FACTORS PREDICTING RECURRENCES OF ATRIAL FIBRILLATION AFTER RADIOFREQUENCY CATHETER ABLATION OF TYPICAL ATRIAL FLUTTER

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Summary

Objectives: The current study aims at determining factors influencing the probability of atrial fibrillation (AF) recurrences after radiofrequency catheter ablation (RFCA) of typical atrial flutter (AFI).

Design, Methods and Results: 63 patients with paroxysmal or persistent AF and AFl were followed up after RFCA for typical AFl. AF did not recur or the frequency of AF paroxysms with antiarrhythmic drugs decreased in 33 (52.4%) patients (Group I). In 30 (47.6%) patients the course of AF did not change or AF progressed into chronic form despite the drug treatment (Group II). Patients of Group II were older, had longer mean duration of AF symptoms prior to RFCA procedure. In 9/11 (81.8%) patients of Group II with sick sinus node syndrome corrected by pacing, the course of AF did not change or AF progressed into chronic form. Statistical analysis has shown that the probability of AF recurrences after AFl RFCA is higher in the patients over 62.5 years old (probability 50%); if duration of AF symptoms exceeds 4 years (probability 73%) and in patients with sick sinus node syndrome (probability increases 11-fold).

Conclusions: Patient's age, atrial fibrillation symptom duration prior to the procedure of atrial flutter ablation and the presence of sinus sick syndrome can be used for prediction of higher probability of AF recurrences after catheter ablation of typical atrial flutter.

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Although genesis and mechanisms of atrial fibrillation (AF) and atrial flutter (AFI) differ [1], these disorders of cardiac rhythm may coexist and transform one into another [2,3]. Development of the persistent or recurring AFI may complicate the treatment of AF with antiarrhythmic drugs (AAD).

Radiofrequency catheter ablation (RFCA) is an effective method of treatment of typical AFI, with 60–90% of success and 10–40% probability of recurrences [4–6]. Ablation procedure can effectively protect from recurrences of AFI, and AF may cease in some patients. There are reports that AF remains in 20–56% of cases after AFI RFCA procedures and may be an important cause of recurrent symptoms and renewed or continued antiarrhythmic therapy [4, 7–9]. Recurrences of AF after AFI RFCA are more common with with older patient's age, longer duration of AF symptoms, bigger left atrium, lower left ventricular ejection fraction, and co-existing cardiovascular pathology [8,10].

The aim of this study was analysis of criteria that could help to predict probability of AF recurrences after AFI RFCA.

Design and Methods

Study population

The study included 63 patients: 45 men (71.4%) and 18 women (28.6%), mean age 57.7 ± 9.6 years with symptomatic paroxysmal or persistent AF and AFI, who underwent RFCA of typical AFI in the Center of Cardiology and Angiology, Vilnius University Hospital Santariskių Klinikos during the period from 1996 to 2001. The duration of symptoms of AF ranged from 2 to 20 years (mean duration 5.7 ± 3.8 years). Structural heart disease was found in 51 of 63 patients (80.9%), and no structural heart disease was found in 12 patients (19.1%).

Present study evaluated demographic data (gender, age), duration of AF symptoms, presence of structural heart disease, presence of concomitant disease (diabetes, thyroid diseases, chronic obstructive pulmonary disease), frequency of AF recurrences prior to and after RFCA of typical AFI, course of AF after RFCA of typical AFI, efficiency of
treatment with class I and class III AAD (according to Vaughan–Williams classification) [11]. Patients with AF or AFl paroxysms, recurring at least once a month, were included into the study.

All the patients had been followed up for 1 year after RFCA of typical AFl because the results were evaluated. The frequency of AF episodes was evaluated in comparison with the frequency of AF episodes prior to the isthmus RFCA. No episodes of AF paroxysms following RFCA were evaluated. Patients received the treatment with class I or class III AAD prior to and at least one month after the procedure. Later, AAD were either transiently or permanently withdrawn in some patients because of the improvement of health state or absence of documented arrhythmia.

