

Cryoballoon ablation of paroxysmal atrial fibrillation: bigger is better and simpler is better

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This editorial refers to ‘The ‘single big cryoballoon’ technique for acute pulmonary vein isolation in patients with paroxysmal atrial fibrillation: a prospective observational single centre study[†], by K.-R.J. Chun *et al.*, on page 699

Pulmonary vein isolation (PVI) is the mainstay of catheter ablation for atrial fibrillation. In an effort to overcome the shortcomings of drawing a continuous line around the pulmonary vein (PV) ostia by point-by-point focal radiofrequency catheter ablation, research in the interventional electrophysiology field currently focuses on developing new energy sources and catheter designs to achieve PVI safer, faster, and with equal efficacy as compared with the conventional radiofrequency approach. In that respect, balloon-based catheter ablation systems are particularly promising because they allow for a ‘single shot’ PVI by placing the balloon at the PV ostium and ablating circumferentially around the PV ostia with a single energy application. Balloon-based catheter systems using various energy sources (cryothermal energy, non-focused ultrasound, highly focused ultrasound, laser, radiofrequency) have been developed or are currently under investigation.¹ With regard to safety aspects, cryothermal energy may have advantages over other energy sources since both human and experimental animal data have demonstrated that the risk for PV stenosis,² atrio-oesophageal fistulae,³ and thrombus formation⁴ is extremely low to absent with application of cryothermal energy.

Chun *et al.*⁵ have reported on their initial experience with a single big cryoballoon technique for isolation of PVs in patients with paroxysmal atrial fibrillation. They included 27 patients with drug-refractory, symptomatic atrial fibrillation in their study. The main finding was that 98% of all PVs could be isolated by application of cryothermal energy at the PV antrum with a single big cryoballoon. During a median follow-up of 271 days, 70% of patients remained in stable sinus rhythm following a 3-month blanking period after the procedure.

The cryoballoon technology (Arctic Front[®], Cryocath Inc.) is currently available in two balloon sizes: 23 and 28 mm. Using a

simple over-the-wire technique in conjunction with a steerable sheath, the balloon can be navigated to each PV ostium. After demonstrating balloon occlusion of the PV through PV angiography and thereby confirming sufficient balloon–wall contact, cryothermal energy is applied by injection of the refrigerant N₂O into the balloon. Typically, one or two freezing cycles of 300 s each are applied at each PV ostium.

In their study, Chun *et al.*⁵ provide some very helpful and well-illustrated insights into special ablation techniques for approaching the different PVs. Of particular note is what the authors termed the ‘cross-talk’ technique: during cryothermal energy application to the inferior PV, simultaneous PV recordings were obtained from a Lasso catheter in the ipsilateral superior PV, demonstrating PV spike sequence changes or PVI in the superior PV during ablation in the inferior PV. This phenomenon points to a significant overlap of the circumferential ablation lines at the PV antrum of ipsilateral veins produced by the big cryoballoon (only the 28 mm balloon size was used in the study by Chun *et al.*). Since the goal is to perform ablation at the level of the PV antrum as far outside the PVs as possible, bigger balloon sizes (perhaps even larger than 28 mm) are clearly preferable over smaller sizes. This is also true with respect to avoiding phrenic nerve palsy as the main complication of cryoballoon ablation. In the study by Neumann *et al.*⁶ phrenic nerve palsy during cryoballoon ablation of the right superior PV was predominantly seen with the smaller (23 mm) cryoballoon. It is of note, however, that even with the 28 mm balloon there is still a significant risk of phrenic nerve palsy (three of 27 patients with temporary phrenic nerve palsies in the study by Chun *et al.*). This emphasizes the need for meticulous monitoring of phrenic nerve function during cryoballoon ablation of the right-sided PVs and immediate termination of cryothermal energy application when impairment of phrenic nerve function is detected. It also emphasizes the need for a cryoballoon even bigger than 28 mm for ablation of larger veins on the right side in order to prevent prolapsing of the balloon into the PVs with subsequently increased risk for phrenic nerve palsy.

Fortunately, no other severe and feared complications of radiofrequency ablation of atrial fibrillation such as symptomatic PV

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stenosis or atrio-oesophageal fistulae have been reported in the published studies on cryoballoon ablation to date.

Notably, the high rate of PVI (98%) in the study by Chun *et al.* was achieved by two investigators with no prior experience with the cryoballoon technology. This underscores the fact that cryoballoon ablation of PVs is a simple and straightforward procedure with a fast learning curve.

High complexity of an interventional procedure is always associated with a negative safety profile. There are numerous examples in the history of interventional cardiology where highly complex and time-consuming procedures are eventually replaced by straightforward and fast procedures. The single big cryoballoon technology clearly has the potential to make PVI in patients with paroxysmal, symptomatic and drug-refractory atrial fibrillation a simple, fast, and safe procedure. Future studies will have to demonstrate that the cryoballoon technology can keep that promise, in particular with regard to its long-term safety and efficacy.

Conflict of interest: M.L.K. and B.S. have received speaker's honorarium and advisory board fees from CryoCath Inc.

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