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Idiopathic ventricular outflow tract arrhythmias from the great cardiac vein: Challenges and risks of catheter ablation

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ABSTRACT

Introduction: Catheter ablation for idiopathic ventricular arrhythmia is well established but epicardial origin, proximity to coronary arteries, and limited accessibility may complicate ablation from the venous system in particular from the great cardiac vein (GCV).

Methods: Between April 2009 and October 2010 14 patients (56 ± 15 years; 9 male) out of a total group of 117 patients with idiopathic outflow tract tachycardias were included undergoing ablation for idiopathic VT or premature ventricular contractions (PVC) originating from GCV. All patients in whom the PVC arose from the GCV were subject to the study. In these patients angiography of the left coronary system was performed with the ablation catheter at the site of earliest activation.

Results: Successful ablation was performed in 6/14 (43%) and long-term success was achieved in 5/14 (36%) patients. In 4/14 patients (28.6%) ablation was not performed. In another 4 patients (26.7%), ablation did not abolish the PVC/VT. In the majority, the anatomical proximity to the left coronary system prohibited effective RF application. In 3 patients RF application resulted in a coronary spasm with complete regression as revealed in repeat coronary angiography.

Conclusion: A relevant proportion idiopathic VT/PVC can safely be ablated from the GCV without significant permanent coronary artery stenosis after RF application. Our data furthermore demonstrate that damage to the coronary artery system is likely to be transient.

1. Introduction

Catheter ablation of sustained ventricular tachycardia (VT) and premature ventricular capture beats (PVC) is an established therapy option especially in patients without structural heart disease [8,15]. High long-term success rates are achievable and the majority of patients with PVC arising from the right or left ventricular outflow tract can successfully be treated using radiofrequency (RF) ablation from the endocardium [6,12].

However, in some patients focal ectopy may arise from the pericardial space, especially the left ventricular summit that in most cases may be reached from the venous cardiac system, namely the great cardiac vein (GCV). It has been shown that epicardial ablation using a subxiphoidal access is also feasible to treat these arrhythmias using radiofrequency (RF) ablation [1,5,11,14].

The least invasive access to target epicardial outflow foci is obtained via the venous cardiac system. In this setting, it is important to be aware of potential limitations that may be encountered when aiming for outflow tract VT/PVC ablation from the GCV. First, the epicardial access may not be easily achievable due to anatomic consideration, e.g. a Thebesian valve or small diameter vessels. Second, as in most cases radiofrequency is used to aim for these foci, energy delivery may be limited due to high impendances and limited irrigation flow. Third and potentially most importantly, the close proximity of the GCV to the coronary artery system and other anatomical structures such as the phrenic nerve may pose limitations for RF application in the GCV. Despite the fact that coronary artery injury has been described to be a rare entity (0.09%) during catheter ablation of atrial or ventricular tachycardia this potentially devastating complication has to be kept in mind, especially when ablating in the coronary sinus [7].

The aim of the present study was to evaluate the possibilities and challenges using RF energy to target these foci from the epicardium and to clarify the associated risks when ablating in close proximity to the coronary artery system.

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Table 1
Baseline characteristics of patients included to the study (m = male; f = female; DCM = dilative cardiomyopathy; ICM = ischemic cardiomyopathy; PVC = premature ventricular capture beat, nsVT = non-sustained ventricular tachycardia).

	Gender	Age	Structural heart disease	VT/PVC	Ablation attempted	Effective energy application	Primary success	Long-term success
#1	M	75	ICM	PVC	No	No	No	No
#2	F	49	No	PVC	Yes	Yes	Yes	Yes
#3	M	28	No	PVC	Yes	Yes	Yes	Yes
#4	F	62	No	PVC	No	No	No	No
#5	M	73	No	PVC	No	No	No	No
#6	M	48	No	PVC	Yes	No	No	No
#7	F	39	No	PVC	Yes	Yes	Yes	Yes
#8	F	68	No	PVC	Yes	Yes	Yes	Yes
#9	M	73	No	PVC	No	No	No	No
#10	M	56	No	PVC	Yes	Yes	Yes	Yes
#11	M	57	DCM	nsVT	Yes	Yes	No	No
#12	F	30	No	PVC	Yes	Yes	Yes	No
#13	M	56	No	nsVT	Yes	No	No	No
#14	F	54	No	PVC	Yes	No	No	No

2. Methods

Patients undergoing catheter ablation for symptomatic idiopathic VT or PVC were included in two high volume centers (University Hospital Hamburg-Eppendorf and University Hospital Münster) if the following criteria were met:

1. Typical 12 lead ECG outflow tract morphology (inferior axis, positive R waves in leads II and III)
2. Ectopy originating from the outflow tract area with the earliest local activation time in the GCV (after GCV leaves the interventricular groove and enters the mitral valvular level) after mapping of the RVOT and/or left ventricular cavity and outflow tract area
3. Absence of anatomical substrate for VT
4. Attempt to abolish VT/PVC using RF energy from the GCV
5. Coronary angiography before and after ablation in the GCV

