Successful Treatment of Iatrogenic External Iliac Artery Perforation With Covered Stent: Case Report and Review of the Literature

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Abstract

Retroperitoneal hemorrhage from iliac artery injury is a potentially serious complication of vascular interventional procedures leading to hemorrhagic shock and death if not diagnosed early and treated promptly. We report a 70-year-old male admitted to our facility with non-ST-elevation myocardial infarction, whose heart catheterization revealed left anterior descending artery (LAD) with 80% proximal, 95% mid and 100% distal disease. The left circumflex and right coronary arteries were 100% occluded proximally and received collaterals from the LAD. The patient declined coronary artery bypass surgery; therefore, the decision was made to perform high-risk percutaneous coronary intervention (PCI) of the LAD with Impella left ventricular assist device support. Left femoral artery angiogram revealed severely tortuous and calcified aorta, left external iliac and left common iliac arteries, and was accessed with 14-inch Impella sheath. He developed groin pain with mild hypotension thought to be due to sedation, which responded to intravenous fluids and dopamine. He underwent successful rotational atherectomy of the proximal and mid LAD with deployment of drug-eluting stents. Following PCI, he suffered acute profound hypotension necessitating intravenous fluids and vasopressor support with epinephrine. Emergency transthoracic echocardiogram did not reveal any pericardial effusion, and showed normal left ventricle and right ventricle systolic function. The Impella device was removed and selective left common iliac angiogram from the right femoral access revealed a vascular injury site with shift of the bladder to the right indicative of retroperitoneal hematoma. A digital subtraction angiogram revealed extravasation of blood at the vascular injury site. An 8.0 × 59 mm iCAST covered stent was deployed to the left external iliac artery with successful sealing of the perforation. The Impella device site was closed with two Perclose devices. The patient required 4 units of packed red blood cell transfusion. His hospital course was complicated by transient acute kidney injury, with return of his renal function to baseline at discharge 10 days later. This case underscores the importance of prompt recognition and treatment of vascular complications associated with interventional procedures, and highlights some of the risk predictors of such complications, which should be anticipated and planned for prior to intervention.

Keywords: Vascular perforation; Covered stent; Impella device

Introduction

Retroperitoneal hemorrhage from iliac artery injury is a potentially serious complication of vascular interventional procedures leading to hemorrhagic shock and death if not diagnosed early [1] and treated promptly. The reported incidence of retroperitoneal hematoma is 0.49-0.74% in patients after an interventional procedure and carries a mortality risk of 4-12% [2, 3]. The use of covered stents to repair such vascular injuries has gained popularity given the high morbidity of emergency surgical vascular repair [4, 5]. We report a life-threatening retroperitoneal bleed caused by an iatrogenic perforation of the left external iliac artery during Impella left ventricular assist device insertion for support in a high-risk coronary artery intervention procedure. The perforation was successfully sealed using an iCAST covered stent.

Case Report

A 70-year-old male with known coronary artery disease and stable angina was admitted to our facility with a prolonged chest pain episode at rest, associated with dyspnea. His electrocardiogram revealed diffuse ST and T wave abnormalities indicative of ischemia and his plasma troponin I levels increased from 0.07 to 0.23 ng/mL. He was treated for non-ST-elevation myocardial infarction and underwent left heart catheterization. This revealed left anterior descending artery (LAD) with 80% proximal, 95% mid and 100% distal disease (Fig. 1a). The left circumflex and right coronary arteries were 100% occluded proximally and received collaterals from the LAD. The patient declined coronary artery bypass surgery; therefore, the decision was made to proceed with high-risk...
percutaneous coronary intervention (PCI) of the LAD with Impella left ventricular assist device and temporary venous pacemaker support. Left femoral artery angiogram, accessed through a 45 mm Arrow sheath, revealed severely tortuous and calcified aorta, left external iliac and left common iliac artery. The left femoral access was pre-dilated and a 14-inch Impella sheath was introduced through the left common femoral artery. He developed groin pain at the access site with mild

**Figure 1.** Left heart catheterization RAO view showing (a) severe proximal and mid LAD disease pre PCI, Impella support device is seen in the LV, and a temporary transvenous pacemaker wire in the RV. (b) Post atherectomy and stent placement in the proximal and mid LAD.

