Endovascular Treatment for an Iliac Artery–Ureteral Fistula with a Covered Stent

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Iliac artery–ureteral fistula (IAUF) is a rare entity that has a potential risk of life-threatening hemorrhage. It is difficult to diagnose and treat appropriately. Conventional treatment for the disease consists of surgical ligation and vascular reconstruction or coil embolization. Surgical treatment is usually difficult for patients with several risk factors. In recent years, endovascular stent-graft treatment for iliac artery pseudoaneurysm has been reported. The present report describes two cases in which endovascular covered stent-graft treatment was successfully applied to treat IAUF, with good clinical outcomes.

ILIAC artery–ureteral fistula (IAUF) is a rare entity that has a potential risk of life-threatening hemorrhage and is difficult to diagnose and treat appropriately (1–4). Clinical presentation is variable, ranging from microscopic or intermittent hematuria to life-threatening hematuria (1–4). Even if IAUF is suspected, radiographic confirmation can be difficult. Conventional treatment of this disease involves simple exclusion or ligation of the involved vessel (1,5). However, direct operative repair of the vessel involved is associated with a high mortality rate, particularly among high-risk groups such as older patients or those with a history of multiple surgical procedures.

In recent years, endovascular stent-graft treatment has been proposed as an alternative method of treatment for various arterial diseases. This technology has been used to treat a wide variety of lesions, including thoracic (6) and abdominal aneurysms (7), traumatic pseudoaneurysm (8), arteriovenous fistula (8), atherosclerotic occlusive disease (9), and IAUF (10–16).

The present article describes two patients with IAUF who were successfully treated with a self-expandable stent covered with expanded polytetrafluoroethylene (PTFE). These patients each experienced a good mid-term clinical course.

CASE REPORTS

Case 1

A 78-year-old man had undergone radical cystectomy and bilateral ureterocutaneostomy for advanced bladder cancer. Tube stents had been placed in both ureters after that operation, and these were externalized through a stoma. On postoperative days 4 and 14, further operations were required for the treatment of constrictive ileus and a small leak from the intestinal suture. Thirteen months after the first operation, pulsatile bleeding occurred from the skin/ureteral fistula when the urologist attempted to exchange the tube stent in the left ureter; this was the 17th tube stent exchange. Immediately thereafter, contrast medium–enhanced helical computed tomography (CT) of the abdomen was performed. A high-density hematoma was observed in the left collecting system, but no extravasation or aneurysm was revealed. The patient was accordingly transferred to our hospital for emergent angiography.

Aortography, iliac arteriography, renal arteriography, and pelvic aortography were performed, and pelvic angiography was also performed after removal of the ureter stent over the wire; however, no abnormalities were revealed. Because the patient remained in hemodynamically stable condition and the cause of hematuria was unclear at that time, he received conservative treatment. However, bleeding recurred at every subsequent stent exchange. Two weeks after initial angiography, whole abdominal CT was repeated with a Sensation16 multidetector CT system (Siemens, Erlangen, Germany), and this successfully revealed a small pseudoaneurysm attached to the left common iliac artery and ureter (**Fig 1a**). In consideration of the existence of left pulsatile hematuria, left common iliac pseudoaneurysm with fistula formation to the left

