Safety of Atrial Fibrillation Ablation With Isolated Surgical Aortic Valve Replacement

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Background. **Surgical ablation of atrial fibrillation (AF) concomitant with cardiac surgery is a Society of Thoracic Surgeons (STS) class I recommendation, although the AF is frequently ignored. Analysis of the STS Database 30-day outcomes of isolated surgical aortic valve replacement (AVR) with and without AF ablation is presented.**

Methods. **Data on 87,426 surgical aortic valve replacement patients were extracted from the STS database (version 2.81, 2014-2017) and patients were divided into 3 groups: (1) No preoperative AF, (2) Preoperative AF with concomitant ablation, and (3) Preoperative AF without ablation. The latter 2 groups were propensity score–matched in 1-(up)-to-2 ratio to alleviate covariate imbalances and reduce bias. Thirty-day outcomes were evaluated and compared.**

Results. **Preoperative AF was present in 17.8% (15,596 of 87,426 patients). Ablation was performed in 33.1% (5,167 of 15,596), and 57.7% (2,983) had left atrial appendage closure. Propensity score matching (AF ablated n = 3692; AF non-ablated n = 5724), revealed that there was no difference between the AF ablated and AF non-ablated groups in mortality (2.8% vs 3.0%, respectively; $P = .65$) or for stroke (1.6% vs 1.7%, respectively; $P = .82$), but postoperative pacemaker implantation was higher in the AF ablated patients (6.8% AF ablated vs 5.0% AF non-ablated, $P < .001$).**

Conclusions. **Despite being a class I recommendation, AF ablation concomitantly with other cardiac surgical procedures remains lower than current guideline recommendation in surgical aortic valve replacement patients. Ablation for AF does not increase the 30-day operative mortality or perioperative morbidity compared with non-ablated patients, although new pacemaker requirements were higher in the AF ablated group.**

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The incidence of preoperative atrial fibrillation (AF) ranges from 5% to 10% in coronary artery bypass graft patients[1] to 30% and more in mitral valve patients.[2] Patients who undergo aortic valve surgery have a 10% to 20% incidence of preoperative AF.[3] It has been documented previously that the presence of preoperative AF is associated with worse survival and an increased risk of thromboembolic complications after cardiac surgery.[4] Multiple studies have demonstrated the benefits of concomitant AF ablation during mitral valve surgery,[5-8] but there are few papers that evaluate the impact of concomitant AF ablation in patients undergoing isolated aortic valve surgery.[3,9] In this study we used data from The Society of Thoracic Surgeons (STS) National Adult Cardiac Surgery Database to analyze the early outcomes of concomitant AF ablation in patients undergoing surgical aortic valve replacement.

Patients and Methods

Data were obtained from the STS Adult Cardiac Surgery Database (version 2.81) on patients discharged between July 1, 2014, and June 30, 2017. Patients who were at least 18 years old at the time of surgery who had isolated aortic valve replacement with or without AF ablation and/or left atrial appendage (LAA) closure were included. The primary outcome was 30-day all-cause mortality. The secondary outcomes were stroke, other in-hospital major

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Abbreviations and Acronyms

AF = atrial fibrillation
AVR = aortic valve replacement
CI = confidence interval
LAA = left atrial appendage
PS = propensity score
SA = surgical ablation
SMD = standardized mean difference
STS = The Society of Thoracic Surgeons

morbidity, readmission rates, as well as the reasons for readmission. In-hospital major morbidity included the following postprocedure complications: permanent stroke, new cases of renal failure, prolonged ventilation (ventilation longer than 24 hours after surgery), reoperation, and deep sternal wound infection.

Patients were divided into 3 groups for analysis: patients without preoperative AF (No AF group), patients with preoperative AF and had AF ablation (AF ablated group) and patients who had preoperative AF and no concomitant AF ablation (AF non-ablated group). We compared postoperative outcomes of the AF ablated and AF non-ablated groups. Within the No AF group, we also compared those with and without LAA closure.

Data summaries included means/standard deviations, medians/interquartile ranges, and frequency counts or percentages. Three-group comparisons were based on 1-way analysis of variance if normally distributed, or the Kruskal-Wallis test, otherwise. Two-group comparisons relied on the 2-sample t test with unequal variance and Satterthwaite's approximation for degrees of freedom and the χ^2 or Fisher's exact test were used for categorical variables.

