Uretero-Arterial Fistula: A pitfall in the Diagnosis of Hematuria

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ABSTRACT

The diagnosis and management of ureteroarterial fistulae (UAF) can be challenging. We report a patient who presented with multiple episodes of macroscopic hematuria but showed negative findings on several multiphasic computed tomography angiography studies. Eventually, during a percutaneous nephrostomy procedure, an antegrade digitally subtracted pyelogram via the right nephrostomy catheter demonstrated a UAF between the right external iliac artery and the right distal ureter. A stent-graft was deployed along the right common and external iliac arteries with embolization of the right internal iliac artery. A temporary ureteric occlusion technique was also used for urinary diversion, to promote UAF healing and to prevent stent-graft infection. The patient was treated with antibiotics for 4 weeks and is being managed with regular retrograde ureteral stent change every 3 months. This case report emphasizes the importance of early recognition and treatment of UAF.

CASE REPORT

Our patient is a 72-year-old female who has a history of cervical squamous cell carcinoma treated with chemoradiation therapy three years prior. Her past medical history included mitral regurgitation, diabetes mellitus, iron deficiency anemia, and prior thyroidectomy. Two years after chemoradiation, she underwent total pelvic exenteration (total hysterectomy, bilateral salpingo-oophorectomy, cystectomy, abdominoperineal resection, bilateral distal ureterectomy, and appendicectomy) and creation of an ileal conduit with ureteric anastomosis constructed in the Wallace configuration for local recurrence.

Within 6 months after surgery, the patient had 3 recurrent admissions for fever attributed to *Klebsiella Pneumoniae* pyelonephritis and hydronephrosis demonstrated on computed tomography (CT) pyelography. During these admissions, the patient underwent conduitoscopy, which revealed strictures of bilateral ureteroileal anastomoses. The anastomotic strictures were treated with laser ureterotomy and dilatation electively. Bilateral retrograde single-J ureteric stents were placed (8 French Puroflex, Bard Medical, Murray Hill, New Jersey, USA) subsequently with plans for ureteric stents change every three months.

During the current presentation (one year after the surgery, six months after the ureteric dilatation and stent insertion), the patient presented with sudden onset per-stomal bleeding and abdominal pain. She was hemodynamically stable, and her hemoglobin level was 10.7 g/dL. A multiphasic computed tomography angiogram (CTA) of the abdomen and pelvis was urgently performed in plain (90kV, 141 mAs), arterial (100kV, 70 mAs), and portovenous phases (100kV, 70 mAs). This demonstrated bilateral hydronephrosis and hyperdensities in the right renal pelvis and ileal conduit, consistent with blood clots (Figure 1). However, the CTA did not reveal the cause of the hematuria, and the patient was managed with the provisional diagnosis of bilateral pyelonephritis. Intravenous antibiotics were administered. A retrograde ureteroscopy was also performed, which showed the right retrograde stent was patent. The left retrograde stent was encrusted and blocked with moderate left hydronephrosis. The site of active bleeding could not be visualized. Both ureteric stents were changed. The patient presented with three further episodes of massive hematuria within a month. Three further multiphasic CTAs were performed, but the site of bleeding could not be identified. A ureteroarterial fistula (UAF) was suspected at this time. The right ureteric stent was removed as it was deemed an inciting factor for hematuria, given the close relation of the right distal ureter to the right common iliac artery (Figure 1). The patient deteriorated subsequently with persistent breakthrough fever, worsening renal function, and elevated inflammatory markers. CT pyelography showed right hydronephrosis, which was suspicious for obstructive pyelonephritis. She was brought down to the angiography suite for right percutaneous nephrostomy to achieve source control.

During the procedure, the lower pole calyx was accessed with a 19G sheathed needle (TFE Sheathed Needle with Chiba Tip and Clear Sheath, Cook Medical, Bloomington, Indiana, United States) under ultrasound guidance. Heavily blood-stained urine was drained on access. An antegrade pyelogram demonstrated stasis of contrast in the pelvicalyceal system. An 8F self-retaining pigtail drainage catheter (Skater, Argon Medical Devices, Plano, Texas, USA) was inserted and positioned with the catheter loop within the renal pelvis. A repeat antegrade pyelogram again showed stasis of contrast within the pelvicalyceal system and upper and mid ureter with poor visualization of the distal ureter (Figure 2). To better delineate the flow of contrast, a digital subtraction pyelogram (DSP) was performed, revealing a UAF with the right external iliac artery (Figure 3). A decision was made to perform a right iliac angiogram to further delineate and treat the UAF. The patient's position was changed from prone to supine. Left common femoral arterial access was obtained, and a 5F sheath (Terumo Medical, Shibuya, Tokyo, Japan) was introduced, which was later changed to an 8F 35mm length sheath (Destination, Terumo Medical, Shibuya, Tokyo, Japan). Using a 4F pigtail catheter (Cordis, Miami Lakes, Florida, USA), pelvic flush digital subtraction angiograms (DSA) were performed. The UAF was initially not well demonstrated on the pelvic angiograms (Figure 4). Based on the DSP, the location of the UAF was determined to be at the proximal right external iliac artery.

