Perception and Documentation of Arrhythmias after Successful Radiofrequency Catheter Ablation of Accessory Pathways

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Background: Some patients continue to have palpitations in spite of successful ablation of Wolff-Parkinson-White (WPW) syndrome. Recurrence of accessory pathways as well as unrelated arrhythmias may explain the symptoms.

Methods: We followed 194 consecutive patients after successful radiofrequency catheter ablation of overt (147) or concealed (47) WPW syndrome. The mean duration of symptoms was 16 ± 13 years. Atrial fibrillation was documented in 54 patients (24%) prior to ablation. 185 patients responded to a questionnaire 24 ± 12 months after ablation.

Results: The physical well-being was improved in 94%, unchanged in 5%, and deteriorated in 1%. However, 76 patients (39%) reported arrhythmia symptoms, in 40 patients causing pharmacological treatment (14 patients) and/or continued contact with their doctor. The underlying arrhythmias were orthodromic tachycardia (10), atrial fibrillation (12), premature beats (12), atrial flutter (1), and ventricular tachycardia (1), while in four patients no explanation was found. Minor symptoms in the other 36 patients were explained by premature beats in 29, while unexplained in 7. All patients with atrial fibrillation after ablation had atrial fibrillation before ablation. Ten relapses of WPW syndrome occurred: eight were known before the time of the questionnaire, two were confirmed at transesophageal atrial stimulation.

Conclusion: 94% patients with a long history of tachyarrhythmias due to the WPW syndrome reported improved physical well-being after ablation, but palpitations were common during a 2-year follow-up period; 8% continued to use pharmacological antiarrhythmic treatment. Five percent had symptomatic relapses and in 6% atrial fibrillation episodes reoccurred, i.e., in half of those who had atrial fibrillation before ablation.

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Patients with Wolff-Parkinson-White (WPW) syndrome suffer from symptoms of paroxysmal reciprocating arrhythmias, i.e., orthodromic tachycardia and/or antidromic tachycardia but frequently also atrial fibrillation that, rarely, may degenerate to ventricular tachyarrhythmias. The reciprocating tachycardias are directly dependent on the presence of an accessory pathway of atrial myocardial fibers connecting the atria and ventricles somewhere along the atrioventricular ring. The same may be true for atrial fibrillation since ablation of the pathway reduces or even abolishes

attacks of atrial fibrillation, at least in younger patients who have no other underlying cause of the fibrillation.¹ Apart from playing a role in the development of the arrhythmia, the rapid pathway conduction of atrial impulses to the ventricles may, at times, lead to extremely high heart rates during preexcited atrial fibrillation.²

Curative catheter ablation, mostly with radiofrequency energy, is extremely effective in terms of definite ablation of the pathway, irrespective of its location around the AV ring.^{3,4} This may lead to the assumption that the patients, who are mostly

healthy except for their paroxysmal tachycardias, would become completely asymptomatic following successful ablation.

The aim of this study was to assess the occurrence of arrhythmias and symptoms related to arrhythmia after successful ablation of WPW syndrome and to identify factors prior to ablation that would predict persistent arrhythmia symptoms and/or recurrence of arrhythmia.

PATIENTS AND METHODS

The study group consisted of 194 consecutive patients who underwent successful radiofrequency ablation. These patients also were the first to undergo treatment with RF ablation at this hospital. There were 115 males and 79 women. Their mean age was 37 ± 16 (range 10-79) years.

Overt preexcitation was present in 147 patients and concealed WPW syndrome in 47 patients. Only two of the patients were asymptomatic and they were ablated because the preexcitation was an absolute obstacle in their choice of education. The mean duration of arrhythmia symptoms was 16 ± 13 years. Atrial fibrillation was documented at least once in 54 patients (24%) prior to ablation. Before ablation, each patient underwent an examination of medical history and physical condition. A 12-lead ECG was recorded as well as a 2 dimensional (2-D) echocardiogram with Doppler measurement. The previously documented arrhythmias, spontaneous or induced at transesophageal stimulation, were verified.

Following successful RF ablation, the patients were discharged and underwent routine clinical follow-up, including medical history, physical examination, and 12-lead ECG within 3 months. Until the end of 1993, all patients ablated for accessory pathways at this hospital underwent a routine invasive electrophysiological investigation at 3 months, but this investigation was thereafter not considered as useful, since recurrences were extremely few and those three patients who had recurring tachycardias due to relapse of the WPW syndrome were already known by the investigators at 3 months. All patients with an overt preexcitation were, however, asked to provide an ECG one week after ablation to be sent to the clinic.