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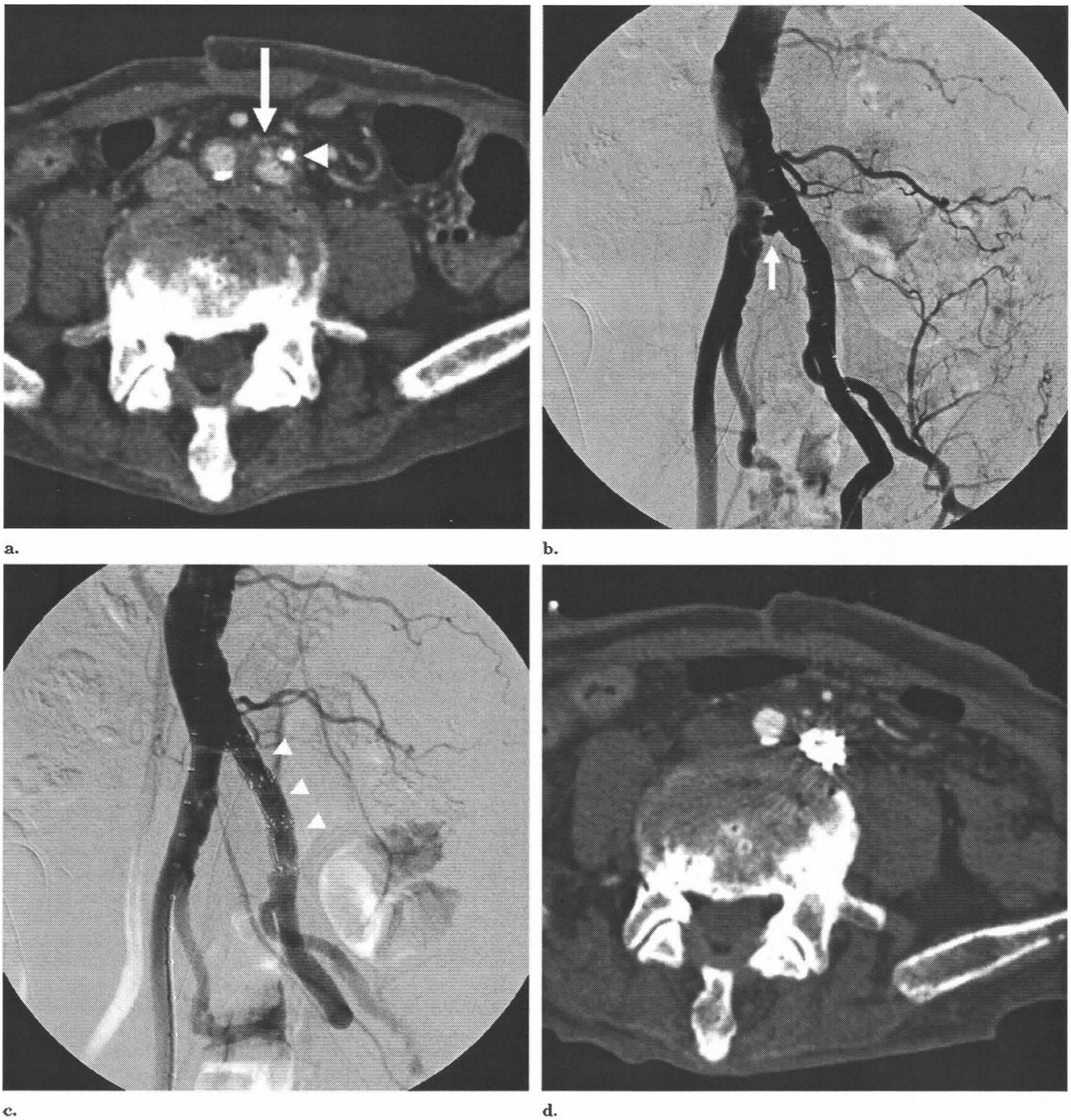

Figure 1. **(a)** CT shows a left common iliac artery pseudoaneurysm (arrow) near the ureteral stent (arrowhead). **(b)** Preprocedural angiography shows an pseudoaneurysm (arrow) originating from the left common iliac artery. **(c)** Immediately after stent-graft placement (arrowheads), complete exclusion of the pseudoaneurysm is confirmed. **(d)** Contrast medium–enhanced CT 8 days later shows no evidence of contrast material extravasation.

ureter was diagnosed. The fistula was located on the side where the ureter had been mobilized and brought over the midline to the conduit.

Laboratory testing revealed a leukocyte count of 4.3 × 10^3/dL, hemoglobin level of 8.4 g/dL, and C-reactive protein level of 1.98 mg/dL. No sign of infection was noted on urinary culture, and no fever was present. Several treatment options were discussed by the urologist, radiologist, and vas-

cular surgeon. Surgical repair was avoided as a result of multiple previous abdominal operations, and the decision was made to treat the IAUF with an endovascular stent-graft. Written informed consent was obtained from the patient in accordance with the standards of the institutional review board before the procedure.

