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Case Report

A Double-wire Technique for Dealing with Catheter-induced Right Coronary Artery Dissection Extending to the Aortic Root

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Abstract

Coronary artery dissection is a well-described complication of diagnostic angiography and has significant mortality and morbidity. The ideal management of acute coronary dissection and occlusion, whatever the cause, is prompt restoration of vessel patency to limit the duration and extent of ischemia. We report a 73-year-old man with simultaneous retrograde and antegrade spiral dissection of the right coronary artery caused by a guiding catheter during coronary angiography. We advised emergency bypass surgery for the patient, but his family refused. As an alternative to surgery, bail-out stenting of the dissected artery was done. We used a double-wire technique to advance a wire to the distal true lumen of the right coronary artery and placed intracoronary stents. This complication is very challenging for interventional cardiologists and the application of this technique may help increase the rate of success in its management. (*Tzu Chi Med J* 2008;20(4):322–326)

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1. Introduction

Coronary artery dissection is a well recognized complication of coronary angiography (CAG) and angioplasty (1). Catheter-induced right coronary artery (RCA) dissection is occasionally observed. These dissections are usually localized and can be treated with stenting. However, catheter-induced extensive antegrade and retrograde RCA dissection is a relatively rare complication (2). It frequently progresses to complete coronary occlusion, and has a very high mortality rate if not treated immediately. Emergency coronary artery bypass graft (CABG) surgery has been suggested to manage coronary dissection and it results in good clinical outcomes (3). The main disadvantage of this approach is the delay in revascularization, especially in centers without onsite surgical back-up. We report a patient with catheter-induced dissection of the RCA with retrograde extension to the sinus of Valsalva during CAG. The patient's condition stabilized after successful placement of intracoronary stents with a double wire technique.

2. Case report

A 73-year-old man was admitted for percutaneous coronary intervention (PCI) because of unstable angina.

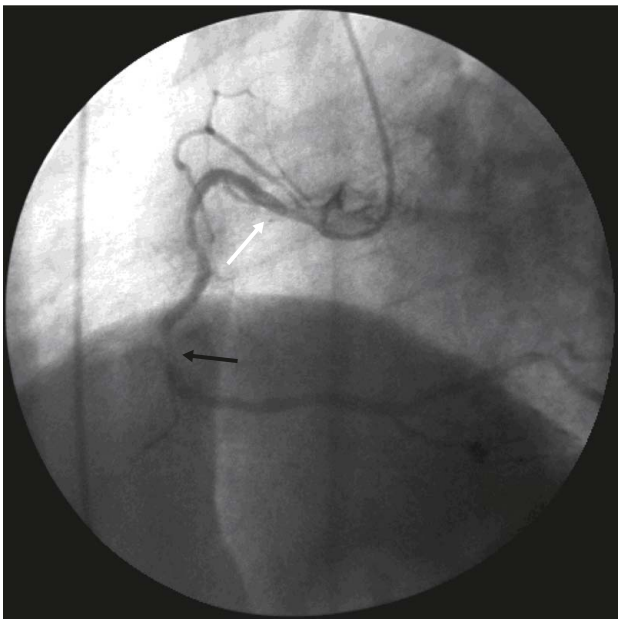

Fig. 1 — Coronary angiography shows critical stenosis of the middle right coronary artery (black arrow) and moderate calcification of the proximal right coronary artery (white arrow).

