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EDITORIAL COMMENT

What Is the Optimal Approach to Ablation of Para-Hisian Atrial Tachycardias?*

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Focal atrial tachycardias (ATs) that arise near the atrioventricular (AV) node, so-called para-Hisian ATs, have challenged electrophysiologists to understand the mechanism of these arrhythmias and design safe and effective ablative strategies. These ATs are defined through biatrial maps as those with earliest atrial activation at sites with His bundle potentials. The first descriptions of these tachycardias emphasized the importance of distinguishing these from AV nodal re-entry (1,2), and more recent studies have probed the mechanism of these arrhythmias. Para-Hisian ATs are characteristically sensitive to adenosine and verapamil (3). Some have interpreted these features to imply a dependence on AV nodal tissue. One hypothesis posits the existence of a small re-entrant circuit adjacent to the tricuspid annulus that is distinct from AV nodal re-entry (4). In contrast, we have proposed that para-Hisian ATs are a subset of a larger category of focal ATs that arise from various locations around the tricuspid or mitral annuli (3). As with most other focal ATs, these annular ATs demonstrate adenosine and verapamil sensitivity, facilitation with catecholamines, and induction and termination with programmed stimulation, which support a mechanism of triggered activity.

The obvious challenge in ablating para-Hisian ATs is to avoid collateral damage to the AV node. In the earliest series to describe ablation of these foci, radiofrequency (RF) energy was used cautiously in the paranodal vicinity, but the risk of AV block was high (1,2). In later years, left atrial mapping was performed more frequently to identify arrhythmias best treated from the left side of the septum. Another approach is to use cryoablation in the right atrium (RA), which allows titration of cryoenergy to avoid permanent injury to the AV node. A breakthrough in approaching these ATs was the recognition that ablation in the noncoronary cusp (NCC) of the aortic valve can effectively treat these paranodal ATs (5).

In this issue of *JACC: Clinical Electrophysiology*, Pap et al. (6) report a single-center experience with these different approaches to ablate focal ATs arising near the AV node. After para-Hisian foci were identified, the approach used for the first patients in this series involved left atrial mapping in order to define the earliest site of activation and guide ablation to either the right or left atrial septum. Over time, their strategy migrated to mapping the aortic root after a para-Hisian focus was identified. Of 34 patients in this series, 14 underwent attempted ablation in the

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RA septum with either RF or cryoenergy, but it was successful in only 7 patients. Eleven patients had ablation attempted in the anteroseptal mitral annulus near the aortomitral continuity, and 7 of these patients were successfully ablated. In contrast, 22 patients underwent RF ablation attempts in the NCC, which were successful in 20, including patients unsuccessfully treated from the RA or the aortomitral continuity. Although His bundle potentials were recorded near the junction of the NCC and right coronary cusp, His potentials were generally not recorded at the successful sites that were more posterior in the NCC. There were 2 cases of AV block occurring in patients treated in the RA and none with the other approaches. In addition, the authors report the usefulness of

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intracardiac ultrasound in confirming catheter positioning and stability in the sinuses of Valsalva. The study concluded that treating ATs from the NCC is the preferred approach with regard to efficacy and safety. In the experience of this group, ablation in the NCC has essentially replaced RA ablation for para-Hisian ATs, whereas left atrial mapping is still required for some patients.

This study adds to an evolving body of literature that supports the NCC approach to ablating para-Hisian ATs (7–12). For example, in a study by Wang et al. (11) of 46 para-Hisian ATs, only 8 were successfully ablated in the RA, whereas 35 were successfully ablated in the NCC and 3 from the aortomitral continuity. Another recent report by Madafferi et al. (12) describes 33 patients, of whom 24 were ablated in the NCC; other successful sites of ablation were the anteroseptal left atrium (LA), superoseptal RA, and left and right coronary cusps. In these reports, conduction disturbances were not observed, and junctional rhythm was less common when ablating in the NCC. Interestingly, activation times in the NCC were slightly later than in the septal RA or LA in some patients, despite successful ablation in the aortic root. This counterintuitive finding was also seen in some patients in the series of Pap et al. (6), although the NCC demonstrated earlier activation in the majority of patients successfully treated at this site.

How can we reconcile the finding that para-Hisian ATs are more successfully treated from the NCC, even if the activation times are not necessarily the earliest? Furthermore, it may appear paradoxical that ablation is successful from this site because there is no atrial myocardium per se in the aortic root (9). Why is injury to the conduction system much less likely? A careful review of anatomy in the paraseptal region provides some clues that elucidate these questions. The lowest part of the NCC is adjacent to the paraseptal region and thus provides access to epicardial atrial tissue. One plausible model is that "para-Hisian" ATs arise from atrial myocardium between the right and left atria just below the NCC, and impulses exit almost simultaneously on both sides of the atrial septum (9). The activation times recorded in the right and left atrial septa and in the NCC depend on their distances from the focal origin as well as anisotropic conduction. Thus, mapping the right and left atrial septa may identify exit sites but not necessarily the origin of the tachycardia. The atrial tissue responsible for these ATs may be remote enough from the AV node that ablation can be performed without injuring this structure. In this regard, the NCC provides a "vantage point" for stable catheter deployment far enough from the AV node. It should be emphasized that not all para-Hisian ATs can be ablated from the NCC, and some require ablation in the superoseptal RA or anteroseptal LA. Cases have also been reported of ablation in the right and left coronary cusps. These constitute a spectrum of related ATs that arise from paraseptal foci, in turn a subset of annular ATs.

The operator faces practical choices after mapping the RA and identifying a para-Hisian focus: either cautiously ablate in the paranodal region, access the LA, or map the aortic root. This study and the previous reports provide convincing evidence that mapping the NCC is the preferred option. The approach will ultimately depend on the distance of a focal source from the AV node. Some focal ATs will be mapped just lateral to the His bundle and may be cautiously ablated with RF energy in the anterior tricuspid annulus. In this study, para-Hisian ATs were defined as within 1 cm of the His bundle recording, which could be an arbitrary benchmark for next choosing the transaortic approach. Cryoablation may be useful to achieve better catheter stability in the superior tricuspid annulus, a region where instability often complicates ablation (6). In most cases of true para-Hisian ATs, it is reasonable to map and ablate in the NCC after RA mapping. If this is not successful, mapping of the LA may be appropriate, with attention to the aortomitral continuity. If activation is late in the LA (and ablation in the NCC is not successful), then ablation in the RA paranodal region may be considered using cryoenergy or careful applications of RF energy. Although this study and recent reports do support the advantages of ablation in the NCC, it should be noted that this option has not been rigorously compared with cryoablation in the superoseptal RA.

The evolving approach to treating para-Hisian ATs is an example of how a detailed understanding of anatomic relationships can suggest novel techniques of catheter ablation. This situation is analogous to that of outflow tract tachycardias, which arise from right, left, or epicardial ventricular sources around the semilunar valves. A remaining challenge is to better understand cardiac development and the cellular electrophysiology of these regions to explain why focal arrhythmias cluster in perivalvular locations.

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