In view of the patient's previous history of pelvic surgery and radiation therapy, surgical repair of UAF was deemed difficult and of high risk. A decision was made to place a covered stent across the right common iliac artery and external iliac artery to exclude the UAF. The right internal iliac artery was catheterized and embolized to prevent retrograde filling of the external iliac artery (i.e., endoleak). A total of eleven 0.035" platinum fibred coils of diameters ranging from 4 to 6 mm (Nester & MReye, Cook Medical, Bloomington, Indiana, United States) were deployed within the right internal iliac artery, achieving stasis. After embolization of the right internal iliac artery, opacification of the lower ureter through the UAF was demonstrated on selective right common iliac DSA (Figure 5). A self-expanding 8mm diameter 80 mm length covered stent (Covera Plus, Becton Dickinson, Franklin Lakes, New Jersey, United States) was deployed, extending from the mid right external iliac artery to the proximal right common iliac artery. A post-stenting DSA showed no further opacification of the UAF, indicating a good seal (Figure 6). The nephrostomy catheter was left in situ without further manipulation of the right ureter which could result in septicemia.

The patient was brought to the angiography suite again 2 days after right iliac artery stenting for right ureteric stenting. The rationale was to provide temporary urinary diversion away from the UAF to promote healing and reduce the risk of seeding of bacteria onto the stent graft. The nephrostomy access was exchanged for an 8F 11cm sheath (Brite tip Cordis, Miami Lakes, Florida, USA). The UAF was then crossed antegradely with a 0.025-inch angled hydrophilic guidewire (Terumo Medical, Shibuya, Tokyo, Japan) and the guidewire exteriorized via the ileal conduit to achieve complete access. The guidewire was then exchanged for a 0.035" PTFE coated guidewire (Teflon, Boston Scientific, Marlborough, Massachusetts, USA), and a 6F 35cm drainage catheter (Skater, Argon Medical Devices, Plano, Texas, USA) was inserted retrogradely to maintain access. The choice of a smaller caliber retrograde stent (6F relative to the standard 8F) was to prevent further erosion at the site of the UAF. The vascular sheath at the right nephrostomy access was then changed to a modified ureteric occlusion catheter using a nephroureteric catheter (8F 24 cm, Percuflex, Boston Scientific, Marlborough, Massachusetts, USA) modified based on a technique described by Bush et al. [1] (Figure 7) The mid ureteral segment of the catheter was heated with steam and then crimped with a forceps. After that, the compressed area was cut obliquely and trimmed, and only the proximal segment of the catheter was used. The crimped end of this modified catheter acts as a valve, which opens when a guidewire goes through it and closes when not.

After the right iliac artery and ureteric stenting, the patient's hematuria resolved. A week after retrograde right ureteric stenting, the modified ureteric occlusion catheter and retrograde stent were changed for an antegrade nephroureteric catheter (8F 24 cm, Percuflex, Boston Scientific, Marlborough, Massachusetts, USA) to achieve internal-external drainage. The patient's serum creatinine was elevated at the diagnosis of UAF, highest at 160 umol/L, and improved to about 90 umol/L after the treatment of UAF. The patient was started on a daily dose of aspirin for life for prophylaxis to prevent stent thrombosis. Throughout this admission, the patient's urine cultures were positive for *Enterococcus Faecalis* and Candida species (both more than 100,000 cfm/ml). She was treated with a combination of antibiotics initially intended for broad-spectrum coverage based on a local antibiogram and subsequently culture-directed. The antibiotics used included ceftriaxone for 3 days, ciprofloxacin for 8 days, piperacillin & tazobactam, as well as fluconazole for 20 days prior to discharge. Three months after right internal iliac artery stenting, the nephroureteric catheter was exchanged for a retrograde single J ureteric stent (8 French Puroflex, Bard Medical, Murray Hill, New Jersey, USA) so that the percutaneous antegrade nephrostomy access was no longer required (Figure 8).

