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Renal pseudoaneurysm after holmium laser lithotripsy with flexible ureteroscopy: an unusual case report and literature review

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Abstract

Pseudoaneurysms of the renal arteries are caused by focal rupture or perforation of the arterial wall, resulting in local bleeding. Such pseudoaneurysms can be observed in conditions such as nodular polyarteritis, penetrating or closed renal injury, and medically induced injuries (such as renal puncture biopsy, percutaneous nephrostomy, or partial nephrectomy). Flexible ureteroscopy (FURS) is performed entirely through the urethra to prevent potentially severe kidney damage. Because of this, almost no renal parenchymal hemorrhage occurs after FURS laser lithotripsy. Only four cases had been documented in the literature as of December 2022. In this report, we describe a 53-year-old man with a history of recurrent kidney stones who underwent FURS laser lithotripsy for bilateral kidney stones. The procedure was smoothly performed, and no active bleeding occurred. However, the patient developed recurrent macroscopic hematuria after discharge from the hospital, and renal angiography revealed a pseudoaneurysm in the distal right kidney. The pseudoaneurysm was treated with selective arterial embolization. Serious complications of FURS surgery are rare, particularly the formation of pseudoaneurysms. We report the present case to bring this potential complication to the attention of urologists.

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Introduction

Flexible ureteroscopy (FURS) is becoming more popular as a minimally invasive treatment for kidney stones, and it is frequently used to treat intrapelvic stones smaller than 2 cm.[1] Compared with more invasive therapies such as percutaneous nephrolithotomy, FURS has a lower complication rate and rarely requires additional intervention.[2,3]

Pseudoaneurysm formation is relatively uncommon following FURS laser lithotripsy; we are aware of only four such cases. These pseudoaneurysms typically manifest as delayed hematuria. By reporting the present additional case, we believe that urologists will become more knowledgeable about this rare condition and better understand its potential causes and remedies.

Case presentation

A 53-year-old man was admitted to our hospital with a more than 2-month history of intermittent bilateral abdominal distension and pain. He denied fever, dysuria, hematuria, and frequency or urgency of urination. He had undergone open bilateral nephrolithotomy approximately 33 years previously and bilateral inguinal hernia repair 1 month previously. He had no history of diabetes, coronary heart disease, or hypertension. An abdominal computed tomography (CT) scan revealed stones in both kidneys (Figure 1).

The patient underwent phased treatment involving placement of bilateral double-J tubes followed by bilateral FURS laser lithotripsy 3 weeks later. A routine preoperative evaluation revealed no abnormalities. A flexible ball-tipped guidewire (Innovex, Shanghai, China) and ureteral access sheath (Well Lead, Guangzhou, China) were inserted into the left ureteropelvic junction during surgery. A flexible ureteroscope (Well Lead) was then placed near the site of the left kidney stone, and a holmium laser was used to smash the stone until the visible stone fragments were less than 3 mm in diameter. The same method was used on the right side. Notably, although the stone was seen in the right superior calices on the CT film, it could not be found after repeated searching. We removed several minor stones from the right kidney using a mesh basket, and the surgery ended after a double-J tube was inserted on each side. During the procedure, we used a hand pump for irrigation to improve the surgical field of view, and the holmium laser energy was adjusted to 0.8 J at a frequency of 25 Hz. A doctor with more than 20 years of experience conducted the surgery. After the procedure, the patient's urine was clear and there was no sign of ongoing bleeding. He was released the following day.

