Non-invasive imaging prior to cryoballoon ablation of atrial fibrillation: what can we learn?

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This editorial refers to ‘Pulmonary vein ostium shape and orientation as possible predictors of occlusion in patients with drug-refractory paroxysmal atrial fibrillation undergoing cryoballoon ablation’ by A. Sorgente et al., on page 205.

Cryoballoon pulmonary vein isolation (CB-PVI) is attractive for many electrophysiologists because the device allows in principle to isolate the pulmonary veins (PVs) with a single application and a short learning curve. In order to achieve an effective lesion, the cryoballoon must be positioned with good circumferential tissue contact at the PV ostium, usually ascertained by the absence of contrast media run-off from the balloon tip into the left atrium during PV angiography. This means that the operator has to face a wide variety of left atrial and PV anatomies with a pre-shaped device that cannot be adapted to a patient’s individual anatomy. Device selection is further limited in that the use of the smaller of the two available cryoballoon dimensions (23 and 28 mm) may impose an increased risk of right phrenic nerve palsy (PNP). To overcome this difficulty, different catheter manoeuvres have to be performed to achieve successful balloon positioning. Although the endpoint of complete PVI may be accomplished with these techniques in the great majority of patients, the individual anatomy impacts on success, ease, and safety of the procedure.

Sorgente et al. present a retrospective analysis in 52 patients who underwent CB-PVI using the 28 mm cryoballoon (and a radiofrequency catheter if PVI was not achievable with the balloon). A semi-quantitative evaluation of PV occlusion by the cryoballoon was correlated with two anatomical parameters acquired by pre-procedural multislice computed tomography imaging (MSCT): the ratio between the maximal and minimal PV ostial diameter (a measure of PV ‘ovality’) and the angle between the PV longitudinal and the frontal body axis. An inverse correlation between the PV ovality index and balloon occlusion grade was found for lateral PVs (which exhibited a higher ovality index when compared with septal PVs). In addition, the more the PV long axis deviated inferiorly in the frontal plane, the lower was the occlusion grade. This may be explained by the fact that a high contact force—by simultaneously pushing the sheath and balloon—can be achieved in the superior, but not in the inferior, direction. This is reflected by a dominance of inferiorly located conduction gaps in patients presenting with recurrent atrial fibrillation following CB-PVI. Of note, despite these anatomical differences, PVI was achieved in 94% of the PVs at first testing after ablation. A focal radiofrequency catheter was used in 6% of PVs to complete isolation. Thus, had patients been selected prospectively on the basis of the analysed parameters, pre-procedural MSCT had added little to the high acute success rate of the procedure. However, although not investigated in the present study, imperfect occlusion may also affect chronic PVI, possibly due to inhomogeneous lesion formation.

Thus, several questions remain to be addressed concerning non-invasive imaging prior to CB-PVI. Perhaps the most interesting subject of future studies is the possible impact of anatomy on chronic success of CB-PVI. In other words, may pre-procedural imaging identify a patient population with a greater long-term efficacy based on left atrium and PV anatomy particularly suitable to the cryoballoon? By showing the association between PV ostial shape/orientation and PV occlusion, Sorgente et al. provided the first analysis of candidate anatomical parameters to be used in such a study.

Another issue is the wide variation in the average procedure duration reported in clinical studies of CB-PVI, up to 370 min in the North American Arctic Front STOP-AF (Sustained Treatment Of Paroxysmal Atrial Fibrillation) trial, recently presented at the Heart Rhythm Society meeting in Denver in May 2010. Procedure duration is subject to the learning curve, raising the question whether pre-procedural imaging may (at least initially) help in patient selection in less experienced centres.

Finally, can pre-procedural imaging improve the safety of CB-PVI? The most common complication of CB-PVI is right PNP. Since the incidence of PNP is related to the cryoballoon position relative to the PV ostium, PNP may occur even with...
the bigger 28 mm balloon during freezing at large septal PVs. Pre-procedural computed tomography (CT) or magnetic resonance imaging may be used to determine PV dimensions. This measurement can simply be performed by angiography during the procedure; however, in centres performing PVI exclusively with the cryoballoon, pre-procedural imaging could be used to determine whether a patient is eligible for CB-PVI based on septal PV size. On the other hand, direct visualization of the phrenic nerve using MSCT has proven to be technically difficult on the right side.

Ultimately, prospective, randomized trial data are needed to determine whether additional costs and radiation exposure (in the case of CT) of non-invasive imaging prior to CB-PVI are justified by improved patient selection.

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References