Immediate catheterization laboratory management of acute femoral artery occlusion due to a vascular closure device

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Acute limb ischemia due to vascular closure devices is an infrequent complication. However, its incidence is increasing because the use of these devices has become commonplace after cardiac catheterization and coronary angioplasty. It is therefore important for interventional cardiologists to be acquainted with the knowledge and cognitive skills of managing this complication in the catheterization laboratory. The present report describes a strategy to manage this complication in a cardiac catheterization laboratory that is not equipped with standard fluoroscopic equipment for peripheral interventions.

Key Words: *Angiography; Complication; Vascular closure device*

Traitement immédiat en laboratoire de cathétérisme d'une occlusion aiguë de l'artère fémorale causée par un dispositif hémostatique

L'ischémie aiguë d'un membre due à un dispositif hémostatique est une complication rare. Toutefois, son incidence est en hausse en raison de l'utilisation de plus en plus répandue de ces dispositifs après le cathétérisme cardiaque et l'angioplastie coronarienne. Il est donc important pour les spécialistes de la cardiologie interventionnelle de maîtriser les aspects théoriques et pratiques de la prise en charge de cette complication en laboratoire de cathétérisme. Le présent rapport décrit une stratégie de prise en charge de cette complication pour les laboratoires de cathétérisme cardiaque qui ne disposent pas d'appareils de fluoroscopie standard pour les interventions périphériques.

Thrombotic occlusion of the arterial access site is an uncommon but limb-threatening emergency after cardiac catheterization. Because vascular closure devices (VCDs) are now commonly used after catheterization procedures, this complication may be increasingly encountered. We illustrate two cases of acute management of this complication in the cardiac catheterization laboratory.

CASE PRESENTATIONS

Patient 1

A 78-year-old woman was referred for cardiac catheterization three days after she presented with flash pulmonary edema. The procedure was performed through the right groin using a 6 Fr sheath. Coronary angiography revealed severe diffuse triple-vessel coronary artery disease and moderate left ventricular systolic dysfunction, and cardiac surgery referral was planned. A 6 Fr Angio-Seal closure device (St Jude Medical, USA) was placed in the right groin to achieve hemostasis.

In the recovery area, the patient indicated having a painful, cold right leg. Because of her recent cardiac instability, it was decided that surgical repair should be avoided and endovascular treatment considered.

Revascularization procedure: Similar to many cardiac catheterization laboratories, the angiography suite at the Royal Columbian Hospital (New Westminster, British Columbia) was equipped with a 9 in intensifier and had no overhead track to allow the image intensifier to reach the lower extremities. The patient was therefore placed in the reverse direction on the procedural table, such that her feet were placed on the head rest, allowing the image intensifier to record her body between the pelvis and the foot. Her body was viewed upside down on the image monitor (Figure 1A).

A 6 Fr sheath was placed retrogradely in the left femoral artery, and a 6 Fr internal mammary artery (IMA) guiding catheter was then crossed over via an angled guidewire (Terumo Medical Corporation, USA) to the right common iliac artery. Selective femoral angiography confirmed an acute occlusion of the right common femoral artery (Figure 1A). A hydrophilic coronary guidewire (Hi-Torque Pilot 50; Guidant, USA) successfully advanced across the occluded lesion, and a 5.0 mm monorail Sprinter balloon catheter (Medtronic Vascular, USA) was used to dilate the lesion (Figure 1B). A large thrombus was present distal to a piece of collagen within the artery (Figure 1C). Subsequent attempts of thromboaspiration with the Pronto extraction catheter (Vascular Solutions Inc, USA) and removal of the collagen with Microsnare catheter (EV3, USA) were unsuccessful. To exclude the collagen and the thrombus from the arterial lumen, a Wallstent 7.0 mm × 30 mm (Boston Scientific Inc, USA) was deployed within the lesion; this was followed by dilation with a 6.0 mm × 20 mm balloon catheter. This provided an adequate angiographic result (Figure 1D). Digital angiography of the distal vessels revealed a patent superficial femoral artery, popliteal artery and single-vessel runoff to the foot via the anterior tibialis artery without evidence of embolization.

At one year, the patient denied claudication, and duplex ultrasound study reported no evidence of restenosis.

Patient 2

An 83-year-old woman was referred for coronary angiography due to recurrent acute pulmonary edema. Coronary angiography revealed diffuse and severe disease in the left main, left anterior and circumflex arteries, which were deemed to be unsuitable for percutaneous or surgical revascularization. A severe focal lesion was present in a dominant

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Figure 1) **A** The patient's body position was reversed such that the right femoral head is at the top of the figure. Selective angiography showed an occluded right femoral artery (black arrow). **B** The occlusion was crossed with a 0.014 in Pilot 50 guidewire (Hi-Torque Pilot 50; Guidant, USA) (arrowhead) and was dilated with a 5.0 mm × 30 mm balloon catheter. **C** After balloon dilation, angiography showed partial re-establishment of flow in the superficial femoral artery and the profundus femoris. A large thrombus was noted distal to a piece of collagen (curved arrow) within the common femoral artery. **D** After failing to remove the clot by the Pronto (Vascular Solutions Inc, USA) and Microsnare (EV3, USA) catheters, a Wallstent 7.0 mm × 30 mm (Boston Scientific Inc, USA) (arrow) was delivered and dilated with a 6.0 mm × 20 mm balloon catheter to exclude the collagen and the thrombus

right coronary artery, which was successfully treated with a coronary stent. An Angio-Seal closure device was placed in the right common femoral artery. Thirty minutes later, the patient complained of pain and numbness in the right foot. A physical examination revealed a cold and pulseless right lower extremity. The patient was immediately brought back to the cardiac catheterization laboratory, and her body was positioned in the same fashion as that used for patient 1.

