

A Hybrid Bleeding Control Method for Retro-Peritoneal or Inguinal Bleeding After Endovascular Procedures

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With the vast increase in endovascular procedures and the use of percutaneous vascular closure devices, there is an increased risk of closure failure and bleeding that might require surgically demanding open surgical repair. We describe two ways, using a modern hybrid technique and tools (endovascular and open surgery), of controlling bleeding with minimal blood loss, which might facilitate the surgery.

Keywords: *Bleeding; Iatrogenic Injury; Endovascular Procedure; Balloon Occlusion*

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INTRODUCTION

Arterial bleeding after endovascular intervention (angiography, endovascular aortic repair (EVAR), percutaneous cardiac catheterization, or other procedures) is a common complication [1–5]. There are several ways to finish an endovascular procedure when the femoral artery is used for access. It is usually achieved today either by manual compression or by using a percutaneous vascular closure device (VCD). When larger VCDs are used for aortic valve replacement, EVAR or other major arterial repair, open cut-down might be used to close the hole in the artery. Alternatively, a larger VCD or double-closure device (such as Pro-glide) might be employed for percutaneous access. Newer methods, like

fascia suture, are also available [6–8]. At times, VCDs might leak and create minor hematomas, which can be easily compressed manually. It is fairly common, however, for the hole in the femoral artery, especially when the puncture is in the upper-third of the common femoral artery, to cause bleeding into retroperitoneal space or the inguinal area [9,10]. The known failure rate of VCDs in different series may be as high as 8–10% [11,12].

The standard treatment to access bleeding after endovascular treatment is open surgical exploration with hematoma evacuation for repair of the artery. Uncontrolled bleeding after a percutaneous procedure with open surgical repair may be challenging, since an expanding hematoma or retroperitoneal bleeding causes tissue displacement and immense pain. Cut-down surgical repair during ongoing bleeding in the inguinal area or retroperitoneum requires experienced surgical hands.

Endovascular usage of balloon occlusion for arterial bleeding control was described as early as in the 1990s [13]. In recent years, as endovascular tools become smaller and better, and hybrid-suite availability and the multidisciplinary approach develop, there is a new interest in minimally invasive methods of bleeding control [14–16, personal communication at the EVTMM Round Table Symposium, 2–4 February 2017].

Balloon placement might ease a surgical repair by decreasing or stopping ongoing bleeding, allowing for the controlled dissection toward the hole in the artery for definitive repair. As endovascular techniques develop, there is the possibility of using a stent graft

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Figure 1 Hematoma after an endovascular procedure and manual compression.



Figure 2 Hybrid repair using a contralateral cross over a balloon in the external iliac artery and open cut-down repair.

(covered stent) to cover the hole and stop the bleeding [17,18, personal communication]. There are several disadvantages to this method. The femoral artery is highly mobile, and stent-graft placement might fail in the long run (due to kinking or thrombi formation). Another problem is that the deep femoral artery might be covered, which can compromise adequate circulation to the leg. A more practical problem is that the hematoma must usually be evacuated, as it causes great pain and takes a long time to absorb spontaneously, and there is also the risk of local infection (Figure 1).

We describe a method of controlling bleeding as a bridge to open surgical repair that involves placement of an arterial occlusion balloon at the site of the vessel puncture. Although partly described in recent publications, combinations of new endovascular tools are now in use and practical recommendations have not been described in detail before [13–18].

