High Success Rate with Cryomapping and Cryoablation of Atrioventricular Nodal Reentrytachycardia

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Introduction: *Cryoablation is a new alternative to radiofrequency (RF) ablation for treatment of atrioventricular nodal reentry tachycardias (AVNRT). Mapping with reversible effect on the arrhythmia substrate or the AV node can be done before irreversible ablation is performed. This study evaluates an approach with systematic cryomapping, ablating only in areas with prompt effect on the arrhythmia substrate and evaluates whether the success rates and procedure times are similar to RF ablation.*

Methods and Results: *Seventy-five consecutive patients with typical slow-fast AVNRT were studied. Cryomapping at −30°C was performed before ablation with a goal temperature of −70°C for 240 seconds. The ablation procedure was successful in 74 of the 75 patients, giving an acute success rate of 99%. During a mean follow-up of 338 days, 70 of the 74 primarily successfully ablated patients were free from the treated arrhythmia, giving a recurrence rate of 5% and a total success rate of 93%. Total procedure time including a 30-minute test after successful ablation was 126 ± 55 minutes. Fluoroscopy time was 18.5 ± 14.9 minutes.*

Conclusion: *Cryoablation of AVNRT appears to be as effective as RF ablation both acute and in long term with minimal risks for unwanted injuries on the conduction system. The procedure can be done with reasonable procedure and fluoroscopy times. (PACE 2006; 29:487–489)*

electrophysiology, ***cryoablation***, ***AV node***, ***radiofrequency ablation***, ***tachycardia***

Background

Radiofrequency (RF) ablation of atrioventricular nodal reentry tachycardias (AVNRT) has a high short- and long-term success rate and is often the preferred therapy.[1–6] There is, however, a small risk for inadvertent nonreversible atrioventricular (AV) block during the procedure. In large series, this risk is about 1%.[4,6] This may induce high-degree AV block necessitating pacemaker implantation. An alternative to RF energy is cryothermic energy. With the cryotechnique, mapping with reversible effect on the arrhythmia substrate or the AV node can be done before irreversible ablation is performed. There are reports that cryoablation of AVNRT has a lower success rate than RF ablation.[7,8] This study evaluates an approach with systematic cryomapping, ablating only in areas with prompt effect on the arrhythmia substrate and evaluates whether the success rates and procedure times are similar to RF ablation.

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Patients and Methods

Patients

Seventy-five consecutive patients, 46 women and 29 men, age 53 ± 16 years (range 19–89) with typical slow-fast AVNRT were studied. Sixty-five patients had no underlying heart disease except treated hypertension (no = 12). Six patients had a previous myocardial infarction (MI), two had angina pectoris, one had a large aortic insufficiency, and two had diabetes. Six patients had previously undergone a failed RF ablation. The study was approved by the Institutional Ethics Committee.

Methods

A standard electrophysiologic (EP) study was done. Catheters were placed initially in the right ventricle, in the coronary sinus, and in the His position. Biplane fluoroscopy (RAO 30° and LAO 60°) was used. After the diagnostic part was completed, a 6-mm cryocatheter Freezor Extra (CryoCath) with the ability of cryomapping and cryoablation was used.[9] Mapping was done combining anatomic location with electrogram analysis to look for dual potentials or low-frequency potentials suggestive for the slow pathway as described by Jackman et al. and Haissaguerre et al.[10,11] At potential target positions, mapping was performed with a temperature setting of −30° to −35° C for 10–20 seconds. AV nodal conduction time was continuously monitored; if any increase was noted

mapping was stopped. Programmed stimulation was used to test the effect. We looked for loss of slow pathway conduction demonstrated as a shift in the refractory period and abolition of echo beats. If we saw effect between 10 and 20 seconds of mapping, we switched to ablation with a goal temperature of −70°C for 240 seconds. Repeated testing was done during the ablation procedure as well as continuous monitoring of the AV nodal conduction. If there were signs of recurrence of slow pathway conduction or AV prolongation, ablation was terminated. After initial successful ablation, we tested for 30 minutes. We used noninducibility as an endpoint, accepting nodal echoes but no complete circles after 30 minutes.

Follow-Up

Follow-up was made either by out-patient visit or by telephone contact. Relapse was defined as recurrence of the index arrhythmia—typical symptoms of tachycardia with sudden onset or tachycardia documented with ECG.

Statistics

Data are given as mean ± SD for normative data and as median and range for nonnormative data.

