Successful Closure of External Iliac Artery Perforation with Super-selective Transcatheter Coil Embolization

1) *Department of Radiology, National Defense Medical College, Japan*
2) *Department of Radiology, Jichi Medical University Saitama Medical Center, Japan*
3) *Department of Radiology, National Center Hospital, National Center of Neurology and Psychiatry, Japan*

Kohei Hamamoto[1)2)], Noriko Oyama-Manabe[2)], Emiko Chiba[3)], Hiroshi Shinmoto[1)]

Abstract

We present two cases of external iliac artery perforation occurring after endovascular interventions successfully treated with direct closure using super-selective transcatheter coil embolization. Two patients, one 78-year-old man and one 78-year-old woman, underwent cardiac catheterization via the right femoral approach for coronary artery disease and atrial fibrillation. Following the procedures, both patients suffered severe acute hypotension, and contrast-enhanced computed tomography revealed a massive retroperitoneal hematoma due to perforation of the right external iliac artery. We attempted direct perforation site closure with super-selective transcatheter embolization using microcoils and achieved complete hemostasis in both cases. Our technique could be an alternative treatment option for external iliac artery perforations associated with the endovascular intervention.

Key words: external iliac artery perforation, retroperitoneal hemorrhage, coil embolization, endovascular intervention

(Interventional Radiology 2022; 7: 75-80)

Introduction

Retroperitoneal hemorrhage due to iliac artery injury is a rare but potentially serious complication of endovascular interventional procedures via femoral arterial access [1]. Retroperitoneal hemorrhage can lead to severe hemorrhagic shock and death unless immediately treated. Hemodynamically stable patients can be managed conservatively with fluid resuscitation, blood transfusion, or coagulopathy correction [1]. Ultrasound-guided compression has been recognized as the first-line treatment for iatrogenic arterial injuries in the femoral area [2]. However, this method cannot be applied to lesions where the bleeding site cannot be identified by ultrasound or lesions above the inguinal ligament, such as the external iliac artery. Traditionally, open surgical repair has been the standard management method for failed cases of ultrasound-guided compression. In recent years, endovascular interventional procedures, such as stent graft placement and balloon tamponade, have become more common treatment options because they are less invasive [3-8].

Herein, we describe two external iliac artery perforation cases following endovascular interventions successfully treated with direct closure by super-selective transcatheter coil embolization.

Case Reports

Patients were informed of the details of this case report, and they provided written consent for the use of their medical records for research purposes. Ethics committee approval is not necessary for this type of case report at our facility.

Received: September 22, 2021. Accepted: March 14, 2022.
doi: 10.22575/interventionalradiology.2021-0025
Correspondence Author: Kohei Hamamoto, E-mail: hkouhei917@gmail.com

Table 1. Patient's Demographics.

Case	Age	Sex	Symptoms	Catheter procedure	Puncture site (sheath size)	Anticoagulant, antiplatelet therapy	Diagnostic imaging	Imaging findings	Perforation site	Interval to onset	Coil size diameter - length
1	78	M	Hypovolemic shock Groin distention	Coronary intervention	Rt CFA (7-Fr)	Heparin, aspirin, clopidogrel	CECT	Retroperitoneal hemorrhage with extravasation	Distal portion of Rt EIA	12 h	2 mm - 60 mm 2 mm - 40 mm
2	78	F	Hypovolemic shock Groin distention	RFCA	Rt CFA (3-Fr) Rt CFV (8-Fr)	Dabigatran	CECT	Retroperitoneal hemorrhage with extravasation	Distal portion of Rt EIA	6 h	3 mm - 80 mm 2.5 mm - 60 mm 2 mm - 80 mm 1.5 mm - 40 mm 1.5 mm - 30 mm

M, Male; F, Female; RFCA, Radiofrequency catheter ablation; Rt, Right; CFA, Common femoral artery; CFV, Common femoral vein; CECT, Contrast-enhanced computed tomography; EIA, External iliac artery.