After a period of 24 ± 12 months, all available patients received a follow-up questionnaire. Three patients had died, two lived abroad, and four did not respond to the questionnaire. These four were alive at the time of evaluation according to the

Swedish National Population Registry. The remaining 185 patients thus constituted the study population. The patients were asked to report their change in physical well-being after RF ablation as well as the presence of specific symptoms such as palpitations, regular or irregular arrhythmia, visits to hospitals and/or physicians caused by these symptoms, continued or new treatment with antiarrhythmic drugs. One hundred seventy-four patients (94%) responded immediately to the questionnaire, while the remaining patients were contacted by the first author. Some patients were contacted due to difficulty classifying some answers given by the patients. For patients who reported symptoms causing contacts with hospitals or physicians, the relevant records were reviewed. All answers indicating palpitations resulted in an examination by the patient's ordinary doctor and if a suspicion of paroxysmal supraventricular tachycardia remained, additional investigations such as a 24-hour Holter recording and/or an electrophysiological investigation were performed.

Fifty-nine patients reported symptoms considered suspicious of paroxysmal tachyarrhythmias. When documentation was not available, transesophageal atrial stimulation was performed in 45 patients, while 14 patients refused to undergo this investigation. Based on the perception of the patients, their reported symptoms were divided into two categories. Symptoms that led the patients to contact their physician or hospital and/or to continue or start antiarrhythmic medication were labeled as major, while all other symptoms were labeled as minor.

Statistical Analysis

Statistical analysis was performed by means of the two-tailed Student's *t*-test for unpaired data and X^2 test for nonparametric data.

RESULTS

Physical well-being was reported to be improved in 171 patients (88%). Ten patients (5%) reported no change, among them the two who were previously asymptomatic. Two patients (1%) reported deterioration of symptoms that could be related to frequent ventricular ectopic beats after 6 and 16 months follow-up.

A total of 76 patients (39%) reported symptoms, 40 of them major and 36 minor. There was no difference between this symptomatic group and

Table 1. Classification of Arrhythmias in Relation to the Severity of Symptoms after RF Ablation

Arrhythmia	Major Symptoms (n = 40)	Minor Symptoms (n = 36)
Orthodromic tachycardia	10	0
Atrial fibrillation	12*	0
Atrial flutter	1	0
Ventricular tachycardia	1	0
Premature beats	12	29
Not known	4	7

* Two patients with atrial fibrillation also had episodes of atrial flutter. Premature beats were of both supraventricular and ventricular origin.

those who did not report symptoms in terms of clinical variables or episodes of atrial fibrillation before the ablation with the exception of the localization of pathways (Table 1).

Recurrence of the accessory pathway was causing the symptoms in ten patients. Their presenting symptoms were distinct, and eight patients had reported their symptoms before they received the questionnaire. Four of them presented with an ongoing tachycardia occurring 1, 1, 3 and 8 months after ablation. One patient had late recurrence of symptoms 24 months after ablation and was identified via the questionnaire. In two of the ten patients with suspected tachycardias and who had a normal resting ECG, the relapse was verified during transesophageal atrial stimulation. The documented arrhythmias were orthodromic tachycardias in all ten patients, i.e., the same arrhythmia that had been present before RF ablation. Another five patients were identified at the 3 month follow-up with recurrence of preexcitation in the 12-lead ECG, but none of them had documented or inducible tachycardias related to the WPW syndrome.

The symptoms were correlated to atrial fibrillation in twelve patients; two of them as well as one other patient also had episodes of atrial flutter. All twelve patients had documented episodes of atrial fibrillation prior to the RF ablation. The first episode of atrial fibrillation was documented 14 ± 14 months after ablation. The three patients with atrial flutter had their episodes 18 days, 3 months, and 13 months after ablation. One 47 year-old patient with ischemic heart disease had an episode of sustained ventricular tachycardia 3 months after ablation.

Forty-one patients were symptomatic because of

supraventricular or ventricular premature contractions. The documentation was made by 12-lead ECG, 24-hour Holter recordings, or a highly suspicious description of symptoms alone. In another eleven patients, symptoms were very vague and no documentation was available; none of them had sought medical attention. Their symptoms may have been caused by arrhythmia but were classified to be of unknown cause.

