Effectiveness of Surgical Ablation in Patients with Atrial Fibrillation and Aortic Valve Disease

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Background. **In patients with atrial fibrillation (AF), the addition of surgical ablation to aortic valve replacement (AVR) does not increase procedural morbidity or mortality. However, efficacy in this population has not been carefully evaluated. This study compared outcomes between patients undergoing stand-alone Cox-Maze IV with those undergoing surgical ablation and concomitant AVR.**

Methods. **From January 2002 to May 2014, 188 patients received a stand-alone Cox-Maze IV (n = 113) or surgical ablation with concomitant AVR (n = 75). In the concomitant AVR group, patients underwent Cox-Maze IV (n = 58), left-sided Cox-Maze IV (n = 3), or pulmonary vein isolation (n = 14). Thirty-one perioperative variables were compared. Freedoms from AF on and off antiarrhythmic drugs were evaluated at 3, 6, 12, and 24 months.**

Results. **Follow-up was available in 97% of patients. Freedom from AF on and off antiarrhythmic drugs in patients receiving a stand-alone Cox-Maze IV versus concomitant AVR was not significantly different at any time point. The concomitant AVR group had more comorbidities, paroxysmal AF, pacemaker implantations (24% vs 5%, $p = 0.002$), and complications (25% vs 5%, $p < 0.001$). Freedoms from AF off antiarrhythmic drugs for patients receiving an AVR and pulmonary vein isolation at 1 year was only 50%, which was significantly lower than patients receiving an AVR and Cox-Maze IV (94%, $p = 0.001$).**

Conclusions. **A Cox-Maze IV with concomitant AVR is as effective as a stand-alone Cox-Maze IV in treating AF, even in an older population with more comorbidities. Pulmonary vein isolation was not as effective and is not recommended in this population. A Cox-Maze IV should be considered in all patients undergoing AVR with a history of AF.**

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Atrial fibrillation (AF) is the most prevalent sustained arrhythmia and currently affects an estimated 1% to 2% of the general population. The prevalence has nearly doubled in the last 15 years, and conservative estimates predict it will double again by mid-century [1]. In patients undergoing cardiac surgery, AF has been associated with increased perioperative morbidity and mortality and worse late survival [2–4]. The Cox-Maze procedure (CMP) was developed in 1987 and has evolved into the gold standard for surgical AF ablation [5, 6]. The current iteration, the CMPIV, utilizes a combination of cryoablation and bipolar radiofrequency ablation to replace most of the surgical incisions of the traditional cut-and-sew technique, which has resulted in a significant decrease in procedural morbidity without sacrificing efficacy [7, 8].

Based on the 2012 Heart Rhythm Society (HRS)/European Heart Rhythm Association (EHRA)/ European Cardiac Arrhythmia Society (ECAS) Expert Consensus Statement, it is appropriate to consider all patients with symptomatic AF undergoing other cardiac surgery for AF ablation [9]. The majority of surgical ablations in the US are performed in a concomitant setting, so it is imperative to evaluate outcomes in this population [10]. While the roles of surgical ablation in concomitant mitral valve and coronary artery bypass surgery have been frequently examined [6, 11–16] the role of surgical ablation in concomitant aortic valve replacement (AVR) is less studied. Moreover, in an analysis of The Society of Thoracic Surgeons (STS) National Database, only 28% of patients undergoing AVR with a history of AF underwent a concomitant surgical ablation [10]. There may be multiple factors responsible for this underutilization including concerns for increased morbidity and mortality. However, recent studies have suggested that adding

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Abbreviations and Acronyms

AAD = antiarrhythmic drugs
AF = atrial fibrillation
ATA = atrial tachyarrhythmia
AVR = aortic valve replacement
CM = continuous monitoring
CMP = Cox-Maze procedure
CMPIV = Cox-Maze IV procedure
CPB = cardiopulmonary bypass
ECAS = European Cardiac Arrhythmia Society
ECG = electrocardiogram
EHRA = European Heart Rhythm Association
HRS = Heart Rhythm Society
IABP = intraaortic balloon pump
ICU = intensive care unit
LA = left atrial
LOS = length of stay
LVEF = left ventricular ejection fraction
MI = myocardial infarction
NYHA = New York Heart Association
PVD = peripheral vascular disease
PVI = pulmonary vein isolation
STS = The Society of Thoracic Surgery

surgical ablation to AVR does not increase morbidity [17, 18].

