Case Reports

Percutaneous Coronary Intervention for Interposed Coronary Graft Stenosis

after Modified Bentall Procedure in a Teenaged Boy with Takayasu Arteritis

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Anastomotic occlusion of an interposed coronary artery graft after a Bentall procedure is rare and catastrophic. It can lead to myocardial infarction or sudden cardiac death. We found several reports of occlusion and stenosis of a coronary-graft anastomosis, but few describe occlusion of the interposed coronary graft itself, as evaluated with use of intracoronary ultrasonography and computed tomography.

We report the case of a 17-year-old boy with Takayasu arteritis who had a myocardial infarction caused by severe ostial stenosis in an interposed left coronary graft. The graft occlusion was confirmed by results of electrocardiography, aortography, and intracoronary ultrasonography. The patient was treated with percutaneous coronary intervention, stenting of the interposed graft, and thrombectomy, but he died of left ventricular dysfunction caused by extensive myocardial infarction. Extrinsic compression may have caused the graft occlusion.

When considering emergency percutaneous coronary intervention to interposed coronary artery grafts, operators need to identify the cause of occlusion and decide on the best approach for each patient. Stenting the graft may provide temporary relief. During a hemodynamic crisis, immediately reperfusing the graft is crucial. ***(Tex Heart Inst J 2019;46(3):207-10)***

Key words: *Anastomosis, surgical/adverse effects; aorta, thoracic/surgery; blood vessel prosthesis implantation/adverse effects/methods; coronary disease/diagnostic imaging; fatal outcome; myocardial infarction; percutaneous coronary intervention; postoperative complications; reoperation; Takayasu arteritis/complications/pathology*

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Bentall and De Bono[1] first reported the use of a composite graft for aortic valve and root replacement. Later, Piehler and Pluth[2] modified the method to avoid various complications.

Although anastomotic complications in interposed grafts are rare after modified Bentall procedures, they can lead to myocardial infarction (MI) or sudden cardiac death. We found several reports of occlusion and stenosis of coronary-graft anastomoses and a few descriptions of occluded interposed coronary grafts evaluated by using intracoronary ultrasonography and computed tomography.[3,4] We present the case of a young patient with Takayasu arteritis (TA) who had an MI caused by severe stenosis at the ostium of an interposed left coronary graft after a modified Bentall procedure. We report his treatment with percutaneous coronary intervention (PCI) and stenting of the interposed graft. In addition, we offer ideas on how to handle similar cases.

Case Report

In August 2011, a 13-year-old boy underwent a modified Bentall procedure to correct severe aortic regurgitation associated with an ascending aortic aneurysm caused by TA. The Carrel patch technique was used to reconstruct his right and left coronary arteries. Two years later, the patient underwent another Bentall procedure to treat valved graft and left coronary artery detachment. Because the aortic composite graft anastomosis was affected by a marked inflammatory response, the left coronary artery was reconstructed with use of an 8-mm-long interposed graft (Piehler technique). For control of the inflammation, the patient was prescribed warfarin, methotrexate (8 mg/d), and prednisolone (12 mg/d).

In 2015, the patient had exertional angina but did not consult a doctor. He was transferred to our hospital in acute cardiogenic shock. An electrocardiogram (ECG) showed new ST-segment depression and wide QRS intervals in all limb and precordial leads without aVR, consistent with extensive MI caused by left main trunk

occlusion. The patient was taken for emergency cardiac catheterization. An aortogram showed occlusion at the ostium of the interposed left coronary graft (Fig. 1A). The surgical risk was high, given unstable acute coronary syndrome and past thoracic surgery. We acquired computed tomograms (Fig. 2) and decided upon PCI to the ostium of the interposed graft.

We immediately inserted an intra-aortic balloon pump through the left femoral artery and began PCI through the right femoral artery. A 6F Judkins left 3.5 guide catheter would not engage, so we positioned a backup left 3.5 HEARTRAIL® II guide catheter (Terumo Medical Corporation) at the ostium of the interposed graft. Two 0.014-in guidewires were crossed forward to the left anterior descending coronary artery and left circumflex coronary artery, and Thrombolysis in Myocardial Infarction (TIMI) grade 2 flow was achieved (Fig. 1B). Intracoronary ultrasonography with use of the ViewIT® guidance system (Terumo) revealed abundant thrombus at the occlusion site, as well as elliptical steno-

