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Electrophysiology

Prospective Randomized Comparison of Antiarrhythmic Therapy Versus First-Line Radiofrequency Ablation in Patients With Atrial Flutter

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BACKGROUND Despite the high success rate of radiofrequency (RF) ablation, pharmacologic therapy is still considered the standard initial therapeutic approach for atrial flutter.

OBJECTIVE We prospectively compared the outcome at follow-up of patients with atrial flutter randomly assigned to drug therapy or RF ablation.

METHODS Patients with at least two episodes of symptomatic atrial flutter in the last four months were randomized to regimens of either antiarrhythmic drug therapy or first-line RF ablation. After institution of therapy, end points included recurrence of atrial flutter, rehospitalization and quality of life.

RESULTS A total of 61 patients entered the study, 30 of whom were randomized to drug therapy and 31 to RF ablation. After a mean follow-up of 21 ± 11 months, 11 of 30 (36%) patients receiving drugs were in sinus rhythm, versus 25 of 31 (80%) patients who underwent RF ablation ($p < 0.01$). Of the patients receiving drugs, 63% required one or more rehospitalizations, whereas post-RF ablation, only 22% of patients were rehospitalized ($p < 0.01$). Following RF ablation, 29% of patients developed atrial fibrillation which was seen in 53% of patients receiving medications ($p < 0.05$). Sense of well being (pre-RF 2.0 ± 0.3 vs. post-RF 3.8 ± 0.5, $p < 0.01$) and function in daily life (pre-RF 2.3 ± 0.4 vs. post-RF 3.6 ± 0.6, $p < 0.01$) improved after ablation, but did not change significantly in patients treated with drugs.

CONCLUSION In a selected group of patients with atrial flutter, RF ablation could be considered a first-line therapy due to the better success rate and impact on quality of life, the lower occurrence of atrial fibrillation and the lower need for rehospitalization at follow-up. (J Am Coll Cardiol 2000;35:1898–904) © 2000 by the American College of Cardiology

In the past few years, several investigations have elucidated the mechanism responsible for typical atrial flutter (1–6). This appears to depend on a macroreentrant circuit that includes, as a critical component, the right atrial tissue surrounded by the tricuspid annulus, the inferior vena cava and the coronary sinus with the eustachian valve and ridge. This isthmus of atrial muscle appears as an ideal target for ablation in view of the anatomic barriers and landmarks that are easy to identify and localize. Creation of a complete line of conduction block across either the tricuspid valve/eustachian ridge isthmus (7) or the tricuspid valve/inferior vena cava isthmus (8–15) has been shown to result in cure of this arrhythmia. Despite the high success rate of radiofrequency (RF) catheter ablation, however, pharmacologic therapy is still considered the standard initial therapeutic approach for atrial flutter. The objective of our study was to assess and compare the clinical efficacy of conventional drug therapy versus first-line catheter ablation to treat atrial flutter in a prospective randomized study.

METHODS

This was a multicenter prospective randomized study. Consecutive patients referred to each institution were considered eligible to enter the study if they had at least two symptomatic episodes of atrial flutter in the last four months. Exclusion criteria included the following; 1) prior evidence of atrial fibrillation (AF); 2) the presence of significant left atrial enlargement (≥4.5 cm); and 3) previous treatment with antiarrhythmic medications. Electrocardioversion or rate control therapy before entering the study was considered acceptable. Before entering the study, each patient signed an informed and written consent. The study population consisted of 61 patients. Of them, 42 were male and

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Abbreviations and Acronyms
AF = atrial fibrillation
AV = atrioventricular
RF = radiofrequency

19 were female. Their mean age was 66 ± 10 years and their mean ejection fraction was 49 ± 3%. After entering the study, each patient was randomized to either pharmacologic antiarrhythmic therapy or to first-line RF catheter ablation of atrial flutter. Antiarrhythmic drugs were chosen by the caring physician based on his or her preference. An effort was made to keep each patient in the same treatment groups for at least one year. Each investigator was required to attempt sinus rhythm maintenance with at least two drugs, including Amiodarone before resorting to rate control medications. Recurrence of AF during Amiodarone therapy was not considered a failure during the initial two months of treatment with this drug.

