Radiofrequency Catheter Ablation of Common Atrial Flutter
Significance of Palpitations and Quality-of-Life Evaluation in Patients
With Proven Isthmus Block

F. Anselme, MD; N. Saoudi, MD; H. Poty, MD; R. Douillet, MD; A. Cribier, MD

Background—Creation of a complete bidirectional inferior vena cava–tricuspid annulus isthmus block (CBIB) by
radiofrequency catheter ablation is now a well-accepted criterion for prevention of common atrial flutter (AFI)
recurrences. However, some patients still complain of palpitations after ablation, and it is not known whether these are
related to AFI recurrences or to other arrhythmias.

Methods and Results—Among 100 consecutive patients referred to our institution for AFI ablation, CBIB was created in
83. There were 54 patients (group A) in whom AFI was the only documented arrhythmia before ablation and 29 patients
(group B) in whom atrial fibrillation (AFib) had been documented in addition to AFI. An electrophysiological control
study was performed in 40 patients 1 to 3 months after ablation. Arrhythmic events, medications, and functional status
were evaluated at midterm follow-up (n=77; 14.7±8.4 months; range, 4 to 34 months). The SF-36 questionnaire and
the Symptom Checklist—Frequency and Severity Scale specific for cardiac arrhythmia were used to assess quality of
life in 63 patients at long-term follow-up (27.1±8.5 months). Recurrence of AFI was documented in only 1 patient 6
months after ablation. AFib was recorded in 28 patients (36.4%), and atypical AFI was found in 3 patients. Thirty-two
group A patients (66.7%) and 17 group B patients (58.6%) were still arrhythmia free at midterm follow-up. Even at
long-term follow-up and in group B patients, AFI ablation was followed by a clear improvement in quality of life.

Conclusions—Palpitations after creation of CBIB are due mostly to AFib but not to AFI recurrence. This technique
provides a significant and persistent clinical benefit and may suppress all atrial arrhythmia in a subset of patients
suffering from both AFI and AFib. (Circulation. 1999;99:534-540.)

Key Words: atrial flutter ■ fibrillation ■ catheter ablation ■ follow-up studies ■ quality of life

Atrial flutter (AFI) and fibrillation (AFib) are reentrant
arrhythmias that are often clinically associated. Although for a given patient 1 is usually predominant, they may
shift from 1 to the other.1,2 In common AFI, the obligatory
route between the inferior vena cava and the tricuspid ring
(IVC-TR) led to the local use of radiofrequency ablation.
Initial series have reported a late recurrence rate ranging from
10% to 40% and a fairly high incidence of AFib.5–12 In most
of these studies,6,7,9,10,12 however, noninducibility of AFI and
flutter termination were the end points of the procedure.
Outcome of the conduction in the IVC-TR isthmus was
inconstantly analyzed.

We reported that creation of a complete bidirectional
conduction block (CBIB) at the IVC-TR isthmus is the best
criterion for predicting absence of AFI recurrences.13,14 De-
spite very strict criteria for the definition of CBIB, some
patients still complain of late palpitations after the procedure.
It is unknown whether these are due to the target arrhythmia
recurrence or to another atrial arrhythmia. The purpose of this
study was to evaluate the incidence of palpitations, AFI
recurrence, and AFib in patients in whom CBIB was proven
at the end of the procedure. In addition, we evaluated to what
extent the presence or absence of palpitations influenced a
patient’s quality of life after successful ablation.

Methods

Pertinent Definitions

Common AFI
Common AFI is defined as tachycardia with negative F waves in the
inferior leads, followed by a positive notch and a slightly descending
plateau. Atrial rate ranges from 240 to 340 bpm. It is due to either a
counterclockwise or a clockwise right atrial rotation with proximal-
to-distal coronary sinus depolarization.15

AFib
AFib is defined as irregular QRS complexes with totally disorga-
nized baseline atrial activity.

Atypical AFI
Atypical AFI is defined as continuous baseline activity with any-
thing other than typical AFI F-wave morphology.