The patient visited our emergency room on the eighth day after discharge because of macroscopic hematuria. His vital signs were stable, and he was moved to the inpatient unit. A CT scan showed that the right double-J tube had migrated, multiple blood clots were present in the bladder, and a dilated hematoma had developed in the right renal pelvis. We performed an emergency cystoscopy, removed a large black blood clot, and replaced the right double-J tube. On the fourth postoperative day, his hematuria persisted. Repeat abdominal digital

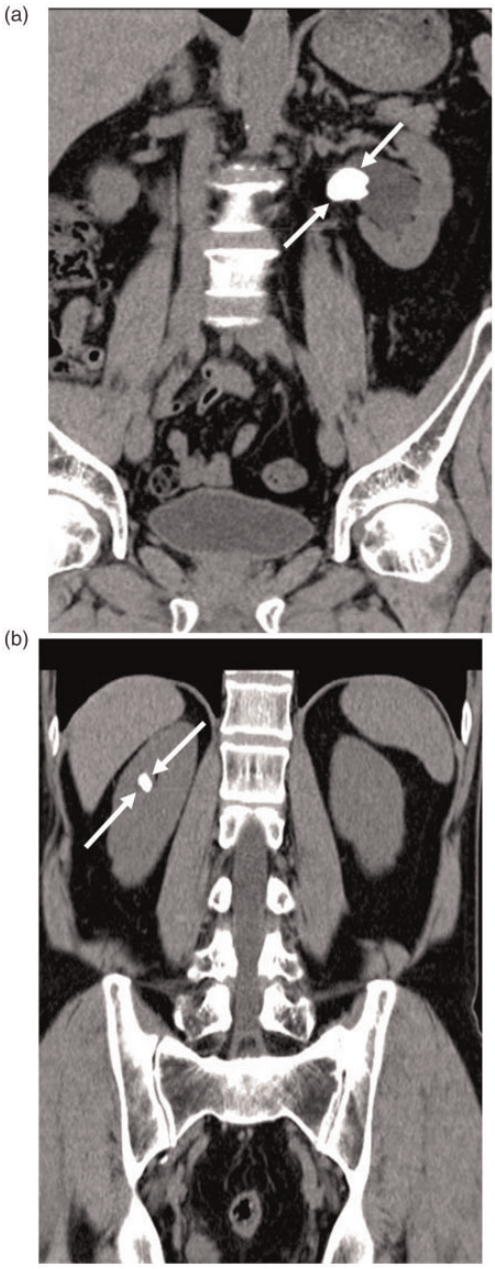

Figure 1. (a, b) Computed tomography shows stones in both kidneys (coronal position).

radiography revealed that the right double-J tube was more downwardly displaced than before, and high-density shadowing was present in the right renal region and bladder. We removed the right double-J tube and administered bed rest, bladder irrigation, and other symptomatic management. One day later, the patient had hematuria again. Finally, with clinical experience, we performed enhanced CT angiography of the urinary tract and found a pseudoaneurysm of the right kidney. We then decided to perform right renal arteriography. During this imaging examination, active extravasation of contrast medium was found in a pseudoaneurysm in a distal branch of the right renal artery. An interventional radiologist used a micro-coil to embolize the bleeding arterial branch (Figure 2). After the procedure, good hemostasis was attained without the need for additional care or a blood transfusion. Five day s later, the patient's hemoglobin concentration had increased from 93 to 107 g/L and his creatinine concentration had decreased from 180 to 126.8 μmol/L. He remained hospitalized because of psychological concerns and was released after 2 weeks with embolization.

Written informed consent was obtained from the patient for treatment and for publication of this case report. Ethics committee approval was not pursued because of the nature of this retrospective case report and the anonymization of the patient's information. This study conforms to the CARE guidelines.[4]

Discussion

We were initially unable to understand how standard FURS could result in considerable bleeding and especially the development of a renal pseudoaneurysm. To our knowledge, the present case is the fifth such case reported to date. We reviewed the relevant literature and summarized the factors responsible for the formation of pseudoaneurysms after FURS surgery (Table 1). It is difficult to definitively attribute a single factor to the formation of pseudoaneurysms in such cases; instead, multiple factors