Every patient enrolled in the study was given anticoagulant therapy to maintain the international normalized ratio between 2 and 3. Following enrollment in the study, institution or change of antiarrhythmic therapy was performed on an outpatient basis unless hospitalization was required by the patient's symptoms. Quality of life and symptoms questionnaires were administered before institution of therapy, six and 12 months thereafter. The study end points were as follows: 1) recurrence of atrial flutter (any type of atrial flutter); 2) need for rehospitalization; and 3) quality of life and symptom scales.

Electrophysiologic study and radiofrequency catheter ablation. At the time of the study, all patients were sedated with intravenous fentanyl and midazolam. Multipolar catheters were placed in the coronary sinus, high right atrium and His bundle recording position. In patients with sinus rhythm at the time of the procedure, atrial flutter was induced by programmed atrial stimulation. Isoproterenol infusion was used when required for induction of atrial flutter. Atrial flutter mapping and verification of the underlying mechanism were performed according to standard criteria and techniques (4,5,12,16,17). Radiofrequency current was delivered to the tip electrode of the ablation catheter using either the EPT 1000 generator (EP Technology) or a Radionics RFG-3C generator (Radionics, Inc.). Radiofrequency catheter ablation was performed by creating linear lesion from the tricuspid annulus to the inferior vena cava using 4- and/or 8-mm tip electrode catheters advanced in the right atrium with a long 8F SRO Daig sheath. The 8-mm tip catheter was used by the investigators if with the 4-mm tip catheter adequate RF energy delivery could not be achieved due to immediate impedance rise even at low power setting. Radiofrequency ablation was continued until either no electrogram or consistent reduction of the electrograms amplitude of at least 90% was documented across the isthmus. Even when the continuity of the line of block was assessed and confirmed by comparing the sequence of activation before and after ablation during pacing from the coronary sinus, and the lateral low right atrium, ablation was continued until a uniformed reduction of the electrogram amplitude as previously described was observed and persisted for 1 h of observation. As part of the protocol, inducibility postablation was also assessed using extrastimulus testing and burst pacing down to the shortest cycle length allowing 1:1 capture. Assessment of the continuity of the line of block postablation was performed in 26 patients using either a halo catheter (Cordis-Webster, Inc.) (11 patients) or by placing a custom-made catheter for recording, pacing and defibrillation which consisted of eight distal electrodes advanced in the coronary sinus and eight proximal electrodes separated by a 9-cm gap (15 patients). The eight proximal electrodes were positioned along the mid-high posterolateral region of the right atrium anterior to the crista terminalis. In these 15 patients, the eight distal electrodes served as coronary sinus recording pairs. In the last three patients undergoing ablation in this study, bidirectional block across the isthmus was assessed using a nonfluoroscopic mapping system (Carto-Biosense, Inc.). Even in those cases, ablation was continued until electrogram amplitude reduction was achieved across the isthmus.

Quality of life and symptoms in activity scale questionnaire. An assessment of the patients quality of life before and after the procedure was performed using a questionnaire that included 16 items to evaluate the physical, social, economics and psychological impairment (Endicott, Quality of Life Enjoyment and Satisfaction Questionnaire) (18). Each item was scored on a scale from 1 to 5 from very poor to very good. Each patient was also asked to score selected symptoms on a scale from 1-absent, to 4-extremely severe or from 1-never, to 5-always. Quality of life and symptoms scores were obtained before the procedure, and six and 12 months after entering this study.

Follow-up. All patients undergoing catheter ablation had treatment with the medications used for rate control discontinued. All patients were followed up in the outpatient clinic at regular intervals. Patients were seen in the outpatient clinic at one, three, six and 12 months after the ablation procedures or after initiation of antiarrhythmic therapy. In addition, patients were advised to reach their electrophysiologist if any symptoms of palpitation or irregular heart beat occurred after institution of therapy or the ablation procedure. In case of recurrence of atrial flutter after ablation, the procedure was repeated. In case of recurrence of atrial flutter in patients treated with antiarrhythmic therapy, a different antiarrhythmic drug was initiated on an outpatient basis unless the patient required hospitalization because of severe symptoms. If patients experienced AF after entering the study, the arrhythmia was treated with medical therapy based on the preference of the