The patient has been followed up for 18 months. She is being managed on regular fluoroscopic retrograde ureteral stent change every 3 months. She has experienced intermittent episodes of urinary tract infection, treated with either oral or intravenous antibiotics depending on the organism isolated from the urine culture. There have been a few self-limiting episodes of mild hematuria with stable hemoglobin count, deemed to be related to infection. CTAs performed at 4 months and 12 months showed the right iliac artery covered stent to be patent with no evidence of UAF recurrence, endoleak, or infection. Bilateral long-term percutaneous nephrostomies with external drainage were offered as an option to completely avoid the UAF and bilateral ureteric strictures to reduce the incidence of infection. This was declined by the patient in view of the difficulties in managing the external catheters. She remains otherwise well on follow-up.

DISCUSSION

Etiology & demographics

Ureteroarterial fistula (UAF) is defined as a fistulous communication between the ureter and arteries, commonly involving the common iliac artery, internal iliac artery, or abdominal aorta. The terms UAF and arterioureteral fistula (AUF) are used interchangeably [2]. The first UAF was described by Moschcowitz in 1908 [3]. According to a literature review in 2022, approximately 445 cases have been reported to date [4]. The true incidence of UAF remains unknown but has been estimated as 3.5-5.6 per year in a recent questionnaire analysis in the Netherlands [5]. UAF is slightly more prevalent in women (57%), with a mean age of 63 years old at the time of diagnosis [4]. It is believed that the incidence of UAF is increasing, due to more aggressive treatment and increased survival of late-stage cancer patients in the past decades [6].

Risk factors, clinical & imaging findings

Risk factors of UAF are pelvic malignancy, pelvic surgery, indwelling ureteric stent, and previous radiation therapy. It has been reported that the pathophysiology of UAF is a combination of multiple factors. Previous pelvic surgery and radiation therapy induce necrosis and ischemic injury of the ureteral wall. Insertion of an indwelling stent, either vascular [7] or ureteral stent, introduces rigidity and limits mobilization. High pressure and pulsatile movement of the artery exerts repetitive force on the ureter, eventually leading to the formation of a fistulous communication [8]. In our case, the patient has a history of previous radiation therapy, extensive pelvic surgery, and a long-term indwelling ureteric stent. During the pelvic exenteration, dissection and mobilization of ureters may contribute to the ischemic effect on the ureters.

The clinical manifestation of UAF is commonly hematuria, ranging from occult to macroscopic hematuria to torrential bleeding. The first line non-invasive diagnostic tool is multiphasic CTA. If contrast extravasation from the arteries into ureters via a fistulous communication is demonstrated on the CTA, the diagnosis can be confirmed. However, CTA findings are often negative, due to the intermittent nature of bleeding and difficulty in visualization of the fistula [2]. Ancillary imaging features on CT include pseudoaneurysm, hydroureter, hydronephrosis, and blood clots in the ureter and renal collecting system. Recent studies demonstrated positive diagnosis of UAF on CTA to be between 20% to 42% [9]. In our case, it was particularly difficult to diagnose the UAF on the CT study alone, as there was long-term bilateral hydronephrosis due to the ureteroileal anastomotic strictures.

The most useful diagnostic tool is DSA. A recent review found that 66.3% (124/187) of UAF patients were diagnosed with DSA [10]. Provocative maneuvers during DSA were reported to increase diagnostic accuracy to 92.9% [11] in clinically highly suspected cases. Commonly used provocative maneuvers include ureteral stent removal or balloon- or catheter-directed endoureteral mechanical friction. Despite employing these diagnostic methods, instances of contrast extravasation and fistulous communication are infrequent. In certain cases, a comprehensive approach involving both DSA and antegrade ureterography may be necessary for a definitive diagnosis [2,12,13].

In our case, a DSP via the nephrostomy catheter demonstrated stasis of contrast in the pelvicalyceal system and sudden washout into the right common and external iliac arteries. To our knowledge, this is the first published record of a UAF diagnosed on DSP.

There are various causes of macroscopic hematuria, commonly including urolithiasis and urinary system malignancy. A list of the differential diagnoses and imaging considerations can be seen in the differential table. Non-contrast CT can be useful to detect urolithiasis, whereas a multiphasic CT or Magnetic Resonance Imaging can diagnose urinary system malignancies. In addition, a multiphasic CT is also the modality of choice to evaluate a clinically suspected UAF (Summary Table).

