CHAPTER 13

Antiarrhythmic surgery to cure AF – subgroups and postoperative management [24]

Thomas Deneke, Krishna Khargi**, Peter H. Grewe*, Frank Kuschkowitz**, Axel Laczkovics**, Bernd Lemke**.*

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* *Cardiology, Bergmannsheil Bochum, Germany.*

** *Clinic for Cardio-Thoracic Surgery, Bergmannsheil Bochum, Germany.*

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Antiarrhythmic Surgery to Cure Atrial Fibrillation—Subgroups and Postoperative Management

Thomas Deneke,[1] *Krishna Khargi,*[2] *Peter H. Grewe,*[1] *Frank Kuschkowitz,*[2] *Axel Laczkovics*[2] *and Bernd Lemke*[1]

[1]*Clinic II (Cardiology) and* [2]*Clinic for Cardio-Thoracic Surgery, Bergmannsheil Bochum, Germany*

Abstract. **Antiarrhythmic surgical procedures to cure atrial fibrillation (AF) are widely used in cardiac surgery. Whereas the Cox maze procedure remains the highly effective gold-standard a variety of different antiarrhythmic procedures aim at reducing the extent and duration of the procedure. Antiarrhythmic procedures are especially effective in patients undergoing mitral valve surgery. In 110 patients with permanent AF undergoing various surgical procedures sinus rhythm was re-established in 75%. Subgroup analyses revealed no significant differences in rhythm or survival after antiarrhythmic intraoperative ablation indicating the usefulness and feasibility of this procedure in patients with a wide range of characteristics. Because conversion usually occurs spontaneously within the first 6 months and antiarrhythmic medication does not increase the incidence of conversion it seems reasonable to wait for spontaneous occurrence of sinus rhythm after antiarrhythmic intraoperative ablation. In patients with permanent AF undergoing open heart surgery additional antiarrhythmic procedures have been shown to be safe and effective.**

Key Words. **atrial fibrillation, antiarrhythmic surgery, postoperative management, indications**

Introduction

Atrial fibrillation (AF), as the most common arrhythmia, presents many problems in everyday clinical practice. Surgical therapy has been introduced for selected patients with therapy-refractory AF, especially in mitral valve disease. The Cox maze procedure, based on the multiple wavelet theory of Moe et al., surgically compartimentalizes both atria to induce electrical conduction block. Different techniques for surgically producing conduction block, like radiofrequency (RF) ablation, cryoablation or the use of microwave energy have been used to treat AF without proven differences in overall efficacy. So far, studies of surgical treatment for AF differ in patient selection, intraoperative lesion pattern, postoperative treatment, acquisition of rhythm data, and endpoints have been performed, but conclusive data is not available on how to select patients, operations or postoperative management in the setting of cardiac surgery [1–4,6–11].

Lesion Pattern and Number of Atria Approached

Whereas the multiple wavelet concept of AF postulates multiple re-entry circuits perpetuating AF, Haissaguérre and co-workers found evidence for spontaneous impulses originating in the pulmonary veins in patients with paroxysmal AF expanding the spectrum of mechanisms of AF. Applying these findings into the operative antiarrhythmia field, the lesion pattern differs widely—especially in the left atrium. Cox et al. proposed an en-bloc excision of the pulmonary veins isolating large parts of the left atrium including the posterior wall. Problems with this procedure may occur when the isolated left atrial mass remains in AF and by this means does not lead to regular contractile function. Many other concepts incorporate the finding of foci in AF by isolating pulmonary veins by themselves. The concept at our institution is to encircle each pulmonary vein at its atrial ostial site plus performing interconnecting lines to produce left atrial substrate modification plus exclusion of foci in or close to the ostium of the pulmonary veins. In addition ablation of the left atrial isthmus seems crucial in preventing left atrial macroreentry (left atrial flutter). Rhythm success differs widely when applying different lesion patterns producing sinusrhythm (SR) rates from 58% up to as high as 100%. In our experience by isolating each pulmonary vein (one-by-one) applied in 110 patients with chronic permanent AF (1 failed medical or DC-shock cardioversion, at least 1 year documented AF) undergoing different cardiac surgical procedures 77 patients converted to stable SR after a mean of 2 (±3) months (only 17% of patients were in SR at discharge) cumulating in a 12-month estimated SR percentage of 75%. No recurrences of AF were seen during a mean follow-up of 28 ± 16 months. A biatrial contraction as documented in transthoracic

