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Pseudo cryomapping for ablation of atrioventricular nodal reentry tachycardia: A single center North American experience

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ABSTRACT

Background: Most literature for cryoablation of atrioventricular nodal reentry tachycardia (AVNRT) is based on −30 degree celsius cryomapping with 4 & 6 mm distal electrode catheters. The cryomapping mode is not available on the 6 mm cryocatheter in the United States. We describe a technique for 'pseudo' mapping at −80° using a 6 mm cryocatheter and report on short and long term outcomes.
Methods: A retrospective analysis of all index cases (n = 253) of cryoablation of AVNRT at a single North American institution during the period of 2003–2010 was performed. The majority of cases utilized a 6 mm distal electrode tip catheter. Long term follow up (2.4 ± 1.8 years) was performed via review of the medical record and by questionnaire or telephone if necessary.
Results: Acute ablation success was achieved in 93% of cases, with transient conduction defects noted in 39% of cases, and long term conduction defects in 1.6% of cases (4 patients with PR prolongation, 2 of which were permanent). General anesthesia, male gender and presence of structural heart disease were more common in the acute failure cohort. The recurrence rate for AVNRT was 8%. These patients tended to be younger and had more transient A-V conduction defects during the index procedure than those without a recurrence.
Conclusions: In conclusion, anatomic cryoablation of AVNRT utilizing a 6 mm electrode catheter with mapping performed at −80° Celsius is a safe procedure with good long term efficacy. Transient A-V block during the index procedure increases the risk of late recurrence.

1. Introduction

Cryoablation is an accepted tool for catheter ablation [1], but widespread use in the treatment of atrio-ventricular nodal re-entry tachycardia (AVNRT) has been limited by perceptions concerning efficacy. Several studies have suggested that acute success rates with cryoablation are almost equivalent to radiofrequency ablation; however, long term recurrence rates may be significantly higher [2–4]. Cryomapping, a mode of reversible thermal lesion mapping performed by lowering catheter tip temperature to −30° Celsius (C), can be performed with both the 4 and 6 mm distal electrode tip catheters in Europe and Asia. In the United States, both catheters are available, but only the 4 mm supports the cryomapping mode. As such, much of the worldwide published literature on cryoablation using a 6 mm cryomapping capable catheter tip is not relevant to the technology utilized in the United States. Early experience suggesting a lower success rate for 4 mm tip cryoablation compared to radiofrequency (RF) ablation, resulted in many abandoning the cryoablation modality altogether, while propelling many users of cryoablation to utilize 6 mm catheters [5–7].

We have employed cryoablation almost exclusively for AVNRT ablation over the last 8 years, most recently utilizing a modified approach of pseudo-cryomapping at −80° Celsius with the 6 mm catheter tip. This study describes our technique, and the acute and long term success rates, in a relatively large cohort from a single North American academic medical center. It illustrates that pseudo-cryomapping is a safe approach and that the 6 mm catheter is not statistically more efficacious than the 4 mm catheter in long term follow up.

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2. Methods

2.1. Recruitment

We retrospectively analyzed consecutive cryoablation procedures for AVNRT, performed between October 2003 and April 2010. Both pediatric and adult patients were included in the analyses. The procedure was performed by one of six electrophysiologists, utilizing a similar basic protocol. Collected study data included: fluoroscopy time, sedation type (conscious sedation or general anesthesia), development of transient or permanent AV block, acute procedural outcome, and presence or absence of dual AV nodal physiology at the end of the procedure. Only the index procedure was included in the analysis, and in cases where an upgrade was made from a 4 mm tip catheter to a 6 mm tip catheter, the case was categorized as a 6 mm tip case. Long term follow up was performed by review of the patient medical record, a mailed questionnaire, and telephone contact with patients. Our institutional internal review board (Committee for the Protection of Human Subjects) approved this research study.

