Clin Res Cardiol 96:794–802 (2007)
DOI 10.1007/s00392-007-0559-z

ORIGINAL PAPER

A. Meissner
M. Christ
P. Maagh
R. Borchard
M. v. Bracht
I. Wickenbrock
H.-J. Trappe
G. Plehn

Quality of life and occurrence of atrial fibrillation in long-term follow-up of common type atrial flutter ablation:

Ablation with irrigated 5 mm tip and conventional 8 mm tip electrodes

Received: 18 March 2007
Accepted: 31 May 2007
Published online: 31 August 2007

Dr. med. Axel Meissner (✉)
Martin Christ · Petra Maagh
Rolf Borchard · Marc van Bracht
Ingo Wickenbrock · Hans-Joachim Trappe
Gunnar Plehn
Medizinische Klinik II
Schwerpunkte Kardiologie und Angiologie
Ruhr-Universität Bochum
Hölkeskampring 40
44625 Herne, Germany
Tel.: +49-2323/499-1600
Fax: +49-2323/499-301
E-Mail: axel.meissner@ruhr-universitaet-bochum.de

Abstract *Objectives* The ablation of common type atrial flutter is mainly performed by two approved techniques, whose efficacy and outcome in terms of quality of life have not been evaluated so far in a long-term follow-up study over years. A high proportion of patients suffer from coexistent atrial fibrillation, which may worsen the ablation result. The question arises whether one technique is more effective than the other when immediate ablation results, the occurrence of atrial fibrillation and the quality of life are compared. Considering these facts, it is reasonable to think about new ablation strategies for common type atrial flutter in the era of new concepts in catheter ablation of atrial fibrillation. *Methods* In a retrospective study we evaluated a detailed questionnaire in 132 patients who underwent ablation of common type between 1999 and 2004. Radiofrequency ablation was performed irrespective of coexistent atrial fibrillation either with an irrigated tip or the 8 mm tip electrode. Acute and long-term ablation outcome, and the associated quality of life, pre-, under- and post-ablation was compared in the two different ablation groups. Recurrent tachycardia were re-evaluated by 12 lead ECG analysis and assessed for both ablation groups. *Results* 88 (67%) of the 132 patients contacted answered the questionnaire polling the perceived benefits of the procedure. Of the other 44 patients (33%); 4 (3%) had died, 7 (5.3%) had moved, 33 patients (25%) could not be included due to missing or incoherent answers. Independent of the ablation technique there was a high acute and long-term ablation success rate at about 95%. After a mean of 3 years of follow-up this benefit persists in spite of a high proportion of recurrent tachycardia, mainly atrial fibrillation (55/88 patients, 59.1%). Despite the occurrence of secondary tachycardia, there was a high significant long-term symptomatic benefit in the state of healthy and daily practice work, evaluated with a p-value of < 0.0005. The frequency of episodes and the symptom "tachycardia" were significantly reduced after effective ablation of common type atrial flutter, p-values of 0.003 and 0.002, respectively.

Therefore the need for hospitalization was significant reduced ($p = 0.001$). Comparison of both approaches revealed that there was no significant difference related to the incidence and occurrence of atrial fibrillation. *Conclusions* The two mainly accepted and applied techniques for the ablation of common type atrial flutter show an excellent outcome

under the aspect of ablation efficacy and quality of life in long-term follow-up. Three years after the ablation procedure the majority of patients consider the intervention beneficial. Despite the relatively high appearance of atrial fibrillation in the long-term follow-up this effect is still traceable.

Key words atrial flutter – atrial fibrillation – quality of life – catheter ablation

Introduction

Radiofrequency catheter ablation targeting the isthmus between the tricuspid annulus and the inferior vena cava is a well-established treatment for typical atrial flutter and its primary success rate is more than 90%. With an incidence of 88/100 000 person-years in the US [8], this highly effective and safe treatment has become the standard treatment for recurrent atrial flutter, which is difficult to treat medically and due to its recurrence rate.

Patients with atrial flutter often present symptoms of palpitations, dyspnea, fatigue, chest pain or worsening heart failure. Under special circumstances of antiarrhythmic drug therapy one-to-one atrioventricular (AV) conduction may occur in patients during exercise which may be associated with life-threatening symptoms.