Table 1. Baseline Characteristics of the Two Patient Groups

	RF Ablation (n = 31)	Drug Therapy (n = 30)	p Value
Age (yr)	67 ± 8	66 ± 11	NS
Male gender	20	22	NS
Mean EF (%)	49.4 ± 5.1	49.6 ± 3.1	NS
Structural heart disease:			
Absent	16	17	
IHD	12	11	
IDC	2	1	
VD	1	—	
Other	—	1	
Paroxysmal atrial flutter (n)	1	2	NS
Persistent atrial flutter (n)	30	28	NS
Median episodes per month of atrial flutter (range)	1 (0–3)	1 (0–2)	NS
Mean No. of cardioversions before entering the study	2.3 ± 0.5	2.2 ± 0.5	NS
Mean No. of cardioversions after entering the study	0.5 ± 1.2	4.4 ± 1.7	< 0.01
Percentage of patients with atrial flutter recurrence after entering the study	6% (2)	93% (28)	< 0.01
Percentage of patients with atrial fibrillation after entering the study	29% (9)	60% (18)	< 0.05
Mean No. of arrhythmia episodes at follow-up	0.7 ± 1.4	5.1 ± 2.0	< 0.01
Percentage of patients requiring arrhythmia-related hospitalization at follow-up	22% (7)	63% (19)	< 0.01

EF = ejection fraction; IDC = idiopathic dilated cardiomyopathy; IHD = ischemic heart disease; RF = radiofrequency; VD = valvular disease.

caring electrophysiologist. The investigators were required to monitor patients by Holter or loop recordings at least at one, three and six months and in the presence of any symptoms of rapid or irregular heart beat.

Statistical analysis. Quality of life and activities scores were analyzed with the use of one-way analysis of variance to discern changes over time within the groups. Comparison between continuous variables was obtained by paired and unpaired Student's *t* test, as appropriate. Comparison between proportions was performed by the Fisher's exact test. A p value <0.05 was considered statistically significant.

RESULTS

Patient population. A total of 61 patients were enrolled in this study. Of them, 42 were male and 19 were female. The clinical characteristics between the two groups were not different. The mean age, gender distribution, mean ejection fraction, presence or absence of structural heart disease, frequency and type of arrhythmia before and after entry in the study are shown in Table 1.

Result of the catheter ablation procedure. Acute successful ablation was obtained in all 31 patients undergoing RF catheter ablation. In all patients, the ablation was initiated with a 4-mm tip electrode and concluded with an 8-mm tip electrode in five of them. Twenty-six of 31 patients had only isthmus-dependent atrial flutter. In the remaining five patients, an incisional atypical atrial flutter was induced or documented either as the only arrhythmia (in three patients) or in association with an isthmus-dependent flutter (in two patients). Of the incisional flutter, four were associated with a posterolateral scar from which a linear lesion was extended down to the inferior vena cava. In one patient with incisional flutter, the scar was identified in the septum and a lesion was made extending from the scar up to the superior vena cava and down to the eustachian valve.

Among the 26 patients undergoing verification of bidirectional block along the ablation line we observed the following: 1) that bidirectional block was present immediately following termination of atrial flutter by catheter ablation in 11 patients (42%); 2) that after demonstration of bidirectional block, additional lesions were required in four patients (15%) to satisfy the electrogram amplitude end

Table 2. Medications Administered in the Drug Therapy Group After Enrollment

Patient No.	Drug 1	Drug 2	Drug 3	Drug 4	Final Therapy
1	Sotal	Prop + Ver	Amio		Amio
2	Flecain + Aten	Sotal	Amio	Aten	Aten
3	Dig + Prop	Amio			Amio
4	Sotal	Prop + Ver	Amio	Ver + Dig	Ver + Dig
5	Prop + Aten				Prop + Aten
6	Flecain + Dig	Procain + Dig	Sotal	Amio	Amio
7	Procain + Dig	Prop + Dig	Amio	Ver + Dig	Ver + Dig
8	Sotal	Amio			Amio
9	Flecain + Aten	Sotal	Amio	Aten + Dig	Aten + Dig
10	Flecain + Dig	Procain + Dig			Procain + Dig
11	Procain + Dig	Flecain + Dig	Sotal	Amio	RF Abl
12	Amio	Quinid + Dig	Prop + Aten	Aten + Dig	Aten + Dig
13	Procain + Dig	Prop + Aten	Amio	Dilt + Dig	Dilt + Dig
14	Sotal	Prop + Ver	Amio	Metop	Metop
15	Sotal	Amio	Dilt + Dig		Dilt + Dig
16	Procain + Dig	Prop + Dig	Sotal	Amio	AV node Abl + PPM
17	Sotal	Flecain + Aten	Amio	Ver + Dig	Ver + Dig
18	Prop + Dig	Sotal	Flecain + Aten	Amio	Amio
19	Flecain + Aten	Sotal	Amio	Procain + Dig	Aten + Dig
20	Sotal	Prop + Dig	Amio	Ver + Dig	Ver + Dig
21	Sotal	Prop + Dig	Amio	Dig	Dig
22	Amio	Sotal	Prop + Aten		RF Abl
23	Procain + Dig				Procain + Dig
24	Amio	Sotal	Prop + Dig	Metop	Metop
25	Sotal	Prop + Aten	Procain + Dig	Amio	Amio
26	Quinid + Dig	Prop + Ver	Amio	Aten	Aten
27	Flecain + Dig	Sotal	Amio	Dilt + Dig	Dilt + Dig
28	Sotal	Prop + Aten	Amio		Amio
29	Amio	Prop + Aten	Sotal	Dig	Dig
30	Amio				Amio

