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Can successful radiofrequency ablation of atrioventricular nodal reentrant tachycardia be predicted by pattern of junctional ectopy?

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Abstract

Background: Emergence of junctional rhythm (JR) during radiofrequency (RF) current delivery directed at the periatrioventricular nodal region has been shown to be a marker of success in atrioventricular nodal reentrant tachycardia (AVNRT). Whereas the characteristics of JR during RF ablation of slow pathway have already been studied, the electrophysiologic features of different patterns of JR are yet to be evaluated.

The aim of this study was to investigate in detail the characteristics of the JR that develops during the RF ablation of the slow pathway.

Materials and Results: The study population consisted of 95 patients: 56 women and 33 men (mean age, 47.2 ± 16.3 years) who underwent slow pathway ablation because of AVNRT. A combined anatomical and electrogram mapping approach was used, and AVNRT was successfully eliminated in all patients. This study identified 7 patterns for JR during the RF ablation of slow pathway: junction-junction-junction, sinus-junction-sinus, intermittent burst, sparse, no junction, sinus-junction-junction, and sinus-junction-block . The characteristics of JR, such as mean cycle length and total number, were gathered.

The incidence of JR was significantly higher during effective applications of RF energy than during ineffective applications (P = .001). The mean number of junctional ectopy was 19.6 ± 19. The total number of junctional ectopy was significantly higher during effective applications of RF energy than during ineffective applications (24.6 ± 18.8 vs 8.4 ± 13.2; P < .001). We found a significant difference between the effective and ineffective applications of RF energy in the mean cycle length of the junctional ectopy (464.6 ± 167.5 vs 263.4 ± 250.2; P <.01). The patterns of JR were compared between effective and ineffective applications. We managed to show a significant correlation between patterns of JR and successful ablation (P = .01).

Logistic regression analysis revealed that the presence of sinus-junction-sinus, sinus-junction-junction, and sinus-junction-block patterns of JR was a predictor of a successful RF ablation (confidence interval [CI], 1.67-15.92 [P < .004]; CI, 1.02-85.62 [P = .048]; and CI, 1.06-32.02 [P = .042], respectively).

Conclusion: This study confirms that JR is often present during successful slow pathway ablation. The pattern of JR is useful as indicator of success.

Keywords: Junctional ectopy; Slow pathway; AVNRT; RF ablation

Introduction

Catheter-based slow pathway modification has become a first−line treatment of recurrent atrioventricular nodal reentrant tachycardia (AVNRT) with success rates approaching 100%.[1,2]

Emergence of junctional rhythm (JR) during radiofrequency (RF) current delivery directed at the periatrioventricular (AV) nodal region has been shown to be a marker of successful catheter ablation in AVNRT and has been considered as a response of the AV node to the thermal injury of either the nodal or the perinodal tissue.[3-6]

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The characteristics of accelerated JR (AJR) during RF ablation of slow pathway have been studied in association with the outcome of catheter ablation.[7] However, the electrophysiologic features of different patterns of JR have not yet been evaluated.

This study sought to investigate in detail the electrophysiologic characteristics of JR that develops after RF ablation of the slow pathway and to determine their significance in predicting the successful RF ablation.

Materials and methods

The study population comprised 95 patients: 56 women and 33 men (mean age, 47.2 ± 16.3 years; range, 18-81 years) who underwent slow pathway ablation because of AVNRT between October 2005 and June 2006 in our center. We excluded 6 patients with more than 5 applications of RF energy from this study because the cumulative effect of burns might be a confounding factor. These patients received a total of 127 RF energy applications. There were 3 patients with coronary artery disease and 2 patients with valvular heart disease; the remainder had no structural heart disease.

