

EDITORIAL COMMENT

Percutaneous Closure of the Left Atrial Appendage

A Major Step Forward*

Horst Sievert, MD, Yves L. Bayard, MD

Frankfurt, Germany

Atrial fibrillation is a common cardiac arrhythmia with a higher prevalence in the elderly population. It is more frequent in men than in women at all ages (1). It might cause a reduced cardiac output and formation of atrial thrombi, especially in the left atrial appendage (2). Atrial fibrillation is associated with a 5-fold increased risk for stroke and embolism (3) and accounts for as much as one-sixth of all ischemic strokes (4). These strokes tend to be more severe than cerebral embolisms caused by other sources, probably due to the larger size of thrombi in atrial fibrillation (5,6).

See page 594

Several randomized studies, such as the AFFIRM (Atrial Fibrillation Follow-up Investigation of Rhythm Management) and the RACE (Rate Control versus Electrical Cardioversion for Persistent Atrial Fibrillation Study) trials, have demonstrated the benefit of anticoagulation treatment in both rhythm and rate controlled atrial fibrillation patients. With a stroke risk reduction of almost 70%, anticoagulation is highly effective in preventing embolic events in atrial fibrillation patients and is superior to other pharmacological approaches (7). Compared with aspirin, oral anticoagulation reduces the risk of stroke by 45%. However, anticoagulation might increase the risk of major bleeding by approximately 70% compared with aspirin, accounting for severe bleedings in up to 2.3% of patients/year (8). Other disadvantages of anticoagulation therapy are its narrow therapeutic range, pharmacological and food interactions, and the need for frequent monitoring and dose adjustments. These might be some of the reasons why only 54% of all high-risk patients who are eligible for oral anticoagulation therapy actually receive warfarin (9). A review of the Food

and Drug Administration Surveillance and Epidemiology Office showed that warfarin was among the top 10 drugs with the largest number of serious adverse event reports from the year 1990 to 2000 (10). Furthermore, U.S. death certificates indicate that anticoagulants ranked first in 2003 and 2004 in the number of total mentions of deaths for drugs causing adverse effects in therapeutic use.

The first surgical attempt to remove the left atrial appendage as a possible source for thromboembolic event was made by Madden (11) in 1948.

In the "Maze" operation introduced by Cox (12), several small incisions are made in the atria to interrupt atrial fibrillation reentry pathways. In a report of 197 patients who underwent the Maze procedure, the mean rate of freedom from atrial fibrillation was 89% after 10 years of follow-up (13). Despite these good results, the Maze procedure is not very commonly used, because it is complicated and time-consuming. Operations that were modified from the original Maze procedure were shown to be less effective than the original procedure (14). Complications of the Maze operation include atrial dysfunction due to extensive injury to the atrial walls and different types of atrial arrhythmias as a possible consequence of partial denervation of the sympathetic and parasympathetic systems of the heart. Most importantly, it does not reduce the risk of embolic events, so patients have to continue with anticoagulation therapy.

Nowadays, surgical obliteration or resection of the left atrial appendage is usually not performed as a stand-alone procedure because of its invasive character. Besides, it might not prevent thromboembolism from the structure dependably, because it is frequently incomplete (15). However, surgical ligation of the left atrial appendage is part of the Maze procedure and recommended by the American College of Cardiology and the American Heart Association guidelines during mitral valve surgery.

Why attempt device closure of the left atrial appendage? A meta-analysis of several echocardiographic, surgical, and autopsy studies of Blackshear et al. (2) revealed that more than 90% of left atrial thrombi in patients with nonrheumatic AF form in the left atrial appendage. Catheter closure of this structure is a logical and minimally invasive method to exclude the left atrial appendage from circulation and thereby prevent cardioembolic events. Basic principles of this technique are similar to other interventions in structural heart disease. So far, transcatheter closure of the left atrial appendage has only been performed in patients who were not eligible for long-term anticoagulation treatment with warfarin.

In 2001, the first percutaneous left atrial appendage occlusion was performed with a dedicated device, the PLAATO (Percutaneous Left Atrial Appendage Transcatheter Occlusion) occluder (16). The nonrandomized PLAATO Multicenter Studies including sites in the U.S.

*Editorials published in *JACC: Cardiovascular Interventions* reflect the views of the authors and do not necessarily represent the views of *JACC: Cardiovascular Interventions* or the American College of Cardiology.

From the CardioVascular Center Frankfurt, Sankt Katharinen, Frankfurt, Germany. Dr. Sievert is a principal investigator of the PLAATO Studies and investigator of the PROTECT AF Study.

and in Europe have demonstrated feasibility and short-term safety of left atrial appendage closure (17).

In this issue of *JACC: Cardiovascular Interventions*, Block et al. (18) report the first long-term results after transcatheter left atrial appendage occlusion with the PLAATO device in 64 patients enrolled in the former PLAATO multicenter study. Their findings are encouraging: only 1 major adverse event (tamponade) was related to the procedure. No other procedure-related major adverse event occurred during follow-up of up to 5 years. When compared with the estimated risk for stroke according to the CHADS₂ score, the actual stroke rate in a mean follow-up time of 3.8 years was almost cut in half.

