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Cryoballoon ablation: a novel technique for treating focal atrial tachycardias from the pulmonary veins

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Aims Cryothermic ablation using a cryoballoon is a novel technique which has been used to treat paroxysmal atrial fibrillation. In this study, we wanted to test this technique to treat focal atrial tachycardias (ATs) from the pulmonary veins (PV).

Methods and Results Five patients (four women, one man, mean age 43 ± 16 years) with severe symptoms due to focal AT originating from a PV were studied. A single transseptal puncture was done. After confirmation of the diagnosis by conventional mapping, a 23 or 28 mm cryoballoon catheter was positioned in the PV of interest. Freezing was done for 300 s and repeated at least once before attempts to induce arrhythmia. All patients were successfully treated. Total procedure and fluoroscopy time was 138 ± 55 and 26 ± 21 min, respectively. During a follow-up of 10 ± 7 months no clinical recurrences occurred.

Conclusion Cryoablation using a cryoballoon might be an easy and safe tool to treat ATs originating from the PV with reasonable procedure time.

Keywords Atrial tachycardia • Catheter ablation • Cryoablation • Cryoballoon • Pulmonary vein

Introduction

Focal atrial tachycardias (ATs) originating from the pulmonary veins (PV) constitute a minor part of all ATs. In a study from Kistler *et al.*,[1] 28 of 172 ATs (16%) came from the PV. These ATs are usually ablated with radiofrequency energy, using either a focal approach or PV encircling.[1]

Ablating with RF energy inside a PV involves a risk of PV stenosis,[2] and PV encircling carries small but serious risks of complications such as atrial–esophageal fistulas or stroke.[3]

Cryothermic energy has the advantage of a decreased thrombus risk compared with RF energy[4] and seems to have a low risk of injury of vascular structures.[5–7]

Cryothermic ablation using a cryoballoon (Arctic Front, CryoCath) is a novel technique which has been used for PV isolation for the treatment of paroxysmal atrial fibrillation with similar results as with RF ablation.[6,8,9] The cryoballoon has also been used to ablate focal ATs from the right atrial appendage.[10] In this study, we wanted to test this new technique to treat focal ATs from the PV.

Methods

Patients

Five patients, four women and one man, with focal AT originating from a PV were studied. Detailed data are presented in *Table 1*. All patients had severe symptoms due to their tachycardia. The diagnosis was primarily based on conventional analysis from a 12-lead surface ECG,[11] and then confirmed during the electrophysiological study. The origin of the tachycardias was inside a PV in all patients. In three patients, tachycardia could be induced by programmed electrical stimulation and the mechanism was presumed to be micro-reentry, in the other two tachycardia was persistent and no attempt was done to terminate it before ablation. Three patients had undergone a previous focal

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Table 1 Patient data

Patient no.	Gender	Age (years)	Duration of arrhythmia (months)	AA tested	Previous ablation attempt	Localization	Heart rate during tachycardia (b.p.m.)
1	M	30	60	meto	Yes	LSPV	250
2	F	30	84	amio, card, meto	Yes	LSPV	170
3	F	39	17	amio, meto	No	LSPV	200
4	F	47	3	biso, flec	Yes	RSPV	200
5	F	69	48	biso	No	LIPV	195
Mean		43	42				
SD		16	33				

AA, antiarrhytmic drugs; amio, amiodarone; biso, bisoprolol; card, cardizeme; flec, flecainide; meto, metoprolol; LSPV, left superior pulmonary vein; RSPV, right superior pulmonary vein; LIPV, left inferior pulmonary vein.

ablation but had experienced recurrence. The study was approved by the Institutional Ethics Committee.

Procedure

Antiarrhythmic medication was discontinued five half-lives before the study. The procedures were performed under light sedation, in the fasting state. A bolus dose of 5000 E heparin was administered immediately after puncturing the right femoral vein. A quadripolar diagnostic catheter was placed in the His bundle region and an octapolar diagnostic catheter in the coronary sinus. A single transseptal puncture was done using a modified Brockenbrough technique to introduce one 8 F sheath (SL1, St Jude Medical) into the left atrium. After the transseptal puncture, additional doses of heparin were administered to keep activated clotting time at 300–350 s. Mapping of the LA was first done with a quadripolar steerable catheter and then with a decapolar Lasso catheter (Biosense Webster). After the diagnosis of foci within the PV was confirmed by means of careful mapping with a Lasso-catheter and a quadripolar steerable catheter, an angiogram of the PV of interest was done. The long sheath was then changed over the wire to a steerable sheath with 12 F inner and 15 F outer diameters (FlexCath, CryoCath). A 23 or 28 mm cryoballoon (ArcticFront, CryoCath), depending on PV diameter, was then advanced over a guide wire into the LA and placed at the PV ostium of interest. The sheaths were continuously flushed with heparinized saline. After inflation of the balloon, contrast was injected through the lumen of the balloon to confirm appropriate positioning and occlusion of the PV (*Figure 1*). Freezing was then done for 300 s and after that the balloon was repositioned and a second freezing done. In one patient with AT from the right superior PV (Patient 4), adequate movement of the diaphragm was checked every 10 s with fluoroscopy to avoid injury to the phrenic nerve. After ablation, isolation of the vein was confirmed with the Lasso catheter both during pacing from the coronary sinus and from the inside of the vein. Arrhythmia induction was then attempted with atrial extrastimulus as well as burst pacing both at basal conditions and during isoproteronol infusion during 30 min post-ablation.