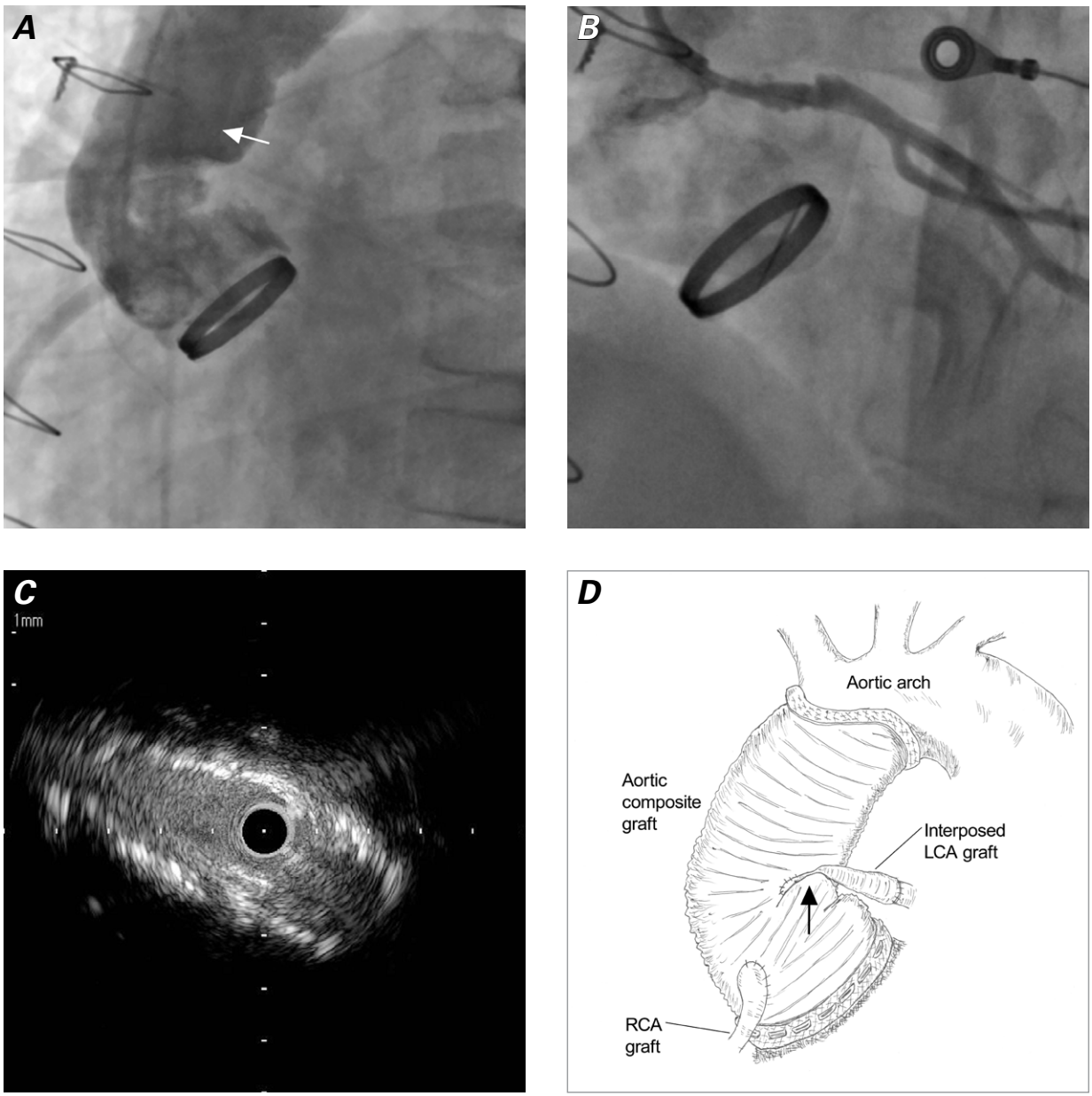
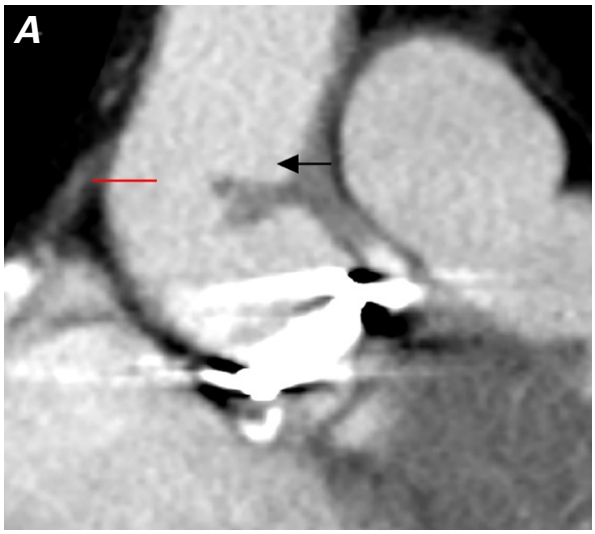


