Event recorder monitoring to compare the efficacy of a left versus biatrial lesion set in patients undergoing concomitant surgical ablation for atrial fibrillation

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Objectives: Various lesion sets and subsequent success rates have been reported in patients receiving concomitant surgical ablation for atrial fibrillation. However, most of these results have been obtained by discontinuous monitoring. We report results using continuous event recorder rhythm monitoring to compare more accurately the efficacy of a left versus biatrial lesion set to treat patients with persistent atrial fibrillation.

Methods: Between July 2008 and December 2011, 66 patients with persistent or long-standing persistent atrial fibrillation underwent concomitant surgical atrial fibrillation ablation with a biatrial lesion set and subcutaneous event recorder implantation. The results and outcomes were compared with a propensity score–matched cohort of 66 patients with a left atrial lesion set and event recorder implantation. Event recorder interrogation was performed at 3, 6, and 12 months follow-up.

Results: The mean patient age was 70.2 ± 7.4 years, and 70.3% were male. No major ablation-related complications occurred. One-year survival was 94.8% with no statistically significant differences between the 2 groups. The overall rate of freedom from atrial fibrillation was 57.3% and 64.4% after 3 and 12 months follow-up, respectively. Three months postoperatively, patients in the biatrial group had a slightly higher rate of freedom from atrial fibrillation (63.6% vs 52.3% $P = .22$), but it did not reach statistical significance. At 12 months follow-up, a statistically significant higher rate of freedom from atrial fibrillation was observed in patients with a biatrial lesion set (74.4% vs 55.8%; $P = .026$). The mean atrial fibrillation burden in all patients was 15.1% ± 12.5% in the biatrial group and 21.2% ± 14.4% in the left atrial group 12 months postoperatively ($P = .03$).

Conclusions: Continuous rhythm monitoring by subcutaneous event recorder implantation was safe and feasible. In patients undergoing biatrial ablation, a statistically significant higher rate of freedom from atrial fibrillation was observed at 12 months follow-up. (J Thorac Cardiovasc Surg 2014;148:2161-6)

Atrial fibrillation (AF) is associated with an increased number of thromboembolic events, including stroke. Furthermore, it can lead to heart failure and results in an increased number of hospitalizations.[1,2] Therefore, concomitant surgical AF ablation is recommended by guidelines for symptomatic patients and for asymptomatic patients at low risk for the surgical ablation procedure.[2,3] Cox first reported his surgical AF ablation technique using the cut-and-sew principle in 1987, which was subsequently revised to the Cox-Maze III procedure.

Because of success rates greater than 90%, the Cox-Maze III procedure became the gold standard for surgical AF ablation. However, because of the complexity of the procedure, it was performed by only a few surgeons. After the cut-and-sew principle was recently replaced with the creation of transmural thermal lesions via the application of different energy sources, such as radiofrequency, high-frequency ultrasound, or cryotherapy, the use of the procedure has become widespread. This procedure is known as the "Cox-Maze IV" and contains a similar lesion set as in the initial Cox-Maze III procedure, including lesions in both atria.[4]

Different modifications and simplifications of the original lesion set have been used over the years. In most patients, AF originates at the pulmonary veins, especially in patients with paroxysmal AF, and in such cases, a left atrial lesion set is considered sufficient by many specialists. However, in patients with persistent or long-standing persistent AF, there is an ongoing discussion about whether a biatrial lesion set results in higher success rates.[4-8] All of the recent published studies comparing the efficacy of different lesion sets used discontinuous rhythm monitoring. However, studies comparing the efficacy of different follow-up

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Abbreviations and Acronyms
AF = atrial fibrillation
ECG = electrocardiography
ER = event recorder

methods after surgical AF ablation have shown that short time rhythm monitoring, even with repeated 24-hour Holter electrocardiography (ECG), underestimates the rate of AF recurrence.[9] The Reveal XT Performance Trial (XPECT) trial showed high sensitivity (96.1%) and negative predictive value (97.4%) for the detection of AF episodes by the Reveal XT (Medtronic Inc, Minneapolis, Minn) device,[10] a subcutaneous implantable event recorder (ER). This device is programmed to detect arrhythmia episodes by analysis of irregularity and incoherence of R-R intervals. The Reveal XT is able to detect the duration of AF episodes and burden, defined as the percentage of time the patient is in AF during follow-up. The aim of our study was to compare the efficacy of left and biatrial lesion sets through continuous rhythm monitoring using subcutaneous ER implantation.

MATERIALS AND METHODS

From July 2008 to December 2011, 255 patients underwent concomitant surgical ablation because of persistent or long-standing persistent AF. Of those patients, 88 received biatrial ablation and 167 received left atrial ablation. Classification of persistent and long-standing persistent AF was according to Heart Rhythm Society/European Heart Rhythm Association/European Cardiac Arrhythmia Society expert consensus statement on catheter and surgical ablation of AF.[3] Propensity score matching resulted in a group of 66 patients who received a biatrial lesion set and subcutaneous ER (Reveal XT) implantation and a control group of 66 patients who received a left atrial lesion set and ER implantation. All patients received implantation of the Reveal device during surgical ablation procedure. Patients were matched by age, gender, left ventricular ejection fraction, left atrial diameter, AF duration, surgical procedure, and energy source type.

