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Original article

Slow pathway modification in patients presenting with only two consecutive AV nodal echo beats

Felix K. Wegner (MS)[a], Maria Silvano (MD)[b], Nils Bögeholz (MD)[a], Patrick R. Leitz (MD)[a], Gerrit Frommeyer (MD)[a], Dirk G. Dechering (MD)[a], Stephan Zellerhoff (MD)[a], Simon Kochhäuser (MD)[a], Philipp S. Lange (MD)[a], Julia Köbe (MD)[a], Kristina Wasmer (MD)[a], Gerold Mönnig (MD)[a], Lars Eckardt (MD)[a], Christian Pott (MD)[a,*]

[a] Division of Electrophysiology, Department of Cardiovascular Medicine, University Hospital Münster, Münster, Germany
[b] Division of Cardiology, Department of Cardiac, Thoracic and Vascular Sciences, University of Padova, Padova, Italy

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ABSTRACT

Background: Slow pathway modification (SPM) is the therapy of choice for AV-nodal reentry tachycardia (AVNRT). When AVNRT is not inducible, empirical ablation can be considered, however, the outcome in patients with two AV nodal echo beats (AVNEBs) is unknown.
Methods: Out of a population of 3003 patients who underwent slow pathway modification at our institution between 1993 and 2013, we retrospectively included 32 patients with a history of symptomatic tachycardia, lack of paroxysmal supraventricular tachycardia (pSVT) inducibility but occurrence of two AVNEBs.
Results: pSVT documentation by electrocardiography (ECG) was present in 20 patients. The procedural endpoint was inducibility of less than two AVNEBs. This was reached in 31 (97%) patients. Long-term success was assessed by a telephone questionnaire (follow-up time 63 ± 9 months). A total 94% of the patients benefited from the procedure (59% freedom from symptoms; 34% improvement in symptoms). Among those patients in whom ECG documentation was not present, 100% benefited (58% freedom from symptoms, 42% improvement).
Conclusion: This is the first collective analysis of a group of patients presenting with symptoms of pSVT and inducibility of only two AVNEBs. Procedural success and clinical long-term follow-up were in the range of the reported success rates of slow pathway modification of inducible AVNRT, independent of whether ECG documentation was present. Thus, SPM is a safe and effective therapy in patients with two AVNEBs.

Introduction

The definite diagnosis of the most common paroxysmal supraventricular tachycardia (pSVT), AV-nodal reentry tachycardia (AVNRT), can only be made when this arrhythmia is induced during an electrophysiological study (EPS). The therapy of choice is a modification of the slow pathway by catheter-based ablation [1,2].

However, in some patients pSVT is not inducible during EPS and the final diagnosis of the tachycardia mechanism thus remains unclear. If dual nodal pathway physiology in the form of an AV nodal echo beat (AVNEB) or an AH jump is present in addition to a SVT documentation suggestive of AVNRT, the American College of Cardiology/American Heart Association/European Society of Cardiology guidelines [2] suggest an empirical slow pathway modification (ESPM).

We [3] and others [4] have recently reported long-term outcome of ESPM under the condition of dual nodal pathway physiology with a maximum of one AVNEB. However, to the best of our knowledge, there are no reports about slow pathway modification in the presence of a maximum of two AVNEBs without inducibility of AVNRT. This question is important since in the clinical setting with a low but present risk of ablation-related complete AV block, the decision of whether or not to modulate the slow pathway may be difficult, especially if a typical electrocardiographic (ECG) documentation is missing.

The clinical relevance of this dilemma is highlighted by a recent survey among electrophysiologists [5]. In the absence of a characteristic ECG documentation, 44% of the questioned

* Corresponding author at: Department für Kardiologie, Abteilung für Rhythmologie, Universitätsklinikum Münster, Albert-Schweitzer-Campus 1, 48149 Münster, Germany. Tel.: +49 0251 8344942; fax: +49 0251 8349965.
E-mail address: christian.pott@ukmuenster.de (C. Pott).

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electrophysiologists stated that they would require a minimum of two AVNEBs as a threshold to perform an empirical ablation, while 19% did not view two AVNEBs as a sufficient indication for a slow pathway modification. The threshold to ablate was lower when a characteristic ECG documentation was present. This considerable inhomogeneity in the decision-making process on whether to conduct an ESPM emphasizes the demand for further guidance. Specifically, there are currently no data to either support or reject the opinion that the occurrence of two AVNEBs is a sufficient reason to decide for an ESPM.

Thus, the long-term outcome of ablation in the setting of two AVNEBs may not even be superior to empirical ablation with a single or even no AVNEB. On the other hand, it may as well be possible that ablation in the presence of two AVNEBs is as effective as catheter ablation in patients with inducible sustained AVNRT.

In the present study, we therefore investigated the procedural success and clinical long-term outcome of patients who had undergone ESPM after induction of only two AVNEBs.

