Associations Between Surgical Ablation and Operative Mortality After Mitral Valve Procedures

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Background. **Surgical ablation (SA) for atrial fibrillation (AF) concomitant to mitral valve repair/replacement (MVRR) improves longitudinal sinus rhythm. However, the risk of adding SA remains a clinical question. This study examined whether the addition of contemporary SA for AF has an impact on operative outcomes.**

Methods. **The study cohort included 88,765 MVRR patients with or without SA, coronary artery bypass grafting (CABG), septal defect, and tricuspid repair in The Society of Thoracic Surgeons Database between 2011 and 2014. Group 1 did not have AF (No-AF) and did not receive SA (No-SA); group 2 had No-AF immediately preoperatively but received SA; group 3 had AF but No-SA; and group 4 had AF with SA. Groups 3 and 4 were stratified into paroxysmal versus nonparoxysmal AF. With the use of logistic regression, with group 1 as reference, risk-adjusted odds ratios (OR) for mortality were compared for SA performance, AF type, and SA technique.**

Results. **Group 3 had higher age, New York Heart Association class, redo operations, and unadjusted mortality than group 4. Relative to group 1, group 3 had an OR for mortality of 1.15 (95% confidence interval: 1.04 to 1.27, $p < 0.01$). OR increments were similar for paroxysmal and nonparoxysmal AF. In group 4, concomitant SA was independently associated with lower AF-related relative risk (OR 1.08), to a level that was not different from group 1 ($p = 0.13$). Observed treatment effects were equivalent for paroxysmal and nonparoxysmal AF and across all levels of baseline risk.**

Conclusions. **For patients with AF at the time of mitral operation, the performance of SA seems associated with a lower risk-adjusted operative mortality compared with patients who do not undergo ablation.**

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Surgical ablation (SA) for atrial fibrillation (AF) performed during mitral valve (MV) repair or replacement (MVRR) has been demonstrated to reduce long-term AF rates and to improve quality of life [1–8]. Performance of SA at the time of mitral operations recently has attained a class I, level of evidence A recommendation in The Society of Thoracic Surgeons (STS) guidelines [9]. Nevertheless, direct associations between SA and perioperative mortality have not been studied in large contemporary cohorts. Previous analyses suggested that SA could be added without increased mortality [10], and others described the safety of adding SA in higher-risk patients [11–13]. More recent data also suggested that SA in multiple valve patients with AF may have been associated with lower operative mortality [14]. Finally, a recent propensity-matched risk analysis of the entire spectrum of contemporary valve and coronary patients suggested an independently lower operative mortality with concomitant SA; however, details for individual operative procedures were not assessed [15]. Thus, the purpose of the present study was to examine the mortality characteristics of AF and SA in contemporary patients undergoing MVRR.

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Abbreviations and Acronyms

AF = atrial fibrillation
BA = biatrial
C&S = cut-and-sew
CABG = coronary artery bypass grafting
Cryo = cryoablation
LA = left atrial
MV = mitral valve
MVRR = mitral valve repair or replacement
OR = odds ratio
RF = radiofrequency
SA = surgical ablation
STS = The Society of Thoracic Surgeons
TVr = tricuspid valve repair

Material and Methods

From July 2011 through June 2014, 89,668 patients were examined who underwent MVRR without other major valve or aortic procedures and whose data were available in the STS data set version 2.73. Patients with associated coronary artery bypass grafting (CABG), atrial septal defect closure, and tricuspid valve repair (TVr) were included [16]. Exclusions were previous MitraClip procedures (n = 17), missing sex or age information (n = 43), participants outside North America (n = 523), and right atrial SA only (n = 320), leaving a final study population of 88,765. MV repair only was performed in 35,534 patients (40%), MV repair + CABG in 17,258 patients (20%), isolated MV replacement in 26,761 patients (30%), and MV replacement + CABG in 9,212 patients (10%). Of the overall population, 12,673 patients (14%) had concomitant TVr. The analysis was organized into the following four clinical categories: group 1 consisted of 53,519 patients (60%) with no history of AF and no SA, group 2 included patients in sinus rhythm immediately preoperatively, who underwent SA presumably because of a relevant arrhythmia history (n = 8,114; 9%), group 3 included patients having AF preoperatively but not treated with SA (n = 10,780; 12%), and group 4 included patients with AF preoperatively and having SA (n = 16,352; 18%).

