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Percutaneous Patent Foramen Ovale Closure in a Patient With Anomalous Aortic Origin of the Left Coronary Artery

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The anomalous aortic origin of the coronary artery is a rare congenital disease that occurs in approximately 0.7% of the general population, often causing sudden death with a high risk of anatomic features, such as a slit-like ostium or an interarterial or intramural course.[1] A left coronary artery (LCA) arising from the nonadjacent sinus is one of the rarest forms of anomalous aortic origin of the coronary artery. Its prognosis and management are controversial despite reports on adverse outcomes.[1] Patent foramen ovale (PFO) is a remnant of fetal circulation in approximately 20%-25% of the adult population, and it increases the risk of an embolic stroke of undetermined source.[2] Therapeutic options include medical therapy, surgical closure, and percutaneous transcatheter closure in patients with embolic stroke of undetermined source. We present a challenging case with this anomaly as a significant concern for successful percutaneous PFO closure.

A 55-year-old woman presented with sudden onset of apraxia, diagnosed by neurologists as PFO-related stroke. Transesophageal echocardiography (TEE) demonstrated a macroscopic PFO with right-to-left shunting at rest and concomitant high-risk features[3] (Videos 1 and 2, view video online). Three-dimensional coronary computed tomography angiography (3D-CCTA; Fig. 1A, left) revealed an anomalous aortic origin of the LCA from the nonadjacent sinus and the artery to the sinus node branching from the left circumflex coronary artery, posing a potential risk of interference with an implanted device. A percutaneous PFO closure could cause a left main trunk obstruction, and pacemaker implantation might be needed with the artery to the sinus node seriously involved. The 3D-CCTA images suggested that a 35-mm device would interfere with the LCA ostium, but that a 25-mm device would not (Fig. 1B, left). Because the patient was asymptomatic, with no evidence of myocardial ischemia and few high-risk anatomic features,[1] the anomalous aortic origin of the LCA was considered a low-level indication for surgical repair.

Novel Teaching Points

- Anomalous aortic origin of the LCA from a nonadjacent sinus might cause serious interference with an implanted PFO device.
- 3D-CCTA can help in establishing the diagnosis of anomalous aortic origin of the LCA and planning the PFO closure procedure.

After careful discussion with our cardiovascular team, the patient opted for a percutaneous PFO closure using multiimaging guidance instead of surgical closure. During the procedure, the LCA ostium was closely monitored using TEE and intravascular ultrasound, and the artery to the sinus node was visualized through frequent selective coronary angiography (Fig. 1C). Based on the waist diameter (7.1-mm) of a 24-mm-sized balloon, a 25-mm Amplatzer PFO Occluder (Abbott Vascular, Abbott Park, IL; 18 mm for the left atrial disc) was implanted successfully, with no interference with the LCA ostium, and with the artery to the sinus node safely patent. At 1 week postimplantation, 3D-CCTA (Fig. 1A [right] and B [right]) revealed that the LCA ostium and the device were adequately separated, and that the artery to the sinus node partially passed through both discs without serious compression. The patient was asymptomatic, and no residual shunting was seen on the TEE at the 6-month follow-up.

Percutaneous PFO closure in patients with an anomalous aortic origin of the LCA from a nonadjacent sinus might carry

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See page 738 for disclosure information.