2.2. Cryoablation technique

Most procedures in adult patients were performed with moderate sedation in the post absorptive state. Most pediatric procedures were performed under general anesthesia. Antiarrhythmic medications were usually held for several half lives prior to the study. Quadripolar catheters were placed in the right atrium, right ventricle, and His bundle position and a decapolar catheter was used to cannulate the coronary sinus (usually via the right internal jugular vein). A routine electrophysiology study was then performed, with atrial and ventricular overdrive pacing, programmed electrical stimulation of the atrium and ventricle, and para-Hisian pacing as appropriate. The diagnosis of AVNRT was made with traditional criteria including a septal VA interval less than 70 ms in tachycardia and a V-A-H-V response to ventricular entrainment. When AVNRT was confirmed, a cryoablation catheter (7 F, Freezor 4 mm tip or Freezor Max 6-mm tip, CryoCath, Montreal, Canada) was advanced via the femoral vein, sometimes with the use of a stabilizing long sheath (Daig SR0).

Typically, the slow pathway was mapped with the ablation catheter starting at the tricuspid annulus near the level of the coronary sinus ostium and proceeding either inferiorly (toward the coronary sinus ostium) or superiorly (toward the His bundle), but only rarely higher than the mid-septum. Three-dimensional electroanatomic mapping with EnSite Nav-X (St Jude Medical) was typically used. If a slow pathway potential was not readily identified, an anatomic-based approach was performed. After a suitable site for ablation was identified, the cryoablation catheter was cooled to target temperature (- 30 °C for the 4 mm tip catheter in 'map' mode, and −80 °C for the 6 mm tip catheter), with close monitoring of AV conduction. If AV conduction remained stable for 60 s, either a full lesion (4–6 min total) was commenced or, if SVT was inducible, the cryocatheter was typically warmed and moved to a new location. A similar strategy was used if cryoablation was performed during SVT. Once AVNRT was not inducible, a full 4–6 min lesion was applied, typically followed by several 'consolidation' lesions contiguous to the successful area. Often, the first consolidation lesion was delivered at the same site as the successful index lesion, in a 'freeze-thaw-freeze' manner. A waiting period of 30–60 min was usually employed, with attempted induction of SVT on isoproterenol. If tachycardia was still non-inducible, the procedure was terminated. A single echo beat was considered an acceptable endpoint, if AVNRT was non-inducible.

2.3. Follow up

Post ablation, all patients were hospitalized and monitored overnight on telemetry. Recurrent SVT was defined as either electrocardiographic recurrence consistent with AVNRT, or recurrence of typical symptoms even in the absence of documented SVT.

2.4. Statistical analysis

The results of the study are displayed as mean ± standard deviation, counts, or percentages. The Student's t-test and chi square test were used for comparison of continuous and categorical variables respectively. All tests were two-tailed, with a p value of <0.05 considered statistically significant.

3. Results

3.1. Patient population (Table 1)

253 consecutive cases of cryoablation of AVNRT were performed during the study period of October 2003 to early 2010. Only 18 patients (7%) were lost to follow up. The majority of patients were female and without structural heart disease. Pediatric patients comprised 12% of the total cohort with an average age of 15.1 years. Atypical AVNRT was diagnosed in 4 patients. In 10 patients, AVNRT was not inducible; in 9 of these patients, there was evidence of dual AV nodal physiology on the basis of a jump in AH interval, PR longer than RR or av nodal echo beats. In 1 patient, the clinical SVT was deemed to be a short RP tachycardia, and empiric cryoablation was performed in the absence of documented dual av nodal physiology. Acute procedural success was achieved in 93% of patients. Transient AV conduction abnormalities (non -permanent first, second or third degree heart block), were seen in 39% of patients, primarily as PR prolongation. PR prolongation persisted in 4 of 253 patients (1.6%).

3.2. Acute success (Table 2)

Excluding patients lost to follow up, acute procedural success was achieved in 93% of the patients. Patients with acute failure were more likely to be male, have structural heart disease, receive general anesthesia and longer fluoroscopy times. Transient AV conduction abnormalities occurred more frequently in the acutely successful group (39% versus 29%) but this difference was not statistically significant.

3.3. Long term follow-up (Table 3)

The mean duration of follow up was 2.4 ± 1.8 years and the recurrence rate was 8%. Patients with long term recurrence all had

Table 1
Patient population.

Total number of cases	253
Cases with long term follow up data	235
Average Age	47 ± 21
% Male	37%
Pediatric Patients	12%
Heart Disease	14%
4 mm Tip	10%
General Anesthesia	31%
Fluoro Time (minutes)	31 ± 22
Acute Success	93%
Transient AV block	39%
Persistent PR prolongation	1.6%

Data are expressed as mean ± one standard deviation.

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