Left Atrial Radiofrequency Ablation During Mitral Valve Surgery for Continuous Atrial Fibrillation: A Randomized Controlled Trial

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Atrial fibrillation is a frequent and important contributor to symptoms and morbidity in patients with mitral valve disease. More than 40% of patients referred for mitral valve surgery have continuous atrial fibrillation.1-3 Patients who remain in atrial fibrillation following mitral valve surgery may have lower survival 3 to 5 years later compared with those in sinus rhythm, although this has not been observed in all studies.3 For a long time, it was believed that atrial fibrillation occurs as a result of a multiple-circuit reentry mechanism. This notion is now challenged by evidence suggesting that, in some circumstances, even continuous atrial fibrillation may be organized by 1 or a small number of high-frequency sources (rotors) in the left atrium, especially in the vicinity of the pulmonary veins.4 Hence, radiofrequency ablation (RFA) of the left atrium during open-heart surgery has emerged as a novel surgical mode for treatment of atrial fibrillation. It is based on the original concept of the maze procedure and aims to eliminate anatomically determined reentrant circuits by creating contiguous lines of scar tissue between the pulmonary veins and the

Context Although left atrial radiofrequency ablation (RFA) is increasingly used for the treatment of chronic atrial fibrillation during mitral valve surgery, its efficacy to restore sinus rhythm and any resulting benefits have not been examined in the context of an adequately powered randomized trial.

Objective To determine whether intraoperative RFA of the left atrium increases the long-term restoration of sinus rhythm and improves exercise capacity.

Design, Setting, and Patients Randomized, double-blind trial performed in a single UK tertiary referral center with enrollment between December 2001 and November 2003. A total of 101 patients referred for mitral valve surgery with at least 6 months’ history of uninterrupted atrial fibrillation were assessed for eligibility; 97 were enrolled. Patients were followed up for 12 months.

Intervention Patients were randomly assigned to undergo mitral valve surgery and RFA of the left atrium (n=49) or mitral valve surgery alone (controls; n=48).

Main Outcome Measures The primary outcome measure was presence of sinus rhythm at 12 months; secondary measures were patient functional status and exercise capacity (assessed by shuttle-walk test), left atrial contractility, and left atrial and left ventricular dimension and function and plasma levels of B-type natriuretic peptide.

Results At 12 months, sinus rhythm was present in 20 (44.4%) of 45 RFA patients and in 2 (4.5%) of 44 controls (rate ratio, 9.8; 95% CI, 2.4-86.3; P<.001). Restoration of sinus rhythm in the RFA group was accompanied by a greater improvement in mean (SD) shuttle-walk distance compared with controls (+94 [102] m vs +48 [82] m; P=.003) and a greater reduction in the plasma level of B-type natriuretic peptide (−104 [87] fmol/mL vs −51 [82] fmol/mL; P=.03). Patients randomized to receive RFA had similar rates of postoperative complications and deaths as control patients.

Conclusions Radiofrequency ablation of the left atrium during mitral valve surgery for continuous atrial fibrillation significantly increases the rate of sinus rhythm restoration 1 year postoperatively, improving patient exercise capacity. On the basis of its efficacy and safety, routine use of RFA of the left atrium during mitral valve surgery may be justified.

Trial Registration ClinicalTrials.gov Identifier: NCT00238706.
mitral valve annulus. Although RFA therapy of the left atrium is being increasingly offered to patients with chronic atrial fibrillation who are undergoing mitral valve surgery, its efficacy has not been tested in the context of an adequately powered randomized study. The aims of this prospective randomized clinical trial were to evaluate early and late outcomes following left atrial RFA during mitral valve surgery for treatment of continuous atrial fibrillation and to assess the functional effects of restoration of sinus rhythm.

**METHODS**

**Participants**

The trial was conducted within the Departments of Cardiac Surgery and Cardiology, Glenfield Hospital, Leicester, England. Patients requiring mitral valve surgery and who also had a history of continuous atrial fibrillation were eligible. The term continuous atrial fibrillation denotes the presence of uninterrupted atrial fibrillation for at least 6 months that showed no evidence of spontaneous reversibility to sinus rhythm and was not possible to revert with medications or direct current cardioversion. Patients with sick sinus syndrome, uncontrolled hyperthyroidism, permanent pacemaker, or previous cardiac surgery were excluded. The protocol was approved by the Leicestershire Research Ethics Committee (reference No. 7503). Written informed consent was obtained from all participants, and the recommendations of the revised version of the Declaration of Helsinki were met.

