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CASE REPORT

A case of pseudoaneurysm of the deep femoral artery successfully treated by NBCA embolization under occlusion

Shingo Hamaguchi · Yukihisa Ogawa · Yasunori Arai · Kazuki Hashimoto · Yasuo Nakajima

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Abstract Transcatheter embolization of bleeding from distal branches of small arteries can be difficult. *N*-butyl cyanoacrylate (NBCA) was originally used as a tissue adhesive material, and recent evidence suggests that it can also be used as an embolic material. This report describes a case in which a pseudoaneurysm arising from the distal portion of a small branch of the deep femoral artery was successfully embolized with NBCA using a new technique with a microballoon catheter. Advantages of this technique include its safely, short treatment time, good control of the embolization range, absence of fragmentation, favorable polymerization dynamics, and absence of glue reflux or excessive distal spread of the glue.

Keywords Embolization · NBCA · Balloon occlusion · Bleeding

Introduction

Transcatheter embolization can be used to manage various arterial injuries. *N*-butyl cyanoacrylate (NBCA) was originally used as a tissue adhesive material, and recent evidence suggests that it can also be used as an embolic material [1–3]. However, the usual technique (that is, the non-occluded technique) used to inject NBCA has been associated with various problems, including proximal embolization, fragmentation, distal migration, and reflux of glue [4–6].

The present report describes a case in which a pseudoaneurysm arising from the distal portion of a small branch of the deep femoral artery was successfully embolized with NBCA using a new technique with a microballoon catheter.

Case report

The patient was a 69-year-old man with a past history of hypertension and benign prostate hypertrophy who experienced a femoral shaft fracture due to a bicycle accident. At the time of the accident, he received treatment at a local hospital. The day after the admission, the patient developed deep venous thrombosis, and associated pulmonary thromboembolism was discovered, requiring continuous intravenous infusion of heparin sodium and placement of an inferior vena cava (IVC) filter. Subsequently, the patient developed anemia and progressive right thigh swelling, and a contrast-enhanced computed tomography (CT) scan 21 days after the trauma revealed a huge intramuscular hematoma and a pseudoaneurysm (diameter, 24 mm) arising from a branch of the right deep femoral artery (Fig. 1).

Endovascular embolization was recommended to control the hemorrhage and pseudoaneurysm, and the patient was transferred to our institution. Upon arrival at our emergency department, his blood pressure was 131/78 and heart rate was 111 bpm. Laboratory evaluation revealed a hemoglobin level of 7.7 g/dl.

S. Hamaguchi · Y. Ogawa · Y. Arai · K. Hashimoto · Y. Nakajima
Department of Radiology, St. Marianna University School of Medicine, Sugao 2-16-1, Miyamae-ku, Kawasaki 216-8511, Japan

S. Hamaguchi (✉)
Department of Emergency and Critical Care Medicine, St. Marianna University School of Medicine, Sugao 2-16-1, Miyamae-ku, Kawasaki 216-8511, Japan
e-mail: hal29120@me.com

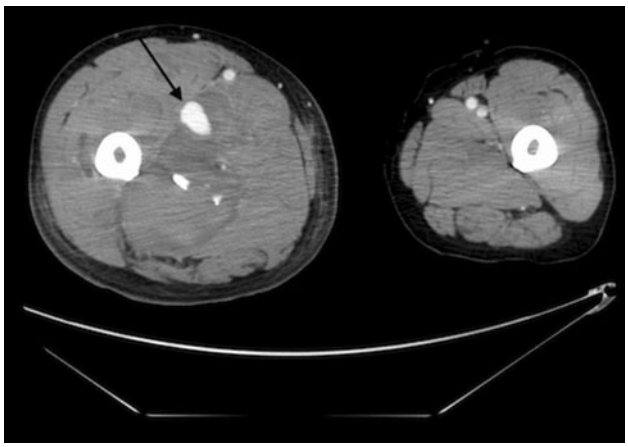

Fig. 1 Contrast-enhanced computed tomography (CT) scan 21 days after the trauma revealed a pseudoaneurysm and surrounding hematoma in the right thigh (*arrow*)

