6]. This is because it is difficult to identify the precise location of the atrioventricular junction [4,6].

Here, we report a case of Ebstein's anomaly treated with the accessory pathway ablation guided by intra-cardiac echocardiography (ICE).

2. Case report

A 50-year-old woman was referred to our hospital for radiofrequency catheter ablation of a paroxysmal supraventricular tachycardia. A 12-lead surface electrocardiogram revealed ventricular pre-excitation associated with type B WPW syndrome. A chest radiograph revealed cardiomegaly with a cardiothoracic ratio of 57% and normal pulmonary vascular markings. Two-dimensional echocardiography demonstrated enlargement of the right atrium, apical displacement of the septal leaflets of the tricuspid valve by 16.3 mm/body surface area, severe tricuspid regurgitation, no shunt flow, and normal left ventricular function (Fig. 1). The diagnosis of Ebstein's anomaly with type B Wolff–Parkinson–White syndrome was confirmed.

2.1. Electrophysiological study and ablation procedure

After written informed consent was obtained, electrophysiological study and catheter ablation were performed under local anesthesia. One wide-band duo-decapolar catheter was introduced via the right jugular vein and advanced into the coronary

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http://dx.doi.org/10.1016/j.joa.2014.02.002
1880-4276

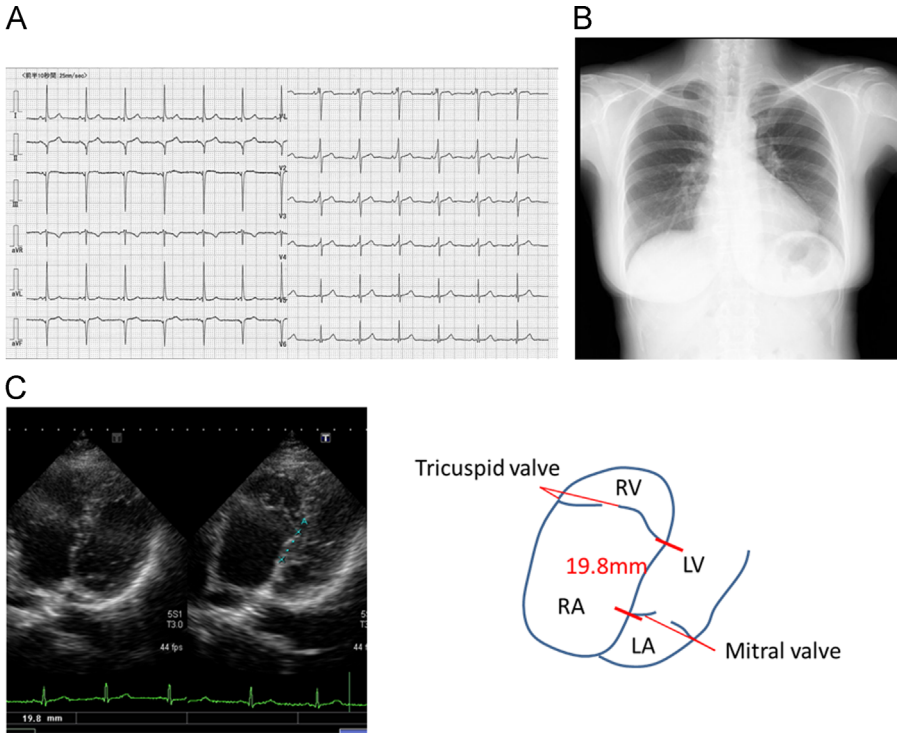

Fig. 1. (A) A 12-lead surface electrocardiogram during sinus rhythm. Ventricular pre-excitation associated with type B WPW syndrome was observed. (B) Chest radiograph. A chest radiograph revealed cardiomegaly with a cardiothoracic ratio of 57% and normal pulmonary vascular markings. (C) An apical 4-chamber view of two-dimensional echocardiography (left) with a schematic representation (right). Apical displacement of the septal leaflets of the tricuspid valve by 16.3 mm/body surface area was documented. RA: right atrium, RV: right ventricle, LA: left atrium, and LV: left ventricle.

