Interventional Management of Femoral Vascular Complications

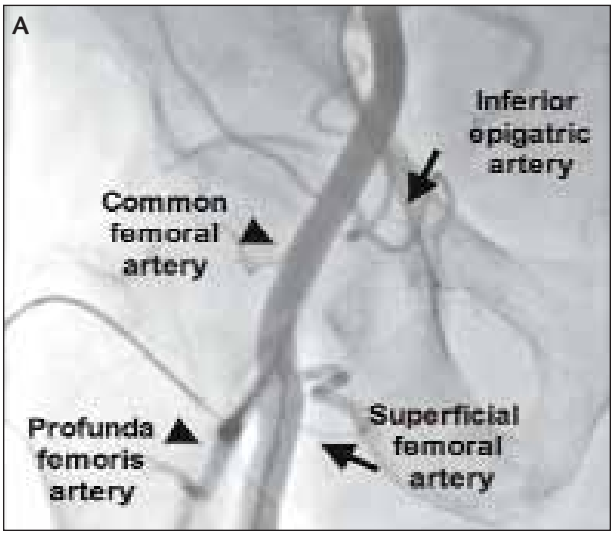
Endovascular rescue for bleeding and ischemic complications.

BY ROBERT J. APPLEGATE, MD

Recent studies indicate that the rates of vascular complications after procedures performed from femoral artery access have been declining.[1] However, significant vascular complications after femoral artery access continue to be observed.

Traditionally, vascular complications at the arterial access site have been divided into minor vascular complications, such as pseudoaneurysm, arterial venous fistulae (AVF), and hematoma, and major vascular complications, including severe bleeding at the access site requiring transfusion and/or vascular repair, retroperitoneal hemorrhage, and limb ischemia. Although this classification system is useful, it should be recognized that significant morbidity may occur with even minor vascular complications. Vascular complications occurring at the femoral artery access site can also be distinguished by the hemodynamic stability of the patient, with hypotension, shock, and/or hemodynamic instability reflecting the presence of a vascular complication that demands immediate attention and intervention. By contrast, in the absence of hemodynamic instability, evaluation can proceed at a more conservative pace.

Recent case series have re-examined the factors associated with retroperitoneal hemorrhage and have provided us with some new insights into this potentially fatal complication.[2-4] An arterial access site above the inferior epigastric artery and into the external iliac artery was present in a substantial number of patients with retroperitoneal hemorrhage in these case series. Although the majority of the cases presented within 3 hours of the completion of their coronary interventional procedure, approximately 25% of patients presented from 3 to 6 hours after the procedure. Of note, the mortality rates in these series ranged from 0% to 10%, suggesting that even in the modern era of low-intensity anticoagulation during percutaneous coronary intervention (PCI) procedures, retroperitoneal hemorrhage remains a potentially dangerous complication. Fortunately,



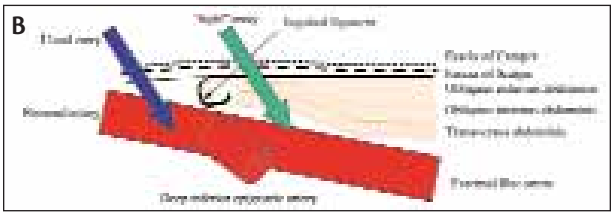


Figure 1. Right anterior oblique view with 20° caudal angulation of the femoral artery obtained via a sheath injection (A). Depiction of the femoral access site from the usual (common femoral artery) or high (above the inferior epigastric artery) entry sites (B). Note the relation of the inferior epigastric artery and the abdominal musculature and retroperitoneal space. (Adapted and reprinted with permission from Ellis SG, Bhatt D, Kapadia S, et al. Correlates and outcomes of retroperitoneal hemorrhage complicating percutaneous coronary intervention. Catheter Cardiovasc Intervent. 2006;67:541-545.)