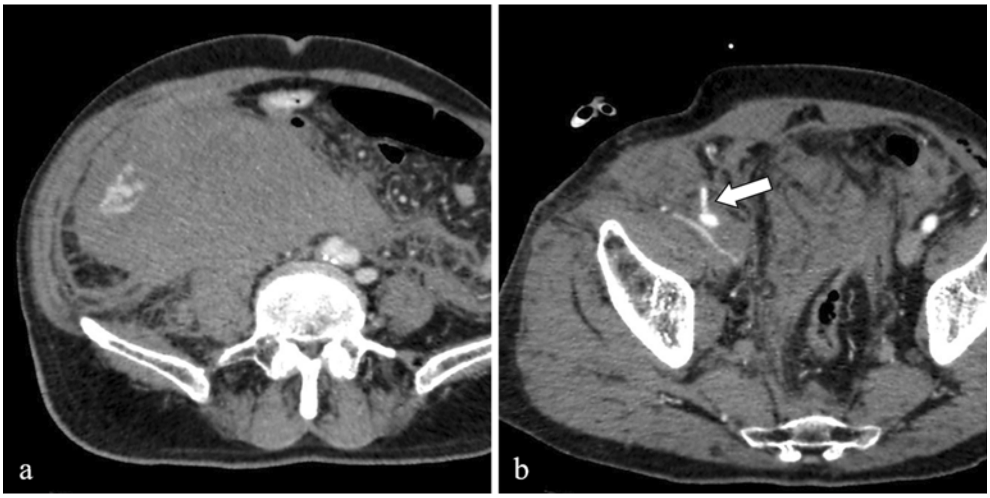

Figure 1. Contrast-enhanced CT images of Case 1. (a) Massive hematoma with extravasation of contrast medium is observed in the right peritoneal space. (b) Perforation is noted in the anterior side of the right external iliac artery (arrow). The diameter of the perforation site is 2.3 mm.

Patient demographics

Table 1 summarizes the background characteristics and clinical course of the two patients. Both patients developed shock with hypotension, decreased hemoglobin concentration, and groin distention after endovascular interventional procedures via the right femoral artery access. In both cases, contrast-enhanced CT revealed a massive retroperitoneal hemorrhage on the right side with extravasation of the contrast medium from the right external iliac artery (**Fig. 1** and **2**), which was diagnosed as external iliac artery perforation. Vascular surgeons, cardiologists, and radiologists discussed the treatment plan for both patients. They decided that endovascular management would be suitable as a first-line treatment because the patient's condition seemed intolerant to urgent surgery. In case 1, an intra-aortic balloon pumping catheter, followed by a percutaneous cardiopulmonary support system, was introduced via the left femoral artery and vein to correct the shock status. Additionally, transcatheter arterial embolization (TAE) for a right retroperitoneal hematoma due to bleeding from the right third lumbar artery was performed prior to the treatment of external iliac artery perforation.

Interventional radiology

In case 1, access was obtained via the right brachial artery with a 4-Fr sheath. Diagnostic angiography with a 4.2-Fr Judkins right (JR) 4.0 angiographic catheter (Goodman, Nagoya, Japan) revealed perforation of the right external iliac artery with massive extravasation of the contrast medium (**Fig. 3a**). Stent graft placement was indicated as a treatment option; however, it was not immediately available. Therefore, we attempted the direct closure of the perforation site with transcatheter embolization using microcoils. Selective catheterization of the perforation site was achieved using the same catheter (**Fig. 3b**); subsequently, a 1.9-Fr microcatheter (Virtus™ two-marker, Boston Scientific, Marlborough, MA, USA) was coaxially introduced. Ten 0.012-inch fibered detachable microcoils (Interlock™-18, Boston Scientific) were sequentially placed at the perfora-

