RESEARCH LETTER

Periprocedural and Short-Term Outcomes of Percutaneous Left Atrial Appendage Closure According to Type of Atrial Fibrillation

Toshiaki Isogai, MD, MPH*; Ankit Agrawal, MD*; Anas M. Saad, MD; Shunsuke Kuroda, MD; Shashank Shekhar, MD; Abdelrahman I. Abushouk, MD; Oussama M. Wazni, MD; Ayman A. Hussein, MD; Amar Krishnaswamy, MD; Samir R. Kapadia, MD

Percutaneous left atrial appendage closure (LAAC) with the Watchman device (Boston Scientific) has emerged as an alternative to anticoagulation for stroke prevention in patients with atrial fibrillation (AF).1 AF generally starts as paroxysmal AF in nature, and progresses to persistent or permanent AF. A greater electrical burden of nonparoxysmal AF than paroxysmal AF is associated with a larger size and a decreased function of the left atrium.2 These features of nonparoxysmal AF may increase the procedural complication risk of LAAC. In addition, since nonparoxysmal AF carries a higher thromboembolic risk than paroxysmal AF among patients receiving anticoagulation,3 nonparoxysmal AF may also pose a higher thromboembolic risk than paroxysmal AF among patients undergoing LAAC. However, it remains unclear whether the effectiveness of LAAC differs among AF types. We hypothesized that patients with nonparoxysmal AF had a higher risk of periprocedural and short-term events following LAAC than patients with paroxysmal AF. Therefore, we sought to compare the periprocedural and short-term outcomes of LAAC according to AF type, using a US population-based database.

This study was exempted from the approval of the institutional review board because it used anonymized and de-identified data in a publicly available database.

The present study is a retrospective analysis using the Nationwide Readmissions Database 2016 to 2017, a publicly available administrative claims database released by the Healthcare Cost and Utilization Project.4 The Nationwide Readmissions Database allows capturing of any readmission in a state until the end of December in a calendar year. The International Classification of Diseases, Tenth Revision (ICD-10) codes were used to identify patients ≥18 years of age with a primary diagnosis of AF (I48.0/I48.1/I48.2) who underwent percutaneous LAAC (02L73DK). Eligible patients were grouped into patients with paroxysmal AF (I48.0) or nonparoxysmal AF (I48.1/I48.2, including persistent, long-standing persistent, and permanent/chronic AF). The primary outcome was the in-hospital composite outcome, defined as death, ischemic stroke/transient ischemic attack, systemic embolism, bleeding requiring blood transfusion, pericardial effusion/cardiac tamponade treated with pericardiocentesis or surgically, and removal of embolized device. The secondary outcomes were the individual components of the composite outcome and 180-day readmission outcomes (any-cause readmission and ischemic stroke/transient ischemic attack). For the present analyses, we used unweighted data in the Nationwide Readmissions Database and compared

Key Words: complication ■ left atrial appendage closure ■ paroxysmal atrial fibrillation ■ persistent atrial fibrillation ■ stroke
Table. Patient Characteristics and In-Hospital and 180-Day Outcomes of Percutaneous Left Atrial Appendage Closure in Patients With Paroxysmal Versus Nonparoxysmal Atrial Fibrillation

