JACC Vol. 25, No. 5
April 1995:982–3

Editorial Comment

Fast Pathway Ablation for Atrioventricular Node Reentrant Tachycardia*

FRED MORADY, MD, FACC

Ann Arbor, Michigan

The pioneering surgical reports of Ross et al. (1) and Cox et al. (2) set the stage for catheter ablation of atrioventricular (AV) node reentrant tachycardia by demonstrating that this type of tachycardia could be cured without damage to the compact AV node or impairment of AV conduction. Several experimental and clinical studies (3–8) have indicated that the anterior and posterior inputs into the compact AV node are critical components of the AV node reentrant tachycardia reentry circuit, with the anterior AV node input serving as the "fast pathway" and the posterior AV node input as the "slow pathway".

In the initial reports of catheter ablation for AV node reentrant tachycardia, direct current shocks or radiofrequency energy applications were delivered near the anterosuperior aspect of the tricuspid annulus, resulting in electrophysiologic effects consistent with fast pathway ablation. The success rates were 76% to 91%, but there was a 2% to 10% incidence of inadvertent high degree AV block (9–11). In subsequent reports, radiofrequency energy was delivered in the region of the posteroinferior aspect of the tricuspid annulus, near the ostium of the coronary sinus, resulting in electrophysiologic effects consistent with slow pathway ablation. With this technique, the success rate increased to 95% to 100%, with <2% incidence of inadvertent AV block (12–16). Although a randomized comparison of the anterior and posterior approaches to ablation of AV node reentrant tachycardia in 50 patients at one center demonstrated no significant differences in efficacy or complication rates between the two techniques (17), the pooled results of studies from several centers have indicated the superiority of the posterior approach, in which the slow pathway is targeted (12–16).

Stepwise approach to fast pathway ablation. The study by Kottkamp et al. (18) in this issue of the Journal describes a stepwise approach to fast pathway ablation in which a radiofrequency energy application initially is delivered at a site that is posterior and superior to the site where the maximal His bundle depolarization is recorded. If necessary, subsequent applications of energy are delivered sequentially at progressively more inferior sites along the midseptal region. In a series of 53 patients, the initial success rate was 96%, the recurrence rate was 6%, and there were no complications. On the surface, the excellent results obtained in this study seem to indicate that fast pathway ablation can be achieved as effectively and safely as slow pathway ablation.

Location of target sites. The compact AV node is situated at the apex of the triangle of Koch, at the point of convergence of the tendon of Todaro and the septal leaflet of the tricuspid valve (14). The fact that fast pathway ablation sites are closer to the apex of the triangle of Koch than are slow pathway ablation sites explains the higher incidence of inadvertent AV block in previous studies that utilized the fast pathway approach. However, the sites targeted by Kottkamp et al. also are close to the apex of the triangle of Koch. In fact, on the basis of the fluoroscopic appearance of the ablation catheter in the right anterior oblique view and the electrogram characteristics at the ablation sites (a large AV ratio and a small His bundle depolarization), it seems likely that the target sites used in the Kottkamp et al. study overlap with the target sites used in earlier reports in which inadvertent AV block occurred. Furthermore, intentional AV junction ablation can be accomplished with a high degree of success at very similar sites. Therefore, a word of caution is in order before applying the technique of Kottkamp et al. in clinical practice. It is probable that the excellent results and absence of complications in their study is attributable much more to the vigilance, experience and careful technique of Kottkamp et al. than to any major difference in the position of the ablation catheter. The target sites used by Kottkamp et al. clearly are within striking distance of the compact AV node. Therefore, indiscriminate use of this technique without the same degree of care used by Kottkamp et al. is bound to result in a significant incidence of inadvertent AV block.

Avoidance of AV block. Three aspects of the technique of Kottkamp et al. may have been instrumental in the avoidance of permanent AV block and are worthy of emphasis. First, atrial pacing at whatever rate necessary to overdrive the junctional ectopic activity that frequently occurs during fast pathway ablation was used, and AV conduction was carefully monitored throughout the duration of the energy applications. Although we are not told how often energy applications had to be discontinued prematurely because of transient AV block, this was almost certainly necessary in a significant percent of energy applications. Second, radiofrequency energy was used conservatively, with temperature monitoring in >50% of the patients and with power settings as low as 5 W. Last, in approximately one third of patients, the energy applications were delivered in a titrated manner. In a previous study (20) in which a titrated approach was utilized to identify the minimal effective power setting, fast pathway ablation was performed in 45 patients with no instances of inadvertent AV block.

Conclusions. Kottkamp et al. have confirmed that fast pathway ablation can be accomplished with a very low risk of

*Editorials published in *Journal of the American College of Cardiology* reflect the views of the authors and do not necessarily represent the views of *JACC* or the American College of Cardiology.

From the Division of Cardiology, Department of Internal Medicine, University of Michigan Medical Center, Ann Arbor, Michigan.

Address for correspondence: Dr. Fred Morady, Division of Cardiology, University of Michigan Medical Center, 1500 East Medical Center Drive, Ann Arbor, Michigan 48109-0022.