Angiography revealed a pseudoaneurysm of the left common iliac artery at the point where the left ureter crossed the common iliac artery (**Fig 1b**). Previous CT images helped determine the appropriate angle for clear demonstration of the target pseudoaneurysm before angiography. The left common femoral artery was then exposed by a vascular surgeon with the patient under local anesthesia. A special 16-F preloading system (Medikit, Tokyo, Japan) was used for stent delivery; this device consists of a tapered dilator tip and pusher mandrel connected to each other with a 5-F catheter. The prepared stent-graft was manually introduced into the 16-F sheath between the dilator tip and pusher mandrel before the procedure. The whole system was introduced over the wire through the left common femoral artery to the abdominal aorta, and an expandable Z stent (Cook, Bloomington, IN; diameter, 12 mm; length, 45 mm) covered with expanded PTFE (Impra, Tempe, AZ) was successfully deployed at the left common iliac artery.

Angiography and CT after stent-graft placement demonstrated complete exclusion of the pseudoaneurysm in the left iliac artery (**Fig 1c,d**). As of 6 months after stent-graft placement, the patient has remained well, and hematuria has not occurred even during ureteric catheter exchange.

Case 2

A 79-year-old man underwent ileocecal mass resection twice for malignant lymphoma. Before the second operation, a 7-F double-J–shaped catheter was placed in the right ureter for the treatment of right hydronephrosis. Three weeks after the second operation, the patient experienced gross hematuria and hemorrhagic shock. He underwent conservative treatment with blood transfusion, but his hemoglobin level gradually decreased. Two days after the hematuria, contrast medium–enhanced CT demonstrated aneurysmal dilation of the right external iliac artery (**Fig 2a**) in the region that had previously been occupied by tumor removed at surgery. In consideration of the finding of hematuria, pseudoaneurysm of the right external iliac artery with ureteral fistula was diagnosed. Laboratory investigations revealed a white blood cell count of 5.2 $\times$ 10^3/dL and a C-reactive protein level of 1.72 mg/dL. The patient was afebrile, and no evidence of urinary infection was shown by on culture. Treatment policy was discussed, and endovascular exclusion of the aneurysm was planned with use of a stent-graft. Written informed consent was obtained from the patient in accordance with the standards of the institutional review board before the procedure.

A pseudoaneurysm was clearly demonstrated at the external iliac artery on angiography (**Fig 2b**). A stent-graft was constructed to be 16–12 mm in diameter and 80 mm in length and was covered with expanded PTFE (Impra). Initially, the right internal iliac artery was embolized with 0.035-inch Gianturco stainless-steel coils (Cook, Bloomington, IN) to prevent potential collateral inflow into the pseudoaneurysm after endovascular exclusion. The stent-graft was then deployed with use of an afterloading method. First, an 18-F Keller-Timmermans sheath (Cook) was introduced into the abdominal aorta through the exposed right femoral artery over the wire. The loading cartridge was used to introduce the stent-graft into the delivery sheath. Second, the stent-graft was advanced from the loading cartridge to the delivery sheath with the pusher mandrel. Finally, the stent-graft was successfully deployed from the common iliac artery to the external iliac artery over the aneurysm. After the procedure, exclusion of the aneurysm was confirmed on angiography (**Fig 2c**) and enhanced CT (**Fig 2d**). As of 6 years and 3 months after treatment, exclusion of the aneurysm has been confirmed on CT, and no recurrent bleeding has been noted.

DISCUSSION

IAUF is a rare entity with a potential risk of life-threatening hemorrhage. Several underlying conditions are known to represent predisposing factors in the development of IAUF. These factors include pelvic extirpative surgery (17), vascular reconstructive surgery, extensive ureteral mobilization, infection, irradiation (5,18), ureterolithiasis, construction of diverting urinary conduits, atherosclerotic and aneurysmal disease of the aortoiliac segment (19), and indwelling ureteral stents (5,20). Both cases presented herein involved two of these factors: pelvic surgery and prolonged ureteral catheter placement. These are the two most frequently cited factors, occurring in approximately two thirds of reported cases (1).

