Should We Ablate Atrial Fibrillation During Coronary Artery Bypass Grafting and Aortic Valve Replacement?

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Background. This study evaluates the safety and efficacy of concomitant atrial fibrillation (AF) ablation in patients with AF undergoing coronary artery bypass grafting (CABG) or aortic valve replacement (AVR) or both.

Methods. This is a single-center retrospective study of patients with AF presenting for CABG or AVR or both between 2009 and 2013. They were divided into an ablation group that underwent concomitant AF ablation and a control group that did not. Follow-up data were obtained using telephone interviews. The data were 100% complete with a median follow-up of 30 months.

Results. A total of 375 patients with AF presented for CABG (44%), AVR (27%), or CABG and AVR (29%). The ablation (129 patients) and control (246 patients) groups had similar baseline characteristics. The ablation group had significantly longer cardiopulmonary bypass and cross-clamp times, adding a mean of 31 ± 3 and 22 ± 3 minutes ($p < 0.01$ for both), respectively. There were similar unadjusted rates of hospital mortality (4.7% versus 5.3%, $p = 0.79$), stroke (3.1% versus 3.3%, $p = 0.94$), and reopening (4.7% versus 6.5%, $p = 0.46$) between the groups. The intensive care and hospital length of stays were similar. The ablation group had a lower incidence of postoperative AF (27% versus 78%, $p < 0.01$). Adjusted operative mortality was similar, but the intervention group had significantly lower odds of postoperative AF (odds ratio 0.11, $p < 0.01$). Although there was no difference in mid-term survival, the ablation group had higher mid-term AF-free survival ($p < 0.01$) and a trend toward higher anticoagulation-free ($p = 0.09$) and stroke-free survival ($p = 0.08$).

Conclusions. Concomitant AF ablation in patients with AF undergoing CABG or AVR or both does not increase perioperative rates of mortality or morbidity. Moreover, concomitant AF ablation is effective at reducing postoperative AF burden and increases mid-term AF-free survival.

(Ann Thorac Surg 2017;104:515–22)

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia and frequently presents in association with other cardiovascular problems such as valvular and coronary artery disease [1]. In patients undergoing cardiac operation, preoperative AF is common, with a prevalence of 11% in North America [2]. Preoperative AF portends a poorer outcome after coronary artery bypass grafting (CABG) and aortic valve replacement (AVR). In fact, untreated AF in patients undergoing cardiac operation is associated with increased risk of perioperative stroke and mortality and reduced long-term survival [3–6].

The efficacy and safety of concomitant AF ablation in patients with AF undergoing mitral valve operation has been previously demonstrated [7]. Although mitral valve disease directly contributes to the genesis of AF through left atrial enlargement, patients with aortic valve and coronary artery disease are pathophysiologically distinct from patients with mitral valve disease. Atrial structural abnormalities, including fibrosis, dilatation, ischemia, and hypertrophy, are some of the mechanisms leading to AF. Extracardiac factors such as hypertension or obesity, which are commonly found in these patients, are also known to be involved in AF genesis. Therefore, extrapolation from studies on concomitant ablation in mitral valve operation to patients undergoing aortic valve and coronary operations is inappropriate.

Surgeons in North America remain hesitant to add AF ablation to CABG, AVR, or CABG and AVR with less than 35% of patients receiving concomitant AF ablation, despite a history of AF [2]. The dearth of data on concomitant AF ablation during CABG or AVR combined with the perceived increased operative risk from adding atriotomies necessitates a thorough evaluation of its safety and efficacy during CABG or AVR. The objective of this study is to evaluate the safety and efficacy of concomitant AF ablation during CABG, AVR, or CABG and AVR and its mid-term efficacy in terms of AF recurrence, the need to resume anticoagulation, and stroke-free survival. We hypothesize that adding a

Accepted for publication Nov 29, 2016.

Presented at the Fifty-second Annual Meeting of The Society of Thoracic Surgeons, Phoenix, AZ, Jan 23–27, 2016.

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0003-4975/$36.00
http://dx.doi.org/10.1016/j.athoracsur.2016.11.081

concomitant AF ablation is safe and does not increase perioperative rate of morbidity and mortality; reduces AF burden postoperatively; and increases AF-free, anticoagulation-free, and stroke-free survival.