Despite the high immediate and long-term follow-up success rate of atrial flutter catheter ablation many patients, sooner or later suffered from new palpitations and secondary arrhythmias, first of all the occurrence of post-ablation atrial fibrillation (AF). After successful atrial flutter catheter ablation, recent reports have shown an incidence of 12 to 63% of AF in long-term follow-up [3, 7, 11, 12, 16].

In consideration of new upcoming ablation technologies of AF it will be of value to think about new ablation strategies at least if these patients show episodes of atrial fibrillation prior to the isthmus ablation of common type atrial flutter. Repeated treatments of potentially curable supraventricular tachycardia (SVT) can be avoided [10, 17].

Methods

Study population

All 132 patients (27 female; 105 male; age 64.3 ± 9.5 years) who had a radiofrequency catheter ablation of typical (common type) atrial flutter at the Department of Cardiology, University Hospital Bochum between 1999 and 2004 were contacted and asked to complete a detailed questionnaire. This questionnaire was a modified and simplified version of the SF-36 Health Survey questionnaire and the Symptom Checklist – Frequency and Severity Scale in order to translate the various domains and components of well being into a quantitative value. Overall 102 (77%) of all contacted patients returned the enclosed questionnaire, the other 30 (23%) patients who did not answer, had moved or died. Fourteen patients gave incomplete or incoherent answers and had to be excluded from the study. Basic clinical characteristics of the 88 (67%) patients included are shown in Table 1. Patients suffering from new palpitations and SVT's were contacted a second time to demonstrate a 12-lead ECG to verify the underlying arrhythmia.

Electrophysiological study and radiofrequency catheter ablation

All patients demonstrating a typical isthmus-dependent circuit with a counter clockwise or clockwise activation sequence around the tricuspid annulus,

Table 1 Baseline patient characteristics and procedural ablation data

Variables	N	Mean	SDA	Min	25th Percentile	Median	75th Percentile	Max
Age (years)	88	64.2	9.2	41.0	58.5	64.0	71.0	81
AF – since months	86	73.9	71.7	14	32.0	52.0	77.0	305.0
AF – since years	86	6.2	6.0	1.2	2.7	4.3	6.4	25.4
RF applications	88	14.22	9.07	0.00	8.00	11.00	20.00	46.00
Ablation technique								
irrigated	55	14.42	9.16	4.00	8.00	11.00	18.00	46.00
8 mm tip	33	13.88	9.05	0.00	7.00	11.00	20.00	40.00

documented in a 12-lead ECG pattern were included in this study. The ablation itself was performed either under continuing atrial flutter or in sinus rhythm after spontaneous or electrical conversion in highly symptomatic patients. The procedure was done only by anatomical and/or electrophysiological orientation, venograms of the vena cava inferior, the inferior right atrium or the coronary sinus like in previous studies processed were not performed.

In all patients a deflectable "halo" catheter with 20 electrodes (Life wire, St.-Jude Medical, CA, USA) was adjusted at an appropriate position to record electrograms of the roof, high right atrium, the right atrial lateral wall and the low right atrial isthmus simultaneously. A decapolar deflectable catheter (Biosense Webster Inc., CA, USA) was inserted into the coronary sinus. Baseline pacing before ablation demonstrated the effective conduction along the isthmus while pacing from the distal halo catheter to the proximal coronary sinus catheter and vice versa. The conduction time and dispersion for each stimulation procedure was determined.

Radiofrequency ablation technique

The ablation itself was carried out either by irrigated tip catheter ablation with a 5 mm tip catheter (Biosense Webster Inc., CA, USA) or a conventional 8 mm tip ablation catheter (Biosense Webster Inc., CA, USA) which were introduced in a long preshaped AR3 sheath (St.-Jude Medical Inc., MA, USA) providing optimal tissue contact while ablation. The preset duration of each radiofrequency pulse was 60 s for the irrigated tip catheter and 120 s for the 8 mm conventional tip catheter. The targeted power output for the irrigated tip catheter was 45–50 W with a target temperature of 42–45 °C; for the 8 mm tip catheter we applied 60–70 W and a target temperature of 60 °C.

