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Case Report

Renal Artery Injury Caused by a 0.035-Inch Guidewire in Navigating a Guiding Sheath during Coil Embolization: A Case Report of Rescue Embolization with n-Butyl-2-Cianoacrylate

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Objective: We report renal artery injury by a guidewire during coil embolization of a cerebral artery aneurysm, which was successfully treated by transarterial embolization using n-butyl-2-cianoacrylate (NBCA).
Case Presentation: A 65-year-old woman underwent coil embolization for an unruptured cerebral aneurysm, resulting in its complete occlusion. However, her blood pressure decreased during embolization and postoperative abdominal computed tomography (CT) revealed a retroperitoneal hematoma. Intraoperative video revealed that the 0.035-inch guidewire had passed deeply into the right renal artery when the guiding sheath was navigated into the abdominal aorta, suggesting renal artery perforation. Transarterial embolization using NBCA was performed immediately, which resulted in hemostasis.
Conclusion: Although renal artery perforation with a guidewire is a rare complication, it can have severe consequences. Early diagnosis with prompt and definitive hemostasis is important.

Keywords ▶ renal artery, vessel injury, NBCA, TAE

Introduction

Recently, endovascular treatment for cerebrovascular diseases has been increasingly performed due to its minimal invasiveness. However, for this treatment, it is necessary to navigate a guiding catheter to the lesion site. Several studies reported complications, such as retroperitoneal hemorrhage, related to vascular injury on puncture or catheter guiding.[1–4] Prior to carotid artery stenting or coil embolization of cerebral aneurysms, majority of patients were administered two antiplatelet drugs orally, and thus, occurrence of vascular injury may lead to serious complications.

In this study, we report renal artery injury related to a 0.035-inch guidewire while guiding an ultralong sheath during coil embolization of an unruptured cerebral aneurysm, which was treated by transarterial embolization with n-butyl-2-cianoacrylate (NBCA).

Case Presentation

Patient: A 65-year-old female.
Complaint: An incidentally diagnosed unruptured cerebral aneurysm.
Medical history: Hypertension.
Present illness: Cephalic magnetic resonance angiography (MRA) for a detailed examination of vertigo revealed an unruptured anterior communicating artery (Acom) aneurysm measuring 11.6 × 10.7 × 11.3 mm, with its neck measuring 6.7 × 6.4 mm. Coil embolization was performed as per patient's preference. Due to the large, broad-neck aneurysm, the oral administration of biaspirin (100 mg/day) and clopidogrel (75 mg/day) was started 1 week before treatment, considering the necessity of stent-assisted embolization.
Neuroendovascular treatment procedures: Under general anesthesia, surgery was performed. Initially, the femoral head was confirmed under fluoroscopic guidance and

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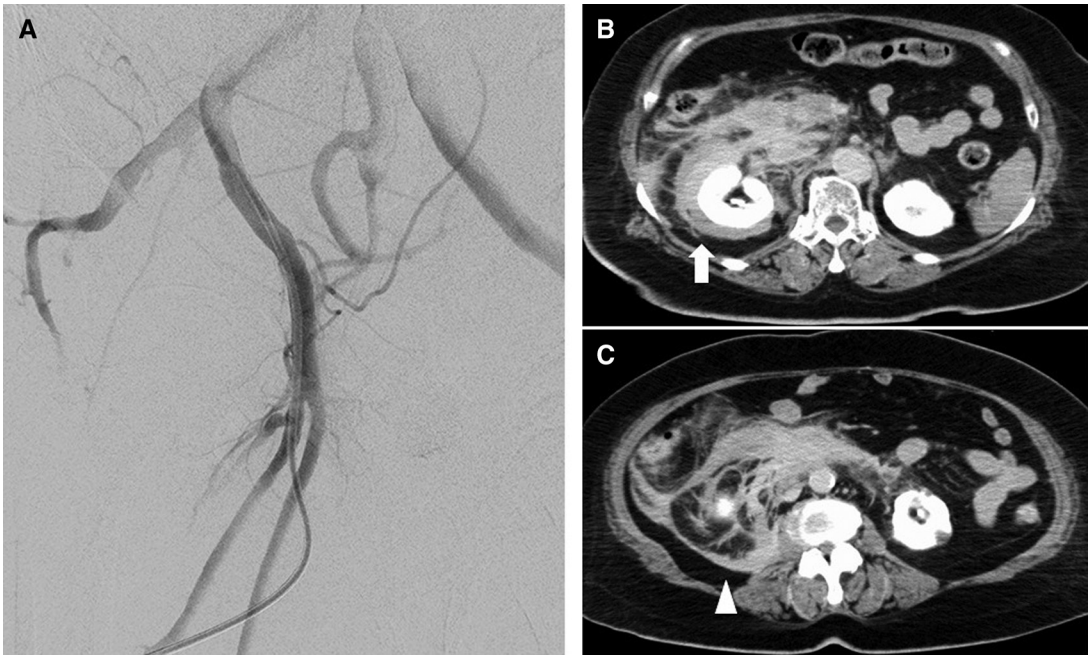

