Safety of radiofrequency catheter ablation without coronary angiography in aortic cusp ventricular arrhythmias

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BACKGROUND Ventricular arrhythmias (VAs) originating from the aortic root are common. Coronary angiography is typically recommended before catheter ablation to document proximity of the ablation catheter to the coronary ostia.

OBJECTIVE To investigate how often catheter ablation in the aortic root could be guided by phased-array intracardiac echocardiography (ICE) and electroanatomic mapping without requiring aortography or coronary angiography.

METHODS We reviewed consecutive patients referred for aortic root VAs to operators experienced in the use of ICE at a single center. An ICE catheter and a 3.5-mm irrigated ablation catheter were used in all cases, and the need for angiography before ablation was documented. Acute success and acute and 30-day complications were noted.

RESULTS Thirty-five patients (age 58 ± 13 years; 74% men) were referred for the ablation of VAs; 32 of 35 (91%) underwent ablation using ICE and 3-dimensional mapping without the need for coronary angiography. Successful acute ablation was achieved in 29 of 35 (83%) patients. In all cases, the catheter tip was directly visualized with ICE >1 cm from the coronary ostia. The site of origin of the earliest VA was the left cusp (17 of 35 [49%]), right cusp (9 of 35 [26%]), right-left cusp junction (8 of 35 [23%]), or right-noncoronary cusp junction (1 of 35 [3%]). There were no cases of coronary injury, embolic stroke, aortic root perforation, worsening of aortic regurgitation, or death acutely or at 30 days.

CONCLUSION Radiofrequency ablation of VAs originating from the aortic root may be safely performed using ICE and electroanatomic mapping in the majority of cases without the need for coronary angiography.

KEYWORDS Catheter ablation; Ventricular tachycardia; Premature ventricular contractions; Aortic cusp

ABBREVIATIONS **ICE** = intracardiac echocardiography; **VA** = ventricular arrhythmias; **VT** = ventricular tachycardia

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Introduction

Radiofrequency catheter ablation is a safe and reliable technique for treating patients with ventricular arrhythmias (VAs) originating from the outflow tract.[1] Approximately 10%–15% of idiopathic ventricular tachycardia (VT) originates from the left ventricular outflow tract and can be mapped and ablated from within the aortic root.[2–9] VA origin from the left cusp is most common, followed by the right cusp, and then the left-right cusp junction.[6,7]

Catheter ablation in the aortic cusps can be challenging owing to the complex anatomic relationships of the aortic valve, coronary arteries, and veins.[1,10] The use of intracardiac echocardiography (ICE) allows real-time visualization of the aortic cusp anatomy, coronary ostia, and catheter tip. Three-dimensional electroanatomic mapping allows the reconstruction of the aortic root anatomy and precise tracking of catheter location during mapping and ablation lesions. Together, these modalities can help improve procedural outcome and reduce the need for fluoroscopy, aortography, and coronary angiography.[1]

We sought to investigate how often catheter ablation in the aortic root could be guided by phased-array ICE and electroanatomic mapping without needing aortography or coronary angiography.

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Methods

We retrospectively reviewed consecutive patients referred to operators experienced in the use of ICE at a single center for electrophysiology study and ablation of left ventricular out flow tract arrhythmias with ablation lesions delivered in the aortic cusps from January 2011 to February 2014. Procedural parameters, baseline characteristics, and medical history were reviewed.

Electrophysiology study

Informed consent was obtained from all patients. Catheter selection and mapping strategy were dependent on the operators. Electroanatomic mapping (Carto, Biosense Webster, Diamond Bar, CA, or NavX, St Jude Medical, St Paul, MN) and phased-array ICE (AcuNav, Siemens Medical Solutions USA, Inc, Malvern, PA) were used to guide aortic cusp ablation in all cases; in some cases, 3-dimensional ICE reconstruction was used (CartoSound, Biosense Webster). A retrograde aortic approach to map and ablate in the aortic cusps was used. Coronary angiography was performed at the discretion of the attending electrophysiologist if it was felt that ICE views were not adequate to ensure safe distance of the ablation catheter tip from the coronary ostia. Heparin was given to all patients after accessing the femoral artery and titrated to maintain an activated clotting time of >250 seconds. A 3.5-mm open-irrigated catheter (ThermoCool or ThermoCool SF, Biosense Webster) was used in all cases for mapping and ablation. Radiofrequency energy was delivered in the "power-controlled" mode. Acute success and acute and 30-day complications were recorded in a prospective database. *Successful ablation* was defined as the complete elimination of the VT/premature ventricular contraction focus at the end of a 30-minute waiting period.