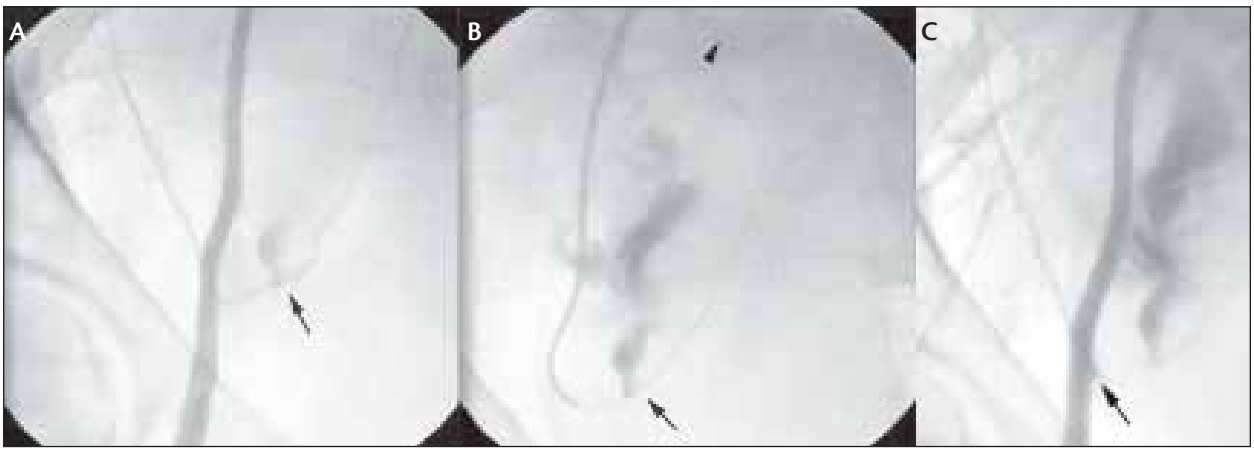


Figure 2. Right anterior oblique view obtained from the crossover sheath showing perforation of the inferior epigastric artery (arrow) and dye extravasation into the retroperitoneal space (A). Selective engagement of the inferior epigastric artery from the crossover sheath and 6-F Judkins right-4 guiding catheter, and a guidewire (.014-inch) placed across the perforation into the distal vessel (B). Thrombosis of the inferior epigastric artery after balloon tamponade and administration of 300 IU of thrombin (C). (Adapted and reprinted with permission from Silva JA, Stant J, Ramee SR. Endovascular treatment of a massive retroperitoneal bleeding: successful balloon-catheter delivery of intra-arterial thrombin. Catheter Cardiovasc Interv. 2005;64:218-222.)

the incidence of retroperitoneal hemorrhage in these case series was <.7% of total PCI procedures performed. The risk of retroperitoneal hemorrhage was six- to 29-fold higher in patients with "high stick" (ie, above the inferior epigastric artery) than in those without "high stick" (Figure 1). This observation suggests that if a high stick observed before anticoagulation is administered in a patient being considered for a coronary intervention, the procedure might reasonably be postponed and performed more safely from a puncture site within the common femoral artery.

INITIAL DIAGNOSTIC EVALUATION STRATEGIES

Diagnostic evaluation of a patient with a perceived minor groin complication in a stable patient is traditionally obtained by local ultrasound. Ultrasound provides an accurate and reliable means of diagnosing both AVF and pseudoaneurysms, as well as a thigh hematoma. In a stable patient with a tentative clinical diagnosis of retroperitoneal hematoma, CT scanning has been the traditional noninvasive means of confirming this diagnosis. The diagnosis of retroperitoneal hematoma can be made with a reasonable degree of confidence even in the absence of contrast agent use. However, in an unstable or hemodynamically unstable patient suspected of retroperitoneal hemorrhage, the decision to proceed with a definitive diagnosis noninvasively may delay a life-saving intervention or vascular repair. Under these circumstances, diagnosis by arteriography with an eye toward interventional repair, or immediate transfer to the operating room with intention of local exploration and repair of the arterial laceration may be better strategies. Ultimately, the decision will rest on the comfort level of the cardiologist or vascular surgeon who is asked to evaluate the patient, and institutional preference for the management of threatened retroperitoneal hemorrhage. Regardless of how the ultimate intervention is performed, rapid and open communication between the cardiologist and the vascular surgeon is essential to optimizing patient outcomes.