**Figure 2.** Peripheral angiogram of the left iliac artery showing (a) site of vascular injury and shift of the bladder to the right indicative of compression from the rapidly accumulating retroperitoneal hemaoma; (b) after endovascular repair of the left iliac perforation using a covered stent.
hypotension thought to be due to sedation given, including
versed and fentanyl, which responded to intravenous fluids
and dopamine. He underwent successful rotational atherecto-
yony (Boston Scientific) drug-eluting stents (Fig. 1b). Follow-
ing PCI, the patient suffered acute profound hypotension
necessitating intravenous fluids and vasopressor support with
epinephrine. Emergency transthoracic echocardiogram did
not reveal any pericardial effusion, and showed normal left
ventricle (LV) and right ventricle (RV) systolic function. The
Impella device was removed and selective left common iliac
angiogram from the right femoral access revealed a vascular
injury site with shift of the bladder to the right indicative of
retroperitoneal hematoma (Fig. 2a). A digital subtraction an-
giogram (DSA) revealed extravasation of blood at the vascular
injury site (Fig. 3a). An 8.0 × 59 mm iCAST covered stent
was deployed to the left external iliac artery with successful
sealing of the perforation (Figs. 2b and 3b). The Impella de-
vice site was closed with two Perclose devices. Computed to-
mography (CT) of the abdomen revealed large retroperitoneal
bleeding along the plane of left external iliac artery (Fig. 4a,
b). The patient required 4 units of packed red blood cell trans-
fusion. His hospital course was complicated by transient acute
kidney injury, with return of his renal function to baseline at
discharge 10 days later.

Discussion

With the advent of progressively sophisticated endovascular
therapies to treat vascular, coronary, valvular and other struc-
tural heart disease, the use of increasingly larger sheaths has
been associated with a surge in iatrogenic vascular access
complications [6]. Vascular perforation or rupture is a serious
potential complication of any endovascular procedures and
can lead to organ, limb, or life loss. The management of this
deleterious complication has evolved from emergent surgery
[7] to now include multiple percutaneous options including the
use of prolonged balloon tamponade [8], stent grafts [9], coil
embolization [10], vascular plug [11], coagulated thrombus in-
jection [12] and localized thrombin injection [13]. Iatrogenic
iliac artery injuries including dissection and perforation appear
to be more common in patients with calcified atherosclerotic
aorto-iliac disease and tortuous vessels [14], as was seen in
our patient.

Case series or trials studying the use of devices to treat
iliac artery perforation or rupture are few. One series [15]
analyzed 1,642 peripheral interventions (46% iliac and 54%
femoro-distal) and reported only two cases of perforation and
hematoma requiring surgery (one retroperitoneal hemorrhage
and one pseudo-aneurysm). Palmaz et al [16] reported a 0.9%
incidence (five out of 587 procedures) of vessel rupture and
pseudo-aneurysms in patients who underwent iliac artery
stenting procedures. Allaire et al [17] examined 657 iliac inter-
ventions from 1981 to 2000 and found a 0.8% incidence (five
patients) of vessel rupture; they recommended covered stents
to treat ruptured vessels.

Risk factors associated with rupture [17-19] include calci-
fied vessels, vascular stenosis, oversized balloons, history of
recent endarterectomy, chronic steroid therapy, and diabetes
mellitus. Some authors have used balloon tamponade for a few
minutes as a treatment for contained bleeding [8, 19], but this

![Figure 3. DSA of the left iliac artery showing (a) extravasation of blood into the retroperitoneal space at the site of vascular perforation; (b) resolution of the bleeding following the deployment of a covered stent.](image-url)
method is thought to be unreliable as bleeding may resume later. In a recent series of seven iliac artery ruptures [20], all were successfully treated with stent grafts.