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**Atrial Tachycardia**

Atrial tachycardia is defined as regular and rapid (>180 bpm) P waves separated by quiescent baseline, with a morphology different from that of the sinus P waves.

**Electrophysiological Study and Ablation Procedure**

The procedure of radiofrequency catheter ablation of common AFl in our laboratory has previously been described.\(^\text{13,14}\) Of major importance, the distal bipole of the duodecapolar Halo catheter (Webster Laboratories or IBI, Inc) was carefully positioned as close to the lateral side of the ablation line as possible (≤5 mm). The criterion for successful ablation was achievement of CBIB, the definition of which was previously reported in detail.\(^\text{14}\)

**Patient Population**

From September 1994 to February 1997, 100 patients were referred to our laboratory for catheter ablation of symptomatic common AFl. AFl had recurred for 38±40 months despite a mean number of 2.2±1.2 antiarrhythmic drugs. Although antiarrhythmic drugs had rendered 8 patients asymptomatic, ablation was performed because of the inefficacy to avoid AFl recurrences. Fifteen patients had associated coronary artery disease, 8 had chronic obstructive pulmonary disease, 8 had dilated cardiomyopathy, 4 had congenital heart disease, 3 had valvular heart disease, and 2 suffered from Steiner dystrophic myopathy. Sixteen patients were treated for high blood pressure. The patient population was divided into 2 groups according to the presence of previous documentation of AFib episodes, either on systematic ECG or during a symptomatic episode of palpitations before ablation. In group A (group A), patients had experienced common AFl only, whereas in group B, additional AFib was documented. In all cases, AFl remained by far the major symptomatic arrhythmia. Patient functional status, including presence of angina, palpitations, and degree of dyspnea, was prospectively determined.

**Follow-Up**

Only patients with CBIB were included in the follow-up study. After the procedure, antiarrhythmic medications were stopped for group A patients but were continued for group B patients. Thereafter, patients were followed at periodic intervals by either the investigators in the outpatient clinic or their cardiologists. The latter could introduce, modify, or stop antiarrhythmic drugs according to patient symptoms or ECG recordings. At least one 24-hour Holter monitoring was recorded for each patient during follow-up.

Patient follow-up evaluation was performed at 3 different stages (Table 1). Short-term follow-up consisted of a systematic electrophysiological control study 1 to 3 months after ablation in the first 40 patients. Because of the lack of clinical AFl recurrences during the initial follow-up, this control study was subsequently stopped. In addition to careful mapping of the activation sequence within the IVC-TR isthmus during proximal coronary sinus (pCS) pacing, incremental pCS pacing up to a cycle length of 180 ms was performed at the end of the study.

Mid-term follow-up consisted of an evaluation of the patient’s functional status. Patients were specifically questioned about palpitations, dyspnea, and angina. In addition, results of ECG and Holter recordings and the potential use of antiarrhythmic medications were noted. For this purpose, all patients and their cardiologists were contacted by telephone during May 1997.

Long-term follow-up consisted of an appreciation of patients’ quality of life, through use of the SF-36 Health Survey instrument,\(^\text{16,17}\) and symptoms, through use of the Symptom Checklist—Frequency and Severity Scale (Bubien RS, Kay GN, revised Jenkins LS, 1993, version 3, used with permission of the author).\(^\text{18,19}\)

The SF-36 Health Survey questionnaire allowed scoring of 8 subscales. The verbatim item corresponding to reported health transition (the only item not included in 8 scales of SF-36) was modified as follows. Instead of, “Compared with one year ago, how would you rate your health in general now?”, we used, “Compared with period before ablation, how . . . .”. For each question of the SF-36 instrument, except for those related to general health, the patient had to indicate whether his or her present situation was better (scored 1), identical (scored 0), or worse (scored −1) compared with the period before ablation to calculate an evolution score.

The Symptom Checklist—Frequency and Severity Scale (version 3) was developed to evaluate the patient’s perception of symptoms related to frequency and severity of cardiac arrhythmia.\(^\text{18}\) An evolution score was also calculated with the same method used for the SF-36 items.