ICE views

For catheter ablation in the aortic cusps, the ICE catheter was positioned in the right ventricular inflow region, just past the tricuspid valve. Doppler color flow was used to determine the degree of aortic regurgitation before and after ablation. Before ablation, care was taken to localize the tip of the catheter. This often required advancing or withdrawal of the ICE catheter to the correct plane and rotation to allow visualization of the catheter tip accompanied by echogenic shadowing. If the catheter tip location was not verified, the catheter was flushed at 60 mL/min, allowing visualization of bubbles emanating from the tip of the catheter (Figures 1 and 2). For ablation performed in the left cusp or at the left-right cusp junction, the left main coronary ostium is easily visualized at approximately 6 o'clock of the cross-sectional view of the aortic root. Once the left main ostium was visualized, the catheter was rotated or advanced to locate the catheter tip to determine the distance from the coronary ostium. If the catheter tip was seen in the same plane as the coronary ostia, or the catheter tip could not be clearly visualized, coronary angiography was performed. When mapping localized the VA to the right aortic cusp, a long-axis view of the aortic root was obtained (Figure 3). If the catheter tip was located at the level of the aortic cusp leaflets, a safe distance from the right coronary ostium was assumed. If the catheter tip was at a level higher than the aortic sinus of

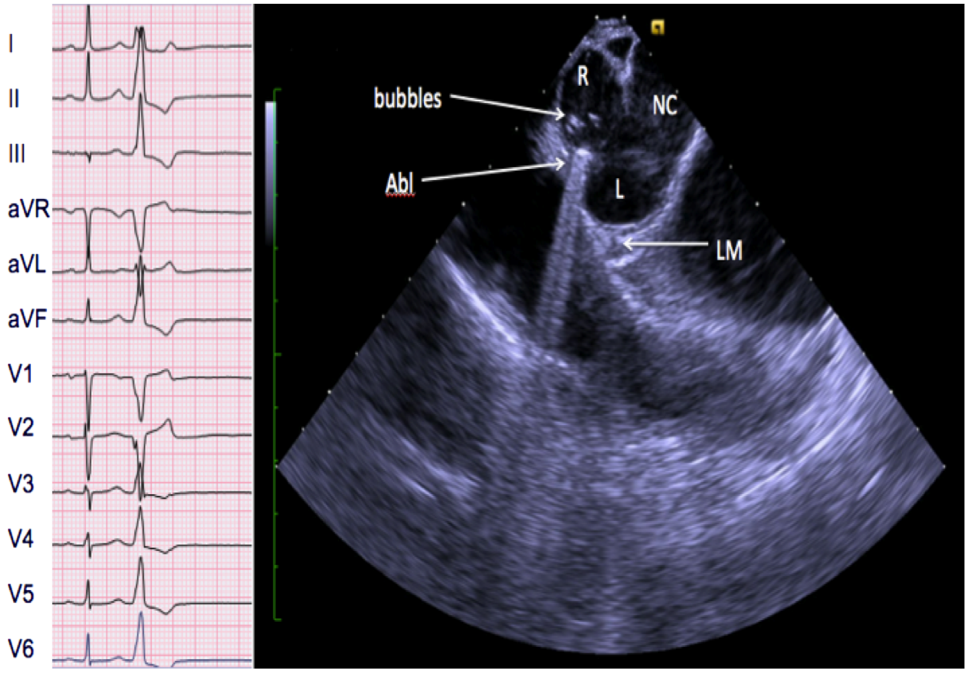

Figure 1 Left panel: 12-lead electrocardiogram of the premature ventricular contraction originating from the left-right aortic cusp junction. Right panel: Intracardiac echocardiography (ICE) imaging showing the location of the right (R), left (L), and noncoronary (NC) cusps. The ICE catheter was positioned in the right ventricular inflow region, just past the tricuspid valve. The left main (LM; arrow) coronary ostium is easily visualized at 6 o'clock on the cross-sectional view of the aortic root. The ablation catheter tip (Abl) is located at the left-right cusp junction at a safe distance from the LM ostium. Bubbles are visualized after flushing the catheter for confirmation of tip location. Full movie is available online.