

Late clinical outcome after successful radiofrequency catheter ablation of accessory pathways

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Aims To evaluate the long-term clinical results of patients who underwent successful radiofrequency catheter ablation of a symptomatic drug-resistant accessory-pathway-mediated tachycardia.

Methods and Results Clinical follow-up was done by direct contact with the patients and their physicians. One hundred and eighty consecutive patients (113 males, 67 females) were followed during a median period of 48.1 months. There were seven procedure related complications (4%). During the follow-up period, 79% of the patients remained asymptomatic; 14% complained of short bouts of palpitations due to isolated or short runs of atrial or ventricular premature beats; 7% had sustained palpitations due either to accessory pathway recurrence (4%) or supraventricular tachyarrhythmias not associated with an accessory pathway (3%). Symptoms due to accessory path-

way recurrence appeared either in the first month following the ablation or at least later than 3 months when sustained supraventricular arrhythmias occurred related to another cause.

Conclusions Initially successful radiofrequency catheter ablation has a low, long-term recurrence rate (4%). Recurrence of accessory-pathway-mediated tachycardia is observed during the first month while later symptoms suggest supraventricular arrhythmias from another cause.

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Introduction

Percutaneous radiofrequency catheter ablation is accepted as the curative approach for patients suffering from symptomatic drug-refractory tachyarrhythmia associated with an accessory pathway^[1–5]. The technique is performed worldwide and several thousands of patients are treated every year^[6,7]. Both the safety and efficacy of this therapeutic approach have been demonstrated in the short- and medium-term follow-up period^[4,8]. However, despite a high acute success rate with the procedure, long-term results, after the initial successful catheter ablation of the accessory pathway, have not been extensively reported; follow-up data are limited to the 12 to 24 months after the procedure and to our best knowledge no long-term observations have been published^[4,8–10]. Furthermore, concern has been raised about potential late harmful effects of the ablation procedure, particularly in infants and young adults^[11,12]. Thus, the goal of this prospective study was to determine the long-term

clinical outcome in patients with drug-resistant symptomatic accessory-pathway-mediated tachycardia successfully treated with percutaneous radiofrequency ablation.

Method

Our study included 190 consecutive patients, referred to our institution, who had undergone successful radiofrequency ablation for drug-resistant accessory-pathway-mediated tachycardia between May 1991 and October 1998. Patients with Mahaim fibres or an accessory pathway with decremental conduction properties were excluded as they are often considered a specific group in the literature. The clinical follow-up was established by direct contact with the patients and their physician. All patients had standard ECGs performed during the follow-up. The median duration of follow-up was 48.1 months.

Definitions

The acute success of the radiofrequency procedure was defined by the absence of accessory-pathway-mediated tachycardia, or delta wave recurrence on the repeated

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ECGs during the first 48 h following the ablation procedure. Acute in-hospital complications were considered significant if they resulted in permanent injury, required intervention, or prolonged the hospital stay. Patients with symptom recurrence after the ablation were classified into two groups: (1) those whose symptoms were similar to the pre-ablation period (2) those whose symptoms differed from the pre-ablation period.

Statistical analysis

Results are expressed as mean \pm standard deviation and as median.

Results

One hundred and ninety consecutive patients, successfully ablated for their symptomatic drug-resistant accessory-pathway-mediated tachycardia, were enrolled in the study. Ten patients (5%) were lost to follow-up, so 180 patients comprised the final studied population (113 males, 67 females), mean age 36.5 ± 13.6 (14 to 67 years).

Symptoms during arrhythmia were distributed as follows: palpitations (45%), pre-syncope (21%), syncope (20%), and dizziness (14%). Symptoms were present daily in 18% of the patients, weekly in 24% and monthly in 43%; in 15% of the studied population a single episode of syncope was the indication for ablation. Orthodromic circus-movement tachycardia was documented in 128 patients (71%), atrial fibrillation in 39 (22%), atrial flutter in eight (4%) and antidromic tachycardia in five (3%).

