De novo atrial fibrillation after mitral valve surgery

Christopher K. Mehta, MD, Patrick M. McCarthy, MD, Adin-Cristian Andrei, PhD, Jane Kruse, BSN, Hangzhi Shi, MS, Andrei Churyla, MD, S. Chris Malaisrie, MD, Duc Thinh Pham, MD, and James L. Cox, MD

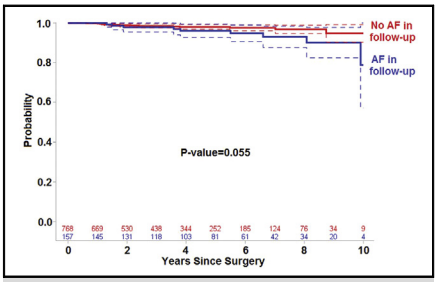
ABSTRACT

Objectives: We sought to determine the incidence and risk factors for de novo atrial fibrillation (>90 days after surgery) in patients without preoperative atrial fibrillation.

Methods: From 2004 to 2014, 2261 patients underwent mitral valve surgery; 1288 patients (57%) did not have a history of atrial fibrillation, and 930 patients had rhythm information more than 90 days after surgery. De novo atrial fibrillation and death probabilities were estimated using a semi-competing risks, multi-state model. Univariable and multivariable risk factors for developing atrial fibrillation were identified using the Fine–Gray model.

Results: The 5- and 10-year incidences of de novo atrial fibrillation were 14% and 23%, respectively. Univariable risk factors were older age, more complex operations, more tricuspid regurgitation, and congestive heart failure (all $P < .05$). Patients with degenerative mitral regurgitation were less likely to develop atrial fibrillation (hazard ratio [HR], 0.4; 95% confidence interval [CI], 0.24-0.65; $P < .001$). Multivariable risk factors for de novo atrial fibrillation were tricuspid valve surgery (HR, 1.80; 95% CI, 1.22, 2.65; $P = .003$), aortic valve surgery (HR, 1.49; 95% CI, 1.03-2.17; $P = .035$), and older age (HR, 1.03; 95% CI, 1.02-1.05; $P < .001$). De novo atrial fibrillation did not affect overall survival ($P = .41$). Among patients who developed de novo atrial fibrillation, we observed increased use of warfarin ($P < .001$) and a strong trend toward an increased risk of stroke ($P = .055$).

Conclusions: De novo atrial fibrillation develops progressively after mitral surgery and is associated with a strong trend toward stroke. Patients at high risk could be studied in a trial to reduce atrial fibrillation. (J Thorac Cardiovasc Surg 2018;156:1515-25)



Freedom from stroke by AF status in follow-up.

Central Message

A steady rate of de novo AF (>90 days postsurgery) develops after MV surgery in patients without a preoperative history of AF and was associated with a trend ($P = .055$) toward increased stroke.

Perspective

Development of de novo AF after MV surgery may affect the risk of stroke and development of functional TR. Identifying patients at risk of developing AF and treating them with prophylactic ablation may reduce the risk of AF, lower stroke risk, and limit late functional TR.

See Editorial Commentary page 1526.

See Editorial page 1514.

Preoperative atrial fibrillation (AF) in patients undergoing surgery for mitral valve (MV) disease is associated with late adverse events and reduced survival.[1,2] When AF is identified preoperatively, surgical ablation is recommended to attempt sinus rhythm restoration.[3,4] Multiple prospective randomized studies have demonstrated that the addition of surgical ablation to MV surgery for patients with preoperative AF significantly increases freedom from AF.[3,5] The addition of a surgical ablation procedure does not increase morbidity or mortality and has even been associated with better perioperative outcomes.[6]

Scanning this QR code will take you to the supplemental figures, tables, appendices, and video for this article.

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

Institutional Review Board Approval: Northwestern University approved STU00012288.

Read at the 43rd Annual Meeting of The Western Thoracic Surgical Association, Colorado Springs, Colorado, June 21-24, 2017.

Received for publication June 21, 2017; revisions received Feb 23, 2018; accepted for publication April 10, 2018.

Address for reprints: Patrick M. McCarthy, MD, Division of Cardiac Surgery, Northwestern University Feinberg School of Medicine and Northwestern Memorial Hospital, Bluhm Cardiovascular Institute, 201 E Huron St, Suite 11-140, Chicago, IL 60611 (E-mail: pmccart@nm.org).