Follow-up

Patients were followed-up by outpatient visits and by telephone.

Statistical analysis

Data are presented as mean ± SD.

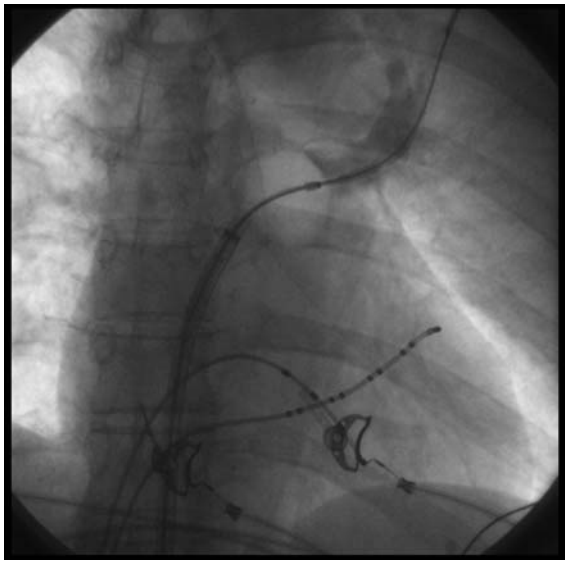

Figure 1 The cryoballoon inflated and positioned in the left superior pulmonary vein (antero-posterior view).

Results

Procedural data

Total procedure and fluoroscopy time was 138 ± 55 and 26 ± 21 min, respectively. Mean number of applications was 3.6 ± 1.3 (range 2–5) with a total duration of 1080 ± 402 s. In two patients, five applications were given: in one patient (no. 5) with AT from the left inferior PV, there was a common trunk and the physician chose to isolate both vessels. In patient no. 3, the occlusion of the vessel was not judged optimal due to contrast leakage during occlusion why additional applications were done before control. Two patients had ongoing AT at the beginning of the ablation, both terminated within 10 s of the first application (*Figure 2*). In all patients, there was complete isolation of the PV of interest at first test both during pacing from the coronary sinus and during

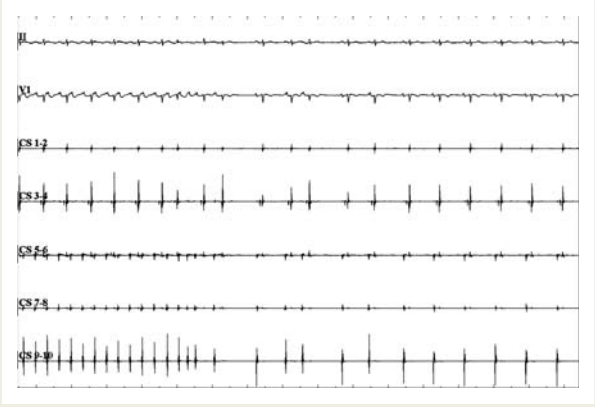

Figure 2 Ten seconds after starting cryoablation the tachycardia terminates.

pacing from inside of the PV. No recurrences were seen during the 30 min waiting period.

Follow-up

During a follow-up of 10 ± 7 months (range 4.5–22), no clinical recurrences occurred. No patient was treated with antiarrhythmic drugs.

Discussion

Ablation of focal ATs from the PV is feasible with RF. There are however associated risks with this technique both during focal ablation within or at the PV ostium, or during encircling of the vein.[2,3] Focal cryoablation has emerged as an alternative to RF ablation for AV-nodal reentrant-tachycardias and other ATs.[12,13] Cryoablation with the cryoballoon has shown promising results in patients with paroxysmal atrial fibrillation.[6,8] Previous experience suggests that cryoablation is a safe procedure with similar results as RF ablation in selected arrhythmias.[6,8,12,13] The present study suggests that cryoablation using the cryoballoon might be an easy and safe tool to treat ATs originating within the PV with reasonable procedure time. In these patients, we used a standard Lasso catheter and a quadripolar steerable catheter to verify origin inside a PV. Using a 3D-mapping system can probably locate the focus more exactly and should therefore be considered, if there is any doubt about the source originating inside the PV.

Using the 28 mm balloon also part of the antrum is ablated. However, if this technique is sufficiently effective in treating foci originating from the antrum region remains to be studied.

The number of patients in this study is small and larger studies are necessary to assess the role for this technique.

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