Treatment & prognosis

Surgical exploration and repair of UAF is difficult, as many of these patients have a history of pelvic surgery or radiation therapy. In acute massive hemorrhage, the patient may also not be fit for major surgery. For these reasons, endovascular treatment of combining stenting and coil embolization has become the treatment of choice in recent years. Surgical options are reserved for those patients who have abscess formation not amenable to percutaneous drainage, complicated fistulous tracks communicating with multiple structures, and failed endovascular treatment with stent-graft infection [10,14]. Endovascular treatment options include percutaneous deployment of stent-grafts and coil embolization of the internal iliac artery and combined with endoureteral procedures such as ureteral stents and percutaneous nephrostomy with or without endoureteral coil embolization [11]. The complication rate of combined endovascular and endoureteral treatment was reported as 28.6%.

Stent-graft infection is a conceivable complication as urine is a milieu for bacteria. Its incidence could be as high as 33% [15]. Given its dire consequences (i.e., lifelong antibiotics for control or the need for an explant of a seeded stent-graft), efforts should be made to prevent infection. In our patient, antibiotics were administered for 4 weeks, and to date there has been no evidence of stent-graft infection.

Temporary ureteric occlusion using a modified nephroureteric catheter to divert urine externally can be used to allow healing of ureter and bladder injuries and prevent infection post-stenting. It is uncommonly used but appropriate in the context of our patient to prevent infection while facilitating the healing of the UAF. Permanent ureteric occlusion for diversion may be necessary if there is persistent stent-graft infection despite adequate therapy.

TEACHING POINT

UAF is challenging to diagnose on non-invasive imaging. In cases with a fitting clinical presentation, pyelographic studies utilizing digital subtraction radiography may occasionally prove valuable in confirming the diagnosis. Endovascular treatment is the mainstay of UAF management by stent-graft deployment within the artery to exclude the UAF. Temporary ureteric occlusion can be considered to facilitate healing and prevent infection of the stent-graft.

Authors' contributions

Ethan Yongqiang Yang was involved in the drafting of the article.

Zehao Tan was involved in the conceptualization, design, and revision of the article.

Kae Jack Tay was involved in the revision and final approval of the article.

Nanda Venkatanarasimha was involved in performing the procedure, revision, and approval of the article.

Bien Soo Tan was involved in the conceptualization, design, revision, and final approval of the article.

DISCLOSURES

All authors declare that they have no conflicts of interest.

CONSENT

Yes.

Human and animal rights

Not applicable.

QUESTION & ANSWER

Question 1: which of the following answer choice is INCORRECT regarding ureteroarterial fistula?

1. Ureteroarterial fistula (UAF) and arterioureteral fistula (AUF) can be used interchangeably.
2. The first UAF was described in the early 20th century.
3. To date, fewer than 500 cases of UAF are reported in the literature.
4. UAF is slightly more common in women.
5. The incidence of UAF is decreasing due to successful treatment and technological advances (applies).

Explanation:

1. Ureteroarterial fistula (UAF) and arterioureteral fistula (AUF) can be used interchangeably. [The terms UAF and arterioureteral fistula (AUF) are used interchangeably.]
2. The first UAF was described as early as 1908. [The first UAF was described by Moschcowitz in 1908].
3. To date, there are fewer than 500 cases of ureteroarterial fistula reported in the literature. [According to a literature review study in 2022, approximately 445 cases have been reported to date]
4. UAF is slightly more common in women. [UAF is slightly more prevalent in women (57%)].
5. Incidence of UAF is increasing due to more aggressive treatment and increased survival of late-stage cancer patients. [It is believed that the incidence of UAF is increasing, due to more aggressive treatment and increased survival of late-stage cancer patients in the past decades.]

Question 2: which of the following answer choice(s) are NOT risk factors for ureteroarterial fistula?

1. Pelvic malignancy
2. Pelvic surgery
3. Indwelling ureteric stent
4. Radiation therapy
5. Diabetes mellitus (applies).

Explanation: [Risk factors of UAF are pelvic malignancy, pelvic surgery, indwelling ureteric stent, and previous radiation therapy.]

Question 3: Regarding imaging findings of ureteroarterial fistula, which of the following answer choice(s) is/are INCORRECT?

1. CT Angiography is the first-line modality of choice.
2. CT Angiography is of high specificity and sensitivity (applies).
3. Hydronephrosis is rarely seen in the CT study of ureteroarterial fistula (applies).
4. Digitally subtracted angiography (DSA) plays an important role in diagnosing ureteroarterial fistula.
5. Provocative maneuvers increase diagnostic accuracy in the ureteroarterial fistula.