Revascularization procedure: Via a 0.035 in angled guidewire, a 6 Fr IMA guiding catheter was advanced across from the left common

femoral artery to the right common iliac artery. Selective angiography confirmed an acutely occluded right common femoral artery (Figure 2A). After giving 5000 U of unfractionated heparin, a Pilot wire was successfully used to cross the occluded site, which was dilated with a 5.0 mm × 30 mm balloon catheter (Figures 2B and 2C). To place a 7.0 mm × 30 mm Wallstent at the lesion, the 6 Fr guiding catheter was changed to a 7 Fr IMA guiding catheter via a stiff Amplatz guidewire (Cook Inc, USA). The Wallstent was then successfully delivered across the lesion and was dilated with a 6.0 mm × 20 mm balloon catheter; a

Figure 2) **A** Selective angiography demonstrating an occluded right common femoral artery (arrow). **B** The lesion was crossed with a 0.014 in Pilot 50 guidewire (Hi-Torque Pilot 50; Guidant, USA) and was dilated with 5.0 mm $\times$ 30 mm balloon catheter. **C** Repeat femoral angiography showing a focal eccentric thrombus that was resistant to balloon dilation (arrow). **D** A Wallstent 7.0 mm $\times$ 30 mm (Boston Scientific Inc, USA) was deployed across the lesion and was postdilated with a 6.0 mm $\times$ 20 mm balloon catheter (arrow). An adequate angiographic result was achieved and the flow was re-established distally

satisfactory result was obtained (Figure 2D). Selective angiography revealed a chronically occluded distal right superficial femoral artery that was reconstituted by profundus femoris at the level around the Hunter's canal. Distal pulses were re-established. The patient remained stable, but suffered from sudden cardiac death six months later.

DISCUSSION

The use of VCDs after diagnostic or interventional cardiac catheterization procedures is intended to offer convenience during the

postprocedural phase by enabling early mobilization and discharge. This is particularly important in high-volume centres such as ours, where same-day discharge after cardiac interventions is desired. However, VCDs have not been shown to reduce the risk of bleeding (1-3), and specific device-related complications, such as infection or limb ischemia, may occur (Table 1).

Conventionally, the management of acute limb ischemia due to VCDs begins with documentation of vessel closure by either duplex ultrasound or computed tomography angiography followed by surgical

TABLE 1
Potential complications of vascular closure devices compared with manual compression after cardiac catheterization procedures

Manual compression	Vascular closure device
Pros	Pros
No foreign body involved	Early mobilization
Cons	Cons
Prolonged bed rest	Failed closure
Bleeding (hematoma, pseudoaneurysm)	Bleeding (hematoma, pseudoaneurysm, retroperitoneal bleeding)
	Thrombotic occlusion of the artery
	Embolization
	Arterial dissection
	Infection

thrombectomy. The process may often take 2 h or longer before reperfusion can be established during surgery. Furthermore, surgery is associated with significant morbidity and may require days of hospitalization for recovery. Compared with surgery, immediate catheter-directed revascularization provides early reperfusion and is well-tolerated, even in high-risk patients such as our index cases, and general anesthesia can be avoided. The recovery was short, and the patients' subsequent courses were minimally affected by the event. Furthermore, because it is important to ensure that distal embolization does not occur after femoral angioplasty, we showed that by reversing body orientation on the procedural table, percutaneous revascularization can be carried out even in cardiac catheterization laboratories that are not designed for lower extremity interventions.

Nevertheless, because lesions related to collagen-based or suture-mediated VCDs are quite resistant to balloon dilation alone, our experience suggests that a self-expanding stent is usually needed to obtain an optimal angiographic result. This may make future arterial access at the same site difficult. A self-expanding stent, but not a balloon-expandable stent, is used to avoid stent crushing associated with hip

flexion. Furthermore, similar to the surgical conduit, close surveillance, both clinical and by duplex ultrasound at four to six months after stent placement, should be performed. The patency rate with a self-expanding stent at this site is considered to be greater than 85% (4).

Prevention is still the best medicine. To minimize the risk of VCD-related complications, angiography limited to the femoral area is recommended to identify features that may prohibit the safe application of a VCD, such as heavy calcification, peripheral vascular disease, small vessel diameter (smaller than 6 mm), entry below the bifurcation or above inferior epigastric artery, or pre-existing bleeding (5). Physician familiarity with a particular device, along with angiographic information, is the main determining factor of the successful implantation of a VCD.

In summary, our cases illustrate the safety and feasibility of percutaneous revascularization of thrombotic arterial occlusion related to collagen-mediated VCDs in a standard cardiac catheterization laboratory that is not equipped with imaging equipment for lower extremity interventions.

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