Propensity score (PS) matching was used to reduce baseline covariate imbalances, with multivariable logistic regression PS estimation. To compare the AF ablated and non-ablated groups, the following variables were included in the regression model: age, sex, body surface area, body mass index, creatinine level, comorbidities (diabetes, dyslipidemia, dialysis for renal failure, infective endocarditis, immunosuppression, peripheral vascular disease, syncope, cerebrovascular disease, carotid stenosis, cerebrovascular accident, prior myocardial infarction, history of heart failure, congestive heart failure, prior cardiovascular interventions, prior coronary artery bypass, prior valve procedure, prior percutaneous coronary intervention, inotropic medication, aortic stenosis, aortic insufficiency, mitral insufficiency, tobacco use), and surgical characteristics (first cardiac surgery, LAA performed). A size 0.1 logit-PS standard deviation units caliper was used, with up to 2 non-AF ablated controls per AF ablated case. The comparison by LAA closure status within the no AF group used a similar regression model, excluding LAA as covariate. A size 0.4 logit-PS standard deviation units caliper was used, with up to 10 non-LAA closed controls per LAA closed case among patients with no AF history. A similar analysis among patients with an AF history used up to 2 controls. Baseline covariate balance after PS matching was evaluated based on standardized mean differences (SMDs), values less than 0.2 being considerate adequate. Residual imbalances were adjusted for via multivariable logistic regression models. Volume-outcome analyses were based on pooled data analyses. Centers with similar volumes were pooled together and outcome incidence was estimated and regressed on volume category, together with Spearman and Pearson correlation estimates.

Statistical significance was declared at the 2-sided 5% level, and no multiplicity adjustments. All statistical analyses were performed in SAS v 9.4 (SAS Institute, Cary, NC).

Results

Of the 87,426 patients, 17.8% had atrial fibrillation and only 33.1% of them underwent AF ablation during the index procedure (Figure 1). LAA closure was performed in 57.9% of patients in the AF ablated group and in 15.8% of the AF non-ablated group ($P < .001$).

Characteristics of the unmatched cohorts are summarized in Supplemental Table 1. There were more men, diabetes, and hypertension in the AF ablated and AF non-ablated groups than in the no AF group. The AF non-ablated group had more patients with a prior history of cardiac surgery than those in the AF ablated group. Patients in the AF ablated group had slightly longer cross-clamp and cardiopulmonary bypass times than the non-ablated patients. In the non-ablated group, 18.5% of patients had an incision other than a complete median sternotomy (ie, partial sternotomy, thoracotomy, port access, or other).

After PS matching, the AF ablated patients (n = 3692) and the AF non-ablated patients (n = 5724) had similar preoperative characteristics as indicated by the much-reduced SMD values (Supplemental Figure 1A).[10] As expected, the perfusion time (119.6 ± 44.4 minutes vs 100.0 ± 39.3 minutes, $P < .001$) and cross-clamp time (86.9 ± 33.5 minutes vs 74.5 ± 28.3 minutes, $P < .001$) were longer in the AF ablated group. In the AF ablated group, 6.6% (n = 243) of patients received a mechanical valve prosthesis compared with 9.1% (n = 518) in the AF non-ablated group. The incidence of postoperative stroke was similar in the AF ablated and AF non-ablated (1.6% vs 1.7%, $P = .82$). The incidence of postoperative AF was lower in AF ablated group than in the AF non-ablated group (17.7 % vs 24.2%, $P < .001$). Thirty-day mortality was similar in both groups (2.8% and 3.0%, respectively, $P = .65$). Postoperative pacemaker implantation was higher in the AF ablated group (6.8%) than in the AF non-ablated group (5.0%, $P < .001$). Because the LAA closure SMD was slightly above 0.25, we further adjusted for LAA closure using multivariable logistic regression. As shown in Supplemental Table 2, the odds of postoperative pacemaker implantation remained significantly higher in the AF ablated group (odds ratio, 1.34 [95% confidence interval, 1.12, 1.59], $P = .001$; adjusted, 1.36 [95% confidence interval, 1.13, 1.62], $P < .001$).