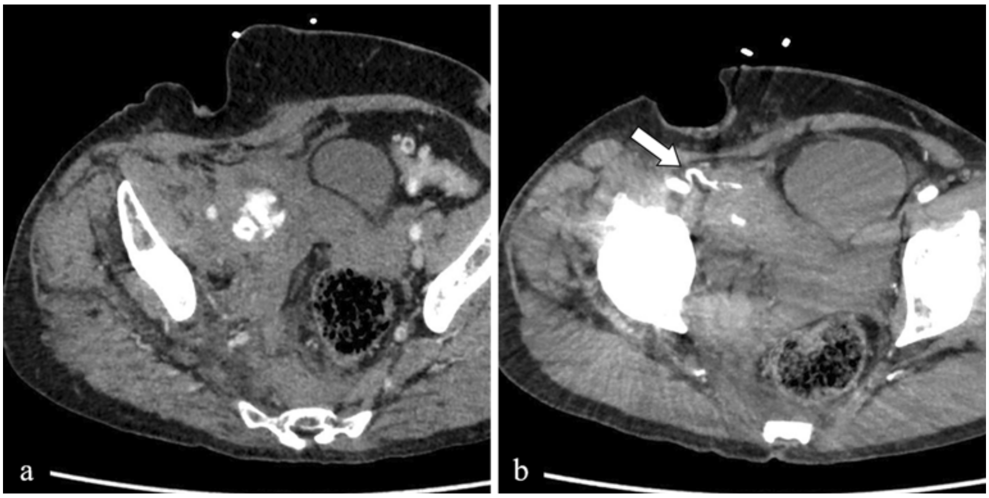

Figure 2. Contrast-enhanced CT images of Case 2. (a) Massive hematoma with extravasation of contrast medium is observed in the right peritoneal space. (b) Perforation is detected on the medial site of the right external iliac artery (arrow). The diameter of the perforation site is 2.1 mm.

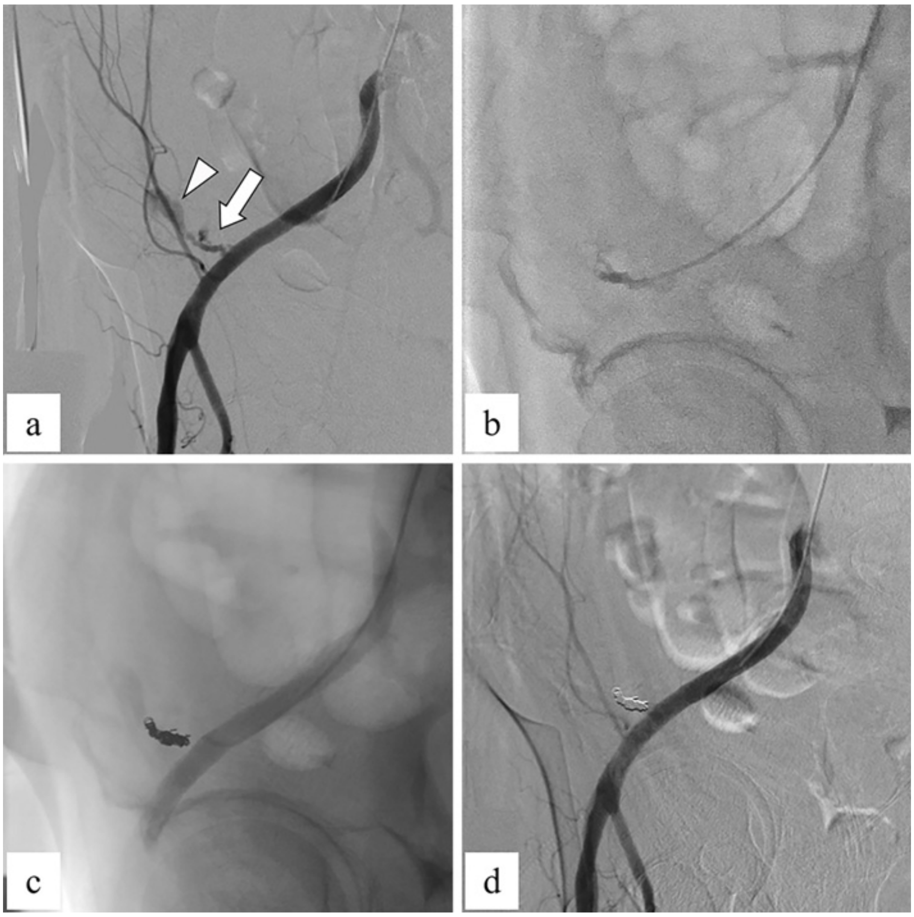

Figure 3. Angiographic findings of Case 1. (a) Pretreatment arteriography shows extravasation of contrast medium from the distal portion of the right external iliac artery (arrowhead). The fistula-like finding was observed at the perforation site (arrow). (b) Engagement of the perforation site by an angiographic catheter. (c) Super-selective coil embolization with microcoils. (d) Posttreatment angiography reveals complete hemostasis and no evidence of residual blood flow in the perforation site.

tion site as close to the vessel lumen as possible (**Fig. 3c** and **Table 1**). Following coil embolization, angiography revealed complete hemostasis, with no evidence of residual blood flow or pseudoaneurysm at the perforation site