Fig. 1 Right femoral angiography showed no evidence of extravasation (**A**). Abdominal computed tomography showing a perinephric (arrow) (**B**) and retroperitoneal (arrow head) hematoma (**C**).

punctured using a puncture needle attached to a 6Fr Axcelguide 80 cm (Medikit Co., Ltd., Tokyo, Japan). A 0.035-inch × 150-cm Radifocus guidewire (Terumo Corporation, Tokyo, Japan) was guided into the abdominal aorta under fluoroscopic guidance. After dilating the puncture site, the Axcelguide was guided into the thoracic aorta under fluoroscopic guidance. Subsequently, heparin at 5000 units was administered. A 6Fr JB2 catheter (Medikit Co., Ltd.) and Axcelguide were coaxially inserted, and Axcelguide was placed in the left internal carotid artery. A 6Fr Cerulean (Medikit Co., Ltd.) was guided coaxially with a 4Fr Cerulean to the petrous part of the left internal carotid artery. Coil embolization was performed using the double catheter technique, and complete occlusion was achieved. The operative time was 3 h and 55 min. At the end of the procedure, the surgeon noticed that the systolic blood pressure and pulse rate remained at <80 mmHg and ≥100/min, respectively, and thereby reviewed the anesthetic records. The systolic blood pressure (<90 mmHg) was observed to decrease 1 h after the femoral artery puncture, and the anesthesiologist had administered a vasopressor. Subsequently, the blood pressure gradually decreased, leading to tachycardia. Blood examination was performed before sheath removal; the activated coagulation time (ACT) was determined to be 298 s, and hemoglobin (Hb) level decreased from 12.8g/dL of pretreatment to 10.0 g/dL. At this time,

Fig. 2 A 0.035-inch guidewire was passed deeply into the right renal artery (arrow).

puncture-related hemorrhage was suspected, and 40 mg of protamine sulfate was administered. Common iliac arteriography immediately after coil embolization did not reveal hemorrhage from the iliac or femoral arteries (**Fig. 1A**). Therefore, the procedure was completed after hemostasis

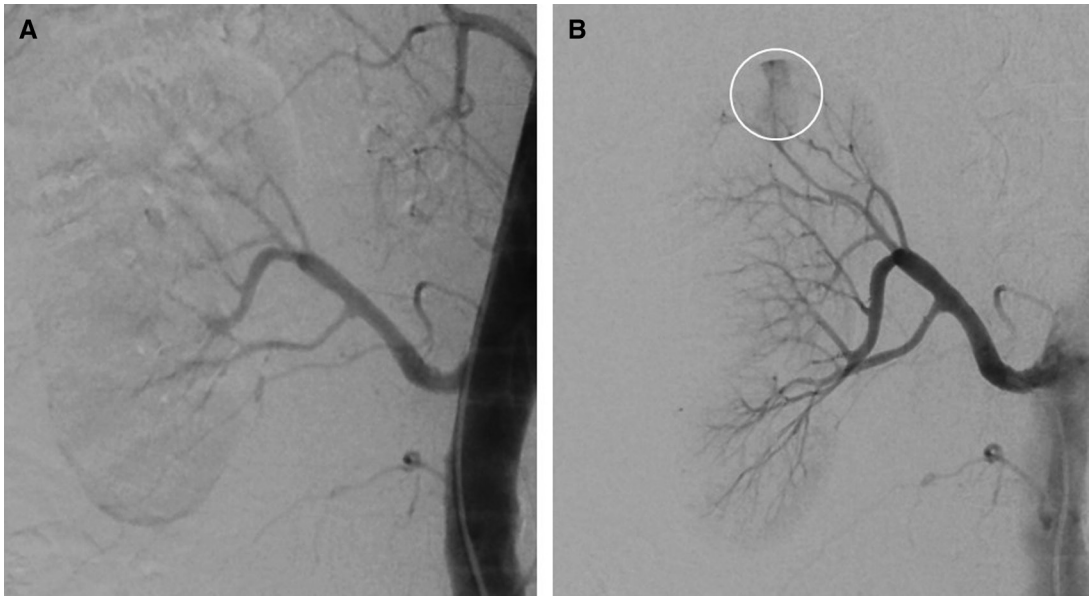

Fig. 3 Abdominal aortic angiography showed no evidence of extravasation (**A**). Selective right renal arteriography showing extravasation from the superior segmental renal artery (white circle) (**B**).

