

Hybrid ablation for persistent atrial fibrillation: how to merge the best from both worlds

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A close collaboration between the cardiac surgeon and the electrophysiologist in a hybrid fashion has represented a novel and intriguing opportunity in order to address the most common supra-ventricular tachyarrhythmia (i.e., atrial fibrillation) and to overcome the drawbacks and suboptimal results of both catheter ablation and minimally invasive surgical procedures, especially in the most complex and chronic scenarios.

While a transcatheter approach yields excellent results in the paroxysmal subset of patients, the clinical outcomes in persistent and especially long-standing persistent atrial fibrillation have been less than satisfactory, with mid-long-term restoration of sinus rhythm occurring only in 50% or less of cases, even after multiple procedures (1).

From the surgical standpoint, closed-chest epicardial and off-pump procedures have been recently favoured over a conventional maze ablation, given the reduced degree of invasiveness especially in presence of stand-alone atrial fibrillation.

The rationale for combining a surgical and a transcatheter strategy in persistent/long-standing persistent atrial fibrillation is related to the evidence that, unlike in paroxysmal forms, a more extensive ablation pattern is required to achieve an extensive isolation of all pulmonary veins and the posterior aspect of the left atrium, thereby not only excluding the ectopic foci within the pulmonary veins but also targeting the macro-reentrant circuits usually located within this area. In other words, both

specialties nowadays agree that a more extensive lesion pattern is necessary while addressing the most complex subsets of atrial fibrillation, such as persistent and long-standing persistent atrial fibrillation: an anatomical lesion set (particularly aimed at the whole posterior aspect of the left atrium) is apparently more effective to treat a complex substrate rather than targeting specific focal areas and/or fragmented potentials (1).

While apparently obvious, this specific anatomical aspect is often erroneously defined and reported both by electrophysiologists and surgeons as simple pulmonary veins isolation, while one of the cornerstones of this ablation pattern (and also part of the original maze procedure) is the “box” lesion set, which encompasses the isolation of all four pulmonary veins *en-bloc* and the posterior aspect of the left atrium. Despite the significant technological advances in electrophysiology, an antral isolation of each (or potentially both in selected cases) pulmonary veins is the widest ablation line that can be performed via an endocardial route to date; therefore, unless additional point-by-point ablations are delivered to connect the couples of pulmonary veins both with a roof and inferior line, this lesion set will not be anatomically equal or potentially effective as a box lesion set.

From the surgical standpoint, over recent years there have been novel tools to allow for an effective delivery of a continuous line and a complete box lesion set, for example thanks to the possibility to use an epicardial linear

device instead of clamps. Furthermore, the intra-operative validation (following surgical ablation) of such lesion set appears to be crucial, especially when a sequential-staged strategy is adopted (2). In fact, it has been widely proven that surgeons should utilize the feedback from the ablation devices as an additional (but not the only) tool to guide their ablations; nevertheless, there should always be a rigorous validation of end-points as—or at least as close as—the electrophysiology lab: for example, the possibility to achieve a bidirectional block at the end of the surgical ablation has been associated with an improved maintenance of sinus rhythm over follow-up (2).

In a recent paper by Bulava *et al.* (3), the surgical technique for minimally invasive ablation implied the use of bipolar clamps for isolation of each couple of pulmonary veins and a bipolar linear pen device to create a roof and inferior line and to complete a box lesion set. Despite bipolar radiofrequency clamps being considered the most reliable device for surgical ablation to date, the findings of the authors were quite unsatisfactory at the staged transcatheter mapping, with only 91% and 76% of isolated pulmonary veins on the right and left side respectively. When the box lesion was assessed during the delayed electrophysiological mapping, it was achieved only in 23% of patients: therefore, this manuscript raises some important questions not only regarding the overall reliability of bipolar radiofrequency clamps but also about the creation of additional connecting lines with a bipolar pen. A previous paper by Pison *et al.* (4) reported the same surgical technique but with a simultaneous validation of the surgical ablation by the electrophysiologist in a hybrid setting: in such experience, the box isolation was confirmed in 64% of patients in the acute setting. It could obviously be argued that some technical factors may have also played a role in explaining the different findings, however it should also be stressed that Pison *et al.* assessed the box lesion set acutely; conversely, Bulava *et al.* performed such evaluation at least 2 months after the index surgical procedure, thereby depicting potential false negatives (following acute testing) over time. Nevertheless, an important finding is that also the use of bipolar clamps may be associated with a relevant percentage of incomplete lesions during follow-up.

Moreover, two additional factors should be taken into account: the approach adopted to achieve a box lesion set and the acute validation technique (or end-points). With respect to the former, one of the theoretical advantages of the surgical ablation (over the transcatheter one) is to avoid several connecting lesions which could represent “per se”

a substrate for incomplete isolation and re-entrant circuits. Furthermore, a strict protocol for the acute validation of any type of surgical ablation appears to be crucial, and the unsatisfactory performance at the staged mapping in the series by Bulava *et al.* may also be related to the insufficient end-point adopted, such as entrance block only, and therefore the incomplete ablation being delivered during the index surgical procedure. In fact, it has been previously demonstrated that the confirmation, even in the acute setting, of a strict end-point such as bi-directional block is associated with improved outcomes over time (2).

The possibility to establish a multidisciplinary environment as to provide a simultaneous hybrid surgical-transcatheter approach yields therefore a relevant potential: the electrophysiological mapping tools are capable of providing unparalleled information and guidance during the surgical ablation; moreover, the endocardial approach can allow for an immediate completion for the surgical lines if required, thereby potentially minimizing the risk to induce an arrhythmogenic substrate at the end of the index ablation procedure.

Further and larger series are obviously warranted to provide any insight whether a sequential-staged or a simultaneous approach should be the preferred option: in the meanwhile, it appears imperative to effectively deliver a box lesion set and validate it with the most advanced tools currently available.

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Footnote

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