Explanation:

1. CT Angiography is non-invasive and readily accessible, hence the first-line modality of choice. [The first line non-invasive diagnostic tool is multiphasic CT angiography.]
2. CT angiography is not sensitive in detecting ureteroarterial fistula. [CT findings are often negative, due to the intermittent nature of bleeding and difficulty in visualization of the fistula. Recent studies demonstrated positive diagnosis of UAF on CTA to be between 20 to 42%.]
3. Hydronephrosis is an important feature in CT of UAF cases. [Ancillary imaging features on CT include pseudoaneurysm, hydroureter, hydronephrosis, blood clots in the ureter, and renal collecting system.]

4. DSA is the most useful diagnostic method. [The most useful diagnostic tool is DSA.]

5. Provocative maneuvers may cause active blood flow from arteries to the ureter, hence increasing diagnostic accuracy. [Provocative maneuvers were reported to increase diagnostic accuracy to 92.9% in clinically highly-suspected cases.]

Question 4: Which of the following answer choice(s) is/are correct regarding the treatment of ureteroarterial fistula?

1. Surgical exploration and repair of fistula are the first-line treatment.

2. Endovascular treatment has become the treatment of choice (applies).

3. Surgical options are only indicated for those patients who can tolerate general anesthesia and premorbidly-well patients.

4. Coil embolization of the internal iliac artery is only performed when there is fistulous communication between the ureter and internal iliac artery.

5. Combined endovascular and endoureteral treatment is well tolerated by patients and has a very low complication rate of less than 5%.

Explanation:

1. Surgical exploration and repair of fistula are the first-line treatment. [In acute massive hemorrhage, the patient may also not be fit for major surgery.]

2. Endovascular treatment has become the treatment of choice (applies). [Endovascular treatment by combining stenting and coil embolization has become the treatment of choice in recent years.]

3. Surgical indications include abscess formation, stent-graft infection, complicated fistulous tracts with multiple structures and failed endovascular treatment. [Surgical options are reserved for those patients who have abscess formation not amenable to percutaneous drainage, complicated fistulous tracks communicating with multiple structures and failed endovascular treatment with stent-graft infection.]

4. Coil embolization of the internal iliac artery is commonly performed to prevent endoleak from the internal iliac artery. [Endovascular treatment options include percutaneous deployment of stent-grafts and coil embolization of the internal iliac artery.]

5. The complication rate of combined endovascular and endoureteral treatment can be as high as 28.6%. [The complication rate of combined endovascular and endoureteral treatment was reported as 28.6%.]

Question 5: Which of the following answer choice(s) is/are INCORRECT?

1. Stent graft infection often comes from the infected urine.

2. Stent graft infection is rarely seen (applies).

3. Antibiotics and ureteric occlusion for diversion can be used to prevent stent-graft infection.

4. Temporary ureteric occlusion can allow healing of ureter and bladder injuries.

5. Permanent ureteric occlusion is commonly performed to prevent infection (applies).

Explanation:

1. Infected urine is a main source of stent-graft infection. [Stent-graft infection is a conceivable complication as urine is a milieu for bacteria.]

2. Stent-graft infection is rarely seen (applies). [The incidence of stent-graft infection could be as high as 33%].

3. Antibiotics and ureteric occlusion for diversion can be used to prevent stent-graft infection. [Given its dire consequences (e.g., lifelong antibiotics for control)…Temporary ureteric occlusion ..…. can be used to allow healing of ureter and bladder injuries and prevent infection post stenting.]

4. Temporary ureteric occlusion can allow healing of ureter and bladder injuries. [Temporary ureteric occlusion using a modified nephroureteric catheter to divert urine externally can be used to allow healing of ureter and bladder injuries and prevent infection post-stenting.]

5. Permanent ureteric occlusion is performed when there is a persistent stent-graft infection. [Permanent ureteric occlusion for diversion may be necessary if there is persistent stent-graft infection despite adequate therapy.]

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FIGURES

Figure 1a: 72-year-old woman with ureteroarterial fistula.
FINDINGS: Coronal contrast-enhanced CT of the abdomen and pelvis in the arterial phase demonstrates a close relation between the right distal ureter (demarcated by the ureteric stent in situ) and the right common iliac artery (white solid arrow).
TECHNIQUE: Coronal CT, Arterial Phase, 100kV, 70 mAs, 3mm slice thickness.