Fig. 1 *Aortograms (right anterior oblique view) show **A**) occlusion at the ostium of the interposed left coronary graft (arrow), and **B**) the 2 crossed guidewires and Thrombolysis in Myocardial Infarction grade 2 flow. **C**) Intracoronary ultrasonogram shows abundant thrombus inside the interposed coronary graft, as well as elliptical stenosis at the graft's proximal portion. **D**) Drawing shows an 8-mm interposed graft anastomosed to the left coronary (LCA) ostium and to the aortic composite graft (Piehler technique), and the right coronary artery (RCA) anastomosis (Carrel patch technique). The aortic composite graft bends under the ostium of the interposed graft and presses that graft from the outside (arrow).*



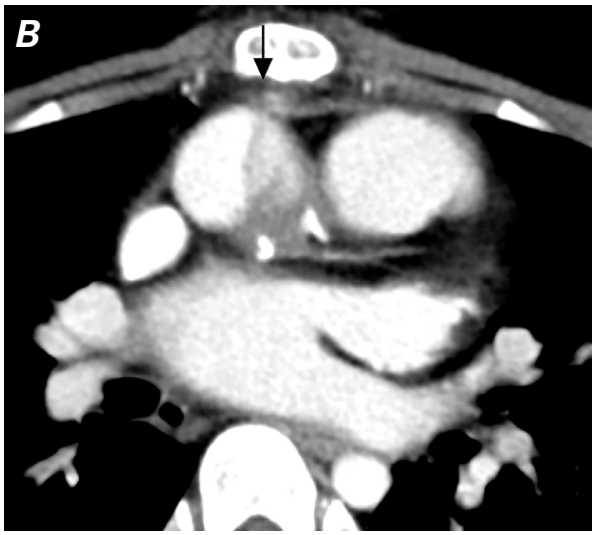
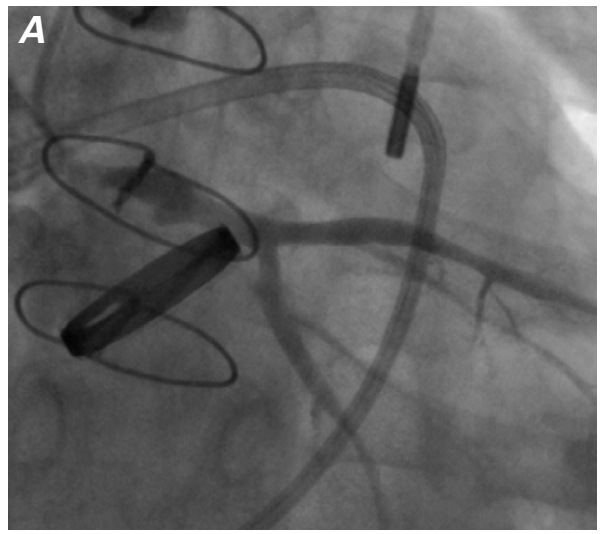


Fig. 2 *Computed tomograms before percutaneous intervention show occlusion at the ostium of the interposed left coronary graft (arrows).* ***A****) Frontal planar view shows the aortic composite graft bending under the ostium of the interposed graft.* ***B****) Vertical planar view (red line in* ***A****) at the level of the ostium shows occlusion at the graft ostium.*



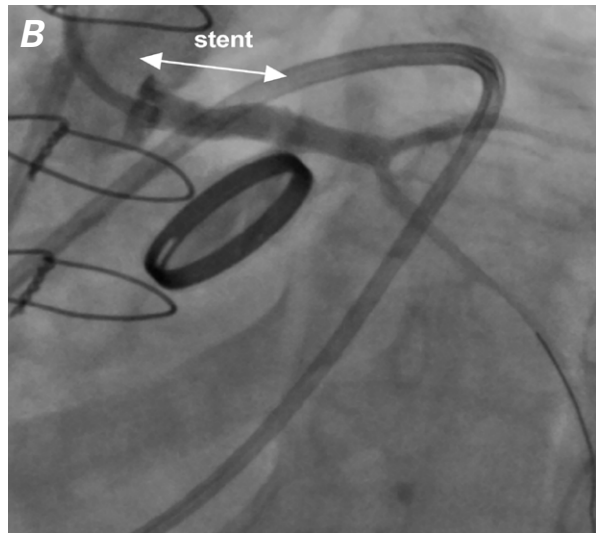


Fig. 3 ***A****) Aortogram shows initial dilation of the lesion with use of a conventional balloon and perfusion balloon catheter; however, inflation was insufficient.* ***B****) Stenting the interposed coronary graft (arrow) resulted in Thrombolysis in Myocardial Infarction grade 3 flow.*

sis in the proximal portion of the interposed graft (Fig. 1C). Figure 1D shows the anatomy that we found.