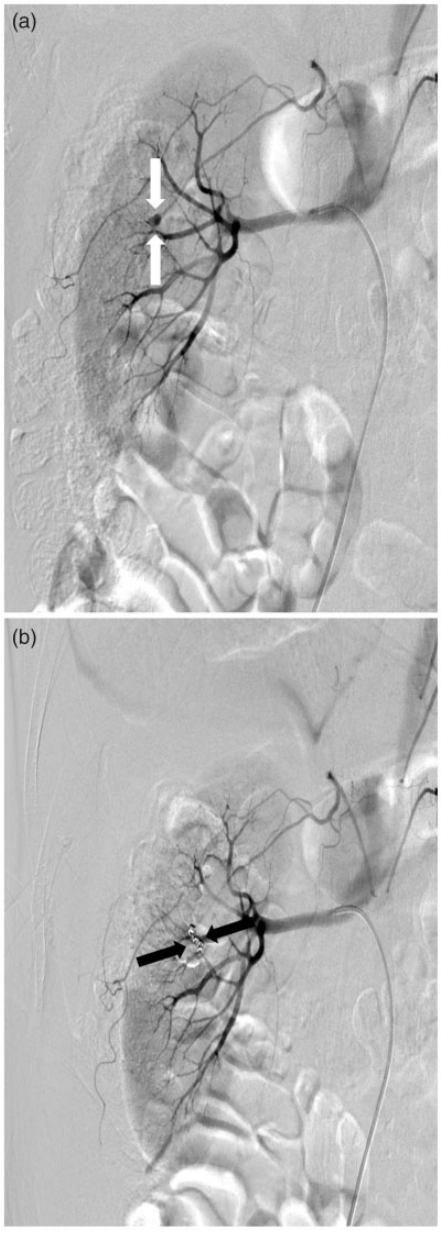

Figure 2. (a) Pseudoaneurysm in the distal branch of the right renal artery (white arrows) and (b) After embolization with micro-coils (black arrows).

may contribute to their development. Durner et al.[5] reported that intrarenal pressure-induced vessel damage may be a cause. Jubber et al.[6] considered that the renal pseudoaneurysm in their case may have been a result of guidewire- or laser-induced trauma with *Proteus* kidney infection eroding into a branch of the renal artery. Deng et al.[7] reported that the causes of pseudoaneurysms might include guidewire-induced mechanical damage, perfusion pressure, laser thermal damage, the operating time, and underlying diseases that influence the renal vasculature. Monteiro et al.[8] believed that a significant factor that may have increased the risk of pseudoaneurysm in their patient was the use of high-energy settings for renal stone fragmentation.

We are inclined to believe that the laser geothermal effect contributed to the pseudoaneurysm in our patient. We followed the standard FURS surgical procedure and used stepwise therapy, and no guidewire-induced renal parenchymal damage had occurred as evidenced by the absence of hematuria after the procedure. However, our case differs from earlier cases in that the patient had a history of open renal lithotripsy, which may have altered the anatomical course of his renal vessels, exacerbating the damage caused by the thermal effects of the laser during this procedure and leading to the development of a pseudoaneurysm. Another contributing factor may have been the 1-cm stone that was undetected during surgery in the renal diverticulum. Further research is required to determine whether a diverticular stone can change the vascular path and exacerbate the laser's thermal damage. Regardless of the factors that contribute to the development of renal pseudoaneurysms, it is critical to avoid damage to the kidney tissue during these procedures by employing the lowest possible energy and frequency of stone fragmentation.[9,10] Direct laser irradiation of the mucosal tissue should be avoided whenever possible, and multiple procedures should be used instead of one lengthy surgical procedure to fragment the stone. It is also essential to ensure proper intrarenal perfusion pressure

Table 1. Flexible ureteroscopy laser lithotripsy.