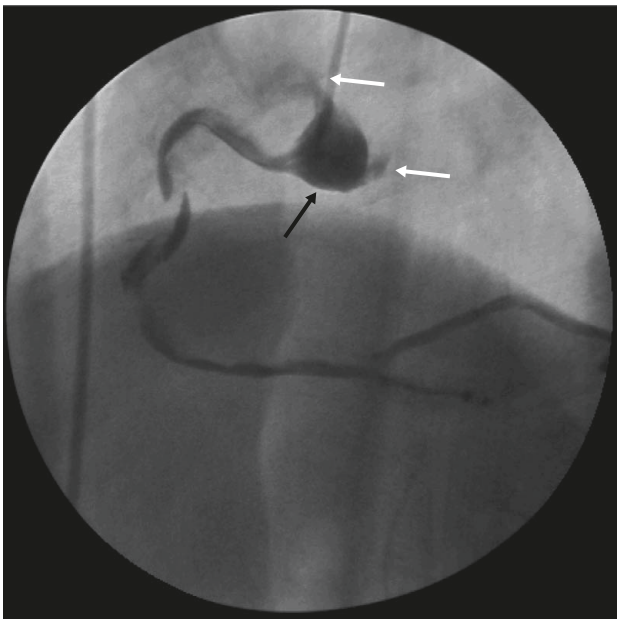

Fig. 2 — Injection of contrast medium through the guiding catheter created a striking expanding saccular image in the sinus of Valsalva (black arrow) with sudden rupture into the aortic lumen (resembling popping soap bubbles) (white arrows). The guiding catheter induced antegrade dissection from the proximal to the distal part of the right coronary artery.

The risk factors for coronary artery disease in this patient included a history of smoking, advanced age, diabetes mellitus and dyslipidemia. Physical examination of the patient was normal. Electrocardiography (ECG) showed ST-segment depression in leads V4–V6 and normal sinus rhythm. The CAG 1 week before this admission demonstrated 95% stenosis in the middle portion of the left anterior descending artery, 95% stenosis in the middle portion of the RCA (Fig. 1), and 99% stenosis in the distal portion of the left circumflex artery. The RCA was a dominant artery. We recommended CABG for the patient because of three-vessel disease; however, the patient refused.

Because of persistent angina pectoris in spite of proper medication, we planned to perform PCI for this patient. We used a 6-Fr Kimny® guiding catheter (Boston Scientific Corp., Natick, MA, USA) to engage the ostium of the RCA and selected a soft-tip IQ guidewire (Boston Scientific) for PCI. When performing CAG to the RCA, we observed an extensive spiral dissection (NHLBI Grade IV) progressing to the posterolateral branch of the RCA with retrograde extension to the right sinus of Valsalva (Fig. 2). Contrast injection revealed *Thrombolysis in Myocardial Infarction* (TIMI) grade I flow in the RCA. The patient began to have severe substernal chest pain with profuse sweating 1 minute after CAG, and his systolic blood pressure dropped to 70 mmHg. The ECG monitor showed ST-segment elevation in leads II and III. An intimal tear of the proximal RCA caused by the guiding catheter complicated by extensive coronary artery dissection was suspected. Intra-aortic balloon counterpulsation (IABC) was used to stabilize the hemodynamics. We suggested emergency CABG for the patient, but his family refused.

Due to the critical condition of our patient and the spiral dissection with limited aortic involvement, we decided to manage this complication with stenting of the dissected RCA. The guiding catheter was replaced with a 6-Fr Judkins right 4 (JR4) guiding catheter (Cordis Corp., Miami, FL, USA) to prevent deep engagement. We tried to pass an IQ wire into the distal true lumen but it could only be advanced to the false lumen. In addition, the JR4 guiding catheter had poor back-up force, and easily slipped out of the RCA ostium. We judged that the entrance of the RCA true lumen should be very close to the ostium of the RCA. We left this wire in the false lumen (Fig. 3A) and gently pulled back the guiding catheter until it was seated near the ostium of the RCA. Then, we advanced another floppy BMW guidewire (Guidant Corp., Santa Clara, CA, USA) into the conus branch of the RCA (Fig. 3B). We used this BMW wire as a tool to stabilize the guiding catheter. We pulled back the IQ wire and carefully advanced it into the conus branch of the RCA to ascertain its location as being in the true lumen. From this location, we successfully passed the wire into the posterior descending branch of the RCA (Fig. 4A). A 4.5 × 12 mm Liberté bare-metal stent (BMS) (Boston Scientific) was deployed at the RCA ostium. Then we implanted

