

the clinical success of AF ablation depends on persistent blocking of electrical conduction across the ablation lines. With bipolar radiofrequency (RF) clamps, the PV cuff is physically clamped and burned repeatedly in order to achieve 'acute' conduction block. A question for further reflection is: are we achieving block at that moment because of local tissue trauma and inflammation resulting from simultaneous crushing and burning of the PV cuff and is that block durable? Indeed, Benussi *et al.* [2] have shown previously that despite achieving block acutely with bipolar RF clamps, the veins often recover their ability to conduct (at 3 weeks in 15% of ablated patients).

It has been hypothesized that HIFU lesions may take time to scar in and mature. The mode of cell death for this energy source may differ from that of RF and thus may not always be instantaneous. Villamizar *et al.* [3] have demonstrated that HIFU ablation achieved 100% transmural.

In our experience of using HIFU in 70 cases, we have observed thought-provoking clinical results. The freedom from recurrence of AF after ablation was 82% at 1 month, 90% at 1 year and 100% at 3 years in patients presenting with preoperative paroxysmal AF and undergoing concomitant open heart cardiac surgery with creation of only a box lesion and no additional ablation lines. Those patients were also free from anti-arrhythmic drugs at the time of follow-up. Those impressive results, however, were not observed in patients presenting preoperatively with permanent AF, showing a freedom from recurrence of AF of 42% at 1 month, 54% at 1 year and 62% at 3 years.

Our experience suggests that in order to achieve good clinical results using the HIFU ablation system it is important to use it in the right patients. In our experience, those patients presented with paroxysmal AF with normal or mildly dilated left atria (area <30 cm²; volume <68 ml). We consider a simple box lesion sufficient to achieve a good postoperative clinical result. In patients with permanent AF, a more complex approach should be applied to treat an evolved histopathological condition of the atria.

We believe that the HIFU epicardial ablation system is a high-performing treatment modality creating transmural lesions in the left atrium and yielding good clinical results. Perhaps it is time to revisit the theory of acute conduction block!

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LETTER TO THE EDITOR RESPONSE

Reply to Colli and Romero-Ferrer

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Colli *et al.*, commenting on the electrophysiological efficacy of high-intensity focused ultrasound (HIFU), propose a revision of the acute conduction block theory, as a means to confirm effective pulmonary veins (PVs) isolation [1, 2].

Although this proposal could be original, albeit not supported by evidence, it is in contrast with the general agreement surrounding the end-points for atrial fibrillation (AF) ablation.

In the areas of consensus on ablation techniques identified by the task force in the recently published Consensus Statement on AF catheter and surgical ablation [3], complete electrical isolation of all PVs should be the goal in every ablation strategy targeting the PVs and/or the PV antrum. So, if the PVs are targeted,

electrical isolation should be the goal, and its achievement requires, at a minimum, the assessment and demonstration of conduction block across the PVs lesion. Likewise for surgical PVs, isolation entrance and/or exit block should be validated.

Since such acute validation can overestimate success, the Consensus also suggests an extra period of 20 min following PV isolation, to identify and treat PVs reconnection initially masked by the inflammation process, which gives an apparent acute conduction block.

The evidence supporting the correlation between complete electrical isolation and clinical efficacy of ablation is clear-cut, since the major predictor of arrhythmia recurrence after catheter

ablations is the absence of PVs isolation, indicating restored PV conduction or ineffective PV disconnection. Such a direct cause-effect relationship between PV isolation and cure supports the central role of durable transmural ablation of the ablations in AF treatment [4].

Despite the penetration properties of HIFU ablations being extensively studied at histology, the results are reported in the very acute context and the conduction block has normally not been evaluated. Hence, inferences between histological transmural and electrophysiological block in the long-term remain undocumented.

Colli and Romero-Ferrer state that in their surgical experience, the freedom from recurrence after HIFU ablation (unpublished data) improves with time, suggesting a progressive increase of the ablation efficacy. They speculate that these results might be related to a putative alternative modality of delayed cell death caused by HIFU.

However, a comprehensive study conducted on eight dogs undergoing PV HIFU ablations suggests that the mechanism of permanent injury is irreversible cell death, through coagulative necrosis due to rapid hyperthermal toxicity occurring within the focused zone [5]. Even if different forms of necrotic cell death can be distinguished, based on their initiating mechanisms, i.e. necrosis, necroptosis and secondary necrosis, the downstream cascade of events that occurs thereafter takes place in an invariant fashion, during the following few hours [6].

In conclusion, to the best of the authors' knowledge, ablation lesions can only get worse with time. Based on current evidence, there is no described biological mechanism that may explain a delayed myocardial cell death where the triggering event occurs

during the ablation and the outcome cannot be detected after 3 weeks, as performed in our study.

Conflict of interest: Dr Benussi has a financial relationship with St. Jude Medical Inc., AtriCure Inc., Medtronic Inc., CryoCath Inc., and Edwards Lifesciences Inc. The other authors report no conflicts.

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Stentless aortic bioprostheses: their role in the treatment of aortic endocarditis should not be underestimated

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We read with great interest the comprehensive review article of Funder [1] on the clinical and experimental data surrounding the use of stentless aortic bioprostheses and fully agree with his conclusions. There is no doubt that they are ideal substitutes in patients with small aortic roots to prevent patient-prosthesis mismatch. In this context, they should be implanted in a 'full-root' type of technique to minimize the postoperative aortic regurgitation that may occur due to

distortion of the prosthesis [2] and to facilitate both prosthesis over-sizing and the optimization of haemodynamic results [3].

However, we were surprised that Funder did not comment on the value of stentless valves in the context of aortic endocarditis, particularly in patients with root abscesses and prosthetic valve endocarditis. Homografts have been the gold standard for valve and root replacement in aortic endocarditis for a long time.