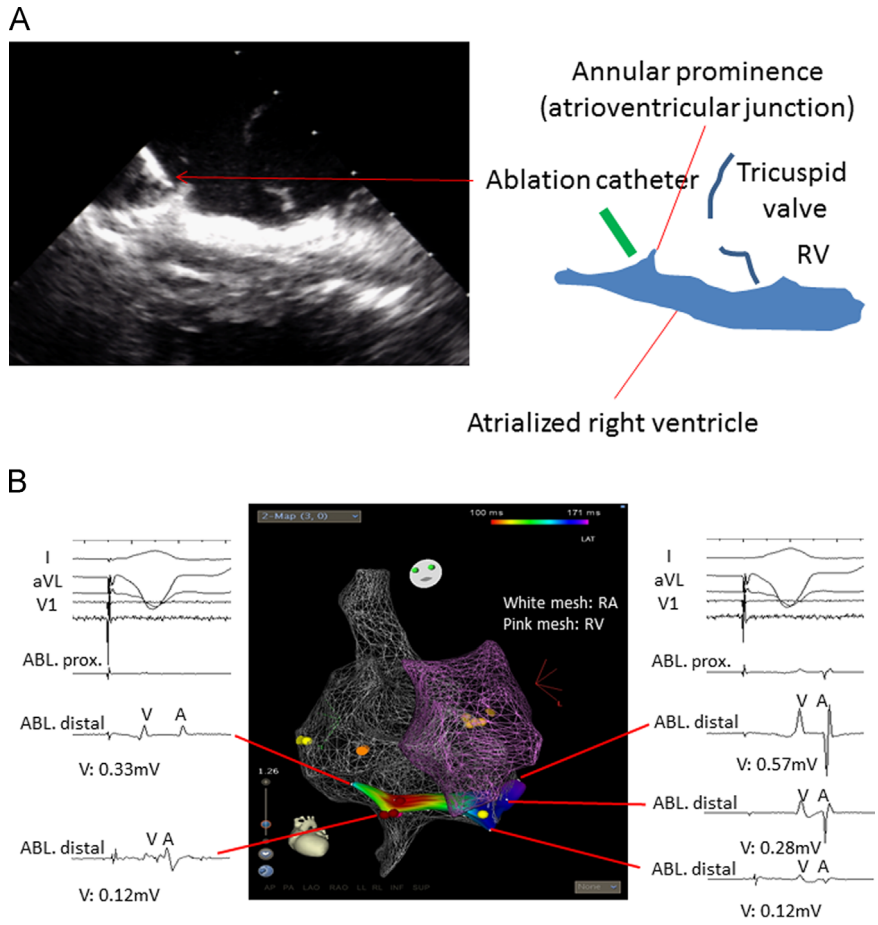

Fig. 2. (A) ICE findings of the posterior region of the atrioventricular junction (left) with a schematic representation (right). The important structures for catheter ablation, such as the atrialized right ventricle, atrioventricular junction, and tricuspid valve, could be clearly visualized. RV: right ventricle. (B) Atrial activation map and local bipolar electrocardiograms during ventricular pacing. The local bipolar ventricular electrocardiograms at the right posterior region revealed a low voltage area. ABL: ablation, prox.: proximal, V: ventricle, and A: atrium.