**Statistical Analysis**

Student’s unpaired t test, χ² test, and Fisher’s exact test were used for comparisons between the 2 groups. Differences were considered significant at \(P \leq 0.05\).

**Results**

There were 8 initial ablation failures (8%). Nine patients had incomplete isthmus block (IIB) (9%), and 83 patients showed CBIB.\(^\text{14}\) Table 1 shows clinical characteristics of these patients. No thromboembolic complication was observed. One patient developed complete AV block during radiofrequency delivery at the septal side of the isthmus and underwent pacemaker implantation. In patients with CBIB, no statistical difference was found between group A and group B in terms of age, sex, presence of heart disease, left atrial dimension, ejection fraction, and number of antiarrhythmic drugs used before ablation.

**Short-Term Follow-Up: Electrophysiological Control Study**

**Various Degrees of Isthmus Block at 1.8±2.3 Months After Ablation**

At a pCS pacing cycle length of 600 ms, 22 patients (55%; group A=14, group B=8; \(P=\text{NS}\)) showed evidence of persistent complete isthmus block (IB) (Figure 1). In 15 patients (37.5%), the degree of conduction block had regressed from complete to incomplete, with a marked intratral conduction delay at the site of ablation, however. In

<table>
<thead>
<tr>
<th>TABLE 1. Study Design</th>
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<tbody>
<tr>
<td><strong>Radiofrequency</strong></td>
</tr>
<tr>
<td>Ablation of AFl</td>
</tr>
<tr>
<td>Sex, F/M</td>
</tr>
<tr>
<td>Age, y</td>
</tr>
<tr>
<td>EF, %</td>
</tr>
<tr>
<td>LAD, mm</td>
</tr>
<tr>
<td>HD, n</td>
</tr>
<tr>
<td>AAD, n</td>
</tr>
<tr>
<td>EPS</td>
</tr>
<tr>
<td>(1.8±2.3 mo), n</td>
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<tr>
<td>Midterm follow-up</td>
</tr>
<tr>
<td>(14.7±8.4 mo), n</td>
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<tr>
<td>Long-term follow-up</td>
</tr>
<tr>
<td>(26.9±8.3 mo), n</td>
</tr>
</tbody>
</table>

GA indicates group A; GB, group B; EF, left ventricular ejection fraction; LAD, left atrial dimension; HD, presence of heart disease; AAD, antiarrhythmic drugs; and EPS, electrophysiological study. Initial population=100 patients (GA=65, GB=35).
these patients, the interval between the stimulation artifact (delivered at the pCS) and the atrial electrogram recorded at the distal dipole of the Halo catheter had shortened from 157±20 to 134±23 ms ($P=0.04$). In the remaining 3 patients (7.5%), the sequence of atrial activation showed an absence of IB.

With a decreasing pacing cycle length (400 ms), the pattern of low lateral right atrial activation sequence shifted to complete IB in 5 of the 15 patients with IIB. Patients without IB at 600 ms of pacing cycle length developed either CBIB (2 patients) or IIB (1 patient) at 400 ms.

**Induced Arrhythmia During Control Studies**

Atrial arrhythmia were induced in 24 patients (group A: 5, group B: 7; $P=NS$). AFib was induced in 15 patients (group A: 11, group B: 4), lasting >1 minute in 13. Atypical AFI was induced in 9 patients (group A: 5, group B: 4; $P=NS$). In 3 of these 9 patients (group A: 2, group B: 1), the AFI circuit was localized in the left atrium. In 3 patients in whom isthmus block had regressed from complete to incomplete, common AFI was induced (group A: 3), and a second ablation procedure was performed, leading again to creation of CBIB.