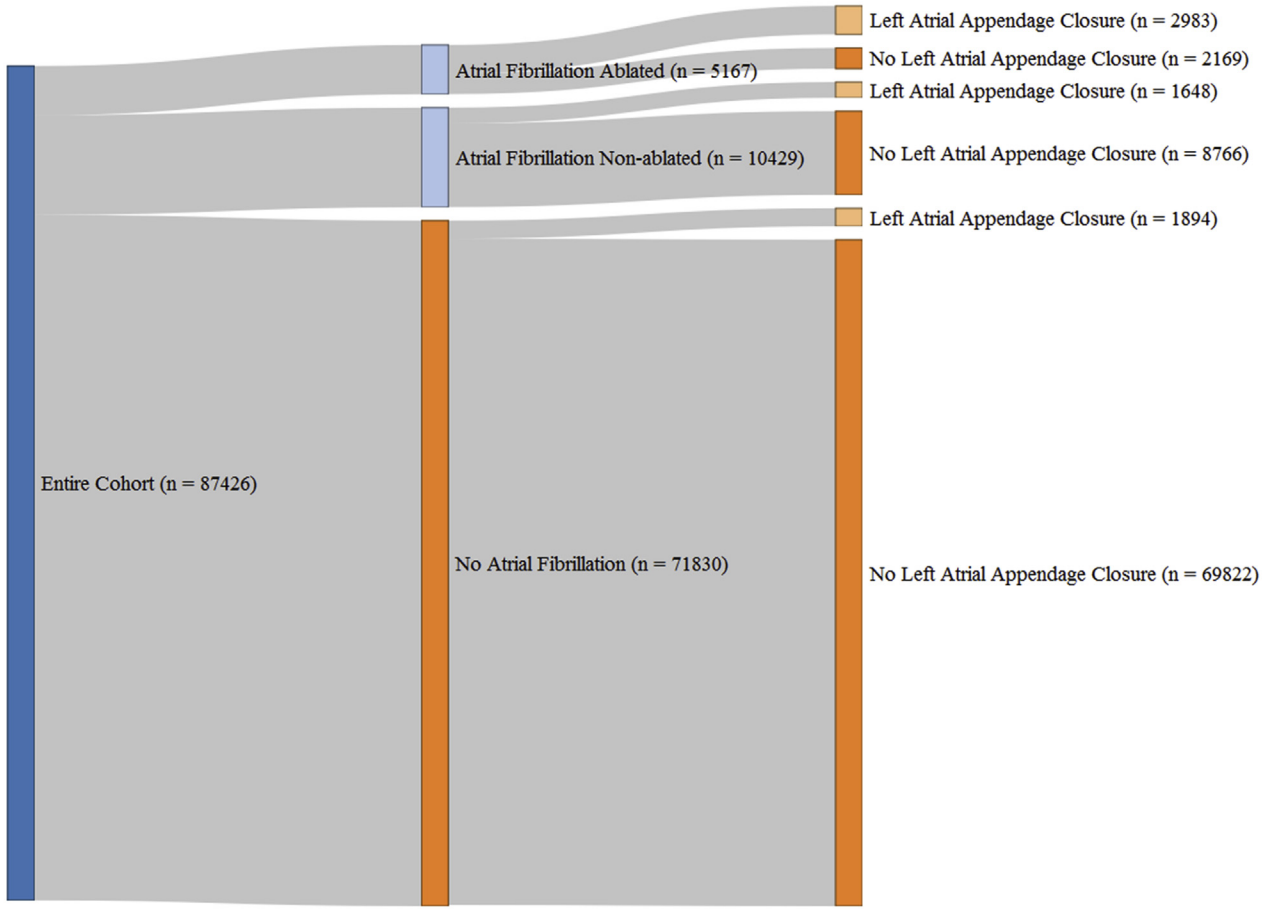

Figure 1. CONSORT (CONsolidated Standards of Reporting Trials) diagram of the original cohort. The Society of Thoracic Surgeons database was queried for isolated aortic valve surgery cases with or without atrial fibrillation surgery between July 1, 2014, and June 30, 2017. Patients were grouped by preoperative atrial fibrillation status and then further stratified in each group according to left atrial appendage closure.

Readmission within 30 days was slightly higher in the AF ablated group than in the AF non-ablated group (16.3% vs 13.1%, $P < .01$). However, if readmitted, the readmission for stroke rate was lower in the AF ablated group than in the AF non-ablated group (0.3% vs 1.7%, respectively, $P = .009$). Readmission for congestive heart failure and arrhythmia/heart block trended slightly higher in AF ablated group (Table 1).

Of the 71,830 patients without preoperative AF, 2.6% had their LAA closed and 97.4% did not. These groups were adequately PS-matched in 1-to-10 ratio (Table 2), as shown by the reduced SMDs (Supplemental Figure 1B). Postoperative stroke and 30-day mortality were similar in both groups. Patients who had LAA closure had more prolonged ventilation than those who did not (7.2% vs 5.6%, respectively, $P = .008$), pneumonia (2.7% vs 1.6%, respectively, $P < .001$), pleural effusion drainage (7.3% vs 3.9%, respectively, $P < .001$), and a higher incidence of postoperative AF (40.2% vs 33.9%, respectively, $P < .001$). Readmission was comparable between groups, although, if readmitted, readmission for stroke was lower in the LAA closure group than in patients who did not have LAA closure (0.7% vs 2.4%, respectively, $P = .25$). If readmitted, readmission for congestive heart failure trended towards being more frequent in the LAA closure group compared w the no LAA closure group (15.1% vs 10%, respectively, $P = .07$) (Table 2).

Analysis of LAA closure in the AF non-ablated compared LAA closure and no LAA closure. PS matching was performed (Table 3), with good covariate balance (Supplemental Figure 1C). Cross-clamp time was longer in LAA closure group by 2.5 minutes (76.2 ± 27.6 vs 73.2 ± 28 minutes, $P < .001$). Postoperative AF was more frequent in No LAA closure group (24.9% vs 20.7%, $P = .001$). Stroke rate and 30-day mortality was similar in both groups.

Higher-volume centers had lower mortality than lower-volume centers in patients who had preoperative atrial fibrillation in both ablated and non-ablated groups despite similar STS predicted risk of mortality scores (Figures 2A, 2B). It was also noted that higher-volume centers did not perform concomitant ablation and LAA closure more frequently than lower-volume centers (Figures 3A, 3B).

