Hybrid Strategy to Treat Life-Threatening Giant Coronary Artery Aneurysm With Severe In-Stent Restenosis
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Summary
Coronary artery aneurysm following drug-eluting stent implantation is rare in the literature. The presentation combined a life-threatening condition with severe in-stent restenosis. How to treat this condition is a complex problem because a surgical approach for a proximal left circumflex lesion is difficult. A hybrid method that is a combination of coronary bypass surgery and coronary stenting for left main bifurcation in-stent restenosis and proximal coronary artery aneurysm is a feasible strategy. (Int Heart J 2017; 58: 283-285)

Key words: Left main bifurcation, Culotte technique, Drug-eluting stent, Coronary arterial bypass grafting

Coronary artery aneurysms are rare and aneurysms following drug-eluting stent (DES) implantation are also rare with a reported incidence of 0.2% to 2.3%. Coronary artery aneurysms are caused by Kawasaki disease, coronary atherosclerosis, trauma, autoimmune disease, and percutaneous coronary intervention. Anti-neoplastic agent coating on the stent structure may affect the healing and remodeling processes of the vessel wall and also cause coronary artery aneurysm formation. We report here a 79-year-old man who experienced a non ST-elevation myocardial infarction related to a very late and giant coronary artery aneurysm of the left circumflex artery (LCX).

Case Report
A 79-year-old male presented with a giant coronary artery aneurysm with severe in-stent restenosis (ISR) that occurred 7 years after DES implantation. He had a medical history of buccal cancer, chronic kidney disease, and coronary artery disease. Seven years earlier, coronary angiography had shown a left main (LM) bifurcation lesion (Figure 1A), and two everolimus-eluting stents (3.5 × 23 mm (LM to left anterior descending artery) and 3.0 × 23 mm (LM-to-LCX); Xience V, Abbott, USA) were deployed at the left main bifurcation site, using the culotte technique (Figure 1B). His condition was stable for 7 years.

Unfortunately, he presented with severe chest pain with cold sweating that lasted for several minutes. Electrocardiography showed lateral wall ST segment depression and inverted T-waves (Figure 2A). Emergency coronary angiography was suggested because of the hemodynamically unstable condition with persisting chest pain. A giant coronary artery aneurysm with ISR at the ostial LCX was noted, along with ISR at the ostial left anterior descending artery (LAD) (Figure 2B). Owing to the patient’s critical condition, coronary arterial bypass grafting (CABG) was performed. However, the cardiovascular surgeon could not explore the ostial LCX aneurysm. The patient experienced progressive angina symptoms, and coronary angiography performed 14 days later showed that the giant coronary aneurysm had gradually grown and delayed flow (Figure 3A, B). Intravascular ultrasonography showed the aneurysm with in-stent plaques (Figure 3C). One 3.5 × 26 mm Covered stent (GraftMaster, Abbott Vascular) was deployed at the ostial LCX to treat the aneurysm and the ISR (Figure 3D), and the aneurysm disappeared (Figure 3E). In this case, a hybrid strategy was applied for a life-threatening giant coronary aneurysm. Following treatment, the patient was symptom-free and continued to receive treatment for buccal cancer.

Discussion
The histologic characteristics of an atherosclerotic coronary artery aneurysm include hyalinization, lipid deposition, disruption of intima and media, focal calcification and fibrosis, cholesterol crystals, intramural hemorrhage, and foreign-body giant cell reaction to the atherosclerotic process. The pathologic mechanism of coronary artery aneurysms remains uncertain. The possible mechanisms are an inherent defect of the vessel wall, weakness and decrease in elasticity of media due to marked atherosclerosis, and increased intraluminal pressure. The chronic transmural inflammation seen in atherosclerotic vessels also aggravates the process.
Figure 1. Coronary angiography of the left coronary artery. A: Left main bifurcation lesion; B: After two everolimus-eluting stents (Xience V, Abbott, USA) were implanted at left main bifurcation site with the culotte technique 7 years previously, good left main bifurcation flow was achieved.