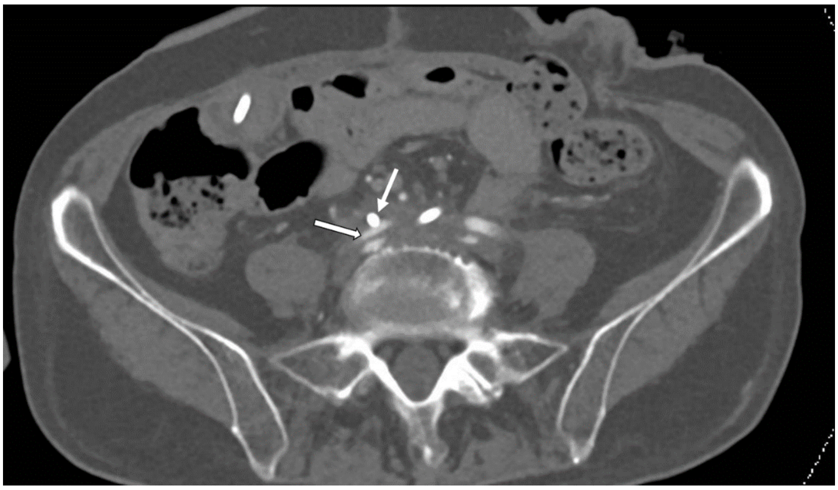

Figure 1b: 72-year-old woman with ureteroarterial fistula.
FINDINGS: Axial contrast-enhanced CT of the abdomen and pelvis in the arterial phase demonstrates a close relation between the right distal ureter (white arrow, demarcated by the ureteric stent in situ) and the right common iliac artery (bordered arrow).
TECHNIQUE: Axial CT, Arterial Phase, 100kV, 70 mAs, 3mm slice thickness.

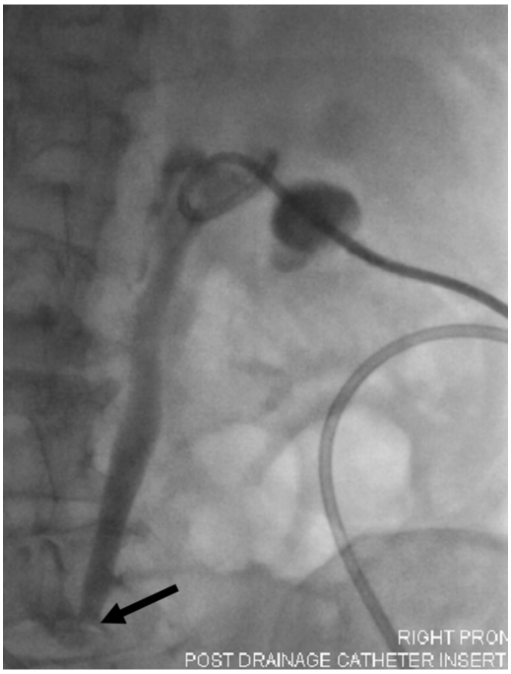

Figure 2: 72-year-old woman with ureteroarterial fistula.
FINDINGS: Posteroanterior view of pyelogram performed upon nephrostomy tube insertion shows hold up of contrast at the mid ureter with no visualization of the lower ureter and ileum.
TECHNIQUE: Pyelogram, posteroanterior view, Omnipaque 10 ml.

Figure 3: 72-year-old woman with ureteroarterial fistula.
FINDINGS: Posteroanterior view of digitally subtracted pyelogram from the right nephrostomy tube showed clear opacification of the right common iliac artery consistent with a uretero-arterial fistula (black arrow).
TECHNIQUE: Digitally subtracted pyelogram, Posteroanterior view, Omnipaque 10 ml.