**Interventions and Randomization Process**

Patients were randomly assigned to undergo mitral valve surgery alone or mitral valve surgery plus RFA of the left atrium. Additional cardiac procedures were performed as required. Blocked stratified randomization by patient characteristics was used. The variables used were age (≥70 vs <70 years), etiology of the mitral valve disease (rheumatic vs nonrheumatic), and the superoinferior left atrial diameter (≥60 vs <60 mm). These 3 variables produced 8 subgroups. Randomized blocks of between 4 and 6 were prepared for each subgroup in advance by computer-generated numbers, and individual allocations were placed in sealed envelopes. Assignment took place on the day of the operation by picking the next envelope for the relevant group by a person masked to previous allocations. In addition, the participants and the assessors of outcomes were blinded to group assignment.

**Outcome End Points and Sample Size**

The primary outcome end point was the presence of sinus rhythm at 12 months. Secondary end points included patient functional status and exercise capacity, left atrial contractility, and left atrial and left ventricular dimension and function and plasma levels of B-type natriuretic peptide (BNP).

At the time of study design, available data on the long-term efficacy of RFA during mitral valve surgery suggested a reduction in postoperative atrial fibrillation of 64%. Assuming that after mitral valve surgery alone, 85% of those who were in atrial fibrillation preoperatively would continue to be in atrial fibrillation, approximately 100 patients (50 in each group) were required to detect a 30% reduction in atrial fibrillation with a power of 90% at the .05 level of statistical significance. This would allow for up to 12% of patients being lost to follow-up or dying within the study period.

**Preoperative Assessment**

Demographics and clinical data were prospectively recorded. The shuttle-walk test (SWT), a validated instrument for assessing functional capacity, was carried out in all patients. Transthoracic echocardiography was performed to examine mitral valve function, left atrium dimensions, atrial transport function, and left ventricular dimension and function. The left atrium size was studied in the 2-dimensional mode on apical views. Mitral inflow velocity was obtained by pulse-wave Doppler examination from the apical 4-chamber view.

**Surgery and RFA Procedure**

Operations were performed between December 2001 and November 2003 by a single surgeon (T.J.S.). Access to the mitral valve was obtained through the left atrium. If tricuspid valve surgery was undertaken, a transeptal approach was used. A Cosgrove-Edwards annuloplasty band was routinely inserted during mitral valve repair, tricuspid valve repair, or both. The left atrial appendage was oversewn from within in all patients in both groups.

Radiofrequency lesions were created endocardially with a handheld monopolar, 7-electrode, temperature-controlled probe (EP Technologies, Boston Scientific Corp, San Jose, Calif). Radiofrequency generators were set at 100 W and 70°C. Radiofrequency waves were delivered for 120 seconds to achieve transmural lesions, as previously described. The left atrial incision was complemented by a semilunar RFA line to isolate the right pulmonary veins. The left pulmonary veins were then encircled and a line was drawn connecting the 2 encircling lines, the obliterated left atrial appendage, and the mitral valve annulus.

**Postoperative Management and Follow-up**

Cardiac rhythm was continuously monitored for 48 hours. Thereafter, daily 12-lead electrocardiograms (ECGs) were performed for the duration of hospitalization. Per protocol, all patients were given amiodarone (or sotalol if amiodarone was not tolerated) for at least 3 months. In patients who were in stable sinus rhythm, the antiarrhythmic agent was stopped at 3 months. Those who developed persistent atrial fibrillation during the hospital stay underwent cardioversion within 24 hours. Patients who re-
mained in atrial fibrillation at hospital discharge had another cardioversion attempt 4 weeks later. If this was unsuccessful, further cardioversion was attempted only if clinically indicated. Patients who remained in atrial fibrillation after the 3-month follow-up interval were treated with a variety of antiarrhythmic agents to achieve appropriate rate control. Warfarin was administered to all patients for the duration of the study. Before hospital discharge, all patients underwent transthoracic echocardiography. The patients were seen at 3, 6, and 12 postoperative months in the outpatient clinics, where they had a clinical examination and a 12-lead ECG. At 6 and 12 months, a transthoracic echocardiogram and an SWT were also carried out. Blood samples were collected for BNP levels preoperatively and at 6 and 12 months postoperatively.