Amio = amiodarone; Aten = atenolol; AV = atrioventricular; Dig = digoxin; Dilt = diltiazem; Flecain = flecainide; Metop = metoprolol; PPM = permanent pacemaker following AV node ablation; Procain = procainamide; Prop = propafenone; Quinid = quinidine; RF Abl = catheter ablation of atrial flutter; Sotal = sotalol; Ver = verapamil.

point; and 3) that uniform reduction of the electrogram amplitude across the isthmus was never associated with persistence of conduction throughout this region.

There was no occurrence of atrioventricular (AV) block or pericardial effusion in the ablation group. One patient experienced chest discomfort, that persisted for about two weeks after the procedure. Another patient had hematoma at the site of the venous puncture which, however, did not require any transfusion or specific intervention. At the end of the one-year follow-up considered for this study, two patients experienced recurrence of atrial flutter (6.4%) and they were both treated with repeat ablation. Nine patients experienced AF after successful catheter ablation of atrial flutter (29%). Of these nine patients, five were treated with antiarrhythmic drugs with long-term persistence of normal sinus rhythm. Three patients had sporadic episodes of self-terminating AF and were treated with rate-control drugs including diltiazem in two patients and metoprolol in one patient. One patient did not respond to antiarrhythmic drugs and because rate control was difficult to achieve with medication, he underwent AV node ablation and implantation of a single-chamber permanent pacemaker nine months after the initial ablation for atrial flutter.

Drug therapy group. The mean number of drugs initiated in this group of patients was 3.4 ± 1.1. The type of drugs administered in individual patients is shown in Table 2. At follow-up, 16 (53%) of these patients were treated with rate control drugs due to the inefficacy of active antiarrhythmics in maintenance of sinus rhythm. Of these 16 patients, 15 had both recurrence of atrial flutter and development of AF. The remaining patient had occurrence of AF that did not respond to medical management. At the time of the first arrhythmia recurrence, AF was observed in one patient, whereas all the remaining patients had atrial flutter. Two patients crossed over to atrial flutter ablation before the end of the first year of follow-up and one patient required AV node ablation and pacemaker due to the inability to maintain normal sinus rhythm and to achieve adequate rate control. In this patient, both atrial flutter and AF were observed. Of the remaining 11 patients, 8 were treated with amiodarone, 1 with propafenone and atenolol, and 2 with procainamide and digoxin. Of the 16 patients receiving rate

Table 3. Quality of Life and Symptoms Scores in the Drug Therapy Group

	Pretreatment	Posttreatment (6 mo)	Posttreatment (12 mo)	Overall p Value
Sense of well being	1.9 ± 0.4	2.0 ± 0.4	2.1 ± 0.3	NS
Function in daily life	2.1 ± 0.4	2.1 ± 0.3	2.3 ± 0.3	NS
Palpitation	3.2 ± 0.6*	2.0 ± 0.5	2.1 ± 0.7	< 0.05
SOB with exercise	3.4 ± 0.4	3.2 ± 0.4	3.0 ± 0.5	NS
Feeling weak	2.9 ± 0.3	3.0 ± 0.4	3.1 ± 0.4	NS
QOL total score	29 ± 3	28 ± 6	31 ± 5	NS

*$p < 0.001$. Pretreatment versus posttreatment 6 months and posttreatment 12 months. All other comparisons did not show statistical significance.
QOL = quality of life overall score; SOB = shortness of breath.

control drugs, 2 were treated with digoxin alone, 7 with diltiazem or verapamil combined with digoxin, 4 with beta-adrenergic blocking agents alone and 3 with a combination of beta-blocker and digoxin.