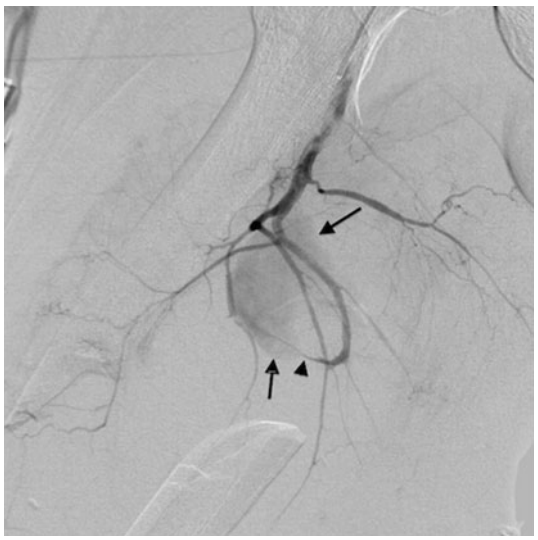

Fig. 2 Deep femoral arteriography clearly visualized the pseudoaneurysm (*arrows*) arising from a distal portion of a small branch (*arrowhead*)

After written informed consent had been obtained, the embolization procedure was performed using a standard angiographic technique. Using the Seldinger technique, a 5-French sheath was inserted into the left common femoral artery. Subsequently, a cobra-shaped 5-French guiding catheter (Elway, Terumo Clinical Supply, Gifu, Japan) was inserted into the right common femoral artery, and an arteriogram was performed to reveal an access path to the pseudoaneurysm. Then, the guiding catheter, together with a 0.035-inch guidewire, was advanced into the right deep femoral artery. The deep femoral arteriogram revealed a pseudoaneurysm arising from the distal portion of a small branch (Fig. 2). The diameter of the injured branch was 2.3 mm. We thought that using NBCA as an embolic material could shorten the treatment time and allow for earlier timing of the subsequent open reduction and internal fixation of the fracture. A microballoon catheter (Attendant LP, 4.5 mm, Terumo Clinical Supply) was advanced into the injured branch selectively using a coaxial technique. Selective arteriography through the microballoon catheter showed easy reflux of contrast material and failed to reveal a pseudoaneurysm (Fig. 3). Consequently, we speculated that the NBCA injected using the usual technique could not reach the pseudoaneurysm. After an arteriogram with

Fig. 3 Selective arteriography showed easy reflux of contrast material (*arrows*) covering the catheter tip (*arrowhead*) and failed to reveal a pseudoaneurysm

Fig. 4 The non-fragmented glue cast successfully reached the injured portion (*arrow*) without reflux or undesirable distal spread. The glue cast was not in contact with the balloon structure (*arrowheads*)

balloon inflation had been performed to confirm complete occlusion, the lumen of the microballoon catheter was flushed with 2.0 ml of 5 % dextrose solution. Subsequently, 0.5 ml of 50 % histoacryl® diluted with lipiodol was slowly infused while maintaining balloon occlusion. The glue cast was gradually extended by increasing the infusion volume of the NBCA mixture and successfully reached the pseudoaneurysm without reflux, fragmentation, or undesirable distal spread of the glue, and the glue cast was not in contact with the balloon structure (Fig. 4). The balloon was deflated 60 s after NBCA injection and safely removed without glue migration or glue particle attachment. On a subsequent deep femoral arteriogram, the pseudoaneurysm was no longer present.

After the embolization, no clinical signs of continuous hemorrhage or soft tissue ischemia associated with the embolization were observed.

Discussion

Various embolic materials have been used for endovascular embolization. Gelatin sponge particles are commonly used in cases with single or multiple injuries of small arteries or multiple collateral channels requiring distal embolization. However, due to its transient embolic effect, repeat embolization is often required. Steel coils can clamp proximal portions of a vessel without impairing the development of distal collateral pathways. However, the coil embolization technique often requires many coils to produce sufficient embolized length, needed to interrupt vessel flow firmly. Moreover, the use of steel coils cannot control bleeding in patients with coagulopathy or anticoagulant therapy.

