Surgical treatment of left atrial dissection caused by percutaneous coronary intervention
Shiqiang Wang, Jiakan Weng, Fan He, Ximing Qian, Yu Liu, Huaidong Chen

Abstract
Left atrial dissection (LatD), also known as left atrial intramural haematoma, is a rare condition that requires rapid diagnosis and frequently calls for timely surgical intervention. Diagnosis can be challenging because of a lack of definitive clinical criteria, and a patient's situation can be complicated by co-morbidities, including unstable haemodynamics.

We surgically repaired a case of LatD related to percutaneous coronary intervention (PCI). The operation went smoothly, and the patient was discharged one week after the operation.

For LatD patients with co-morbidities, especially haemodynamic disorders, active surgical intervention is recommended.

Keywords: left atrial dissection, percutaneous coronary intervention, intramural haematoma

Case report
A 57-year-old male patient of our hospital's Cardiology Department underwent percutaneous intervention due to recurrent angina. This angina was caused by obstruction of a stent that was implanted following acute myocardial infarction four years prior. No obvious pathological results were found in pre-operative transthoracic echocardiography and haematology. Coronary angiography demonstrated a complete occlusion of the right coronary artery due to stent thrombosis but no obvious stenosis of the left coronary artery (Fig. 1A).

Cardiologists repeatedly failed to pass a catheter through the right coronary artery via an antegrade approach. After several unsuccessful attempts, a SION guidewire was inserted in a retrograde manner through a collateral of the posterior descending branch. Then, the antegrade guide wire was passed through the occlusion site of the distal right coronary artery with the guidance of the retrograde guide wire in the epicardial collateral vessels of the right coronary artery (Fig. 1B). A PROMUS Element drug-eluting stent, measuring 2.25 × 28 mm, was placed in the distal right coronary segment of the proximal left ventricular branch. An EXCEL drug-eluting stent, measuring 3.5 × 24 mm, was placed in the middle and distal segment of the right coronary artery, overlapping with the anterior stent by 1 mm.

Angiography demonstrated that stent expansion was satisfactory and coronary flow was unobstructed, but the myocardium was slightly stained (Fig. 1C). There was no obvious pericardial effusion per echocardiography. The patient was sent to the coronary care unit (CCU) after the procedure.

Unfortunately, the patient felt obvious chest pain that could not be relieved by nitroglycerin one hour after entering the CCU. Because acute embolism of the coronary stent was a possibility, coronary angiography was repeated. Meanwhile, in order to exclude iatrogenic injury of the aorta, computed tomography angiography (CTA) of the entire aorta was also performed.

Coronary angiography showed that coronary blood flow was comparable to that seen in the initial angiography, and no thrombosis was found in the stent, but contrast extravasation was observed in a distal branch of the right coronary artery (Fig. 1D).
Fig. 1. A. The original stent was completely occluded in the middle of the right coronary artery. An arrow indicates the collateral circulation of the distal coronary artery. B. The guide wire passed through the occlusion site of the distal right coronary artery under the guidance of a retrograde guide wire in the epicardial collateral vessels of the right coronary artery. C. The blood flow of the right coronary artery was smooth after the placement of two stents, but the myocardium was slightly stained, as indicated by the circle. D. The second angiograph shows contrast extravasation as would be seen in the heart of a chronic smoker.

Fig. 2. CTA multiplanar reconstruction showed a filling defect indicating a left atrial mass with maximum dimensions of approximately 7.3 × 5.1 cm.
1D). CTA showed a mass approximately 7.3 × 5.1 cm within the left atrium (Fig. 2).

Emergency transthoracic echocardiography demonstrated a large haematoma adjacent to the left atrium without any pericardial effusion. During the echocardiography procedure, the patient experienced obvious hypoxia, including increased breathing frequency and a reduction of oxygen saturation to approximately 90% under the support of mask oxygen supplied at a rate of 6 l/min.

The patient was referred to cardiac surgery for an emergency left atrial thrombectomy, and LatD was diagnosed intra-operatively. The operation was performed under general anaesthesia and cardiopulmonary bypass (CPB). Significant bloody pericardial effusion was seen, and the left atrium appeared bruised in its entirety. A large haematoma was seen within the posterior atrial wall after the left atrium was opened via an interatrial sulcus incision. The endocardial layer of the left atrium had been separated from the left atrial wall (Fig. 3A). No obvious left atrial endocardial rupture was found, and the structure and function of the mitral valve were normal.

Blood clots were carefully removed from the endocardium and epicardial cavity. After repeated irrigation of the left atrium, the left atrial endocardium and epicardium were sutured intermittently with 4-0 polypropylene sutures, and a drainage window was opened at the proper location of the endocardium to allow for decompression (Fig. 3B). The left atrium was sutured continuously with 4-0 polypropylene sutures. The patient was successfully weaned from CPB. The total operative time was 150 min, of which 73 min involved CPB, and the time required for aortic clamping was 53 min.

The patient recovered uneventfully and was discharged one week after the operation. During follow up, transthoracic echocardiography showed no significant change in cardiac function, and coronary CTA showed no new haematoma in the left atrium (Fig. 4).