**Midterm Follow-Up**

After a mean of 14.7±8.4 months (group A: 14.4±8.7, group B: 15.1±7.9; range, 3 to 34 months; $P=NS$), 3 patients died of noncardiac causes (group A: 3), and 3 were lost to follow-up (group A: 3). Among the 9 patients with primarily IIB, 1 had AFl recurrence. 1 was in chronic AFib, 6 had experienced paroxysmal AFib. In 25 group B patients, antiarrhythmic drugs were either transiently or permanently withdrawn because of symptom improvement and/or absence of documented arrhythmia. However, after 14.7 months, 28 patients (36.4%; group A: 17, group B: 11; $P=NS$) were on Vaughan-Williams class I and III antiarrhythmic drugs. Twenty-one (group A: 14, group B: 7; $P=NS$) received antiarrhythmic drugs after documentation of atrial arrhythmia. In the remaining 7 patients, drugs were introduced because of symptomatic palpitations (group A: 3) or were continued after the ablation procedure (group B: 4). Thirty-seven patients were on oral anticoagulant therapy (48%; group A: 17, group B: 20; $P=0.004$). Nineteen patients (24.7%) were on low-dose (250 mg/d) aspirin (group A: 13, group B: 6; $P=NS$).

**Long-Term Follow-Up**

After a mean of 27.1±8.5 months (range, 15 to 46 months), 3 more patients died of noncardiac causes, 2 patients refused to fill out the questionnaires, and 9 were lost to follow-up. Therefore, 63 patients were contacted for evaluation of quality of life and arrhythmia-related symptoms. Table 2 shows the Quality of Life and Symptom Checklist scores, in addition to the evolution scores. The latter indicated an improvement after the procedure in all items except bodily pain.

Of note, at this late follow-up, no other recurrence of AFl was reported.

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**Figure 1.** Number of patients according to degree of isthmus block recorded at various pCS pacing cycle length. AFI was induced in 3 patients in whom incomplete isthmus block was recorded at 400-ms pacing cycle length who underwent a successful repeated ablation. CIB indicates complete isthmus block.
Discussion

Common AFl Recurrence
To the best of our knowledge, this is the first study to analyze the long-term follow-up of a large patient population with proven CBIB after common AFl ablation. This successful ablation criterion has been found to be the best predictor for long-term success. Our results further underscore its validity and therefore the need to carefully map the isthmus ablation site at the end of the procedure. However, regression of conduction block from complete to incomplete was ob-

![Figure 2](https://example.com/fig2.png)

**Figure 2.** Incidence of palpitations, presyncope, and angina and number of asymptomatic patients before and after ablation in overall population and within groups. The y axis represents percentage of patients with symptom, and number in each bar diagram represents number of patients.

![Figure 3](https://example.com/fig3.png)

**Figure 3.** Incidence of dyspnea before and after ablation in overall population and within groups. The y axis represents percentage of patients, and numbers in each bar diagram represents number of patients. Pre indicates before ablation; post, after ablation.
Follow-Up After Atrial Flutter Ablation

Atrial Fibrillation

Incidence

After a mean of 14.7 months, paroxysmal AFib incidence was 36.4%, which appears to be higher than reported in the literature (8% to 27%).\textsuperscript{5-7,9-12} In previous large series, however, it was not precisely noted whether this incidence referred to chronic AFib, paroxysmal AFib, or both.\textsuperscript{11,12} Several factors may explain these findings. Because AFib could be organized into AF with antiarrhythmic drugs,\textsuperscript{21,22} the former could have been the primary arrhythmia in some group A patients. Drug withdrawal after the procedure would have allowed AFib resumption, leading to a final AFib incidence of 33.3% in this group. This concept is of great interest because it suggests that a combination of IVC-TR ablation and antiarrhythmic medications would cure AFib in patients in whom drugs can convert AFib into AF. One can also speculate about the possible arrhythmogenic properties of radiofrequency applications. This possible adverse event was not evaluated in our study but was very unlikely in our opinion. Finally, occurrence of AFib during follow-up may also be consecutive to the “natural” progression of the atrial disease.

Prevention?