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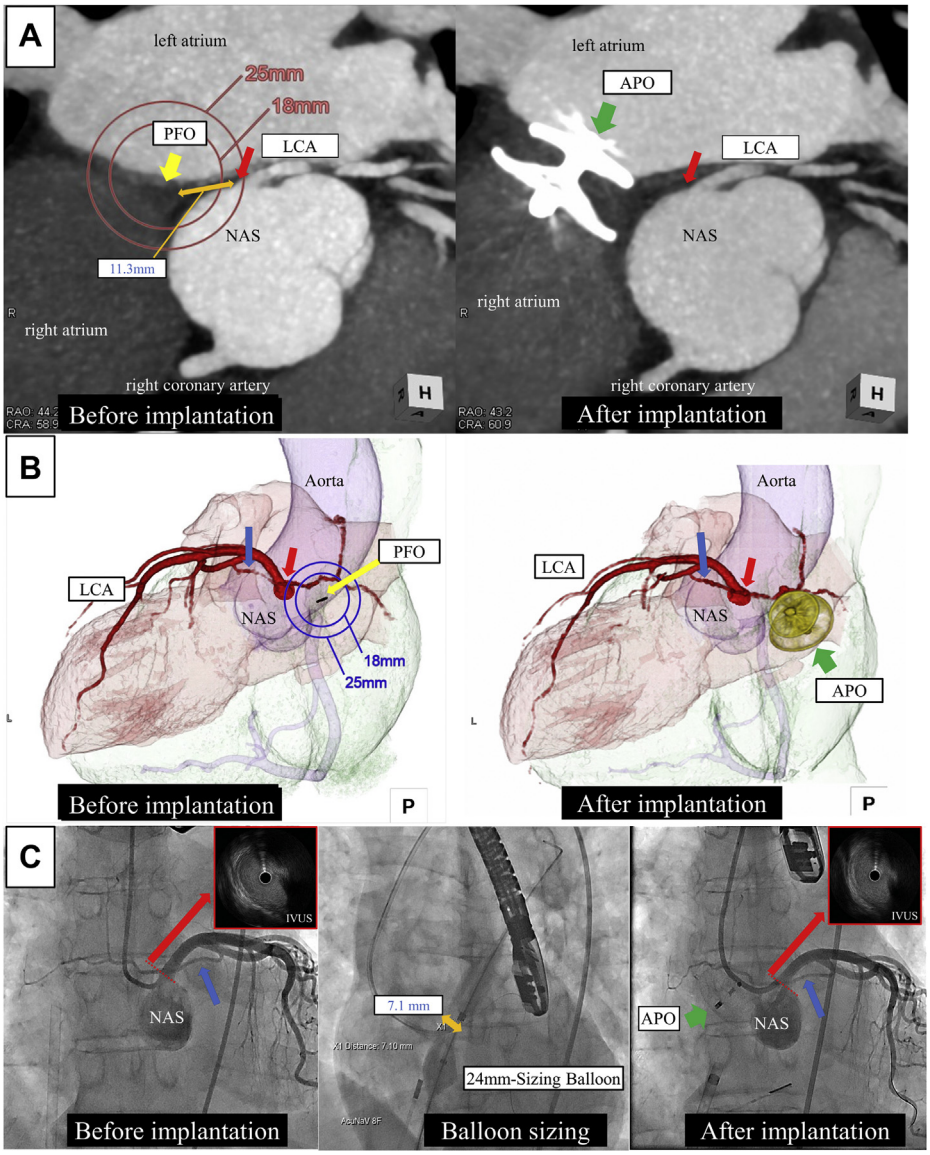

Figure 1. Computed tomography-based and fluoroscopic illustrations of percutaneous patent foramen ovale (PFO) closure. (**A**) Oblique axial and (**B**) volume-rendered images of coronary computed tomography angiography (**left**) before and (**right**) after the 25-mm Amplatzer PFO Occluder (APO) implantation, highlighting the anatomic relationship among the (**red arrow**) left coronary artery (LCA) ostium, (**blue arrow**) the artery to the sinus node, (**yellow arrow**) PFO, and (**green arrow**) the implanted device. (**C**) Coronary angiogram (**left**) before and (**right**) after device implantation with (**middle**) the balloon sizing. H, head; IVUS, intravascular ultrasound; L, left; NAS, nonadjacent sinus; P, posterior.

a unique risk of coronary artery involvement with an implanted device and often requires careful monitoring during the procedure. We emphasized the usefulness of pre- and post-procedural CCTA in performing the percutaneous PFO closure, which would be superior to TEE regarding the anatomic assessment of all cardiac structures. However, procedural monitoring would be unfeasible with CCTA as a limitation.

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Disclosures

The authors have no conflicts of interest to disclose.

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Supplementary Material

To access the supplementary material accompanying this article, visit *CJC Open* at https://www.cjcopen.ca/ and at https://doi.org/10.1016/j.cjco.2022.05.008.