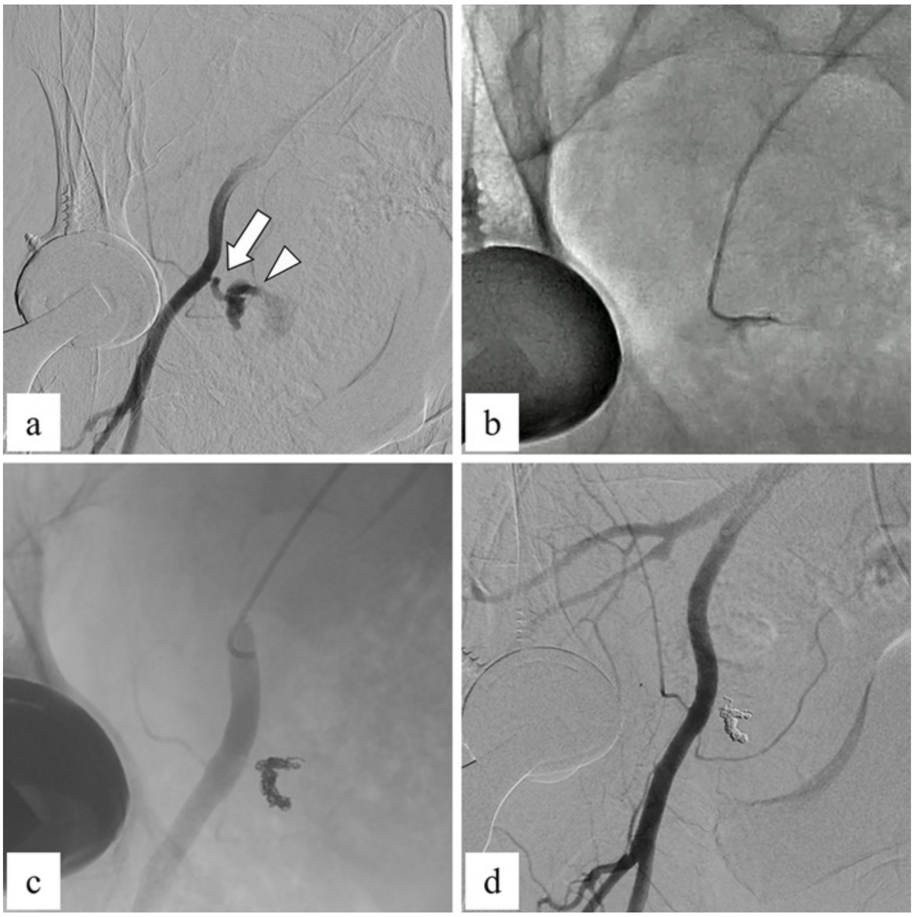

Figure 4. Angiographic findings of Case 2. (a) Pretreatment arteriography shows extravasation of contrast medium from the distal portion of the right external iliac artery (arrowhead). The fistula-like finding was observed at the perforation site (arrow). (b) Engagement of the perforation site by an angiographic catheter. (c) Super-selective coil embolization with microcoils. (d) Posttreatment angiography reveals complete hemostasis and no evidence of residual blood flow in the perforation site.

(**Fig. 3d**).

In case 2, access was obtained via the left femoral artery with a 4-Fr sheath. Diagnostic angiography was performed with a 4.2-Fr JR 4.0 angiographic catheter (Goodman) and revealed massive extravasation of contrast medium in the right external iliac artery (**Fig. 4a**). As in case 1, the stent-graft was not immediately available; thus, we performed direct closure of the perforation site with super-selective coil embolization. We engaged the same catheter into the perforation site (**Fig. 4b**), and a 2.2-Fr microcatheter (Progreat β3, Terumo, Tokyo, Japan) was coaxially introduced. First, five 0.0105-inch bare microcoils (Penumbra SMART COIL-EXTRA SOFT, Penumbra, Alameda, CA, USA) were placed at the distal site. Subsequently, the microcatheter was exchanged with a 1.7-Fr microcatheter (Veloute; ASAHI INTECC, Nagoya, Japan) for tight packing of the proximal site. Six 0.0105-inch bare microcoils (Penumbra SMART COIL-WAVE EXTRA SOFT, Penumbra) were placed as close to the vessel lumen as possible (**Fig. 4c** and **Table 1**). Following coil embolization, angiography revealed complete hemostasis with no evidence of pseudoaneurysm at the perforation site (**Fig. 4d**). Subsequently, diagnostic angiography of the right internal iliac artery revealed extravasation of contrast medium from the peripheral branch of the superior gluteal artery. TAE with a liquid mixture of n-butyl-2-cyanoacrylate (NBCA) and lipiodol was performed, and complete hemostasis was achieved.