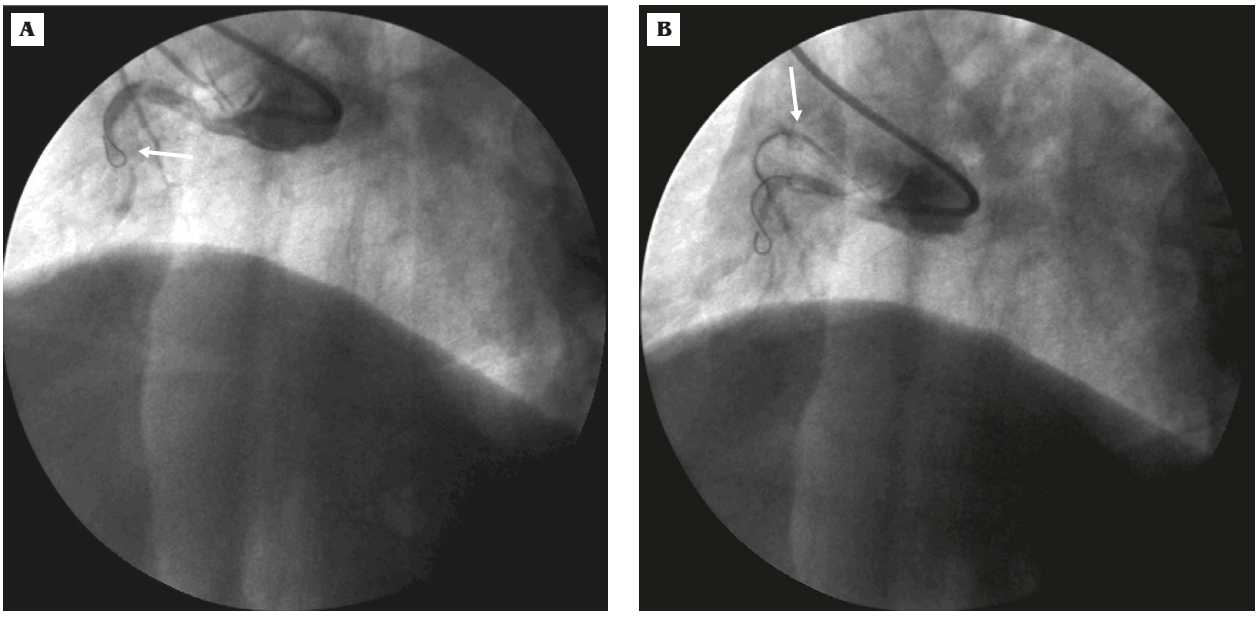

Fig. 3 — (A) First wire in the false lumen (white arrow). (B) Second wire in the conus branch of the right coronary artery (white arrow).