We performed point to point application of radiofrequency energy during pullback of the ablation catheter from the right ventricle toward the inferior vena cava to create a linear lesion of the inferior vena cava-tricuspid-annulus isthmus. To stay on the line we analyzed exclusively anatomical and electrophysiological orientation data and worked using the biplane technique, right anterior oblique 30°, left anterior oblique 50°. Successful ablation was defined as achievement of bidirectional isthmus conduction block with suitable prolongation of the conduction time. In addition we were looking for double potentials with a minimum interval of 90 ms along the ablation line. These endpoints were reevaluated after a waiting period of at least 20 min.

Anticoagulation treatment after catheter ablation

All patients received an anticoagulation treatment with phenprocoumon and a target INR of 2–3 after the catheter ablation for at least 4 to 6 weeks. Patients with documented AF prior to the ablation continued the anticoagulation for a lifelong therapy. Patients with atrial flutter only and documented sinus rhythm after the initial anticoagulation treatment stopped the therapy. Patients with recurrent arrhythmias were individually treated, dependent on the underlying arrhythmia.

Statistical analysis

For the description of the metric variables the results are expressed as number, mean, standard deviation (SDA) and extreme (minimum and maximum), and median. The 95% confidential interval is described by Person-Clopper. The analysis of the time to recurrence was done by Kaplan-Meier.

The comparison of the distribution of the categorical variables before and after ablation concerning two variables was expressed by the McNemar test. With the Chi-squared distribution, we compared more than two variables.

The Mann Whitney U Test was applied for the comparison of the two ablation techniques.

Results

Study population

Our study comprised 132 patients with common type atrial flutter treated with irrigated 5 mm tip electrode or the conventional 8 mm tip electrode. The follow-up period was 36 ± 17 months. Treatment decision and therapeutic approach were independent from atrial fibrillation burden prior to radiofrequency ablation.

A total of 88 patients (67%) answered the questionnaire completely, of the other 44 patients (33%) four patients (3%) had died of a co-morbid illness and seven (5.3%) had moved. Of the remaining 33 patients (25%) not included into the study, 19 patients did not answer (58%), 14 patients had to be excluded (42%) because of incomplete or incoherent answers. The answers to the questionnaire were dependent on the year of the ablation. While 45% of the patients with ablation in the year 1999 answered, more than 86% of the patients with ablation in the year 2004 answered the questionnaire. There was a continuous increasing number of patients answering

to the questionnaire from the year 1999 to 2004. The baseline characteristics of the included patients are shown in Table 1.

Ablation procedure

The 88 patients studied suffered from atrial flutter for a mean of 6.2 ± 6.0 years prior to the ablation procedure. Most of the patients (68/88–77.3%) were in sinus rhythm on the day of ablation, the remaining 20 patients (22.7%) had predominantly persistent common type atrial flutter, whereas four patients (4.7%) showed mainly atrial fibrillation. The latter group was converted into sinus rhythm prior to the ablation by biphasic DC shock. The other patients with persistent common type atrial flutter were ablated under continuing atrial flutter and sinus rhythm was restored by DC shock only if the first isthmus line failed to interrupt the arrhythmia.

In 55 (62.5%) patients ablation was performed with the 5 mm irrigated tip electrode and 33 (37.5%) underwent the procedure with the 8 mm tip electrode. The Mann Whitney U test showed that there was no significant difference in the number of ablation procedures per year in each study group (1999 to 2004, p = 0.698).

Regarding all patients, bidirectional block could be achieved in 84 patients (95.5%), in four patients (4.6%) unidirectional block or no isthmus block was processed. For this latter group and four of the patients with bidirectional block, thus 8 patients (9.2%) in total, more than one isthmus ablation line was completed in the ablation procedure. No differences were found between the two ablation techniques relating to a second or third ablation line (p = 1). The acute success rate did not depend on the ablation strategy, bidirectional conduction block was achieved in 52 of 55 (94.6%) patients with irrigated ablation and in 32 of 33 (97.0%) applying the 8 mm tip ablation group (p-value = 1).