Follow-up and outcome

In both cases, serial laboratory examinations after TAE revealed no evidence of rebleeding. In case 1, a plain CT scan the following day revealed no evidence of retroperitoneal hematoma expansion, and the patient was discharged 15 days after embolization. There was no evidence of rebleeding on the follow-up CT performed 3 months after TAE. In case 2, contrast-enhanced CT one day later showed no expansion of the retroperitoneal hematoma or pseudoaneurysm of the perforation site, and the patient was discharged six days after embolization. Follow-up CT performed 2 months after TAE showed no evidence of rebleeding.

Discussion

The major clinical relevance of this case report is that we successfully treated an external iliac artery perforation that occurred after catheter intervention by direct closure of the perforation site with super-selective TAE using microcoils.

The treatment strategy for pseudoaneurysm or perforation of the external iliac artery after endovascular intervention depends on the lesion site and patient status. Ultrasound-guided manual compression is widely performed as the first-line treatment for vascular injury of the femoral artery because of its less invasiveness; however, this method is difficult to apply to lesions in which the target cannot be identified by ultrasound. In recent years, several endovascular repair options, such as prolonged balloon tamponade [3], stent-graft placement [4-6], and ultrasound-guided thrombin injection [7], have been used to treat external iliac artery injury instead of invasive surgical repair with favorable outcomes. However, open surgical repair is still required in patients who fail to undergo endovascular treatment or whose vital signs are unstable. In the present case, ultrasound-guided thrombin injection was not used because we could not detect a pseudoaneurysm or perforation site by ultrasound in both cases. In addition, we did not perform prolonged balloon tamponade because we considered that this method alone could have failed during hemostasis since both patients had already taken anticoagulant or antiplatelet drugs. Long-term balloon tamponade had a risk of thrombosis. Furthermore, stent-graft placement was a viable treatment option in the present case; however, it was not immediately available at our hospital. Therefore, we elected super-selective coil embolization of the perforation site, achieving complete hemostasis without complications.

Recently, Ueda et al. reported the efficacy of balloon-assisted TAE with NBCA for iatrogenic arterial bleeding caused by groin puncture [8]. The authors successfully treated one external iliac artery injury with extravasation, two pseudoaneurysms in the common iliac artery, and two pseudoaneurysms in the femoral artery with this method, and it may also be applied in our case. However, this technique requires two punctures or the insertion of a large-diameter guiding sheath; thus, there is a risk of new vascular complications. In addition, there is a potential risk that NBCA might adhere to the balloon and microcatheter; therefore, we did not use this technique as a first-line treatment.

The key to successful hemostasis in our method was packing the coils as tightly as possible adjacent to the perforated vessel lumen. Embolization at a site far from the vessel lumen may cause rebleeding or leave a pseudoaneurysm after embolization. To achieve tight packing of the coils without protrusion into the external iliac artery, using detachable microcoils that can be easily controlled by a delivery wire and ensuring the stable engagement of the guiding catheter tip to the perforation site are essential. In addition, the use of a thin and soft coil that can be placed over tightly overlapping coils during embolization is recommended. The balloon-assisted technique may be useful to prevent coil migration into the external iliac artery. However, it requires two punctures or the insertion of a large-diameter sheath (at least more than a 6-Fr sheath); thus, this technique should be applied in limited cases where it is difficult to optimize coil placement using conventional techniques.

Our method has several advantages over stent-graft placement. First, TAE can be generally performed with a low-profile system (less than a 4-Fr sheath) compared with stent placement (which requires a minimum of a 6-Fr sheath), thus potentially reducing the risk of additional vascular complications. Second, super-selective TAE does not necessitate anticoagulant or antiplatelet drug administration after the procedure, instead of stent placement, where anticoagulant and/or antiplatelet drug administration is mandatory to prevent in-stent thrombosis. This issue is particularly important in hemorrhagic cases. Third, the present method can also be applied to lesions adjacent to the hip joint, where stent placement is difficult. Finally, microcoils are relatively easily available in many facilities compared with stent-grafts.