Address correspondence to: Thomas Deneke, M.D., Clinic II (Cardiology), Bergmannsheil Bochum, Bürkle-de-la-Camp-Platz 1, GER–44789 Bochum, Germany. E-mail: thomas.deneke@ruhr-uni-bochum.de

Table 1. *Subgroup comparison of 110 patients undergoing either a biatrial or a left atrial antiarrhythmic RF ablation procedure*

	Biatrial $N = 68$	Left Atrial $N = 42$	$p =$
MV replacement	29	4	
MV repair	7	7	
AV replacement	7	6	
CABG	14	11	
CABG + MV replacement	4	4	
CABG + MV repair	3	5	
Combination	4	5	
Ejection fraction (%)	59	56	0.16
Duration of AF (y)	6	11	0.30
Left atrium (mm)	51	53	0.53
Age (years)	66	69	0.07
Bypass time (min)	178	151	<0.05
Aortic clamp (min)	101	99	0.70
12-month sinus rhythm	75%	75%	0.97
12-month survival	88%	86%	0.86

MV = mitral valve; AV = aortic valve; CABG = coronary artery bypass grafting; AF = atrial fibrillation.

echocardiography was seen in 83% of patients in SR 6 months after the procedure [1,12–15].

With more experience in invasive curative treatment of AF a crucial role of treating the left atrium becomes apparent. Different studies indicated that linear lesions only in the right atrium fail to produce SR in AF patients but ablating only the left atrium effectively cures AF in over 80% of patients with paroxysmal and permanent AF. In a prospective trial at our institution comparing patients undergoing cardiac surgery plus antiarrhythmic RF ablation either of both atria ($N = 68$) or restricted to the left atrium ($N = 42$) no difference in regard to rhythm conversion was found in between these two groups (12-month SR percentages: biatrial approach 75% and left atrial approach 75%, $p = 0.97$) (patient characteristics see Table 1). These findings indicate that treating only the left atrium seems to be sufficient in restoring SR even in patients with long-lasting permanent AF. Whether different patient subgroups will benefit from biatrial lesion patterns remains unclear. In some institutions patients with a broader fibrillation waves in the ECG or with a history of right atrial flutter are candidates for a biatrial approach (personal communication). But in patients presenting with postoperative atrial flutter originating from the right atrium transvenous catheter ablation can easily be perform with high effectiveness [3,4,16–20].

Energy Source to Deliver Linear Lesions

Different energy sources to induce linear transmural lesions have extensively been studied but data comparing these methods in a homogenous patient collective is lacking. The success of an antiarrhythmic procedure does not seem to dependent on a specific form of energy used to perform lesions in the atria (independent from the performed lesion pattern). Because the Cox maze procedure using "cut-and-suture"-technique is extensive and time consuming RF ablation has been used to perform lesion patterns in the right and left atrium. In a first randomized prospective trial we evaluated the effectiveness and safety of **S**aline-**I**rrigated **C**ooled-**T**ip **RF** **A**blation (**SICTRA**) in 30 consecutive patients with long-lasting permanent AF undergoing mitral valve replacement. Fifteen patients receiving an additional biatrial SICTRA procedure documented significantly higher rates of SR (12-months estimated SR rate 80%) compared to mitral valve replacement alone (27% SR). This first randomized study indicated the beneficial effects on postoperative SR in a homogenous patient group of mitral valve replacement patients [1,3,4,14,20].

In summary, the mode of energy used to perform linear lesions in the atria to cure AF does not seem to affect rhythm conversion rates but adding an antiarrhythmic procedure increases rhythm success in patients undergoing mitral valve surgery. Because no difference in mortality or complication rates have been documented it seems feasible to apply antiarrhythmic surgery in addition to mitral valve surgery in all patients with a history of AF (in the setting of mitral valve disease needing surgical therapy) [3,20,21].