0022-5223/$36.00

https://doi.org/10.1016/j.jtcvs.2018.04.050

Abbreviations and Acronyms

AF = atrial fibrillation
AV = aortic valve
CARD = Cardiovascular Research Database
CI = confidence interval
DMR = degenerative mitral regurgitation
HR = hazard ratio
MV = mitral valve
PS = propensity score
TR = tricuspid regurgitation
TV = tricuspid valve

De novo AF, defined in this study as new AF 90 days or more after MV surgery (to exclude patients with only early postoperative AF), has been infrequently studied, and there are little data on incidence and risk factors for this.[7] We therefore sought to (1) characterize the incidence over time of de novo AF in patients who underwent MV surgery with or without additional cardiac surgical procedures; (2) identify potentially modifiable preoperative or perioperative risk factors for de novo AF, such that a prophylactic AF ablation procedure might be considered; and (3) evaluate the sample size of a potential study designed to reduce the incidence of de novo AF (Video 1).

MATERIALS AND METHODS

Patients

From April 2004 to December 2014, 2261 patients had mitral ± other cardiac procedures, and of these, 1370 had no AF history and therefore no surgical AF ablation. A preoperative Holter monitor was routinely obtained in any patient with symptoms suggestive of arrhythmias to confirm absence of AF. After excluding patients who refused to participate in the Bluhm Cardiovascular Institute's Clinical Trials Unit Cardiovascular Research Database (CARD) at Northwestern University (IRB#STU00012288), 1288 patients (94%) were included. Of those, 930 (72%) had follow-up heart rhythm information at 90 days or more after surgery and comprise the study cohort. Preoperative, intraoperative, and postoperative data were obtained from CARD, and the Society of Thoracic Surgery database definitions were used for complications. Reported stroke includes transient ischemic attack and cerebrovascular accident (hemorrhagic or ischemic). Postoperative AF includes patients with new AF or atrial flutter persisting longer than 1 hour or requiring treatment before discharge per Society of Thoracic Surgeons definitions.

Atrial Fibrillation Monitoring and Clinical Follow-up Protocols

Unlike Northwestern patients treated with AF ablation who undergo a regimen of postoperative AF monitoring,[8] these patients were not routinely monitored. Test results and office visits were prospectively collected by patient surveys at 6 and 12 months postdischarge and annually thereafter. Records pertaining to reported office visits, echocardiography and rhythm information, operations, cardioversions, catheter ablation, or hospitalizations were obtained and analyzed. Mortality data were aggregated continuously consulting sources that included (1) CARD registry; (2) reviews of medical records and correspondence with the treating physician; (3) online death indexes, including the Social Security Death Index and genealogy resources (ancestry.com); and (4) newspaper death notices. With the use of these sources, mortality follow-up information was available on 100% of the cohort.

Statistical Analyses

Data summaries included the mean and standard deviation or median and interquartile range for continuously distributed variables, such as age and left ventricular ejection faction. For discrete or categoric variables, such as gender or postsurgical complications, we have reported counts and percentages. Comparisons between patients who developed de novo AF during follow-up and those who did not were based on the 2-sample *t* test with unequal variances and Satterthwaite's approximation or the Wilcoxon rank-sum test for continuous variables. Comparisons involving discrete or categoric variables were based on the chi-square or Fisher exact test (when cell counts were <5).

To estimate the probabilities of de novo AF, death, or AF-free survival, we used a 3-state Markov model that relies on the Aalen–Johansen estimator, as implemented in the R package etm.[9] Comparisons between patients with and without de novo AF were made at 1, 2, 3, 5, and 10 years after the index surgical procedure, both in the entire cohort and separately for those with degenerative mitral regurgitation (DMR), rheumatic, and ischemic MV cause, as well as the group with mixed causes or otherwise hard to classify that were grouped together as ''other.'' Overall survival was estimated using the Kaplan–Meier estimator.

To identify univariable or multivariable risk factors for de novo AF during follow-up, the subdistribution functions were modeled using the Fine-Gray model implemented in the R package survival.[10] We report (sub) hazard ratios and corresponding 95% confidence intervals (Table E1). To assess whether postoperative AF was associated with a higher risk of de novo AF during follow-up or with overall survival, we have used 1-to-1 propensity score (PS) matching. A total of 32 variables (included in the online Appendix, Table E2, and Figure E1), including demographics (age, body mass index), medical history, preoperative medications, and concomitant procedures (aortic valve [AV], TV surgery) were used to create the PS model of which the outcome was postoperative AF. A caliper of size 0.1 logit-PS standard deviation units was used. Association between TV surgery and risk of de novo AF was assessed using a 2-to-1 PS-matched analysis with a size 0.2 logit-PS standard deviation units caliper (Table E3 and Figure E2). Additional information is provided in the Appendix (Tables E4 and E5, Figures E3 and E4).

VIDEO 1. Dr Patrick M. McCarthy and Dr James L. Cox discuss aspects of the article. Video available at: https://www.jtcvs.org/article/S0022-5223(18)31035-3/fulltext.