Methods

Study design

After screening of 3003 patients who underwent slow pathway modification in our center between 1993 and 2013, 32 patients who exhibited two AVNEBs without induction of pSVT were retrospectively included. The specific inclusion and exclusion criteria are depicted in Table 1.

Electrophysiological study and induction of AVNEB

All patients gave written informed consent prior to the EPS. If necessary, conscious sedation was administered. Usually, venous access was gained via the left femoral vein using three sheaths. Three diagnostic catheters were placed in the apex of the right ventricle, in the His region and in the right atrium (HRA) or the coronary sinus (Cs). Usually, programmed atrial stimulation was performed to induce AVNRT with one (S_2) and then with two (S_2S_3) premature beats. The basic stimulation cycle length (S_1) was gradually reduced throughout the protocol with an attempt to reach an S_1 cycle length of 330 ms. If this did not induce AVNRT, orciprenaline (0.25 mg; bolus) was added. Independent of heart rate, orciprenaline administration was usually repeated if these measures failed to induce AVNRT. Orciprenaline was also given, if programmed stimulation at high rates was impossible because of AV nodal refractoriness. In one patient orciprenaline was avoided after induction of two AVNEBs because atrial fibrillation had been induced by programmed atrial stimulation. One patient was additionally given adenosine (18 mg) to exclude an accessory pathway. If AVNRT or more than two consecutive AVNEBs were induced throughout this protocol, the patient was excluded from this study. The protocol has been described previously [3].

Table 1
Inclusion and exclusion criteria.

Inclusion criteria
Symptomatic paroxysmal tachycardia
Inducibility of two consecutive AVNEB during electrophysiological study
Performance of empirical slow pathway modification
Completion of a telephone questionnaire for long-term follow-up
Exclusion criteria
Inducibility of three or more consecutive AVNEB or sustained AVNRT
Inducibility of less than two AVNEBs
Start or escalation of antiarrhythmic drug therapy directly or shortly after empirical slow pathway modification

AVNEBs, AV nodal echo beats; AVNRT, AV-nodal reentry tachycardia.

Electrophysiological criteria and differential diagnosis of AVNEB

An AVNEB was considered as a retrograde activation on the HRA or Cs catheter following the preceding QRS complex induced by the S_2 or S_3 beat during programmed atrial stimulation. Criteria to distinguish AVNEBs from repetitive atrial responses were earliest atrial activation site on the His catheter, an interval of less than 70 ms from ventricular activation to the earliest retrograde atrial activation (VA interval) and a similar VA interval between the first and second AVNEB. We also considered AV junctional beats as a differential diagnosis; however, these are usually characterized by longer RR intervals, instable VA intervals, and persistence of more than two beats in form of a junctional rhythm. To our knowledge, stimulation maneuvers to definitely distinguish slow AVNRT from a junctional rhythm are only possible during ongoing tachycardia [6]. Thus we cannot exclude the registration of junctional beats with final certainty but the above-described characteristics and the procedural outcome of this study with suppression of two AVNEBs after slow pathway modification in all but one patient make this possibility extremely unlikely.

In all patients, two consecutive AVNEBs were induced at least once. In some patients AVNEBs were preceded by a jump of the atrium to His (AH) interval defined as a sudden prolongation of the AH or AV interval of >50 ms after S_2 or S_3 stimulation in comparison to the preceding stimulation cycle.

Slow pathway modification

The procedure of slow pathway modulation by radio frequency (RF) ablation has been described previously [3]. The procedural endpoint was non-inducibility of two consecutive AVNEBs. One AVNEB with or without an AH jump was tolerated. In one patient, RF ablation was switched to cryoablation since single beats were not conducted via the AV node. The procedure time was 110 ± 5 min.

Ethics statement

This study was submitted to the research ethics committee of the chamber of physicians Westfalen-Lippe/Federal Republic of Germany. The committee confirmed that written consent for our study is not necessary since it is a retrospective study on anonymized clinical routine data with no experimental interventions having been performed (document reference # 2015-170-f-N).

Results

Patient population characteristics

A total of 32 patients were included according to the above-listed criteria. The patient population characteristics are depicted in Table 2.

In 20 patients, a surface ECG or Holter documentation of the tachycardia was available prior to the EPS. These demonstrated narrow QRS complex tachycardia with stable cycle lengths. P waves were not distinguishable with certainty. Therefore the documentation was compatible with typical AVNRT. Four patients had received prior EPS. Out of these, 3 had received a previous slow pathway ablation due to inducible AVNRT.

Slow pathway modification and procedural outcome

Slow pathway modification was performed in all patients. RF delivery was repeated until two consecutive AV nodal echo beats were no longer inducible. This endpoint was reached in 31 (97%) of the patients (Fig. 1). Since the procedural endpoint consisted of a slow pathway *modification* and not (complete) *ablation*, a residual

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