Results

Efficacy and Safety

All patients had an inducible typical tachycardia either at baseline or during isoproteronol infusion. The ablation procedure was successful in 74 of the 75 patients, giving an acute success rate of 99%. In the patient where cryoablation did not succeed, RF ablation was performed also without success. During a mean follow-up of 338 days (93–830, median 290), 70 of the 74 primarily successfully ablated patients were free from tachycardia, giving a recurrence rate of 5% among patients with a primary successful ablation and a total success rate of 93%.

Two of the patients with recurrence of AVNRT underwent a successful second cryoablation. Two patients declined a new procedure as they experienced fewer tachycardias than before ablation.

Procedure and Fluoroscopy Time

Total procedure time including a 30-minute test after successful ablation was 126 ± 55 minutes. Commonly we saw a recurrence of inducibility within 5 minutes, but in three cases we saw recurrence between 20 and 30 minutes, suggesting that a 30-minute test after ablation is a requirement.

Fluoroscopy time was 18.5 ± 14.9 minutes.

The number of cryoapplications was 3.3 ± 3.1, the total number of cryomapping sequences (including those where ablation was done) was 7.8 ± 3.3, and total application time was 596 ± 345 seconds.

In 19 patients, one single application was successful. In 18 patients, two applications and in 38 patients three or more applications were used.

In seven cases of cryomapping, transient AV block was noted in posteroseptal positions resulting in repositioning of the ablation catheter.

Complications

One patient had a small pneumothorax after catheterization of the subclavian vein; otherwise no complications were recorded. Six patients showed transient AV block during cryoablation, which had not been demonstrated during cryomapping. In all cases, there was a prompt return of AV nodal conduction within seconds of normalized temperature.

Discussion

Efficacy and Safety

The present study shows that cryoablation therapy of AVNRT has a very high primary success rate that compares favorably with RF ablation.[2–5] The acute success rate was higher than reported in previous studies.[7,8,12] This may be due to the larger catheter tip (6 mm) used in this study presumably giving larger and deeper lesions. Another reasonable explanation for the high success rate is in our opinion that the feasibility of reversible cryomapping makes it possible to deliver cryoapplications at the most effective positions. In several cases, we would have hesitated to deliver RF applications due to the proximity of His bundle at the effective sites of cryoablation. Cryomapping also makes it possible to avoid unnecessary tissue injury and thereby shortens procedure time.

In some cases transient AV block occurred during cryoablation, which had not been demonstrated during cryomapping. This is probably due to the fact that the affected area gets larger with the increased cryoenergy. The AV blocks came gradually and there was a prompt return of AV nodal conduction within seconds of normalized temperature.

In this study, long-term results were similar to what is previously reported for RF ablation. Five percent of our patients had late recurrences, which is similar to what is previously reported for RF ablation where late recurrences have been observed in 3–6% of the cases.[2–5] Despite long experience and technique improvement, RF ablation of AVNRT still carries a 1% risk of irreversible AV block necessitating pacemaker

implantation.[4] There are currently no reports of permanent inadvertent injuries of the AV node during AVNRT ablation with the cryoablation technique. This suggests that cryoablation of AVNRT is a safer treatment than RF ablation.

Procedure Time

The procedure times with cryoablation have been reported to be longer than for RF ablation. Cryoablation does not give any nodal response during application. When we initially started using cryothermic energy, as with several other centers we used it in the same way as RF energy. Cryoenergy was applied with an anatomical or semi-anatomical approach moving from posterior sites to more anterior sites. This led to long application and procedure times compared to RF where only short test applications are needed. The lesions with RF catheters probably were larger than with the 4-mm cryocatheters used because the RF catheter moves during the heartbeats in contrast to cryoablation where the catheter stays frozen adjacent to the endocardium. With the introduction of larger tips, the lesions became larger and more effective. The mapping technique used in this study makes shorter mapping sequences and causes minimal injuries. This is also reflected in the reasonable total procedure and fluoroscopy times (mean 126 and 19 minutes). Our results included a learning curve for the four physicians doing the procedures and at the end of the study procedure times were decreasing.

Our initial experience with cryoablation and mapping was with the 4-mm tip. For this study the 6-mm tip was available. We found this latter electrode slightly stiffer than the 4-mm tip electrode but with perfectly good maneuverability. Several of the authors found the extra stiffness as an advantage when mapping the posteroseptal tricuspid region.

Conclusions

Cryoablation of AVNRT appears to be as effective as RF ablation both acute and in the long term with minimal risks for unwanted injuries on the conduction system. At present cryocatheters are more expensive than RF catheters and the cost-effectiveness with cryoablations should be considered; however, in patients with an anticipated higher risk for AV block than normal, the cryotechnique should definitively be considered.

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