At the time of ablation, 128 patients were on medication for arrhythmia, 91 on sotalol, and 9 on conventional beta-blockade. Fourteen patients (8%) continued with pharmacological treatment after ablation, mostly because of premature contractions but some because of atrial fibrillation. Forty-five patients with perceived tachycardia symptoms and/or palpitations were subjected to a follow-up noninvasive transesophageal electrophysiological investigation; 13 also underwent routine invasive electrophysiological investigation after 15 ± 14 months that was normal in all patients. Of these 45 patients, 11 had documented atrial fibrillation after RF ablation with no sign of accessory pathways.

Three patients died during the follow-up period. Their causes of death were heart failure due to ischemic heart disease, lung cancer, and cerebral hemorrhage, respectively. No death was related to arrhythmia or the radiofrequency ablation procedure.

The patients with major symptoms were older than the rest of the patients (42 ± 16 vs 36 ± 16 years, $P = 0.02$). All patients with atrial fibrillation after ablation had atrial fibrillation prior to treatment. Atrial fibrillation prior to ablation predicted major symptoms after ablation (18 of 40 in the "major" group vs 36 of the remaining 154 patients, $P = 0.0005$). The patients with atrial fibrillation after ablation were older than the rest of the patients (52 ± 13 vs 37 ± 16 years, $P = 0.002$).

DISCUSSION

Excellent short term results of radiofrequency ablation in WPW syndrome have been reported by many investigators.³⁻⁵ This usually means that the function of the pathway was eliminated as confirmed by loss of preexcitation (during sinus rhythm, during atrial pacing, and if necessary during adenosine injection) in the antegrade direction and by confirming conduction exclusively via the AV node or by demonstrating VA block in the retrograde direction as verified during ventricular stimulation with or without adenosine injection. In

the present study, the immediate result was confirmed 30 minutes after ablation before the procedure was regarded as successful.

The long-term efficacy in terms of permanent elimination of the accessory pathway is equally excellent and routine invasive or noninvasive follow-up procedures are no longer justified.⁶ Radiofrequency ablation has become a first line treatment of WPW syndrome and an increasing number of patients refuse the option of long-term or even life-long medication for control of their symptoms. The treatment is cost-effective as it virtually cures the patients from symptoms related directly to the WPW syndrome.⁴ Quality of life in patients with supraventricular tachycardias was comparable to that of patients with heart failure and recent myocardial infarction, while dramatic improvement occurred within the first month after treatment.^{7,8} Recurrences of episodes of atrial fibrillation were greatly reduced in studies by Chen et. al.⁹ During a 6-year follow-up after surgical division of the accessory pathway from 49% to 5% (9 of 153 patients) were successful compared with 23% (3 of 13 patients) after unsuccessful surgical outcome. After successful direct-current shock catheter ablation, Haissaguerre¹⁰ found a reduction from 58% to 9%, most occurring in patients with increased atrial vulnerability, at 35 months postablation. It is noteworthy that both materials included a large proportion of patients with pretreatment atrial fibrillation and that the latter included 14 patients, 11%, with ventricular fibrillation. In our study, 24% of the patients had documented preablation episodes of atrial fibrillation versus 6% postablation.

In these first consecutive patients successfully ablated for WPW syndrome in our hospital, the recurrence rate of orthodromic tachycardia (10/194, 5%) and asymptomatic preexcitation (5/194, 2.5%) during the follow-up period probably reflects the learning curve of the staff. Another important factor was that ablation was performed without the help of temperature control during energy delivery. In addition, this first series of patients may be regarded as a selection of the most symptomatic patients. Importantly, recurrences of tachycardias were detected early by symptoms while the cases of asymptomatic preexcitation, as expected, was found at predetermined ECG controls.

As many as 88% of our patients considered their physical well-being improved. Twenty-three patients (12%) had persistent arrhythmias (orthodromic tachycardia, atrial fibrillation, or atrial flut-

ter) at least once after ablation. Therefore, it may seem strange that as many as 39% of all patients continued to have symptoms that they perceived as arrhythmia and that 21% continued or restarted antiarrhythmic medication or kept contact with their physician or hospital because of these symptoms. However, 41 patients suffered from palpitations that were related to premature beats or unknown causes and as many as 14 of them continued pharmacological treatment with beta-blockade or antiarrhythmic agents. A more or less abrupt cessation of treatment lead, in some patients, to a relative sinus tachycardia that caused temporary discomfort to the patients and made them want to continue their medication for a shorter or longer period (Table 2).