Quality of life and symptoms for assessment. The scores of the overall sense of well being and the most relevant symptoms before and after institution of drug therapy or catheter ablation are shown in Tables 3 and 4. In the patients randomized to drug therapy, with the exception of palpitation, there was no statistically significant change in all the variables presented. Differently, the patients treated with catheter ablation reported a significant improvement in their quality of life and symptoms scores.

Follow-up results. Besides the overall success rate and crossover previously mentioned, after a mean follow-up of 22 ± 11 months, 25 patients (80%) who underwent catheter ablation were in sinus rhythm without the need of active antiarrhythmic drugs, whereas only 11 (36%, $p < 0.01$) of those receiving antiarrhythmic therapy remained in sinus rhythm. At follow-up, AF was seen in 9 patients undergoing catheter ablation (29%) versus 18 of those receiving antiarrhythmic drug therapy (60%, $p < 0.05$). Eight of the nine patients (88%) experiencing AF following catheter ablation had this arrhythmia controlled by medical therapy. Differently, in the drug therapy group, only 1 of the 18 patients (6%) developing AF had this arrhythmia successfully managed with drugs.

During the follow-up period, hospitalization was required for occurrence of severely symptomatic arrhythmia in 7 patients (22%) undergoing catheter ablation and 19 (63%, $p < 0.01$) of those receiving medication. Among the patients treated with antiarrhythmic drugs, recurrence of atrial flutter was never associated with 1:1 AV conduction. At follow-up, the median number of Holter or loop monitorings was 5 (ranged from 3 to 10) in the drug therapy group and 3 (ranged from 3 to 7) in the ablation group.

DISCUSSION

Radiofrequency catheter ablation has revolutionized treatment for patients with supraventricular tachycardia involving either AV node reentry or AV reentry as the underlying mechanism. For these patients, catheter ablation has been proved to be a curative therapy with low rate of complications and may also represent a cost-effective approach as compared with a life-long medical treatment. However, for patients with atrial flutter, catheter ablation is considered an option only after drug therapy has failed. Although large prospective series assessing the efficacy of drug therapy only for atrial flutter are lacking in the literature, in general, is recognized that medical management of this atrial arrhythmia can be particularly difficult and may cause a higher risk of morbidity and mortality secondary to bradyproarrhythmia or tachyproarrhythmia. This is certainly more common in patients with associated heart disease, which is more frequently encountered in subjects with atrial flutter.

Table 4. Quality of Life and Symptoms Scores in the Catheter Ablation Group

	Preablation	Postablation (6 mo)	Postablation (12 mo)	Overall p Value
Sense of well being	2.0 ± 0.3*	3.9 ± 0.3	3.8 ± 0.5	< 0.01
Function in daily life	2.3 ± 0.4*	3.8 ± 0.5	3.6 ± 0.6	< 0.01
Palpitation	3.1 ± 0.6*	1.0 ± 0.4	1.0 ± 0.5	< 0.01
SOB with exercise	3.0 ± 0.4*	1.0 ± 0.5	1.2 ± 0.3	< 0.01
Feeling weak	2.9 ± 0.5*	0.8 ± 0.4	0.8 ± 0.5	< 0.01
QOL total score	30 ± 4†	59 ± 7	57 ± 6	< 0.001

*$p < 0.001$. Preablation versus postablation 6 months and postablation 12 months. †$p < 0.0001$. Preablation versus postablation 6 months and postablation 12 months. Postablation 6 months versus postablation 12 months, p = NS.
QOL = quality of life overall score; SOB = shortness of breath.

Background. In the past few years, our understanding of the electrophysiologic and anatomic substrate of atrial flutter has grown considerably and has led to the implementation of effective ablative therapies (1–17). Once corridors of slow conduction are identified, either in the isthmus between the tricuspid annulus and the eustachian ridge or between a surgical scar and other right atrial anatomic boundaries, creation of linear lesions by RF catheter ablation has been proved to be effective and safe (7–17). It is therefore reasonable to consider this approach an alternative to standard medical therapy. However, prospective studies are lacking to support early catheter ablation for the treatment of atrial flutter.

