Lesion Size Index-guided high-power ablation for atrial fibrillation: opening the therapeutic window

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Abstract

Radiofrequency (RF) ablation for the treatment of atrial fibrillation has gained widespread acceptance since the concept was introduced by Haissaguerre et al a quarter of a century ago. High power short duration ablation has been widely adopted in the management of atrial fibrillation. Evidence for combining lesion size index and high power short duration ablation is lacking. In this issue of the journal, Cai et al evaluated the combination of HPSD with LSI with a focus on long-term efficacy.

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Radiofrequency (RF) ablation for the treatment of atrial fibrillation has gained widespread acceptance since the concept was introduced by Haissaguerre et al a quarter of a century ago[1]. It continues to gain traction with strengthening evidence for intervention in different patient cohorts and as a primary approach for those in the earlier stages of atrial fibrillation[2].

Delivery of RF current via an ablation catheter results in resistive heating at the catheter tip-tissue interface, with tissue destruction at the site. With increasing duration of ablation lesions, deeper tissues are heated (and can be injured) by transfer of thermal energy[3]. Ablating at a higher power – typically 45 watts and above – for a shorter duration (HPSD) allows ablation of the thin atrial wall while limiting thermal injury to deeper structures such as the esophagus[4]. The approach has been widely adopted in the management of atrial fibrillation due to this theoretical widening of the therapeutic window.

In parallel over the past decade, mapping systems have been embellished by algorithms designed to remove variability from the procedure. Indices including the Force Time Integral, and subsequently Ablation Index (AI) and Lesion Size Index (LSI) have developed as a way of standardizing energy delivery to the myocardium[5,6]. They have the advantage of identifying lesion endpoints, beyond which additional ablation is unlikely to be therapeutic or may lead to an unacceptable increase in adverse events such as steam pops. These technological features were developed and validated in the era of lower power ablation in the atrium, when lesion duration was longer[5,7]. HPSD has previously been shown to reduce esophageal injury when combined with AI[8]. The authors of the current paper have previously published their findings on the safety and procedural efficacy of HPSD and LSI[9]. In this issue of the journal, Cai et al evaluated the combination of HPSD with LSI with a focus on long-term efficacy.

The study is a single-center retrospective study of 186 consecutive ablations, in which procedures were performed by a single operator. The ablations were performed at 50W with a target LSI of 4.5 to 5.5 anteriorly and 4.0 to 4.5 posteriorly. First pass isolation was achieved in 83.9% of cases. The complication rate was 3.7% including 3 steam pops. The 2-year freedom from AF was remarkably good at 87.1% after one procedure. Receiver operating characteristic analysis identified optimum target LSIs of 4.7 for anterior lesions and 4.3 for posterior lesions.

The specific findings of the paper need to be interpreted cautiously, however. The outcomes reported – 90% success rates – are comparable to other observational data, but exceed those of well-conducted randomized trials of pulmonary vein isolation such as RAAFT-2, EARLY-AF, STOP-AF and CAPLA[2,10,11]. While these successes should be lauded, they may indicate unmeasured confounders and inherent biases that could limit the generalizability of the findings. Additionally, the procedures were performed under conscious sedation. Extrapolating these findings to the more common scenario in which AF ablation is performed under general anesthesia is questionable, as the two approaches would be expected to result in differences in catheter stability[12].

Caution using an LSI guided approach to HPSD is required, particularly when ablating posteriorly. One of the features of LSI is that the value is only seen after 6 seconds of ablation, and with a higher amount of contact force, the first LSI value seen would likely be above target in many cases. Indeed, one of the steam pops that was reported in the paper occurred in conjunction with an LSI of 5.9. It should also be noted that the study provides evidence for LSI values when ablating around the pulmonary veins. Ablation of other targets, such as the mitral isthmus, SVC, or rare cases where isolation of the posterior wall is indicated, may require use of lesion endpoints other than LSI as the targets may be lower or higher than those presented here.

Most improvements in interventional subspecialities occur in relatively frequent and small increments until a much larger disruption (such as the advent of pulsed field ablation), after which the whole field shifts, and the process begins anew. The interregnum between disruptive changes is characterized by individual operators incorporating these smaller, incremental improvements in a variety of untested combinations. Large scale randomized trials of every combination are not feasible, so we rely on data from lower down the chain of evidence including, importantly, the experience of our peers. The current study, although limited in scope, is a welcome and necessary effort at evaluating the long-term benefit of combining HPSD and LSI and adds to the evidence that the practice is safe and likely an effective means of achieving durable PVI.

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