Clinical Investigation

Efficacy of Oral Anticoagulation in Stroke Prevention

among Sinus-Rhythm Patients Who Lack Left Atrial Mechanical Contraction after Cryoablation

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The customary recommendation is that oral anticoagulation be withdrawn a few months after cryoablation for atrial fibrillation, independently of left atrial mechanical contraction in patients in sinus rhythm. Recently, a 5-fold increase in stroke has been described in sinus-rhythm patients who lack atrial mechanical contraction. One aim of this study was to evaluate the efficacy of oral anticoagulation in preventing postoperative stroke in such patients.

This prospective study divided 154 sinus-rhythm patients into 2 groups, depending on the presence (108 patients) or absence (46 patients) of left atrial mechanical contraction at 6 months after surgery, and monitored them annually for 5 years. Those without left atrial contraction were maintained on acenocumarol. The primary endpoint was the occurrence of ischemic stroke.

The median follow-up period was 29 ± 16 months; 4 patients (2.5%), all belonging to the group with preserved atrial contraction, had ischemic stroke; the group of patients without left atrial contraction had no episodes of stroke during follow-up. Logistic binary regression analyses showed no evidence of factors independently predictive of stroke.

Among anticoagulated patients in sinus rhythm without left atrial contraction, we found the incidence of stroke to be zero. In a small, nonrandomized group such as this, we cannot discount the element of chance, yet we suggest that maintaining anticoagulation might lower the incidence of stroke in this population. ***(Tex Heart Inst J 2015;42(5):430-7)***

Restoration of sinus rhythm (SR) with the modified Cox maze procedure (using various energy sources in patients who are undergoing concomitant cardiac surgical procedures) is well established, and there have been some excellent results in the short-to-medium term.[1-6] However, some studies have appeared to show that the left atrium (LA) is not always capable of maintaining intact contractile capacity after a maze procedure, despite the patient's presenting in SR. The absence of LA mechanical contraction (LAMC) implies a nonfunctional mechanical status.[7,8]

The maze procedure has been shown to reduce substantially the risk of thromboembolic events.[9] However, it is not known if the absence of LAMC in a patient who is in SR after atrial fibrillation (AF) predisposes that patient to ischemic stroke. Investigators in a recent study observed a very high incidence of stroke (up to 21% at 2 yr) in patients who had maintained SR after cryoablation but who, for lack of effective atrial contraction, had undergone systematic withdrawal of anticoagulation.[10]

The objective of the present study was to evaluate the incidence of stroke, in the medium-to-long term, among patients who maintained SR after cryoablation of AF. We also attempted to determine whether anticoagulation affords some measure of protection against stroke among patients who have maintained SR in the absence of LAMC.

Patients and Methods

From 2006 through 2011, 190 consecutive patients underwent cryoablation for AF with use of the biatrial modified technique of Cox maze (Cox maze ablation) or with use of isolated ablation of the LA (LA endocardial ablation). Patients were considered for a cryoablation procedure if they were undergoing a cardiac surgery procedure and had clinically relevant AF (paroxysmal or persistent/long-standing AF)

that was resistant to medical therapy. The cryoablation technique has been described previously by our group.[11]

Cryoablation was performed in all patients with the ATS CryoMaze™ device (then manufactured by ATS Medical, Inc.; Minneapolis, Minn) and the Cryocath Surgifrost® catheter (ATS Medical). This device uses argon gas to achieve rapid cooling to temperatures as low as –160 °C and has a flexible metal probe that conforms to the contours of the heart. In addition, the insulation sheath that covers the cryoablation segment in the device is adjustable, which enables the size of the ablation zone to be adjusted between 0 and 100 mm.

In this study, patients underwent different types of cryoablation in accordance with the pattern of lesions: for a left- and right-sided lesion set, they underwent a Cox maze procedure; and in the absence of the right-sided lesion set, they underwent LA endocardial cryoablation. The same equipment was used for both procedures.