Even though the procedural outcomes of adding surgical ablation to AVR have been evaluated, the efficacy of surgical ablation of AF in the AVR population has not been carefully evaluated, particularly in regard to whether the CMPIV or pulmonary vein isolation (PVI) have similar efficacy in this group. The goal of this study was to directly compare outcomes between patients undergoing stand-alone CMPIV to those undergoing surgical ablation and concomitant AVR.

Patients and Methods

This study was approved by the Washington University School of Medicine Institutional Review Board. Written informed consent was obtained from each patient prior to enrollment. All data were entered prospectively into a longitudinal database maintained at our institution. The database contained more than 400 demographic and perioperative variables.

Patient Selection

A total of 188 consecutive patients who received either a stand-alone CMP or surgical ablation with concomitant AVR from January 2002 to May 2014 were retrospectively reviewed. These patients were divided into 2 groups based on whether or not they underwent a concomitant AVR. All 113 patients in the stand-alone CMP group underwent standard CMPIV lesion set (Fig 1) [19]. In the concomitant AVR group, 75 patients underwent AVR with concomitant surgical ablation. This group was further subdivided into 3 ablation sets: CMPIV (n = 58); left-sided CMPIV (n = 3); or PVI (n = 14). All patients undergoing other concomitant valvular surgery or any other incision besides a full sternotomy were excluded.

Thirty-two preoperative and perioperative variables (Tables 1, 2, respectively) were selected for comparison after preliminary analysis of all the variables collected between the STS and our institutional AF database. Major complications, which were defined as pneumonia, mediastinitis, need for intraaortic balloon pump,

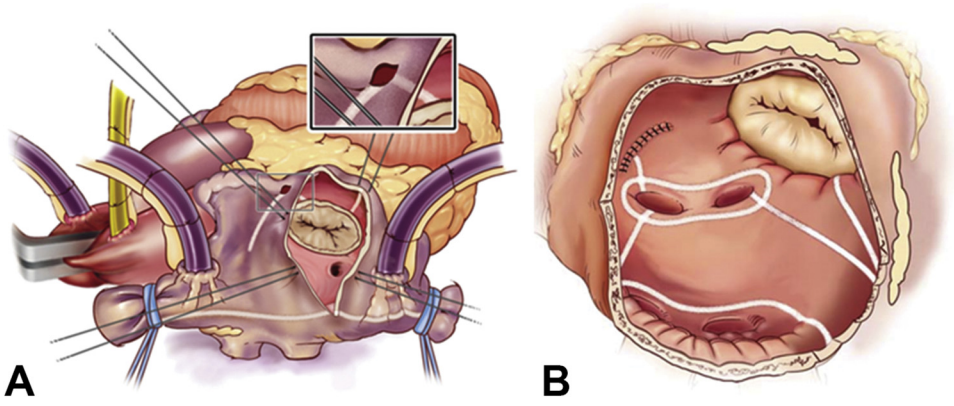

Fig 1. Cox-Maze IV right (A) and left (B) atrial lesion sets. In the right atrium, radiofrequency (RF) ablation lines (white lines) extend from the superior vena cava to inferior vena cava and along the right atrium free wall down to tricuspid valve annulus. In the left atrium, RF ablation lines (white lines) are created including pulmonary vein isolation, pulmonary vein roof and floor connecting lesions, lesion from left superior pulmonary vein and amputated atrial appendage, and lesion from inferior atriotomy to mitral valve annulus. (Adapted from Weimar T, Bailey MS, Watanabe Y, et al. The Cox-maze IV procedure for lone atrial fibrillation: a single center experience in 100 consecutive patients. J Intervent Card Electrophysiol 2011;31:47-54, with kind permission from Springer Science and Business Media.)