Impact of radiofrequency catheter ablation of accessory pathways on the frequency of atrial fibrillation during long-term follow-up

High recurrence rate of atrial fibrillation in patients older than 50 years of age

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Aims Atrial fibrillation represents a frequent and potentially life-threatening arrhythmia in patients with accessory atrioventricular pathways. Radiofrequency ablation has become the curative treatment of first choice for these patients. Investigations after successful surgical pathway dissection reported an almost complete elimination of paroxysmal atrial fibrillation. However, there are only a few reports which include a small number of patients undergoing radiofrequency ablation. The purpose of this study was to examine whether successful radiofrequency ablation of accessory pathways prevents the occurrence of paroxysmal atrial fibrillation, and to identify possible predictors of atrial fibrillation recurrence.

Methods and Results A total of 116 consecutive patients (mean age 42 ± 15 years) with manifest or concealed accessory pathways and documented paroxysmal atrial fibrillation underwent radiofrequency catheter ablation. The patients were reexamined at 6 and 12 months. Long-term follow-up information was obtained by questionnaire and/or by consulting the referring physician. Pathway conduction was abolished in 101 cases (87%). Late follow-up information was obtained from 91 of these 101 patients (90%) with successful ablation with a mean follow-up duration of 23.9 ± 12.3 months. During follow-up, 25 of 91 patients (27%) experienced arrhythmias. Recurrent episodes of atrial fibrillation were observed in 18 of these 25 cases (i.e. 20% of the 91 patients). Differences between patients with and without recurrences of atrial fibrillation were examined for age, sex, associated cardiac disease, presence of multiple pathways, pathway location, atrial fibrillation inducibility during the procedure and cycle length of the atrioventricular reentrant tachycardia. Only older age was a significant independent predictor of atrial fibrillation recurrence ($P=0.02$). Eleven of 31 patients (35%) older than 50 years of age had atrial fibrillation recurrences during follow-up compared to seven of 60 patients (12%) under age 50. The recurrence rate of atrial fibrillation was even higher in patients older than 60 years (6 of 11 patients, i.e. 55%). In comparison, the occurrence rate of atrial fibrillation during follow-up in a control group of 100 consecutive patients with successful accessory pathway ablation, who did not have evidence of paroxysmal atrial fibrillation prior to ablation, was 4% and, thus, significantly lower than in the study group of the 91 patients ($P=0.001$).

Conclusions The recurrence rate of paroxysmal atrial fibrillation after successful radiofrequency ablation of accessory pathways shows an age-related increase, being low in patients younger than 50 years of age (12%) and high in the older patients: 35% in patients older than 50 years and 55% in patients older than 60. These results have significant therapeutic implications concerning the decisions on pharmacological therapy after successful ablation in patients older than 50 years. Furthermore, these data will help physicians advise older patients properly about their risk of recurrence of atrial fibrillation after ablation.


Key Words: Atrial fibrillation, radiofrequency catheter ablation, accessory pathway.
Introduction

Atrial fibrillation represents a potentially life-threatening arrhythmia in patients with accessory atrioventricular pathways since it may lead to ventricular fibrillation[1]. Possible mechanisms of atrial fibrillation initiation in these patients include enhanced atrial vulnerability and degeneration of atrioventricular reentrant tachycardia into atrial fibrillation[2-5]. Investigations after successful surgical dissection of accessory pathways reported an almost complete elimination of paroxysmal atrial fibrillation[6-8]. However, little information exists concerning catheter-based techniques and most relates to ablation using direct current[7,9]. There are no long-term follow-up data on the frequency of atrial fibrillation following radiofrequency catheter ablation in a large patient cohort[10,11]. Considering the significant morbidity and potential complications of atrial fibrillation, as well as the fact that radiofrequency ablation is nowadays curative treatment of first choice for symptomatic patients with accessory pathways, data on the effect of successful radiofrequency ablation on the frequency of atrial fibrillation would be of significant importance. Therefore, the purpose of this study was (1) to examine whether successful radiofrequency pathway ablation also prevents paroxysmal atrial fibrillation and (2) to identify predictors of atrial fibrillation recurrences after successful ablation.