Diagnosis of IAUF has been difficult. Clinical presentation is variable, ranging from microscopic or intermittent hematuria to life-threatening hematuria. Physicians often consider other more common causes of hematuria, such as ureteral stones and genitourinary malignancy, higher in the differential diagnosis, because IAUF is so rare that the possibility is seldom considered. Even if IAUF is suspected, radiographic confirmation can be difficult. However, thin-slice CT with contrast medium on a multidetector CT unit might be useful for the demonstration of small pseudoaneurysms and confirmation of diagnoses. In case 1, thin-slice images obtained with multidetector CT successfully demonstrated a small aneurysm adjacent to the iliac artery, whereas previous angiography and conventional CT had failed to show this. In addition, CT images helped to determine a better projection to demonstrate the aneurysm before second angiography and intervention. If IAUF is suspected, enhanced CT including thin-slice sections on a multidetector CT unit is therefore advocated.

Conventional treatment of this disease involves simple exclusion or ligation of the involved vessel (5,21). Ligation at the level of the common iliac artery is usually tolerated without reconstruction, particularly when no associated infrainguinal occlusive disease is present and the ipsilateral hypogastric artery is patent. Even separate ligation of the common iliac and external iliac vessels may be tolerated as a result of cross-pelvic and inferior epigastric collateral pathways. However, direct operative repair of the involved vessel is associated with high