The other variables like re-induction of a tachycardia post intervention, atrial fibrillation prior to ablation and or at the day of intervention, as well as patients with persistent atrial flutter prior to the treatment showed no significant differences between the two ablation groups (Table 2).

The Mann Whitney U Test showed no differences in the number of radiofrequency ablation applications, 14.2 ± 9.1 for all patients, 14.4 ± 9.2 in the irrigated tip group and 13.9 ± 9.1 in the 8 mm tip electrode group (p = 0.976). There was a wide variation of necessity of radiofrequency applications, ranging from 4 to 46 burns in both groups without significant difference (Table 1).

Questionnaire in long- term follow-up

Applying a modified version of the SF-36 Health Survey questionnaire and the Symptom Checklist – Frequency and Severity Scale the patients had to estimate the ablation procedure itself using a ranking scale from 1 to 6: extremely, very strong, strong, moderate, low, none (Table 3). Most of the patients confirmed that the physical (75.9%) and emotional (77.3%) load of the ablation procedure, independently of conventional ablation or irrigated tip ablation, was moderate or below. This circumstance is expressed by 66/88 patients (75%) who would agree to a re-ablation procedure if necessary. Relating to the intervention, independent of the ablation technique used, for almost two-thirds of the patients (63.8%) the result of the ablation is good or better, while for 75.5% well-being is even good or better (Table 3).

Table 2 Comparison of the categorical variables of the two ablation techniques

Variables	Value	Irrigated		8 mm tip		
		Number	%	Number	%	p-value
Bidirectional block	yes	52	94.6	32	97.0	1
	no	3	5.5	1	3.0	
Bidirectional block, no reinduction	yes	50	90.9	29	87.9	0.723
	no	5	9.1	4	3.0	
Atrial fibrillation in history	yes	7	12.7	5	15.2	0.757
	no	48	87.3	28	84.9	
Atrial flutter while ablation	yes	12	21.8	8	24.2	0.798
	no	43	78.2	25	75.8	
	missing			2		
Atrial fibrillation while ablation	yes	1	1.8	3	9.7	0.131
	no	54	98.2	28	90.3	

Table 3 Relative frequency of the categorical variables for the evaluation of the ablation procedure (p-value [a] = calculated with the exact test of Fisher)

Variables	Value	Irrigated		8 mm tip		
		Number	%	Number	%	p-value [a]
Physical exposure	missing	3		2		0.750
	extremely	3	5.8	2	6.5	
	very strong	1	1.9	2	6.5	
	strong	7	13.5	5	16.1	
	moderate	15	28.9	10	32.3	
	low	11	21.2	7	22.6	
	none	15	28.9	5	16.1	
Mental exposure	missing	2		2		0.276
	extremely			1	3.2	
	very strong	4	7.6	4	12.9	
	strong	6	11.3	4	12.9	
	moderate	14	26.4	3	9.7	
	low	16	30.2	13	41.9	
	none	13	28.9	6	19.4	
Content with the result of the ablation	missing	6		2		0.574
	extremely	8	16.3	3	9.7	
	very strong	9	18.4	9	29.0	
	strong	15	30.6	7	22.6	
	moderate	6	12.2	7	22.6	
	low	1	2.0			
	none	10	20.4	5	16.1	
Evaluation of the state of health	missing	2				0.477
	very good	7	13.2	8	24.2	
	good	20	37.7	10	30.2	
	moderate	14	26.4	6	18.2	
	low	8	15.1	4	12.1	
	very low	4	7.6	5	15.2	
Would you agree to a re-ablation?	yes	41	74.6	25	75.8	1
	no	14	25.5	8	24.2	
Duration/intensity of the recurrent tachycardia	missing	29		11		0.916
	less	17	65.4	15	68.2	
	equal	5	19.2	3	13.6	
	more	4	15.4	4	18.2	

In comparison of the subjective well-being and state of health before and after the ablation procedure in long-term follow-up, applying the Chi-squared distribution, there was a high significant improvement ($p < 0.0005$) despite the ablation technique deployed.