Despite promising results with transcatheter closure with the PLAATO device, there has never been a randomized trial versus best medical treatment to prove this trend. The randomization study was successfully conducted with another device: the Watchman left atrial appendage filter. On this year's American College of Cardiology congress, it was reported to be noninferior to anticoagulation therapy regarding stroke risk reduction.

One might argue that the obvious benefit of the procedure regarding stroke reduction might be outweighed by long-term complications. However, to date we do not have data supporting this.

Given the results of the PROTECT AF (WATCHMAN Left Atrial Appendage System for Embolic PROTECTION in Patients With Atrial Fibrillation) trial and the current long-term follow-up report with the PLAATO device, left atrial appendage occlusion has done a major step forward.

Reprint requests and correspondence: Dr. Horst Sievert, Cardiovascular Center Frankfurt, Seckbacher Landstrasse 65, 60389 Frankfurt, Germany. E-mail: HorstSievertMD@aol.com.

REFERENCES

1. Go AS, Hylek EM, Phillips KA. Prevalence of diagnosed atrial fibrillation in adults: national implications for rhythm management and stroke prevention: the Anticoagulation and Risk Factors in Atrial Fibrillation (ATRIA) study. *JAMA* 2001;285:2370-5.
2. Blackshear JL, Odell JA. Appendage obliteration to reduce stroke in cardiac surgical patients with atrial fibrillation. *Ann Thorac Surg* 1996;61:755-9.
3. Lip GY, Edwards SJ. Stroke prevention with aspirin, warfarin, and ximelagratran in patients with non-valvular atrial fibrillation: a systematic review and meta-analysis. *Thrombosis Res* 2006;118:321-33.
4. Wolf PA, Abbott RD, Kannel WB. Atrial fibrillation as an independent risk factor for stroke: the Framingham Study. *Stroke* 1991;22:983-8.
5. Anderson DC, Kappelle LJ, Eliasziw M, et al. Occurrence of hemispheric and retinal ischemia in atrial fibrillation compared with carotid stenosis. *Stroke* 2002;33:1963-7.
6. Harrison MJ, Marshall J. Atrial fibrillation, TIAs and completed strokes. *Stroke* 1984;15:441-2.
7. Hart RG, Halperin JL, Pearce LA, et al. Lessons from the stroke prevention in atrial fibrillation trials. *Ann Intern Med* 2003;138:831-8.
8. Levine MN, Raskob G, Landefeld S, Kearon C. Hemorrhagic complications of anticoagulant treatment. *Chest* 2001;119:108S-21S.
9. Waldo AL, Becker RC, Tapson VF, et al. Hospitalized patients with atrial fibrillation and a high risk of stroke are not being provided with adequate anticoagulation. *J Am Coll Cardiol* 2005;46:1729-36.
10. Wysowski DK, Nourjah P, Swartz L. Bleeding complications with warfarin use: a prevalent adverse effect resulting in regulatory action. *Arch Intern Med* 2007;167:1414-9.
11. Madden J. Resection of the left auricular appendix. *JAMA* 1948;140:769-72.
12. Cox JL, Canavan TE, Schuessler RB, et al. The surgical treatment of atrial fibrillation. II. Intraoperative electrophysiologic mapping and description of the electrophysiologic basis of atrial flutter and atrial fibrillation. *J Thorac Cardiovasc Surg* 1991;101:406-26.
13. Gaynor SL, Schuessler RB, Bailey MS, et al. Surgical treatment of atrial fibrillation: predictors of late recurrence. *J Thorac Cardiovasc Surg* 2005;129:104-11.
14. Barnett SD, Ad N. Surgical ablation as treatment for the elimination of atrial fibrillation: a meta-analysis. *J Thorac Cardiovasc Surg* 2006;131:1029-35.
15. Katz ES, Tsiamtsiouris T, Applebaum RM, et al. Surgical left atrial appendage ligation is frequently incomplete: a transesophageal echocardiographic study. *J Am Coll Cardiol* 2000;36:468-71.
16. Sievert H, Lesh MD, Trepels T, et al. Percutaneous left atrial appendage transcatheter occlusion to prevent stroke in high-risk patients with atrial fibrillation: early clinical experience. *Circulation* 2002;105:1887-9.
17. Ostermayer SH, Reisman M, Kramer PH, et al. Percutaneous left atrial appendage transcatheter occlusion (PLAATO system) to prevent stroke in high-risk patients with non-rheumatic atrial fibrillation: results from the international multi-center feasibility trials. *J Am Coll Cardiol* 2005;46:9-14.
18. Block PC, Burstein S, Casale PN, et al. Percutaneous left atrial appendage occlusion for patients in atrial fibrillation suboptimal for warfarin therapy: 5-year results of the PLAATO (Percutaneous Left Atrial Appendage Transcatheter Occlusion) study. *J Am Coll Cardiol Intv* 2009;2:594-600.

Key Words: atrial fibrillation ■ stroke ■ left atrial appendage ■ WATCHMAN ■ PLAATO.