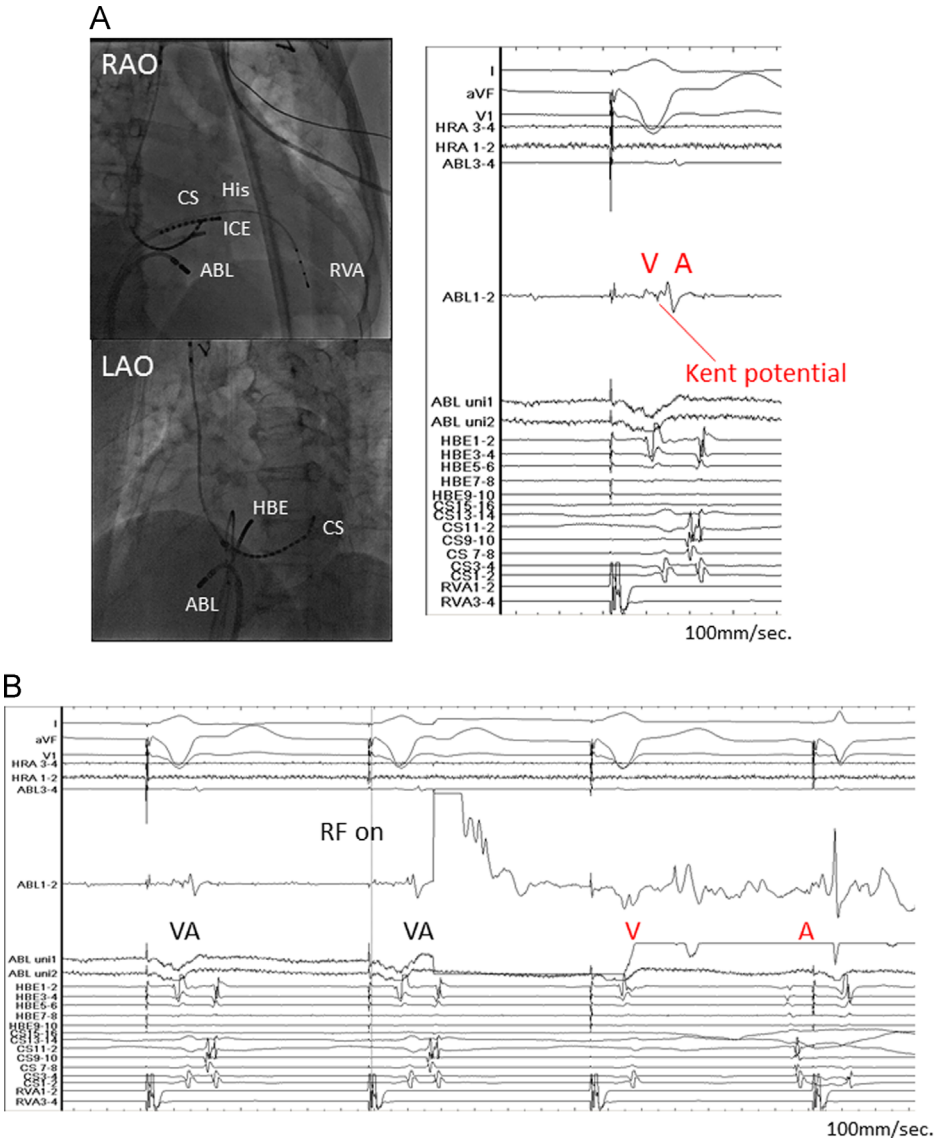

Fig. 3. (A) Fluoroscopic findings and local bipolar electrograms from the site with successful ablation. RAO: right anterior oblique, LAO: left anterior oblique, CS: coronary sinus, His: His bundle, RVA: right ventricular apex, and ABL: ablation catheter. From the top, surface ECG: leads I, II, aVF and V1, intracardiac recordings: high right atrium (HRA) from the proximal (3–4) to distal (1–2) electrodes, ablation catheter (ABL) from the proximal (3–4) to distal (1–2) electrodes, unipolar electrogram of the ablation catheter from the distal (uni1) to proximal (uni2) electrodes, His bundle electrogram (HBE) from the most distal (1–2) to the most proximal (9–10) electrodes, coronary sinus (CS) from the most distal (1–2) to most proximal (15–16) electrodes, and right ventricular apex (RVA) from the distal (1–2) to proximal (3–4) electrodes. (B) The retrograde conduction was abolished during the radiofrequency current delivery.

sinus under fluoroscopic guidance. One decapolar and one quadripolar catheter were introduced via the right femoral vein and positioned in the His bundle region and right ventricular apex (RVA), respectively. One 3.5-mm tip, deflectable, 7-Fr irrigation catheter (Navistar Thermocool, Biosense-Webster, Diamond Bar, CA, USA) and an electroanatomical mapping system (Carto3, Biosense-Webster, Diamond Bar, CA, USA) were used for ablation and mapping.

Clinical tachycardia was induced without any sudden increase in the AH interval by single extra-stimulation from the coronary sinus ostium. The earliest atrial activation was observed in the right posterior region. The intra-atrial activation sequence during the tachycardia was reproduced by ventricular pacing. Retrograde conduction did not demonstrate any decremental properties. The tachycardia was diagnosed as orthodromic AVRT with a right posterior accessory pathway. The accessory pathway was mapped under ventricular pacing because the ventricular pre-excitation was intermittent. An intra-cardiac echo probe (Soundstar, Biosense-Webstar, Diamond Bar, CA, USA) was introduced via the right femoral vein and positioned in the right atrium to visualize the atrioventricular junction. The important structures for catheter ablation, such as the atrialized right ventricle, atrioventricular junction, and tricuspid valve, could be clearly visualized on ICE (Fig. 2A). The right posterior atrioventricular junction was carefully mapped under echocardiographic guidance. The local bipolar ventricular electrocardiograms from the right posterior region revealed a low voltage (Fig. 2B). Radiofrequency current was successfully delivered at a power of 30 W, with a target temperature of 42 °C where the Kent potential was recorded (Fig. 3). During delivery of the radiofrequency current, real-time catheter–tissue contact and stability could be confirmed by ICE findings (Fig. 4). The retrograde conduction of the accessory pathway and ventricular pre-excitation was abolished after the ablation. During a 6-month follow-up period, the patient was free from any arrhythmias, and a 12-lead surface electrocardiogram exhibited no ventricular pre-excitation.