During follow-up, if a patient reported symptoms suggestive of dysrhythmia either at a specified visit or between visits, a 24-hour Holter tape (and an ECG if appropriate) was obtained, and if atrial fibrillation was observed in a patient with previous sinus rhythm, the patient was deemed to have reverted to atrial fibrillation at the next formal assessment. Likewise, the findings on any sporadic ECGs obtained by the patients’ physicians were similarly taken into account.

Shuttle-Walk Test

Functional capacity during exercise was assessed using the SWT. This is a maximal symptom-limited test with 12 progressive levels during which patients are required to walk 10 m back and forth. The walking speed is paced by an audio signal from a cassette that emits beeps at regular intervals. The speed is increased each minute by 0.17 m/s until the next level is attained. The test is terminated either by the patient when he/she becomes breathless maintaining the required speed or by the operator when the patient fails to complete a shuttle in the time allowed. For this study, the level reached in the SWT (ie, the distance traveled in meters) was measured at the end of each effort.

BNP Measurement

Five milliliters of venous blood was collected in tubes containing 1 mg/mL of EDTA and 500 U/mL of aprotinin. Blood was centrifuged and the plasma stored at −70°C until assay. Plasma for BNP was extracted on C18 columns before assay. B-type natriuretic peptide levels were quantified using specific antibodies in a competitive immunoluminometric assay.15

Statistical Analysis

Analysis was undertaken on an intention-to-treat basis. Categorical variables were compared with χ² test or Fisher exact test and continuous variables with an unpaired t test or Mann-Whitney test as appropriate. Predictors of sinus rhythm conversion within the RFA group were identified with univariate and multiple logistic regression analysis. First, a series of variables were screened with univariate analysis. Then, the variables that attained a P value of ≤0.05 were entered into a multiple logistic regression model. Statistical analysis was performed using SPSS software, version 11 (SPSS Inc, Chicago, Ill).

RESULTS

Study Design and Conduct

The design and flow of the trial is shown in the FIGURE. One hundred one consecutive patients requiring mitral valve surgery who also had continuous atrial fibrillation were assessed for eligibility; 97 were enrolled and randomized. All patients underwent RFA as randomized with the exception of 1 patient, who was found unexpectedly to have mild mitral regurgitation during the preoperative on-table transesophageal echocardiography and did not undergo mitral valve surgery. This patient was excluded from further analysis. During the follow-up period, none of the controls crossed over to the RFA group.

Preoperative Clinical Profile

There were no significant differences between the RFA and control groups in their demographics, type of mitral valve pathology, prevalence of tricuspid regurgitation, left atrium size, left ventricular function, and duration of atrial fibrillation (TABLE 1). Patients in both groups had similar rate-control antiarrhythmic medication use. Associated conditions were evenly distributed. There were no differences in New York Heart Association classification, SWT distance walked, or Parsonnet score (a scoring system based on preoperative risk factors that aims to predict the mortality risk in patients about to undergo coronary and heart valve operations) (Table 1).

