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Editorial Comment

What Price Success?*

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Atrioventricular (AV) node reentrant tachycardia is certainly the most common mechanism of paroxysmal supraventricular tachycardia encountered in clinical practice. In 1973 its electrophysiologic substrate was recognized to involve dual AV node pathways by Denes and others in the late Ken Rosen's group (1). They described the presence of two types of AH intervals in affected patients: short AH intervals that were observed when test atrial stimuli had long coupling intervals and long AH intervals that were seen with critically premature test atrial stimuli. These observations led to the concept of a fast pathway with a long refractory period and a slow pathway with a short refractory period, both capable of anterograde (and sometimes retrograde) conduction through the AV junction, that is, dual AV node pathways. In the vast majority of patients with AV node reentrant tachycardia, the tachycardia circuit involves anterograde slow pathway conduction and retrograde fast pathway conduction.

Ablation therapy. Surgical (2–5) and catheter ablation techniques (6–8) for the modification of AV node conduction and cure of AV node reentrant tachycardia have destroyed the dogma that the reentrant circuit in this tachycardia is confined to the AV node. Although there is still plenty of argument as to how much of the perinodal tissue should be considered part of the AV node, it is abundantly clear that the reentrant circuit not only includes what is most conveniently termed the "compact AV node" but also has as a necessary component the inferior aspects of Koch's triangle, especially along the tricuspid anulus as low as the level of the ostium of the coronary sinus. Ablation therapy applied to these inferior approaches to the AV junction will selectively destroy or impair slow pathway conduction, whereas current delivered close to the compact AV node will selectively destroy or impair the fast pathway (which may or may not be the same as the compact AV node!). Although the first catheter ablations for AV node reentrant tachycardia were directed to selective ablation of the fast pathway, the manifest risk of inducing complete heart block when an ablation target is close to the compact AV node has led most workers to select slow pathway ablation as the therapeutic procedure of choice.

Catheter ablation therapy of AV node reentrant tachycardia has a uniquely high success rate. When an aggressive strategy is employed, it is virtually always possible to render AV node tachycardia noninducible whether the ablation site is chosen by anatomic-electrophysiologic landmarks (8,9) or by slow pathway potential recordings (10). In fact, to eliminate the clinical recurrence of AV node reentrant tachycardia, it is not necessary for the ablation procedure to eliminate all evidence of slow pathway conduction or even to destroy the capacity of the slow pathway to conduct single echo beats (9,10), although in our own experience (11) the persistence of slow pathway conduction has been a risk factor for such clinical recurrence.

Present study. Wu et al. (12) in this issue of the Journal describe a modification of the anatomic-electrophysiologic approach to selective slow pathway ablation whereby the target site for ablation is selected by first positioning the ablation catheter at the site recording the biggest proximal His bundle deflection and then turning the catheter tip down and toward the tricuspid anulus until the His deflection is no longer apparent and the local atrial electrogram amplitude is smaller than the local ventricular electrogram amplitude. They found that application of radiofrequency energy to this site was very successful in ablating the induction of AV node reentrant tachycardia, usually by the selective ablation or modification of the slow pathway. Among the 100 patients who form the core of their report, slow pathway conduction was ablated or modified in 94 patients, counting the 12 patients who had both anterograde slow pathway and retrograde fast pathway ablation but not counting the 3 patients with complete heart block (who also no longer had effective slow pathway conduction). The fast pathway was ablated or modified without effect on the slow pathway in three patients. Wu et al. also update their series with a brief addendum that describes an additional 89 patients treated with the same approach, including 1 additional patient who had heart block for several weeks. Several comments about this technique are appropriate.

Proximity of the ablation site to the compact AV node. The site identified as HB in Figure 2, where the maximal proximal His deflection was recorded, is the site where radiofrequency current is applied to deliberately ablate the AV node and induce complete heart block in patients with medically refractory atrial fibrillation. The technique as described by Wu et al. (12) would typically place the ablation catheter closer to the compact AV node than is *usually* necessary to selectively ablate the anterograde slow pathway of AV node reentrant tachycardia. In our group's experience (13) with 252 patients undergoing radiofrequency ablation of AV node reentrant tachycardia, only about 15% of patients required energy application as close to the compact node as occurred routinely with the technique of Wu et al. This difference occurred even though our routine objective was total elimi-

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nation of all evidence of residual slow pathway conduction, a more rigorous criterion for a successful end point of the ablation therapy than that in the series of Wu et al. In our series only three patients have developed complete heart block, in each case as a consequence of a deliberate shift of the ablation target site from close to the coronary sinus ostium toward the compact AV node, the site targeted by Wu et al. as their primary site of ablation therapy. The maxim to remember is that the closer a lesion is to the compact AV node, the more likely that lesion is to create complete heart block.

Overlap of sites that resulted in slow versus slow plus fast pathway ablation. In the study of Wu et al. there was marked overlap in the sites of ablation that selectively ablated the slow pathway and sites that also resulted in ablation of the fast pathway. This overlap is to be expected when all ablation sites are relatively close to the compact AV node. Jackman et al. (10) observed fast pathway ablation remote from the compact AV node in only one patient and in the our series (13), fast pathway ablation occurred remote from the compact AV node in only one patient.

Is a permanent pacemaker necessary? Of the four patients who developed complete heart block, a permanent pacemaker was implanted in only one, apparently with no complications in the patients who did not receive a pacemaker. This interesting observation would be very difficult to confirm in the medical-legal climate of the United States but implies that the escape pacemaker is quite stable, at least for months at a time and that the decision to implant a permanent pacer in the event of the inadvertent production of heart block can be delayed for at least a few days to see whether AV conduction will return. However, we have seen a patient with late, although asymptomatic, development of complete heart block; therefore, the early preservation of AV conduction does not mean that there is no late risk (8).

Informed decision making. The need of patients for ablation of AV node reentrant tachycardia, and hence their willingness to risk complete heart block as a complication of the procedure, varies greatly. Although no one can absolutely guarantee that there will be no accidental dislodgment of a catheter during ablation with inadvertent creation of complete heart block, the risk of heart block can be made <1% by targeting only those ablation sites that are in the most inferior aspects of Koch's triangle and by avoiding slow pathway ablation in the rare patient with inadequate anterograde fast pathway conduction. This means that the physician and patient can and should make an informed decision about the aggressiveness of the ablation procedure in advance of the procedure, determining "what price success?" on the basis of an acceptable risk of complete heart block for that patient. For most patients, complete heart block is too dear a price to pay for the ablation of AV node reentrant tachycardia.

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