Methods

Study patients

Between October 1993 and May 1997, radiofrequency ablation of a manifest or concealed accessory pathway was attempted in 519 patients in the Department of Cardiology, University of Münster, Germany. Paroxysmal atrial fibrillation prior to ablation was documented in 116 patients (22%). The characteristics of these patients are summarized in Table 1. Associated cardiac disease was present in 19 patients: coronary artery disease (n=9), Ebstein’s anomaly (n=4), mitral valve prolapse (n=2), coronary sinus diverticulum (n=1), hypertrophic obstructive cardiomyopathy (n=1), Marfan’s syndrome (n=1) and Noonan’s syndrome (n=1).

In the 116 patients with paroxysmal atrial fibrillation, main indications for ablation were symptomatic episodes of atrioventricular reentrant tachycardia in 110 cases (95%), rapid anterograde conduction over the accessory pathway during episodes of atrial fibrillation in 78 patients (67%) and ventricular fibrillation and/or cardiopulmonary resuscitation in 10 patients (9%).

Most patients (n=83, 72%) experienced more than one episode of palpitations per month before the procedure, with a mean frequency of 7.8 ± 13.2 episodes per month. A mean of 1.4 ± 1.1 antiarrhythmic drugs had either been ineffective or had intolerable side effects prior to ablation.

Control group

In order to compare the frequency of atrial fibrillation during follow-up with patients without atrial fibrillation before the ablation procedure, we formed a control group consisting of 100 consecutive patients (mean age 41 ± 14 years) who underwent successful radiofrequency ablation of an accessory pathway between November 1994 and February 1996 and did not have evidence of paroxysmal atrial fibrillation prior to ablation.

Radiofrequency ablation

The technique of radiofrequency catheter ablation has been described previously[12,13]. The retrograde aortic approach via the femoral artery was used for left-sided pathways. Right-sided pathways were approached via the femoral veins. Temperature-guided energy application was used[14]. The patients were monitored for 36–48 h after the procedure. A 12-lead ECG was obtained before discharge.

Follow-up

The patients were seen 6 and 12 months after ablation in the hospital or by the referring physician. Furthermore, patient reports concerning clinical course, symptoms and medication, as well as ECGs were regularly sent to us by the referring physicians. Since the great majority of the patients were referred by regularly referring physicians, mostly cardiologists practising in Münster and its surroundings, such follow-up data could be

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**Table 1 Clinical characteristics of patients with atrial fibrillation prior to ablation**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients (n)</td>
<td>116</td>
</tr>
<tr>
<td>Age (years)</td>
<td>42 ± 15</td>
</tr>
<tr>
<td>Presence of coronary artery disease</td>
<td>9 (8%)</td>
</tr>
<tr>
<td>Other associated disease</td>
<td>10 (9%)</td>
</tr>
<tr>
<td>Single pathway/multiple pathways</td>
<td>110 (95%)/6 (5%)</td>
</tr>
<tr>
<td>Left-sided</td>
<td>83 (68%)</td>
</tr>
<tr>
<td>Free wall</td>
<td>71 (58%)</td>
</tr>
<tr>
<td>Septal</td>
<td>12 (10%)</td>
</tr>
<tr>
<td>Right-sided</td>
<td>39 (32%)</td>
</tr>
<tr>
<td>Free wall</td>
<td>11 (9%)</td>
</tr>
<tr>
<td>Septal</td>
<td>25 (21%)</td>
</tr>
<tr>
<td>Mahaim</td>
<td>3 (3%)</td>
</tr>
<tr>
<td>Overt</td>
<td>103 (84%)</td>
</tr>
<tr>
<td>Concealed</td>
<td>19 (16%)</td>
</tr>
<tr>
<td>Total of accessory pathways</td>
<td>122</td>
</tr>
</tbody>
</table>

Data are presented as number (%) of patients or accessory pathways in the study group or mean ± SD.
obtained for most patients. Late follow-up after a mean of 23.9 ± 12.3 months was performed by questionnaire or direct telephone interviews with the patients and/or direct contact with the referring physician. When patients reported arrhythmias during the follow-up period, information regarding these arrhythmias was obtained from the referring physicians and documentation was sought.