GENERAL TREATMENT STRATEGIES

In the unstable patient with suspected retroperitoneal hemorrhage, fluid resuscitation and arrangement for transfusion should be performed immediately, anticoagulation reversed, and glycoprotein IIb/IIIa inhibitors, if used, stopped. In cases in which a coronary stent has been freshly placed, the patients almost universally will have received aspirin and clopidogrel so that stopping these two medications is a moot point. We have not utilized the strategy of administering platelets in these circumstances for fear of precipitating stent thrombosis. Although physical signs of retroperitoneal hemorrhage should be sought (eg, tenderness above the access site), hypotension remains the most common clinical finding associated with retroperitoneal hemorrhage. Fortunately, stopping anticoagulation and intravenous antiplatelet therapy, in combination with fluid resuscitation and transfusion of packed red blood cells, is sufficient to manage this complication in the majority of patients.[5]

INTERVENTIONAL TREATMENT

In a few patients, however, hypotension and/or hemodynamic instability may persist or recur despite general

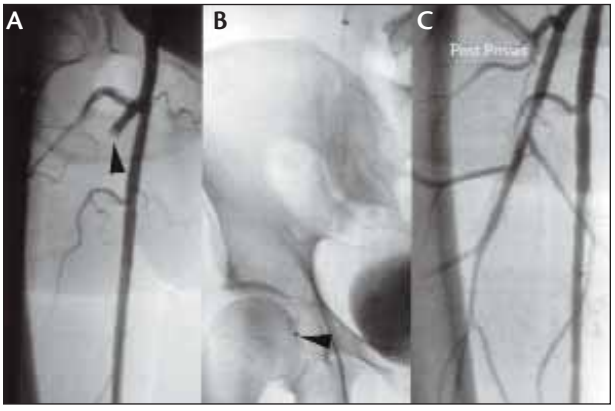


Figure 3. Retrograde opacification of the right femoral artery via crossover sheath. Note the occlusion of the profunda femoris artery (arrow) (A). The AngioJet device (Possis Medical, Inc., Minneapolis, MN) placed into the profunda femoris via a 6-F crossover sheath and after a .014-inch guidewire was placed distal to the occlusion (B). Final result after AngioJet thrombectomy showing resolution of occlusion and restoration of flow (C). (Adapted and reprinted with permission from Samal AK, White CJ. Percutaneous management of access site complications. Catheter Cardiovasc Intervent. 2002;57:12-23.)

supportive measures, and are indicative of ongoing and active bleeding. Immediate consultation with vascular surgery, followed by operative exploration and repair, is one strategy that has been traditionally used in the management of these refractory patients. Recently, case reports and experience have emerged describing utilization of percutaneous-based strategies to treat both bleeding and ischemic complications that occur spontaneously, and as a result of, endovascular procedures.[5-8] These strategies have developed as a result of experience with treating noncoronary artery bleeding complications (particularly gastrointestinal bleeding) of uncertain etiology with catheter-based techniques using coil embolization and/or thrombin. Additionally, experience with catheter-based embolization techniques for perforations during PCI of coronary arteries, as well as expanding experience with peripheral vascular interventional techniques, including crossover access for contralateral iliofemoral interventions, have provided a foundation for endovascular treatment of bleeding and/or ischemic complications. Mak et al[6] were the first to report treatment of retroperitoneal bleeding using balloon tamponade after failed surgical repair. More recently, Silva et al reported percutaneous treatment of retroperitoneal hemorrhage after a coronary interventional procedure.[7] In this case, the patient was suspected of having retroperitoneal bleeding and was returned to the catheterization lab for angiography of the contralateral femoral artery, which demonstrated laceration and bleeding of the inferior epigastric artery, presumably as a result of a guidewire injury. The bleeding was successfully tamponaded using endovascular techniques, including crossover sheath placement on the contralateral femoral artery and placement of intravascular thrombin through an inflated coronary balloon (Figure 2).

The endovascular methods available for treating noncoronary active bleeding after a cardiac procedure include simple prolonged balloon inflation at the bleeding site and/or placement of a stent graft for refractory bleeding from the femoral or iliac vessels.[8] For bleeding from smaller vessels within the pelvis, use of coils and/or thrombin can successfully treat bleeding. A key factor in the success of endovascular strategies is the ability to visualize the potential bleeding site. This is usually accomplished via use of a catheter such as a left internal mammary artery catheter to gain access to the contralateral iliac artery, and subsequent angiography to identify the bleeding site. If a bleeding site is identified, a 6-F crossover sheath can be placed, a guidewire can be placed distal to the bleeding site, and prolonged balloon inflation with an appropriately sized peripheral angioplasty balloon can be performed. If reversal of anticoagulation and prolonged simple balloon inflation do not stem the bleeding from the femoral or iliac vessels, a stent graft should be placed to complete the sealing of the perforation. Alternatively, consultation with a vascular surgeon can be undertaken to help make a decision to proceed with vascular repair in the operating room under direct visualization.