0735-1097/95/$9.50
0735-1097(94)00515-R

AV block. However, as they point out, slow pathway ablation continues to be the preferred technique for elimination of AV node reentrant tachycardia. Although measures to avoid inadvertent AV block are also necessary with slow pathway ablation, there is a larger margin of safety when target sites are near the coronary sinus ostium than when they are near the apex of the triangle of Koch. Slow pathway ablation has the additional advantages of not causing the first-degree AV block that often accompanies fast pathway ablation and allowing the monitoring of ventriculoatrial (VA) conduction during junctional ectopic activity to monitor for impending AV block (21). Probably the only advantage of the fast pathway approach is that efficacy can be quickly assessed simply by ventricular pacing to identify the elimination or attenuation of VA conduction. Therefore, fast pathway ablation may be appropriate in the occasional patient in whom slow pathway is ineffective or in whom the efficacy of slow pathway ablation is difficult to assess because the inducibility of AV node reentrant tachycardia is not reproducible. However, this role is a highly limited one, as evidenced by the finding that intentional fast pathway ablation was necessary in only 3 of the last 450 consecutive patients with AV node reentrant tachycardia who underwent slow pathway ablation at one center (Morady F, et al., unpublished observations).

References

1. Ross DL, Johnson DC, Denniss AR, et al. Curative surgery for atrioventricular junctional (AV nodal) reentrant tachycardia. J Am Coll Cardiol 1985;6:1383–92.
2. Cox JL, Holman WL, Cain ME. Cryosurgical treatment of atrioventricular node reentrant tachycardia. Circulation 1987;6:1329–36.
3. Sung RJ, Waxman HL, Saksena S, et al. Sequency of retrograde atrial activation in patients with dual atrioventricular nodal pathways. Circulation 1981;64:1059–67.
4. Iinuma H, Dreifus LS, Mazgalev T, et al. Role of the perinodal region in atrioventricular nodal reentry: evidence in an isolated rabbit heart preparation. J Am Coll Cardiol 1983;3:465–73.
5. McGuire MA, Lau KC, Johnson DC, et al. Patients with two types of atrioventricular junctional (AV nodal) reentrant tachycardia. Circulation 1991;83:1232–46.
6. Keim S, Werner P, Jazayeri M, et al. Localization of the fast and slow pathways in atrioventricular nodal reentrant tachycardia by intraoperative ice mapping. Circulation 1992;86:919–25.
7. McGuire MA, Bourke JP, Robotin MC, et al. High resolution mapping by Koch's triangle using sixty electrodes in humans with atrioventricular junctional (AV nodal) reentrant tachycardia. Circulation 1993;23:2315–28.
8. DeBakker JMT, Coronel R, McGuire MA, et al. Slow potentials in the atrioventricular junctional areas of patients operated on for atrioventricular node tachycardias and in isolated porcine hearts. J Am Coll Cardiol 1994;23:709–15.
9. Haissaguerre M, Warin JF, Lemetayer P, et al. Closed-chest ablation of retrograde conduction in patients with atrioventricular nodal reentrant tachycardia. N Engl J Med 1989;320:426–33.
10. Lee MA, Morady F, Kadish A, et al. Catheter modification of the atrioventricular junction with radiofrequency energy for control of atrioventricular nodal reentry tachycardia. Circulation 1991;83:827–35.
11. Calkins H, Sousa J, El-Atassi R, et al. Diagnosis and cure of the Wolff-Parkinson-White syndrome or paroxysmal supraventricular tachycardias during a single electrophysiology test. N Engl J Med 1991;324:1612–8.
12. Jazayeri MR, Hempe SL, Sra JS, et al. Selective transcatheter ablation of the fast and slow pathways using radiofrequency energy in patients with atrioventricular nodal reentrant tachycardia. Circulation 1992;85:1318–28.
13. Kay GN, Epstein AE, Dailey SM, et al. Selective radiofrequency ablation of the slow pathway for the treatment of atrioventricular nodal reentrant tachycardia. Circulation 1992;85:1675–88.
14. Haissaguerre M, Gaita F, Fischer B, et al. Elimination of atrioventricular nodal reentrant tachycardia using discrete slow potentials to guide application of radiofrequency energy. Circulation 1992;85:2162–75.
15. Jackman WM, Beckman KJ, McClelland JH, et al. Treatment of supraventricular tachycardia due to atrioventricular nodal reentry by radiofrequency catheter ablation of slow pathway conduction. N Engl J Med 1992;327:313–8.
16. Wathen M, Natale A, Wolfe K, et al. An anatomically guided approach to atrioventricular node slow pathway ablation. Am J Cardiol 1992;70:886–9.
17. Langberg JJ, Leon A, Borganelli M, et al. A randomized, prospective comparison of anterior and posterior approaches to radiofrequency catheter ablation of atrioventricular nodal reentry tachycardia. Circulation 1993;87:1551–6.
18. Kottkamp H, Hindricks G, Willerns S, et al. An anatomically and electrogram-guided stepwise approach for effective and safe catheter ablation of the fast pathway for elimination of atrioventricular node reentrant tachycardia. J Am Coll Cardiol 1995;25:974–81.
19. Becker AE. Atrioventricular nodal anatomy revisited. American College of Cardiology, Learning Center Highlights 1994:17–22.
20. Langberg JJ, Harvey M, Calkins H, et al. Titration of power output during radiofrequency catheter ablation of atrioventricular nodal reentrant tachycardia. PACE 1993;16:465–70.
21. Jentzer JH, Goyal R, Williamson BD, et al. An analysis of junctional ectopy during radiofrequency ablation of the slow pathway in patients with atrioventricular nodal reentrant tachycardia. Circulation 1994;90:2820–6.