Table 1. Preoperative, Intraoperative, and Postoperative Characteristics of Patients With Preoperative Atrial Fibrillation in Propensity Score–Matched Groups

Variable	n (per group)	AF Ablated (n = 3692)		AF Non-ablated (n = 5724)		
Baseline variable						
Age, y	(3692, 5724)	71.5	± 8.9	71.5	± 10.1	
Body surface area, m^2	(3692, 5724)	2.1	± 0.3	2.0	± 0.3	
Creatinine	(3692, 5724)	1.1	± 0.9	1.1	± 0.8	
Ejection fraction	(3587, 5576)	55.6	± 11.9	55.0	± 12.5	
STS risk score, %	(2509, 5710)	3.1	± 3.0	3.4	± 3.3	
Sex (male)	(3692, 5724)	2454	(66.5)	3754	(65.6)	
Diabetes	(3687, 5717)	1312	(35.6)	2033	(35.6)	
Hypertension	(3688, 5718)	3231	(87.6)	4971	(86.9)	
Dialysis	(3688, 5719)	69	(1.9)	121	(2.1)	
Infectious endocarditis	(3686, 5718)	110	(3.0)	185	(3.2)	
Cerebrovascular disease	(3673, 5700)	715	(19.5)	1088	(19.1)	
Prior stroke	(3665, 5690)	302	(8.2)	466	(8.2)	
Transient ischemic attack	(3656, 5679)	222	(6.1)	326	(5.7)	
First cardiovascular surgery	(3692, 5724)	3522	(95.4)	5463	(95.4)	
Full conventional sternotomy	(3692, 5724)	3552	(96.2)	5492	(95.9)	
Mechanical valve	(3681, 5706)	243	(6.6)	518	(9.1)	
Left atrial appendage procedure	(3680, 5719)	1487	(40.4)	1540	(26.9)	
Outcomes						*P* Value
Red blood cells intraoperatively, units	(1145, 1801)	1.3	± 1.6	1.4	± 1.6	.34
Perfusion time, min	(3683, 5707)	119.6	± 44.4	100.0	± 39.3	<.001
Cross-clamp time, min	(3685, 5701)	86.9	± 33.5	74.5	± 28.3	<.001
Postoperative length of stay, d	(3691, 5723)	7	(5, 9)	6	(5, 9)	<.001
Red blood cells postoperatively, units	(1293, 1855)	2.6	± 3.7	2.6	± 3.7	.99
Reoperation for bleeding	(3689, 5720)	105	(2.8)	185	(3.2)	.29
Postoperative stroke	(3687, 5719)	59	(1.6)	95	(1.7)	.82
Transient ischemic attack	(3689, 5720)	10	(0.3)	16	(0.3)	.94
Prolonged ventilation >24 h	(3690, 5720)	369	(10.0)	549	(9.6)	.52
Renal failure	(3690, 5721)	128	(3.5)	150	(2.6)	.018
Postoperative atrial fibrillation	(3690, 5721)	652	(17.7)	1385	(24.2)	<.001
Postoperative pacemaker implantation	(3686, 5720)	250	(6.8)	288	(5.0)	<.001
Readmission within 30 d	(3485, 5377)	569	(16.3)	706	(13.1)	<.001
Readmission reason within 30 d	(560, 701)					.011
Arrhythmia/heart block		108	(19.3)	127	(18.1)	.61
Congestive heart failure		99	(17.7)	99	(14.1)	.09
Stroke		1	(0.2)	12	(1.7)	.009
30-day mortality	(3622, 5617)	103	(2.8)	169	(3.0)	.65

Data are presented as number (%); mean ± SD; or median (first quartile, third quartile).

AF, atrial fibrillation; STS, The Society of Thoracic Surgeons.

Comment

This is the largest study to date looking at the outcomes of AF ablation in isolated aortic valve replacement (AVR) in a modern cohort. We did not identify an increase in short-term mortality (2.8% vs 3.2%, $P = .65$) or major morbidity in patients who underwent concomitant ablation of AF in AVR patients in well-matched cohorts.

Unlike Badhwar and colleagues'[6] findings in a report on an STS cohort, we found no short-term survival benefit of concomitant AF ablation. This is most likely due to the fact that a significant part of the cohort in the Badhwar and associates paper had mitral valve procedures performed—the cohort that benefits the most in the short term.[11] The benefit of concomitant AF ablation is longitudinal and becomes more prominent over time.[9,12-16] This is the main reason to perform concomitant AF ablation as long as adding the procedure does not increase a patient's operative risk.

In 2017, the STS published the Clinical Practice Guidelines for the Surgical Treatment of Atrial Fibrillation, stating that concomitant surgical ablation for AF can be performed without additional operative risk of mortality or major morbidity, and they recommended concomitant AF ablation at the time of isolated aortic

Table 2. Preoperative, Intraoperative, and Postoperative Characteristics of Propensity Score–Matched (10:1 ratio) in No Left Atrial Appendage vs Left Atrial Appendage Closure in Patients With No Preoperative Atrial Fibrillation