Figure 2. A: Electrocardiography: lateral wall ST segment depression and inverted T-waves; B: Coronary angiography of the left coronary artery. Left main to left anterior descending artery (LAD) shows in-stent restenosis. A giant coronary artery aneurysm (white arrows) with in-stent restenosis is noted at the ostial left circumflex artery (LCX).

Figure 3. A, B: Coronary angiography of the left coronary artery: the giant coronary aneurysm at the ostial LCX became larger, with TIMI grade 2 flow at the LCX. C: Intravascular ultrasound study showed a giant aneurysm (white arrow) and considerable in-stent plaques. D: One 3.5 × 26 mm Covered stent was deployed at the ostial LCX (black arrows). E: LAD flow eliminated and the LCX aneurysm disappeared after Covered stent deployment.
The most frequent cause of a coronary artery aneurysm is atherosclerosis. Other causes include congenital heart disease, trauma, Kawasaki disease, systemic lupus erythematosus, polyarteritis nodosa, Takayasu’s arteritis, scleroderma, rheumatic fever, bacterial endocarditis, and percutaneous intervention. The reasons for coronary artery aneurysm formation after percutaneous intervention include residual non-healing dissection, barotrauma secondary to high-pressure balloon dilatation, the use of oversized balloons or stents, and other debulking therapies such as rotational atherectomy or cutting balloon angioplasty. Antiproliferative agents on drug-eluting stents can decrease restenosis by suppressing neointimal growth. The mechanisms of drug-eluting stents causing a coronary artery aneurysm are delayed re-endothelialization, inflammatory changes of the medial wall, and hypersensitivity reactions. Pathologically, true coronary aneurysms have an intact vessel wall with intima, media, and adventitia. Pseudoaneurysms are caused by dissections or perforation after percutaneous intervention which damaged the natural vessel wall. Pseudoaneurysms are often found after interventions and are rarely occur spontaneously. Most patients with a coronary artery aneurysm do not have symptoms. However, when symptoms are present, they are usually related to myocardial ischemia, such as angina, myocardial infarction, congestive heart failure, or sudden death.

Complications from coronary artery aneurysms include thrombosis, embolism, arteriovenous fistulaization, or rupture. Most of the cases of giant coronary artery aneurysm in previous reports were surgically treated. However, the prognosis of coronary artery aneurysms remains a controversial issue. The appropriate therapy is uncertain, and there continues to be controversy regarding surgical versus conservative management. Aoki, et al recommended that treatment should depend on the aneurysm, expansion history, pathophysiology (true or false aneurysm), and the symptoms of the patient. Some case reports have demonstrated successful deployment of Covered stents for the treatment of coronary artery aneurysm, and have shown that Covered stents are effective and safe for large (diameter of 6 mm to 10 mm) atherosclerotic aneurysms. In this case, simply Covered stent implantation seemed to be unable to solve the problem due to the critical condition of the patient and position of the coronary artery aneurysm. First, the patient developed a life-threatening coronary aneurysm with severe ISR and presented with acute coronary syndrome. Only Covered stent deployed from left main to LAD or left main to LCX cannot make the patient survive. Second, surgical exposure and repair was difficult to perform because of the location of the aneurysm in the ostial LCX. The LCX was located posteriorly in the heart, which made a surgical approach difficult. Third, after coronary artery bypass graft (CABG) surgery, the patient still complained about chest pain without any improvement. Follow-up coronary angiography showed rapid progression of the ostial LCX coronary artery aneurysm. One possible reason for the rapid progression of the ostial LCX coronary artery aneurysm was increases in the shearing forces and lamina flow to the ostial LCX coronary aneurysm. A hybrid strategy was then adopted after CABG for the LAD ISR and Covered stent implantation for the LCX ISR and giant coronary artery aneurysm.

**Conclusion:** Coronary artery aneurysms following DES implantation combined with a life-threatening condition and severe ISR are rare. A hybrid strategy for left main bifurcation in-stent restenosis and proximal coronary artery aneurysm is feasible.

**DISCLOSURES**

**Conflict of interest:** None.

**Ethical approval:** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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