Authors (year)	Sex	Age (years)	History	Stone burden (cm)	Pump water method	Lithotripsy method	Laser energy	Clinical features	Embolization time (days)
Durner et al.[5] (2017)	Male	56	CHD	1	NR	HLL	NR	Persistent hematuria	14
Jubber et al.[6] (2018)	Female	68	NSTEMI	1.1	NR	HLL	NR	Vomiting, abdominal pain, fever	21
Deng et al.[7] (2022)	Male	29	DM	2.5	Hand-pump irrigation	HLL	0.8 J, 25 Hz	Hematuria, pain, fever	47
Monteiro et al.[8] (2022)	Male	24	NR	NR	NR	TLL	0.4–2.0 J, 20–40 Hz	Persistent hematuria	22
Present case (2022)	Male	53	History of open kidney surgery	2	Hand-pump irrigation	HLL	0.8 J, 25 Hz	Persistent hematuria	31

CHD, congenital valvular heart disease; NSTEMI, non-ST elevation myocardial infarction; DM, diabetes mellitus; NR, not reported; TLL, thulium laser lithotripsy; HLL, holmium laser lithotripsy.

and to perform the entire procedure under direct vision.[11,12] This case also reminds urologists to be more cautious when performing FURS laser lithotripsy on patients who have a history of kidney surgery or who have kidney stones at specific sites. When a patient has symptoms of severely delayed postoperative hematuria with no other explanation, a pseudoaneurysm should be considered. Renal enhanced CT angiography helps to identify pseudoaneurysms or the presence of vascular malformations in the kidney, and interventional embolization is an effective treatment option.

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Data availability statement

The image and table data are available upon reasonable request.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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References

1. Sanguedolce F, Bozzini G, Chew B, et al. The evolving role of retrograde intrarenal surgery in the treatment of urolithiasis. *Eur Urol Focus* 2017; 3: 46–55.
2. Zheng C, Xiong B, Wang H, et al. Retrograde intrarenal surgery versus percutaneous nephrolithotomy for treatment of renal stones >2 cm: a meta-analysis. *Urol Int* 2014; 93: 417–424.
3. Ricchiuti DJ, Smaldone MC, Jacobs BL, et al. Staged retrograde endoscopic lithotripsy as alternative to PCNL in select patients with large renal calculi. *J Endourol* 2007; 21: 1421–1424.
4. Gagnier JJ, Kienle G, Altman DG, et al. The CARE guidelines: consensus-based clinical case reporting guideline development. *Headache* 2013; 53: 1541–1547.
5. Durner L, El Howairis MEF and Buchholz N. Renal pseudoaneurysm after flexible ureterorenoscopy – an unusual complication. *Urol Int* 2017; 99: 484–486.
6. Jubber I, Patel PR, Hori S, et al. Renal pseudoaneurysm: a rare and potentially fatal complication following ureteroscopy and laser fragmentation of stones. *Ann R Coll Surg Engl* 2018; 100: e51–e52.
7. Deng XX, Zhang W, Fu D, et al. Renal pseudoaneurysms after flexible ureteroscopy and holmium laser lithotripsy: a case report. *Front Surg* 2022; 9: 896548.
8. Monteiro A, Waisanen KM, Ermolovich EV, et al. Case – renal artery pseudoaneurysm: a life-threatening occurrence following thulium laser lithotripsy. *Can Urol Assoc J* 2022; 16: E298–E300.
9. Liang H, Liang L, Yu Y, et al. Thermal effect of holmium laser during ureteroscopic lithotripsy. *BMC Urol* 2020; 20: 69.
10. Wang XK, Jiang ZQ, Tan J, et al. Thermal effect of holmium laser lithotripsy under ureteroscopy. *Chin Med J (Engl)* 2019; 132: 2004–2007.
11. Loftus C, Byrne M and Monga M. High pressure endoscopic irrigation: impact on renal histology. *Int Braz J Urol* 2021; 47: 350–356.
12. Sener TE, Cloutier J, Villa L, et al. Can we provide low intrarenal pressures with good irrigation flow by decreasing the size of ureteral access sheaths? *J Endourol* 2016; 30: 49–55.