Before the ablation, a mean of 1.75 ± 1.25 anti-arrhythmic drugs had been ineffective or not tolerated because of side effects. Class I drugs were administered in 62% of the patients, Class III drugs in 43%, calcium channel blockers in 20%, beta-blockers in 18% and digoxin in 8%.

The follow-up data were obtained after a median period of 48.1 months (1 to 92 months) and 90% of the patients had a >12 months follow-up period. Three patients had two accessory pathways ablated; 139 accessory pathways were overt (76%) and 44 concealed (24%). One hundred and thirty-three accessory pathways were left sided (73%) and 50 right sided (27%). There were 127 left free wall accessory pathways (70%); 25 in the right free wall (14%), 20 in the posteroseptal space (10%) and 11 in the septal region (6%).

Inhospital complications

There were no deaths but seven acute complications (4%) all related to the ablation of a left sided accessory pathway. Five complications were linked to the arterial approach used for the ablation: one perforation of the

Table 1 Clinical characteristics of patients with symptom recurrence

	Group 1	Group 2
Patients (n)	25	13
Male (%)	10 (40)	7 (54)
Age (mean \pm SD)	37 ± 14	33 ± 14
Overt AP (%)	20 (80)	7 (54)
Symptoms <1 month (%)	0	8 (62)
Recurrence of AP (%)	0	8 (62)

AP=accessory pathway.

right cuspid of the aortic valve requiring uncomplicated surgical repair 3 months later; one laceration of the right femoral artery successfully treated surgically 3 days later; one important groin haematoma treated conservatively and two cerebral transient ischaemic attacks without persistent neurological sequelae. Two patients had brachial plexus injury with a spontaneously favourable recovery. No procedure-related significant complications were registered in patients ablated for a right-sided accessory pathway.

Late clinical follow-up

During a mean follow-up of 36 ± 13 months (median: 48 months) one patient died as a passenger in a car accident 18 months after the ablation; he had not previously complained of any symptom recurrence. There were no other deaths.

One hundred and forty-two patients (79%) remained totally asymptomatic and considered the ablation entirely successful. Thirty-eight patients (21%) reported recurrence of palpitations: they were separated into two groups according to symptom characteristics (Table 1). Twenty-five patients (14%) (Group 1) complained of very rare short bouts of palpitations, a few seconds in duration, which felt as if the pre-ablation arrhythmia was starting up. Events recurred after a minimal symptom-free period of 2 months and were described by the patients as completely different from the previous long-lasting tachycardia episodes preceding the ablation.

Thirteen other patients (Group 2) (7%) complained of long-lasting episodes of palpitations very similar to the pre-ablation symptoms; these episodes appeared between 2 weeks and 48 months after the ablation (median: 3 weeks).

In Group 1, all but two patients refused any invasive diagnostic procedure as they considered the ablation a clinical success. No pre-excitation recurrence was demonstrated during follow-up on the repeated ECGs in the 19 patients being ablated for an overt accessory pathway. One very anxious patient, suffering from short bouts of effort-related palpitations 6 years after the ablation of a left-sided overt accessory pathway, underwent an electrophysiological study: accessory pathway recurrence was excluded and short runs of left atrial

Table 2 Clinical characteristics of group 2 patients

Patient	Sex	Age	AP	Follow-up (months)	Recurrence of symptoms (months)	Diagnosis	Treatment
1	M	44	R overt	82	0.5	AP recurrence	AA drugs
2	M	37	L overt	72	0.5	AP recurrence	RF ablation
3	F	20	L concealed	62	0.5	AP recurrence	AA drugs
4	M	29	L concealed	57	0.5	AP recurrence	RF ablation
5	M	12	R overt	56	0.75	AP recurrence	RF ablation
6	F	25	L concealed	47	0.75	AP recurrence	RF ablation
7	F	51	L concealed	43	0.5	AP recurrence	RF ablation
8	F	20	L overt	11	0.5	AP recurrence	RF ablation
9	M	41	L overt	92	33.0	AFL; no AP	AA drugs
10	M	61	L concealed	79	12.0	SSS; no AP	DDD pacemaker
11	F	19	L overt	64	47.0	AVNRT; no AP	RF ablation
12	M	27	L concealed	30	24.0	AF; no AP	AA drugs
13	F	47	L overt	7	3.0	AVNRT; no AP	RF ablation