Subgroups and Antiarrhythmic Procedures

A major concern arising from increasing pressure on financial refunding in the clinical setting seems to be to identify patient-subcollectives with the highest benefit from restored regular rhythm and atrial contraction.

Little data is available on the outcome of patients undergoing any antiarrhythmic surgery in addition to different cardiac procedures. In our experience of 110 patients undergoing intraoperative cooled-tip RF ablation patients were divided into 5 groups based on the performed cardiac surgical procedure (mitral valve surgery: 47; aortic valve surgery: 13; CABG: 25; CABG plus mitral valve surgery: 15; combined procedures: 10) without differences in their baseline patient characteristics (especially duration of atrial fibrillation, left atrial dimensions). There was no statistically significant difference in between rates of SR or survival in these small patient subgroups. Twelve months estimated SR rates (12-month survival) were found to be 73% in patients undergoing mitral valve surgery (89%), 83% in patients undergoing aortic valve surgery (85%), 68% in CABG patients (96%), 91% in patients receiving additional mitral valve surgery (73%) and 71% in

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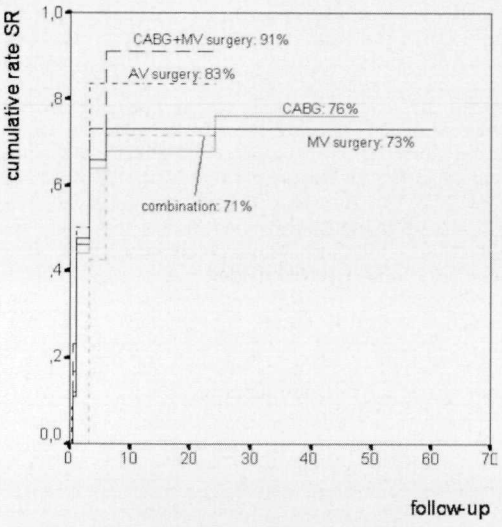

Fig. 1. Cumulative rates of stable SR over follow-up in different patient subgroups without statistically significant differences. MV = mitral valve; AV = aortic valve; CABG = coronary artery bypass grafting; SR = sinus rhythm.

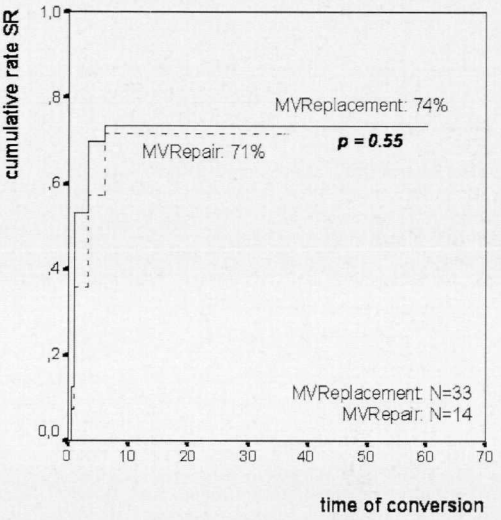

Fig. 2. Comparison of cumulative conversion to sinus rhythm (SR) in patients undergoing mitral valve (MV) replacement or repair.

patients undergoing combined procedures (80%) (see Figure 1). Interestingly patients in the CABG group seemed to have extremely high survival rates in the postoperative phase (only 2 out of 25 patients died) [3,4,14].

Another interesting point is the effectiveness of this procedure in heart failure patients who will show hemodynamic benefit from restored atrial rhythm and contraction. Comparing the outcome of patients with ejection fraction over 35% ($N = 95$) to those below 35% ($N = 15$) in our patient collective there is no statistically significant difference in 12-months SR rates (72% versus 73%, $p = 0.28$) but the number of patients is too small to draw powerful conclusions.

Limited data about different indications for antiarrhythmic surgery is available from the literature. Izumoto et al., Mohr et al. and Guden et al. have performed studies including patients undergoing antiarrhythmic surgery plus other cardiac procedures producing SR in up to 81% of patients but no subgroup analysis is available so far. From our data it can be concluded that antiarrhythmic intraoperative ablation can safely and effectively be combined with a large variety of cardiac surgical procedures without intergroup differences [4,22–24].

