Direct Puncture Embolization of a Recurrent Internal Iliac Artery Aneurysm with N-Butyl-2-Cyanoacrylate Under Flow-Control with Balloon

Yukihisa Ogawa¹, Hiroshi Nishimaki², Kenji Murakami¹, Kiyoshi Chiba², Yuka Sakurai², Keishi Fujiwara¹, Takeshi Miyairi², Yasuo Nakajima¹

Abstract

Background If only proximal embolization or ligation is performed for an internal iliac artery aneurysm (IIAA), transcatheter arterial embolization is sometimes difficult due to complex collateral circulation. A new method of direct percutaneous n-butyl-2-cyanoacrylate (NBCA) sac embolization (b-DNSE) under balloon arterial occlusion for re-intervention of an IIAA after proximal ligation is presented.

Methods The patient was placed in the supine position under local anesthesia. A 20-cm-long, 20G-PTCD needle was advanced to the aneurysmal sac using fluoroscopy. A 5F, 11-cm sheath was inserted via the left common femoral artery, and a Selecon MP catheter was advanced to the left limb. Sacography showed the sac with only the iliolumbar artery as the involved branch. Then, the left limb was balloon-occluded, and the sac was more widely visualized with the appearance of the superior gluteal artery and the obturator artery on sacography. Sac embolization using 10 ml of 50% NBCA diluted with lipiodol was performed under balloon arterial occlusion, and the needle was removed. Completion arteriography showed good Lipiodol distribution without a residual sac or involved branches. No obvious complications were seen, and the procedure was completed.

Results The patient was discharged 2 days after the procedure. At 6-month follow-up, contrast-enhanced computed tomography showed no sac enhancement without Lipiodol washout and no expansion of the excluded aneurysm.

Conclusion b-DNSE for re-intervention of an IIA aneurysm is feasible when embolization of all involved branches proves difficult. We intend to further investigate this technique.

Key words: direct puncture, balloon occlusion, NBCA, sac embolization

(Interventional Radiology 2016; 1: 63-66)

Introduction

When planning endovascular therapy for an internal iliac artery aneurysm (IIAA), it is important to completely embolize both the proximal and distal branches [1]. If only proximal embolization or ligation is performed or distal branches remain patent, the aneurysm may enlarge due to recruitment of retrograde flow into the aneurysm. These recurrent aneurysms require re-intervention [1,2]. Transcatheter arterial embolization (TAE) is often difficult for those recurrent aneurysms, because the catheterization and embolization of all involved distal branches are usually difficult due to complicated collateral circulation. In such cases, direct puncture embolization with n-butyl-2-cyanoacrylate (NBCA; Aesculap, Tuttlingen, Germany) would be reason-
able. However, embolization using NBCA has a potential risk of incomplete embolization caused by early polymerization of NBCA due to a high-flow in the aneurysm sac from multiple distal branches.

We present here a modified technique of direct puncture embolization with NBCA for the treatment of a recurrent IIAA after proximal ligation. In this technique, NBCA is injected under flow-control with balloon occlusion of the upstream artery (balloon-assisted) to obtain sufficient embolization of the aneurysm.

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**Material and Methods**

**Case**

A 68-year-old man had undergone Y-grafting with ligation of both proximal IIAs for an abdominal aortic aneurysm and both IIAs 10 years earlier. The left IIAA had gradually enlarged, measuring 67 mm in maximum short diameter (Fig. 1). TAE was attempted, but the catheter could not reach the involved branches, including the gluteal artery or the obturator artery, via the left deep femoral artery because of the complex collateral circulation (Fig. 2). Therefore, direct puncture embolization was scheduled; left limb graft balloon occlusion was planned to alter the hemodynamics of the in-

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**Fig. 1.** The endoleak (circle) was thought to be reachable along the left ilium (arrow).

**Fig. 2.** Previous left iliac angiography shows multiple distal branches including the superior gluteal artery (white arrow) and the obturator artery (yellow arrow) connecting with the aneurysmal sac (circle). 2a: early phase, 2b: delayed phase

**Fig. 3.** Sacography shows the sac with only the iliolumbar artery (arrowhead) as the involved branch. (arrow: needle).
volved branches and reduce inflow volume, enabling complete sac embolization even without branch embolization.

This procedure was approved by the Ethics Committee at our institution, and the patient’s informed consent was obtained before the procedure.

**Procedure**

This procedure was performed using an angiography equipment (Infinix Celeve-i, Toshiba Medical, Tochigi, Japan).