Operative Procedures and Clinical Outcomes

The 2 groups underwent comparable numbers and types of operations with similar bypass and ischemic times (Table 2). There were 3 hospital deaths in the RFA group (6.1%) and 4 in the control group (8.3%) (P=.71). There were no differences between the
### Table 1. Baseline Patient Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Radiofrequency Ablation Group (n = 49)</th>
<th>Control Group (n = 48)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>31 (63.3)</td>
<td>24 (50)</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>67.2 (8)</td>
<td>67 (8)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>15 (30.6)</td>
<td>11 (23)</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>5 (10.2)</td>
<td>7 (14.5)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1 (2)</td>
<td>2 (4.2)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>4 (8.2)</td>
<td>2 (4.2)</td>
</tr>
<tr>
<td>CVA or TIA</td>
<td>9 (18.3)</td>
<td>4 (8.3)</td>
</tr>
<tr>
<td>Renal impairment</td>
<td>3 (6.1)</td>
<td>2 (4.2)</td>
</tr>
<tr>
<td>Angina symptoms</td>
<td>11 (22.4)</td>
<td>14 (29)</td>
</tr>
<tr>
<td>β-Blocker use</td>
<td>33 (67.3)</td>
<td>31 (64.6)</td>
</tr>
<tr>
<td>Digoxin use</td>
<td>38 (77.6)</td>
<td>40 (83.3)</td>
</tr>
<tr>
<td>Calcium channel blocker use</td>
<td>17 (34.6)</td>
<td>14 (29.2)</td>
</tr>
<tr>
<td>NYHA class, mean (SD)</td>
<td>2.5 (0.7)</td>
<td>2.4 (0.6)</td>
</tr>
<tr>
<td>Duration of atrial fibrillation, mean (SD), mo</td>
<td>57 (55.1)</td>
<td>46.7 (64.3)</td>
</tr>
<tr>
<td>Mitral regurgitation</td>
<td>41 (83.6)</td>
<td>40 (83.3)</td>
</tr>
<tr>
<td>Mixed mitral valve disease</td>
<td>8 (16.4)</td>
<td>8 (16.7)</td>
</tr>
<tr>
<td>Mitral valve disease etiology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degenerative</td>
<td>36 (73)</td>
<td>32 (66.6)</td>
</tr>
<tr>
<td>Rheumatic</td>
<td>11 (22.4)</td>
<td>11 (23)</td>
</tr>
<tr>
<td>Ischemic</td>
<td>2 (4.1)</td>
<td>5 (10.4)</td>
</tr>
<tr>
<td>Moderate or severe tricuspid regurgitation</td>
<td>12 (24.5)</td>
<td>14 (29.2)</td>
</tr>
<tr>
<td>Impaired left ventricular function</td>
<td>13 (26)</td>
<td>9 (19)</td>
</tr>
<tr>
<td>Left atrial size, mean (SD), cm</td>
<td>5.8 (0.7)</td>
<td>6.0 (1.1)</td>
</tr>
<tr>
<td>Parsonnet score†</td>
<td>13.7 (7)</td>
<td>14.4 (9.1)</td>
</tr>
<tr>
<td>shuttle-walk distance, mean (SD), m</td>
<td>281 (143)</td>
<td>253 (115)</td>
</tr>
</tbody>
</table>

Abbreviations: CVA, cerebrovascular accident; NYHA, New York Heart Association; TIA, transient ischemic attack.
*Data are reported as No. (%) unless otherwise indicated.
†Score range is 0 to 56.

### Table 2. Operative Data and Early Clinical Outcomes

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Radiofrequency Ablation Group (n = 49)</th>
<th>Control Group (n = 48)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitral valve repair</td>
<td>38 (77)</td>
<td>34 (71)</td>
</tr>
<tr>
<td>Quadrangular resection</td>
<td>15 (30.6)</td>
<td>13 (38)</td>
</tr>
<tr>
<td>Sliding plasty</td>
<td>4 (11)</td>
<td>3 (8)</td>
</tr>
<tr>
<td>Edge-to-edge repair</td>
<td>5 (13)</td>
<td>6 (18)</td>
</tr>
<tr>
<td>Artificial chordae insertion</td>
<td>3 (8)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Annuloplasty band only</td>
<td>10 (27)</td>
<td>12 (35)</td>
</tr>
<tr>
<td>Mitral valve replacement</td>
<td>11 (23)</td>
<td>14 (29)</td>
</tr>
<tr>
<td>Coronary artery bypass graft surgery</td>
<td>5 (10.2)</td>
<td>6 (12.5)</td>
</tr>
<tr>
<td>Tricuspid valve repair</td>
<td>9 (18.4)</td>
<td>7 (14.6)</td>
</tr>
<tr>
<td>Bypass time, mean (SD), min</td>
<td>106 (34)</td>
<td>99 (37)</td>
</tr>
<tr>
<td>Aortic clamp time, mean (SD), min</td>
<td>70 (26)</td>
<td>64 (28)</td>
</tr>
<tr>
<td>Elective procedures</td>
<td>44 (88)</td>
<td>42 (87)</td>
</tr>
<tr>
<td>Operative mortality†</td>
<td>3 (6.1)</td>
<td>4 (8.3)</td>
</tr>
<tr>
<td>Chest infection</td>
<td>8 (16.4)</td>
<td>9 (18.7)</td>
</tr>
<tr>
<td>CVA or TIA</td>
<td>2 (4)</td>
<td>1 (2.1)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>3 (6.1)</td>
<td>2 (4.2)</td>
</tr>
<tr>
<td>Hemofiltration</td>
<td>3 (6.1)</td>
<td>6 (12.5)</td>
</tr>
<tr>
<td>Intensive care unit stay, mean (SD), d</td>
<td>1.93 (1.96)</td>
<td>2.42 (2.93)</td>
</tr>
<tr>
<td>Total hospital stay, mean (SD), d</td>
<td>11.9 (5.5)</td>
<td>12.2 (7.1)</td>
</tr>
</tbody>
</table>

