Case Report

Catheter Ablation of Repetitive Ventricular Tachycardia Originating From Left Aortic Sinus Cusp

HERCULES MAVRAKIS, FEIFAN OUYANG, SABINE ERNST, XINGPENG LIU, MATTHIAS ANTZ, KARL-HEINZ KUCK

II. Med. Abteilung, Allgemeines Krankenhaus St. Georg, Hamburg, Germany

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In this report we describe the case of a 19-year-old girl with symptomatic, repetitive, non-sustained, monomorphic ventricular tachycardia and frequent ventricular premature contractions, refractory to antiarrhythmic drugs, who underwent successful radiofrequency ablation. The arrhythmia origin and ablation target, defined by the earliest activation in bipolar electrograms and the presence of a low-amplitude diastolic ventricular potential, was located in the anterior segment of the left aortic sinus cusp, 9.1 mm below the ostium of the left coronary artery.

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Address:
Hercules Mavrakis

Allgemeines Krankenhaus St. Georg,
2. Med. Abteilung (Kardiologie),
Lohmühlenstr. 5
20099 Hamburg,
Germany
e-mail:
mavrir@med.uoc.gr

Ventricular extrasystolic activity [ventricular tachycardia (VT) and symptomatic ventricular premature contractions (VPCs)] in patients with normal hearts commonly originates from the so-called "superior septal" aspect of the right ventricular outflow tract[1-4] and is often provoked by emotional or physical stress.[5] The electrocardiographic (ECG) pattern of the arrhythmia is typical in most patients, showing a left bundle branch block (LBBB) QRS morphology with an inferior axis. Radiofrequency ablation can be performed with a high success rate and provides a curative approach resulting in alleviation of symptoms.[1-4,6] However, not all VTs with LBBB and inferior axis can be ablated from the right ventricular outflow tract.[7] In patients with failed right ventricular outflow tract ablation and specific ECG characteristics, aortic sinus cusps should be considered as potential foci of the arrhythmia[8-10]

Case report

A 19-year-old girl with symptomatic, repetitive, non-sustained VT and frequent ventricular premature contractions of identical QRS morphology was referred to our center for radiofrequency ablation. The patient's symptoms were repeated severe palpitations resulting in a limitation of physical activity, although no syncopal episode was described. Multiple antiarrhythmic medications, including beta-blocker, calcium antagonist, sotalol and flecainide, failed to control the arrhythmia. Prior to the procedure the patient underwent a complete physical examination, echocardiography and magnetic resonance imaging of the heart, which revealed normal findings.

The patient's ECG showed trigeminy with LBBB QRS morphology and inferior axis of the VPCs (Figure 1). Holter monitoring revealed short episodes of monomorphic non-sustained ventricular tachycardia (maximum 4 beats).

After informed written consent was obtained, the patient underwent an electrophysiologic evaluation under sedation. Catheters were introduced under fluoroscopy to the right ventricular apex, the

