Migration to the pulmonary artery of nine metallic coils placed in the internal iliac vein for treatment of giant rectal varices

Wataru Yamasaki[1], Hideaki Kakizawa[2], Masaki Ishikawa[2], Shuji Date[2], Fuminari Tatsugami[2], Hiroaki Terada[2], Keiichi Masaki[3], Tomokazu Kawaoka[3], Masataka Tsuge[3], Hiroshi Aikata[3], Kazuaki Chayama[3] and Kazuo Awai[2]

[1]Department of Radiology, Hiroshima City Hospital, Hiroshima; [2]Department of Diagnostic Radiology, Hiroshima University Hospital, Hiroshima; [3]Department of Medicine and Molecular Science, Hiroshima University Hospital, Hiroshima, Japan
Correspondence to: Wataru Yamasaki. Email: melonsoda_51@yahoo.co.jp

Abstract

Transcatheter venous embolization with metallic coils is a safe and reliable method for the treatment of pelvic congestion syndrome and pelvic varicocele. While rare, coil migration to the pulmonary arteries is potentially fatal. We report the migration to the pulmonary artery of a cluster of nine metallic microcoils placed in the internal iliac vein to obliterate giant rectal varices. Our patient suffered no severe sequelae. To avoid coil migration to the pulmonary arteries, the coils chosen for placement must take into consideration the characteristics of the target vessels, particularly of larger veins.

Keywords: Vascular, angiography, embolization, rectum, adults, varices

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Transcatheter venous embolization with metallic coils is a safe and reliable method for the treatment of pelvic congestion syndrome and pelvic varicocele (1, 2). Coil migration to the pulmonary arteries during and after the procedure, while rare, is potentially fatal (1–4). We report the migration to the pulmonary artery of a cluster of nine microcoils placed in the internal iliac vein to obliterate giant rectal varices.

Case report

A 64-year-old man with liver cirrhosis, advanced hepatocellular carcinoma (HCC) that invaded the main portal vein, and adrenal metastasis was admitted for the treatment of giant rectal varices due to portal hypertension. During the preceding 6 years he had undergone partial hepatectomy, six sessions of transcatheter arterial chemoembolization, and radiation therapy (39 Gy) for his HCC. He had no history of melena.

On admission, his functional reserve of the liver was Child-Pugh grade B. Colonoscopy showed huge tortuous rectal varices. Contrast-enhanced computed tomography (CT) revealed giant varices with tori inside the rectal lumen (Fig. 1a). Flow from the dilated inferior mesenteric vein was into the rectal varices that drained primarily into the left internal iliac vein. On inspiratory CT the diameter of the inferior mesenteric vein and left internal iliac vein was 10 mm.

After obtaining informed consent from the patient and his family we attempted interventional therapy to prevent rupture of the varices. The plan was to fill the varices with a sclerotic agent via the IVM using balloon assistance. As tumor thrombosis into a main portal vein ruled out the percutaneous transhepatic approach we chose an ileocolic vein approach after laparotomy under general anesthesia. Portal venography via the superior mesenteric vein (SMV) confirmed that the rectal varices were supplied by the inferior mesenteric vein and mainly drained into the left internal iliac vein (Fig. 1b–d). Inflation of a 6-Fr balloon catheter (Selecon MP Catheter, Terumo Clinical Supply, Gifu, Japan) with a 2-cm diameter balloon in the inferior mesenteric vein failed to produce congestion in the varices. Consequently, we inflated a 6-Fr balloon catheter placed in the main trunk of the left internal iliac vein via the right common iliac vein (CIV) to block the in- and outflow of the rectal varices. However, we could not obtain congestion in the varices and contrast material in the varices drained into the collateral circulation of the left and right internal iliac vein. Thinking that flow in the rectal varices could be reduced by balloon occlusion of the left common

