Iatrogenic Left Main Coronary Artery Dissection and Intramural Hematoma Caused by Diagnostic Transradial Cardiac Catheterization

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The growing use of the transradial approach for percutaneous coronary interventions has been shown to decrease the risk of major vascular complications. However, in this case report we describe a iatrogenic left main dissection during diagnostic coronary catheterization, which remains a rare, but still life-threatening condition. The adjunctive use of intravascular ultrasound may assist in the accurate diagnosis and treatment process.

In recent years, the transradial approach for percutaneous coronary interventions has become more widespread. Although this approach has been shown to decrease the risk of major vascular complications, iatrogenic left main dissection remains a rare, but still life-threatening condition.

Case presentation

A 50-year-old woman was admitted to our hospital for diagnostic cardiac catheterization. She was initially referred to the outpatient clinic because of recent episodes of chest pain on exertion radiating to her left arm. Risk factors for coronary artery disease included smoking, controlled hypertension under angiotension-converting enzyme inhibitors, and untreated hyperlipidemia with total cholesterol levels of 250 mg/dL and low-density lipoprotein (LDL) levels of 150 mg/dL. The patient’s resting electrocardiogram (ECG) was normal and the clinical examination was unremarkable. Transthoracic echocardiography showed normal left ventricular function without wall motion abnormalities (ejection fraction 70%). The patient underwent a bicycle stress test that was positive for ischemia with typical ST-segment depressions.

Coronary angiography was performed two days later via the right transradial approach. Following local anesthesia, the radial artery was punctured with a 20-gauge needle and cannulated with a soft, 0.025” straight guidewire. A 6 Fr, 23 cm radial sheath (Cordis Corporation, Miami, FL, USA) was placed. Intra-arterial verapamil (2.5 mg), nitroglycerin (200 μg) and 5000 units of unfractionated heparin were administered. Angiography of the right coronary artery with a diagnostic 6 Fr right Judkins 4.0 catheter (Cordis) was normal (Figure 1). The left coronary system was engaged with a diagnostic 6 Fr left Judkins 3.5 catheter (Cordis). The first view (left anterior oblique - LAO cranial) showed a normal left main (LM) coronary artery and a mild eccentric plaque in the mid left anterior descending artery (LAD) after the take-off of the first diagonal branch.
The second view (right anterior oblique - RAO caudal) showed a 60-70% angiographically estimated lesion in the left circumflex artery (LCX) (Figure 2B). The third view (RAO cranial) showed an acute occlusion or amputation of the distal LM (Figure 2C). Almost immediately, the patient started to complain of chest pain, accompanied by ST elevations on the ECG and a blood pressure drop from 120 mmHg to 90 mmHg. Oxygen, fluids and analgesia were administered. After careful interpretation of the angiographic images, the diagnosis of iatrogenic dissection of the LM coronary artery was made.

The case was discussed in an emergency consultation between the interventional cardiologists and the cardiac surgeon. Percutaneous intervention (PCI) was decided upon as the therapeutic option of choice over coronary bypass graft surgery (CABG). Urgent CABG was not immediately available, because both our cardiac theater suites were occupied. In addition, the patient was hemodynamically and electrophysiologically relatively stable. The strategy was to wire both the LAD and the LCX, followed by intravascular ultrasound (IVUS) imaging of the LAD in order to confirm the correct position of the wire in the true lumen (Figure 3), and to seal the dissection by bailout stenting. Insertion of an intra-aortic balloon pump was considered as a supportive option, but finally not needed. The patient’s hemodynamic stability was a surprise, and contrasted with the complete angiographic occlusion of the LM. Presumably, the true lumen was still patent and contrast was injected only into the false lumen instead, resulting in an angiographic “pseudo-occlusion”.

A 6 Fr 3.5 XB-LAD guiding catheter (Cordis, Warren, NJ, USA) was used to promptly engage the ostium of the LM, and two 0.014” soft-tip floppy wires (BMW, Abbott Vascular, Santa Clara, CA, USA) were advanced through the LCX and the LAD. The LAD wire was advanced to the distal vessel without any significant resistance.

Figure 1. The first diagnostic angiographic view showing a normal right coronary artery.

Figure 2. A. The first view of the left coronary system (left anterior oblique, cranial) showing a mild eccentric plaque (arrow) in the mid left anterior descending artery. B. The second view of the left coronary system (right anterior oblique, caudal) showing a 60-70% stenosis (long arrow) in the left circumflex artery. Note the small indentation in the left main shaft (short arrow), which was not visible on the first projection. C. The third view of the left coronary system (right anterior oblique, cranial) showing an acute occlusion of the distal left main artery.
IVUS imaging was performed using a 40-MHz IVUS catheter (Atlantis SR Pro, Boston Scientific Corporation, Natick, MA, USA) and a motorized transducer pullback at 0.5 mm/s, beginning >5 mm distal to the diagonal branch and continuing to the aorto-ostial junction of the coronary artery. The IVUS examination confirmed the correct position of the wire in the true lumen (Figure 4). Additionally, IVUS imaging showed an extended intramural hematoma creating a huge false lumen along the LAD (Figure 4C), with a tiny intimal tear in the distal LM (Figure 4D). A small plaque-rupture cavity was also visible in the LAD distal to the diagonal branch (Figure 4A).