Among group B patients, 17 (58.6%) were arrhythmia free at the midterm follow-up. No arrhythmia was documented in 4 of 6 patients with a follow-up duration >2 years. Of these 4 patients, 3 did not take antiarrhythmic drugs, whereas several antiarrhythmic medications had unsuccessfully been tested before the procedure. Several hypotheses may explain these observations. Radiofrequency current is delivered in the low right atrium, an area that recently also appeared to be of major importance in the genesis of AFib.\textsuperscript{23,24} Creation of atrial lesions at the IVC-TR isthmus may render the initiation of AFib more difficult. This ablation line is 1 step of compartmentalization in the right atrium.\textsuperscript{25,26} Therefore, it may make AFib easier to control with drugs known to increase the conduction wavelength, rendering AFib less likely to occur, whereas AF cannot occur anymore. As frequently observed clinically, the episodes of AFib occurring before ablation could have been triggered by preexisting AFib (Figure 5). The absence of AFib recurrence after the procedure would therefore suppress the initiation of AFib. Therefore, this technique remains of potential interest for those patients, provided that AFib is not the major clinical arrhythmia.

Predictive Factor of Late Occurrence of AFib

In the study of Philippon et al, several clinical variables have been found to be associated with late occurrence of AFib. After multivariate analysis, only AFib inducibility remained an independent predictive factor. In another study,\textsuperscript{11} the combination of right or left atrial enlargement (>40 mm) and history of AFib was found to be a predictor of subsequent AFib. In our study, although previous history of AFib and inducible AFib were more frequent in patients with recurrence of this arrhythmia, none of these variables was significantly correlated with the late documentation of AFib (Table 3). The paroxysmal or chronic character of AFib was not clearly defined in these 2 series, which can account for the observed discrepancy in our study. In addition, one cannot exclude the occurrence of AFib episodes triggered by AF recurrences because the CBIB criterion was not always required for definition of acute successful ablation in these studies.

Functional Status and Quality of Life

The clinical benefit of ablation was clearly demonstrated at midterm follow-up because the incidence of all evaluated symptoms (except angina) decreased significantly. These results were further confirmed at late follow-up with the evaluation of arrhythmia-related symptoms and quality of
Again, these scores were rather higher than those reported by Bubien et al.19 after AFib catheter ablation. The evolution scores were normalized to a scale ranging from −100 to 100 for SF-36 items and are coded from −16 to 16 for Symptom Checklist—Frequency, with lower values representing greater symptomatic status. Evolution scores were normalized to a scale ranging from 0 to 100, with the higher score representing better quality of life.

### Table 2. Quality of Life and Comparison Group at Long-Term Follow-Up

<table>
<thead>
<tr>
<th></th>
<th>Group A (n=39)</th>
<th>Group B (n=24)</th>
<th>Overall Population (n=63)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Scores</td>
<td>Evolution</td>
<td>Scores</td>
</tr>
<tr>
<td>SF-36 mental health</td>
<td>56.10</td>
<td>19.74</td>
<td>57.83</td>
</tr>
<tr>
<td>SF-36 vitality</td>
<td>62.18</td>
<td>31.41</td>
<td>66.04</td>
</tr>
<tr>
<td>SF-36 physical functioning</td>
<td>81.04</td>
<td>26.03</td>
<td>85.63</td>
</tr>
<tr>
<td>SF-36 physical role function</td>
<td>69.23</td>
<td>25.96</td>
<td>78.13</td>
</tr>
<tr>
<td>SF-36 emotional role function</td>
<td>76.92</td>
<td>26.92</td>
<td>86.11</td>
</tr>
<tr>
<td>SF-36 social role function</td>
<td>81.41</td>
<td>12.82</td>
<td>89.58</td>
</tr>
<tr>
<td>SF-36 bodily pain</td>
<td>72.51</td>
<td>−8.51</td>
<td>78.38</td>
</tr>
<tr>
<td>SF-36 general health</td>
<td>68.85</td>
<td></td>
<td>67.13</td>
</tr>
<tr>
<td>SF-36 reported health transition</td>
<td>2.10</td>
<td></td>
<td>2.04</td>
</tr>
<tr>
<td>Symptom checklist—frequency</td>
<td>12.61</td>
<td>4.30</td>
<td>10.71</td>
</tr>
<tr>
<td>Symptom checklist—severity</td>
<td>10.89</td>
<td>8.13</td>
<td>9.82</td>
</tr>
</tbody>
</table>