Patients and Methods

Study Design

This is a single-center retrospective study of prospectively collected data, which was obtained from the University of Ottawa Heart Institute cardiac surgery and anesthesiology databases. All patients with AF presenting for isolated CABG, isolated AVR, or combined CABG and AVR between 2009 and 2013 were included. These patients were divided into a group that underwent concomitant AF ablation and a control group that did not undergo any ablation procedures. Preoperative, operative, and postoperative data were obtained on all patients, and the two groups of patients were compared. In addition to routine follow-up, all patients or their health care providers were contacted for telephone interviews for vital statistics for a mean follow-up of 32 months, which was complete.

AF during hospitalization was diagnosed using both continuous telemetry and 12-lead electrocardiograms (ECGs). Patients at our center are followed at 30 days, 3 months, 6 months, and 1 year by the surgeon (30 days) and the cardiologist (subsequent follow-ups). Patients who had valve replacement are also followed up yearly thereafter. It is standard that all postoperative patients received a 12-lead ECG, a chest roentgenogram, and routine blood work (complete blood count, electrolytes, blood urea nitrogen, and creatinine) on their first postoperative visit. At subsequent visits it is standard that patients receive a 12-lead ECG, and any further tests were at the discretion of the ordering physician. AF was diagnosed using conventional methods, including both 12-lead ECGs and Holter monitoring. A Holter monitor was ordered at the discretion of the surgeon or cardiologist, which was usually due to patient-reported symptoms of palpitations. However, there was no prespecified protocol for ordering Holter monitoring. The duration of the monitoring was most commonly for 48 hours.

The primary purpose of the study is to compare safety outcomes between patients who had AF ablation and patients who did not. The primary safety end point was the occurrence of death, stroke, or myocardial infarction. Secondary end points included the incidence of postoperative bleeding requiring transfusion of packed red blood cells or reopening, rates of acute renal failure, pneumonia, and prolonged ventilation (>24 hours). Other secondary end points included mid-term survival, stroke-free survival, AF-free survival, and anticoagulation-free survival (freedom from warfarin or novel anticoagulants).

Ethics

The University of Ottawa Heart Institute has approval from its institutional research ethics board to anonymously publish data that are prospectively collected from the perioperative surgery clinic. Data were only used from patients who have provided consent to allow confidential use of their clinical information. Consent was also obtained from patients to collect information from them or their physicians through telephone interviews.

Surgical Technique

The decision to add an AF ablation procedure and the choice of lesion set was at the discretion of the surgeon. For biatrial AF ablation, the Cox-Maze IV lesion set was used as previously described [8]. Left-sided AF ablation used the left atrial lesion set from the Cox-Maze IV. Pulmonary vein isolation (PVI) included lesions encircling both right and left pulmonary veins. These lesions included a cuff of left atrium and at least three different applications of the bipolar clamp were performed on each side. A combination of radiofrequency and cryothermy was used as the energy sources. Cryothermy ablation lines were performed using 2 minutes of adequate contact with the tissue. No classic "cut and sew" procedure was performed in these patients. All patients had a standard median sternotomy, were placed on cardiopulmonary bypass, and underwent diastolic arrest using cold blood cardioplegia. All patients undergoing AF ablation also had a left atrial appendage (LAA) excision, which consisted of amputation and oversewing at the base of the LAA.

Statistical Analysis

Data were imported and analyzed in STATA 14 statistical software (Stata Corporation, College Station, TX). Continuous variables were expressed as a mean $\pm$ standard error or median $\pm$ interquartile range, whereas categorical variables were described as a percentage of the total. Continuous data were compared with an independent Students *t* test when normally distributed and with a Wilcoxon rank sum test when data were skewed. Categorical variables were compared with a χ^2 test or Fisher's exact test when count was less than 5. Multivariable logistic regression was used to adjust for preoperative and operative patient characteristics, including age, sex, type of AF, history of stroke, diabetes mellitus, hypertension, dyslipidemia, chronic obstructive pulmonary disease, left ventricular ejection fraction, redo operation, urgency of procedure, type of operation, and bypass and cross-clamp times. Kaplan-Meier survival curves were used to summarize survival, stroke-free survival, AF-free survival, and anticoagulation-free survival. Log-rank test and Cox regression model were used to compare groups after assessing the feasibility of the proportional hazards assumption. The proportionality assumption of the Cox regression model was tested using plots of log (-log Survival) versus log (time). A p value less than 0.05 was considered statistically significant throughout all analyses.

Results

Between the year 2009 and 2013, 375 patients known to have AF presented for isolated CABG, isolated AVR, or combined CABG and AVR. Those patients were divided