Most trials published focused on the specific setting of mitral valve disease plus antiarrhythmic procedures indicating a significantly higher conversion rate after additional antiarrhythmic procedures in between 65 to 98% SR during long-term follow-up. Restoring SR and producing biatrial contraction seems especially desirable in patients undergoing mitral valve reconstruction aiming at omitting anticoagulation therapy and improving valve hemodynamics. In our patient collective there is no difference in regard to SR in patients undergoing mitral valve replacement ($N = 33$, 74%) or mitral valve repair ($N = 14$, 71%; $p = 0.55$) (mean duration of AF 8 versus 4 years, $p = 0.08$, left atrial dimensions 54 versus 53 mm, $p = 0.79$) (see Figure 2). There are hints that a left atrial procedure in these patients is sufficient to restore SR which proposes mitral valve repair plus left atrial antiarrhythmic procedure to be the most beneficial and least invasive procedure type in this specific patient group. The etiology of mitral valve disease does not seem to influence rhythm outcome after antiarrhythmic procedures as indicated by Lee et al. comparing patients with rheumatic and degenerative mitral valve disease (95% versus 98% SR, $p > 0.05$) [3,21,25–28].

Postoperative Treatment

The "optimal" postoperative treatment in terms of medication and cardioversion after any antiarrhythmic procedure is a matter of debate. Because of the wide range of applied treatment protocols the efficacy of a surgical antiarrhythmic procedure itself is hard to evaluate especially when antiarrhythmic medical protocols are used. Usually antiarrhythmic agents (either class I or class III) are

administered to increase and stabilize rhythm success. In a prospective trial we compared consecutive patients treated with sotalol (at least 80 mg bid) to patients treated without antiarrhythmic medication (only ß-blocking agents administered) and found no significant difference in regard to rhythm conversion or mortality [5]. Patients in SR under sotalol were switched over to metoprolol during late follow-up without reoccurrence of AF. From these data it can be concluded that an antiarrhythmic medication does not increase rhythm success or stabilize SR after surgical antiarrhythmic procedures. The success of a non-medical anti-AF procedure can only be assessed when antiarrhythmic agents are withheld [3,4,6,19,21,23,29,30].

In order to increase rhythm outcome, DC-shock cardioversion has been extensively used during early follow-up of antiarrhythmic procedures. It seems crucial though to define a successful cardioversion not only as immediate conversion to SR but as long-term stable conversion to SR. In our initial experience DC-shock cardioversion was performed at least twice in patients presenting with AF during follow-up. Only 1 patient (5% of all cardioverted patients) remained in SR for the next follow-up visit indicating a low long-term success-rate of DC-shock cardioversion in these patients. This is especially interesting when considering that 76 patients converted spontaneously to SR, usually within the first 6 postoperative months. These findings have influenced our postoperative management to waiting 6 months for spontaneous conversion without antiarrhythmic medication or anticipated DC-shock.

Conclusions

Antiarrhythmic procedures using intraoperatively radiofrequency ablation are highly effective in curing AF and can be combined with different open heart surgical procedures. Especially in patients where anticoagulative treatment may be omitted conversion to SR seems to be a pursuable goal.

In regard to the underlying heart disease, all patient subgroups seem to equally benefit from additional rhythm surgery to achieve SR. The indicated cardiac procedure (in regard to underlying heart disease) does not seem to influence rhythm or survival outcome. This also seems to be true for heart failure patients (determined by preoperative ejection fraction below 35%).

Antiarrhythmic agents in the postoperative treatment do not produce higher or more stable SR rates. These findings document that there is no need for a specific antiarrhythmic medical regimen after AF surgery.

Due to the high rate of spontaneous conversion within 6 months and the uselessness of DC-shock cardioversion, it appears feasible to be patient during early follow-up and wait for rhythm success without using medical or DC-shock cardioversion.

If eligible an antiarrhythmic procedure proven to be effective and safe (and not increase morbidity or mortality) should be performed in patients with permanent AF anticipated for open heart surgery.

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