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Case Report

Occult renal artery pseudoaneurysm causing persistent hematuria after flexible Thulium fibered laser lithotripsy: A case report and literature review of rare but potentially fatal complication ☆

Moncef Al Barajraji, MD^{a,*}, Mathieu Coscarella, MD^a, Serge Holz, MD^a, Ilan Moussa, MD^a, Michel Naudin, MD^a, Nicolas Brassart, MD^b

^a Urology Department, Ambroise Paré Hospital, Mons, Belgium

^b Radiology Department, Ambroise Paré Hospital, Mons, Belgium

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ABSTRACT

Renal artery pseudoaneurysm may develop after laser flexible ureteroscopy stone lithotripsy (FURSL). Typical symptoms include flank pain, persistent hematuria, delayed refractory anemia, or hemorrhagic shock in case of pseudoaneurysm rupture. This complication of laser FURSL is very rare with only five cases reported in the literature as of April 2023, of which one involved Thulium laser. We report the case of a 65-year-old man with recurrent renal lithiasis who underwent FURSL using Thulium fibered laser (TFL) for 8 mm stone of left kidney upper pole. Persistent hematuria developed postoperatively, secondary to a pseudoaneurysm from a segmental branch of the left renal artery. It was diagnosed on arteriography performed for sudden hemorrhagic shock 27 days after surgery. Selective embolization with metallic micro-coils resolved hematuria. Although laser FURSL is often uncomplicated and TFL is regarded as safe, this complication should be suspected when refractory hematuria or hemodynamic instability follows the procedure. We report this case to add support to the current literature and outline procedural risk factors and useful precautions during the procedure.

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Introduction

Nowadays, flexible ureteroscopy stone lithotripsy (FURSL) is often performed for intrarenal stones less than 2 cm us-

ing laser energy devices [1]. In this indication, the Thulium fibered laser fiber (TFL) has recently shown benefits over Holmium: YAG laser [2]. Development of renal artery pseudoaneurysm (RAP) is a rare but potentially fatal complication

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* Corresponding author.

E-mail address: Moncef.Al.Barajraji@ulb.be (M. Al Barajraji).

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after endoscopic renal procedures such as laser FURSL. Typical symptoms include flank pain, persistent hematuria, refractory anemia, or sometimes massive bleeding after pseudoaneurysm rupture with the need for emergent intervention. We report the case of a 65-year-old man experiencing persistent hematuria with left flank pain after FURSL with TFL for recurrent left renal stone. The procedure was complicated by a small distal ureteral breach with early persistent hematuria attributed to the breach, but the latter was found to arise from an occult pseudoaneurysm of the left renal artery. It was diagnosed on renal arteriography after brutal hemorrhagic shock on the 27th postoperative day. Selective angio-embolization with metallic micro-coils allowed to resolve hematuria. To our knowledge, only 5 similar cases have been reported in the literature as of April 2023 [2–6], with 1 involving TFL [2]. We report this case to additionally highlight this complication after FURSL and encourage urologists to actively consider this diagnosis when postoperative hematuria persists.

