Effect of Ablation for Atrial Fibrillation on Heart Failure Readmission Rates

Parijat Saurav Joy, MD, MPH[a,*], Rakesh Gopinathannair, MD[b], and Brian Olshansky, MD[a]

Atrial fibrillation (AF) and heart failure (HF) cause numerous hospital admissions. We investigated if AF increases readmissions in patients with HF and whether AF ablation alters readmissions for HF exacerbations. The 2013 Nationwide Readmissions Database was analyzed for all-cause 90-day readmissions, after discharge for HF exacerbation. Kaplan-Meier analysis was used to compare hazard rates for readmissions due to HF exacerbation, after recent ablation versus no ablation. There were 885,270 admissions for HF exacerbation of which 364,447 had coexisting AF. All-cause 90-day readmission rates were higher in patients with HF with coexisting AF versus those without AF (41.4% vs 37.6%, p <0.0001). Associated factors increasing all-cause 90-day readmissions after ablation in patients without HF were female (odds ratio [OR] 1.44, p <0.001), complication of ablation (OR 1.44, p = 0.022), coronary artery disease (OR 1.56, p <0.001), chronic lung disease (OR 1.74, p <0.001), and malnutrition (OR 10.33, p <0.001). These factors were not significant for patients with HF. HF was not a significant risk factor for complications of ablation (adjusted OR 0.82, 95% confidence interval 0.57 to 1.18). Patients who underwent ablation versus patients who were discharged after HF exacerbation without ablation had a lower rate and length of stay for the 90-day readmission episode, due to HF exacerbation (27.5% vs 41.4%, p <0.0001, and 5.58 days vs 6.60 days, p = 0.031, respectively). In conclusion, AF increased 90-day readmissions in patients with HF, and ablation for AF in patients with HF was associated with reduced frequency, length of stay, and readmissions without an increase in complication rates. **© 2017 Published by Elsevier Inc. (Am J Cardiol 2017;120:1572–1577)**

Five million patients around the world develop new-onset atrial fibrillation (AF) annually and the incidence of AF is expected to increase twofold in 20 years.[1,2] AF not only reduces the survival rate but also impairs quality of life.[3] Heart failure (HF) by itself is a rising concern with a doubling of prevalence in the last decade.[4,5] Moreover, uncontrolled AF often leads to tachycardia-induced cardiomyopathy and worsens symptoms in patients with preexisting HF.[6] Considered together, AF and HF have reached epidemic proportions.[7] Ablation for AF reportedly has reduced rates of hospitalization for cardiovascular causes by a greater proportion than antiarrhythmic drug therapy alone.[8] However, reports on the improvement in the ejection fraction, quality of life, and reduction in the recurrence of AF after ablation in patients with HF have been mixed.[9–12] It remains uncertain how ablation of AF in patients with HF translates to real-world outcomes such as hospital readmission rates. Our study sought to investigate the following from a large nationwide database: (1) if AF increases the frequency of all-cause readmissions in patients with HF and affect outcomes and (2) if AF ablation alters readmissions due to HF exacerbations. The study cohort was compiled from admissions in the United States within a single calendar year to minimize variations in outcomes due to changes in practice patterns and trends.

[a]Department of Medicine, University of Iowa Hospitals and Clinics, Iowa City, Iowa; and [b]Department of Medicine, University of Louisville, Louisville, Kentucky. Manuscript received March 19, 2017; revised manuscript received and accepted July 10, 2017.

See page 1576 for disclosure information.

*Corresponding author: Tel: (267) 979-8293; fax: (319) 356-3086.
E-mail address: parijat-joy@uiowa.edu (P.S. Joy).

Methods

We obtained discharge level population data from the Nationwide Readmissions Database (NRD) for 2013, from the Healthcare Cost and Utilization Project (HCUP) of the Agency for Healthcare Research and Quality.[13] The NRD includes information on all hospitalizations, regardless of payer. Each hospitalization in the NRD is treated as an individual entry coded with 1 principal discharge diagnosis, up to 24 associated diagnoses and 15 procedural diagnoses. NRD variables were used to identify patient characteristics of age, gender, and insurance status. The Clinical Classification Software developed as part of HCUP was utilized to analyze for associated primary and secondary diagnoses. Because this is a publicly available deidentified database, it is exempt from institutional review board.

From the 2013 NRD we selected adults admitted with a primary diagnosis of HF. To analyze 90-day readmission rates, we excluded patients admitted in the last 3 months of the calendar year and those who died. All the remaining "index" admissions were included in the comparison of all-cause 90-day readmission rates in 2 groups: with or without preexisting AF. Next, we analyzed readmissions specifically for HF exacerbations. For this, we selected adults with any known history of HF and AF. They were divided into 2 groups: those who were discharged after ablation for AF versus patients who were discharged after HF exacerbation without ablation. Ninety-day readmission rate due to HF exacerbation was compared in these 2 groups. To select patients who underwent an ablation for AF procedure we searched for discharges with a principal diagnosis of AF with a concurrent catheter ablation procedure (International Classification of Diseases, Ninth

0002-9149/© 2017 Published by Elsevier Inc.
https://doi.org/10.1016/j.amjcard.2017.07.057