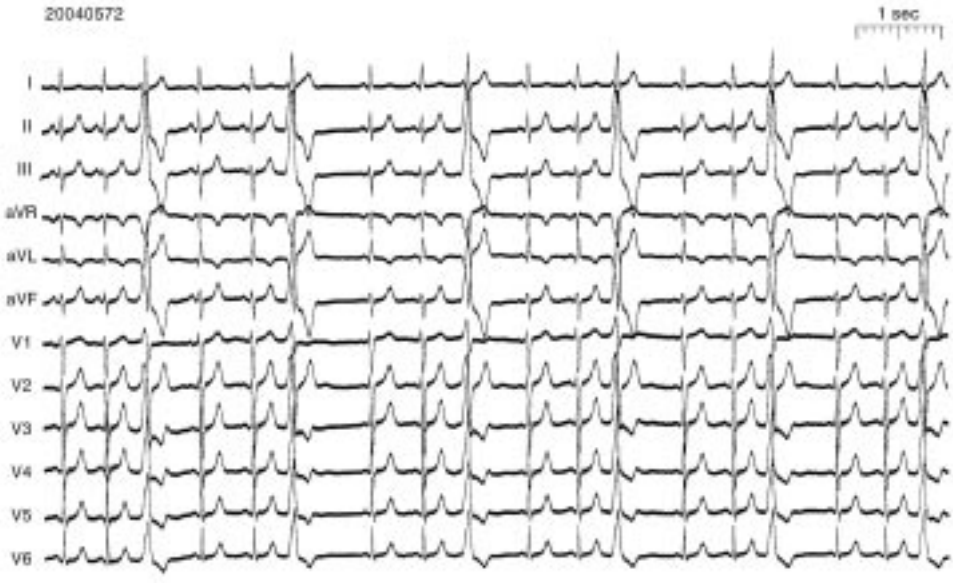

Figure 1. Twelve-lead ECG shows trigeminy with monomorphic ventricular premature contractions. Note the long R wave duration and the R/S amplitude ratio >1 in lead V1.

His bundle region and the right ventricular outflow tract (RVOT) via the femoral veins and into the coronary sinus via the left subclavian vein.

Frequent VPCs were present during the procedure and activation mapping was performed with a 7F, 4-mm tipped ablation catheter (Cordis-Webster Inc). Bipolar and unipolar electrograms were filtered at 30 to 400 Hz and 0.05 to 400 Hz, respectively. Mapping of the left ventricle and aortic cusps was performed retrogradely through the right femoral artery, since initial mapping performed in the RVOT failed to identify an early endocardial activation site. The earliest ventricular activation was recorded at the left aortic sinus cusp, preceding the onset of the QRS complex by 129 ms. Two ventricular activation components were recorded at the earliest site. The first was a low amplitude diastolic component, whereas the second component was coincident with the QRS complex (Figure 2). The ventricular activation in the unipolar recording was always simultaneous with the second bipolar component. Additionally, a far-field potential from the left atrial appendage was recorded from the aortic sinus cusp.

After activation mapping, the left coronary artery was cannulated with a 5F left Judkin's catheter, as a marker and for protection in case of ablation catheter dislodgment. The distance between the ablation catheter and the ostium of the left coro-

Figure 2. Activation mapping recordings of a sinus beat and a ventricular premature contraction at the successful ablation site (Mp dis: distal bipolar signals, Mp prx: proximal bipolar signals and M uni: unipolar signals recorded from the mapping catheter). Surface ECG leads I, avF, V_1 and bipolar signals from coronary sinus catheter (CS) are also shown. Earliest ventricular activation precedes the onset of QRS complex by 129 ms in the distal bipolar recordings. Note the low-amplitude diastolic ventricular potential indicated by the asterisk. A: atrial potential, V: ventricular potential.