Abbreviations: CVA, cerebrovascular accident; TIA, transient ischemic attack.
*Data are reported as No. (%) unless otherwise indicated.
†Causes of death in the radiofrequency ablation group were low cardiac output (n = 1), pneumonia (n = 1), and stroke (n = 1) and in the control group were right-sided heart failure (n = 2), intestinal infarction (n = 1), and sudden cardiac arrest (n = 1).

### Antiarrhythmic Drug Therapy, Cardiac Rhythm, and Predictors of Sinus Rhythm Restoration

Eighty-two patients (92%) were taking amiodarone and 7 (2 in the RFA group and 5 controls) were taking sotalol at hospital discharge. At 12 months, 22 of the 22 patients who were in sinus rhythm, none were taking amiodarone and 4 were taking β-blockers for other indications. Of the 67 patients in atrial fibrillation at 12 months, 28 were taking amiodarone, 39 β-blockers, 57 digoxin, and 22 calcium channel antagonists.

Information on cardiac rhythm at hospital discharge and during follow-up is shown in Table 3. At each time point, sinus rhythm was significantly more prevalent in the RFA group (eg, at 12 months, rate ratio, 9.8; 95% confidence interval, 2.4-86.3; P < .001). In a multivariate logistic regression analysis, a left atrium larger than 6 cm in patients with rheumatic mitral valve disease was the only independent predictor of persisting atrial fibrillation 12 months following RFA (adjusted odds ratio, −0.76; 95% confidence interval, −1.70 to −0.20; P = .01). Tricuspid valve repair was a negative factor that approached but did not reach statistical significance (P = .06).

### Functional Outcomes

Compared with baseline, the RFA and control groups both achieved greater SWT distances postoperatively (Table 4). At 12 months, the RFA group recorded longer SWT distances in patients with rheumatic mitral valve disease was the only independent predictor of persisting atrial fibrillation 12 months following RFA (adjusted odds ratio, −0.76; 95% confidence interval, −1.70 to −0.20; P = .01). Tricuspid valve repair was a negative factor that approached but did not reach statistical significance (P = .06).
from baseline was not statistically significantly higher in the RFA group \((P = .13)\). Within the RFA group, there was no difference in the baseline SWT between patients who subsequently converted to sinus rhythm and those who did not. However, patients who converted to sinus rhythm had significantly greater improvements in SWT distances at both 6 and 12 months compared with those who remained in atrial fibrillation (Table 4). The control and the RFA groups had similar average New York Heart Association class scores 1 year postoperatively (Table 4).

**BNP Levels**

At baseline, BNP levels were similar between the RFA and control groups (Table 4). At 12 months, BNP values had decreased in both groups. The change from baseline was significantly greater in the RFA group \((P = .02)\). Within the RFA group, there was no difference in baseline BNP level between those who converted to sinus rhythm and those who remained in atrial fibrillation. At 12 months, BNP levels were lower in those in sinus rhythm, but not significantly so. However, those who converted to sinus rhythm had a significantly greater reduction in their BNP levels from baseline compared with those who did not convert \((P = .03)\).