The choice of procedure for the individual patient was made by the attending surgeon. Patients tended to undergo LA endocardial ablation if they had paroxysmal AF or persistent/permanent AF of recent onset (<6 mo), if they were to undergo non-mitral valve surgery, or if there was substantial benefit in limiting the operation time.

In both the Cox maze ablation and the LA endocardial ablation, the LA was entered through a standard incision in the interatrial groove. A circumferential cryolesion around the 4 pulmonary veins was performed with 90-s cryolesions that connected to both ends of the left atriotomy. In some instances, the right and left pulmonary veins were encircled independently, and a connecting lesion was then made. Two radial cryolesions were extended from the circumferential pulmonary vein lesion: one to the LA appendage and the other to the base of the posterior mitral valve leaflet. The LA appendage was excised or ablated in a linear or circular fashion (in most cases, it was internally obliterated or externally ligated).

In the Cox maze ablation, the right-sided lesions were made laterally (superior vena cava-to-inferior vena cava), and a perpendicular lesion was incised up to the atrioventricular groove. Two more cryoablations were performed. Both extended to the tricuspid valve annulus, one starting from the entry site of the retrograde catheter and the other from the opening in the right atrium. The duration of ablation was 90 s for each lesion.

After surgery, follow-up evaluation was conducted with a clinical examination, electrocardiography (ECG), 24-hour Holter monitoring, and echocardiography (in search of LAMC). All patients were evaluated in the outpatient cardiac surgery clinic at 1, 3, 6, and 12 months after surgery, and annually thereafter.

To be included in the study analysis, all patients had to fulfill the following requirements at the 6th month: 1) stable SR documented not only by ECG in the outpatient clinic but also by 24-hour Holter monitoring; 2) availability of echocardiographic records from the 6th month, with a record of transmitral flow to enable evaluation of the LAMC; and 3) availability of all clinical and demographic data. Sinus rhythm was defined on the basis of ECG and Holter records, in the absence of AF or atrial flutter episodes of whatever duration.

Two groups were created, as a function of the presence or absence of LAMC at the 6th month (the LAMC group and the No LAMC group). Follow-up evaluation was conducted with use of ECG, 24-hour Holter monitoring, and echocardiography obtained on every clinic visit (12 mo after surgery, and annually thereafter). Because an LA contractile profile can change over time, when it did change we concluded the monitoring of the patient at that point, in order to keep that patient's LA mechanical contractility profile consistent with the rest of the study cohort.

Management of Oral Anticoagulation

After the withdrawal of the chest tubes, all 154 patients in the 2 study groups were orally anticoagulated with acenocumarol (a vitamin K antagonist currently not available in the United States, with an action similar to that of warfarin). At 6 months after surgery, oral anticoagulation was discontinued in patients with stable SR (on ECG and Holter), with an echocardiographic finding of LAMC (LAMC group), and without other indications for anticoagulation. Antiplatelet therapy with aspirin (100 mg/d) was substituted, unless the patient was hypersensitive to that drug, in which case clopidrogel (75 mg/d) was administered instead. Oral anticoagulation was maintained indefinitely for those patients who presented with stable SR in the absence of echocardiographic LAMC (No LAMC group). Oral anticoagulation was monitored periodically by our hematology unit, and a mean international normalized ratio (INR) was calculated from the values obtained at every outpatient clinic visit.

Data Collection

All the perioperative data were collected prospectively in all the patients during their hospitalizations and follow-up visits. The CHA_2DS_2–VASc score[12] (congestive heart failure [or left ventricular systolic dysfunction], hypertension, age ≥75 yr, diabetes mellitus, prior stroke or TIA; vascular disease, age 65–74 yr, female sex) was calculated retrospectively in all patients. The individual follow-up evaluation was conducted in the cardiac surgery outpatient clinic in all patients. All diagnostic tests were conducted in Hospital de León, Spain.