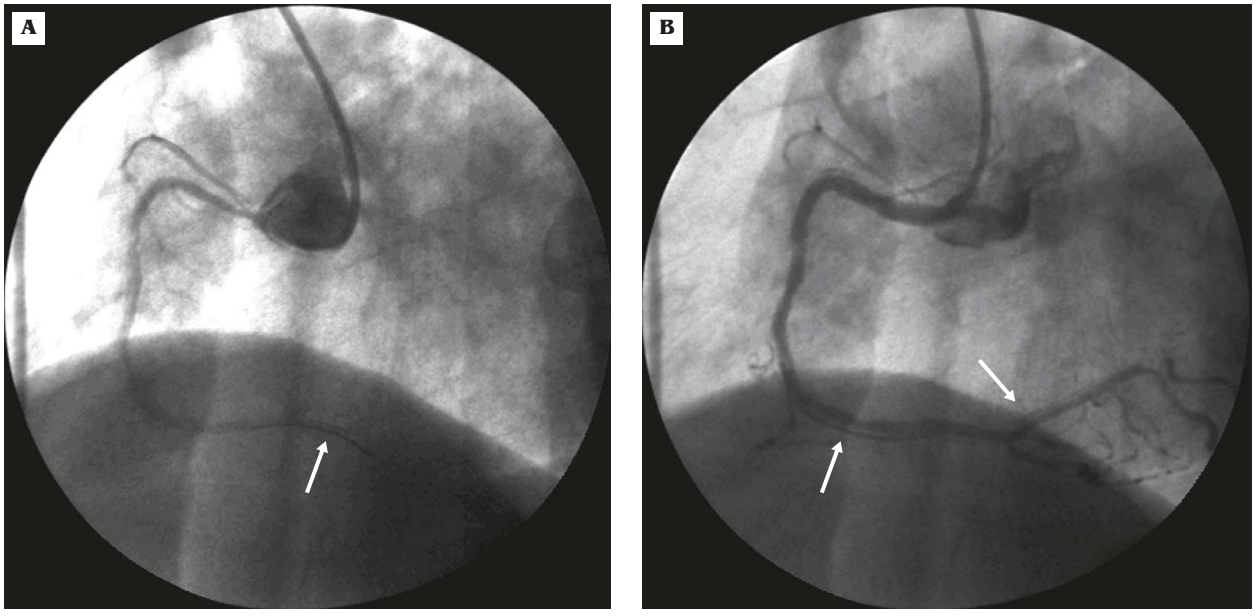

Fig. 4 — (A) The first wire is advanced to the posterior descending branch of the right coronary artery (white arrow). (B) Right coronary angiography after stenting. A dissection flap (white arrows) between the true and false lumens in the distal right coronary artery is noted.

a 3.0×16 mm FlexMaster F1 BMS (Abott, Ulestraten, Netherlands) for the middle RCA lesion and a 3.5×38 mm Penta BMS (Guidant Corp.) between the above two stents. The result was acceptable with TIMI grade III flow (Fig. 4B). The patient's chest tightness improved immediately and his blood pressure returned to normal after the stenting. Serial cardiac enzymes after PCI were within normal limits.

IABC was removed the next day and the patient was discharged without symptoms on the 6th post-procedure day. The patient complained of effort angina in the outpatient clinic 1 month later. Repeat CAG revealed

an unsealed localized cuspid dissection flap, a patent proximal RCA and persistence of the false lumen in the distal RCA. Transthoracic echocardiography showed normal left ventricular wall motion without pericardial effusion. The patient later underwent elective CABG. At the 9-month follow-up, the patient was asymptomatic and clinically stable.

3. Discussion

Guiding catheter-induced simultaneous retrograde dissection to the ostium and antegrade dissection to the distal portion of the RCA is very unusual during coronary angiographic examination [2]. The incidence of coronary artery dissection during CAG is <0.1% [2]. Coronary artery dissection may result in complete occlusion of the true vessel lumen by compression from the false lumen [4]. Extensive spiral dissection of the coronary artery has the potential risks of nonfatal myocardial infarction, emergency surgery and even a fatal outcome. Therefore, learning and mastering how to quickly manage this complication is pivotal for interventional cardiologists.

There are several mechanisms responsible for this complication. It appears that catheter trauma first produces coronary artery dissection which can then progress in a retrograde fashion through the subintimal space into the aortic root. Vigorous hand injection of contrast medium, subintimal passage of the guidewire, and improper manipulation of the catheter have been proposed as possible mechanisms of iatrogenic coronary dissection [5]. We observed that injection of contrast medium into the subintimal space was the cause of the retrograde progression of the dissection in this case. This was probably due to reverse flow generated proximal to the catheter tip during injection. Forceful contrast injections promote its propagation, so this should be avoided. Susceptibility to the development of intimal tears and progression of a hematoma may be related to underlying structural weakness of the media [6]. The predisposing factors include hypertension, congenital unicuspid and bicuspid aortic valves, Marfan syndrome, cystic media necrosis and extensive atherosclerosis [6,7].

The structural features of the guiding catheter, anatomy of the coronary arteries and operator experience are the most important factors associated with coronary artery dissection. In one original study, the incidence of proximal RCA dissection increased with selection of a Kimny® guiding catheter, atherosclerotic plaque lesions in the proximal RCA, angulation (>90°) of the proximal RCA and various degrees of calcification of the proximal RCA [8]. Most of the above mentioned factors were present in our patient.

