Percutaneous Coronary Intervention Through a Retrograde Approach in Complete Occlusion of the Coronary Ostium Following Surgical Aortic Valve Replacement

Jianxue Bu, MD, Tao Hu, MD, Guoyong Zhang, MD, Ling Tao, MD, Shenxu Wang, MD and Tao Yin, MD

Summary
Coronary ostial stenosis, treated by either percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG), is a rare but potentially life-threatening complication following surgical aortic valve replacement. However, in cases of complete occlusion of the coronary ostium (COCO), CABG is the typical treatment because guiding catheter engagement is extremely challenging. Herein, we presented a case of a patient with COCO who underwent successful PCI through a retrograde approach, and this case first demonstrates the feasibility of PCI for the treatment of COCO, which could help avoid the high risk of redo surgery.

Key words: Coronary complication, Cardiac surgery, Coronary ostial occlusion

Coronary ostial stenosis (COS) is a rare but potentially life-threatening complication following surgical aortic valve replacement (SAVR). It requires revascularization by either coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI). However, for a complete occlusion of the coronary ostium (COCO), CABG is the typical treatment strategy due to the challenge of guiding catheter (GC) engagement. Herein, we presented a case of a patient with COCO following SAVR who underwent successful PCI through a retrograde approach.

Case Report
A 22-year-old man was admitted to the local hospital with severe aortic valve stenosis (mean transaortic gradient of 53 mmHg) and underwent SAVR with a mechanical prosthesis. He was routinely weaned off cardiopulmonary bypass. On the eighth postoperative day, the patient presented with sudden chest pain and syncope. Electrocardiography showed ST-segment elevation in leads II, III, aVF, V3R, V4R and V5R.

After considering the possibility of coronary compromise, emergent coronary angiography was performed. The angiographic results demonstrated COCO of the right coronary artery (RCA), without any information regarding the location of the ostium, and the angiography showed a normal left coronary artery (Figure 1). Since the GC could not be engaged into or even next to the RCA, primary PCI was not performed, nor was CABG, because the cardiac team decided not to proceed with CABG after considering the high risk of early redo surgery. Instead, the patient was treated with medication for complicated right ventricular failure. Transthoracic echocardiography revealed normal transvalvular gradients and no paravalvular leak, but an enlargement of the right atrium and a decreased wall motion of the right ventricle were seen.

Eight months later, the patient was referred to our hospital for further treatment due to complaints of exertional dyspnea and intermittent fatigue. Since the patient was very young, if the RCA chronic total occlusion was left untreated, the patient might be more prone to future cardiovascular events and have less cardiac reserve, especially if the patient should later develop an acute occlusion in one of the remaining coronary arteries. A recanalization of the RCA by PCI in this patient could still be necessary for symptom relief and a better long-term prognosis. Moreover, the shorter duration of occlusion and the fully formed collateral vessels for the retrograde approach facilitated the PCI procedure with a reasonable risk-to-benefit ratio. Thus, a PCI was scheduled after routine preoperative examinations. Based on the angiographic results and due to the lack of antegrade GC support and the ambiguity of the RCA ostium in this patient, a retrograde approach through a septal branch was used as the initial treatment strategy, which was successful. The retrograde approach...

From the 1Department of Cardiology, The 988th Hospital of the Joint Logistic Support Force, Luoyang, China and 2Department of Cardiology, Xijing Hospital, Air Force Medical University, Xi’an, China.

*These authors contributed equally to this work.

Address for correspondence: Tao Yin, MD, Department of Cardiology, Xijing Hospital, Air Force Medical University, Changle West Road No. 127, Xi’ an, 710032, China. E-mail: yintaofmmu@163.com or Shenxu Wang, MD, Department of Cardiology, The 989th Hospital of the Joint Logistic Support Force, Huaxia West Road No. 2, Luoyang, 471000, China. E-mail: wawawxw@126.com

Received for publication June 24, 2021. Revised and accepted November 15, 2021.

Released in advance online on J-STAGE March 15, 2022.

All rights reserved by the International Heart Journal Association.
Figure 1. Emergent coronary angiographic images. A, B: Normal left coronary artery. C, D: The faint distal right coronary artery (RCA) was supplied by the left coronary artery (LCA) via collateral circulation. E, F: Nonselective angiography with the absence of visualization of the RCA, and an ostial occlusion of the RCA was implied.

guidewire was snared and externalized after reaching the aorta, and this was followed by routine balloon dilatation and stent implantation (Figure 2). The patient had an uneventful recovery after the PCI procedure and was discharged home. At the 1-month follow-up, he had no active complaints, and his right atrium had decreased in size.