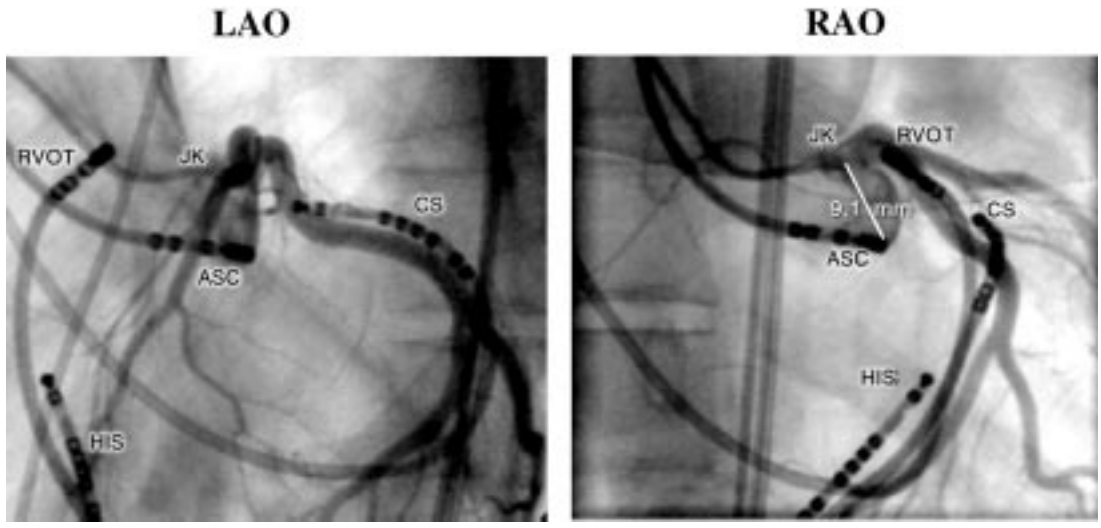

Figure 3. Left (50°) and right (30°) anterior oblique views (LAO and RAO, respectively) of the mapping catheter at the successful ablation site in the left coronary sinus cusp. JK: left Judkin's catheter, ASC: aortic sinus cusp mapping catheter, HIS: His bundle catheter, CS: coronary sinus catheter, RVOT: right ventricular outflow tract mapping catheter.

nary artery was 9.1 mm (Figure 3). Radiofrequency energy (RF) was delivered at the distal electrode of a thermocouple catheter, starting at 15 Watts (titrated to maximum 30 Watts) with a preselected temperature of 55°C. A single RF delivery at the site with earliest activation abolished the VPCs after 8 s. However, to consolidate the lesion, ablation was continued for 120 s.

Ablation success was defined by the absence of spontaneous or isoproterenol-induced premature ventricular contractions at the end of the procedure and no arrhythmias during 48-hour Holter monitoring or exercise stress test. No procedure-related complications occurred and no damage to the aortic valve was revealed by transesophageal echocardiography.

During a follow up period of 4 months, the patient was free of arrhythmias, without antiarrhythmic drugs.

Discussion

Although idiopathic ventricular outflow tract tachycardia has a benign prognosis, it usually affects young adults and results in significant symptoms, such as palpitations, syncope and limitation of physical activity, with consequent worsening of quality of life. In most patients, the ECG of the arrhythmia typically shows an LBBB QRS morphology with inferior axis, and radiofrequency ablation can be performed with high success rate in the RVOT.[1-4,6]

However, in patients with failed RVOT ablation other sites of origin should be considered. Aortic sinus cusps have been previously reported as regions with potential arrhythmogenicity and specific ECG criteria have been defined for their recognition.[8-10] Aortic sinus cusps are located more towards the posterior and right compared to the RVOT and the arrhythmia originating from these foci produces a slightly different vector. The anatomic differentiation results in a longer R-wave duration and higher R/S-wave amplitude ratio in leads V_1 and V_2. In patients with a typical LBBB inferior axis QRS morphology of VPCs, the value of an R-wave duration index ≥50%, (calculated as a percentage by dividing the QRS complex duration by the longer R-wave duration in lead V_1 or V_2) and R/S-wave amplitude index ≥30 % have been identified as EGG markers strongly suggestive that the origin of the arrhythmia is located in aortic coronary sinus cusps.[11] The absence of an S wave in leads V_5 and V_6 also supports an aortic cusp focus of the arrhythmia.[9] However, it should be remembered that the surface ECG pattern of VPCs or VT depends not only on the focus of the arrhythmia but also on the heart's orientation within the chest and the position of the ECG leads.

In a previous study it was reported that during activation mapping at the earliest site a low-amplitude high frequency late diastolic or presystolic potential always preceded the onset of the VPCs' QRS complex during the arrhythmia in patients with aortic

cusp ventricular tachycardia. Interestingly, during sinus rhythm two ventricular activation components were also recorded, but the sequence of the two components was reversed.

The verification of the distance between the tip of the ablation catheter and the coronary artery ostia by coronary angiography is of paramount importance, since occlusion or stenoses of the coronary arteries and aortic valve damage are potential severe complications.[12] In addition, continuous fluoroscopic visualization of the mapping catheter during the ablation should always be used and the RF application should be terminated if the arrhythmia is not eliminated after 10 seconds.[10]

In conclusion, ablation of symptomatic repetitive monomorphic ventricular tachycardia originating from the aortic sinus cusps can be performed safely and effectively provided that specific ECG criteria, precise activation mapping and certain ablation strategy have been implemented.

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