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Empiric slow pathway ablation in non-inducible supraventricular tachycardia

Mohammed Shurrab [a], Tamas Szili-Torok [b], Ferdi Akca [b], Irving Tiong [a], Darren Kagal [a], David Newman [a], Ilan Lashevsky [a], Orhan Onalan [c], Eugene Crystal [a,*]

[a] Arrhythmia Services, Schulich Heart Centre, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada
[b] Clinical Electrophysiology, Department of Cardiology, Erasmus MC, Rotterdam, The Netherlands
[c] Department of Cardiology, Faculty of Medicine, Gaziosmanpasa University, Tokat, Turkey

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ABSTRACT

Background: The data supporting the practice of empiric slow pathway ablation (ESPA) in patients with documented supraventricular tachycardia (SVT) who are non-inducible at electrophysiology study (EPS) is limited. The aim of this study is to assess the efficacy of ESPA in adults.
Methods: A multi-center cohort study of patients who had ESPA between January 2008 and October 2013 was performed. Patients were identified by screening sequential SVT ablation procedures.
Results: Forty-three (5%) out of 859 SVT ablation procedures were identified as ESPA. The median age was 53 (IQR: 24) years; 63% were female. All patients had pre-EPS documentation of SVT (either strip or ECG). In 23 (53.5%) cases, pre-EPS ECG showed short RP tachycardia. Thirty-two (74.4%) patients had dual atrioventricular nodal physiology (DAVNP) plus echo beats. Junctional rhythm (JR) as procedural endpoint was noted in 39 (90.7%) patients. In 18 (41.9%) patients, the abolishment of DAVNP was achieved. No complications were encountered. A median follow-up of 17 months (range: 6 to 31 months) revealed 83.7% (36 of 43) success rate, defined as the absence of pre-procedural symptoms and any documented sustained arrhythmia. As compared to patients with recurrence (n = 7), patients with no recurrence (n = 36) had significantly higher prevalence of clinical short RP tachycardia (61.1% vs. 14.3%, p = 0.038), and EPS finding of DAVNP plus echo beats (80.6% vs. 42.9%, p = 0.034).
Conclusions: ESPA is a reasonable approach in patients with documented SVT, in particular in short RP tachycardia, who are not inducible at EPS. Larger studies are required to assess this practice.

1. Introduction

Catheter ablation has become a well-established, first-line therapy for atrioventricular nodal reentrant tachycardia (AVNRT), the most common clinical reentrant supraventricular tachycardia (SVT) [1,2]. Some patients have documentation of SVT (either strip or ECG) suggestive of AVNRT but fail to demonstrate the induction of AVNRT during the electrophysiology study (EPS). Empiric slow pathway ablation (ESPA) as a plausible option in these patients, even in the absence of proven AVNRT, can be considered [1,3].

The practice of ESPA is common (~5–10% of SVT cases) [3,4]. However, unlike pediatric population [5,6], there is a very limited data to support and guide this practice in adults. Very few studies have reported on the efficacy of ESPA [4,7,8], with little input on predictors of success. Currently, there is a significant variability in the practice of ESPA among operators [3]. Factors like operator's experience and perception of complication rate and outcomes have shown to influence the operators' tendency to ablate slow pathway empirically [3].

The aim of this study is to assess the clinical efficacy of ESPA in adults. Furthermore, we aimed to evaluate clinical characteristics and peri-procedural measures that could help operators to guide their ESPA practice.

2. Methods

All patients who had any catheter ablation procedure for SVT at Sunnybrook Health Sciences Centre (Canada) and Erasmus University Medical Center (Netherlands) between January 2008 and October 2013 were identified by reviewing procedure and clinic notes. Ethics approval was obtained from the institutional review board. The following inclusion criteria were applied 1) age >18 years old; 2) pre-EPS documentation of SVT (either strip or ECG); 3) radiofrequency (RF) ESPA was performed and defined as slow pathway ablation/modification in the absence of three or more beats of inducible SVT at the time of EPS and 4) clinical follow-up available for at least 6 months post-procedure.