The minimum skills necessary to perform endovascular treatment of suspected bleeding require a basic understanding of peripheral interventional techniques performed from a contralateral femoral or alternative access site. It would seem prudent to attempt endovascular repair if one is quite familiar with peripheral endovascular treatment methods. However, it would be reasonable to defer attempted endovascular repair if the interventionist is not accustomed to using the equipment or is unfamiliar with these techniques until such time that the skill could be acquired. Although the endovascular approach appears promising and appears to be used by a growing number of experienced interventionists, there is little evidence to guide therapy, including how frequently a bleeding site will be determined by angiography and the success rate of endovascular versus surgical repair. This evidence base should develop in the next several years as experience with this technique grows.

Ischemic complications after cardiac catheterization procedures are infrequent and often occur in patients with underlying peripheral vascular disease. Fortunately, most of

these complications can be treated conservatively with removal of the sheath and/or short-term anticoagulant therapy. In patients who have evidence of progressive limb ischemia with threatened tissue loss, endovascular repair and/or surgical intervention are necessary to restore flow and salvage the affected limb. The endovascular approach would be similar to that used for the patient with suspected bleeding, including the contralateral approach as well as crossover angiography and potential intervention. However, because the issue is thrombosis and not bleeding, the interventionist must be familiar with the use of local lytic therapy in addition to percutaneous iliofemoral interventional techniques. Additionally, use of passive thrombectomy catheters similar to those used in the coronary vasculature would be sufficient for thrombectomy of the profunda or superficial femoral arteries, whereas use of the AngioJet active thrombectomy system (or other active thrombectomy systems) might be necessary for the femoral or iliac vessels themselves (Figure 3). Ultimately, close collaboration with a vascular surgeon will be important to achieve an optimal result.

CONCLUSION

Interventional treatment of bleeding and ischemic complications arising during cardiac catheterization procedures, although infrequent, is becoming an accepted standard of care in the management of these critically ill patients. Ultimately, sharing information and experience gained in interventional treatment of these vascular complications should provide a better foundation for the optimal management of these patients. ■

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1. Applegate RJ, Sacrinty MT, Kutcher MA, et al. Vascular complications 1998-2007: evidence for better outcomes (abstr). Am J Cardiol. 2007;100:6L.
2. Sherev DA, Shaw RE, Brent BN. Angiographic predictors of femoral access site complications: implication for planned percutaneous coronary intervention. Catheter Cardiovasc Intervent. 2005;65:196-202.
3. Ellis SG, Bhatt D, Kapadia S, et al. Correlates and outcomes of retroperitoneal hemorrhage complicating percutaneous coronary intervention. Catheter Cardiovasc Intervent. 2006;67:541-545.
4. Farouque HMO, Tremmel JA, Shabari FR, et al. Risk factors for the development of retroperitoneal hematoma after percutaneous coronary intervention in the era of glycoprotein IIb/IIIa inhibitors and vascular closure devices. J Am Coll Cardiol. 2005;45:363-368.
5. Chan YC, Morales JP, Reidy JF, et al. Management of spontaneous and iatrogenic retroperitoneal haemorrhage: conservative management, endovascular intervention or open surgery? Int J Clin Pract. 2007; Epub ahead of print.
6. Mak GY, Daly B, Chan W, et al. Percutaneous treatment of post catheterization massive retroperitoneal hemorrhage. Catheter Cardiovasc Diagn. 1993;29:40-43.
7. Silva JA, Stant J, Ramee SR. Endovascular treatment of a massive retroperitoneal bleeding: successful balloon-catheter delivery of intra-arterial thrombin. Catheter Cardiovasc Interv. 2005;64:218-222.
8. Samal AK, White CJ. Percutaneous management of access site complications. Catheter Cardiovasc Intervent. 2002;57:12-23.