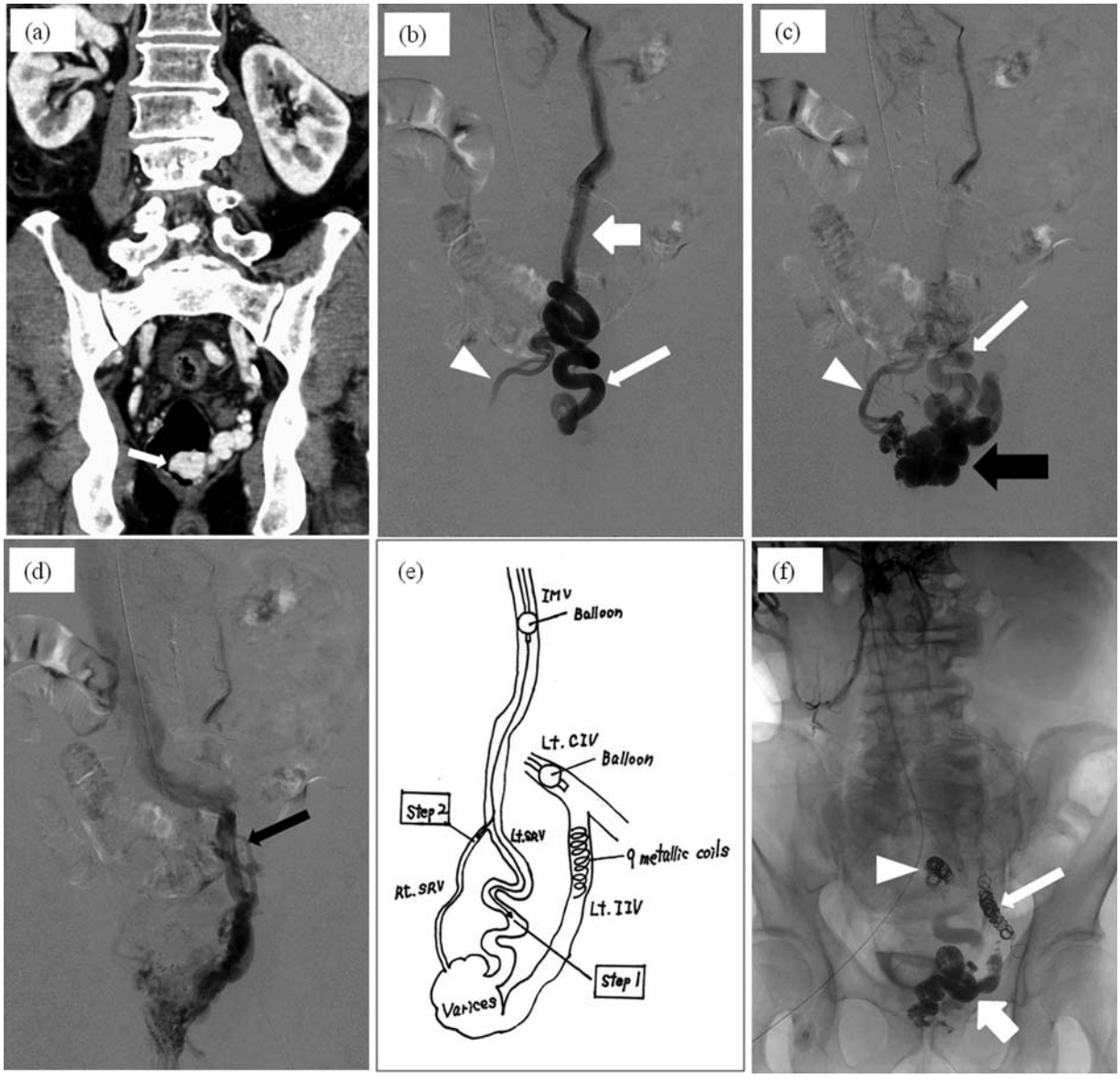

Fig. 1 (a) CT scan acquired 24 days before treatment. Note the giant rectal varices with tori (arrow) inside the rectal lumen. (b–d) Portal venography via the superior mesenteric vein. Flow from the hepatofugal dilated inferior mesenteric vein (IMV) (white large arrow) into rectal varices (black large arrow). The varices mainly drained into the left internal iliac vein (IIV) (black small arrow). White arrowheads and small arrows indicate the right and left superior rectal vein (SRV), respectively. (e) Schema of obliteration procedures. Step 1: 5.5 mL of a 1:10 mixture of *N*-butyl cyanoacrylate (NBCA)-lipiodol were injected from the left (Lt.) SRV via the microcatheter under inflation of the balloons in the IMV and left common iliac vein (CIV) and nine coils were placed in the left IIV. Step 2: 40 mL of 50% glucose and 12.5 mL of 5% ethanolamine oleate with iopamidol were injected into the right (Rt.) SRV and eight pushable microcoils were placed in the IMV under double balloon inflation. (f) Radiograph of portal venography obtained immediately after obliteration of the rectal varices. The presence of nine microcoils in the left IIV (small arrow) and of eight microcoils in the IMV (arrowhead) was confirmed. The rectal varices were filled with an NBCA-lipiodol mixture (large arrow)

iliac vein after coil embolization of the left internal iliac vein, we embolized the main trunk of the left internal iliac vein with nine microcoils. A 3-Fr microcatheter (Renegade, Boston Scientific, Natick, MA, USA) was advanced through the inflated 6-Fr balloon catheter placed into the orifice of the left internal iliac vein to prevent coil migration. First, one interlocking detachable microcoil (diameter 12 mm, length 30 mm) (Interlock^{TM}, Boston Scientific, Cork, Ireland) was introduced as an anchor coil. Then we intertwined six pushable microcoils (diameter 8 mm, length 14 cm) (Micronester, Cook, Bloomington, IN, USA) with the anchor coil. Lastly two Interlock^{TM} coils (diameter 10 mm and 12 mm, length 30 cm) was placed to hold the other seven coils and to obtain embolization.