The emphasis in the management of this complication is rapid restoration of vessel patency. In previous reports, surgery, PCI and conservative treatment have all been successful [3,9,10]. CABG is best suited for left main (LM) stem lesions, multivessel disease and refractory recurrent ischemia [11]. The main disadvantage of this approach is the delay in performing emergency surgery, mainly in centers lacking cardiovascular surgery.

PCI has emerged as a new alternative treatment for this condition, and it has been developed and improved over the past several years. In one original study [9] and one case report [12], bail-out stenting for treating catheter-induced LM dissection was technically feasible and showed good acute and long-term results. In cases with severe extensive dissection of the RCA with extension to the aortic root that may avulse the RCA origin off of the aorta and cause RCA closure, finding the true lumen is the key to procedure success. However, the guiding catheter is easily engaged into the false lumen near the RCA ostium. The double-wire technique was described in one retrospective review [8]. The guiding catheter can be disengaged and anchored by one wire near the RCA ostium. A second wire is then used to find the true lumen.

In our case, there was significant difficulty in engaging the RCA with a JR4 guiding catheter after the dissection. The double-wire technique we used is described below. We passed the first wire into the false lumen and manipulated the guiding catheter to seat near the RCA ostium. The guiding catheter slipped out many times when we tried to advance the second wire into the true lumen. We found that the conus branch of the RCA communicated with the true lumen. We passed the second wire into the conus branch by wiring the true lumen near the RCA ostium from a distance. The second wire was used as a tool to stabilize the catheter. Then we withdrew and tried placing the first wire into the conus branch by tracing the second wire. Thus, we could pass our first wire into the distal RCA true lumen without difficulty. Why did we not use the second wire to enter the distal RCA when it entered the conus branch? There are two reasons for this: firstly, the JR4 guiding catheter was seated near the RCA ostium and the first wire in the false lumen was not strong enough to fix the guiding catheter properly; secondly, we passed the wire in the spiral dissection true lumen with more difficulty and strong guiding catheter support was needed. We suggest using this technique when there is poor guiding back-up and the side branch of the RCA is not occluded by the false lumen. We must try advancing a single wire first to the distal true lumen before using this technique.

Dunning et al [6] proposed a classification system to guide treatment and prognosis. A dissection limited to the cusp is considered low-risk, a dissection involving the cusp and extending up the ascending aorta less than 40 mm is intermediate-risk, and a dissection longer than 40 mm is high-risk. Our case would fall in

Dunning et al's low-risk category, for which stenting of the entry point with bare or covered stents [13,14] is advised. In our case, the iatrogenic dissection created one entry point and two exit points. The proximal exit point was near the sinus of Valsalva and the distal one was in the distal RCA. There are questions regarding the efficiency of stenting, because the proximal exit point may become the entrance point of the false lumen from the cusp to the distal RCA when stenting the original entry point in the RCA. We assumed that the false lumen would shrink and become obliterated with time after stenting of the true lumen [11]. This was proved on CAG follow-up. It is also possible that a stent may fail to seal the entry port and a covered stent might be useful [15].

Management of this complication depends on the clinical manifestations and the location and extent of the coronary artery dissection. For example, spontaneous healing of a severe RCA spiral dissection after 1 month was reported in one case [16]. The presence of TIMI grade III flow at coronary artery dissection in the absence of ischemia was associated with a favorable outcome and predicted a low restenosis rate without revascularization in one original study [10]. For a single coronary artery dissection with TIMI grade III flow and no symptoms or signs of ischemia, we recommend conservative therapy without intervention.

In summary, catheter-induced coronary artery dissection is a rare complication during CAG and PCI. This complication may be life-threatening and represents a challenge for interventional cardiologists. Catheter-induced occlusive dissection is more difficult to manage than PCI-related dissection because the guidewire is usually in the true lumen during a PCI procedure, which makes stenting easier. From this case, we also learned that precautions should be taken during CAG to avoid improper catheter engagement and forceful contrast injection. Therefore, knowledge of this complication, operator experience and patience in careful wiring are essential in this clinical setting. The double-wire technique is a feasible method for entering the true lumen when iatrogenic retrograde coronary dissection to the sinus of Valsalva occurs.

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