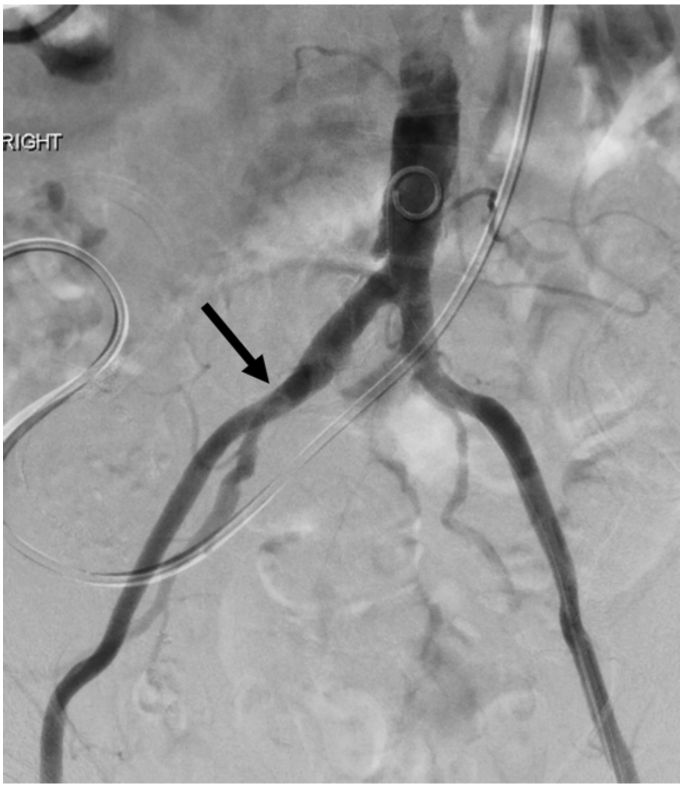

Figure 4: 72-year-old woman with ureteroarterial fistula.
FINDINGS: Anteroposterior view of digitally subtracted arteriography performed via a pigtail catheter from the left common femoral artery access for stent-graft placement to treat the ureteroarterial fistula again did not opacify the uretero-arterial fistula.
TECHNIQUE: Digitally subtracted arteriography, Anteroposterior view, Omnipaque 10 ml.

Figure 5: 72-year-old woman with ureteroarterial fistula.
FINDINGS: Anteroposterior view of digitally subtracted arteriography (DSA) shows opacification of the lower ureter through the UAF at the proximal right external iliac artery (black arrow).
TECHNIQUE: Digitally subtracted arteriography, Anteroposterior view, Omnipaque 10 ml.

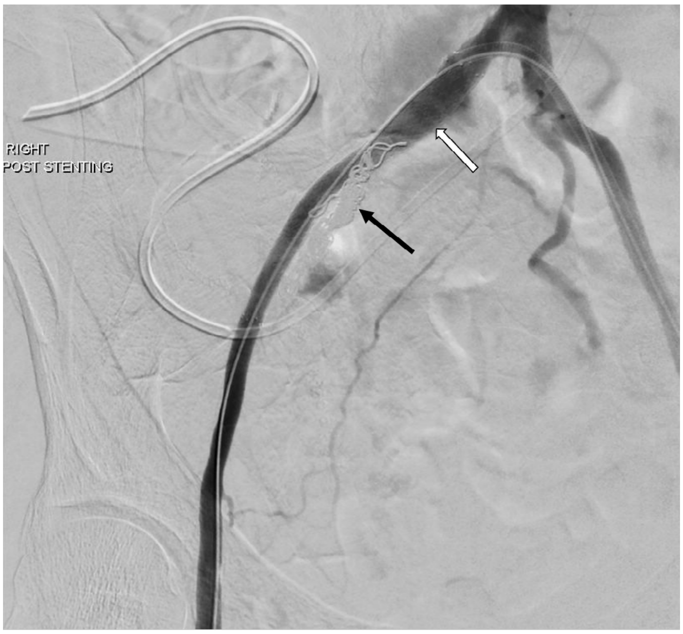

Figure 6: 72-year-old woman with ureteroarterial fistula.
FINDINGS: Anteroposterior view of digitally subtracted arteriography (DSA) shows no further opacification of the fistula, indicating a good seal. The iliac stent (bordered arrow) and right internal iliac artery embolization coils (black arrow) are also demonstrated.
TECHNIQUE: Digitally subtracted arteriography, Anteroposterior view, Omnipaque 10 ml.