| Patient characteristics                  | Unmatched cohort | Propensity score–matched cohort |
|------------------------------------------|------------------|---------------------------------|
|                                          | Paroxysmal atrial fibrillation (n=3694) | Nonparoxysmal atrial fibrillation (n=4130) | Absolute standardized difference, %∗ | Paroxysmal atrial fibrillation (n=3290) | Nonparoxysmal atrial fibrillation (n=3290) | Absolute standardized difference, %∗ |
| Age (y) mean±SD                          | 75.4±8.0         | 76.6±7.9                        | 16.4                                | 75.9±7.7                             | 76.0±8.1                             | 1.0                                  |
| Women                                    | 1705 (46.2)      | 1439 (34.8)                    | 23.2                                | 1348 (41.0)                          | 1350 (41.0)                          | 0.1                                  |
| CHA2DS2-VASc score, mean±SD             | 4.1±1.5          | 4.2±1.5                        | 3.2                                 | 4.1±1.5                              | 4.1±1.5                              | 0.7                                  |
| Prior percutaneous coronary intervention | 568 (15.4)       | 650 (15.7)                      | 1.0                                 | 512 (15.6)                           | 516 (15.7)                           | 0.3                                  |
| Prior coronary artery bypass grafting    | 530 (14.3)       | 643 (15.6)                      | 3.4                                 | 480 (15.0)                           | 508 (15.4)                           | 2.4                                  |
| Prior valve implantation                 | 188 (5.1)        | 253 (6.1)                      | 4.5                                 | 177 (5.4)                            | 178 (5.4)                            | 0.1                                  |
| Prior pacemaker/defibrillator implantation | 929 (25.1)     | 1089 (26.4)                    | 2.8                                 | 849 (25.8)                           | 868 (26.4)                           | 1.3                                  |
| Prior cerebrovascular disease            | 947 (25.6)       | 978 (23.7)                      | 4.5                                 | 813 (24.7)                           | 802 (24.4)                           | 0.8                                  |
| Mitral regurgitation                     | 235 (6.4)        | 325 (7.9)                      | 5.9                                 | 216 (6.6)                            | 225 (6.8)                            | 1.1                                  |
| Tricuspid regurgitation                  | 72 (1.9)         | 112 (2.7)                      | 5.1                                 | 70 (2.1)                             | 69 (2.1)                             | 0.2                                  |
| Pulmonary hypertension                   | 176 (4.8)        | 335 (8.1)                      | 13.7                                | 176 (5.3)                            | 179 (5.4)                            | 0.4                                  |
| Carotid artery disease                   | 94 (2.5)         | 78 (1.9)                       | 4.5                                 | 73 (2.2)                             | 71 (2.2)                             | 0.4                                  |
| Chronic pulmonary disease                | 701 (19.0)       | 829 (20.1)                     | 2.8                                 | 624 (19.0)                           | 651 (19.8)                           | 2.1                                  |
| Renal failure                            | 670 (18.1)       | 884 (21.4)                     | 8.2                                 | 628 (19.1)                           | 645 (19.6)                           | 1.3                                  |
| Liver disease                            | 87 (2.4)         | 118 (2.9)                      | 3.2                                 | 81 (2.5)                             | 88 (2.7)                             | 1.3                                  |
| Malignancy                               | 83 (2.2)         | 107 (2.6)                      | 2.2                                 | 81 (2.5)                             | 77 (2.3)                             | 0.8                                  |
| Anemia                                   | 517 (14.0)       | 605 (14.6)                     | 1.9                                 | 447 (13.6)                           | 462 (14.0)                           | 1.3                                  |
| Obesity                                  | 521 (14.1)       | 627 (15.2)                     | 3.0                                 | 468 (14.2)                           | 471 (14.3)                           | 0.3                                  |
| Hospital status                          | 3184 (86.2)      | 3568 (86.4)                    | 0.6                                 | 2845 (86.5)                          | 2845 (86.5)                          | 0.0                                  |
| Annual hospital procedural volume*       | 1301 (35.2)      | 1487 (36.0)                    | 1.6                                 | 1163 (35.3)                          | 1178 (35.8)                          | 1.0                                  |
| In-hospital outcomes                     |                   |                                 |                                     |                                     |                                     |                                      |
| Composite outcome of the following events | 87 (2.4)         | 96 (2.3)                       | 0.94                                | 78 (2.4)                             | 69 (2.1)                             | 0.45                                 |
| Death                                    | ≤10 (≤0.3)†       | ≤10 (≤0.2)‡                    | 1.00                                | ≤10 (≤0.3)‡                          | ≤10 (≤0.3)‡                          | 1.00                                 |
| Ischemic stroke/transient ischemic attack | 18 (0.5)        | 21 (0.5)                       | 1.00                                | 17 (0.5)                             | 16 (0.5)                             | 1.00                                 |
| Bleeding requiring blood transfusion     | 21 (0.6)         | 22 (0.5)                       | 0.88                                | 17 (0.5)                             | 14 (0.4)                             | 0.72                                 |
| Pericardial effusion/cardiac tamponade treated with pericardiocentesis or surgically | 39 (1.1)         | 36 (0.9)                       | 0.42                                | 35 (1.1)                             | 27 (0.8)                             | 0.37                                 |
| Removal of embolized device              | ≤10 (≤0.3)†       | 13 (0.3)                       | 0.67                                | ≤10 (≤0.3)‡                          | ≤10 (≤0.3)‡                          | 0.65                                 |
| Length of stay ≥2 d                      | 528 (14.3)       | 564 (13.7)                     | 0.43                                | 465 (14.1)                           | 442 (13.4)                           | 0.43                                 |
patient characteristics and outcomes between the groups using a propensity score matching.

Of 7824 eligible patients, 3694 (47.2%) had paroxysmal AF and 4130 (52.8%) had nonparoxysmal AF (Table). In the unmatched cohort, patients with nonparoxysmal AF, as compared with those with paroxysmal AF, were older, more often male, and had a higher prevalence of pulmonary hypertension. CHA2DS2-VASc score did not differ significantly between the 2 groups. Propensity score matching created 3290 pairs, in whom patient characteristics were well balanced. In the propensity score–matched cohort, there were no significant differences in the in-hospital composite outcome (2.4% versus 2.1%, \(P=0.45\)) and its components between the paroxysmal AF and nonparoxysmal AF. Furthermore, there were also no significant differences between the groups in terms of 180-day any-cause readmission (27.6% versus 27.2%, log-rank \(P=0.86\)) and 180-day ischemic stroke/transient ischemic attack (1.4% versus 1.4%, log-rank \(P=1.00\)) (Table). In subgroup comparisons of persistent (48.1, n=1828) versus permanent/chronic AF (48.2, n=2302), there were no significant differences in the composite outcome (2.1% versus 2.5%, \(P=0.41\)) and 180-day ischemic stroke/transient ischemic attack (1.3% versus 1.3%, log-rank \(P=0.964\)).

