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AV nodal reentrant tachycardia or AV reentrant tachycardia using a concealed bypass tract-related adverse events

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ABSTRACT

Objectives: To jointly study paroxysmal supraventricular tachycardia (SVT)-related adverse events (AE) and ablation-related complications, with specific emphasis on the predictors of SVT-related AE as well as their significance by investigating their association with long-term mortality.
Methods: 1770 patients were included, aged 6 to 97, with either atrioventricular nodal reentrant tachycardia (AVNRT) or orthodromic atrioventricular reciprocal tachycardia (AVRT) mediated by concealed accessory pathway, consecutively referred for SVT work-up in a tertiary care center.
Results: SVT-related AE were identified in 339 patients (19%). Major AEs were identified in 23 patients (1%; 15 cardiac arrests or ventricular arrhythmias requiring cardioversion and 8 hemodynamic collapses). Other AE were related to syncope ($n = 236$), acute coronary syndrome ($n = 57$) and heart failure/rhythmic cardiomyopathy ($n = 21$). In multivariable analysis, higher age, heart disease and requirement of isoproterenol to induce SVT were independently associated with a higher risk for SVT-related AE.
During follow-up (2.8 ± 3.0 years), death occurred more frequently in patients with SVT-related AE, especially in patients with major adverse events ($p < 0.001$). In multivariable analysis, major SVT-related AE remained significantly associated with occurrence of death (HR = 6.72, IC = (2.58–17.52), $p < 0.001$) independently of age and presence of underlying heart disease.
Major SVT-related AE in the whole population referred for SVT were more frequent than immediate major ablation complications in patients undergoing SVT ablation (5/1186 vs. 23/1770, $p = 0.02$).
Conclusions: SVT-related AE are independent predictors of mortality and are more frequent than immediate major ablation complications in patients undergoing SVT ablation. The present findings support systematically performing SVT ablation in patients with SVT-related adverse events.

What's new?

- Supraventricular tachycardia-related adverse events were found to occur in 19% of patients with atrioventricular tachycardia.
- Life-threatening adverse events related to supraventricular tachycardia are rare (1%). Yet, our study demonstrates for the first time that major adverse-events are associated with a six-fold increase in the risk for long-term mortality. This higher risk of death suggests that a specific watchful follow-up is needed in these patients, even after successful ablation.
- The prevalence of immediate major ablation-related complications is lower than the prevalence of major adverse events related to supraventricular tachycardia. This novel finding further establishes the favorable benefit-risk ratio of ablation for SVT.

1. Introduction

Paroxysmal supraventricular tachycardia (SVT) is a common form of tachycardia [1]. There are approximately 89,000 new cases/year and 570,000 persons with a history of SVT in the United States. SVT is considered to be benign and ablation is required only in symptomatic patients [2]. However, a more conservative approach has been suggested based on the long-term follow-up of a large cohort of atrioventricular nodal reentrant tachycardia (AVNRT) patients who became asymptomatic, none of which had undergone ablation [3]. This approach is also supported by the risk of ablation-related complications.

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Nevertheless, adverse events related to SVT are a relatively frequent cause for emergency department admission [4]. During SVT episodes, symptoms suggestive of myocardial ischemia, including chest pain (31%), ST-segment depression (61%) and elevated troponin levels (12%), are frequently recorded [5]. Major adverse events can also occur, although far less commonly [6,7].

As a result of the risk for SVT-related adverse events and the risk of ablation-related complications, risk to benefit ratio should therefore to be considered when choosing treatment strategy for a patient with SVT.

The purpose of the present analysis was to jointly study SVT-related adverse events and ablation-related complications in patients presenting with either AVNRT or orthodromic atrioventricular reciprocal tachycardia (AVRT). The study also aimed to identify the predictors of SVT-related adverse events as well as their clinical significance in comparison with ablation-related complications.

2. Methods

2.1. Study population

The present is a retrospective observational study of patients consecutively referred for a regular paroxysmal SVT in a tertiary care center between January 1990 and January 2014. Patients with preexcitation syndrome on ECG and patients with antidromic AV reciprocating tachycardia (AVRT) due anterograde conduction through an accessory pathway were excluded (n = 480). Among these last patients 55 of them had a normal ECG in sinus rhythm and the diagnosis of anterograde conduction over accessory pathway was made at electrophysiological study. Patients in whom atrial arrhythmia was identified during the work-up were also excluded (n = 182). A total of 1770 patients with either AVNRT (N = 1460) or orthodromic AVRT mediated by a concealed accessory pathway (N = 310) were ultimately included. Among these patients, 85 old patients with an initial diagnosis of atrial tachycardia were shown as having AVNRT or orthodromic AVRT mediated by a concealed accessory pathway after an electrophysiologic study.