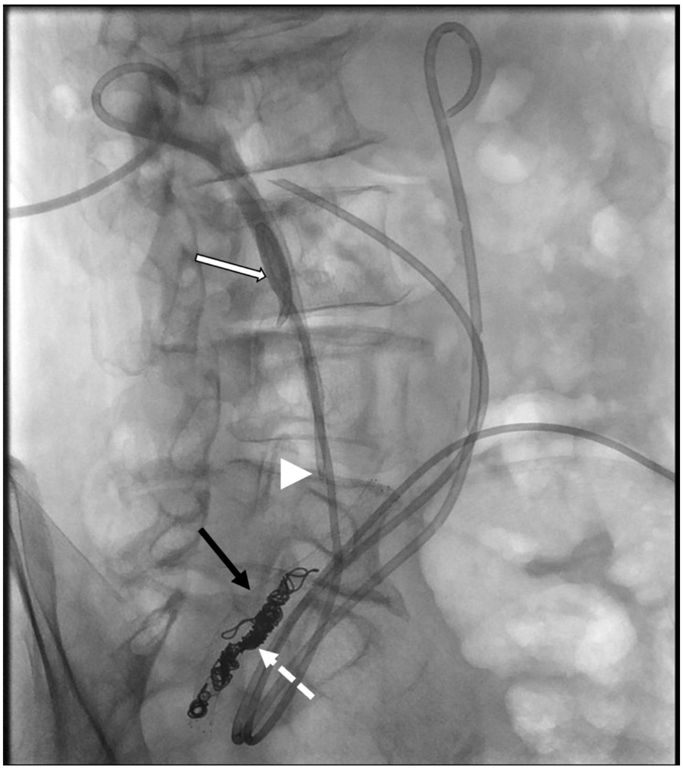

Figure 7: 72-year-old woman with ureteroarterial fistula.
FINDINGS: A radiograph shows the distal tip (arrowhead) of a temporary ureteric occlusive catheter (An 8Fr x 24cm nephroureteric stent (Percuflex) fashioned with steam), the loop of retrogradely inserted nephrostomy catheter (bordered white arrow), embolization coils in the right internal iliac artery (white dashed arrow) and the stent in the right common iliac artery (black solid arrow).
TECHNIQUE: Radiography, Anteroposterior view.

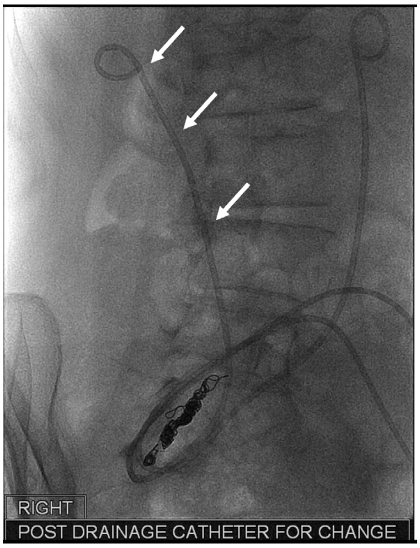

Figure 8: 72-year-old woman with ureteroarterial fistula.
FINDINGS: A radiograph shows a single J ureteric stent (white arrows) was inserted retrogradely, and the antegrade nephrostomy access was abandoned (not shown).
TECHNIQUE: Radiography, anteroposterior view.

TABLES

Summary table

• Etiology	Longstanding indwelling ureteric stents. High pressure and pulsatile movement of the artery exerts repetitive force on the ureter, eventually leading to formation of a fistulous communication.
• Incidence	Approximately 3.5-5.6 per year (in the Netherlands).
• Gender ratio	Slightly more prevalent in women (57%).
• Age predilection	Mean age at the diagnosis is 63 years old.
• Risk factors	Risk factors of UAF are pelvic malignancy, pelvic surgery, indwelling ureteric stent and previous radiation therapy.
• Treatment	Endovascular treatment is the main treatment option. Surgical exploration and repair of fistula is reserved for complicated cases.
• Prognosis	The complication rate of combined endovascular and endoureteral treatment was reported as 28.6%, with the most conceivable complication being stent-graft infection.
• Findings on imaging	If contrast extravasation from the arteries into ureters via a fistulous communication is demonstrated on the CTA, the diagnosis can be confirmed. Ancillary imaging features on CT include pseudoaneurysm, hydroureter, hydronephrosis, and blood clots in the ureter and renal collecting system. The most useful diagnostic tool is DSA.

Differential table

	Ultrasound	Computed Tomography	Angiography
Ureteroarterial fistula	Hypoechoic or hyperechoic materials in a dilated renal collecting system.	Active bleeding from arteries into ureters via a fistulous communication confirms diagnosis but rarely seen. Ancillary imaging features on CT include pseudoaneurysm, hydroureter, hydronephrosis, blood clots in the ureter and renal collecting system.	Contrast opacification of ureter when performing angiography.
Urolithiasis	Hyperechoic lesion with posterior acoustic shadowing or ‘twinkle’ artifact, with or without hydronephrosis.	Hyperdensity of varying sizes in the renal collecting system with or without hydronephrosis and hydroureter.	Not applicable.
Malignancy (Primary renal or ureteric cancer or metastasis)	Hypoechoic or hyperechoic nodular lesion in the renal parenchyma, with or without internal vascularity.	Solid enhancing space-occupying lesion with or without hydronephoris or hydroureter.	Hypovascularized mass with internal irregular vessels.

KEYWORDS

Urinary Fistula, Digital Subtraction Angiography, Pyelogram, Computed Tomography, X-Ray; Endovascular procedures, Case report

ABBREVIATIONS

UFA: Ureteroarterial Fistula, AUF: Arterioureteral Fistula, CT: Computed Tomography, CTA: Computed Tomography Angiography, PCN: Percutaneous Nephrostomy, DSP: Digital Subtraction Pyelogram, DSA: Digital Subtraction Angiography

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