Echocardiographic Methods

Echocardiography was performed with use of the Vivid 7® cardiac ultrasonography system (GE VingMed Ultrasound AS; Horten, Norway) and the Vivid® S5 (GE

Healthcare; Wausheka, Wisc). The measurements of the LA were performed in accordance with the American Society for Echocardiography's recommendations for the quantification of chambers' diameters.[13] The anterior–posterior diameter of the LA was measured by using bidimensional echocardiography at the end of left ventricular systole in the long-axis parasternal view. The diameter of the LA was measured by using the M-mode or 2-dimensional-derived anterior–posterior linear dimension obtained from the parasternal long-axis view, and the LA area was measured by means of the Simpson method, from the 4-chamber apical view.

The transmitral peak velocity and the velocity-time integral of the early (E) and late (A) atrial contraction filling waves were measured from the 4-chamber apical view. Absence of a transmitral A-wave (or a value <0.3 m/s) was understood to be absence of mechanical atrial contraction.

The study was approved by the ethics committee of the hospital, and all patients provided written informed consent.

Endpoint Evaluation

The study endpoint was the incidence of ischemic stroke during clinical follow-up of the SR patients in the overall patient group and also in the study groups that had been segregated in regard to the presence or absence of LAMC. Our definition of stroke was acute loss of neurologic function of >24 hours' duration, consequential to abnormal perfusion of the brain tissue. All patients were admitted to our hospital and were evaluated and diagnosed by our neurologist. In all cases, a computed tomographic scan was performed in order to eliminate the diagnosis of hemorrhagic cerebrovascular accident.

Statistical Analysis

The data were collected in the database File Maker Pro 12.0 (FileMaker, Inc., an Apple subsidiary; Santa Clara, Calif) and were analyzed with use of SPSS 17.0 (IBM Corporation; Armonk, NY). Descriptive analysis of the qualitative variables was made with the χ^2 test, and the quantitative variables were compared with use of the unpaired Student *t* test. To reach the fundamental objective (the presence of stroke during follow-up evaluation), survival curves were compared by means of the Kaplan-Meier method, and multivariate analysis was performed with use of binary logistic regression.

In order to establish the role of LAMC as a possible independent predictor for the occurrence of stroke, a multivariate, multiple linear regression analysis was performed that included the presence or absence of LAMC (the variable around which the entire analysis revolves) and the presence or absence of other factors whose possible association with stroke can be established on the basis of prior scientific evidence, the common sense of the researchers, and the statistical significances obtained in the univariate analysis. Values of $P < 0.05$ were considered statistically significant.

Results

Of 190 consecutive patients who were alive at the time of the study and undergoing cryoablation for AF, 154 were in SR at the time of the 6-month follow-up evaluation and, in all cases, had completed the scheduled clinical follow-up evaluation that involved ECG, Holter monitoring, and echocardiography. Hence, 100% of the 154 were included in the statistical analyses. Of these, 46 patients (30%) did not have evidence of LAMC at the 6th month after surgery (the No LAMC group) and 108 patients (70%) maintained atrial contraction (the LAMC group).

The baseline characteristics of the patients in the study, as a function of the presence or absence of LAMC, are summarized in Table I. There were significant differences only in relation to sex, with a greater proportion of women (31 [67%] in the No LAMC group than in the LAMC group (51 [47%], $P=0.02$); in relation to paroxysmal atrial fibrillation, with a lower proportion of patients (9 [20%] in the No LAMC group than in the LAMC group (48 [45%], $P<0.01$) before surgery; and in relation to continuous atrial fibrillation, with a higher proportion of patients (permanent and persistent AF) in those same groups (37 [80%] vs 59 [55%], $P<0.01$).