However, our method has several considerable drawbacks compared with other therapeutic options. First, we presumed that super-selective coil embolization alone could not achieve complete hemostasis in rupture or tear of the external iliac artery (e.g., injury during balloon angioplasty). Second, this technique cannot be used when it might be technically difficult to cannulate a microcatheter into the perforation site. In such cases, alternative treatment options should be considered, such as stent placement or surgical repair. Finally, our method risks a pseudoaneurysm remaining at the embolization site; thus, close follow-up with laboratory tests and imaging modalities, such as CT is needed after embolization. If rebleeding or residual pseudoaneurysm is suspected, stent-graft placement or surgical repair should be considered.

Although the precise cause of external iliac artery perforation in the present cases is unclear, we considered that these are associated with endovascular procedures because they developed ipsilateral to the puncture site. Angiography showed fistula-like findings at the perforation site (**Fig. 3a** and **4a**). High-level puncture of a common femoral artery is a well-recognized risk factor for iliac artery injury, and other risk factors, such as the use of a large-diameter sheath, inappropriate manipulation of the guidewire, administration of anticoagulation or antiplatelet drugs, and simultaneous artery and vein catheterization have also been reported [2, 5]. In both cases, the cardiologists performed the vascular puncture and wire manipulation under fluoroscopic guidance; however, the vascular injury might have been caused during the procedures that were not visualized on the fluoroscopic images. In addition, the use of anticoagulants may have contributed to bleeding from the external artery in both cases because it has been reported as a risk factor for vascular injury, as described above. Similarly, with regard to the bleeding from the lumbar artery in case 1 and the bleeding from the internal iliac artery in case 2, the use of anticoagulants or antiplatelet drugs might have contributed as well as inappropriate vascular puncture and wire manipulation.

In conclusion, we present two cases of external artery perforation that were successfully treated by direct closure of the perforation site using super-selective TAE with microcoils. This technique can provide early hemostasis with less invasiveness and may be applicable to other types of arterial bleeding, such as iliac and femoral arteries.

Conflict of Interest: None

Author Contribution: Kohei Hamamoto: Conceptualization, Data curation, Writing- Original draft preparation.
Noriko Oyama-Manabe: Writing- Reviewing and Editing.
Emiko Chiba: Data curation, Reviewing and Editing.
Hiroshi Shinmoto: Writing- Reviewing and Editing.

References

1. Chan YC, Morales JP, Reidy JF, Taylor PR. Management of spontaneous and iatrogenic retroperitoneal haemorrhage: conservative management, endovascular intervention or open surgery? Int J Clin Pract. 2008; 62: 1604-1613.
2. O'Sullivan GJ, Ray SA, Lewis JS, et al. A review of alternative approaches in the management of iatrogenic femoral pseudoaneurysms. Ann R Coll Surg Engl. 1999; 81: 226-234.
3. Cooper SG, Sofocleous CT. Percutaneous management of angioplasty-related iliac artery rupture with preservation of luminal patency by prolonged balloon tamponade. J Vasc Interv Radiol. 1998; 9: 81-83.
4. Nyman U, Uher P, Lindh M, Lindblad B, Brunkwall J, Ivancev K. Stent-graft treatment of iatrogenic iliac artery perforations: report of three cases. Eur J Vasc Endovasc Surg. 1999; 17: 259-263.
5. Kufner S, Cassese S, Groha P, et al. Covered stents for endovascular repair of iatrogenic injuries of iliac and femoral arteries. Cardiovasc Revasc Med. 2015; 16: 156-162.
6. Awan MU, Omar B, Qureshi G, Awan GM. Successful treatment of iatrogenic external iliac artery perforation with covered stent: case report and review of the literature. Cardiol Res. 2017; 8: 246-253.
7. Vlachou PA, Karkos CD, Bains S, McCarthy MJ, Fishwick G, Bolia A. Percutaneous ultrasound-guided thrombin injection for the treatment of iatrogenic femoral artery pseudoaneurysms. Eur J Radiol. 2011; 77: 172-174.
8. Ueda T, Murata S, Saito H, et al. Balloon-assisted transcatheter arterial embolization using N-butyl cyanoacrylate for iatrogenic arterial bleeding by groin puncture: a new technology. CVIR Endovasc. 2020; 3: 42. doi: 10.1186/s42155-020-00132-3.