AA=antiarrhythmic; AP=accessory pathway; AF=atrial fibrillation; AFL=atrial flutter; AVNRT=atrioventricular nodal reentrant tachycardia; F=female; L=left; M=male; R=right; RF=radiofrequency; SSS=sick sinus syndrome.

tachycardia originating near the ostium of the left superior pulmonary vein were demonstrated and later controlled by antiarrhythmic drugs. A second patient had several episodes of short palpitations, the last one having preceded a syncope 8 years after radiofrequency ablation of a right-sided overt accessory pathway. The electrophysiological study was normal and the syncope vasovagal in origin.

Eleven other patients had a repeated outpatient event or 24-h Holter monitoring. Three patients had short runs of atrial premature beats and four had ventricular extrabeats during symptoms noted as palpitations. In four other patients (two of them symptomatic during the recording period) sinus rhythm only was documented. Only four patients in Group 1 (17%) required transient antiarrhythmic drug medication, mainly beta-blockers for isolated or short runs of atrial or ventricular premature beats.

In Group 2, nine out of 13 patients underwent a second electrophysiological study: recurrence of accessory pathway conduction was documented in six patients, atrioventricular nodal reentrant tachycardia (never documented and not inducible after accessory pathway ablation) in two patients and atrial fibrillation recurrence in one patient. Two other patients had documented recurrence of orthodromic tachycardia on the ECG during the first 2 weeks following the ablation but declined a second ablation. A 62-year-old patient 1 year after the ablation had atrial tachyarrhythmia episodes related to sinus bradycardia: he was treated with dual chamber pacemaker implantation. Finally, one patient had a first episode of typical atrial flutter documented on a 12-lead ECG 33 months after the ablation (Table 2).

In all eight patients with accessory pathway recurrence (4%), symptoms reappeared during the first month following the ablation (median: 2 weeks); there were six left-sided and two right-sided accessory pathways, four were overt and four concealed. Six patients underwent a

successful second ablation procedure and remained asymptomatic and two others were treated further with Class IC drugs as they refused a second ablation procedure.

In contrast to the above described subgroup, recurrence in all five patients with documented sustained non-accessory pathway-related supraventricular arrhythmias was much later: between 3 and 47 months (median: 28 months). Two patients underwent a successful slow atrioventricular nodal pathway ablation, and three had atrial tachyarrhythmias treated medically.

Overall, 18 patients from the studied population (10%) required either invasive or medical antiarrhythmic therapy during follow-up to suppress their symptoms.

Focusing on the subset of patients less than 20 years old (the youngest being 10 years old), during a mean follow-up period of 42 months, four patients had a recurrence of accessory-pathway-mediated tachycardia, one had atrioventricular nodal reentrant tachycardia and three had short bouts of palpitations. In one of them, in whom Holter monitoring documented runs of atrial tachycardia 6 months after the ablation, the outcome was spontaneously favourable.

Discussion

Long-term clinical outcome, in patients who undergo a successful radiofrequency catheter ablation of an accessory pathway is not well known, as published studies report only short- or medium-term follow-up data^[1,2,10,13-23]. The present study, to the best of our knowledge, reports on the longest post-procedure period in these patients. Our data show that during a median follow-up period of 48 months the vast majority of patients successfully treated by radiofrequency catheter ablation have a very favourable long-term clinical outcome: 79% remained asymptomatic, 14% complained

only seldom of short bouts of palpitations, which rarely required invasive testing or antiarrhythmic drug medication, and in 7% long-lasting palpitations recurred similar to the pre-ablation period. Thus, as 93% of patients were either asymptomatic or only mildly symptomatic, we conclude that radiofrequency ablation of the accessory pathway has a persistent high acute success rate as demonstrated during long-term follow-up. In concordance with others^[7,8,24] we have a similar incidence of major complications (4%); no atrioventricular blocks were registered, probably due to the low number of patients with septal accessory pathway (6%).