In group 1, biatrial ablation was performed in 66 patients, including left atrial bilateral pulmonary vein ablation, box lesion, and left atrial appendage and isthmus isolation. Right sided-lesion set included an intercaval lesion and isolation of the cavotricuspid isthmus, right atrial appendage, and terminal crest. In group 2, only the left atrial lesion set was conducted. Applied energy sources included argon-based cryoablation (cryoICE cryoablation probe, AtriCure Inc, West Chester, Ohio; Cardioblate CryoFlex Surgical Ablation Probe, Medtronic Inc) in 21 patients (biatrial, n = 12; left atrial, n = 9; $P = .63$), unipolar radiofrequency ablation (Cardioblate unipolar RF pen, Medtronic Inc) in 52 patients (biatrial, n = 28; left atrial, n = 24; $P = .37$), and bipolar ablation (Cardioblate BP2 device and Cardioblate Surgical Ablation System Generator, Medtronic Inc; Atricure Isolator Synergy Ablation Clamp, AtriCure Inc) in 59 patients (biatrial, n = 26; left atrial, n = 33). None of these energy sources were used in combination.

Statistical Analysis

All statistical analyses were performed using SPSS version 18.0 (SPSS Inc, Chicago, Ill). Continuous values are expressed as mean ± standard deviation and were compared using the Student *t* test or Mann–Whitney test as appropriate. Categoric variables are displayed as frequencies, and percentages were compared using the chi-square test or Fisher exact test as appropriate. Reported *P* values are 2-sided. A logistic regression model was used to generate a control group with a left atrial lesion set matched for the variables detailed earlier. Matching was performed by selecting a patient randomly from the biatrial group and identifying a partner in the control group with the nearest logit-transformed propensity score. Matching balance was assessed using statistical analysis with the Fisher exact test for categoric variables and the Student *t* test for continuous variables.

Follow-up

Follow-up with ER interrogation was conducted 3, 6, and 12 months postoperatively. AF recurrence was defined as an AF burden greater than 0.5% or a single stored AF episode with duration more than 30 seconds on ER interrogation. However, one needs to realize that the Reveal ER has a blanking period of 2 minutes because R-R intervals are analyzed within each 2-minute period of time. When there is a uncorrelated irregularity of the R-R intervals within the 2-minute interval, the heart rhythm in this period is classified as AF. All stored episodes were manually validated during follow-up visits. The primary end point of the study was freedom from AF after 12 months. To obtain success rate at 12 months, stored AF episodes from ER interrogation between 6 and 12 months were included. The postoperative and discharge rhythm results were obtained using 12-lead ECG. The antiarrhythmic drugs and anticoagulation regimens were maintained for 3 months postoperatively in all patients and then adapted according to the ER rhythm results. In patients without contraindications, amiodarone was used as the first-line antiarrhythmic drug therapy; otherwise, other class I or III antiarrhythmic drugs were used for at least 3 months postoperatively.

RESULTS

Baseline patient characteristics are shown in Table 1. Because of the matching process, there were no statistically significant differences between the 2 groups. The mean patient age was 70.1 ± 7.5 years in the left atrial group and 70.5 ± 7.3 years in the biatrial group. The mean left ventricular ejection fraction was 51.5% ± 10.9% in patients with a left atrial lesion set and 51.9% ± 10.8% in the biatrial group. The mean left atrial diameter was 53.6 ± 7.5 mm for patients with a left atrial lesion set and 54.9 ± 8.0 mm in patients with biatrial ablation. The mean AF duration was 3.9 ± 3.2 years in patients with a left atrial set and 4.5 ± 3.8 years for patients with a biatrial lesion set. Surgical procedures and applied energy sources were equally distributed between the 2 groups (Table 2).

No major ablation or ER-associated complications occurred in any of the patients. There were no cases of intraoperative death. The in-hospital mortality rate was 2.2% (3/132) (biatrial, 3.0% 2/66; left atrial, 1.5% 1/66; $P = .25$), whereas the 30-day mortality rate was 3.0% (4/132) (biatrial, 3.0%; left atrial, 3.0%). The 1-year survival was 94.8% (125/132), and there were no statistically significant differences between the 2 groups (biatrial, 95.6%; left atrial, 93.9% $P = .68$). Three of 125 patients (2.4%) experienced perioperative stroke (left atrial, 2/63 [1.8%]; biatrial, n = 1/62 [1.0%]). Postoperative new permanent pacemaker implantation rate was 11.2% (7/62) and 6.5% (4/63) ($P = .5$) in the biatrial and left atrial groups, respectively.