Role of Transesophageal Echocardiography during Left Atrial Appendage Occlusion Device Closure in a Patient with Non-Valvular Atrial Fibrillation and Angiodysplasia of the Colon

Abstract
Atrial fibrillation is the most common arrhythmia associated with significant mortality and morbidity secondary to thrombo-embolism. To prevent this thrombo-embolism oral anticoagulation therapy is the recommended treatment. In patients with contraindications to oral anticoagulation therapy, percutaneous left atrial appendage occlusion device is indicated. TEE is essential to guide in all the stages of LAA device deployment. Right from pre-procedure screening, to guiding during deployment, to rule out any complications and post-procedure surveillance and monitoring long term outcomes.

Keywords: Amplatzer cardiac plug, atrial fibrillation, left atrial appendage occlusion device, transoesophageal echocardiography

Introduction
Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia encountered in clinical practice. The incidence is around 3%–5% in the age group of 65–75 years and increasing to >8% in patients more than 80 years. It is associated with increased mortality and morbidity. One of its most devastating complications is stroke secondary to thromboembolism. Overall, AF accounts for 15%–20% of strokes in the general population and for up to 30% in patients over the age of 80 years. If untreated, the risk of stroke is 3–5%/year in patients with nonvalvular AF (NV AF).[1‑6] To prevent this, oral anticoagulation (OAC) is the treatment of choice.[7] This anticoagulant therapy has been proven to effectively prevent thromboembolic strokes but increases the risk of serious bleeding, which has an incidence of 2–4%/ year.[8] In addition, these drugs have a small therapeutic window, several food and drug interactions, and require frequent blood testing, which makes this therapy inconvenient to many patients. Novel OACs are also associated with increased bleeding and gastric intolerance.[9] So far, neither pharmacological cardioversion nor radiofrequency catheter ablation has been proven to eliminate the indication for long-term OAC therapy.[7,9] Hence, alternative treatment options are essential. Left atrial appendage (LAA) occlusion device is one such option in patients where OAC is contraindicated. Transesophageal echocardiography (TEE) plays a very important role in all the stages of LAA occlusion device therapy.

Case Report
A 71-year-old gentleman presented to us with a history suggestive of gastrointestinal (GI) bleed. When evaluated, he was found to have gastric erosion and angiodysplasia of the colon. He was a known case of diabetes, hypertension, and ischemic heart disease with percutaneous transluminal coronary angioplasty to left circumflex (LCX) 12 years back. As he developed AF during the follow-up period and CHA²DS₂‑(VASc) score >2 [Table 1],[10] he was treated with oral anticoagulant (Acitrom) and single antiplatelet therapy (Ecosprin). GI endoscopy showed gastric erosions and colonoscopy showed angiodysplasia of the colon. Two-dimensional (2D) echocardiography revealed ejection fraction - 58%, no wall motion abnormality, Grade III diastolic dysfunction, and mild tricuspid regurgitation with pulmonary hypertension (right ventricular systolic...
pressure - 42 mmHg). Routine blood investigation hemoglobin was 5 g/dl, and after the blood transfusion, it became 9 g/dl. Prothrombin time, and international normalized ratio were within normal limits; activated partial thromboplastin time was prolonged as the patient was on heparin. Platelet counts were within normal limits. Renal and liver functions were within normal limits. At present, as the patient was having GI bleed with anemia requiring multiple transfusions and HAS-BLED score >2 [Table 2],[11] anticoagulant therapy was contraindicated. He was posted for LAA device occlusion therapy. Percutaneously, LAA occlusion device (20 mm Amplatzer cardiac plug [ACP], St. Jude Medical Incorporation, Minnesota, USA) was deployed under general anesthesia with TEE and fluoroscopic guidance. Postoperative period was uneventful. We are describing the role of TEE in creating a roadmap to guide during LAA device occlusion therapy.

**Discussion**

TEE plays a very important role in all the stages of the procedure.[12,13] Before deployment, TEE is used to rule out any thrombus in the left atrium or LAA as it is a contraindication for deployment of the device [Video 1]. The presence of spontaneous echocardiography contrast is not a contraindication. Preprocedure, one has to define the morphology and dimensions of LAA. Morphologically, there are four types of LAA – chicken wing, cauliflower, windsock, and cactus type.[14] One has to assess the shape and size of the ostium, the width of the “landing zone” (area within the LAA where the device will be positioned), the length of the LAA, and, if possible, the number, shape, and location of the lobes. Lobes are better defined with cardiac computed tomography or LA angiography [Video 2].