Recurrence of conduction of the previously ablated accessory pathway is a rare event: 4% in our population, comparable to other published studies^[1,5,19]. In our study, recurrences of accessory-pathway-related arrhythmias appeared during the first month following the ablation and symptoms were similar to those of the pre-ablation period. These data are in concordance with other short-term follow-up: recurrence of accessory pathway conduction was documented in the first 2 to 3 months after the ablation^[13,15,23]. However, Dages *et al.* recently showed that 25% of all recurrences in their studied population were seen more than 6 months after the ablation. In contrast, in our population sustained palpitations appeared much later after the ablation, suggesting that the arrhythmias were triggered by an anatomical substrate different from the former ablated accessory pathway — mainly atrioventricular nodal reentrant tachycardia or atrial tachyarrhythmia. In our experience, these symptoms appeared after a median event-free follow-up period of 28 months. According to our results and those previously published, a cut-off limit of 3 months could be used to distinguish sustained palpitations due to a true recurrence of accessory pathway conduction from other supraventricular arrhythmias.

Three recurrences were observed in the first 50 ablated patients (6%) compared to five recurrences in the last 130 patients (3.8%); this difference is not significant and our observation is similar to others^[10]. However, Kay *et al.* have shown a learning curve with the ablation procedure that was entirely due to increased ablation efficacy with right free-wall and posteroseptal accessory pathways^[19]; a lower proportion of these accessory pathway locations (25% vs 40%) could explain the absence of a learning curve in our experience.

In agreement with Dages *et al.*^[10] we found no predictors for the reappearance of accessory pathway conduction after ablation. However, others have shown a higher recurrence rate after ablation of right sided accessory pathways^[19,23].

A significant proportion of our patients (13%=Group 1), complained of very short bouts of palpitations different from the pre-ablation period and spontaneously described as a 'starting-up phenomenon' of the previous episodes of sustained palpitations. Investigations, mainly non-invasive, showed isolated or short runs of atrial or ventricular premature beats related to symptom recurrence. It is possible that these ectopic activities,

now self-limited, were the trigger mechanisms for the induction of the pre-ablation sustained accessory-pathway-mediated tachycardia. Once the pathway is ablated, the trigger event remains symptomatic. It is also possible that some patients had an aborted episode of circus movement tachycardia due to incomplete ablation of the accessory pathway. However, in the absence of electrophysiological studies in all patients, these explanations remain hypothetical.

One out of 39 patients (3%) suffering from atrial fibrillation prior to ablation had atrial fibrillation recurrence after successful ablation. During a longer follow-up period our data confirm the experience of Haissaguerre *et al.* who demonstrated a very low incidence of recurrence of symptomatic atrial fibrillation after successful fulguration of accessory pathway^[25].

The proarrhythmic potential of the created ablation lesions is difficult to assess in our population, as only 16% of our patients were ≤ 20 years old. Clinically, no symptomatic sustained atrial or ventricular tachycardia was documented during a mean follow-up period of 42 months in these young patients. However, only invasive investigations could answer this specific question. Interestingly, Calkins *et al.* recently demonstrated no difference in the outcome of catheter ablation in children and adults^[7].

Limitations of the study

The major limitation of this study is the absence of electrophysiological testing during the late follow-up period and particularly in Group 1 patients. This may have resulted in failure to detect any recurrence of either concealed or manifest accessory pathways. However, this was difficult to consider after such a long follow-up period in completely asymptomatic or mildly symptomatic patients, as was the case in 93% of our population. Indeed, only two patients in Group 1 accepted an invasive study. Group 1 patients considered the ablation as a clinical success and declined any invasive procedure. Chen *et al.* previously showed that follow-up electrophysiological studies are not warranted in asymptomatic patients^[17].

Conclusions

This long-term follow-up study shows that successful radiofrequency is persistent and that late recurrence of accessory pathway conduction after ablation is a rare event; it mainly occurs as sustained palpitations during the first month after the ablation. Sustained palpitations appearing more than 3 months after the ablation are highly suggestive of supraventricular arrhythmias not related to an accessory pathway and justify a new electrophysiological study. Finally, short runs of palpitations are frequent and can be easily

managed with symptomatic treatment without further investigation.

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