Despite significant differences in age and sex, there was no significant difference in CHA2DS2-VASc score between the paroxysmal AF and nonparoxysmal AF groups. This finding suggests that LAAC is performed in patients with AF with high CHA2DS2-VASc score regardless of AF type. Importantly, our propensity score–matched analysis did not find any statistically significant association between AF type and in-hospital and 180-day adverse outcomes following LAAC. Given that approximately half of the candidates for LAAC have nonparoxysmal AF,\(^1\) this finding appears to be clinically meaningful with respect to periprocedural and short-term risk management following LAAC among patients with different AF types. Meanwhile, a recent study revealed that patients with long-standing persistent AF, as compared with those with non-long-standing persistent AF, had a higher incidence of moderate peridevice leak (3–5 mm) at 6 weeks following LAAC (27% versus 4%; \(P=0.003\)) despite the similar moderate peridevice leak immediately postimplant (2% versus 0%; \(P=0.14\)).\(^5\) This finding suggests that peridevice leak may occur at a later phase among patients with nonparoxysmal AF. The peridevice leak might be associated with future thrombus formation in left atrium. Therefore, further studies are warranted to understand the impact of AF type on long-term outcomes following LAAC.

The present study has several limitations related to the data source. The Nationwide Readmissions Database lacks data on bleeding risk score, laboratory/imaging findings, details of LAAC procedure, peridevice leak, pre-/post-LAAC antithrombotic therapy (anticoagulant/antiplatelet), and long-term follow-up. Nonetheless, the present study provides an insight into the application of LAAC in patients with different AF types. Our analyses did not find any significant difference in procedural safety and short-term effectiveness between patients with paroxysmal AF or nonparoxysmal AF, implying LAAC as a safe, effective therapeutic option regardless of AF type. Further studies are warranted to examine the differences in long-term effectiveness of LAAC according to AF type.

**ARTICLE INFORMATION**

Received April 19, 2021; accepted September 29, 2021.

**Affiliation**
Department of Cardiovascular Medicine, Heart, Vascular and Thoracic Institute, Cleveland Clinic, Cleveland, OH.

**Sources of Funding**
This study was made possible by a generous gift from Jennifer and Robert McNeil. The funders had no role in the design and conduct of the study, in
the collection, analysis, and interpretation of the data, and in the preparation, review, or approval of the manuscript.

Disclosures
Dr Wazni reports personal fees from Boston Scientific during the conduct of the study. The remaining authors have no disclosures to report.

REFERENCES
1. Brouwer TF, Whang W, Kuroki K, Halperin JL, Reddy VY. Net clinical benefit of left atrial appendage closure versus warfarin in patients with atrial fibrillation: a pooled analysis of the randomized PROTECT-AF and PREVAIL studies. *J Am Heart Assoc.* 2019;8:e013525. doi: 10.1161/JAHA.119.013525

2. Gupta DK, Shah AM, Giugliano RP, Ruff CT, Antman EM, Grip LT, Deenadayalu N, Hoffman E, Patel I, Shi M, et al. Left atrial structure and function in atrial fibrillation: ENGAGE AF-TIMI 48. *Eur Heart J.* 2014;35:1457–1465. doi: 10.1093/eurheartj/ehu500

3. Steinberg BA, Hellkamp AS, Lokhnygina Y, Patel MR, Breithardt G, Hankey GJ, Becker RC, Singer DE, Halperin JL, Hacke W, et al. Higher risk of death and stroke in patients with persistent vs. paroxysmal atrial fibrillation: results from the ROCKET-AF Trial. *Eur Heart J.* 2015;36:288–296. doi: 10.1093/eurheartj/ehu039

4. Healthcare Cost and Utilization Project (HCUP). NRD overview. Rockville, MD: Agency for Healthcare Research and Quality; April 2021. Available at: www.hcup-us.ahrq.gov/nrdoverview.jsp. Accessed April 19, 2021.

5. Glassy MS, Wung W, Westcott S, Smith TWR, Fan D, Rogers JH, Singh GD. Watchman occlusion in long-standing persistent atrial fibrillation: larger left atrial appendages with greater residual leak. *JACC Cardiovasc Interv.* 2019;12:1018–1026. doi: 10.1016/j.jcin.2019.04.007