Standard STS valve model covariates were used [17]. Baseline and procedural characteristics for groups 1 to 4 were summarized with medians for continuous variables and frequencies and proportions for categorical variables. With the use of appropriate tests, baseline descriptive and unadjusted outcome data were compared between groups, including operative mortality, a composite of major morbidities (prolonged ventilation, deep sternal infection, permanent stroke, renal failure, and reoperation), and new pacemaker insertion.

Logistic regression models were developed to compute adjusted odds ratios (OR) for mortality and morbidity for each of the various risk factors. Less than 5% of data were missing and were handled with simple imputation, as described previously [17]. In subsequent multivariable analyses, group 2 patients (those in sinus rhythm preoperatively but with some presumed arrhythmia history) were excluded because of uncertainties about the exact types of arrhythmias present, as described previously [15]. From the antecedent multiple valve analysis [14], a sample size of 26,000 was required to provide 90% statistical power to assess an independent treatment effect of 0.85 associated with SA for AF at a p value of less than 0.05 for a 10% mortality event rate. Therefore, the main multivariable analyses for the MVRR population (with an approximate 5% mortality event rate) was prespecified to generate ORs for group 3 referenced to group 1 (patients without AF) and for group 4 referenced to group 1, thus providing sample sizes of more than 60,000 for each comparison. This approach allowed inferences about relative treatment effects, while maintaining adequate sample sizes as demonstrated in the multiple valve study. For completeness, a direct multivariable comparison of group 3 with group 4 also was performed, understanding that interpretation was limited by lower statistical power, based on a total sample size of approximately 25,000 patients and the previously demonstrated treatment effect.

Paroxysmal AF was defined as recurrent AF episodes (≥2) that terminated spontaneously within 7 days [18]. Persistent AF was recurrent AF for 7 days or more, and this category was combined with longstanding persistent AF (>1-year duration) and termed nonparoxysmal AF. In groups 3 and 4, AF type was subdivided into paroxysmal and nonparoxysmal groups, and the logistic regression was reanalyzed, referencing paroxysmal to nonparoxysmal.

In an analysis of energy sources for SA, patients in group 4 only were divided into (1) radiofrequency (RF) only (n = 5,077; 31%), (2) cryoablation (Cryo) only (n = 4,938; 30%), (3) RF + Cryo (n = 2,346; 14%), and (4) cut-and-sew (C&S) only (n = 790; 5%). Of the remaining patients, 9% having less common combinations and 10% not having specific sources were excluded. RF only was used as the reference. Finally, locations of lesion sets were stratified into left atrial (LA) only (n = 6654; 47%) and biatrial (BA; n = 7890; 48%), and ORs for mortality and morbidity were recomputed. An additional 808 patients (5%) had missing location data and were excluded. Multiple formal interaction tests were performed between AF type and SA location and also energy sources, and none were statistically significant. Therefore, interaction terms were not included in the final analyses, and relative treatment effects appeared to be consistent across all levels of baseline risk.

Computations were performed with SAS version 9.4 (SAS Institute, Cary, NC). A p value less than 0.05 was considered significant. This study of de-identified data from the STS Adult Cardiac Surgery Database was granted a waiver of informed consent by the Duke University Institutional Review Board.

Results

Baseline and procedural characteristics for overall patients and for the four groups are listed in Table 1. In general, MVRR patients with AF at the time of operation (groups 3 and 4) exhibited worse baseline characteristics