Study findings. The present investigation provides data that justified catheter ablation of atrial flutter as a first-line approach as compared with active antiarrhythmic medications. In our series, atrial flutter ablation was not only more effective in the long-term management of this arrhythmia, but also required less rehospitalizations; it was also associated with lower occurrence of atrial fibrillation during the follow-up.

It is also important to recognize that most patients treated with antiarrhythmic therapy did not perceive their quality of life and symptoms positively impacted by this intervention. However, catheter ablation by providing a cure for more patients was associated with a significant improvement of all the variables assessed.

Technical issues. Interestingly, the recurrence rate observed in our series is either lower or similar than what was previously reported (1,7,9,13–17). This could reflect our ablation approach, which was targeted to eliminate electrograms in the isthmus region by performing ablation with an 8-mm tip electrode in nearly all the patients. However, procedures in which the continuity of the line of block was assessed by demonstration of complete bidirectional conduction block across the right atrial isthmus following the procedure were associated with a recurrence rate similar to our series (3,10,11,19,20). It is possible that our extensive ablation may have resulted in a higher likelihood of achieving continuous and persistent bidirectional block. However, in a preliminary report by Tomassoni et al. (21), continuous and bidirectional conduction block across linear lesions with intentional gaps has been demonstrated in the acute setting by high density electrical mapping. Similarly, Tomassoni et al. (21) and other investigators (22) observed that the best predictor of contiguous and transmural lesions was the attenuation of the electrogram amplitude. This may argue against more limited ablation procedures and may explain the overall good success rate achieved in our series despite sophisticated techniques to assess complete bidirectional block after ablations were not performed consistently.

Clinical implications. Several studies have reported a significant occurrence of AF after ablation of type I atrial flutter (14,19,23–25). Although clinical characteristics were recognized as predictors of the occurrence of this arrhythmia after catheter ablation, the frequency of onset of AF following the procedure raised concerns about the potential proarrhythmic effect of the procedure itself. Our study, while confirming the occurrence of AF in a significant number of patients following ablation, appeared to exclude proarrhythmic effects of this procedure. In fact, atrial fibrillation occurred more frequently in the group of patients treated with antiarrhythmic therapy. This finding has two important implications: 1) in some of these patients, AF may reflect the existence of an altered electrical substrate that is not the result of the ablation procedure and does not reflect the delayed effect of discontinuation of suppressive antiarrhythmic therapy previously used; and 2) the ineffective prevention of atrial flutter by antiarrhythmic therapy may potentiate an unfavorable electrical remodeling of the atrium which, in turn, could facilitate degeneration to AF at follow-up, as demonstrated in our series. Considering the significant morbidity and mortality associated with the presence of AF, this observation represents an additional argument to support catheter ablation as a first-line approach in the treatment of atrial flutter.

Finally, although our series is not sufficiently powered to provide strong statistical evidence, AF after catheter ablation of atrial flutter appeared easier to control with medical management.

In our study, initiation or change of medical therapy was performed on an outpatient basis. Despite this practice, hospitalization was required due to significant symptoms associated with recurrence of tachyarrhythmias in a larger proportion of patients treated with antiarrhythmic therapy. Therefore, it is possible that antiarrhythmics also have the potential to increase the overall cost of this treatment approach. In addition, one must consider that most of our patients were ultimately treated with amiodarone which, over time, may be associated with a significant incidence of side effects; this was not observed in our series probably due to the short study follow-up. This certainly represents a concern that must be weighed when proposing treatment options to patients with atrial flutter.

CONCLUSION

In this prospective randomized study, catheter ablation of atrial flutter in a selected group of patients with normal or mildly enlarged left atrial size appeared to be associated with a higher likelihood of persistence of sinus rhythm, a significant improvement of quality of life and symptoms scores, a lower occurrence of AF and less need for rehospitalization at follow-up. In view of the low efficacy and the higher persistence of atrial flutter and AF observed with conventional medical management, catheter ablation could be considered a first-line therapy for atrial flutter, at least in patients with clinical characteristics similar to those of the subjects entered in this study. Whether our findings can be extended to the overall patient population with atrial flutter

is likely, but it requires further investigations. In addition, this study was designed to assess the efficacy of catheter ablation versus antiarrhythmic therapy in preventing reoccurrence of atrial flutter. Whether maintenance of sinus rhythm has any impact on mortality as compared with rate control therapy is not clear at this point.

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