**Statistical analysis**

Data are presented as mean ± 1 SD. Differences between patients in the study group with and without recurrences of atrial fibrillation were examined for age, sex, associated cardiac disease, presence of multiple pathways, pathway conduction (overt/concealed) and location, atrial fibrillation inducibility during the procedure and cycle length of atrioventricular reentrant tachycardia. For dichotomous variables, the chi-square test and Fisher’s exact test were used as appropriate. Continuous variables were compared by the Mann–Whitney Rank Sum test.

Multivariate logistic regression analysis was used to examine the independent relationship of the above named parameters to the recurrence of atrial fibrillation using the SPSS (version 8.0, SPSS Inc., Chicago, Illinois, U.S.A.) software package. Parameters not remaining in the model were added to the final model separately (in turn) to determine their partial significance.

For all statistical evaluations, a $P$ value <0.05 was considered significant.

**Results**

**Atrial fibrillation recurrences during follow-up**

Successful radiofrequency ablation (defined as successful initial or repeat ablation) was achieved in 101 (87%) of the 116 patients with paroxysmal atrial fibrillation prior to ablation. Late follow-up information was obtained from 91 patients with successful ablation (90%). These 91 patients (successful ablation and available follow-up information) formed the study group.

Duration of follow-up was 23.9 ± 12.3 months (3–47 months). During this period, 66 of 91 patients (73%) were asymptomatic. Twenty-five patients (27%) experienced arrhythmias. Documentation of the arrhythmias revealed recurrent episodes of paroxysmal atrial fibrillation in 18 cases, i.e. 20% of the study group. In most other cases, symptoms were caused by premature ventricular beats. Eleven of the 18 patients with atrial fibrillation recurrences were taking antiarrhythmic drugs during follow-up.

**Predictors of atrial fibrillation recurrences**

Clinical and electrophysiological characteristics of patients in the study group with and without recurrent atrial fibrillation during follow-up are shown in Table 2. Among the parameters examined in this investigation, only age and the presence of coronary artery disease were significantly different between patients with and without recurrence of atrial fibrillation after the procedure. There was an age-related increase in atrial fibrillation recurrences (Fig. 1). In patients younger than 50 years of age, recurrent atrial fibrillation was documented in 7 of 60 patients (12%) whereas 11 of 31 patients (35%) in the older age group (>50 years) had paroxysmal atrial fibrillation after successful ablation ($P=0.015$). The recurrence rate of atrial fibrillation was even higher in patients older than 60 years (6 of 11 patients, i.e. 55%). In addition, using Fisher’s exact test, the recurrence rate of atrial fibrillation was related to the presence or absence of coronary artery disease: four of seven patients (57%) with coronary artery disease had atrial fibrillation recurrences in comparison to 14 of 84 patients (17%) without coronary artery disease ($P=0.026$).
When combining the age and the presence or absence of coronary artery disease, the recurrence rate was low (5 of 58 patients, 9%) in the absence of coronary artery disease in the younger age group (≤50 years) whereas in the older age group the recurrence rate was 35% (9 of 26 patients) in the absence of coronary artery disease and 40% (2 of 5 patients) in the presence of coronary artery disease. However, using multivariate logistic regression, older age was the only independent predictor of atrial fibrillation recurrences (P=0.02). The presence of coronary artery disease was not significantly related to the recurrence of atrial fibrillation in the multivariate logistic regression due to the higher prevalence of coronary artery disease in the older age group (5 of 31 patients, i.e. 16% in the older age group vs 2 of 60 patients, i.e. 3% in the younger age group).

The presence of associated cardiac disease, other than coronary artery disease, the presence of multiple accessory pathways, the location (left- vs right-sided; septal vs free wall) and the anterograde conduction capacity (overt vs concealed) of the pathway did not affect the recurrence rate of atrial fibrillation (Table 2). The cycle length of atrioventricular reentrant tachycardia and the inducibility of atrial fibrillation during the ablation procedure were not significantly different either.

**Comparison with the control group**

There was no difference between the study and the control group concerning age (42 ± 15 vs 41 ± 14 years, P=0.48), follow-up duration (23.9 ± 12.3 vs 23.8 ± 4.9 months, P=0.41) and incidence of coronary artery disease (7 of 91 patients in the study group vs 5 of 100 patients in the control group, P=0.64). Furthermore, age distribution was similar in both groups with 31 patients in the study group being older than 50 years of age vs 28 patients in the control group (P=0.45).