Variable	n (per group)	No LAA Closure (n = 17,360)		LAA Closure (n = 1736)		
Baseline variable						
Age, years	(17360, 1736)	67.9	± 11.5	68.0	± 11.0	
Body surface area, m^2	(17360, 1736)	2.0	± 0.3	2.0	± 0.3	
Creatinine	(17360, 1736)	1.0	± 0.7	1.1	± 0.7	
Ejection fraction	(17360, 1736)	57.0	± 11.5	57.0	± 11.5	
STS risk score (%)	(17358, 1731)	2.2	± 2.3	2.2	± 2.2	
Sex (male)	(17360, 1736)	10,785	(62.1)	1071	(61.7)	
Diabetes	(17348, 1735)	4761	(27.4)	483	(27.8)	
Hypertension	(17353, 1735)	13,677	(78.8)	1347	(77.6)	
Dialysis	(17353, 1735)	230	(1.3)	23	(1.3)	
Infectious endocarditis	(17340, 1734)	816	(4.7)	80	(4.6)	
Cerebrovascular disease	(17360, 1736)	2613	(15.1)	262	(15.1)	
Prior stroke	(17360, 1736)	1081	(6.2)	109	(6.3)	
Transient ischemic attack	(17331, 1731)	736	(4.2)	77	(4.4)	
First cardiovascular surgery	(17360, 1736)	17,028	(98.1)	1702	(98.0)	
Full conventional sternotomy	(17360, 1736)	15,213	(87.6)	1520	(87.6)	
Mechanical valve	(17360, 1736)	1357	(7.8)	132	(7.6)	
Outcomes						*P* Value
Red blood cells intraoperatively, units	(4666, 475)	1.5	± 1.61	1.6	± 1.8	.24
Perfusion time, min	(17319, 1735)	97.6	± 37.6	98.4	± 39.5	.38
Cross-clamp time, min	(17315, 1736)	73.3	± 27.2	75.7	± 27.7	<.001
Post-operative length of stay, d	(17358, 1735)	6	(4, 7)	6	(5, 8)	<.001
Reoperation for bleeding	(17353, 1732)	472	(2.7)	42	(2.4)	.47
Postoperative stroke	(17344, 1732)	190	(1.1)	12	(0.7)	.12
Transient ischemic attack	(17351, 1732)	64	(0.4)	4	(0.2)	.36
Prolonged ventilation >24 h	(17351, 1733)	973	(5.6)	124	(7.2)	.008
Renal failure	(17349, 1732)	271	(1.6)	37	(2.1)	.07
Postoperative atrial fibrillation	(17352, 1735)	5889	(33.9)	698	(40.2)	<.001
Postoperative pacemaker implantation	(17347, 1733)	661	(3.8)	68	(3.9)	.81
Readmission within 30 d	(16532, 1647)	1573	(9.5)	147	(8.9)	.44
Readmission reason within 30 d	(1564, 146)					
Arrhythmia/heart block		293	(18.7)	19	(13.0)	.30
Congestive heart failure		157	(10.0)	22	(15.1)	.07
Stroke		37	(2.4)	1	(0.7)	.25
30-day mortality	(17016, 1716)	303	(1.8)	31	(1.8)	.94

Data are presented as number (%); mean ± SD; or median (first quartile, third quartile).

LAA, left atrial appendage; STS, The Society of Thoracic Surgeons.

valve replacement, isolated coronary artery bypass graft surgery, and aortic valve replacement plus coronary artery bypass graft operations to restore sinus rhythm (class I, level B nonrandomized).[17] Similar recommendations were made by the American Association of Thoracic Surgeons in their Expert Consensus Guidelines on concomitant AF ablation.[18] In our study, the rate of AF ablation was low, as only 33.1% of the patients with preoperative AF undergoing isolated AVR received concomitant AF ablation. Nevertheless, that represents a modest increase from the 28% reported by Gammie and coworkers[2] in 2008. This low utilization might be explained in part by the higher rate of redo cardiac surgical procedures in the AF non-ablated group 22.6% vs only 3.3% in the AF ablated group. It is more challenging to perform AF ablation in the setting of reoperative cardiac surgery. Because of the limitations of the information available in the database, however, we cannot evaluate why operators decided not perform concomitant AF ablation. We hope that the guideline recommendations will lead to an increase in the adoption rate for concomitant AF ablation in cardiac surgery.

In 18.5% of patients with a preoperative diagnosis of AF, operative access other than a complete median sternotomy was used and that undoubtedly lowered the likelihood of performing concomitant AF ablation. Only 2.7% of the patients who underwent a form of AF ablation had access other than sternotomy. Although minimal access surgery for AVR might provide some potential benefits,[19,20] we are not aware of any guideline

Table 3. Preoperative, Intraoperative, and Postoperative Characteristics of Propensity Score–Matched (2:1 ratio) in No Left Atrial Appendage vs Left Atrial Appendage Closure in Non-ablated Patients With Preoperative Atrial Fibrillation