of the puncture site with a 6Fr Angio-Seal STS PLUS (St. Jude Medical, Minnetonka, MN, USA).

Postoperative course

On extubation after surgery, facial sweating and peripheral coldness were noted. The systolic blood pressure and pulse rate were <90 mmHg and ≥120/min, respectively, suggesting hypovolemic shock. Abdominal computed tomography (CT) immediately after the procedure revealed right subrenal capsule and retroperitoneal hemorrhage (**Fig. 1B** and **1C**). When the intraoperative video recording was reviewed, the 0.035-inch × 150-cm Radifocus guidewire had instantly migrated into the right renal artery while guiding the ultralong sheath (**Fig. 2**), suggesting hemorrhage from the superior polar branch of the right renal artery. As 300 mL of contrast medium had been used for embolization of the aneurysm, we did not perform contrast-enhanced abdominal CT and requested the Department of Radiology to identify the site of hemorrhage and perform hemostatic treatment. Another blood examination demonstrated a decreased Hb level (7.7 g/dL), and shock vital signs had persisted; therefore, treatment was promptly performed by interventional radiologist. Considering the possibility of transarterial embolization with NBCA, informed consent (involving explanation of risks) was obtained at pretreatment.

Course of transarterial embolization

The left inguinal femoral artery was punctured, and a 4Fr sheath was inserted. Using a 4Fr OptiFlush 70 cm Pig Tail (Terumo Corporation), abdominal aortography was performed. However, there was no source of hemorrhage (**Fig. 3A**). Selective right renal arteriography with a 4Fr ST40 (Medikit Co., Ltd.) confirmed extravasation from the superior polar renal artery (**Fig. 3B**). Using an ASAHI Meister 0.016 inch (Asahi Intecc, Aichi, Japan), an ASAHI Tellus (Asahi Intecc) was guided into the superior polar renal artery. Angiography at this site demonstrated extravasation. (**Fig. 4A**). After eliminating the intracatheter contrast medium with 5% glucose, 0.5 mL of 20% NBCA diluted with Lipiodol was injected. Additional angiography confirmed persistent extravasation (**Fig. 4B**), suggesting hemorrhage originating from a more proximal branch. A microcatheter was guided to the distal portion of another vessel, and 0.5 mL of 20% NBCA was injected. Angiography through the renal artery trunk has confirmed the absence of extravasation, and the procedure was completed (**Fig. 4C**).

After embolization, six units of erythrocytes and six units of fresh frozen plasma were transfused. The time course from coil embolization until transarterial embolization/the start of blood transfusion is shown in **Fig. 5**.

Blood examination the day after treatment revealed an Hb level of 9.1 g/dL and platelet count of 66000/L. Additionally, six units of erythrocytes, six units of fresh frozen plasma, and ten units of platelets were transfused. Furthermore, blood urea nitrogen (BUN)/creatinine (Cre) value was 23.7/1.97 mg/dL and the estimated glomerular filtration rate (eGFR) was 20 mL/min/l, suggesting renal hypofunction. Subsequently, follow-up blood examination and abdominal CT were