1. The patient was placed in the supine position under local anesthesia.

(2) A 20-cm-long, 20-G, elaster needle (Medikit, Tokyo, Japan) was advanced to the aneurysm sac along the left ilium under fluoroscopy using isocenter puncture [3].

(3) A 5-F, 11-cm sheath was inserted via the left common femoral artery, and a balloon catheter with a 9-mm balloon diameter (Selecon MP catheter, Terumo Clinical Supply, Gifu, Japan) was advanced to the left limb graft. An intravenous bolus dose of heparin (50 units/kg) was administered to maintain an activated clotting time over 200s.

(4) After removing the inner needle, sacography was performed with manual injection of 12 ml of contrast medium. The contrast medium partially filled the aneurysmal sac and drained into the iliolumbar artery (Fig. 3).

(5) Then, repeat sacography with manual injection of 12 ml of contrast medium was performed with balloon occlusion of the left limb; this showed the aneurysmal sac was sufficiently opacified; the superior gluteal artery and the obturator artery newly appeared (Fig. 4). It was difficult to reach both branches using a microcatheter through the sac via the outer tube.

(6) Sac embolization using 10 ml of 50% NBCA diluted with Lipiodol (Guerbet, Tokyo, Japan) was performed under balloon arterial occlusion via the outer tube over 60s by manual injection.

(7) Angiography immediately after embolization showed complete occlusion of the aneurysm with the involved branches (Fig. 5).

(8) The outer tube was removed, and the procedure was completed without obvious complications.

**Results**

The patient was discharged 2 days after the procedure. At 6-month follow-up, computed tomography showed no Lipiodol washout and no expansion of the excluded aneurysm (Fig. 6).
Discussion

Balloon-assisted direct puncture embolization with NBCA may be a useful technique for re-intervention of a recurrent IIAA when selective branch embolization is difficult. Although a combination of direct puncture embolization and TAE may be useful, it is sometimes difficult to catheterize all involved branches due to complex collateral communications or increased complications, even if NBCA embolization is performed proximally.

In the present case, the superior gluteal artery and obturator artery were visualized on sacography only with balloon arterial occlusion, enabling wider distribution of NBCA. On the other hand, the iliolumbar artery disappeared during balloon arterial occlusion, which suggests that flow inversion occurred due to decreasing sac pressure from the reduction of inflow from the superior gluteal artery and obturator artery. The patient had undergone Y-grafting with sacrificed lumbar arteries, and the iliolumbar artery should have been supplied from various branches including cross-circulation. That is the reason why the iliolumbar artery itself was not directly affected by ipsilateral balloon arterial occlusion. To prevent distal embolization, we decided to use a high concentration of NBCA for sac embolization; however, the periphery of these involved branches was not clearly visualized, possibly due to residual flow from the collateral circulation, which might have worked to protect against distal embolization. The injection volume of NBCA-Lipiodol was the same as the volume of contrast material used to achieve visualization of the entire sac. Balloon occlusion was only performed in the left iliac limb leg graft, although there was cross-circulation from the right side in the pelvic cavity. Because the right IIA was ligated, it had less effect on the collateral circulation. However, bilateral iliac artery occlusion may be more suitable for changing blood flow. A similar clinical condition is seen with arteriovenous malformations (AVMs) that require embolization of both the sac/nidus and involved branches [4, 5]. There are high rates of recurrence, even when direct puncture embolization with NBCA is performed, which may be due to unexpected embolization from retrograde flow through involved branches. Thus, balloon-assisted direct puncture embolization with NBCA would be appropriate for the treatment of AVMs when embolization of all involved branches is difficult, but further clinical trials are needed.

This technique has some limitations. First, it is complicated to perform in a patient in prone position with a femoral arterial approach. This might require a supine position or a brachial arterial approach, despite the risk of cerebral infarction. Second, additional arterial approaches may increase the risk of complications such as a pseudoaneurysm, vessel wall injury, or distal embolization. Therefore, this technique should be selected with care, and its use may be limited to a situation in which it is difficult to embolize all involved branches.

Conclusion

This case suggests that balloon-assisted direct puncture embolization with NBCA for re-intervention in a recurrent IIAA is feasible when embolization of all involved branches is difficult. We intend to further evaluate this technique.

Conflict of interest: There are no conflicts of interest that could influence this study.

Acknowledgement: The idea of this technique was created by Hiroshi Nishimaki.

References