In contrast, NBCA can be used as an embolic agent in patients with coagulopathy or anticoagulant therapy [1, 2]. Other advantages of embolization with NBCA are the short treatment time and good rates of long-term occlusion. Yoo et al. [3] reported that embolization with an NBCA mixture is effective and safe for management of active intramuscular hemorrhage. However, the usual technique used to inject NBCA through microcatheters within small arterial branches has some limitations in controlling embolization range, including proximal embolization, fragmentation, distal migration, and reflux of glue [4–6]. The proximal embolization and fragmentation will lead to incomplete embolization. The undesirable distal migration of glues can cause tissue ischemia. The reflux can cause undesirable parent artery obstruction, catheter adhesion to the vascular wall, and withdrawal of glue during catheter pullback [7, 8]. In this case, selective arteriography showed easy reflux of the contrast material, suggesting that the injected NBCA mixture would also reflux. Therefore, other methods for NBCA injection are required to achieve the desired result.

Microballoon catheters were originally developed for balloon-assisted embolization of cerebral aneurysm, and the coaxial structure enables contrast/embolic material infusion dueing balloon occlusion. When arterial branches are occluded using a microballoon catheter, the arterial pedicle beyond the tip of the occluded portion becomes a functional extension of the microcatheter; this is akin to the wedge injection technique often used for brain arteriovenous malformations [9, 10]. Compared with wedge injection, microballoon catheters can firmly occlude the optimal portions of small branches, thereby arresting blood flow and preventing glue reflux. Arrest of flow reduces the risk of fragmentation of the NBCA mixture. Flushing the microballoon catheter lumen with dextrose solution preceding an NBCA mixture injection can delay the contact of NBCA with blood, thereby delaying the initiation of polymerization. Thus, this technique results in non-fragmented glue casts without any reflux and distal glue spread. Furthermore, cast length is easily controlled by increasing the infusion volume of the NBCA mixture. Incomplete polymerized glue casts may migrate with resumption of blood flow, which occurs after balloon deflation. Therefore, we deflated the balloon 60 s after injection of the NBCA mixture in order to allow time for the glue cast to solidify prior to resumption of blood flow, but no conclusion has been reached on the optimal time for balloon occlusion. Moreover, investigators should be aware that glue casts might migrate in larger arteries with higher blood flow after balloon deflation. On the arteriogram, the glue cast was not in contact with the balloon structure; this is because the microballoon catheter structures had a little distance to the catheter tips and balloon structures. Therefore, we could remove the microballoon catheter safely without any resistance or withdrawal of the polymerized glue particles. However, we must take care not to inject too much, which could cause backflow to the balloon structures and make catheter removal difficult.

One of limitations of concern is that this balloon-occluded technique requires a 5-Fr sheath, which is larger than that required for the usual technique (3 or 4 Fr). Also, compared to the non-occluded system, it may be difficult to reach distal target points with microballoon catheters. However, recently developed smaller microballoon catheters (Attendant Delta, Terumo Clinical Supply; Logos, Piolax) that allow passage through a 4-Fr diagnostic catheter may help alleviate any limitations associated with this technique. Another limitation can be that if there are any side branches from the artery to occlude between the catheter tip and bleeding point, collateral blood flow may enter into the artery retrogradely. In this situation, NBCA glue may come in contact with the blood before reaching

the bleeding point, resulting in more proximal occlusion than intended.

Conclusions

In our case, endovascular embolization under balloon occlusion could solve the limitations of NBCA injection using microcatheters within small arterial branches.

When active bleeding is observed in the distal portions of small arterial branches, and a target vessel is close to the parent artery that must be saved, this balloon technique can be considered one of the useful treatments.

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Conflict of interest The authors have no conflicts of interest that could influence this report.

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