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Left Atrial Appendage Closure and Pulmonary Vein Isolation

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Atrial fibrillation (AF) is the most common arrhythmia, affecting 2.7 to 6.1 million people in the United States and 4.5 million people living in the European Union.[1] The left atrial appendage (LAA) is the major site of thrombus formation in nonvalvular AF, responsible for more than 90% of cases in patients with AF.[2] Pulmonary vein isolation (PVI) is a recommended treatment option in selected groups of patients with AF.[3] Left atrial appendage exclusion is performed among eligible patients with AF to prevent thrombus formation and subsequent cardioembolic stroke.[1] We review the possible role of combined LAA closure (LAAC) and catheter ablation for treatment of AF.

Left Atrial Appendage Isolation for Atrial Fibrillation Treatment

The LAA is the focal point of AF and tachycardia in at least 27% of patients presenting with recurrent AF after ablation procedures.[4] Although acute LAA electrical isolation can be achieved by catheter ablation in most patients, the durability of endocardial LAA isolation is dismal (success rate, only 50% in the most experienced hands), and focal ablation does not work in the long term.[5] Left atrial appendage isolation is technically challenging with currently available devices, and it often requires redo ablation. The failure rate of LAA isolation at index procedure is between 10% and 15%, and the rate of LAA reconnection after single-procedure ablation is 35% to 40%.[6]

In the Belief trial, Di Biase and colleagues[7] showed that empirical electrical isolation of the LAA, after a single or redo procedure in patients with longstanding persistent AF undergoing catheter ablation, is a safe approach and improves the success rate of the procedure. At 12-month follow-up, 48 patients (56%) in the LAA isolation group and 25 patients (28%) in the non-LAA isolation group were free from AF recurrence after a single procedure. Cumulative success at 24-month follow-up in repeat patients was 65 (76%) in the LAA isolation group and 49 (56%) in the non-LAA isolation group.

Disadvantages of Endocardial Ablation with Isolation

Endocardial LAA ablation with isolation has several disadvantages, as follows[8,9]:

- Complete electrical isolation may be difficult to accomplish.
- There is a risk of perforating the thin pits of the LAA wall.
- The loss of LAA contractility has adverse effects on LA emptying and stroke volume.
- The loss of LAA contractility also produces a high risk for thrombus formation and, thus, the need for prolonged anticoagulation.
- There is a risk of damaging the cardiac arteries because the LAA ostium lies close to the left main coronary artery (distance, 7–12 mm) and the left circumflex coronary artery (distance, 3–7 mm).
- There is a risk of damaging the left phrenic nerve (LPN). The LPN travels over the distal portion of the posterior wall of the LAA in 59% of patients and over the middle or proximal portion in 23%.

Concomitant Left Atrial Appendage Closure and Pulmonary Vein Isolation

In different clinical trials, the safety and efficacy of combining LAAC with PVI has been studied as a new approach to treating AF patients and to improving the PVI

success rate, while, at the same time, reducing the incidence of stroke.[10-12] Phillips and colleagues[10] showed the feasibility and safety of combined catheter ablation for AF and LAA device occlusion by reviewing the data from 2 prospective, real-world WATCHMAN™ (Boston Scientific Corporation) registries, running in parallel: the first included data from Europe, the Middle East, and Russia (EWOLUTION), and the second, from Asia and Australia (WASP). Among 1,140 patients in these registries, 139 patients at 10 centers underwent concomitant AF ablation and the WATCHMAN procedure; the complication rates for the combined procedure and for catheter ablation alone were similar. In another study, Panikker and his team[11] showed that concomitant LAA electrical isolation and LAAC was feasible in patients who underwent AF ablation to manage persistent AF. In addition, the study showed that the technique could improve the success rate of the treatment of persistent AF with ablation at 12-month follow-up. At that time, 19 of 20 patients (95%) who had a single procedure (the study group) were free from AF, compared with 25 of 40 patients (63%) who had ablation alone (the control group).

The safety and feasibility of combined cryoballoon ablation and LAAC were confirmed in a study by Fassini and colleagues,[12] in which 35 patients had combined cryoballoon ablation and LAAC with use of the AMPLATZER™ Cardiac Plug (St. Jude Medical, part of Abbott) and the WATCHMAN.

Pulmonary vein isolation should be done before an LAA implant.[11] Left atrial appendage occlusion (LAAO) devices do not produce electrical isolation of the LAA, so if an LAA focus is a trigger for AF, it would be more difficult or impossible to eliminate the focus in the presence of an LAA implant.[10,11] Although combined PVI and LAAO has been shown to be feasible and safe, recurrence rates of LAA isolation are high, and LAA implants may impede re-isolation.[11]

Atrial Fibrillation Ablation in Patients with an Existing WATCHMAN Device

Atrial fibrillation ablation in patients with an existing WATCHMAN LAAC device is feasible and safe; however, the device makes it difficult to isolate the LAA. Complete isolation was achieved in only 60% of patients in a study by Turagam and associates,[13] and when attempted, it increased the risk of new leaks—requiring patients to be placed on lifelong oral anticoagulation therapy—and recurrence of atrial tachycardia/AF.

Left Atrial Appendage Ligation and Atrial Fibrillation Ablation

The LAA is the main site of clot formation in patients with AF and a potential source of cardiac arrhythmia; it is also where atrial natriuretic peptide (ANP) and brain natriuretic peptide (BNP) are produced and stored. In addition, the LAA has a regulatory role in intravascular volume status and hemodynamic conditions, such as mediating thirst and maintaining cardiac output.[14]

Although both endocardial and epicardial LAAO approaches lower the risk of stroke and improve the LA reservoir function, only epicardial LAAO leads to the electrical isolation of the LAA and decreases BNP and ANP levels.[15]

Left atrial appendage ligation with the LARIAT® Suture Delivery Device (SentreHEART, Inc.) results in extensive LAA inflammation, which causes fibrosis and scarring, as well as electrical isolation and permanent closure of the LAA.[16,17] Electrical isolation may be beneficial in reducing AF burden, especially in patients with nonparoxysmal AF.[15] The LAALA-AF Registry study[18] showed that, at one-year follow-up after one ablation procedure and off antiarrhythmic therapy, freedom from AF was higher in the group that had the LARIAT procedure and ablation than in the ablation-only group (65% vs 39%; P=0.002). In addition, more patients in the ablation-only group underwent redo ablation because of AF recurrence (16% vs 33%; P=0.018).[18]

The LAA HOMEOSTASIS study showed decreasing BNP and ANP levels after epicardial LAAO, which resulted in significantly lower blood pressure at 24-hour and 3-month follow-up.[19]

Sequential LAA epicardial exclusion (LARIAT), followed by AF ablation, is one possible strategy for maximizing the efficacy and safety and long-term outcomes in patients with nonparoxysmal AF and is under investigation in the aMAZE trial.[20]

Summary

We conclude with several points:

- Left atrial appendage isolation is an important adjunct for improving the treatment success rate in nonparoxysmal AF.
- Endocardial LAAO does not produce electrical isolation.
- It is technically challenging to achieve empirical isolation of the LAA with catheter ablation only.
- Several investigators have studied the feasibility of simultaneous PVI and endocardial LAA exclusion with or without LAA isolation, but the question of redo ablation and the challenges associated with endocardial devices remain.
- Complete exclusion is safer and more effective than endocardial ablation.

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