Revision [ICD-9] 37.34) performed at the same admission. Patients with secondary diagnosis codes for atrial flutter, Wolff-Parkinson-White syndrome, nonparoxysmal atrioventricular tachycardia, paroxysmal supraventricular tachycardia, paroxysmal ventricular tachycardia, and ventricular premature beats and patients who underwent open surgical ablation were excluded. To exclude patients who underwent atrioventricular node ablation, we excluded patients with procedural codes indicating implantation of a pacemaker or an implantable cardioverter-defibrillator during the index admission. The previously mentioned algorithm and exclusion criteria have also been utilized in a previous study to identify patients who underwent an ablation procedure for AF.[14] To identify readmissions for a single patient, we used the unique patient identifier from the database. The primary outcome was readmission within 90 days of the day of discharge. Secondary outcomes at initial admission when ablation was performed were in-hospital complications of ablation procedure (tamponade, neurological complications attributed to the procedure, vascular complications including those requiring surgery, and hematoma or hemorrhage and acute ischemic stroke). Secondary outcomes on readmission episode within 90 days included all of the previously mentioned complications, mortality, as well as associated cost and length of stay (LOS). As hemorrhage was the most common among vascular complications, this was also analyzed as a standalone complication. Charge-to-cost ratio files provided by HCUP were utilized to estimate the cost for inpatient stay.

Using STATA IC 13.0 (StataCorp, College Station, Texas), 2-tailed Pearson chi-square test, and Student *t* test were used to compare categorical and continuous variables, respectively. Covariates were selected for multivariable logistic regression analyses after univariate analyses if they were significant at $p < 0.1$ and if they were clinically plausible risk factors for the outcome variable. Stepwise backward regression was utilized to optimize the model performance, retaining covariates if they were clinically relevant even if insignificant at $p > 0.05$. We checked variables used in the final model for multicollinearity using a variance inflation factor. We performed a Kaplan-Meier analysis to compare the hazard rates of readmission due to HF among those who underwent ablation or not. The day of discharge from index admission was set as "time zero," the beginning of the follow-up period. Failure was defined as a readmission for HF exacerbation or the need for a repeat ablation.

Results

In 2013, 29,936,410 adults were admitted, of which 2,530,712 patients had coexisting HF and AF. There were 885,270 admissions for HF exacerbation, of which 364,447 had coexisting AF. The 90-day all-cause first readmission rate after HF admission was 39%. Readmission rates were higher in patients discharged for HF with coexisting AF compared with those without AF (41.4% vs 37.6%, $p < 0.0001$). On multivariable regression analysis adjusting for age and associated co-morbidities (diabetes, hypertension, coronary artery disease, hyperlipidemia, obesity, chronic kidney disease, smoking, and alcohol abuse), AF increased the likelihood of first readmission after discharge for HF (odds ratio [OR] 1.18, confidence interval [CI] 1.14 to 1.21); patients with AF had a higher percentage of multiple readmissions than patients without AF (Supplementary Figure S1). Among 90-day readmissions after ablation for AF, the top 3 primary diagnoses in patients without HF were AF (36.1%), atrial flutter (6.7%), and pericarditis (3.4%), whereas in those with HF, the most common primary diagnoses were HF (31.3%), AF (13.9%), and pneumonia (3.2%) (Figure 1, Supplementary Figure S2). The most common procedures performed in readmitted patients were cardioversion, echocardiogram, and blood transfusion. These procedures were common to patients with and without HF (Table 1).

On multivariable logistic regression analysis, the associated factors that increased the likelihood of all-cause 90-day readmissions after ablation in patients without HF were female (OR 1.44, $p < 0.001$), complication of ablation (OR 1.44, $p = 0.022$), coronary artery disease (OR 1.56, $p < 0.001$), chronic lung disease (OR 1.74, $p < 0.001$), and malnutrition (OR 10.33, $p < 0.001$). For patients with a history of HF, the previously mentioned factors were not significant (Figure 2, Supplementary Table S1). After an ablation procedure, the most common complications were tamponade and vascular complications. Fewer complications were encountered during a 90-day readmission episode than those that manifested during the index admission (1.70% vs 6.83%). The rates of individual complications at index admission among patients with and without HF were similar, and differences were not statistically significant (Table 2). Considering the rate of all complications encountered at index admission and readmission within 90 days, there was no statistically significant difference in patients with and without HF (8.89% vs 8.47%, $p = 0.578$). On multivariable logistic regression analysis to elucidate possible risk factors for complications, adjusting for age, gender, and other co-morbid conditions, associated HF was not a significant risk factor for complications of ablation procedure encountered at index admission (adjusted OR 0.82, 95% CI 0.57 to 1.18). Of patients discharged after ablation for AF, the mortality rate for patients readmitted within 90 days was 0.36%, including 0.04% who had a complication of ablation at index admission. The most common primary diagnoses in patients who died at readmission within 90 days were respiratory failure (23.5%), septicemia (11.8%), and pneumonia (11.8%).

An estimated 13,387 ablation procedures for AF were performed in 2013. Among patients who underwent ablation for AF, 18.7% were carried out in those with coexisting HF. In patients with HF who underwent ablation versus patients who were discharged after HF exacerbation without an ablation procedure, the 90-day readmission rate due to HF exacerbation was 27.5% versus 41.4% ($p < 0.0001$). Demographic characteristics and co-morbidities of patients with coexisting HF and AF, with and without ablation, are presented in Table 3. Ablation was less commonly performed in women and in those with $CHA_2DS_2VAS_c$ scores >4 (32% vs 68%, $p < 0.0001$). Repeat ablations for AF were performed less often in patients with HF than in patients without HF (1.1% vs 3.3%, $p < 0.001$). Among patients who underwent ablation procedures in a single calendar year, 2.9% had two ablation procedures and 0.14% had 3 procedures. On Kaplan-Meier analysis for all subsequent readmissions for HF exacerbation, the cumulative hazard rate at 90 days was 0.323 (95% CI 0.24 to 0.42) for patients after ablation compared with 0.624