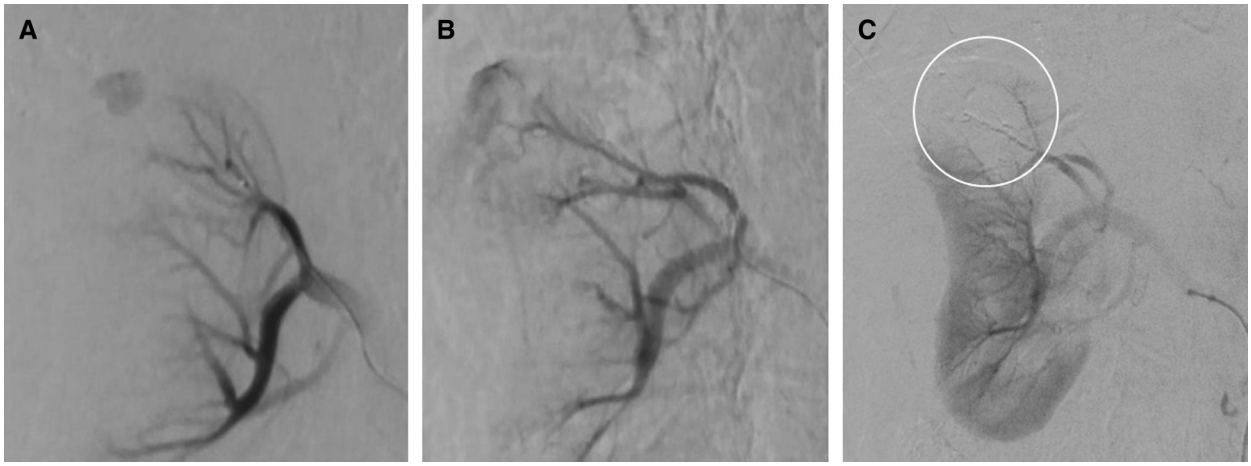

Fig. 4 Selective superior segmental renal angiography showing extravasation (**A**). Another segmental renal angiography still exhibiting extravasation (**B**). Transarterial embolization using NBCA resulted in complete hemostasis (white circle) (**C**). NBCA: n-butyl-2-cianoacrylate

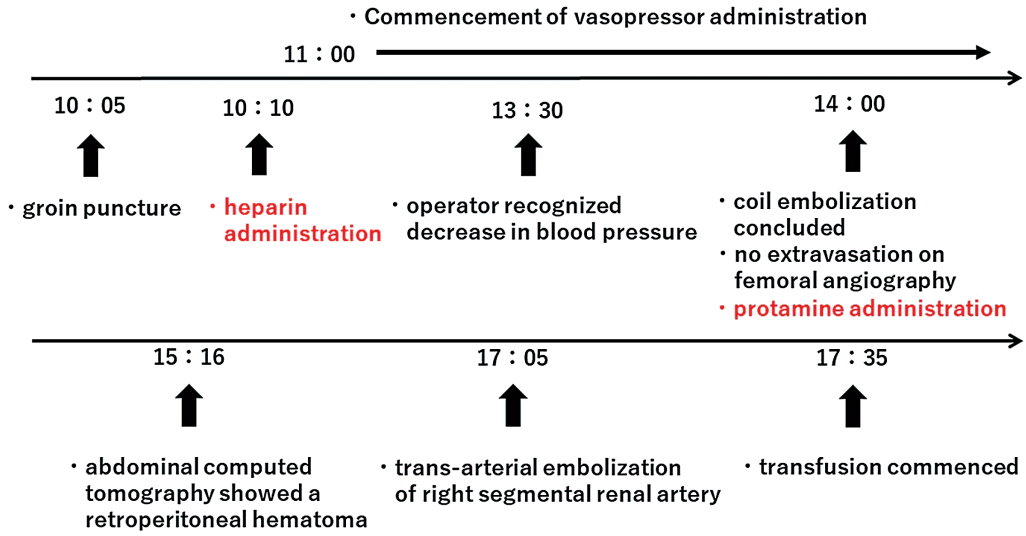

Fig. 5 Time course of coil embolization and transarterial embolization

conducted. The blood examination 26 days after treatment suggested improvement (the Hb level, platelet count, BUN/Cre value, and eGFR were 10.1 g/dL, 210,000/mL, 14.2/0.58 mg/dL, and 78 mL/min/L, respectively). Abdominal CT confirmed the absence of retroperitoneal hematoma. The patient was discharged 30 days after treatment.

Discussion

We reported a case of renal artery injury related to a 0.035-inch guidewire, which was sustained during the initial phase of coil embolization of a cerebral aneurysm. It was successfully treated by transarterial embolization with NBCA. Regarding vascular injury related to femoral artery puncture, Chandrasekar et al.[1] analyzed 11821 patients who underwent coronary angiography, and reported that the incidence of puncture-related vascular injury was 1.8% when a diagnostic angiography was performed and that it was 4.0% when therapeutic intervention was performed. Furthermore, a previous study described that retroperitoneal hemorrhage related to femoral artery puncture was relatively rare (0.15%), whereas the mortality rate was 20%.[2] Retroperitoneal hemorrhage related to renal artery injury, as demonstrated in the present case, is markedly rare, and only a few case reports have been published.[3,4]