Endovascular therapy of traumatic and iatrogenic vascular complications varies among reports in the literature. Lagana et al [21] reported 13 patients with traumatic and iatrogenic arterial iliac ruptures who were all treated successfully with stent grafts. Hamilos and colleagues [22] reported successfully treating a large iliac artery rupture with a coated stent. Trehan et al [23] used a longer stent-graft on a shorter balloon to emergently treat an iatrogenic iliac artery rupture. Mehta et al [24] successfully treated a massive bleed from a guidewire perforation of an external iliac artery with hand-made stent-graft placement. Arat and colleagues [25] reported successful treatment of a femoral bleeding site with two covered self-expanding coronary stent-grafts. Nozary and Hashemi Fard [26] reported a rare simultaneous dissection, perforation and thrombosis of the external iliac artery following angiography which did not respond to firm compression and required arteriotomy and vascular repair. Overall, iliac artery injury and rupture outcomes have significantly improved, especially as endoluminal management has evolved as the primary treatment strategy [27].

With the introduction of the radial approach to endovas-
vascular procedures, vascular complications of the radial artery have been increasingly reported. Chatterjee et al [28], Narayan et al [29] and Al-Sekaiti et al [30] all reported successfully treating radial artery perforation during transradial catheterization using polytetrafluoroethylene-covered coronary stents. Other vascular injuries have also been reported with successful endovascular repair using covered stents including carotid injury [31, 32], subclavian injury [33], brachial injury [34] and traumatic vascular injuries [35].

Iatrogenic iliac artery injury during other intravascular or orthopedic surgery has been reported, with successful endovascular repair using covered stents including carotid injury [31, 32], subclavian injury [33], brachial injury [34] and traumatic vascular injuries [35].

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Table 1. Predictors of Iatrogenic Vascular Complications Reported in the Literature, Divided in Potentially Modifiable Versus Non-Modifiable Factors

| Potentially modifiable                        | Non-modifiable                        |
|----------------------------------------------|---------------------------------------|
| High femoral artery puncture                 | Diffuse vascular calcifications        |
| Larger sheath size                           | Increased vascular tortuosity          |
| Excessive guidewire manipulation             | High grade iliac stenosis             |
| Manual inflation (pressure and time)         | Female gender                         |
| Oversized balloon                            | Older age                              |
| Procedure time                               | Low body surface area (BSA)            |
| Anticoagulation or thrombolytics             | Chronic kidney disease (CKD)           |
| Hypertension during procedure                | Diabetes mellitus (DM)                 |
| Patient agitation and movement               | Prior stroke                           |
| Long-term steroid therapy                    | Connective tissue disease (e.g. Ehlers Danlos) |

Table 2. Procedures Reported in the Literature to Treat Iatrogenic Vascular Complications

- Classical vascular surgery
- Covered stent/ stent graft (iCAST)
- Vascular plug (Amplatzer)
- Percutaneous suture delivery (Perclose)
- Endovascular coil embolization (Interlock & IDC)
- Collagen plug (Angio-Seal)
- Localized thrombin injection (Thrombin JMI)
- Coagulated thrombus injection
- Prolonged balloon tamponade
- Prolonged external compression

Sustained during laparoscopic hysterectomy.

Conclusion

Iatrogenic or traumatic vascular injuries remain uncommon, however, with a rising incidence due to the increasing number of endovascular therapies requiring larger catheters and sheaths and offered to older individual with vulnerable vascular anatomy. Table 1 lists some of the reported predictors for iatrogenic vascular injury which should be taken into consideration during any intravascular procedure. Although multiple modalities have been employed to seal vascular ruptures depending on the extent of bleeding and size of perforation (Table 2), endovascular treatment with covered stents appears to have emerged as the treatment of choice, especially for large, life-threatening perforations [42, 43], with great success rates of immediate control of bleeding, in addition to adequate patency rates on follow-up. When planning a coronary revascularization strategy, we recommend that a multidisciplinary team approach be implemented not only with a Heart Team approach to decide about the best interventional modality, but also with a vascular interdisciplinary team approach to help mitigate the potential risk of iatrogenic vascular complications (Fig. 5).

Disclosures

All authors declare no disclosures related to this manuscript.

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Figure 5. Vascular interdisciplinary team (VIT) approach to help mitigate the risk of iatrogenic vascular complications during planned interventional procedures. OR: operating room; MAP: mean arterial pressure.
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