Pre-EPS documentation of SVT (either strip or ECG) was further grouped into short RP tachycardia and non-short RP tachycardia. Short RP tachycardia was defined as R-P

Abbreviations: ESPA, empiric slow pathway ablation; SVT, supraventricular tachycardia; EPS, electrophysiology study; JR, junctional rhythm; DAVNP, dual atrioventricular nodal physiology.

* Corresponding author at: Arrhythmia Services, Schulich Heart Centre, Sunnybrook Health Sciences Centre, 2075 Bayview Avenue, Suite D-377, Toronto, ON, Canada M4N 3M5.
E-mail address: Eugene.Crystal@sunnybrook.ca (E. Crystal).

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Table 1
Baseline characteristics of the study group (n = 43).

Age (year)	53 (24)
Female gender	27 (62.8%)
Clinical tachycardia	
Short RP tachycardia	23 (53.5%)
Non-short RP tachycardia	20 (46.5%)
Modality	
Radiofrequency	40 (93.0%)
Stereotaxis	3 (7.0%)
Electrophysiological endpoint	
DAVNP + echo beat	32 (74.4%)
DAVNP only	9 (20.9%)
None of above	2 (4.7%)
Ablation endpoint	
Junctional rhythm + abolishment of DAVNP	18 (41.9%)
Junctional rhythm only	21 (48.8%)
None of above	4 (9.3%)
Follow-up duration (month)	17 (14)
No recurrence	36 (83.7%)

Continuous variables are presented as median and interquartile range, and categorical variables as number and percentages. DAVNP indicates dual atrioventricular nodal physiology.

interval of less than 70 ms during the tachycardia and non-short RP tachycardia included long RP tachycardia, or ECGs/strips of limited diagnostic value. The interpretation of each strip/ECG as short RP versus non-short RP tachycardia was performed by two operators and sometimes by a third operator to solve disagreements.

We retrieved data related to 1) baseline clinical/demographic characteristics; 2) intraprocedural data related to EPS endpoints (dual atrioventricular nodal physiology (DAVNP) only or DAVNP plus echo beats), ablation endpoints (junctional rhythm (JR) only or JR plus abolishment of DAVNP); 3) complications; and 4) follow-up data based on symptoms or documentation of any sustained arrhythmia with extended monitoring.

2.1. Electrophysiology study

Whenever possible all antiarrhythmic drugs were discontinued for 5 half-lives prior to the EPS. Only limited sedation protocols were used. A comprehensive EPS was performed. Ventricular and atrial programmed electrical stimulation (including sensed triggered atrial stimuli), with up to two extrastimuli was performed with at least two driving cycle lengths (at minimum cardiac pacing cycle length of 400 msec and 600 msec, respectively), as well as burst atrial and ventricular pacing. Isoproterenol infusion was administered in all patients resulting in at least 20% increase in baseline sinus cycle. Pacing protocol was performed during isoproterenol infusion and washout. Dual AV node physiology was defined as the prolongation of the AH interval during atrial pacing or extrastimulus or the HA interval during ventricular pacing or extrastimulus for >50 ms with a 10-ms decrease of the coupling interval [8,9]. Ablation endpoint varied among operators as some ended the procedure with only a 60–90 s of JR transitioning into sinus rhythm, while others repeated applications until the abolishment of DAVNP (abolishment of DAVNP was defined as eliminating DAVNP with ablation as confirmed by EPS post-ablation). All operators delivered a power of 50 W during RF ablation, using non-irrigated catheter.

2.2. Follow-up

Patients were followed up initially in 2–3 months after the procedure with extended monitoring including holters (typically 72 h to week) and in case of symptoms with external loop recorders (2–4 weeks). Routine follow-up was conducted at variable frequency based on clinical need and to cover twice typical baseline symptoms frequency at least (i.e. in patents with quarterly symptoms at least 6 months etc.). Moreover, patients with recurrence of symptoms had more rigorous monitoring and follow-ups to document recurrence of tachycardia using multiple extended monitors.

