Subcapsular Renal Hematoma Following Ureteroscopic Lithotripsy: An Uncommon Complication of a Common Procedure—A Report of Two Cases

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Abstract

Objective: To highlight the unusual complication of subcapsular renal hematoma (SRH) after a seemingly simple ureteroscopic lithotripsy (URSL), to try and identify the predisposing factors that lead to this complication, and steps that can be taken to further decrease the incidence of this rare but potential life-threatening complication.

Methods: We highlight two cases of obstructed ureteral stones with upstream hydronephrosis who presented with colicky pain. Both underwent URSL with 8F/9.8F semirigid ureteroscope and were found to have post-procedure SRH.

Results: Both our patients were managed conservatively with culture-directed intravenous antibiotics. One patient needed intervention in the form of aspiration of the hematoma. Follow-up ultrasound revealed complete resolution of the hematoma in both the cases and are doing fine on follow-up.

Conclusion: Various risk factors have been identified, which predispose an individual to this complication and all endourologists must take certain precautionary measures such as decreased operative time and perfusion pressures, treating urinary tract infections and preoperative optimization of hypertension, diabetes, and chronic kidney disease (CKD) to further decrease the incidence of SRH. Management is conservative in majority of cases with percutaneous drainage and antibiotics, with surgery being reserved for hemodynamically unstable patients.

Keywords: subcapsular renal hematoma, ureteroscopic lithotripsy, ureteral stones, ureteroscopy

Introduction

URETERORENOSCOPIC LITHOTRIPSY, WHICH involves endoscopic fragmentation and retrieval of stones, is indicated for ureteral as well as renal stones of size <2 cm.¹ With the increasing use of ureterorenoscopy for multiple and complex stones, the complications associated with it have also risen. The overall complication rates associated with ureteroscopy in a recent study² was found to be 7.4% and the most common complications after ureteroscopic lithotripsy (URSL) were bleeding, fever, and urinary tract infections (UTIs). Another unusual but previously described complication is a subcapsular renal hematoma (SRH) especially seen in patients with certain predisposing factors.

Traditionally, perinephric and subcapsular hematomas have been described with other forms of stone management such as percutaneous nephrolithotomy (PCNL) and extracorporeal shockwave lithotripsy. Such hematomas are also seen after trauma or some image-guided interventional pro-

cedures. They have also been reported to arise spontaneously, especially in those on anticoagulants. SRH seen post-URSL has been previously reported, although its incidence appears to be low and has been associated with certain high-risk predisposing factors.

We herein present details of two patients, both of whom underwent URSL with 8F/9.8F semirigid ureteroscope and were found to have postprocedure SRH and were managed conservatively. Our aim is to highlight this unusual complication after a seemingly simple endourologic procedure, to try and identify the predisposing factors that lead to this complication, and steps that can be taken to further decrease the incidence of this rare but potential life-threatening complication.

Case Details

Case 1

A 32-year-old man, recurrent stone former with previous history of PCNL on the left side presented with acute colicky

left flank pain with associated fever for 2 weeks. An ultrasound revealed left hydroureteronephrosis caused by a left upper ureteral calculus. Endoscopic placement of left Double-J stent resulted in relief of pain episodes and fever. A computed tomography (CT) urography done subsequently revealed a hyperdense obstructive calculus of size 10×8 mm in the upper ureter causing moderate upstream hydroureteronephrosis and a nonobstructive 9 mm left lower caliceal stone.

He underwent a laser endolithotripsy using a 8F/9.8F semirigid ureteroscope and a 30 W holmium laser machine (Litho, Quanta System, Italy) for the left upper ureteral stone. Complete clearance was done with an energy setting of 0.6 J/8 Hz followed by a placement of the Double-J stent. The procedure was uneventful with an intraoperative time of 35 minutes. Postoperatively, the patient developed hypotension and fever suggestive of urosepsis. Urine culture grew *Escherichia coli* and was managed conservatively with inotropic support and intravenous (IV) antibiotics. A postoperative CT urography (Fig. 1) done revealed an SRH of size 7×2 cm appearing hyperdense (60–70 HU) at upper and interpolar region and the persistent 9 mm lower calix stone (Fig. 1c). There was no significant fall in the hemoglobin postsurgery (preoperative Hb 12.3 g/dL, postoperative Hb 11.8 g/dL). The patient was managed conservatively and recovered completely. A repeat ultrasound done 6 weeks later showed complete resolution of the SRH and was planned for retrograde intrarenal surgery of the 9 mm left lower caliceal stone at a later stage. On follow-up the patient is doing well.