We used a Thrombuster III GR™ catheter (Kaneka Corporation) to aspirate a visible clot from the interposed graft. We then dilated the lesion by using a 5 × 12-mm conventional balloon catheter at a pressure of 8 atm. However, inflation was insufficient, so we dilated it again by using a 3.5 × 20-mm Ryusei™ perfusion balloon (Kaneka) at a pressure of 14 atm for 240 s (Fig. 3A). During the long inflation, the patient became hemodynamically unstable, so he was intubated, and percutaneous cardiopulmonary support (PCPS) was started. We deployed a 4 × 8-mm Multi-Link 8 bare-metal stent (Abbott Vascular) at a pressure of 12 atm, and we performed postdilation with use of a 5 × 12-mm noncompliant balloon. Finally, TIMI grade 3 flow was achieved (Fig. 3B). The patient's creatine kinase level increased to more than 20,000 U/L; however, no ischemic ECG changes occurred, nor did myocardial enzyme levels increase to indicate stent occlusion. The patient's condition continued to deteriorate; several days later, he died of left ventricular dysfunction caused by extensive MI.

Discussion

In the Piehler technique, a Dacron interposed graft is anastomosed to the left coronary artery ostium and to the aortic composite graft. Although the Bentall pro-

cedure with use of the Carrel patch technique is safe, durable, and associated with high survival and reoperation-free rates,[5] the Piehler technique is often used during repeat procedures.[6] Every 2 months after the repeat Bentall procedure, our patient was monitored with use of 12-lead ECG and laboratory results. Extrinsic compression at the interposed graft caused by aortic composite graft kinking had never been noted. We speculate that the interposed graft occluded because of subsequent thrombus formation within it.

Anastomotic complications of interposed grafts after the Bentall procedure occur in less than 2% of cases.[7] In addition, TA is associated with chronic inflammation of the aorta, its main branches, and the pulmonary arteries, and it can cause arterial stenosis and occlusion or dilation. The most severe complication after the Bentall procedure for TA is dehiscence of the anastomotic site.[8,9] Our patient had undergone a repeat Bentall procedure to treat valved graft and interposed coronary graft detachment, which may have been related to active inflammation associated with TA. Stenosis of the interposed graft may also have been caused in part by inflammation.

In general, stenosis of a graft-coronary anastomosis is treated with use of coronary artery bypass grafting or, in an emergency, with PCI and stenting.[3] We found no other reports of stenting an occluded interposed coronary graft itself to relieve extrinsic graft compression.

Absent effective PCI techniques to correct kinking of an interposed graft, especially during a hemodynamic crisis, urgent surgery may be performed. However, we think that PCI with stenting of the interposed coronary graft is the only way to achieve immediate reperfusion and to save the patient's life. We considered the surgical risk in our patient's acute phase to be prohibitive because of his 2 previous coronary artery bypass grafting procedures and severe TA. We intended to perform surgery after his condition improved, but left ventricular dysfunction precluded operative treatment. The ECG and myocardial enzyme data indicated that stent thrombosis had not occurred. Despite the risk of stent thrombosis and extrinsic compression, stenting the interposed coronary graft may still be useful for temporary relief during a hemodynamic crisis.

During acute cardiogenic shock, mechanical support is useful. In this case, we started PCPS because the Impella® (Abiomed, Inc.) support device was not available in Japan. Hemodynamic support should be initiated as soon as possible; in our patient's case, we performed PCI and started PCPS almost simultaneously. Nevertheless, mortality rates for patients in cardiogenic shock remain very high.[10]

When interposed coronary grafts occlude, operators need to identify a cause and decide on a strategy during emergency PCI. This report may be meaningful in such cases. To ensure immediate reperfusion, we consider it crucial to stent an interposed coronary graft for temporary relief during a hemodynamic crisis.

To our knowledge, this is the first case report of MI caused by severe stenosis of an interposed left coronary graft evaluated by using intracoronary ultrasonography, and treated with PCI and stenting of the interposed graft.

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