Postprocedure portal venography obtained under double balloon inflation in the inferior mesenteric vein and left common iliac vein revealed flow reduction in the rectal varices. However, as drainage via collateral vessels in the pelvis persisted 5 mL of absolute ethanol and 40 mL of a glucose solution were injected via the inflated balloon catheter in the IMV to embolize these drainers. This also failed to obtain complete congestion in the varices. As filling the rectal varices with a sclerotic agent was difficult under the existing conditions we attempted to embolize the varices

with liquid glue. A 3-Fr microcatheter was advanced through the inflated balloon catheter in the internal mesenteric vein into the left superior rectal vein as close as possible to the rectal varices. Then 5.5 mL of a 1:10 mixture of *N*-butyl cyanoacrylate (NBCA) (Histoacryl, Aesculap, Tuttlingen, Germany) – lipiodol (André Guerbet, Aulnay-sous-Bois, France) was injected via the microcatheter under inflation of the balloons in the IMV and left CIV. As portal venography revealed that the right superior rectal vein flowed into residual rectal varices we injected 40 mL of 50% glucose and 12.5 mL of 5% ethanolamine oleate (Oldamin, Takeda Pharmaceutical, Osaka, Japan) with iopamidol (Iopamiron 300, Bayer HealthCare, Osaka, Japan) as a sclerotic agent through the microcatheter in the right superior rectal vein. Then eight pushable microcoils (diameter 8 mm) (Micronester) were placed in the internal mesenteric vein under double balloon inflation. As portal venography confirmed the complete obliteration of the rectal varices we removed the catheters (Fig. 1e, f). A plain radiograph obtained 30 min later confirmed that the coils remained in the left internal iliac vein. Throughout these procedures the patient's condition was stable and he was under continuous observation by anesthesiologists.