Table II summarizes the operative variables, stratified by the absence or presence of LAMC. The No LAMC group underwent significantly more ablation (29 [63%]) by means of the Cox maze procedure than did the LAMC group (37 [34.3%], $P<0.01$). Similarly, in regard to the type of concomitant surgery, aortic valve surgery was significantly more frequent in the LAMC group (38 [35.2%] vs 0, $P<0.01$). Conversely, all types of mitral surgery, isolated or in combination, were more frequent in the No LAMC group, albeit without reaching statistical significance.

All of the patients in the No LAMC group were maintained under anticoagulation indefinitely at 6 months after surgery, despite being in SR. In the group of patients in SR with LAMC, 36 (33.3%) were maintained under anticoagulation because of other indications, such as mechanical prosthesis or CHA_2DS_2–VASc score ≥2. In the remaining 72 patients of this group (66.7%), oral anticoagulation was discontinued at 6 months after surgery, and antiplatelet therapy was substituted.

The mean follow-up duration (29 ± 16 mo) was similar in both groups (26 ± 15 vs 31.9 ± 17 mo; $P=0.64$).

During the immediate postoperative period, 14 patients (9%) needed a pacemaker, in most cases for sinus dysfunction. Of these, 6 patients (13%) were from the No LAMC group at 6 months and 8 (7%) from the LAMC group. Of the patients who needed a pacemaker, 50% had undergone a mitral valve intervention.

The absence of LAMC in the No LAMC group was maintained throughout follow-up in all the patients. Most patients in the LAMC group did not lose LAMC during follow-up. Only 12 patients (11.1%) lost LAMC despite their being in stable SR (mean duration, 19 ± 4 mo). Follow-up monitoring was concluded at this time point in this group. During follow-up, 4 patients died: one in the No LAMC group, of sudden death secondary to an acute myocardial infarction diagnosed at autopsy; the other 3 from the group with A-wave (the LAMC group), one from endocarditis (an infected bioprosthesis), and the remaining 2 from noncardiac causes (vasculitis and a pancreatic neoplasm). None of the patients died of stroke.

Incidence of Suspected Thromboembolic Stroke in Relation to the Absence or Presence of Effective Left Atrial Contraction

During follow-up, 4 patients (2.5%) had suspected thromboembolic stroke. The group in SR without LAMC (all of whom had been given anticoagulation) did not present any episode of ischemic or hemorrhagic stroke. However, 4 patients (3.7%) in the LAMC group had suspected episodes of thromboembolic stroke. Of these 4 patients, 3 had undergone LA appendage ligation. None had antecedents of preoperative stroke, only one had a left ventricular ejection fraction of <0.30, all had permanent AF before the intervention, and 2 had a severely dilated LA (>40 cm^2). With respect to

TABLE I. Baseline Characteristics of Patients Grouped in Accordance with the Presence or Absence of LAMC

Variable	**No LAMC** (n=46)	**LAMC** (n=108)	***P* Value**
Age (yr)	66 ± 11	68 ± 9	0.22
Female	31 (67.4)	51 (47.2)	0.02
Body mass index (kg/m^2)	27 ± 4	27 ± 4	0.35
Clinical variables			
CHA_2DS_2–VASc score	2.6 ± 1.3	2.4 ± 1.5	0.33
EuroSCORE	6.8 ± 3.5	6.7 ± 4.8	0.22
Hypertension	22 (48)	56 (52)	0.64
Dyslipidemia	25 (54)	40 (37)	0.07
Smoking	17 (38)	34 (31)	0.45
NYHA functional class IV	1 (2.2)	8 (7.4)	0.37
Severe pulmonary hypertension	10 (21.7)	15 (14.3)	0.25
Peripheral arterial disease	0	1 (0.9)	0.51
Previous stroke	5 (11)	12 (11)	0.95
Type of atrial fibrillation			
Paroxysmal	9 (19.6)	48 (44.9)	<0.01
Chronic (persistent and permanent)	37 (80.4)	59 (55.1)	<0.01
Echocardiographic values			
Postsurgical diameter of LA (cm)	5.3 ± 0.6	4.9 ± 0.7	0.37
Postsurgical area of LA (cm^2)	34 ± 7	31 ± 8	0.08
Postsurgical area of LA >40 cm^2	10 (22)	20 (19)	0.65
LA appendage ligation	44 (96)	101 (94)	0.71
LVEF <0.30	2 (4.3)	4 (3.7)	0.65
Overall follow-up duration (mo)	26 ± 15	31.9 ± 17	0.64
Oral anticoagulant at 6 mo	46 (100)	36 (33.3)	<0.01
Mean INR in anticoagulated patients	2.3	2.5	0.73
Suspected thromboembolic stroke	0	4 (3.7)	0.41