METHOD DESCRIPTION

Option Number 1 (Figures 2–4)

Access from above the hole – proximal access

A 6-7-8 Fr sheath is inserted in a retrograde manner via arterial puncture on the contralateral side, and a cross-over wire is passed by fluoroscopic control (C-arm) to

reach the ipsilateral common femoral artery. An intra-arterial balloon can be passed from above. The size of the balloon should be around 8–10 mm, and the manufacturer's instructions for the size of the sheath should be checked if needed. If completion angiography is anticipated, it might be beneficial to use a long sheath catheter (Table 1). This permits working with the balloon distally, and also securing its position and injecting contrast solution via the sheath (downstream). When the balloon is in place, open exploration of the ipsilateral common femoral artery is performed. When bleeding starts (or even before), the balloon should be gently inflated using a manometer. A low pressure of around 4–6 mmHg might be enough, and balloon inflation can be confirmed by angiography, or clinically when bleeding decreases or totally stops. Alternatively, the balloon might be inflated manually until bleeding stops, followed by the locking of a three-way stopcock. After cut-down and open exploration, the hole is sealed with 5.0 or 6.0 non-absorbable sutures. It is advisable to confirm flow when the balloon is deflated and that no bleeding is observed by hand-doppler or flow meter, and also to perform a clinical examination of distal extremity status and pulses. Another option is to perform a completion angiography through the catheter sheath, verifying that the hole is covered and normal flow maintained. After hematoma evacuation, the



Figure 3 Hand compression during bleeding after elective angiography with failure of the closure device.

wound is closed in a standard fashion, with or without a drain. The contralateral access can be closed by a VCD or by manual mechanical compression. Obviously, the contralateral leg must be examined clinically to assure normal perfusion.

Option Number 2 (Figure 5)

Access from below the hole – distal access

At times, for example, when a C-arm is not readily available or the surgeon doubts his/her ability to cross the aortic bifurcation with a guide wire, the vessel can be accessed from below the hematoma (distal puncture). Instead of the traditional way of opening the skin at the common femoral artery/hematoma location or above it for surgical vessel control, it can be started distally (in “virgin territory”). Open the skin a few centimeters below the common femoral artery, at the level of the superficial femoral artery (SFA) just around 7–10 cm below the inguinal ligament. By surgical cut-down, the SFA can be identified and controlled. A retrograde puncture is made using an 18 G needle, and a wire (any standard wire will do) is passed into the artery under direct vision, followed by a 6-7-8 Fr sheath placement. Then, over the wire, an arterial PTA balloon (8–10 mm in diameter) is inserted and advanced to the common

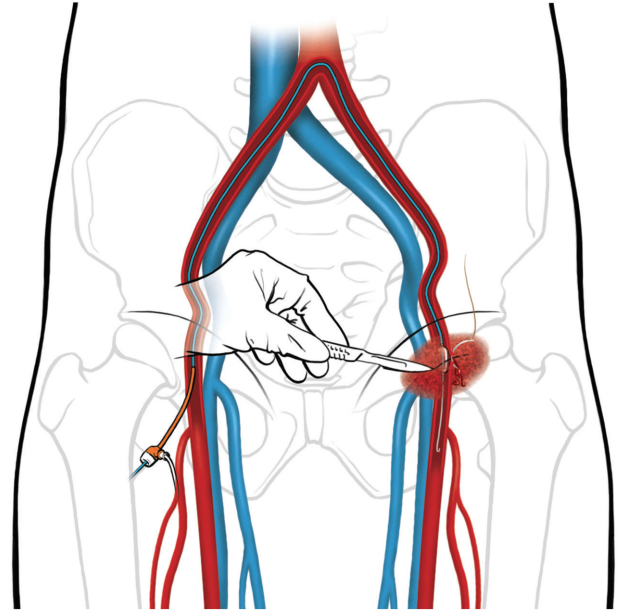


Figure 4 Illustration of method option no. 1 with balloon insertion from the contralateral femoral artery and balloon control over the puncture site before surgical cut-down and repair.