Radiofrequency catheter ablation of typical atrial flutter

The ablation of typical AFl was performed according to established techniques [12,13]. The procedure was started from the intracardiac electro physiologic study. Typical AFl was considered to be either “counterclockwise” or “clockwise” macroreentrant tachycardia dependent on cavotricuspid isthmus and limited to the right atrium. The line of ablation spots was created between the tricuspid valve and inferior vena cava. In six patients with recurrences of AFl after the first procedure, CARTO electroanatomic system was used for the isthmus ablation. Termination of AFl and bidirectional conduction block in the cavotricuspid isthmus were considered as early success markers of the procedure [6].

For at least one month after the procedure, 325 mg of aspirin daily, or warfarin to maintain international normalized ratio (INR) in a range of 2.0–3.0, were administered. These drugs were chosen depending on the risk of thromboembolic complications [11] and later – on the course of AF.

Statistical analysis

The tests were performed using the SAS and SPSS statistical packages. Results were expressed as mean ± SD, median, and range. Univariate analysis of factors associated with the occurrence of AF was performed using Student’s t-test for continuous variables. Two-tailed paired or unpaired Student’s t-tests were performed when appropriate. Chi-square analysis was used for testing homogeneity in contingency tables. Statistical significance was established at p < 0.05. Multivariate and univariate logistic regression model analysis was performed to determine independent predictors of the development of AF. Odds ratios (OR) with 95% CI were calculated. Optimal sensitivity of diagnostic criteria determining value was stated using cut-off point in receiver operating characteristic (ROC) curve.

Results

Results were evaluated one year after the successful procedure of RFCA of typical AFI. In 17 of 63 patients (26.9%) RFCA had to be repeated because of recurrence of typical AFI. Electrophysiological evaluation showed restitution of cavotricuspid isthmus conduction, and the isthmus block was created by completing the ablation line. After the successful RFCA of typical AFI positive effect was achieved in 33 (52.4%) patients (Group I). In 30 (47.6%) patients AFl remained despite the treatment with class I or III AAD (Group II). Paroxysmal AF progressed into chronic AF in 16 (25.4%) patients.

One month after the procedure aspirin or warfarin were discontinued in 6 (9.5%) patients, 19 (30.2%) patients continued aspirin and 38 (60.3%) patients – warfarin.

Statistically significant correlation between the age (p = 0.017), duration of symptoms of AF prior to the procedure (p = 0.022) and the results of AF treatment was found. Patients of Group II were older (60.7 ± 9.6 years) in comparison with those of Group I (55.0 ± 9.0 years). The results were evaluated in the patients who were under 60 years and older. For the patients, who were older than 60 years (18 of 32, 56.3%) AF paroxysms sustained or converted into chronic AF after the successful procedure more frequently, in comparison with those who were under 60 years (12 of 31; 38.7%), p = 0.004 (Table 1). The mean duration of AF symptoms prior to the procedure was longer in patients of Group II (6.83 ± 3.75 years) in comparison with patients of Group I (4.76 ± 3.17 years).

Logistic regression model analysis showed that the increase in patients’ age by 5 years had increased the probability of recurrence of AF for 1.4 times, by 10 years – twice (OR = 2.3, p = 0.015).

According to the cut-off points of ROC curve, the age could be used as prognostic criterion of AF recurrence. The point “age = 62.5 years” showed 0.5 sensitivity and 0.85 specificity. Therefore, it was probable that AF after RFCA of typical AFI would not recur in 85% of the patients, younger than 62.5 years. For the patients over 62.5 years, probability of AF recurrence achieved 50% (Figure 1).

Logistic regression model analysis showed that the increase in duration of AF symptoms by 3 years had increased the probability of AF recurrence after successful RFCA 1.75-fold (OR = 1.75, p = 0.017).