Case presentation

A 65-year-old man with a medical history of renal lithiasis presented with an 8 mm stone in the upper pole of the left kidney, diagnosed on imaging. One year before, he had undergone FURSL for the same condition. Medical history included mild hypertension, obstructive sleep apnea, and treated coronary heart disease. There was no coagulation disorder, oncologic history, or trauma. Family history was not contributory. Pre-operative blood test results, including coagulation parameter studies, were within normal ranges. FURSL with TFL was performed using an energy level of 0.8–1 J and a frequency of 30 Hz. A flexible soft-tipped guidewire, ureteral access sheath, and hand-pump irrigation device were used to reduce intrarenal pressure. The surgery resulted in a small breach of the lower third of the left ureter, but there was no contrast extravasation from the renal pelvis on retrograde opacification and a double J ureteral stent was easily inserted. Immediately after surgery, the patient experienced gross hematuria with left flank pain. Physical examination and blood test results were normal, and contrast-enhanced abdomen computed tomography (CT) demonstrated a small breach of the distal left ureter without active bleeding (as shown in Fig. 1). The patient was discharged from the hospital on postoperative day 3 but returned to our emergency department a week later with urinary retention, flank pain, and persistent hematuria. Repeat contrast-enhanced abdomen CT showed several blood clots inside the bladder and left renal pelvis without active bleeding. Emergency cystoscopy was performed to remove blood clots. Bladder irrigation was administered as the hematuria persisted, and 3 days later, the patient abruptly suffered hemorrhagic shock from massive bleeding outside the urinary catheter. Arterial-phase abdomen CT was performed after stabilization and focal contrast extravasation outside the left kidney upper pole was seen, indicating active bleeding (as shown in Fig. 1). Emergent arteriography was performed by an interventional radiologist, revealing a subsegmental renal artery pseudoaneurysm that was selectively embolized with metallic micro-coils by the same radiologist (as shown



Fig. 1 – Contrast-enhanced computed tomography of abdomen and pelvis after initial surgery. Contrast extravasation indicating active bleeding is seen at the level of the left kidney upper pole.

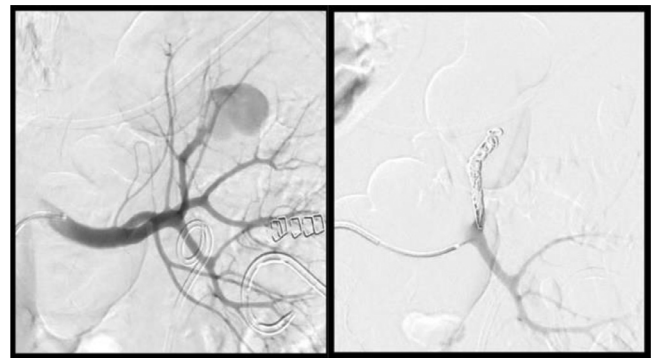


Fig. 2 – Left renal arteriography. (A) Arteriogram showing contrast filling of the left renal artery and his branches. Contrast extravasation is seen onto a pseudoaneurysm arising from segmental branch of the left renal artery. (B) Imaging study showing the successful selective embolization of the left renal artery pseudoaneurysm using several metallic micro-coils.

in Fig. 2). Hematuria rapidly settled, and the patient was discharged after 48 hours, as repeat imaging showed no residual bleeding or contrast extravasation outside the left kidney. Currently, 6 months after hospital discharge, the patient remains asymptomatic with normal follow-up imaging.

Discussion

Persistent hematuria requiring treatment after ureteroscopic stone lithotripsy occurs in less than 6% of cases [1]. Occasionally, bleeding occurs from a renal artery pseudoaneurysm (RAP) that develops following injury to the renal artery or