CHA_2DS_2–VASc = congestive heart failure (or left ventricular systolic dysfunction), hypertension, age ≥75 yr, diabetes mellitus, prior stroke or TIA, vascular disease, age 65–74 yr, female sex; INR = international normalized ratio; LA = left atrium; LAMC = left atrial mechanical contraction; LVEF = left ventricular ejection fraction; NYHA = New York Heart Association

Values are presented as mean ± SD or as number and percentage. *P* <0.05 was considered statistically significant.

the type of concomitant surgery, 2 patients underwent biological aortic valve replacement, the 3rd underwent mechanical mitral valve replacement, and the 4th underwent surgical coronary revascularization, this last being the only stroke patient in whom treatment with acenocumarol had been discontinued. Of the remaining 3 patients, one had been given anticoagulation because of the mechanical mitral valve; the other 2 had biological aortic valves, and their attending physician had continued anticoagulation therapy for such reasons as a severely dilated LA, a several year history of permanent AF, and advanced age.

All of the patients hospitalized with suspected thromboembolic stroke were in SR at the time of hospital admission, LAMC was preserved, and no thrombus was detected in the atrium on echocardiography. Of the 3 patients given anticoagulation, 2 were correctly anticoagulated (INR in the therapeutic range). The carrier of a mechanical mitral valve prosthesis, although anticoagulated, was not in the therapeutic range (INR, 1.8).

In the subgroup of LAMC patients in whom LAMC was absent at the 6th month (12; 11.1%), oral anticoagulation was initiated indefinitely, and there was no episode of ischemic or hemorrhagic stroke during a mean follow-up period of 14 ± 8 months.

In the LAMC group, the accumulated probability of survival without stroke was 95.2% at 24 months, compared with 100% probability of survival without stroke among No LAMC patients receiving anticoagulation (Fig. 1). Survival-curve analysis by means of the Mantel-Haenszel test showed a χ^2 value of 1.595 (1 degree of freedom, P=0.207).

In applying the sequential exclusion method of binary logistic regression analysis, we included the presence or absence of LAMC (the variable around which the entire analysis revolves), those variables possibly associated with stroke (postsurgical area of LA, >40 cm^2; CHA_2DS_2–VASc score, >2; oral anticoagulation; and LA appendage ligation), and those variables with statistical significance in the univariate analysis. In the final model, there was no evidence of a factor independently predictive of stroke.

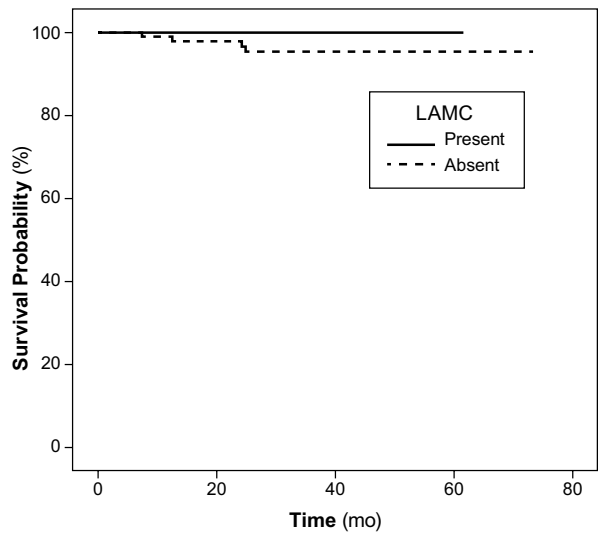

Fig. 1 *Kaplan-Meier curve shows the probability of survival (freedom from stroke), grouped in accordance with the presence or absence of left atrial mechanical contraction (LAMC).*