2.2. Data extraction

Clinical data were retrospectively extracted from the patients' medical records. As part of the systematic work-up performed for SVT, patients underwent a standardized clinical evaluation including the accurate determination of prior adverse events. The study was approved by the *Commission nationale de l'informatique et des libertés* (*CNIL*). Under French law, no formal IRB approval is required for data extraction from patients' medical records.

The prescription of beta-blockers, verapamil and class I antiarrhythmic drugs was not systematically collected in patients without prior SVT-related adverse events during SVT work-up.

2.3. Adverse event definition

Adverse events collected during the SVT work-up, i.e. adverse events that occurred prior to or during the work-up, were classified as major (requiring resuscitation) or minor (management changes). Major events were defined as cardiac arrest or documented life-threatening hemodynamically nontolerated arrhythmia, with collapses or syncope and requiring emergency treatment, generally cardioversion. All major adverse events were witnessed and SVT was confirmed as the cause of the major adverse event after careful adjudication. Minor adverse events were defined as events that required patient hospitalization. These included syncope, ischemic coronary event, acute heart failure or other poorly-tolerated event directly related to an SVT episode. These SVT episodes ended spontaneously or after infusion of either verapamil or adenosine triphosphate. Of note, an isolated increase in troponin level was not considered as an adverse event.

2.4. Electrophysiology laboratory protocol

All patients underwent an electrophysiological study as part of the systematic work-up performed for SVT. Electrophysiological studies were performed after signing the clinical informed consent form endorsed by the French Society of Cardiology (*Societé Française de Cardiologie*). All antiarrhythmic drugs were discontinued at least five half-lives prior to the study. Details of the protocol have been previously described [8–10].

Briefly, atrial pacing and programmed atrial stimulation were systematically performed during sinus rhythm with atrial pacing conducted at two cycle lengths, 600 and 400 ms. Premature stimuli (S2) were delivered after every eighth paced atrial complex with 10 ms decrements until atrial refractoriness was reached. When a supraventricular tachycardia was induced, the protocol was halted. In the absence of tachycardia induction, isoproterenol (0.02 to 1 $\mu g.min^{-1}$) was alternatively infused to increase the sinus rate to at least 130 bpm. Atrial pacing was repeated and programmed atrial stimulation was performed at a cycle length of 400 ms.

Diagnosis of SVT was confirmed by the electrophysiological study.

The mechanism of SVT was determined according to the method of induction, the relation of atrial and ventricular activation at the onset of tachycardia and during tachycardia, the sequence of retrograde atrial activation and, if necessary, the effect of premature extra-stimulus during SVT. The SVT was classified as typical AV nodal reentry within the atrioventricular node (AVNRT) or atypical AVNRT or reentry within a concealed accessory atrioventricular connection (AVRT).

In instances of adverse events occurrence or in the case of abnormal clinical examination, echocardiography was systematically performed.

Ablation of SVT was performed in most patients, either immediately after the identification of SVT mechanism during the electrophysiological study or during a second procedure. A 7F deflectable catheter with a 4 mm tip electrode was used to perform AVNRT or accessory pathway ablation.

In the case of AVNRT, the slow pathway potential was identified, and a radiofrequency current was applied at this level with an energy limit of 40 watts and a temperature limit of 65 °C. Radiofrequency current was immediately halted if junctional rhythm did not appear within 15 s, otherwise it was continued for 60 s. The absence of AVNRT induction after ablation was verified. If still present, application of the radiofrequency current was repeated, a new application of radiofrequency current was performed. When AVNRT remained inducible, anatomically-guided ablation was used. Slow pathway block or single-AV nodal echo beat represented a procedural endpoint. Isoproterenol infusion was systematically used and the protocol repeated to verify the absence of AVNRT re-induction.

In the case of AVRT via a concealed accessory pathway, ablation was performed at the earliest atrial retrograde activation either during ventricular pacing or during AVRT.

For both AVNRT and AVRT ablation, catheters were removed 20 min after the disappearance of the anterograde conduction over the slow pathway or of the retrograde conduction over the accessory pathway.

Ablation-related complications were defined as major if they were life-threatening and required the admission of the patient in intensive care unit or as minor if they regressed without the need of monitoring in intensive care. Complications considered as major were mostly pericardial tamponade requiring emergency drainage, complete AV block requiring pacemaker implantation and death. Complications considered as minor were local bleeding, vagal syncope at femoral puncture, minor pericardial suffusion, transient traumatic or radiofrequency-related second or complete AV block and transient sinus bradycardia.

As a general rule, patients with recurrent tachycardias who refused ablation were discharged with beta-blockers.