During extubation the patient suffered a paroxysm of coughing and immediately after extubation he developed dyspnea and shivering. His partial pressure of arterial oxygen and percutaneous oxygen saturation slightly fell to 87 mmHg and 95% under oxygen inhalation of 5 L/min. Under continuous oxygen inhalation his symptoms abated somewhat and he was placed under observation with oxygen inhalation.

On the first postoperative day his dyspnea disappeared and the percutaneous oxygen saturation was 98% in room air. There were no respiratory symptoms. Although the liver function deteriorated transiently he developed no acute complications. A CT study performed on the fifth postoperative day confirmed complete obliteration of the rectal varices (Fig. 2a). However, all nine metallic coils placed in the left internal iliac vein had migrated into a lower branch of the right pulmonary artery (Fig. 2b and c). As this elicited no respiratory symptoms and as we considered the removal of the coils by interventional procedures inadvisable at that time, he was discharged 10 days after undergoing the procedures.

He subsequently received hepatic arterial infusion chemotherapy for HCC and endoscopic treatment for aggravated esophageal varices. Although colonoscopy showed shrinkage of the rectal varices, CT obtained 3 months later revealed progression of his intrahepatic HCC, enlargement of the adrenal metastasis, and newly developed lung metastasis. He died of HCC 5 months after the obliteration of the rectal varices.

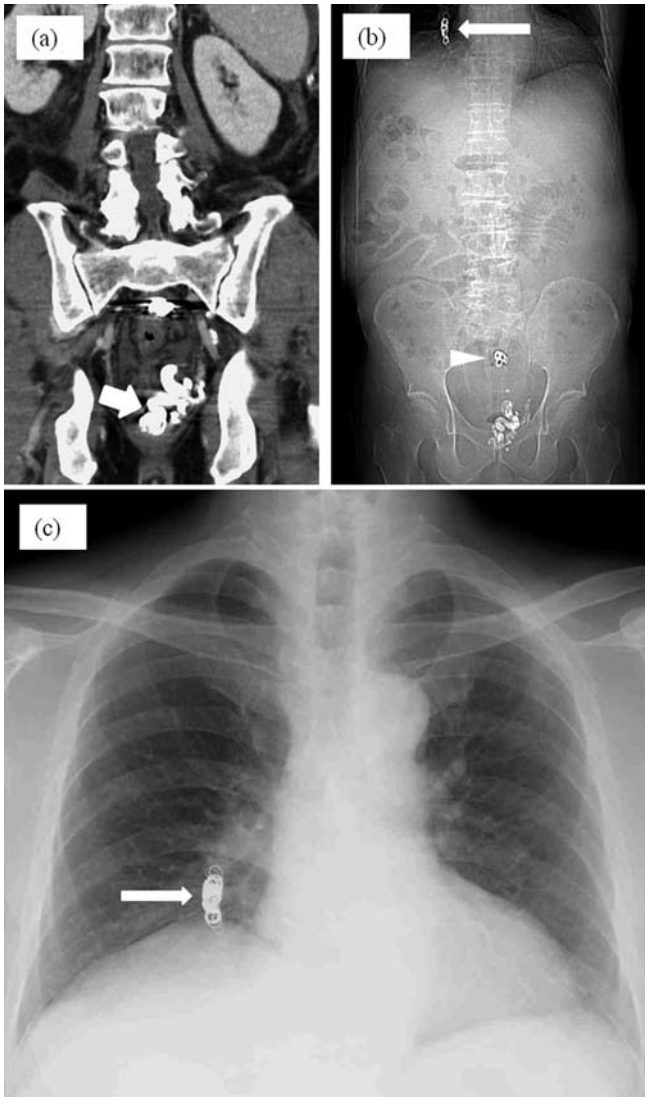

Fig. 2 (a, b) CT scan acquired 5 days after treatment of the giant rectal varices. Complete obliteration of the rectal varices was obtained with the NBCA-lipiodol mixture (large arrow). A CT scout view shows that all microcoils placed in the left IIV had migrated into the right lung (small arrow). Microcoils placed in the IMV remained in place (arrowhead). (c) Chest X-ray study performed one month after treatment of the giant rectal varices. The coils remained in a lower trunk of the right pulmonary artery