TABLE II. Surgical Data Grouped in Accordance with the Presence or Absence of LAMC

Variable	**No LAMC** (n=46)	**LAMC** (n=108)	***P* Value**
Left atrial endocardial ablation	14 (30.4)	25 (23.1)	0.34
Cox maze ablation	29 (63)	37 (34.3)	<0.01
Cross-clamp time (min)	125 ± 38	109 ± 39	0.59
Mechanical prosthetic valve placement	17 (37)	19 (17.6)	<0.01
Aortic valve surgery	0	38 (35.2)	<0.01
Mitral valve surgery	13 (28.3)	21 (19.4)	0.23
Mitral and tricuspid valve surgery	9 (19.6)	8 (7.5)	0.02
Aortic and mitral valve surgery	7 (15.2)	8 (7.5)	0.14
Aortic, mitral, and tricuspid valve surgery	4 (8.7)	4 (3.7)	0.2
Coronary surgery	3 (6.5)	13 (12.1)	0.3
Coronary and aortic valve surgery	1 (2.2)	8 (7.5)	0.2
Coronary and mitral valve surgery	7 (15.6)	5 (4.6)	0.02
Coronary, aorta, and mitral valve surgery	1 (2.2)	0	0.12
Other surgery	1 (2.2)	2 (1.8)	0.47

LAMC = left atrial mechanical contraction

Values are presented as mean ± SD or as number and percentage. P <0.05 was considered statistically significant.

Discussion

In the current study conducted in a single center, the incidence of ischemic stroke in the medium-to-long term was evaluated in 154 patients who were in SR at 6 months after surgical cryoablation for AF. Currently, we are not aware of any other study that has dealt with the incidence of stroke in patients in SR who were receiving systematic anticoagulation in the absence of effective atrial contraction.

Our findings, essentially, are these: 1) the overall incidence of stroke in patients who were in SR after surgery plus cryoablation was low (2.5%); 2) the incidence of stroke in the group in SR without LAMC (all of them in receipt of anticoagulation) was zero; and 3) the maintenance of anticoagulation among patients in SR without LAMC might be a good method of achieving a low incidence of stroke in this population.

There is a risk of stroke and systemic embolism in patients with AF—particularly in the presence of several clinical criteria (such as CHA_2DS_2–VASc score, rheumatic disease, and the presence of mechanical valves) and echocardiographic criteria (including those associated with LA size, appendage morphology, and LA dysfunction). Anticoagulation in patients with AF and increased risk markers reduces thromboembolic risk but is not perfect.[1]