Electrophysiology considerations

All the patients gave their informed consent, and electrophysiologic tests were done under local anesthesia in fasting state. Three 6F quadripolar electrode catheters were introduced percutaneously into the femoral veins and positioned at the high right atrium, His-bundle region, and right ventricular apex; and a 7F steerable decapolar catheter was placed in the coronary sinus from the right femoral vein or subclavian vein. Mapping and RF ablation were performed using a steerable 7F quadripolar catheter with a 4-mm tip and 2-mm interelectrode spacing (Ablatr or Mariner, Medtronic Inc, Minneapolis, MN). Radiofrequency current was delivered by a 500-KHz generator (Attakr II, Medtronic Inc) at a constant preset electrical power (30-50 W) between the distal electrode and a large patch electrode on the posterior thorax as the indifferent electrode. A preset target temperature of 50°C to 70°C was programmed. Concomitant recording of leads I, II, III, and V_1, in addition to the said intracardiac recordings, were used. Incremental pacing and programmed stimulation were performed in the right atrium and right ventricle to define antegrade and retrograde AV nodal conduction and refractoriness. In 4 patients, the induction of AVNRT required the infusion of isoproterenol. When isoproterenol was required to induce AVNRT, RF energy delivery was delayed until the effects of isoproterenol had dissipated and sinus rate had returned to baseline.

There were 79 patients with slow-fast typical AVNRT, 2 patients with both slow-fast and fast-slow AVNRT, and 1 patient with left variant slow-fast type. The mean of AV Wenckebach point was 323.98 ± 68 milliseconds with a range from 210 to 575. The mean of ventriculoatrial Wenckebach point was 323.3 ± 57 milliseconds with a range from 200 to 530, that of antegrade effective refractory period of slow pathway was 244 ± 45 milliseconds, and that of fast pathway was 313 ± 54 milliseconds.

Anatomical area between the His catheter and the coronary sinus ostium in the left oblique anterior projection was divided into 5 areas: low posteroseptal, high posteroseptal, low midseptal, high midseptal, and anteroseptal. The suitable site for ablation was identified according to electeroanatomical mapping by multicomponent A wave and A/V ratio of less than 0.5.

RF energy was applied with 50 W energy and 60°C temperatures. All the burns that lasted for more than 15 seconds were included; and after each RF energy application, the inducibility of AVNRT was reexamined with the same protocol, which was used for induction. If AVNRT was noninducible, isoproterenol infusion was started and inducibility was rechecked. In some cases, after applying a few RF energy (<15 seconds) using electeroanatomical approach at the site of recorded slow pathway potential if no JR was observed, programmed stimulation was performed to reassess the inducibility of the AVNRT. If tachycardia was not inducible, RF energy was applied for 60 seconds despite the absence of JR.

Success was agreed only if AVNRT was noninducible after isoproterenol infusion. Residual slow pathway conduction, demonstrated as a single AV nodal echo, was present in 65 patients. In the remaining 24 patients, there was no evidence of residual slow pathway activity.

After each RF application, the patterns of JR were analyzed according to the following definitions:

(1) JJJ (junction-junction-junction) pattern: JR span is more than 95% of total time of each application of RF energy and lasts more than 15 seconds. It could even persist after interruption of RF application.
(2) SJS (sinus-junction-sinus) pattern: JR appears after at least 5 sinus beats and persists during RF energy delivery. It is terminated by more than 5 sinus beats before the cessation of RF application.
(3) SJJ (sinus-junction-junction) pattern: JR appears after more than 5 sinus beats and persists up to cessation of the RF application.
(4) Intermittent burst: individual bursts of JR (at least 5 beats in each burst) with more than 5 sinus beats between bursts that intermittently appear during RF energy delivery.
(5) Sparse: the junctional ectopy appears in a sparse pattern (>5 ectopies during each burst).
(6) No junction: absence of JR during RF energy delivery.
(7) SJB (Sinus Junction Block) pattern: the RF energy delivery interrupted after the appearance of ventriculoatrial block or AV block during JR.

Statistical analysis

Data were analyzed with Statistical Package for the Social Sciences (SPSS, Chicago, IL) software (version 13) using conventional methods for mean and SDs and nonparametric tests to evaluate group differences. Univariate and