Case 2

A 68-year-old man presented with bilateral flank pain for 2 months and acute right colicky pain for 7 days. On admission he had raised creatinine (6.5) and metabolic acidosis. An non-

contrast computed tomography (NCCT) kidney, ureter, and bladder radiograph revealed bilateral obstructive ureteral calculi of 8 mm in the right lower ureter and 1 cm in the left mid-ureter with a left pelvi ureteric junction calculus of size 2 cm. He was diagnosed to have acute on chronic kidney disease and underwent dialysis in view of refractory hyperkalemia and metabolic acidosis. Diversion with endoscopic stenting on both the sides was done. Once the nadir creatinine (1.8 ng/mL) was reached and urine culture was sterile, patient was planned for elective stone removal. He underwent bilateral ureteroscopic pneumatic lithotripsy (Swiss LithoClast 2, Electro Medical Systems, Switzerland) using a 8F/9.8F semirigid ureteroscope. Pneumatic lithotripsy was used in accordance with preference of the operating surgeon and the lower ureteral location of the stones. Complete stone clearance was achieved and bilateral Double-J stents placed. It took 55 minutes to complete the procedure.

Postoperatively patient developed urosepsis and had an ICU stay for 4 days. Also, the patient complained of right flank pain and an ultrasound done revealed a 4 cm SRH on the right side. There was a fall in hemoglobin postoperatively (preoperative Hb 11.6 g/dL, postoperative Hb 10.2 g/dL). An NCCT scan also revealed a 4×5 cm subcapsular collection of blood density suggestive of a hematoma at the upper pole and central region of right kidney (Fig. 2). He underwent aspiration of the hematoma and was managed conservatively on IV antibiotics. He subsequently improved and was discharged in a stable condition.

Discussion

SRH occurs as an infrequent complication after URSL. Various retrospective studies have been performed in an

FIG. 1. CT urography showing an SRH in the upper pole and central region (a, b) post-URSL with Double-J stent *in situ* and a 9 mm left lower caliceal stone (c) in a 32-year-old patient. URSL, ureteroscopic lithotripsy; SRH, subcapsular renal hematoma.

FIG. 2. (a, b) CT urography showing an SRH post-URSL with Double-J stent *in situ* in a 68-year-old patient.

attempt to find out the incidence of this rare complication and the risk factors that help predict its occurrence after URSL.

A systematic review done by Whitehurst et al.³ found the incidence of perirenal hematoma after URSL to be 0.45% across all the studies (40 out of 8929 patients). There was a female preponderance with a mean age of 53 years and a mean stone size of 1.7 cm. A subcapsular hematoma is identified postoperatively usually with flank pain and/or fever and is diagnosed with an ultrasound or a computed tomography scan. Certain risk factors have been identified, which predispose some patients to develop hematomas postoperatively as compared with others. These include hydronephrosis, large stone size, perfusion pressure used during surgery, UTIs, prolonged operative time, chronic kidney disease (CKD) status, and parenchymal thickness. The most frequently attributed cause of formation of a subcapsular or a perinephric hematoma is because of increased pressure in the pelvicaliceal system in accordance with the Laplace law that states that Tension = Pressure $\times$ Radius. Also it could be caused by direct injury by the guidewire placed during the surgery.

Hydronephrosis is the most well-established risk factor identified for hematoma formation. Possible explanations include raised intrapelvic pressures in obstructed hydronephrotic kidneys that predispose them to forniceal rupture, deformed blood vessels in such kidneys, and also loss of elasticity in obstructed kidneys. Larger stone size would increase the operative time of the procedure and thus expose the pelvicaliceal system to high pressures for a longer time.

Hypertension and CKD make the patients prone to bleeding and thus increase the risk of hematoma formation. UTIs also increase the propensity of kidneys to bleed as it causes a neutrophilic inflammatory insult to the kidneys. With respect to body mass index (BMI), contrasting data exists. Kao et al. suggested low BMI and thus less perinephric fat had higher incidence of SRH, whereas Chiu et al. found higher BMI causing technical difficulties to be the reason for higher SRH (Table 1).

Another commonly used instrument during URSL, which was also used during both the cases in this study is the path finder that helps in improving vision at the cost of raising intrarenal perfusion pressures, thus predisposing it to cause caliceal rupture and subsequent subcapsular fluid and hematoma collection. The recommended irrigation pressures while performing a ureteroscopy is <150 mm Hg without an access sheath and 200 mm Hg when an access sheath is used.⁴

Both the cases also have a striking similarity in terms of development of postoperative hypotension and fever suggestive of urosepsis. Susceptibility to postoperative urosepsis in both the patients could be explained by a positive urine culture (*E. coli* in case 1 and *Klebsiella* species in case 2), which was treated with IV antibiotics according to culture sensitivity ensuring a sterile urine culture before subjecting the patients to stone clearance. Although this life-threatening condition was mitigated using broad spectrum IV antibiotics and proper critical care, it highlights another important complication of URSL.

