Midterm survival in patients treated for atrial fibrillation: A propensity-matched comparison to patients without a history of atrial fibrillation

Richard Lee, MD, MBA, Patrick M. McCarthy, MD, Edward C. Wang, PhD, Muthiah Vaduganathan, BA, Jane Kruse, RN, S. Chris Malaisrie, MD, and Edwin C. McGee, Jr, MD

Objective: Patients undergoing cardiac surgery with a history of untreated atrial fibrillation have reduced survival compared with similar patients without atrial fibrillation. We sought to compare the midterm survival of patients who received concomitant surgical ablation treatment for atrial fibrillation (atrial fibrillation ablated) with that of matched patients without a history of atrial fibrillation (no atrial fibrillation).

Methods: We evaluated 3262 consecutive patients (813 [25%] with atrial fibrillation and 2449 [75%] without preoperative atrial fibrillation) undergoing cardiac surgery at a single institution from April 2004 to April 2009. Of patients with atrial fibrillation, 565 (70%) were treated with a concomitant surgical ablation procedure. Propensity scores were calculated on the basis of 37 known preoperative risk factors and yielded 744 patients. Midterm survival was compared between patients with atrial fibrillation ablation (n = 372) and patients without atrial fibrillation (n = 372). Survival was also compared between patients with successful vs unsuccessful ablation, and a matched analysis was performed at 1 year between the 2 groups.

Results: Mean follow-up was 2.7 ± 1.6 years. Patients without atrial fibrillation and patients with treated atrial fibrillation had similar early 30-day mortality (1.2% vs 0.3%, $P = .37$) and overall mortality rates (11.6% vs 9.4%, $P = .344$), respectively. Survival analysis showed no differences at 1, 3, and 5 years between the 2 groups (log-rank $P = .22$). At last follow-up, 78% of treated patients were free of atrial fibrillation. At 1 year, 68% of patients were free of atrial fibrillation and antiarrhythmic medication. Freedom from atrial fibrillation and antiarrhythmic medication at 1 year predicted improved midterm survival ($P = .03$) compared with patients in atrial fibrillation or taking antiarrhythmic medication. Propensity-matched analysis after 1 year demonstrated improved survival for patients who were successfully treated ($P = .016$).

Conclusions: Patients undergoing surgical treatment of atrial fibrillation had survival similar to that of patients without a history of atrial fibrillation. Those with successful sinus restoration had improved survival compared with those who were treated but remained in atrial fibrillation. (J Thorac Cardiovasc Surg 2012;143:1341-51)

Patients with atrial fibrillation (AF) have a reduced survival when compared with patients in sinus rhythm.[1] Patients with AF have increased rates of stroke, heart failure, and all-cause mortality.[2] Pharmacologic attempts at sinus restoration have been unable to establish a survival advantage over rate control alone.[3] However, on subsequent multivariate analysis, patients with successful restoration of sinus rhythm demonstrated a survival advantage over those in AF, suggesting that a therapy that successfully treats AF may affect survival.[4]

Patients with preoperative AF undergoing cardiac surgery also have an increased risk of mortality.[5-9] For example, patients with AF undergoing coronary artery bypass grafting (CABG) have a 24% survival disadvantage at 10 years compared with matched patients undergoing CABG without preoperative AF.[5,6] In matched patients undergoing aortic valve replacement, patients with AF have worse survival and an increased incidence of strokes and heart failure.[7,8]

Surgical ablation of AF in patients undergoing cardiac surgery has improved and is more widely applied, but it is still performed in the minority of cases.[10] Ablation usually adds little to the operation (9 minutes to crossclamp time and 9 minutes to cardiopulmonary bypass time in patients

From the Bluhm Cardiovascular Institute, Division of Cardiac Surgery at Northwestern University Feinberg School of Medicine and Northwestern Memorial Hospital, Chicago, Ill.

Disclosures: Authors have nothing to disclose with regard to commercial support.

Read at the 37th Annual Meeting of The Western Thoracic Surgical Association, Colorado Springs, Colorado, June 22-25, 2011.

Received for publication June 25, 2010; revisions received Jan 12, 2012; accepted for publication Feb 3, 2012; available ahead of print April 2, 2012.

Address for reprints: Richard Lee, MD, MBA, Division of Cardiac Surgery, Northwestern University, 201 East Huron Street, Suite 11-140, Chicago, IL 60611-2968 (E-mail: ricklee@nmh.org).

0022-5223/$36.00

doi:10.1016/j.jtcvs.2012.02.006

Abbreviations and Acronyms
AA = antiarrhythmic
AF = atrial fibrillation
CABG = coronary artery bypass grafting
CI = confidence interval
HR = hazard ratio

undergoing mitral valve surgery).[10] Surgery for AF has been shown to be safe and effective and does not add to perioperative morbidity and mortality when combined with other cardiac procedures; however, a benefit to midterm survival has not been established.[11-15]

The purpose of this study was to compare the midterm survival of patients with AF who received surgical ablation for AF (AF ablated) at the time of cardiac surgery with that of similar patients without preoperative AF (no AF). Our hypotheses were that (1) the AF ablated group would have a similar survival as the no AF group after adjusting for preoperative risk factors, and that (2) the successful restoration of sinus rhythm would improve survival compared with patients who return to AF.