To understand the continued symptomatology one should, first, take into consideration the very long duration of tachycardia symptoms with a mean of 16 years in patients with a mean age of 37 years. Thus, they have been at a long-term risk for getting used to and being successively more traumatized by the tachycardias per se or the always present risk of getting a tachycardia. Many patients have learned during their years of symptoms that a single or increasing irregularities in their rhythm also means that a tachycardia might be imminent and they may even take precautions as to withdraw from stressful activity trying to avoid the arrhythmia. In some instances the fear for tachycardia developed an increased level of discomfort during normally innocent and asymptomatic arrhythmias that the patients had learned to identify as triggers of tachycardias that would in turn cause severe palpitations, chest pain, anxiety, dizziness, or even syncope. Second, after having been cured in the sense that an accessory pathway was successfully ablated, the patient perception of arrhythmia may, in part, depend on the information given before ablation. All patients were informed that all symptoms related to the pathway would disappear but that those irregularities that used to be triggers of the tachycardia would remain and probably be noticed by the patients for a shorter or longer period. The perception of these irregularities would probably gradually wane to freedom of arrhythmic symptoms.

It is very reasonable that a patient with a 16-year history of symptoms has become very observant to even minor irregularities and that it will take a considerable time for the patient to realize and trust that the tachycardias will not recur. However, 36 of the 76 patients who reported symptoms after

Table 2. Characteristics of Patients With or Without Palpitations

	Palpitation	No Palpitation	P
Number	76	109	
Age, years	39 ± 16	36 ± 17	NS
Males, %	55	65	NS
Preexcitation preablation, %	72	77	NS
Duration of symptoms, years	15 ± 13	16 ± 13	NS
Type of symptoms			
syncope, %	33	41	NS
near syncope, %	14	6	NS
Cardiovascular diseases, %	7	8	NS
Arrhythmias-preablation			
orthodromic tachycardia, %	78	55	NS
atrial fibrillation			
non-preexcited, %	12	4	NS
preexcited, %	20	20	NS
Attacks per month	7 ± 12	6 ± 18	NS
Localization of accessory pathways (total number of known localization: 177)			
left-sided, number	45	83	0.007
septal, number	22	20	
right-sided, number	6	1	

ablation neither took any medication nor had sought medical attention afterwards. Almost all of them confirmed improved well-being together with most of the remaining patients including all 40 patients who were classified as having major symptoms (Table 3). There was no difference in the perception of arrhythmia symptoms between the patients who had undergone ablation for overt or concealed accessory pathways, which leads to the conclusion that their remaining symptoms were not directly related to the WPW syndrome but rather to their habitual rhythm. The indirect connection, however, very likely, was that their increased observation as to innocent premature beats as potential triggers of tachyarrhythmia kept them consistently symptomatic before ablation and for a considerable time after ablation.

This study has some limitations. It was a non-randomized study. The first 100 patients were prospectively followed during the first 3 months, but apart from that, this was a retrospective study. It focused, apart from the general question of physical well-being, on questions directly related to arrhythmias. The answers to these open questions sometimes had to be clarified with the patients in order to be classified and evaluated as to the indication for an electrophysiological investigation. Apart from the first 100 patients, only symptomatic patients underwent noninvasive and/or invasive follow-up procedures. This approach does not exclude that new and asymptomatic arrhythmias may have occurred.

In conclusion, the vast majority of patients improved their well-being after ablation of an acces-

Table 3. Characteristics of Patients With Symptoms

	Major Symptoms (n = 40)	Minor Symptoms (n = 36)	P
Age, years	42 ± 16 years	36 ± 16 years	0.04
Males, %	63	47	NS
Preexcitation, %	83	67	NS
Duration of symptoms, years	16 ± 14	15 ± 13	NS
Cardiovascular diseases, %	5	0	0.05
Atrial fibrillation, preablation, %	45	22	0.05

sory pathway. In spite of that, as many as 21% continued to use beta-blockade and/or maintain contact with their physician or hospital due to perception of arrhythmia. Relapse of tachycardias due to WPW syndrome was verified in 5% of the patients who were all cured following a second ablation procedure. Atrial fibrillation or atrial flutter were responsible for the symptoms in another 7%, all of whom had also experienced such episodes before ablation. It is important to explain to the patient before ablation how much of the symptomatology can be expected to be immediately cured by RF ablation and what can be expected during long-term follow-up.

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