Recurrent tachycardia

As described above, all patients suffering from new palpitations and or recurrent tachycardia were re-evaluated in our study, and a 12-lead ECG was requested. 52 (59.1%) of the 88 studied patients reported about recurrent arrhythmias at follow-up, the 95% confidence interval corresponding to Person-Clopper was 48.1%; 69.5% (Fig. 1).

The medium time interval from therapy to a recurrent tachycardia in all patients was 48.8 months (Kaplan-Meier estimate), the 95%-confidential time interval was 43.1 months to 54.55 months. According to the statistical analysis of the Kaplan-Meier estimation, it is presumable that after 7–8 years only a very small proportion of initially effective ablated patients are free from a recurrent arrhythmia (Fig. 1).

The evaluation of the requested ECG's demonstrated that the majority of 38/52 patients (73.1%) suffered from atrial fibrillation, whereas 2/52 patients (3.8%) demonstrated a left atrial tachycardia, the remainder 12/52 patients (23.06%) showed 12-lead ECG pattern of atrial flutter, 9 patients (17.3%) showed atypical, non-isthmus dependent atrial flutter, while 3 patients (5.7%) patients had typical atrial

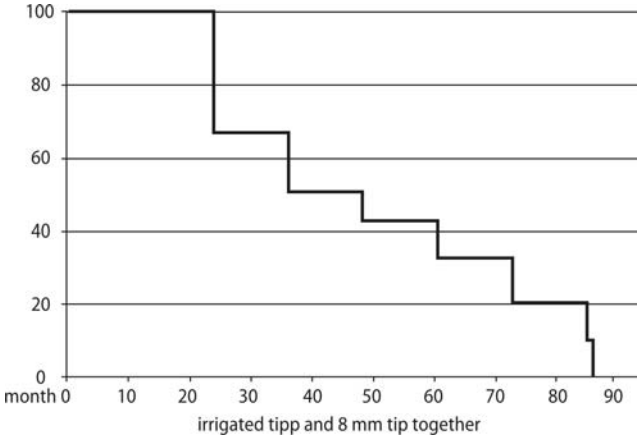

Fig. 1 Long-term follow-up after ablation of atrial flutter (Kaplan-Meier evaluation, time interval to recurrence)

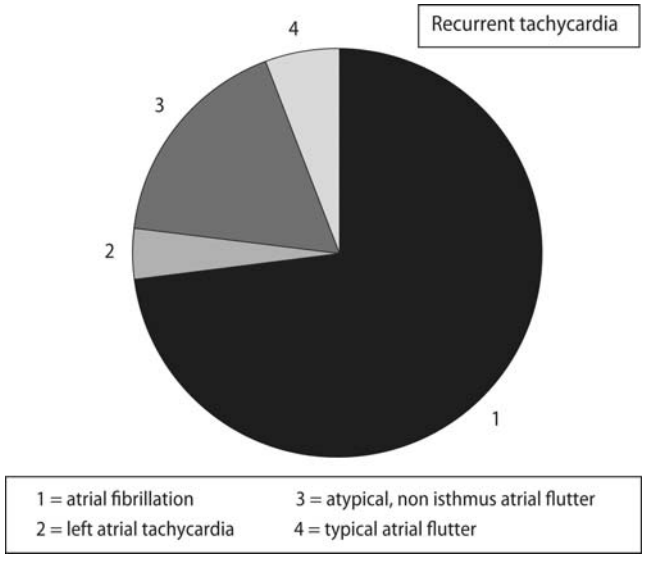

Fig. 2 Allocation of recurrent tachycardia (1 = atrial fibrillation, 2 = left atrial tachycardia, 3 = atypical, non isthmus atrial flutter, 4 = typical atrial flutter)

flutter, corresponding to the initially 5% of basic failures (Fig. 2).

Regarding the two different ablation groups, in the irrigated ablation group 29/55 patients (59.1%) presented a recurrent tachycardia, the 95%-confidential interval was 38.8%; 66.3%. The medium estimated time interval was 59 months (Kaplan-Meier estimate, 95%-confidential time interval 37.8%; 80.3% month).