Variable	N (per group)	No LAA Closure (n = 3206)		LAA Closure (n = 1604)		
Baseline variable						
Age, y	(3206, 1604)	73.9	± 9.2	73.8	± 8.6	
Body surface area, m^2	(3206, 1604)	2.0	± 0.3	2.0	± 0.3	
Creatinine	(3206, 1604)	1.1	± 0.6	1.1	± 0.7	
Ejection fraction	(3206, 1604)	54.6	± 12.8	54.5	± 12.7	
Sex (male)	(3206, 1604)	2142	(66.8)	1072	(66.8)	
Diabetes	(3206, 1604)	1108	(34.6)	549	(34.2)	
Hypertension	(3200, 1603)	2806	(87.7)	1401	(87.4)	
Dyslipidemia	(3198, 1602)	2428	(75.9)	1211	(75.6)	
Dialysis	(3201, 1603)	48	(1.5)	23	(1.4)	
Infectious endocarditis	(3206, 1604)	102	(3.2)	57	(3.6)	
Cerebrovascular disease	(3190, 1596)	724	(22.7)	375	(23.5)	
Prior stroke	(3182, 1593)	316	(9.9)	175	(11.0)	
Transient ischemic attack	(3179, 1590)	203	(6.4)	119	(7.5)	
First cardiovascular surgery	(3206, 1604)	3120	(97.3)	1563	(97.4)	
Full conventional sternotomy	(3206, 1604)	2824	(88.1)	1405	(87.6)	
Mechanical valve	(3206, 1604)	167	(5.2)	90	(5.6)	
Outcomes						*P* Value
Red blood cells transfused intraoperatively, units	(1055, 487)	1.5	± 1.8	1.4	± 1.6	.23
Perfusion time, min	(3190, 1601)	98.9	± 39.9	100.8	± 36.2	.11
Cross-clamp time, min	(3188, 1600)	73.2	± 28.0	76.2	± 27.6	<.001
Postoperative length of stay, d	(3204, 1603)	6	(5, 9)	7	(5, 9)	.006
Reoperation for bleeding	(3204, 1604)	109	(3.4)	55	(3.4)	.96
Postoperative stroke	(3203, 1604)	56	(1.7)	24	(1.5)	.52
Transient ischemic attack	(3203, 1604)	11	(0.3)	4	(0.2)	.58
Prolonged ventilation >24 h	(3203, 1604)	313	(9.8)	161	(10.0)	.77
Renal failure	(3204, 1604)	92	(2.9)	43	(2.7)	.71
Postoperative atrial fibrillation	(3204, 1604)	797	(24.9)	332	(20.7)	.001
Postoperative pacemaker implantation	(3203, 1604)	148	(4.6)	87	(5.4)	.22
Readmission within 30 d	(3011, 1499)	388	(12.9)	204	(13.6)	.50
Readmission reason within 30 d	(387, 202)					
Arrhythmia/heart block		70	(18.1)	30	(14.9)	.36
Congestive heart failure		61	(15.8)	32	(15.8)	1.00
Stroke		8	(2.1)	2	(1.0)	.51
30-day mortality	(3138, 1579)	101	(3.2)	45	(2.8)	.49

Data are presented as number (%); mean ± SD; or median (first quartile, third quartile).

LAA, left atrial appendage.

recommendation favoring minimal access surgery over conventional median sternotomy. Therefore, it would seem prudent to perform a conventional median sternotomy plus concomitant AF ablation in AVR patients with preoperative AF as opposed to limiting one's access to the heart in order to accommodate a smaller incision.

It is interesting that in the unmatched groups, 6.9% of the AF ablated patients received mechanical valves compared with 9.6% ($P < .001$) in the AF non-ablated group. The increased use of mechanical valves in the latter group could potentially be explained by the fact that patients with mechanical valves need to be on life-long anticoagulation. However, American College of Cardiology/American Heart Association guidelines in the past have recommended increasing the level of oral anticoagulation in patients with mechanical prosthetic valves and atrial fibrillation, suggesting that valve-related thromboembolism is increased in patients with AF.[21]

As shown in previous studies,[3,6,7,9] overall postoperative complications were similar in PS-matched AF ablated and AF non-ablated groups, with some complications being more prevalent in 1 group than the other. For example, as has been shown previously,[7,22] the postoperative pacemaker implantation rate was higher in PS-matched ablated patients 6.8% than in non-ablated patients 5.0%, $P < .001$. This was most likely due to "unmasking" of underlying sinus node pathology by the restoration of a sinus-dependent rhythm postoperatively.[22]