SF-36 is the Medical Outcomes Study Short-Form Health Survey. US Norm gives US normative population scores. Except for SF-36 reported health transition, scores are normalized to a scale ranging from 0 to 100, with the higher score representing better quality of life. For the SF-36 reported health transition, scores ranged from 1 to 5, with lower score corresponding to a feeling of much better health compared with period before ablation. Symptom Checklist—Frequency and Severity scores ranged from 0 to 64 and 0 to 48, respectively, with lower score representing better symptomatic status. Evolution scores are normalized to a scale ranging from −100 to 100 for SF-36 items and are coded from −16 to 16 for Symptom Checklist—Frequency, with lower values representing greater impairment. Follow-up duration was 27.2±8.8, 26.5±7.7, and 26.9±8.3 for group A, group B, and overall population, respectively.

### Table 3. Potential Predictive Factors for Subsequent AFib Episodes

<table>
<thead>
<tr>
<th></th>
<th>AFib+ (n=28)</th>
<th>AFib− (n=49)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>56±11</td>
<td>61±11</td>
<td>0.07</td>
</tr>
<tr>
<td>Sex, M/F</td>
<td>22/6</td>
<td>38/11</td>
<td>0.9</td>
</tr>
<tr>
<td>HD, n</td>
<td>12/28</td>
<td>30/49</td>
<td>0.12</td>
</tr>
<tr>
<td>LAD, mm</td>
<td>37±5</td>
<td>36±7</td>
<td>0.5</td>
</tr>
<tr>
<td>EF, %</td>
<td>65±9</td>
<td>61±13</td>
<td>0.25</td>
</tr>
<tr>
<td>AAD, n</td>
<td>2.4±1.3</td>
<td>2.2±1.2</td>
<td>0.47</td>
</tr>
<tr>
<td>History of AFib*</td>
<td>12 (42.8%)</td>
<td>17 (34.7%)</td>
<td>0.47</td>
</tr>
<tr>
<td>Inducible AFib†</td>
<td>6/14 (42.8%)</td>
<td>5/23 (21.7%)</td>
<td>0.17</td>
</tr>
</tbody>
</table>

**Abbreviations as in Table 1.**

*Before ablation.
†During control electrophysiological study (n=37 because 3 patients were lost to follow-up). Results are from univariate analysis in the follow-up population of 77 patients.
in all patients and continuation of oral anticoagulation for 3 months in patients with previous AFib episodes. In the absence of AFib recurrence at the end of this period, oral anticoagulation may be stopped.

Study Limitations
Several limitations of this study should be mentioned. Because patients were followed mainly by their referring cardiologists, it was not always possible to control the prescription of drugs, especially antiarrhythmic medications. In slowing ventricular response during atrial arrhythmia, initialization of β-blockers or calcium inhibitors may have rendered patients asymptomatic. Fifty percent of the AFib episodes were documented in patients without palpitations, which was in accordance with the study of Page et al. Possible asymptomatic AFib episodes could have led us to underestimate the true incidence of AFib during follow-up. For the same reason, creation of 2 groups of patients according to documentation of AFib before ablation may actually be theoretical, and this may explain the roughly similar late outcomes in the 2 groups. We used a retrospective method to appreciate the evolution of arrhythmia-related symptoms and quality of life at late follow-up. A prospective evaluation, as in the Bubern et al19 study, would probably have been more appropriate.

Conclusions
Although a significant number of patients still complain of palpitations after catheter ablation of common AFI, only 1 had clinical recurrence of common AFI. It is further confirmed that CBIB is a criterion for long-term success. Palpitations were due to AFib episodes in most patients, even those in whom common AFI was the only documented arrhythmia. Although a fairly high incidence of AFib was found during follow-up, ablation at the IVC-TR isthmus seems to be able to suppress all atrial arrhythmia in a subset of patients suffering from both AFI and AFib. Late occurrence of AFib episodes remains a therapeutic challenge for physicians. Nonetheless, this study has demonstrated the long-term clinical benefit of catheter ablation of common AFI because the patient population enjoyed a clear improvement in functional status.

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