In the conventional 8 mm tip electrode group, 29/33 patients (69.7%) presented a new tachycardia, the 95%-confidential interval was 35.3%; 84.4%. The medium estimated time interval was 35 month (Kaplan-Meier estimate, 95%-confidential time interval 26.6%; 45.4% month.

Quality of life

We studied the shift in quality of life in the 52/88 patients presenting with a new arrhythmia post ablation, predominantly atrial fibrillation, in long-term follow-up. The results from this investigation are summarized in Table 4.

Despite the change from one tachycardia to another there was a high significant long-term symptomatic benefit in state of alteration in every day life (daily practice work), evaluated with a p-value of < 0.0005. The quantity of episodes and the symptom "tachycardia" were significantly reduced after effective ablation of common type atrial flutter, p-values of 0.003 and 0.002, respectively. In contrast to these results quantity and duration of episodes, the symptoms palpitation, dyspnea, anxiety, eye fibrillation, reduction of ability, angina pectoris and chest pain were not significantly modified.

Following the classification of Vaugham Williams of antiarrhythmic drugs we found in the drug treated patients a significant ($p = 0.001$) increase in the antiarrhythmic drug-group II, the β-blockers post-ablation, whereas there was no significant change in medication behavior concerning the groups I, III and IV.

Pre-ablation 31% of the medically treated patients received β-blockers, 69% did not. In the long-term post-ablation period this relationship changed to nearly 66% of patients treated with β-blockers and 34% not treated with β-blockers.

Discussion

Our retrospective analysis of life quality in patients after atrial flutter ablation revealed a substantial symptomatic benefit for as long as 36 ± 17 months. To the best of our knowledge this is the first study which describes the effect irrespective of the ablation technique used, either irrigated ablation or conventional 8 mm tip electrode.

The relatively high number of patients lost in long-term follow-up, 102 of the 132 patients answered the questionnaire, whereby 88 were complete and could thus be studied, is in concordance with other groups [1, 2]. This matter of fact is mainly explained by the long time interval between the procedure and the questionnaire, so that a high number of patients could not remember the symptoms in detail. The answers to the questionnaire were therefore dependent on the year of the ablation with a continuously increasing number of patients answering to the questionnaire from the years 1999 to 2004.

Table 4 Comparison of the patients symptoms and quality of life with recurrent tachycardia pre- to post-ablation

Variables	V-Value	Pre-ablation		Post-ablation		
		Number	%	Number	%	p-value
Quantity of episodes	1×/day	11	23.9	8	17.4	0.003
	1–3×/week	21	45.7	6	13.0	
	1×/month	5	10.9	10	21.7	
	Rare events	9	19.6	22	47.8	
Duration of episodes	< 1 h	16	33.3	21	43.8	0.536
	< 12 h	17	35.4	8	16.7	
	< 1d	6	12.5	14	29.2	
	longer	9	18.8	5	10.4	
Symptom: tachycardia	Yes	42	84	30	60	0.002
	no	8	16	20	40	
Symptom: palpitation	Yes	24	49.0	29	59.2	0.359
	no	25	51.0	20	40.8	
Symptom: dyspnea	Yes	21	42.9	31	63.3	0.453
	no	28	57.1	18	36.7	
Symptom: anxiety	Yes	20	40.0	14	28.0	0.146
	no	30	60.0	36	72.0	
Symptom: eye fibrillation	Yes	11	22.5	9	18.4	0.688
	no	38	77.6	40	81.6	
Symptom: reduction of ability	Yes	29	58.0	31	62.0	0.754
	no	21	42.0	19	38.0	
Symptom: none	Yes	0	0	5	10.2	0.064
	no	49	100	44	89.8	
Symptom: angina pectoris and pain in the thorax	Yes	28	57.1	21	42.9	0.118
	no	21	42.9	28	57.1	
Symptom: other	Yes	2	4.0	6	12.0	0.289
	no	48	42.9	44	57.1	
Alteration in every day life	Extreme	3	6.0	1	2.0	< 0.0005
	Very heavy	12	24.0	2	4.0	
	Heavy	26	52.0	5	10.0	
	Moderate	8	16.0	32	64.0	
	Low			7	14.0	
	Very low	1	2.0	3	6.0	
Medication Therapy	Yes	38	79.2	31	64.6	0.064
	no	10	20.8	17	35.4	