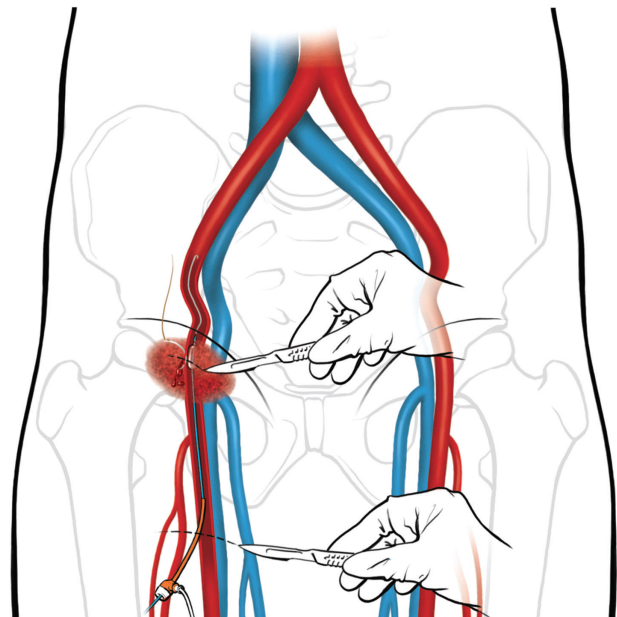


Figure 5 Illustration of method option no. 2 with balloon insertion from the distal SFA and separate cut-down.

femoral artery under fluoroscopy guidance (i.e., C-arm). When positioned, the incision is extended proximally to reveal the bleeding artery, and open repair follows as described above. Theoretically, after preliminary measurement of the distances to the anatomical landmarks, the balloon can be inserted blindly and gently inflated manually in the injury zone without fluoroscopy. Fluoroscopy, however, is always recommended. When the

Table 1 A set of endovascular materials that can be used for temporary balloon control of bleeding from the iliac, femoral and SFA arteries.

Description	Type (examples only)
Puncture needle 18 G	Cordis Endovascular, USA
PTA over-the-wire balloon catheter 6–12 mm × 4–10 cm	ev3, USA; Cordis, USA; Medtronic, USA
Sheath 6-7-8 Fr	Terumo, Japan or Cordis Endovascular, USA
Standard wire	Cook, USA
Hydrophilic wire	Terumo, Japan
Cross-over catheter	Contralateral Cordis Endovascular, USA
Guiding (introducer) sheath	Flexor Ansel Cook, USA
Destination Terumo, Japan	Iohexol (Omnipaque) 300 mgI/mL, 100 mL
Iodine contrast solution	
Saline solution	–

main hole in the artery is treated, the distal arterial hole after sheath removal can be easily sealed with one or two non-absorbable stitches.

SUMMARY

We describe a simple, up-to-date method of hybrid surgical repair to manage ongoing femoral artery bleeding, which might be used in other arteries as well (for example, the iliac arteries). The method can be used for both iatrogenic and traumatic injuries. Its success depends on the continuity of the vessels but might be useful for proximal control when open access is hard to achieve (due, for example, to obesity, unavailability of access, etc.). It is fast and effective and can probably decrease the volume of bleeding during surgical repair, and also provide technical help when dissecting to the artery and viewing the puncture hole. The advantages of temporary balloon occlusion as a bridge to repair may be obvious:

- 1 It controls unstable bleeding and converts the situation into a stable one;
- 2 It decreases bleeding during open repair;
- 3 It eases surgical cut-down and decreases pain by using local anesthetics, and might eliminate the need to convert to general anesthesia;
- 4 It gives time if surgical help is not available (at an angiography suite, for example).

Possible risks of balloon insertion include further injury to the vessel, such as intima dissection, but these can be prevented by gently manipulating the balloon and working with fluoroscopy. It should be borne in mind that full inflation is not needed for adequate bleeding control. You have to be careful when advancing the wire and balloon in the vessel, and confirm easy passage into the bleeding area. For these reasons, it is self-evident that the operator should be trained in interventional radiology, or at least has basic skills in endovascular surgery.

CONCLUSION

Temporary arterial endovascular balloon occlusion may be helpful in certain patients for bleeding control by converting an ongoing bleeding problem into a controlled state, thereby facilitating open repair.