According to the cut-off points of the ROC curve the point “duration of AF symptoms = 4.5 years” showed 0.73 sensitivity and 0.58 specificity. Therefore, for the patients in whom duration of AF symptoms had exceeded 4.5 years, probability of recurrence of AF after RFCA was 73% in comparison with 58% for those in whom duration of symptoms had been less than 4.5 years (Figure 2).
Table 1. Correlation between age, duration of symptoms of atrial fibrillation prior to radiofrequency catheter ablation of atrial flutter and the results of treatment

<table>
<thead>
<tr>
<th>Result</th>
<th>Number of patients</th>
<th>Mean (years)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No AF/AF frequency decreased</td>
<td>33</td>
<td>55.0 ± 9.0</td>
<td>0.017</td>
</tr>
<tr>
<td>AF paroxysms sustained /converted to chronic AF</td>
<td>30</td>
<td>60.7 ± 9.6</td>
<td></td>
</tr>
<tr>
<td>Duration of symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No AF/AF frequency decreased</td>
<td>33</td>
<td>4.8 ± 3.2</td>
<td>0.022</td>
</tr>
<tr>
<td>AF paroxysms sustained /converted to chronic AF</td>
<td>30</td>
<td>6.8 ± 3.8</td>
<td></td>
</tr>
</tbody>
</table>

AF – atrial fibrillation

The correlation between duration of AF symptoms prior to RFCA of typical AFI, age and the results of treatment were evaluated. With the increase of duration of AF symptoms in the patients under 60 years old, the probability of positive result decreased 4.5-fold (OR = 4.5; \( p = 0.087 \)), and for those who were 60 years old and above – 12.7-fold (OR = 12.75, \( p = 0.013 \)). Statistically significant results were found only in the group of patients who were 60 years old and above (Table 2).

![Figure 1](image1.png)

Figure 1. Patient’s age as a prognostic criterion of atrial fibrillation recurrence

Statistically significant correlation between the presence of sick sinus syndrome corrected by pacing and results of AF treatment was found. In patients with sick sinus syndrome and pacemaker implanted, positive effect was significantly less common (only in 2 of 11 patients, 18.2%, Table 3).

Logistic regression analysis showed that probability of AF recurrence after successful catheter RFA of typical atrial flutter is 11 times greater in patients with sick sinus syndrome, even corrected by pacemaker implantation (OR = 0.088; 95% CI 0.015–0.6; \( p = 0.007 \)).

No statistically significant association between other structural heart diseases, concomitant diseases, gender and the results of the treatment was found.

Discussion

RFCA is a method of choice for the treatment of typical AFI because usually AAD are not effective. On the other hand, AF is often treated with AAD, because the catheter treatment of AF is a complicated and not always effective procedure [14,15]. While treating AF with AAD of class IC and III, conditions favourable for the development of AFI may arise in case of the preserved cavotricuspid isthmus conduction. This leads to the development of hybrid therapy for coexisting AF and AFI, i.e. administration of AAD and appliance of RFCA for the treatment of typical AFI [4,7–10,16–18].
Table 2. Correlation of duration of atrial fibrillation symptoms and the results of treatment considering age

<table>
<thead>
<tr>
<th>Duration of AF symptoms</th>
<th>Under 60 years</th>
<th>60 years and over</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No AF/AF paroxysms</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>frequency sustained/converted to chronic AF (n)</td>
<td>(n)</td>
</tr>
<tr>
<td>1–3 years</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>4 years and over</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>12</td>
</tr>
</tbody>
</table>

AF – atrial fibrillation; OR – odds ratio

Table 3. Correlation between the presence of sinus sick syndrome corrected by pacing (permanent pacemaker) and results of atrial fibrillation treatment