one of its branches [2]. Focal rupture or perforation of the arterial wall with localized bleeding outside the vessel creates a localized hematoma contained within the kidney by the adjacent soft tissues [3]. The most serious complication, in this case, is the rupture of the pseudoaneurysm, resulting in massive bleeding [4–5]. Risk factors for the rupture of non-traumatic RAP include hypertension, pregnancy, and a size larger than 3 cm [1]. Although RAP is rare with a low risk of rupture, current reports indicate a mortality rate of up to 80% [7]. Symptoms typically appear shortly after the procedure and include persistent hematuria, flank pain, unexplained anemia, or hemodynamic collapse due to massively bleeding ruptured pseudoaneurysm. Pseudoaneurysm rupture can be fatal and requires prompt emergent intervention [2–6]. All 5 cases reported in the current literature presented with delayed hematuria after FURSL, without evident active bleeding observed during surgery. This may be due to the initial tamponade effect of the perirenal soft tissues on the injured renal vessel [5]. The particularity in our case lies in the fact that the initial procedure caused a left distal ureteral breach with early, rather than delayed, persistent hematuria attributed to the ureteral breach itself with several imaging studies and diagnostic ureteroscopy excluding active bleeding from the operative site. Imaging is important to exclude potential renal injury with active bleeding and/or RAP when assessing persistent hematuria after FURSL. Contrast-enhanced abdomen CT is the first-line imaging study in this scenario, but duplex scan ultrasonography or magnetic resonance imaging offer equivalent results without contrast exposure (eg, in cases of renal failure or allergy) [8]. In our case, the pseudoaneurysm was initially missed on contrast-enhanced abdomen CT, but a careful retrospective review revealed subtle contrast extravasation from the left kidney upper pole at the level of the identified pseudoaneurysm. When RAP or active bleeding is suspected on imaging, renal arteriography is performed in hemodynamically stable patients to confirm the diagnosis and selectively embolize the bleeding vessel with occlusive coils or thrombogenic agents. The procedure is safe with excellent results and is considered as the first-line treatment for hemodynamically stable patients when technically achievable [5,8]. All 5 similar cases in the literature underwent this treatment successfully after a delay ranging from 14 to 47 days [2–6]. Conservative management with active surveillance is only indicated with a pertinent reason to avoid treatment, as the spontaneous closure of a pseudoaneurysm is unpredictable [4]. Surgery should be considered in selected cases (hemodynamic instability, failed or unavailable endovascular treatment) and radical nephrectomy for refractory bleeding management should remain the very last option [4]. After reviewing the current literature, risk factors for RAP formation during FURSL were identified as guidewire-associated trauma, thermal laser injury, high intrarenal pressure (due to hand-pump fluid irrigation or poor use of an access sheath to decrease intrarenal pressure), and prolonged operative time [2–6]. In our case, we used a soft-tip guidewire to access the renal pelvis, along with an access sheath and careful hand-pump irrigation. The most significant factor that could have played a role was the use of the TFL fiber at high-energy levels (1 J and 30 Hz) in the renal pelvis. In this location, the short distance between the laser fiber and posterior renal hilar ves-

sels increases the risk of vascular injury at high energy levels, as reported by Monteiro et al. [2]. The manufacturer recommends TFL energy settings of 15–30 W in the renal pelvis and 10–15 W in the ureter [9]. Compared to Holmium:YAG laser, TFL emits more focused pulsed waves with a theoretical penetration depth of 2–3 mm, allowing for less retropulsion and quicker stone ablation [10]. However, in vivo, studies suggest that the penetration depth might be greater, with risks of tissue injuries at high energy levels [11]. The first and, as of yet, only reported case of renal artery pseudoaneurysm after Thulium FURSL was reported in May 2022 by Monteiro et al. [2], highlighting the rarity of this event. However, urologists performing FURSL with TFL should keep this complication in mind, considering the increasing use of this device.

Conclusion

Recently, the use of TFL has shown promising results in the treatment of ureteral and renal stones. However, it is important to note that this tool carries the risk of renal artery injury, which can manifest as persistent hematuria and/or flank pain due to the development of a renal artery pseudoaneurysm that is prone to sudden and severe hemorrhagic rupture. In the case of our patient, this complication occurred but was successfully managed through selective angio-embolization, which was performed about 1 month after the surgery when the diagnosis was made. It is crucial to have an early diagnosis of this complication as it carries a high mortality rate, and early management is essential. However, prevention should be the primary focus in order to avoid such complications. This includes adhering to the recommended laser energy settings provided by the manufacturer, taking precautions to prevent guidewire-related renal injury, minimizing operative time, and ensuring that low intrarenal pressure is maintained within the renal pelvis throughout the procedure. By following these preventive measures, the occurrence of renal artery pseudoaneurysm and its associated complications is extremely rare.

Patient consent

Written informed consent was obtained from the patient for anonymous publication of this case report and accompanying images. Approval for publication was granted from our institution.

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