Discussion

The migration of metallic coils to pulmonary arteries during or after pelvic transcatheter venous embolization has been reported, however, as the number of migrated coils was low, no serious adverse events were elicited (1–4) and the prevention of such coil migration has not been addressed in the literature.

In our patient, nine coils migrated into the pulmonary artery. We posit that their migration occurred during or immediately after extubation. The location of the migrated coils (a lower trunk of the pulmonary artery) elicited no serious respiratory symptoms.

Metallic coils stay in the target vessel due to frictional resistance between the vessel wall and the coils. Therefore, to avoid their migration, the characteristics of the target vessel must be considered carefully (5). As elastic fibers and smooth muscles are more scarce in venous than arterial walls, frictional resistance in veins may be weak (6). Also, caliber changes are larger in veins than arteries. Murphy *et al.* (7) reported that the inferior vena cava deforms

during the normal respiratory cycle. Its diameter significantly increased with the Valsalva maneuver from 14.3 ± 4.1 to 19.6 ± 1.2 mm in the short axis and the vessel became approximately 40% larger during this maneuver. During the respiratory cycle and upon pressure on the abdomen the diameter of the main trunk of the IIV also changes.

According to Ratnam *et al.* (1), for venous embolization the diameter of the coil should be larger than that of the vein. For venous sac embolization of pulmonary arteriovenous malformations, Takahashi *et al.* (8) used interlocking detachable coils with a diameter 10% larger than the structure to be embolized. Hashimoto (5) recommended that the coil diameter should be 20–50% larger than that of the target vein and up to two times larger for venous embolization. On the inspiratory CT scan the diameter of the left IIV in our patient was 10 mm. We first placed a 12-mm diameter anchor coil and followed its introduction by placing six 8-mm intertwining coils and then two coils to hold them in place; the latter coils were 10 and 12 mm in diameter and were introduced via the outlet of the left IIV. Our results show that the diameter of the coils we used was too small for successful IIV embolization; to prevent coil migration to the pulmonary artery, the diameter of the coils should have been at least 30% or 50% larger than the diameter of the left IIV.

As microcoils do not exert a strong radial force, frictional resistance between the vessel wall and the microcoils used was not sufficiently strong, this permitted their migration to the pulmonary artery. We think that coils with stronger radial force, for example coils measuring 0.035 inch, could have been placed via the inflated 6-Fr balloon catheter and that this could have prevented their migration.

High flow in the target vessel may also result in coil migration. We suspect that in our patient the coils migrated to the pulmonary artery not during embolization of the left internal iliac vein but soon after the obliteration of the rectal varices. Although the blood flow in the left internal iliac vein at that time was not high, the blood flow in the internal iliac vein may have contributed to their being pushed out.

We suspect that coil migration occurred during or immediately after extubation because the left internal iliac vein may have been dilated by an increase in abdominal pressure during the patient's coughing paroxysm during extubation, also resulting in their migration to the pulmonary artery.

After the experience reported here, we now inject a small amount of NBCA to facilitate adherence of the placed coils to the vessel walls when we embolize vessels with a larger diameter and high-flow veins as are seen in portal-systemic shunts. We found this technique to be useful and are in the process of collecting additional data for a later publication.

In conclusion, our case report may be valuable as a warning that microcoils placed in the internal iliac vein to assist obliteration of giant rectal varices can migrate to the pulmonary artery. To avoid this complication, the characteristics of the target vessel must be assessed carefully to ensure that the coils are appropriately-sized, particularly when the diameter of the target vessels is large.

Conflict of interest: None.

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