TABLE 1. PREDISPOSING RISK FACTORS FOR SUBCAPSULAR RENAL HEMATOMA AFTER URETEROSCOPIC LITHOTRIPSY, A COMPARISON BETWEEN VARIOUS STUDIES IN THE SYSTEMATIC REVIEW BY WHITEHURST ET AL.³ AND THE INDEX PATIENTS

Risk factors identified for SRH	Bai and colleagues	Chiu and colleagues	Kao and Wang	Kozminski and colleagues	Meng and colleagues	Tao and colleagues	Present study Case 1	Present study Case 2
Incidence, <i>n</i> (%)	11 (0.4)	4 (0.36)	4 (8.9)	7 (0.8)	8 (0.4)	3 (0.15)	—	—
Hydronephrosis	91%	75%	—	—	100%	100%	Present	Present
Operative duration	41 minutes	>60 minutes	—	—	—	—	35 minutes	55 minutes
CKD	—	—	75%	—	—	—	Absent	Present
Stone size	0.9–1.4 cm	—	—	—	—	—	1.2 cm	0.7 cm
Thin cortex	—	75%	75%	—	—	100%	Absent	Absent
UTI	—	—	100%	—	—	66%	Present	Present
High BMI	—	75%	50%	—	—	—	Absent	Absent
Hypertension	—	—	—	72%	50%	—	Absent	Absent
Perfusion pressure	177 mm Hg	—	—	—	—	—	—	—

BMI=body mass index; CKD, chronic kidney disease; SRH=subcapsular renal hematoma; UTI=urinary tract infection.

The possible etiologies to the development of urosepsis in the index cases and required interventions for early resolution included the following:

	<i>Etiology</i>	<i>Interventions done</i>
1.	Dissemination of bacteria during stone fragmentation	IV antibiotics according to culture/sensitivity
2.	Possible infection of the subcapsular hematoma	Aspiration of the infected hematoma
3.	Prior history of UTI (positive urine culture)	Treating UTI with antibiotics according to sensitivity and ensuring sterile urine culture before stone clearance Continuing the same antibiotic in the perioperative period

The management of SRH in most of the cases is conservative with antibiotics and blood transfusions as necessary. Infrequently it may require percutaneous drainage and in rare circumstances it may require surgery and open drainage. Also, in the systemic analysis by Whitehurst et al.,³ 22 out of 40 (55%) patients were managed conservatively, 11 (27.5%) required percutaneous drainage, and 7 (17.5%) required surgery. In our case series, case 1 was managed conservatively with antibiotics with a resolution documented on ultrasound 6 weeks later and case 2 required drainage of the subcapsular collection in view of hemodynamic compromise. Both the patients had complete ureteral stone clearance.

After a thorough review of literature and also based on our experience we suggest the following precautions to be taken to decrease the incidence of SRH after URSL:

- Treat UTIs and ensure sterile urine culture before surgery.
- Extra caution to be taken in hypertensive and CKD patients
- Preoperative dialysis in CKD patients
- Preoperative optimization of diabetic and hypertensive patients
- Perioperative antibiotic prophylaxis
- Intraoperative variables such as intraoperative time and the perfusion pressure should follow the ALARA (as low as reasonably achievable) principle.
- Stone clearance should be done with laser lithotripsy using flexible lithotripters as it decreases the time and increases the stone clearance rates.
- Avoid sudden increases in perfusion of irrigation.
- Constant monitoring of the guidewire tip during the procedure
- Placing a Double-J stent postprocedure.

These few precautions if taken in a timely manner can help alleviate this rare but life-threatening complication after a common procedure such as URSL. All endourologists must keep in mind this complication and thus take up ureteroscopy in a safe manner utilizing the aforementioned precautions for achieving the best results and avoiding a dreadful complication.

Conclusion

Subcapsular hematoma is an infrequent complication after URSL. Various risk factors have been identified, which predispose an individual to this complication and all the endourologists must take certain precautionary measures such as decreased operative time and perfusion pressures, treating UTIs and preoperative optimization of hypertension, diabetes, and CKD to further decrease the incidence of SRH. Management is conservative in majority of cases with percutaneous drainage and surgery reserved for hemodynamically unstable patients.

Disclosure Statement

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Abbreviations Used

BMI = body mass index
 CKD = chronic kidney disease
 CT = computed tomography
 IV = intravenous
 NCCT = non-contrast computed tomography
 PCNL = percutaneous nephrolithotomy
 SRH = subcapsular renal hematoma
 URSL = ureteroscopic lithotripsy
 UTI = urinary tract infection

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