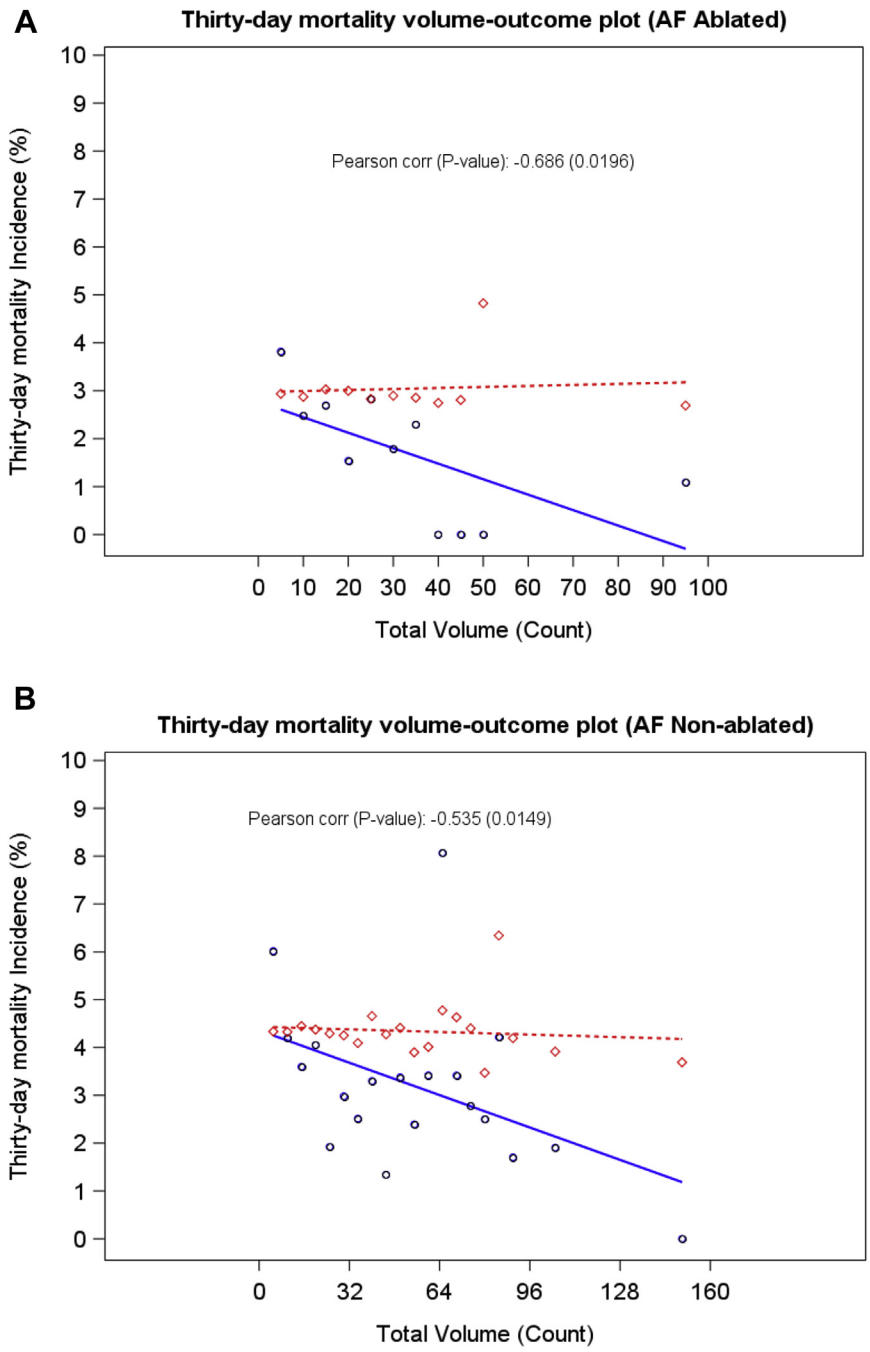

Figure 2. Center volume/mortality relation in isolated surgical aortic valve replacement patients with preoperative AF with AF ablation (A) and without AF ablation (B). Estimated mortality rates are blue circles; The Society of Thoracic Surgeons predicted risk of mortality scores are red diamonds. (AF, atrial fibrillation; Corr, correlation.)

The readmission rate was slightly higher in the PS-matched AF ablated group than in the AF non-ablated group (16.3% vs 13.1%), mostly driven by arrhythmias, heart block, congestive heart failure, and pleural effusions in both groups. Stroke as a reason for readmission was higher in AF non-ablated group (1.7% vs 0.2%), however, documenting the protective benefit of ridding the patients of AF.

It was interesting to note that slightly over 2% of the patients in the no AF group had their LAA closed. Among those with no AF history, in PS-matched analyses, patients who had their appendage closed had significantly more respiratory complications and postoperative AF but mortality was similar. The readmission rate was similar in both groups (9.5% vs 8.9%, $P < .44$) as well as readmission for stroke (0.7% vs 2.4%, $P = .25$), and this was not statistically significant. Long-term follow-up is not available, but short-term results do not support LAA closure in patients without a history of AF.