Discussion

The incidence of COS following SAVR, which was first described by Roberts and Morrow in 1967, is estimated to be < 5%, and it generally manifests within 6 months after the procedure. This complication could occur in the left main coronary artery, in the RCA, or in both. Several pathophysiologic mechanisms have been suggested, and these include coronary spasm, debris/thrombus embolization from the aortic valve or wall, and intraoperative iatrogenic causes, such as extraluminal compression (e.g., the surgical material, the suture used to close, hematoma or vessel kinking). The usual symptoms and clinical findings of COS after SAVR include the development of unstable angina, which could be treated by either CABG or PCI. Advancements in the techniques and instruments over the past 20 years have led to the increased utility of PCI to successfully treat COS, and favorable outcomes have been achieved compared to early repeat surgery.

Rapid clinical recognition is crucial for patients with acute COCO (referring to the stumpless total occlusion at the ostium), since patients usually present with heart failure, life-threatening ventricular arrhythmias, hemodynamic collapse, or sudden death. If possible, diagnostic imaging with coronary angiography should be performed immediately to prevent severe adverse outcomes. Once COCO is confirmed, early revascularization by primary PCI or CABG is a prerequisite for obtaining an optimal prognosis. Under such conditions, the engagement of antegrade GC in emergent primary PCI is challenging, which was seen in the present patient, and CABG is often preferred. Nevertheless, CABG also might not be approved by the surgeons, since redo surgery during the early period following SAVR has many disadvantages, which are listed below. In general, such CABG in these patients might result in a high operative mortality rate and a poor long-term outcome due to the risk of severe bleeding on oral anticoagulation mediations, and the close temporal relationship of the redo cardiac surgery with the graft sites next to the region of the previous operation. Krakulli et al. reported a case of a patient who needed emergent CABG for the treatment of COCO following SAVR. However, the patient appeared to have a poor response to emergent CABG and shortly thereafter developed unstable hemodynamics due to right ventricular failure. Therefore, a staged revascularization might be an alternative for some patients with COCO, such as in the present case. With respect to a staged revascularization, PCI appears to be a more reasonable revascularization option for COCO in a minimal invasive way, which has
been rarely reported before. The retrograde approach turned out to be the better strategy, since COCO with an ambiguous proximal cap was a major obstacle for the antegrade approach.

To the best of our knowledge, this is the first report of a case of COCO following SAVR treated with retrograde PCI. Our case report indicates that staged PCI through a retrograde approach appears to be a feasible and effective alternative to surgery for the treatment of COCO. Although the present patient has experienced very good short-term results, further data on the long-term outcome are still needed to determine the optimal revascularization strategy.

**Disclosure**

**Conflicts of interest:** None.

**References**

1. Agrawal AM, Arora D, Sanyal A, Lohchab SS. Intraoperative right coronary artery obstruction due to aortic root prosthesis mismatch after aortic valve replacement-A case report. J Card Surg 2019; 34: 1396-8.
2. Krakulli K, Prifti E, Fiorani V, Zogno M. Successful surgical employment of Impella recovery system for right ventricular failure after previous aortic valve replacement. J Surg Case Rep 2017; 2017: rjx091.
3. Roberts WC, Morrow AG. Late postoperative pathological findings after cardiac valve replacement. Circulation 1967; 35: 148-
4. Todaro MC, Ielasi A, Silvestro A, et al. An unusual case of cardiogenic shock late following surgical aortic valve replacement. J Cardiol Cases 2016; 13: 162-4.
5. Umran S, Chetty G, Sarkar PK. Acute right coronary ostial stenosis during aortic valve replacement. Int J Prev Med 2012; 3: 295-7.
6. Kanar BG, Tigen K, Atas H, Cincin A, Ozben B. Subacute aortic prosthetic mechanical valve thrombosis complicated with acute coronary syndrome. Am J Emerg Med 2018; 36: 1924.e1-3.
7. D’Angelo MP, Kilic A, Chan P, Sultan I. Total thrombotic occlusion of the right coronary artery after surgical aortic valve replacement. J Card Surg 2019; 34: 1359-60.
8. López Castillo M, Martín Reyes R, Palfy J, et al. Successful treatment of compression of an anomalous circumflex artery after aortic valve replacement with percutaneous coronary intervention. JACC Cardiovasc Interv 2016; 9: 1629-30.
9. Goldsmith MP, Allan CK, Callahan R, et al. Acute coronary artery obstruction following surgical repair of congenital heart disease. J Thorac Cardiovasc Surg 2020; 159: 1957-65.e1.
10. Nazir SA, Sarfraz S, Krishnamoorthy S, Tapp L. Biostial iatrogenic coronary artery stenosis: a rare complication of aortic valve surgery successfully treated with percutaneous coronary stenting. Interact Cardiovasc Thorac Surg 2019; 28: 996-8.
11. Ono N, Sawai T, Ishii H. Coronary ostial stenosis detected by transesophageal echocardiography after aortic valve replacement: a case report. JA Clin Rep 2017; 3: 14.
12. Turillazzi E, Di Giammarco G, Neri M, Bello S, Riezzo I, Fineschi V. Coronary ostia obstruction after replacement of aortic valve prosthesis. Diagn Pathol 2011; 6: 72.