MATERIALS AND METHODS

We queried the Bluhm Cardiovascular Institute's Clinical Trials Cardiac Surgery Outcomes Registry for all patients who underwent cardiac surgery since the inception of the database from April 2004 to April 2009. This Registry is approved by the institutional review board at Northwestern University (project STU00012288). Data were collected from patients enrolled in the Registry and from medical record review. All patients in this study consented for the use of their follow-up data. Data were deidentified before analysis.

Study Population

We evaluated 3262 consecutive patients (813 [25%] with AF and 2449 [75%] without preoperative AF). Of the 813 patients with AF, 565 (70%) were treated with a surgical AF ablation procedure (classic cut-and-sew Maze in 78, biatrial Maze in 140, left atrial Maze in 213, pulmonary vein isolation [island] in 108, pulmonary vein isolation [box] in 23, and procedures that not fit into any other category in 3). The AF untreated (n = 248) group had similar age but several adverse preoperative risk factors, including diabetes, hypertension, congestive heart failure, New York Heart Association class, renal failure, chronic obstructive pulmonary disease, peripheral vascular disease, myocardial infarction, stroke, and transient ischemic attack compared with the AF ablated group (Table 1). Patients were treated for AF when the risks of adding the procedure were considered to be low, there was a reasonable chance for success, and the surgery was performed by an experienced surgeon in accordance with the Heart Rhythm Society/European Heart Rhythm Association/European Cardiac Arrhythmia Society Expert Consensus Statement.[16] Preoperative demographic and clinical data were collected on all patients, as were perioperative outcomes. The standard Society of Thoracic Surgeons' database definitions were used for all variables. The Society of Thoracic Surgeons' risk score could not be implemented in those with AF; therefore, Ambler risk scores were calculated and compared. Midterm survival was identified by the Social Security Death Index and measured as time (days) to death or last follow-up from date of surgery. Follow-up was 100% complete.

Statistical Analysis

Before final statistical analysis, preliminary data were analyzed using univariate and graphic methods wherever applicable to facilitate inspection and interpretation of the data. Outliers and influential observations were identified and checked for accuracy. Data error due to data entry oversight was appropriately corrected. Data were summarized using descriptive statistics (eg, means and standard deviation for continuous variables; count and frequency for categoric variables). Group differences in patient demographics and clinical and surgical characteristics were compared using a *t* test (parametric) or Wilcoxon Mann–Whitney test (nonparametric) for continuous variables and chi-square test or Fisher exact test for categoric data.

Unadjusted survival estimates were analyzed using the Kaplan–Meier method, and adjusted hazard ratio (HR) of long-term mortality was estimated using the Cox proportional hazard models. Risk factors by which these survival estimates were adjusted for are shown in Table 2. Propensity scores were further calculated on the basis of the probability of undergoing a surgical AF ablation procedure and no preoperative AF condition. The propensity score was developed by fitting a logistic regression model with AF treatment as the outcome variable and all risk factors in Table 1 as the predictor variables. Missing data of predictor variables were imputed using multiple imputations of SAS PROC MI (SAS Institute Inc, Cary, NC) procedure. All *P* values after propensity score adjustment were not statistically significant (Table 2), indicating a good balance after adjustment.

The AF ablated group (n = 372) was propensity matched (1:1) with the no AF history (n = 372) group using the caliper-matching method.[17] Specifically, we imposed a 0.02 propensity score tolerance on the maximum propensity score distance (caliper) in our matching algorithm so that bad matches could be avoided. Balance of covariates before and after propensity adjustment was checked using both density distribution of the propensity score and Wald chi-square statistics to access the quality of the match. The 744 matched patients were analyzed for differences in midterm survival using Kaplan–Meier and log-rank methodology. Additional matches were performed for patients undergoing isolated aortic valve replacement (n = 44), mitral valve repair or replacement (n = 130), and concomitant coronary artery bypass and valve intervention (CABG + valve) (n = 186).

For the AF ablated group, the standard protocol for postoperative monitoring and medication management of AF at Bluhm Cardiovascular Institute, developed in collaboration with cardiac electrophysiologists, was reviewed with patients and shared with referring cardiologists. The protocol recommends continuous electrocardiographic monitoring for a minimum of 24 hours at 3 and 6 months to guide medication changes and every 6 months for 2 years after intervention to monitor rhythm status. Pacemaker interrogation was used whenever possible. If any monitor showed AF and no further attempts were made to restore sinus rhythm, the patient was deemed a "failure" and continuous monitoring was no longer required. Patients were also contacted by phone at 3, 6, and 12 months to track medications and provide support.

Survival was compared in the AF ablation group between patients with successful sinus restoration and patients with "failed" treatment. Success was defined at 1 year as freedom from of any episode of AF without antiarrhythmic (AA) medications. Throughout the report, statistical significance was established at an alpha level of .05. All statistical analyses were performed using SAS 9.2 statistical software (SAS Institute Inc). In an effort to assess whether the return to AF was a marker or cause of mortality, after 1 year, 77 patients successfully treated were propensity matched (1:1) with 77 patients with unsuccessful treatment using the caliper matching method.[17,18] We again imposed a 0.02 propensity score tolerance on the maximum propensity score distance (caliper) in our matching algorithm so that bad matches could be avoided. Covariate balance before and after propensity adjustment was checked using both density distribution of the propensity score and Wald chi-square statistics to access the quality of the match. The 154 matched patients were analyzed for differences in midterm survival using Kaplan–Meier and log-rank methodology.