### Echocardiographic Evaluation

Preoperatively, the RFA and control groups had similar ejection fraction, left ventricular end-systolic diameter, and left ventricular end-diastolic diameter. Compared with controls, patients who underwent RFA had significantly lower left ventricular end-systolic diameter and higher ejection fraction at 12 months (Table 5). Of the 22 patients (20 in the RFA group and 2 controls) who were in sinus rhythm at 12 months, 19 (86.4%) (18 in the RFA group and 1 control) exhibited a
Twelve months

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who underwent biatrial RFA. The pro-

cluded 30 patients (15 in each arm)

tion. A previous randomized study in-

patients with continuous atrial fibrilla-

trial to assess the efficacy of left atrial

is almost equal to that of correcting the

additional benefit of sinus rhythm res-

levels. We noted, by comparing pa-

contractility, enhanced exercise capac-

satisfactory rates of recovery of left atrial

ventricular dimensions and function,

tion of sinus rhythm was accompa-

prevalence of sinus rhythm 12 months

surgery significantly increased the

ous atrial fibrillation during mitral valve

found that left atrial RFA for contin-

In this randomized controlled trial, we

COMMENT

In this randomized controlled trial, we

found that left atrial RFA for continu-

ous atrial fibrillation during mitral valve

surgery significantly increased the

prevalence of sinus rhythm 12 months

later without an increase in peripera-

tive morbidity. At 6 months, restora-

tion of sinus rhythm was accompa-

nied by significant improvements in left

ventricular dimensions and function,

satisfactory rates of recovery of left atrial

contractility, enhanced exercise capacity,

and a significant decrease in BNP

levels. We noted, by comparing pa-

tients in the RFA group who did and
did not achieve sinus rhythm, that the

additional benefit of sinus rhythm rest-

oration in terms of exercise capacity is

almost equal to that of correcting the

mitral valve pathology.

To our knowledge, this is the first ad-

equately powered randomized clinical

trial to assess the efficacy of left atrial

RFA during mitral valve surgery in pa-

tients with continuous atrial fibrilla-

tion. A previous randomized study in-

cluded 30 patients (15 in each arm) who underwent biatrial RFA. The pro-

portion of patients who regained si-

nus rhythm 6 months after biatrial RFA

was approximately 50%, increasing to

82% at 12 months. In a more recent re-

port, 30 individuals were randomized
to receive pulmonary vein isolation,

maze procedure, or mitral valve sur-

gery alone and were reported to have

similar likelihood of sinus rhythm res-
toration following pulmonary vein iso-
lation and maze procedure. Several

centers have published nonrandom-

ized studies describing success rates in

restoring sinus rhythm of 60% to

90%. Direct comparison of our find-
ings with those in these studies is
difficult, as they lacked randomiza-
tion, often used different tools and le-

son sets, and, in several cases, in-

cluded patients with intermittent atrial

fibrillation.

The lack of difference in periopera-
tive morbidity and mortality between

the RFA and control groups in our

study attests to the safety and reliabil-

ity of the RFA procedure. Our pa-

tients included a significant propor-
tion of individuals requiring concomitant coronary artery bypass graft surgery (11%) and/or tricuspid valve surgery (17%). In this context, the perioperative mortality in the 2 groups (7%) is in keeping with previously published figures.

Functional capacity improved in both
groups, reflecting a beneficial hemody-
namic effect derived from correction of

mitral regurgitation. However, within the

RFA group, patients converting to si-
nus rhythm achieved significantly longer

SWT than their counterparts remaining

in atrial fibrillation. This suggests that

sinus rhythm restoration in patients un-
dergoing successful correction of mi-

tral regurgitation further improves func-
tional status. Although the mere resi-

tion of sinus rhythm may be im-

portant, perhaps a more relevant index

is recovery of atrial contraction. Evi-
dence of recovery of left atrial contrac-
tility was observed in 86% of patients

who regained sinus rhythm and could ac-

count for the improvements in cardiac

dimensions and function and the better

exercise capacity following RFA.

B-natriuretic peptide is released from

the myocardium in response to stretch

and is used to monitor the success of vari-

ous therapeutic interventions in pa-

tients with heart failure. We noted that

BNP levels were reduced postopera-
tively in both groups as a result of cor-

rective valve surgery with consequent

duction in the filling pressures. However,

this reduction was significantly more

prominent in those who converted to si-
nus rhythm. This is in agreement with

a recent report showing significant de-

creases in BNP levels following success-

ful maze procedure.