During follow-up, 92 patients (92%) of the control group were asymptomatic. Recurrent episodes of atrial fibrillation were observed in four of the eight patients reporting symptoms (4% of the control group). Thus, the frequency of paroxysmal atrial fibrillation during follow-up was significantly lower in the control group than in the study group (4 of 100 patients in the control group vs 18 of 91 patients in the study group, P=0.001). Only one of the four patients with atrial fibrillation recurrences in the control group was older than 50 years of age.

**Discussion**

The present study investigated the largest number of patients with paroxysmal atrial fibrillation and radiofrequency ablation of accessory pathways reported so far. Our results demonstrate that the recurrence rate of atrial fibrillation following successful ablation in patients with paroxysmal atrial fibrillation prior to ablation shows an age-related increase, being low in patients younger than 50 years of age (12%) and high in the older patients: 35% in patients older than 50 years and 55% in patients older than 60.

Previous studies have reported almost complete elimination of atrial fibrillation after successful surgical[6,8] or direct-current ablation[7,9]. The recurrence rates of atrial fibrillation in these reports did not exceed 9%. This fact can be easily explained by the significantly younger mean age of the study population in these studies ranging from 29 to 33 years (compared to 42 ± 15 years in our study), and is consistent with the low atrial fibrillation recurrence rate of 12% in patients younger than 50 years in our investigation. The present report is the first so far to examine the relationship of age and atrial fibrillation recurrences after successful accessory pathway ablation.

Data from the Framingham Study show that the prevalence of atrial fibrillation increases with age[15,16]. However, the prevalences reported in the Framingham Study in patients older than 50 years are much lower than the atrial fibrillation recurrence rate in this age group in our study group.

These results have significant importance, since:

1. These data will help physicians advise patients older than 50 years properly about their risk of recurrence of atrial fibrillation after the ablation procedure.
2. Taking into consideration the results of the present study, physicians should examine whether continuation of pharmacological antiarrhythmic treatment could be a therapeutic option in patients older than 50 years of age, even if the ablation procedure is successful.
3. An interval free of symptoms suspicious of recurrent atrial fibrillation should possibly be awaited before discontinuing anticoagulation in older patients after successful ablation.
It should be stressed that the pre-existing reports on the occurrence of atrial fibrillation after elimination of accessory pathway conduction concern almost exclusively surgical dissection or direct-current ablation: the series of Haissaguerre et al.\[^{19}\] consisted of patients undergoing direct-current ablation of overt pathways, and the report of Wasse et al.\[^{7}\] considered a small series of only 20 patients with surgical or direct-current ablation. Data on the effect of radiofrequency ablation on paroxysmal atrial fibrillation in large patient cohorts is lacking. The study of Wathen et al.\[^{18}\] included only 20 patients who underwent radiofrequency ablation of an accessory pathway. Only eight of the 20 patients had documented atrial fibrillation prior to ablation. However, the pathophysiology of surgical and direct-current ablation is different from that of radiofrequency ablation. The fact that radiofrequency ablation is the ablation form used nowadays is another point indicating the clinical significance of the present study.

Limitations of the study

This study has the following limitations:

1. The data of the ablation procedures were collected retrospectively. However, long-term follow-up was prospectively designed.
2. The time of patient observation before the ablation procedure varied.
3. There was no data available regarding the number of atrial fibrillation episodes before the procedure since many patients could not differentiate between atrioventricular reentrant tachycardia and atrial fibrillation episodes prior to ablation.
4. We did not use event recorders or transtelephonic monitoring for the assessment of symptoms. Newer approaches to the treatment of atrial fibrillation have shown the usefulness of these methods.

Conclusions

The recurrence rate of paroxysmal atrial fibrillation after successful radiofrequency ablation of accessory pathways shows an age-related increase, being low in patients younger than 50 years of age (12%) and high in the older patients: 35% in patients older than 50 years and 55% in patients older than 60. These results have significant therapeutic implications concerning the decisions on pharmacological therapy after successful ablation in patients older than 50 years. Furthermore, these data will help physicians advise the older patients properly about their risk of recurrence of atrial fibrillation after ablation.

References