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Uretero-iliac fistula: Modern treatment via the endovascular route

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Abstract We report three cases of ureteral-iliac fistula (UIF) in patients referred for treatment of macroscopic haematuria. Though it is a classic aetiology of haematuria, it is often difficult to diagnose and the treatment is not yet standardized. A diagnostic evaluation in combination with multidisciplinary approach improves the prognosis of the patients. Curative treatment via the endovascular route is effective and safe, and has a rapidly favourable course in all of our patients. The use of covered stents combined with the Amplatzer\textsuperscript{TM} vascular plug makes the procedure easy and safe. © 2012 Éditions françaises de radiologie. Published by Elsevier Masson SAS. All rights reserved.

Arterio-ureteral fistula is a rare pathology which is life-threatening. Mortality is estimated to be approximately 9% and morbidity is 23% [1,2]. The diagnosis is difficult. Rarely primary, and related to a disease of the arterial wall, arterio-ureteral fistulae are most often secondary to an outside factor that affects the arterio-ureteral crossing, such as radiotherapy, double J stent placement or loco-regional surgery. They mainly concern the iliac axes, though other arteries can be involved, such as the lower mesenteric artery or even the aorta, particularly in relation with an aneurismal disease [3–5].

Several treatment modalities have been described, which are endoscopic surgical, endovascular or combination [6].

The precision and the time to diagnosis are also important prognostic factors in this disease.

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We report three cases of endovascular treatment of UIF that illustrate both the presentation and the challenges of this pathology.

Case 1

A 56-year-old woman with a history of pelvic irradiation for cervical cancer was referred by her treating physician to an urologist for the treatment of relapsing haematuria that was not very abundant. While the urologist was performing endoureteral manoeuvres, a cataclysmic macroscopic haematuria was observed via the left ureteral meatus. A retrograde injection of an iodinated contrast material (ICM) in the left ureter showed an uretero-iliac fistula by simultaneous opacification of the ureter and the primitive iliac artery (PIA) (Fig. 1a). Faced with this observation, the patient was sent to interventional radiology for endovascular treatment of this fistula. Through a left retrograde common femoral approach, the angiography images showed spiculation of the middle part of the left primitive iliac artery (PIA), without opacification of the fistulous trajectory. This was visualized via selective injection with a catheter placed against the spicule (Fig. 1b, c and d). The strategy that was adopted consisted of excluding the fistulous track using a bridge-type implantation of a balloon-expandable covered stent measuring $12 \times 41$ mm (Advanta V12™, Atrium Hudson, NH, 03051 USA). Because the distance between the stent distal part and the posterior iliac artery take-off was sufficient, no other stent, nor iliac internal artery embolization was

![Figure 1. Opacification of the left primitive iliac artery during left ureteral opacification (a). Opacification of the fistula through the arterial route (b, c). PIA nipple (b, arrow) indicating the entry of the fistula track, directly opacified (c) by the selective injection. Significant dilation of the left urinary tract (d). Final opacification after implantation of a covered stent covering the starting point of the UIF (e, arrows).]
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It is necessary to prevent any type of endoleak. At the end of the procedure, the angiographic controls confirmed the full iliac arteries patency and showed effective exclusion of the fistula track (Fig. 1e). There were no complications after the procedure and the haematuria resolved.

Case 2

A 59-year-old male patient monitored for adenocarcinoma of the rectum was referred to us for the treatment of massive macroscopic haematuria. He also had a history of endoscopic resection of the prostate for an adenoma. This haematuria occurred 1 year after the pelvic surgery (pelvectomy with Bricker enterocystoplasty due to bladder involvement of the rectal tumour) and the beginning of adjuvant radio-chemotherapy (FOLFOX-Avastin®). The haematuria was associated with acute renal insufficiency obstructed by clots despite the single J ureteral stents. Anaemia with 7 g/dL of haemoglobin was observed. Faced with these signs and symptoms, the patient was transferred to intensive care and had a transfusion of six red cell units. An abdominal-pelvic CT scan with and without injection of ICM was carried out (Fig. 2a, b and c). This examination, at the arterial and portal phases, revealed a right ilio-ureteral fistula and confirmed the dilation of the pyelocaliceal cavities due to bilateral clotting in the urinary tract.