3. Statistical analysis

Continuous variables were expressed as median and interquartile range (IQR), and categorical variables as number and percentages. The distributions of the continuous variables across the study groups were tested with the Shapiro–Wilks test. Continuous data were analyzed using Mann–Whitney U test. Categorical data were compared using chi-square or Fisher's exact tests, where appropriate. The probability of freedom from recurrence following the procedure was estimated using the Kaplan–Meier method. Differences in the probabilities were assessed using the log-rank test. Cox's proportional hazards regression analysis was used to evaluate predictors of recurrence. A 2-tailed p value < 0.05 was considered statistically significant. All statistical analyses were performed using the IBM SPSS software (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.).

4. Results

Forty-three (5%) out of 859 SVT ablation procedures were identified as cases of ESPA. The median age of patients was 53 (IQR: 24) years, 63% were female; none had structural heart disease. Pre-EPS documentation of SVT in 23 (53.5%) cases demonstrated short RP tachycardia. Frequency of pre-procedural episodes ranged between daily to quarterly.

During diagnostic EPS, none of the patients had explicit signs of an accessory pathway. Thirty-two (74.4%) patients had DAVNP plus echo beats, 9 (20.9%) patients had DAVNP only, and 2 (4.7%) patients had no DAVNP. All patients underwent ablation of the slow pathway area with radiofrequency application. JR as procedural endpoint was noted in 39 (90.7%) patients. In 18 (41.9%) patients, the abolishment of DAVNP was also achieved. No complications were encountered.

A median follow-up of 17 months (range: 6 to 31 months) revealed 83.7% (36 of 43) success rate, defined as the absence of pre-procedural symptoms and any documented sustained arrhythmia during follow-up (Table 1).

All recurrences (n = 7) occurred within 2 months after the procedure. As compared to patients with recurrence (n = 7), patients with no recurrence (n = 36) had significantly higher prevalence of clinical short RP tachycardia (61.1% vs. 14.3%, p = 0.038), and EPS finding of DAVNP plus echo beats (80.6% vs. 42.9%, p = 0.034). Groups were similar with respect to other baseline characteristics (Table 2).

Patients with pre-EPS documentation of short RP tachycardia had significantly higher 2-year probability of freedom from recurrence (95.7% vs. 70%, log-rank p = 0.023) (Fig. 1). In patients with baseline DAVNP, the presence of echo beats at EPS was associated with a higher 2-year probability of freedom from recurrence (90.6% vs. 55.6%, log-rank p = 0.023) (Fig. 2). Baseline absence of both DAVNP plus echo beats on EPS was the only predictor of recurrence in Cox proportional hazards model (HR: 4.53, 95%CI 1.013 to 20.23; p = 0.048). In 21 cases, operators achieved 60–90 s of JR as a procedural endpoint without abolishment of DAVNP. JR alone versus JR plus abolishment of DAVNP as ablation endpoints had no influence on long-term success (p = 0.27).

5. Discussion

This study demonstrates that ESPA is effective in eliminating SVT recurrence in patients with documented tachycardia which is

Table 2
Baseline characteristics of the patients with and without recurrence.

	Recurrence		
	No (n = 36)	Yes (n = 7)	p value
Age (year)	40 (37)	55 (24)	0.339
Female gender	21 (58.3%)	6 (85.7%)	0.229
Clinical tachycardia			
Short RP tachycardia	22 (61.1%)	1 (14.3%)	0.038
Non-short RP tachycardia	14 (38.9%)	6 (85.7%)	
Modality			
Radiofrequency	34 (94.4%)	6 (85.7%)	0.421
Stereotaxis	2 (5.6%)	1 (14.3%)	
Electrophysiological endpoint			
DAVNP + echo beat	29 (80.6%)	3 (42.9%)	0.034
DAVNP only	5 (13.9%)	4 (57.1%)	
None of above	2 (5.6%)	0 (0.0%)	
Ablation endpoint			
JR + abolishment of DAVNP	17 (47.2%)	1 (14.3%)	0.270
JR only	16 (44.4%)	5 (71.4%)	
None of above	3 (8.3%)	1 (14.3%)	

Continuous variables are presented as median and interquartile range, and categorical variables as number and percentages. DAVNP indicates dual atrioventricular nodal physiology; JR: junctional rhythm.