In our institution, an angle-type 0.035-inch Radifocus guidewire is used to guide an ultralong sheath and is a super-elastic alloy consisting of nickel and titanium at its core, with favorable traceability and pushability. Furthermore, its surface is coated with a hydrophilic polymer, which facilitates a smoother guidance. However, even when this guidewire migrates into a branch, it may advance further, resulting in vascular injury in some cases. Therefore, a guidewire should be carefully navigated with accurate blood vessel selection under fluoroscopic guidance. According to previous reports, a similar complication was associated with the use of a 0.035-inch hydrophilic-polymer-coated guidewire.[4] If a J-shaped spring wire instead of the hydrophilic-polymer-coated Radifocus guidewire had been used on sheath insertion and carefully guided under fluoroscopic guidance, this complication may have been prevented.

Decreased hematocrit (Ht) value (73%), hypovolemic shock (64%), femoral nerve palsy (54%), lower limb pain (45%), and flank pain (36%) have been identified as signs/symptoms of retroperitoneal hemorrhage. Early diagnosis and therapeutic intervention are important.[2] Based on a retrospective review on the treatment course of the present case, decreased blood pressure and tachycardia were observed at the early stage of the procedure, and blood examination at this time revealed slightly decreased Hb and Ht values (10.0 and 29.3, respectively), which suggested signs of hemorrhage. Femoral arteriography immediately after the embolization of the aneurysm did not demonstrate vascular injury; however, postoperative abdominal CT has revealed retroperitoneal and subrenal capsule hemorrhage. A previous study showed that the site of hemorrhage was identified by confirming extravasation using contrast-enhanced CT.[3] However, in the present case, selective renal arteriography confirmed the site of hemorrhage. If hypovolemic shock or decreased Ht value strongly suggests hemorrhage, selective angiography should be performed to start the treatment promptly. Furthermore, in the present case, the blood pressure slightly decreased from 1 h after the start of embolization and the administration of a vasopressor was started by the anesthesiologist; however, any other neurosurgeon was not aware of them. Intraoperative cooperation/communication with other departments may also be important for early diagnosis.

As embolic materials for transarterial embolization for renal artery injury, coils, Gelfoam, polyvinyl alcohol (PVA), and NBCA alone or their combinations have been reported.[5] Sam et al. reported the use of a coil alone in 34 of 50 patients who underwent embolization for iatrogenic renal artery injury.[6] Recently, embolization with NBCA for vascular injury related to femoral artery puncture has been increasingly reported.[7] NBCA is easy to adjust the concentration, which can be sufficiently embolized to the distal part of injured vessel and expected to have a high hemostatic effect. However, regurgitation or migration into a normal blood vessel may occur; therefore, technical skills are required.

When performing renal artery embolization, the risk of postoperative renal dysfunction must be considered. In the present case, the eGFR decreased at posttreatment, although it was transient. Sam et al. performed transarterial embolization on 50 patients with iatrogenic renal artery injury and reported no significant decrease in the eGFR postoperatively as compared with the preoperative value.[6] However, they indicated that postoperative dialysis was required for two patients with a low eGFR at pretreatment. In particular, embolization should be minimized in patients with renal hypofunction.

We reported a case of guidewire-related renal artery injury, which is markedly rare. When guiding an ultralong sheath, it may be necessary to accurately confirm the absence of wire migration into a branch vessel under fluoroscopic guidance. In the present case, we could finally suspect guidewire-related renal artery injury based on a postoperative review of video recording, and the wire had deeply migrated into the superior area of the right renal artery in the early phase of the procedure; earlier diagnosis and therapeutic intervention may have been possible. Acute-phase revascularization for ischemic stroke, which has recently been increasingly performed, has a time limit; thereby, a guiding catheter should be inserted immediately. Furthermore, tissue plasminogen activator (tPA) is often used in many cases, and vascular injury demonstrated in the present case may become fatal. If decreased blood pressure, tachycardia, or reduced Ht value is observed during procedure, vascular injury should be suspected, and selective angiography of the injured vessel should be promptly performed for early diagnosis and therapeutic intervention.

Conclusion

We reported a patient who underwent transarterial embolization with NBCA for renal artery injury caused by a 0.035-inch guidewire, which led to hemostasis. This is a rare complication related to endovascular treatment; however, vascular injury becomes serious in some cases. Early diagnosis and accurate hemostatic treatment are important.

Disclosure Statement

The authors declare no conflicts of interest.

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