3D echocardiography will also better define the shape and lobes of LAA, but due to irregular heart rate, artifacts are common. Live 3D will be more useful. Baseline left atrial dimensions are measured in anteroposterior and craniocaudal plane using mid-esophageal views at sector angle 0 and 120 degrees respectively. Ostial dimensions are noted in four mid-esophageal (ME) views: (i) 0°–20° four-chamber view with slight flexion or withdrawal to open the LAA, (ii) 45°–60° aortic valve (AV) short-axis view (SAX), (iii) 90° apical two-chamber view, and (iv) 120–135° long-axis view with probe turned counterclockwise to open the subsidiary lobes. While using the ACP, the size is determined by the width of the landing zone. The LAA neck width (Landing zone) is typically measured 10-mm distal to the LAA ostium [Figure 1]. 3-5 mm more than the largest diameter should be used to size the device. LA inflow and outflow has to be assessed initially, which may get altered following the device deployment. The diameter of the left upper pulmonary vein (LUPV) and peak systolic and diastolic velocities should be noted. In the mitral valve, presence of any regurgitation and its peak velocity should be noted.

The device is deployed using vascular access through the right femoral vein and then entering the left atrium through transseptal puncture. Most important step during the procedure is transseptal puncture. TEE is very useful in guiding the puncture. Unlike transseptal puncture for balloon mitral valvotomy, the puncture is made in the inferior and posterior part of the fossa ovalis to get better alignment with the axis of LAA. The orthogonal views ME AV SAX and bicaval views are used to guide the cardiologist

**Table 1:** CHA₂DS₂-(VASC) score (maximum score-9) to assess the risk of thromboembolism[10]

| Condition     | Points |
|---------------|--------|
| CHF           | 1      |
| Hypertension  | 1      |
| Age >75 years | 1      |
| Diabetes      | 1      |
| Stroke/TIA    | 2      |
| Vascular disease | 1  |
| Age 65-74 years | 1  |
| Sex (female)  | 1      |

TIA: Transient ischemic attack, CHF: Congestive heart failure

**Table 2:** HAS-BLED score to assess the risk of bleeding in the patient on oral anticoagulation therapy (maximum score-9)[11]

| Condition             | Points |
|-----------------------|--------|
| Hypertension          | 1      |
| Abnormal liver or renal function | 2  |
| Stroke                | 1      |
| Bleeding              | 1      |
| Liable INR            | 1      |
| Elderly (age >65)     | 1      |
| Drugs or alcohol      | 2      |

INR: International normalized ratio
during transseptal puncture [Video 3 and Figure 2]. While puncturing the septum, it should be away from the AV in ME AV SAX view and toward inferior vena cava in bicaval view. After the transseptal puncture, the patient is heparinized to maintain an ACT >250 s. TEE and contrast angiography of the LAA (right anterior oblique 30°/cranial 30°) are used to measure the LAA dimensions (ostium, neck width, and depth) – based on these measurements, the size of the device is chosen [Video 2]. The positioning of the device in the LAA cavity is ensured by TEE and fluoroscopy; the axis of the device should be in alignment with the major axis of LAA. Once in position, the device stability is confirmed by a tug test, and complete sealing is verified by color Doppler imaging with lower Nyquist limits [Video 4]. Finally, the device is released from the delivery cable, and possible complications such as compression of LUPV [Figure 3], impingement on the mitral valve, residual leak [Figure 4], and new-onset mitral regurgitation or regional wall-motion abnormality of the lateral wall due to LCX compression to be excluded [Videos 5 and 6].

Various devices like WATCHMAN, AMPLATZER cardiac plug [Figure 5], and COHEREX WaveCrest are available.\textsuperscript{[17]} Surgical/thoracoscopic LA appendectomy and the epicardial LARIAT suture delivery device are also described.\textsuperscript{[15,16]} WATCHMAN is US FDA approved device for NVAF with contraindication for OAC therapy. Various complications are described during the procedure, such as device embolism, cardiac perforation, thrombus on the left atrial side of the device, pericardial effusion, residual flow across LAA, compression of LCX artery or superior pulmonary vein, and CVA secondary to thrombus or air. As more and more patients are undergoing minimally invasive and percutaneous device closure, cardiac anesthesiologist should be well versed in echocardiographic imaging in the catheterization laboratory similar to the operating room. TEE-guided transseptal puncture will be the standard of care for left-sided interventions such as LAA device closure, balloon mitral valvuloplasty, or mitral clip.

**Conclusion**

The percutaneous LAA occlusion device has been shown to be a safe, efficacious, and cost-effective strategy for
stroke prevention in patients with NVAF with an increased risk of stroke and bleeding. TEE is useful to assess the suitability of the patient for device closure, to measure the size and select the device to be deployed, to guide during transseptal puncture and deployment of the device, to assess the stability of the device following deployment, and to rule out any complication following procedure and during long-term follow-up.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.

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