A limitation of our study is that our

analysis is based on ECGs obtained at

3-month intervals and on Holter and

ECG assessment at other times only for

symptoms. Episodes of recurrent atrial

fibrillation could have been paroxys-
mal and asymptomatic, although the

likelihood of such occurrences in pa-

tients who were previously in continu-

ous atrial fibrillation is difficult to es-

timate. Our study cannot exclude the

occurrence of such episodes; to detect

these would have required continu-

ous rhythm monitoring for prolonged

periods, which was not practicable.

However, the finding that the major-

ity of patients who had restored sinus


Table 5. Echocardiographic Dataa

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Radiofrequency Ablation Group (n = 45)</th>
<th>Control Group (n = 44)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ejection fraction, %</td>
<td>57 (6)</td>
<td>58 (7)</td>
<td>.70</td>
</tr>
<tr>
<td>LVEDD, cm</td>
<td>4.4 (0.5)</td>
<td>4.5 (0.7)</td>
<td>.39</td>
</tr>
<tr>
<td>LVESD, cm</td>
<td>5.92 (0.4)</td>
<td>5.97 (0.6)</td>
<td>.61</td>
</tr>
<tr>
<td>Maximum left atrial area, cm²</td>
<td>35 (7)</td>
<td>34 (9)</td>
<td>.49</td>
</tr>
<tr>
<td>Minimum left atrial area, cm²</td>
<td>26 (7)</td>
<td>26 (8)</td>
<td>.85</td>
</tr>
<tr>
<td>Ejection fraction, %</td>
<td>56 (7)</td>
<td>51 (6)</td>
<td>.01</td>
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<td>LVEDD, cm</td>
<td>3.96 (0.7)</td>
<td>4.33 (0.7)</td>
<td>.02</td>
</tr>
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<td>LVESD, cm</td>
<td>5.77 (0.6)</td>
<td>5.80 (0.7)</td>
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</tr>
<tr>
<td>Maximum left atrial area, cm²</td>
<td>34 (8)</td>
<td>32.4 (9)</td>
<td>.38</td>
</tr>
<tr>
<td>Minimum left atrial area, cm²</td>
<td>23 (8)</td>
<td>25.6 (8)</td>
<td>.11</td>
</tr>
<tr>
<td>Ejection fraction, %</td>
<td>59 (7)</td>
<td>54.2 (7)</td>
<td>.004</td>
</tr>
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<td>LVEDD, cm</td>
<td>3.93 (0.7)</td>
<td>4.26 (0.6)</td>
<td>.03</td>
</tr>
<tr>
<td>LVESD, cm</td>
<td>5.65 (0.6)</td>
<td>5.90 (0.6)</td>
<td>.27</td>
</tr>
<tr>
<td>Maximum left atrial area, cm²</td>
<td>32 (6)</td>
<td>33.5 (7)</td>
<td>.24</td>
</tr>
<tr>
<td>Minimum left atrial area, cm²</td>
<td>21 (6)</td>
<td>25 (7)</td>
<td>.14</td>
</tr>
</tbody>
</table>

Abbreviations: LVEDD, left ventricular end-diastolic diameter; LVESD, left ventricular end-systolic diameter. *Data are reported as mean (SD).
rhythm were in this rhythm at discharge and consistently at each follow-up suggests that they were in this rhythm permanently.

The search for the optimal treatment of atrial fibrillation accompanying mitral valve disease will continue, and further randomized clinical trials are needed to examine the efficacy of bipolar ablation, which more consistently achieves transmural lesions, and also the role of the less-invasive thoracoscopic interventions. In the meantime, on the basis of its safety and efficacy, our findings suggest that routine use of left atrial RFA during mitral valve surgery is justified.

**Author Contributions:** Dr Spyt had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Study concept and design:** Doukas, Samani, Chin, Stafford, Spyt.

**Acquisition of data:** Doukas, Oc.

**Analysis and interpretation of data:** Doukas, Samani, Alexiou, Ng, Spyt.

**Drafting of the manuscript:** Doukas, Samani, Alexiou, Oc.

**Critical revision of the manuscript for important intellectual content:** Samani, Alexiou, Chin, Stafford, Ng, Spyt.

**Statistical analysis:** Alexiou, Oc.

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**REFERENCES**