In several clinical studies, the withdrawal of anticoagulation at 3 to 6 months after a procedure of surgical ablation of AF was standard practice when the patient was observed to be maintaining SR.[14] In the pioneering series of Cox and colleagues,[15] who used the maze cut-and-suture technique, the long-term incidence of thromboembolic events was extremely low (1 stroke in 306 patients monitored for a mean duration of 3.7 yr), despite the fact that 72% of those patients were not on systematic anticoagulation. Nevertheless, 58% of the 306 patients had presented with lone paroxysmal AF preoperatively, and the mean age of the patients was only 54 years. Subsequent investigators have observed consistently low incidences of thromboembolic events in other series of patients who had been treated for AF by means of alternative energy sources that had been used in other cardiac interventions (chiefly, valve surgery). Investigators who performed a meta-analysis in 2011[14] suggested that the withdrawal of anticoagulation at a mean of 3.6 months (range, 0–8 mo) after surgery for AF in patients maintaining SR appeared safe, because the annual incidence of stroke was 0 to 3.8%. The procedures that isolated the pulmonary veins were those with the lowest annual incidence of stroke (≤0.4%).[16] However, mitral surgery (above all, mitral repair) increased the risk exponentially (to >4.2% strokes/yr). The highlighted risk factor was the incidence of stroke—15% in some studies.[17] Most of these studies were retrospective and observational. In practically none of them was the documentation of mechanical activity of the LA taken into account in defining successful ablation of the arrhythmia, despite the absence of an association between LAMC and an increase in thromboembolic risk.[18] It would seem logical to infer that a significant load of paroxysmal AF can be the origin of the absence of the A wave in patients who display SR after ablation. This indeed has been suggested by investigators who have observed an absence of LAMC after electrocardioversion[19-21] and an increase in embolic risk during that same period. In addition, the presence of SR in the ECG is not sufficient to justify a conclusion that the patient does not have paroxysmal AF. It has been clearly shown that asymptomatic paroxysmal AF (also associated with an increased incidence of stroke) is very frequent in patients after ablation of AF.[22] However, the Heart Rhythm Society/European Heart Rhythm Association/European Cardiac Arrhythmia Society Expert Consensus Statement (2012)[23] recommended that anticoagulation therapy not be interrupted after AF ablation in patients with a CHA_2DS_2 score ≥2 (an indication of thromboembolic risk). In addition, the 2012 update of the European Society of Cardiology guidelines[24] focused on patients with CHA_2DS_2–VASc scores ≥2, independently of the patient's rhythm status—the assumption being that the probability of paroxysmal AF development is elevated when there are coexisting risk factors associated with recurrence, such as advanced age, arterial hypertension, or prior permanent AF. However, none of these guidelines recommends what management should be adopted in treating a patient who is in SR in the absence of LAMC.

Investigators have shown the absence of contraction (that is, electromechanical dissociation) of the LA in patients in SR, several months after having undergone the maze procedure.[8,10,25,26] Feinberg and colleagues[8] found a 40% absence of LA contraction in patients in SR at a mean follow-up period of 8 ± 3 months after intervention. Buber and associates[10] detected 31% of patients in SR at 3 months after surgery who did not present with LAMC. Our study is in concordance with these findings, with 30% of patients in SR without LAMC at 6 months. That is, a high percentage of patients can have electromechanical dissociation of the LA after the maze procedure. Impaired LA contractile function in this series was statistically more likely in patients who, before surgery, had persistent or permanent AF, or larger atria—each of which is likely to accompany more advanced atrial disease.

In the study by Buber and associates,[10] the design of which is similar to that of our present study in regard to number of patients and follow-up criteria, the incidence of stroke in the patients with LAMC (5%) was very similar to our own (3.7%) and was significantly lower than that of the study group (21%) not systematically anticoagulated and without LAMC. In our series,

we maintained systematic anticoagulation in a similar number of patients without LAMC, during a longer follow-up period. Anticoagulation was associated with no embolic events in patients with reduced LAMC (despite their mechanical disadvantage and greater preoperative atrial disease) and was associated with a low incidence of stroke in patients with risk markers other than LA mechanical dysfunction.

Conclusion. The small size of this trial and its nonrandomized nature make it impossible to say whether the difference between these 2 groups (distinguished one from the other only by LA mechanical function) has been determined by anything greater than chance. Yet it is possible to report in this series that the continuation of anticoagulation in patients with LA mechanical dysfunction (and SR) was associated with the absence of embolic events, despite mechanical dysfunction (and more severe atrial disease).

Hence, it is reasonable to suggest that anticoagulation be continued if LA mechanical dysfunction is present, even after SR has been restored. The benefit of continued anticoagulation might be associated with its effect on more advanced atrial disease, regardless of postoperative LA mechanical function. Endothelial dysfunction is not necessarily corrected by surgery.

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