First, the single J ureteral stents were changed over guidewires. Due to the continued macroscopic haematuria, and in the absence of a possible surgical option, an endovascular treatment of this ilio-ureteral fistula was suggested. The arteriography through the right common femoral route confirmed the presence of a fistula between the right external iliac artery (EIA) and the homolateral ureter (Fig. 3a and b). The treatment of this fistula consisted first of embolising the right internal iliac artery (IIA) with an

Figure 2. 3D scan reconstructions, frontal (a) and oblique (b) showing the extravasation of contrast medium of the right external iliac artery, along the right single J stent (white arrow) and the caliceal clots (arrowheads); c: the axial scan cuts after injection at the arterial time. At the level of the crossing of the right single J stent and the right external iliac artery, the UIF is indicated by the extravasation of the ICM (white arrow).
Amplatzer™ vascular plug (St. Jude Medical, Inc. St. Paul, MN, USA) measuring 12 mm in diameter. This embolisation device was deployed in a proximal manner (Fig. 4a). Second, a balloon-expandable covered stent measuring 10 × 59 mm (Advanta V12™) was implanted in the right iliac artery, bridging the ostium of the IIA (Fig. 4b and c). This endovascular approach made it possible to exclude the fistula. Angiographic controls at the end of the procedure showed the tapering off of the flow of the arterio-ureteral fistula (Fig. 5a and b). The clinical course was rapidly favourable with the resolution of the haematuria and restarting of chemotherapy in the days following the procedure.

Case 3
A 72-year-old patient with a history of endoscopic resection of an adenoma of the prostate and pelvic radiotherapy for rectal cancer 10 years earlier was referred by his general practitioner as an emergency for macroscopic haematuria associated with acute renal insufficiency due to an obstacle. A double J stent had been placed in the left ureter via the endoscopic route. Since the implantation of the double J stent, the patient had signs of haemorrhagic shock associated with haematuria. After haemodynamic stabilisation of the patient, a CT scan was performed. A voluminous retroperitoneal fluid collection adhering to the left ureter was shown. The primitive iliac artery (PIA) and the homolateral internal iliac artery (IIA) were enhanced after injection of ICM during the arterial phase (Fig. 5a). The diagnosis that was retained was uretero-iliac fistula complicated by a pseudo-aneurism. Endovascular treatment was proposed immediately. The initial angiographic evaluation, via a left common femoral retrograde approach, confirmed the existence of a fistula associated with a voluminous pseudo-aneurism of the convergence of the PIA and IIA (Fig. 5b and c). Due to the important obliquity of IIA take-off, a right retrograde femoral approach was necessary to make it possible to embolise with an Amplatzer™ vascular plug measuring 12 mm. The plug was implanted away from the neck of the pseudo-aneurism due to the complex anatomy of fistula neck involving both IIA take-off and PIA. (Fig. 6a and b). Then, via the left femoral route, two balloon-expandable covered stents measuring 10 × 61 mm (Advanta V12™) were implanted in a bridge-like manner on the ostium of the IIA so as to widely cover the neck of the pseudo-aneurism.
Figure 4. Arteriography centred on the right iliac bifurcation, from a 30° left anterior oblique perspective, showing the leak of contrast material from the antero-external part of the right external iliac artery in contact with the single J stent (a and b, white arrow).

Figure 5. The injector scan (a) shows the existence of a circulating (star) voluminous pseudo-aneurism (arrows), developed due to contact with the vasculo-ureteral clamp. The left iliac angiography confirms the presence of this pseudo-aneurism (b, arrows) associated with an UIF that is visible due to the two spiculations (c, arrows).
and the fistula (Fig. 6c). At the end of the procedure, the angiographic images confirmed the slowing down of the flow of the fistula and the pseudo-aneurism (Fig. 6d). The haemodynamic clinical condition of the patient corrected itself rapidly and the haematuria resolved.