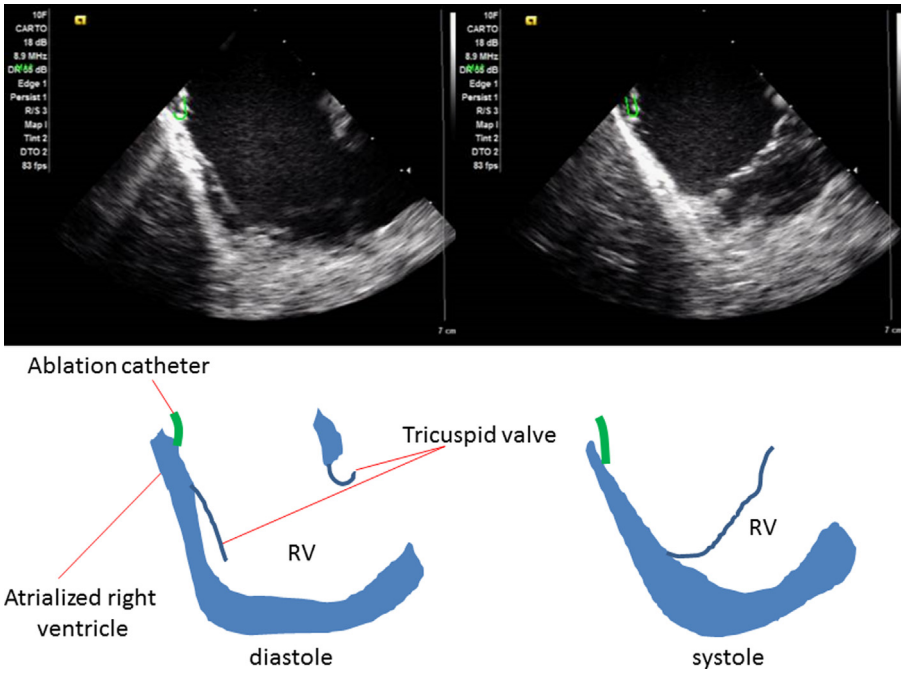

Fig. 4. ICE findings at the site with successful ablation. During delivery of the radiofrequency current, real-time catheter–tissue contact could be confirmed. RV: right ventricle.

3. Discussion

Catheter ablation of accessory pathways has a lower success rate and higher risk of recurrence in patients with Ebstein's anomaly than in those with structurally normal hearts. Moreover, the need for repeat procedures is common [4–7]. The success rates relative to patients and accessory pathways are reported to be 76–88% and 82–91%, respectively [4,7].

Several factors are responsible for the low success rate of accessory pathway ablation in patients with Ebstein's anomaly [4–6]. First, up to 50% of patients with Ebstein's anomaly have multiple accessory pathways [4,6]. The presence of multiple accessory pathways may complicate the localization of accessory pathways. Second, most accessory pathways are located along the atrialized right ventricle [4–6]. The local activation potentials recorded along the atrialized ventricle reveal continuous fragmented electrical activity with multiple spikes in 53% of patients [4]. Because of these abnormal potentials, it is difficult to distinguish an atrial electrogram from a ventricular electrogram, and localize the atrioventricular junction. The success rate of accessory pathway ablation is lower in patients with an abnormal electrogram than in those without an abnormal electrogram (55% and 100%, respectively) [4]. Finally, the catheter stability is often impaired by a large right atrium, tricuspid insufficiency, and downward displacement of the tricuspid valve.

ICE was introduced as a real-time imaging technique to assist catheter ablation procedures. Chu et al. performed an ICE-guided catheter ablation in 9 dogs. They concluded that ICE can accurately guide catheter ablation directed at anatomic landmarks. They also used ICE to confirm the endocardial contact, identify electrode movement, and directly visualize lesions [8].

The SoundStar 3D ultrasound catheter (Biosense-Webstar, Diamond Bar, CA, USA) is a phased-array ultrasound-tipped catheter that consists of a 64-element transducer. It provides high-resolution longitudinal 90° sector images. In the present case, the important structures for catheter ablation, such as the atrialized right ventricle, atrioventricular junction, and tricuspid valve, could be clearly visualized by a phased-array ICE introduced via the femoral vein. During delivery of radiofrequency current, the real-time catheter–tissue contact and stability were confirmed.

The findings in this case suggest that phased-array ICE is useful for ablation of right-sided accessory pathways in patients with Ebstein's anomaly.

Conflicts of interest

The authors have no conflicts of interest to disclose.

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