Discussion

LatD is a potential complication of cardiac surgical procedures, including mitral valve repair or replacement. Recently, increasing numbers of cases of LatD have been reported in concert with the growth of PCI. It is important to note that distal coronary artery perforation, which is generally believed to be a major initiator of LatD, occurs in 0.3 to 0.6% of all PCI procedures, as demonstrated by a comprehensive review of more than 50 000 PCI cases.6

Distal wire perforations are an especially common risk in long or complicated procedures that require repeated application of an antegrade approach or a retrograde operation through the epicardial collateral vessels. This complication is especially relevant to patients with total occlusion of the coronary artery.8

In our case, the guide wire passed through the occlusion site of the distal right coronary artery under the guidance of the retrograde guide wire in the epicardial collateral vessels of the right coronary artery. After stent implantation, angiography showed a slight staining of the surrounding myocardium without

Fig. 3. A. Simulation of intra-operative findings. The posterior atrial wall had suffered a large haematoma, which partially blocked the entrance of the bilateral pulmonary veins. The endocardial layer of the left atrium was separated from the left atrial wall. B. Schematic diagram of surgical operation. After removal of the haematoma, the endocardial false lumen was closed by 4-0 polypropylene sutures with pledgets to protect the entrance of the bilateral pulmonary veins. An endocardium drainage window was opened at the proper location within the endocardium for decompressing.

Fig. 4. A coronary CTA performed one month after the event indicated that the left atrium was well filled with no residual haematoma.
obvious evidence of contrast extravasation. It is likely that the guide wire was inadvertently pushed into the distal end of an atrial branch, especially as damage to this branch was identified during the second angiography. We suggest, therefore, that the cause of LatD in this case was perforation of the epicardial collateral branch of the right coronary artery. Blood from this perforation entered the endocardial false lumen but did not rupture the pericardium.

The first symptom experienced by the patient was chest pain, followed by gradually worsening hypoxia. The chest pain was caused by an intimal tear and hypoxia was secondary to obstruction of mitral valve inflow or the pulmonary vein orifice, which led to congestive heart failure and low-output syndrome. The left atrium is especially susceptible to these issues, because it can be easily compressed by an intramural haematoma.\(^2\)

Our case emphasises the importance of utilising patients’ clinical manifestations and underlying conditions in the performance of differential diagnoses. Upon recurrence of chest pain after PCI, the first consideration is acute stent thrombosis. Accordingly, the spectrum of myocardial enzymes should be analysed, an ECG should be performed, and coronary angiography should be strongly considered. At the same time, bedside echocardiography should be performed to exclude pericardial effusion or pericardial tamponade, and CTA should be performed to exclude acute aortic dissection.

In the case of our patient, while the first bedside echocardiography following PCI showed no abnormality, a substantial haematoma in the left atrium became apparent after the onset of symptoms. We therefore concluded that while bedside echocardiography is an important monitoring tool following PCI, it is equally important to monitor patients’ symptoms, including chest pain and hypoxia. Of course, for some complex cases or cases with unclear histories, multimodal examinations, including echocardiography, CTA and magnetic resonance imaging (MRI), may be required for diagnosis.\(^2\,\,1\)

Due to the rarity of LatD, clear guidelines for diagnosis and treatment have yet to be established.\(^2\,\,1\) Clinicians therefore must remain vigilant in the identification of LatD and the differentiation of its distinct clinical manifestations (stable and unstable LatD) prior to making decisions concerning treatment. Determining the stability of the LatD separation influences the choice of treatment.

Two general treatment options, surgical repair and close observation, are currently available. Prompt intra-operative diagnosis and surgical repair are recommended in any case of haemodynamic instability that is accompanied by rapid expansion of the haematoma. Such instability may result in occlusion of the left atrial cavity, pulmonary vein or mitral valve.\(^10\) In previously reported cases, prompt surgical repair has been undertaken in most patients (73.4%; 63 of 87 cases).\(^2\)

Surgeons have a variety of available surgical approaches. Maeda et al.\(^11\) first reported surgical repair of LatD through left thoracotomy in 1985. Since then, several different surgical approaches have been described.\(^11\) Most operative repair approaches focus on evacuation of the haematoma, obliteration of the false lumen, and repair of the entry injury.\(^11\)

In our case, the surgical procedure involved closing of the endocardial false lumen via intermittent suture to protect the entrance of the bilateral pulmonary vein. In order to prevent the reformation of a haematoma, a drainage window was reserved for decompression due to potential uncertainty regarding the site of haemorrhage. This surgical procedure was deemed successful, as the patient recovered fully without incident. We and others have therefore observed significant benefit from a surgical approach, and we suggest that clinicians take a more aggressive approach to LatD, especially for those patients with obvious haematoma enlargement or rapid progression of symptoms.

In addition, despite clear divisions of work between cardiovascular medicine and cardiac surgery departments, co-operation among teams and the delivery of detailed information are particularly important in PCI cases in order to facilitate diagnoses and decision making regarding treatment plans.\(^14\) In particular, LatD should be considered by medical and surgical teams when contrast agent infiltration of myocardial tissue is found during PCI.

### Conclusion

As cases of coronary artery total occlusion increase, the application of retrograde PCI is becoming more common. Therefore, we should expect more frequent incidents of rare but dangerous complications, especially LatD.

Rapid diagnosis of LatD is essential, and multimodal examinations, including echocardiography, CTA and MRI, can help. Careful examination of test results and clinical symptoms of PCI patients can help to guide clinical decisions. For patients with minimal symptoms, close observation is likely to be the best option. For patients with haemodynamic disorders, however, active surgical intervention is recommended.

This study was funded by China International Medical Foundation (CIMF) (No CIMF-Z-2016-23-1823).

### References