Pre-dilatation was performed with a 2.0 × 12 mm compliant balloon (Apex, Boston Scientific Corporation). Systematic distal to proximal stenting of the LAD was performed with overlapping 2.5 × 18 mm and 3.0 × 36 mm drug-eluting stents (Biomatrix, Biosensors International, Morges, Switzerland). The moderate lesion in the proximal part of the LCX was...
treated with a $2.75 \times 23$ mm stent, following which the LM was stented over the ostium of the LCX into the proximal LAD with a $4.0 \times 23$ mm stent (Biomatrix). TIMI 3 flow was restored in the LAD by sealing the hematoma and the LM dissection. After the last LAD stent had been placed, the patient developed a rapid ventricular tachycardia with hemodynamic collapse, for which she was successfully treated with one external DC shock of 360 J. Final angiography showed good results with TIMI 3 flow across the left coronary artery (Figure 5).

The patient was free of symptoms after the procedure and was transferred to the coronary care unit. She was discharged two days later on dual antiplatelet therapy for at least 1 year. At 1-year follow up, she remains free of angina and in a good clinical condition.

Discussion

Iatrogenic LM dissection during diagnostic coronary catheterization, the nemesis of interventional cardiologists, is a rare but life-threatening event with a reported incidence of less than 0.1%. It results from mechanical injury to the arterial wall during catheter or wire manipulation, passage or deployment of an interventional device, forceful injection of contrast medium, or balloon dilatation or stenting. Patients with LM stenosis, hypertension, Marfan syndrome, congenitally unicuspid and bicuspid aortic valves, and cystic medial necrosis have been reported to be at higher risk of dissection.

In our case, one can remark the slightly aberrant position of the diagnostic catheter, with its tip into the roof of the LM coronary artery, which might have caused a hydraulic dissection during the second injection. In a large study of 38 patients with iatrogenic LM dissection, an inappropriate position of the diagnostic catheter was responsible for 58% of the cases. The transradial approach has been shown to decrease the risk of major vascular complications, promote early ambulation, shorten hospital stay, reduce resource use, and improve clinical outcomes compared to the transfemoral approach, especially in patients with ST-segment elevation myocardial infarction. It has been suggested that catheter manipulation is more difficult via the right radial approach compared to the femoral; consequently, there may be a higher risk of damage. However, this probably reflects the learning curve of the transradial approach, since experienced radial operators will manipulate the catheters without any difficulties. Some technical aspects should be considered, however, such as downsizing the catheter size of the Judkins left catheter by 0.5 compared to the femoral approach.

Depending on the extent of the dissection flap and the resulting luminal obstruction, the clinical manifestation varies from an asymptomatic angiographic finding to a complete hemodynamic collapse due to the abrupt closure of the LM. The original National Heart, Lung and Blood Institute classification system for intimal tears is based upon their angiographic appearances and is graded from type A through F. A simplified and more practical classification, though, has been proposed, based on the extension of the dissection flap: a localized dissection without extension into the LAD or LCX is defined as type I; extension of the dissection from the LM into the LAD or LCX is defined as type II; and extension of the dissection flap into the aortic root is classified as type III. While type I dissections were associated with excellent outcomes (no hemodynamic instability nor in-hospital death), type III dissections had 100% in-hospital mortality. Prompt bailout stent implantation, urgent CABG, or conservative therapy, are the alternative strategies for the treatment of a iatrogenic LM dissection. Conservative therapy is considered in a minority of the cases, and only in selected stable patients with localized dissections and TIMI III flow. LM stenting with a drug-eluting stent and CABG have shown favorable long-term results for
stable coronary artery disease, with similar rates of death and major adverse cardiovascular events during long-term follow up.⁷,⁸ Both treatment options are valid in the case of an acute LM dissection and should be weighed against each other in terms of the extension of the dissection, the patient’s hemodynamic status, technical feasibility, prompt treatment availability, and the operator’s experience. If PCI is chosen, wiring the true lumen of the dissection is paramount, because inadvertent stenting of the false lumen will completely occlude the coronary artery, with dramatic hemodynamic consequences ultimately resulting in the patient’s death.⁹ If doubt exists as to whether the true lumen is wired or not, IVUS may be the best imaging tool. In our case, IVUS imaging confirmed the correct position of the wire in the true lumen. In addition, it helped to detect the media dissection, and the existence and extent of the intramural hematoma, and also allowed adequate vessel sizing and proper stent selection.¹⁰

In a larger observational study of 38 patients with iatrogenic LM dissection, 17 patients were treated by CABG and 14 patients were treated by bailout stenting. There was no in-hospital mortality. Patients were more likely to undergo CABG if they were stable and had multivessel disease. Unstable patients were more likely to undergo PCI. Outcomes at 5 years were independent of the initial revascularization strategy, with rates of major adverse cardiac events (including cardiac death, myocardial infarction, and target vessel revascularization) being 41% and 36% for CABG and PCI, respectively (p=0.8).¹¹ In a review of the literature, with a total of 54 patients and not including the previous study, the vast majority (50 patients) were treated by PCI and only 4 were treated by CABG. Among the 54 patients there was only 1 cardiac death.¹² Hence, although the complication is rare, outcomes are favorable when it is recognized promptly and managed properly.

Several lessons can be learned from this case. First, it obliges us to remember that coronary angiography remains an invasive investigation with rare but life-threatening complications. Indications for diagnostic angiography should therefore be sound. Second, all catheters must be manipulated cautiously, especially when engaging the LM. Injections should only be made when catheters are properly placed and when normal pressures have been identified. Third, in the unlucky situation of a iatrogenic LM dissection, prompt diagnosis and therapy must be initiated, and the most experienced colleagues and surgeons should be alerted. Fourth, if available and if tolerated by the patient, IVUS can help confirm the correct position of the wire in the true lumen, determine the extension of the dissection, and guide stent sizing.

References