In concordance with other series in which catheter ablation was performed with a high primary success rate and where bidirectional isthmus conduction block was the end point for ablation, we found a low rate of atrial flutter recurrence in our long-term follow-up [2–4, 7]. The few recurrences of typical common type atrial flutter are mainly explained by basic limitations of the ablation procedure with the inability to achieve bidirectional block. This effect was independent of the ablation technique and the procedural method applying a second or third ablation line.

No differences were found between the two ablation groups comparing the number of RF applications used to achieve bidirectional block, as demonstrated by the similar success rates. Quality of life assessed as the emotional and physical stress of the ablation procedure itself showed no significant difference between the two ablation groups. When considering the potential need for a re-ablation, the major portion of patients in both study groups would have given their consent. From this point of view, the results of the follow-up study were independent of the ablation technique used.

The relatively high incidence of secondary arrhythmias, the so-called "recurrences", were mainly related to the occurrence of atrial fibrillation in long-term follow-up as reported by other groups [1, 7, 18]. Despite the high incidence of atrial fibrilla-

tion, the majority of patients considered the intervention beneficial, because of a significant symptomatic improvement in daily practice work, a significant reduction of episodes which led to significant less symptomatic tachycardia and palpitations.

Different explanations may help us to understand these findings: First these results may reflect an overall better tolerance for atrial fibrillation than for atrial flutter, since atrial flutter often causes two-to-one conduction from the atrium to the ventricle. The ventricular rate therefore will constantly be fast at about 130 to 150 beats/min and an adequate rate control by medication is frequently more difficult to achieve in patients with atrial flutter than in atrial fibrillation. Therefore symptoms are often more intense during atrial flutter compared to atrial fibrillation. This may also be the reason for our observation that in our long-term follow-up study significant more β-blockers are required after the ablation procedure, which is the most reasonable for optimal rate control in post-ablative atrial fibrillation tachycardia.

Second, the reduction in symptomatic palpitations may also be due to a diminished burden of AF that was triggered by atrial flutter before ablation. Different authors have reported reductions in atrial fibrillation following atrial flutter ablation [9, 13, 18]. They believe that atrial flutter helps to maintain atrial fibrillation in a proportion of these patients, resulting in sustained atrial fibrillation; atrial flutter ablation may result in a normalization of atrial refractoriness and reversal of electrical remodelling, making atrial fibrillation burden less likely. The reverse effect of increasing atrial fibrillation after atrial flutter ablation with induction of bidirectional block is according to our data and different other groups not supported [1, 9, 11, 18].

Regarding the two ablation groups, the ablation with irrigated tip and the ablation with conventional 8 mm tip, we found similar data in both groups concerning the acute ablation procedure and results. There were slight differences in both groups in term of recurrent tachycardia, the quality of life pre and post ablation in long-term follow-up. The two ablation subgroups, however, were to small in our investigation to reply to these questions. It is conceivable that two different ablation techniques lead to different electrical remodelling making atrial fibrillation burden less likely or unlikely. Further investigations with much more patients should clarify the role of different ablation techniques under these circumstances.

Study limitations

The study of the subjective benefit of a procedure is a complex process. Different tools, such as the SF-36 Health Survey questionnaire and the Symptom Checklist – Frequency and Severity Scale – have been developed trying to translate the various domains and components of well-being into a quantitative value. We opted to assess the clinical, subjective benefit with a modified and simplified questionnaire. Although conclusions are clinically relevant, they do not provide quantitative assessment of quality of life.

The detailed statistical subgroup analysis is difficult for the two ablation techniques because of relatively small number of patients in each group. Furthermore some heterogeneity in the two ablation groups exists, regarding the ablation technique with different duration of burns. The decision which ablation technique was applied was casual, probably the learning curve may have favored one technique over the years. The data regarding the two ablation techniques should be interpreted under these circumstances and are therefore mainly based on the quality of live in long-term follow-up and not on the technical skills of ablation.