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REFERENCES

- [1] Arora N, Matheny ME, Sepke C, Resnic FS. A propensity analysis of the risk of vascular complications after cardiac catheterization procedures with the use of vascular closure devices. *Am Heart J.* 2007;153:606–11.
- [2] Tavis DR, Wang Y, Jacobs S, et al. Bleeding and vascular complications at the femoral access site following percutaneous coronary intervention (PCI): an evaluation of hemostasis strategies. *J Invasive Cardiol.* 2012; 24:328–34.
- [3] Young N, Chi K-K, Ajaka J, McKay L, O'Neill D, Wong KP. Complications with outpatient angiography and interventional procedures. *Cardiovasc Intervent Radiol.* 2002;25:123–6.
- [4] Blankensteijn JD, de Jong SECA, Prinssen M, van der Ham AC, Buth J, van Sterkenburg SMM, et al. Two-year outcomes after conventional or endovascular repair of abdominal aortic aneurysms. *N Engl J Med.* 2005;352:2398–405.
- [5] Maleux G, Koolen M, Heye S. Complications after endovascular aneurysm repair. *Semin Interv Radiol.* 2009;26:3–9.
- [6] Larzon T, Geijer H, Gruber G, Popek R, Norgren L. Fascia suturing of large access sites after endovascular treatment of aortic aneurysms and dissections. *J Endovasc Ther Off J Int Soc Endovasc Spec.* 2006;13:152–7.
- [7] Torsello GB, Kasprzak B, Klenk E, Tessarek J, Osada N, Torsello GF. Endovascular suture versus cutdown for endovascular aneurysm repair: a prospective randomized pilot study. *J Vasc Surg.* 2003;38:78–82.

- [8] Jahnke T, Schäfer JP, Charalambous N, Trentmann J, Siggelkow M, Hümme T-H, et al. Total percutaneous endovascular aneurysm repair with the dual 6-F Perclose-AT preclosing technique: a case-control study. *J Vasc Interv Radiol JVIR*. 2009;20:1292–8.
- [9] Farouque HMO, Tremmel JA, Raissi Shabari F, 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 1;45:363–8.
- [10] Eisen A, Kornowski R, Vaduganathan M, et al. Retroperitoneal bleeding after cardiac catheterization: a 7-year descriptive single-center experience. *Cardiology*. 2013;125:217–22.
- [11] Vidi VD, Matheny ME, Govindarajulu US, et al. Vascular closure device failure in contemporary practice. *JACC Cardiovasc Interv*. 2012;5:837–44.
- [12] Schnyder G, Turi ZG. Complications of vascular closure devices - not yet evidence based. *J Am Coll Cardiol*. 2002;39:1705–8.
- [13] Scalea TM, Sclafani SJ. Angiographically placed balloons for arterial control: a description of a technique. *J Trauma*. 1991;31:1671–7.
- [14] Gilani R, Tsai PI, Wall MJ, Mattox KL. Overcoming challenges of endovascular treatment of complex subclavian and axillary artery injuries in hypotensive patients. *J Trauma Acute Care Surg*. 2012;73:771–3.
- [15] Shih J-C, Liu K-L, Shyu M-K. Temporary balloon occlusion of the common iliac artery: new approach to bleeding control during cesarean hysterectomy for placenta percreta. *Am J Obstet Gynecol*. 2005;193:1756–8.
- [16] Mehta TA, Subramaniam AV, Chetter I, Nicholson AA, Wilkinson AR. Temporary balloon catheter occlusion for control of haemorrhage following penetrating axillary artery injury. *EJVES Extra*. 2004;8:29–30.
- [17] Sedaghat A, Neumann N, Schahab N, et al. Routine endovascular treatment with a stent graft for access-site and access-related vascular injury in transfemoral transcatheter aortic valve implantation. *Circ Cardiovasc Interv*. 2016;9:e003834.
- [18] Tsetis D. Endovascular treatment of complications of femoral arterial access. *Cardiovasc Intervent Radiol*. 2010;33:457–68.