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EDITORIAL

Reflections on reconduction after pulmonary vein isolation

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This editorial refers to 'Early recovery of pulmonary vein conduction after cryoballoon ablation for paroxysmal atrial fibrillation: a prospective study' by G. B. Chierchia *et al.*, on page 445

Cryoballoon has proven to be a formidable competitor in the field of novel technologies for the ablation of atrial fibrillation (AF). Several reports have shown this technique to be safe and effective in treating AF, with 59–74% freedom of paroxysmal AF and 42% of persistent AF, for more than 1 year. Its major complication is temporary phrenic palsy caused by the ablation of the right superior phrenic nerve.[1–3] In contrast to other balloon technologies, it is the only one whose outcome results are currently extensively reported in scientific literatures and seem promising. Two other balloon-based devices, but employing a different energy source, have not proven to live up to safety standards: high-intensity focused ultrasound (HIFU) balloon and endoscopically guided laser balloon. The former was not only reported to have a high percentage of permanent phrenic nerve paralysis (which seems a problem inherent to any balloon concept),[4] but evidence emerged that the dreaded atrio-oesophageal fistula was one of its major complications.[5] After that, the FDA-approved HIFU ablation system study (randomizing ablation against anti-arrhythmic drugs) was suspended. Similarly, the first generation of the endoscopically guided laser balloon did not survive early phase III testing, and the FDA-approved ENABLE study (comparing ablation against anti-arrhythmic drugs) was terminated. Another investigational device (not a balloon catheter, however) showing promising results seems to be the multipolar ablation catheter with duty-cycled bipolar and unipolar radiofrequency energy, which has recently shown to have 83% freedom of AF at 6 months and no major complications.[6] Two studies are currently underway: the TOPP AF trial (multicentre, randomizing ablation against DC cardioversion for permanent AF) and a single-centre trial for paroxysmal AF randomizing against wide circumferential pulmonary vein (PV) isolation. This shows that the current scientific interest in catheters capable of simplifying AF ablation is major and that knowledge on these new devices is still scarce but urgently needed.

Reporting on the cryoballoon ablation, Chierchia *et al.*,[7] try to leap beyond merely reporting on AF recurrence, by shedding some light on the time span for early recovery of conduction after PV isolation. On this matter, a large volume of publications exist in radiofrequency ablation, but little is known about cryothermal ablation. It has long been known that in radiofrequency PV ablation, reconduction to the PVs is an important cause of recurrent AF. It is responsible for ~80% of recurrences of AF.[8,9] Early reconduction after RF ablation of the PVs occurs usually within 60 min after ablation and, on average, in two veins.[10] Therefore, a large number of operators take into account a 60 min waiting period after PV isolation before rechecking conduction. Moreover, dormant or stunned PV sleeves can be made apparent using adenosine infusion,[11] and ablating these has proven to be successful in preventing recurrent AF. In a population with recurrence of AF after a successful cryoballoon isolation, repeat procedures have shown reconduction in 100% of patients, occurring, on average, in three PVs. Similar to RF ablation, re-ablation yields a high freedom of AF after re-ablation.[3] However, although the mechanism for the recurrence of AF seems to be the same (i.e. reconduction), the difference in ablation energy seems to have an essential effect on the time to recovery of the ablated tissue. As shown in the report by Chierchia *et al.*,[7] early reconduction during the first 60 min seems to be very rare, since it only happened in ~3% of the ablated veins. The reconducting veins are all right inferior veins, the most difficult to occlude using this balloon device, showing that probably superficial cryomapping is responsible for this phenomenon, linked to the heat-sink effect the passing blood flow has on the endocardial surface. Reconduction after cryoablation occurring later during the clinical course is

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probably not related to the degree of occlusion, but to anatomical or physiological determinants, such as heating of deeper lying PV tissue by nearby structures with a high blood flow. It has been previously reported that reconduction after cryoballoon ablation is more frequent in the left-sided veins,[3] probably due to the descending aorta directly underlying them and the close proximity of the mitral valve region, warming the deeper PV tissue. If lack of occlusion were responsible for late reconduction, this would have to be more frequent in the lower right-sided vein. Tackling the problem of reconduction seems to be a balance between the power of the ablation and the risk of damaging adjacent structures. In this report, one temporary phrenic nerve palsy was observed, roughly coinciding with the 3% expected incidence reported in larger studies.[2,3] The findings of Chierchia *et al.* pose another problem trying to find how and when recovery of conduction to the PV takes place (if ever) after cryoablation and focus attention on the important challenge of preventing this. It is an essential study in understanding the temporal recovery sequence of the atrial myocardium after cryoablation and aids in determining crucial factors to optimize the cryoballoon ablation strategy.

Conflict of interest: none declared.

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