**Discussion**

The three cases presented here illustrate the efficacy and safety of the endovascular treatment of uretero-iliac fistulae. This technique has the advantage of a less invasive, rapid and simple approach. It is suitable to the many comorbidities of the patients. It is perfectly suited to the emergency situations that uretero-iliac fistulae represent. Implementation of this technique within a multidisciplinary approach (anaesthetist-intensive care physicians, urologists, radiologists and interventional radiologists) makes it possible to set the patient from the diagnostic to the treatment.

Uretero-iliac fistulae are the consequence of chronic inflammatory events that create a fibrous and poorly vascularised uretero-vascular adhesion. They often occur in patients with a history of surgery and pelvic radiotherapy. Most often, these inflammatory events are caused by a stenosis of the ureter. The many cases of trauma to the ureter that occur during repeated endo-ureteral manoeuvres (changing of ureteral catheters) or the activity of anticancer biotherapies (case 1) are the cause of the repeat ischaemic events that are the source of the UIF [7].

The UIFs mainly concern the iliac axes, with preferential involvement of the external iliac artery but can involve the terminal aorta, PIA or take-off of the IIA [8]. Pseudoaneurism (case 3) or abscesses are frequently associated. The diagnosis has a crucial role in the treatment. It makes it possible and set the procedure. The excellent time and space resolution of the CT scans associated with multi-planar reconstructions make it possible to perform a precise morphological evaluation [5,9]. Arteriography, though it has sensitivity that is superior to non-invasive techniques (sensitivity > 50%), must be reserved for the
However, a possible bacterial colonisation may occur, due to its wide coverage of the fistula neck [17]. To prevent the onset of a type II endoleak, a proximal IIA embolisation could be needed when there is a risk of worsening the haematuria.

Historically, the treatment was surgical. It mainly combined ureteral tutorization with a catheter and the surgical approach of the IA [12]. However, the complex dissection and difficulty in performing the prosthetic bridges or exografts have left room for the endovascular approach [2]. This procedure is possible due to the use of a covered stent. These stents are covered with a thin membrane of biocompatible PTFE. We chose the balloon-dependent PTFE stent for our patients. It has four advantages. First, stents that are balloon-mounted provide implantation precision that is superior to that of self-expanding stents [13]. Second, the compatibility of the stent with a 6Fr sheath makes it possible to easily control the puncture point at the end of the procedure. Third, the possibility of over-dilating the stent to make it conform in an optimal manner to the various diameters of the target arteries without a major loss in length. And fourth, the use of PTFE provides increased resistance to bacterial colonisation in case of deployment of the stent in a septic environment [14].

Depending on the location of the fistula track with regard to the iliac confluent, occlusion of the IIA can be necessary. To prevent the onset of a type II endoleak wide coverage of the fistula neck is necessary. Furthermore, proximal IIA embolisation could be needed when fistula neck is close to the IIA take-off [15]. For these patients, we used the first generation Amplatzer™ vascular plug. This embolisation device can be easily implanted and repositioned if needed. In addition, it ensures proximal occlusion of the IIA that respects the crossing between the anterior trunk and the posterior trunk of the IIA. This technique is useful to overcome buttock claudication [16]. In addition to the ease of use, the Amplatzer™ vascular plug is a less costly alternative to embolisation via coils [16].

The main limit to endovascular treatment of UIF remains the absence in the literature of long-term patient follow-up. Arterial permeability and the course of the fistula itself remain poorly studied due to the importance of the comorbidities of the patients that are the cause of death.

Krambeck et al. suggested a treatment strategy for this type of haematuria [17]. Using the identification of the clinical symptomatology (based on the patient’s medical history and clinical presentation of the haematuria), it is mainly based on the diagnostic CT scan examination. The endovascular approach is the primary treatment suggestion. On Fig. 7, we propose an algorithm that, contrary to that of

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**Figure 7.** Adaptation of the algorithm for the treatment of macroscopic haematuria and uretero-iliac fistula by Krambeck et al. [17].
Krambeck et al., makes the endovascular approach the tool for diagnosis and treatment.

Due to its efficacy, safety and rapid implementation, the endovascular approach to UIFs within the framework of a multidisciplinary treatment is becoming the reference treatment. The pre-treatment scan is a key point in the treatment of these patients and conditions the prognosis.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References