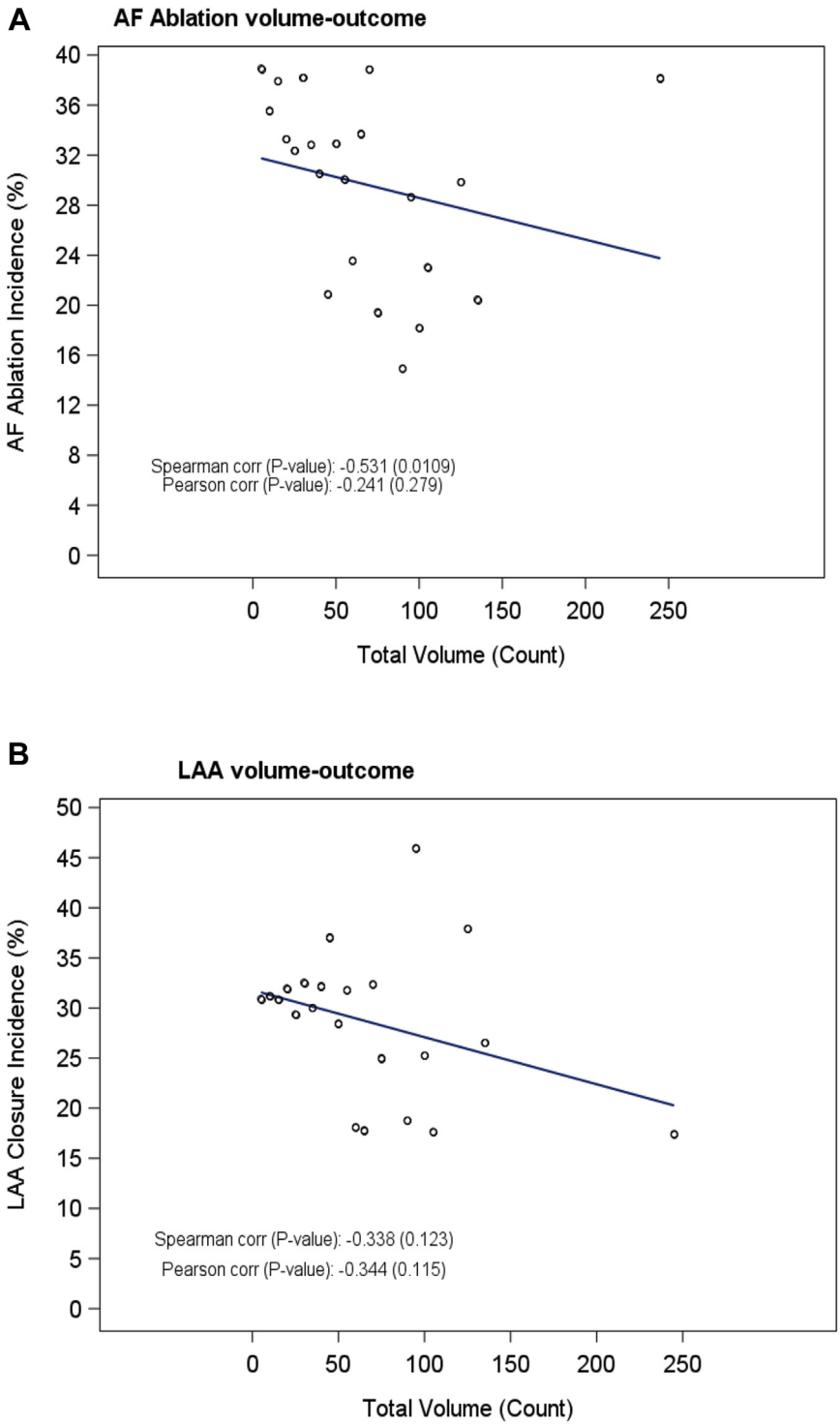

Figure 3. Center volume/likelihood to perform concomitant AF ablation (A) and LAA closure relation (B). (AF, atrial fibrillation; LAA, left atrial appendage.)

As expected, mortality in patients with preoperative AF was reduced in higher-volume centers regardless of ablation status. One could suspect that higher-volume centers had patients with a higher STS predicted risk of mortality score. This was not the case, however. What came as a surprise is the fact that higher-volume centers (likely academic institutions) did not perform concomitant AF ablation of LAA closure more frequently than lower-volume ones. There was a trend towards performing fewer such procedures by higher-volume centers.

Study limitations include those inherent to an observational registry study and include incomplete data

reported by participants and the possibility of residual confounding. Another limitation is the lack of available long-term outcomes data in the STS database. Additionally, no reliable information was available on the lesion sets used to ablate the AF or on the techniques used to close the LAA.

In conclusion, concomitant AF ablation with isolated aortic valve surgery is safe, therefore AF ablation should be performed more frequently on patients undergoing isolated AVR with preoperative AF. All centers (higher- and lower-volume) should consider this. Long-term follow-up is warranted in this cohort to assess late morbidity and mortality benefits.

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Concomitant Surgical Ablation for Atrial Fibrillation: No Longer a Mitral Monopoly?

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Invited Commentary:

Although surgical ablation (SA) is commonplace in patients with atrial fibrillation (AF) undergoing mitral valve surgery, it is less commonly performed during other cardiac surgery procedures. Adding a biatrial ablation to a mitral valve case does not introduce much additional complexity, because 1 or both atria have already been opened to access the valve (depending on approach or tricuspid valve involvement). SA in this context has been shown to be safe, effective, and durable and has been widely recommended as a valuable addition to mitral valve surgery when AF is present.[1]

However, when considering procedures such as coronary artery bypass or aortic valve replacement (AVR) the evidence is less clear. Small cohort studies or trials that typically incorporate AVR as part of the case mix along with mitral valve procedures have shown safety and

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