Two patients had additional structural heart disease (dilative cardiomyopathy, n = 1; ischemic cardiomyopathy, n = 1). All patients gave written informed consent and underwent conscious sedation under spontaneous ventilation and continuous monitoring of oxygen saturation and blood pressure. Venous and arterial access was gained via the right femoral artery and vein using an 8 French sheath (St. Jude Medical, St. Paul, MN, USA). Mapping usually was first performed in the right ventricular outflow tract using a 3.5 mm ablation catheter (Thermocool®, ThermoCool Navistar®, Biosense-Webster, Diamond Bar, CA, USA; IBI Coolpath, SJM, St. Paul, MN, USA) Mapping was performed during spontaneous ectopy with or without orciprenalin to provoke ectopy. Mapping regions consisted of right and left ventricular outflow tract including the aortic root and its cusps in all patients. If right or left ventricular mapping did not reveal early activation (≤−20 ms) and/or no pacemap of at least 11/12 was achievable from right or left ventricular sites (10 mA; 2 ms) the procedure was continued on the left ventricular site. If earliest

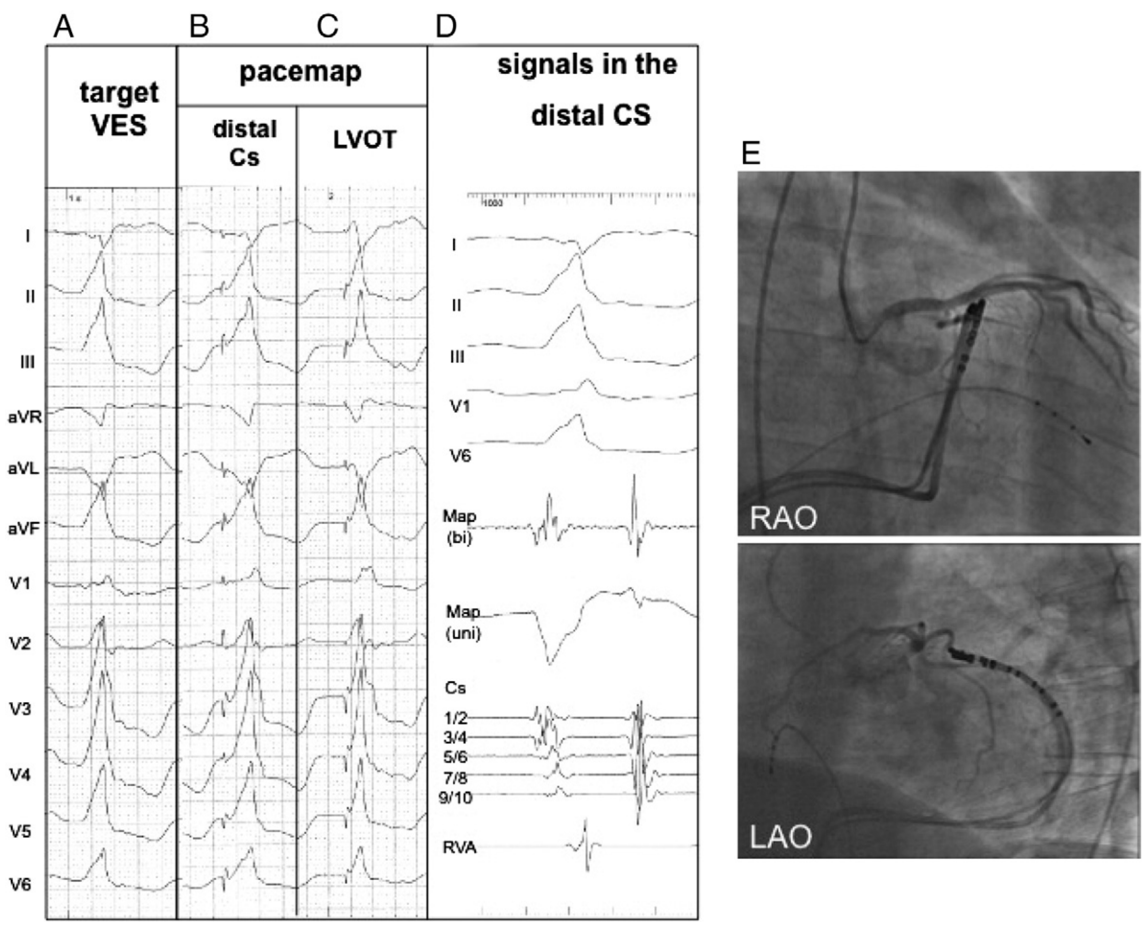

Fig. 1. Mapping characteristics of VES originating from the distal coronary sinus (Cs). A: 12 lead ECG showing target VES. B: 12 lead ECG during pacemapping in the distal coronary sinus and (C) the LVOT. D: signals with mapping and 6 lead diagnostic catheter placed in the distal coronary sinus during target VES (from top to bottom): surface ECG; mapping catheter with uni- and bipolar lead; 6 lead diagnostic catheter; RVA catheter. E: corresponding fluoroscopic view of catheter positions during coronary angiography of the left coronary artery (RAO: right anterior oblique; LAO: left anterior oblique).