References

1. Anne W, Willems R, Adriaenssens B et al (2006) Long-term symptomatic benefit after radiofrequency catheter ablation for atrial flutter despite a high incidence of post-procedural atrial fibrillation. Acta Cardiol 61(I): 75–82
2. Anselme F, Saoudi N, Poty H et al (1999) Radiofrequency catheter ablation of common atrial flutter. Significance of palpitations and quality-of-life evaluation in patients with proven isthmus block. Circulation 99:534–540
3. Bernhardt P, Schmidt H, Sommer T et al (2006) Atrial fibrillation – Patients at high risk for cerebral embolism. Clin Res Cardiol 95:148–153
4. Bertaglia F, Zoppo F, Bonso A et al (2004) Long term follow up of radiofrequency catheter ablation of atrial flutter: clinical course and predictors of atrial fibrillation occurrence. Heart 90:59–63
5. Bielik H, Schrickel J, Shlevkov N et al (2005) Pharmacological and ablative hybrid therapy of atrial fibrillation. Long term effect on quality of life and arrhythmia-related symptoms. Z Kardiol 94:564–569
6. Calkins H, Canby R, Weiss R et al (2004) Results of catheter ablation of typical atrial flutter. Am J Cardiol 94: 437–442

7. Da Costa A, Romeyer C, Mourot S et al (2002) Factors associated with early fibrillation after ablation of common atrial flutter. A single center prospective study. Eur Heart J 23: 498–506
8. Granada J, Uribe W, Chyou PH et al (2000) Incidence and predictors of atrial flutter in the general population. J Am Coll Cardiol 36:2242–2246
9. Katritsis D, Iliodromitis E, Fragakis N et al (1996) Ablation therapy of type I atrial flutter may eradicate paroxysmal atrial fibrillation. Am J Cardiol 78:345–347
10. Kettering K, Greil G, Busch M et al (2006) Catheter ablation of atrial fibrillation: Ongoing atial fibrillation inside a single pulmonary vein after successful electrical disconnection and restoration of sinus rhythm in both atria. Clin Res Cardiol 95:663–667
11. Kleemann T, Becker T, Dönges K et al (2007) The prognostic impact of successful cardioversion of atrial fibrillation in patients with organic heart disease. Clin Res Cardiol 96: 103–108
12. Lee SH, Tai CT, Yu WH et al (1999) Effects of radiofrequency catheter ablation on quality of life in patients with atrial flutter. Am J Cardiol 84: 278–283
13. Movsowitz C, Callans DJ, Schartzmann D et al (1996) The results of atrial flutter ablation in patients with and without a history of atrial fibrillation. Am J Cardiol 78:93–96
14. Natale A, Newby KH, Pisano E et al (2000) Prospective randomized comparison of antiarrhythmic therapy versus first-line radiofrequency ablation in patients with atrial flutter. J Am Coll Cardiol 35:1898–1904
15. O'Callaghan PA, Meara M, Kongsgaard E et al (2001) Symptomatic improvement after radiofrequency catheter ablation for typical atrial flutter. Heart 86:167–171
16. Ricci RP, Russound M, Santini M (2006) Management of atrial fibrillation. What are the possibilities of early detection with home monitoring. Clin Res Cardiol 95:10–16
17. Strohmer B, Schernthanerund C, Pichler M (2006) Simultaneous angiographic imaging of ipsilateral pulmonary veins for catheter ablation of atrial fibrillation. Clin Res Cardiol 95:591–599
18. Tai CT, Chen SA, Chiang CE et al (1998) Long term outcome of radiofrequency catheter ablation for typical atrial flutter: risk prediction of recurrent arrhythmias. J Cardiovasc Electrophysiol 9:115–121
19. Wazni O, Marrouche NF, Martin DO et al (2003) Randomized study comparing combined pulmonary vein-left atrial junction disconnection and covotricuspid isthmus ablation versus pulmonary vein-left atrial junction disconnectionalone in patients with typical atrial flutter and atrial fibrillation. Circulation 108:2479–2483