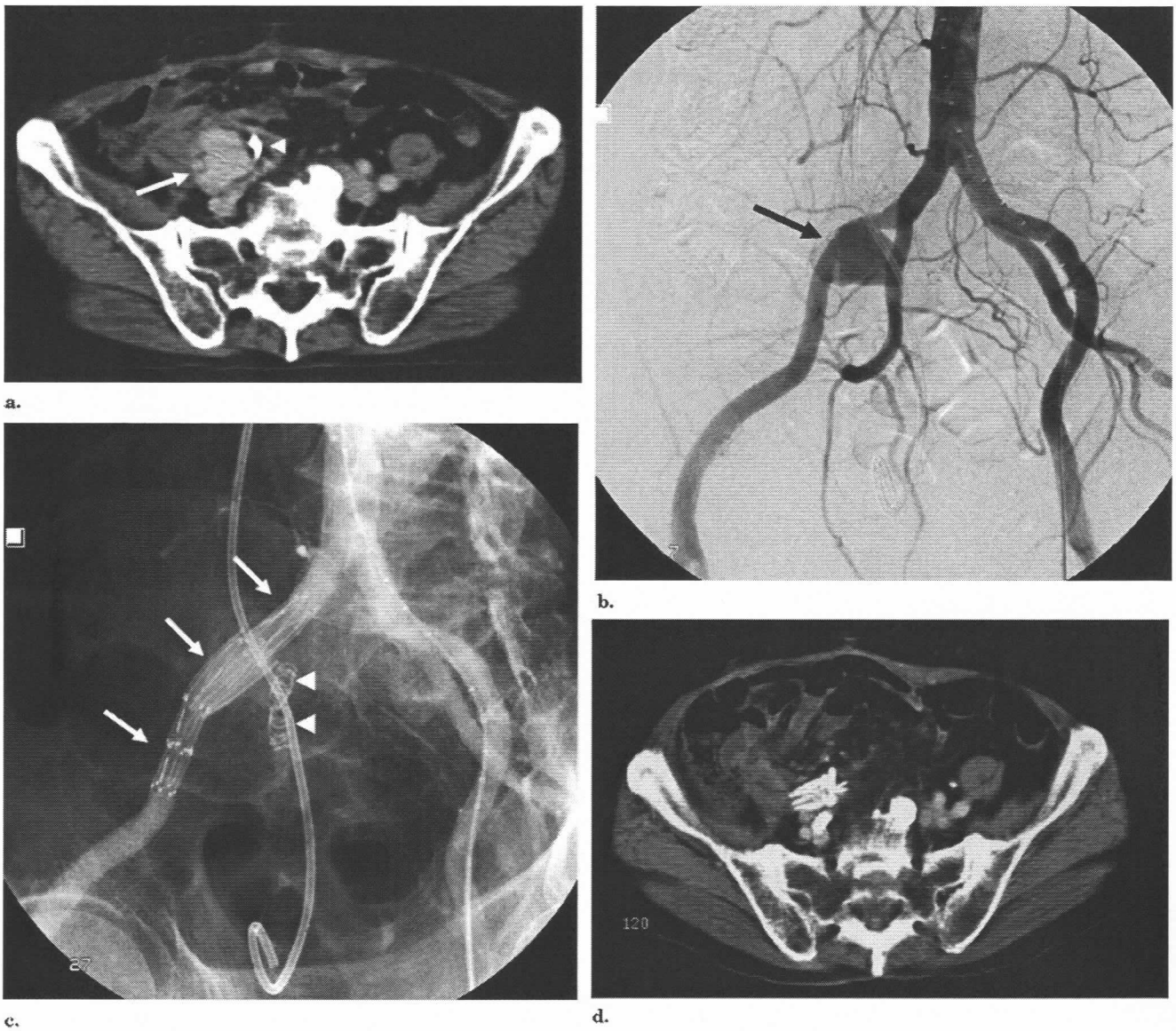

Figure 2. **(a)** Contrast medium–enhanced CT image obtained on admission shows an irregularly shaped pseudoaneurysm (arrow) in the right external iliac artery originating near the site of ureteric stent placement (arrowhead) as a result of ureteral stenosis. **(b)** Preprocedural aortography shows a large pseudoaneurysm (black arrow) in the right external iliac artery. **(c)** After right internal iliac artery embolization (arrowheads), stent-graft placement (arrows) is performed. Complete exclusion of pseudoaneurysm and absence of endoleak is confirmed. **(d)** Contrast medium–enhanced CT shows no evidence of endoleak and confirms preservation of blood flow inside the stent.

mortality rates, particularly in high-risk groups such as elderly patients or those with a history of multiple surgical procedures. In the present cases, surgical repair was avoided because of the patients' age and their history of multiple abdominal surgical procedures.

Regarding nonsurgical treatment for IAUF, Keller et al (22) reported the successful use of angiographic occlusion techniques incorporating coil embolization. They treated the fistula without a direct surgical approach, but additional bypass surgery was necessary. Three patients in the series of Quillin et al (5) were also treated with embolization of the iliac arteries. Although such techniques can be useful to treat IAUF without surgery, the risk of potential future leg ischemia remains.

Recently, multiple cases of stent-graft treatment for IAUF have been reported (11–16). In a previous report, Kerns et al (10) reported successful treatment of IAUF with use of an autologous vein–covered stent. The use of personally constructed PTFE- or Dacron-covered stents is also reported (2,11–16). These reports described successful placement of stent grafts for IAUF and suggested that, although

long-term results were not confirmed, the procedure appeared useful in the treatment of IAUF. Regarding graft patency after stent placement for IAUF, stent-graft occlusion has been reported in two cases at 8 months and 17 days after the procedure, respectively (23,24). Fortunately, in the present cases, the stent-grafts have remained patent. In case 2, patency of the stent-graft has been confirmed for more than 6 years.

Stent-graft treatment of infected sites is controversial because of the risk of delayed stent-graft infection, which can potentially be life threatening. Although some investigators have reported success in treating infected aneurysms in the uncontrolled active stage with stent-grafts and long-term antibiotic therapy, no standardized treatment has yet been defined (25,26). Because the patients reported herein had no signs of infection, we decided to use stent-grafts for treatment.

In conclusion, placement of a stent-graft covered with expanded PTFE is one useful treatment option for IAUF.

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