<table>
<thead>
<tr>
<th>Sick sinus syndrome corrected by pacing</th>
<th>AF ceased/frequency sustained/converted to chronic AF (n)</th>
<th>AF paroxysms</th>
<th>Total</th>
<th>OR</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is</td>
<td>2</td>
<td>9</td>
<td>11</td>
<td>0.14</td>
<td>0.01–0.79</td>
<td>0.009</td>
</tr>
<tr>
<td>No</td>
<td>31</td>
<td>21</td>
<td>52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>30</td>
<td>63</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AF – atrial fibrillation; CI – coincidence interval; OR – odds ratio

While evaluating our data, we considered that patients with no recurrences of AF after RFCA of AFI and free from AAD therapy, had no marked remodelling of atrial muscle. For these patients AFI could be the leading rhythm disorder and the cause of AF. A rather high percentage of AF after RFA of AFI was not unexpected. We think that these patients had AF due to the marked electrical and structural remodelling of atrial muscle [19,20]. AF sustaining after RFCA of AFI is likely to be an independent arrhythmia, but not the consequence of previous AFI. For patients, in whom AF paroxysms remain after RFCA, procedures affecting the substrate of AF, or ablation of AV node and implantation of a permanent pacemaker should be taken into account as the alternative method of treatment [21].

Age, duration of symptoms prior to the procedure have been determined as factors, having impact on the results of the treatment of AF after RFCA of typical AFI.

The current study showed the age’s influence on the results of AF treatment. Epidemiological studies described the age as an independent factor of risk of developing AF [22]. Although several studies, evaluating the course of AF after RFCA of typical AFI, showed the impact of age on the results of AF treatment [7,8], the majority of studies showed no correlation with the results [4,9,10,16,17]. This phenomenon may be explained by the slight differences in the patients’ age analysed in the latter studies.

The current study showed that AF after the AFI RFCA procedure recurred more frequently in patients for whom duration of symptoms of AF prior to the procedure was longer. We failed to find such data in literature. We suppose these criteria to be an important prognostic factor of further AF course, as the probability of atrial remodelling increases with the increase of duration of symptoms.

Among the patients of our study who had sick sinus syndrome corrected using implantation of permanent pacemaker, for 9/11 patients (81.8%) AF remained or became chronic after the procedure. The other studies on the results of the treatment of AF after RFA of typical AFI have not analyzed the patients with sick sinus syndrome corrected with permanent pacemaker [4,7,9,15,16] or showed that this factor was not statistically significant due to insufficient number of patients [8]. We suppose that recurrences of AF after the AFI RFCA procedure for these patients was determined by severe structural and electrophysiologic changes, as sick sinus syndrome is generalized disease of conductive system of the heart, affecting sinus node, AV node and atria.

The other structural heart diseases, concomitant diseases, gender had no statistically proven impact on the results. The data of epidemiological studies showed that the risk of development of AF was
greater for males, also for patients with the structural heart disease [22]. Some studies evaluating the course of AF after RFCA of AFI showed that the structural heart disease and the decreased LV EF, were the risk factors of the development of AF after AFI RFCA [8,10,16,23,24], that increased the risk of AF 3.8-fold [8]. Other studies, as well as the current one, showed no statistically significant correlation between these factors and the results of treatment of AF after RFCA of typical AFI [4,9,17]. In our study the latter phenomenon may be explained by the fact that the number of patients with any of structural heart diseases was not large enough. The largest proportion of patients had arterial hypertension; this condition had been controlled prior to the procedure (goal arterial blood pressure <140/90 mmHg) and the treatment was continued after AFI RFCA [25].

The current study showed that the older age, longer duration of AF symptoms and presence of sinus sick syndrome prior to AFI RFCA had negative impact on the results of the AF treatment.

Conclusions

The probability of recurrence of atrial fibrillation after catheter ablation of typical atrial flutter is higher in the following cases:

- patient’s age over 62.5 years (probability of atrial fibrillation 50%);
- duration of symptoms of atrial fibrillation exceeds 4 years (probability of atrial fibrillation 73%);
- presence of sick sinus node syndrome corrected by permanent pacemaker (probability of atrial fibrillation increases 11 times).

References

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