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Original article

Risk factors for developing a perirenal hematoma after flexible ureteroscopic lithotripsy

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ABSTRACT

Objective: To investigate the risk factors of perirenal hematoma (PRH) after flexible ureteroscopic lithotripsy (FURSL).

Materials and methods: We retrospectively reviewed the medical records of 45 patients who underwent FURSL with a holmium:yttrium–aluminum–garnet laser. We divided all patients in two groups: the PRH group and the non-PRH group. The patient demographic and baseline characteristics, surgical outcomes, and complications were compared and risk factors were identified and analyzed.

Results: Of the 45 consecutive patients treated with FURSL, four (8.9%) developed PRH. Compared with patients without PRH, patients with PRH had a lower body mass index (BMI; 20.2 ± 3.2 kg/m^2 vs 26.9 ± 5.5 kg/m^2, $p = 0.015$), thinner kidney cortex thickness (0.88 ± 0.41 cm vs 1.39 ± 0.41 cm, $p = 0.024$), and a history of chronic kidney disease (CKD; 75% vs 14.6%, odds ratio = 17.5, confidence interval = 1.55–197.46, $p = 0.021$). However, patient age, diabetes mellitus, hypertension, liver disease, coronary artery disease, history of urolithiasis, presence of multiple stones, and stone size and location were comparable in both groups. Three patients with PRH were successfully managed with conservative treatment. One patient with PRH underwent an emergency nephrectomy within 1 day but died 2 weeks later despite vigorous resuscitation.

Conclusion: Among our patients, those with lower BMI, CKD, and a thinner renal cortex had a higher risk of developing PRH after FURSL. Endourologists should have a heightened awareness for potential PRH when treating patients who present with low BMI, CKD, and a thin renal cortex.

1. Introduction

Many studies of ureteroscopic lithotripsy (URSL) using a holmium:yttrium–aluminum–garnet (Ho:YAG) laser have demonstrated its effectiveness and safety in managing ureteral stones. The major complication rates associated with using this treatment method are low, and Bai and associates[1] reported only 11 (0.4%) cases of perirenal hematoma (PRH) in 2848 patients who received URSL operations. In urological daily practice, PRH is a common complication of extracorporeal shock wave lithotripsy, renal trauma, and renal angiographic procedures.[2,3] In addition, PRH can occur spontaneously in patients with malignancy and patients on anticoagulation therapy.[4] To our knowledge, previous reports on PRH after flexible URSL (FURSL) are scarce.

With the advances in technology, FURSL is viewed as an alternative for managing proximal ureteral stones and renal stones in selected patients.[5] In previous reports, only two case reports mentioned PRH after FURSL.[6,7] However, we observed several episodes of PRH after FURSL in our institution and suspected that the exact incidence of PRH after FURSL might not be as low as suggested previously. When performing FURSL, the irrigation pressure is usually higher than the pressure in conventional URSL to maintain adequate vision.[8] We propose that high intrarenal pressure and other factors may be associated with postoperative PRH. However, more attention to this potentially serious complication is warranted. Therefore, to clarify the relationship between PRH and FURSL, we conducted a retrospective study to investigate the risk factors for developing PRH after FURSL.

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2. Materials and methods

After Institutional Review Board approval, we identified 45 consecutive patients treated with FURSL using the Ho:YAG laser for proximal ureteral stones and renal stones between January 2011 and September 2014 at a regional hospital (Identifier ECK-IRB1021006). Informed consent requirement was waived for this study, and patient information was retrospectively reviewed from a prospectively collected database that recorded the hospital chart data and complications of all patients treated with FURSL. Patient data included age, sex, body mass index (BMI), and medical history [e.g., chronic kidney disease (CKD), hypertension, diabetes mellitus, liver disease, and coronary artery disease]. In addition, information on stone laterality, location and size, operation time, and preoperative laboratory data was collected. For CKD staging, estimated glomerular filtration rate was calculated using the Chronic Kidney Disease Epidemiology Collaboration formula for each patient.[9] Patients who met the criteria for Stage 3 (moderately decreased glomerular filtration rate 30–59 mL/min/1.73 mm^2) or greater were defined as patients with CKD. Hematuria was defined as a red blood cell count greater than three cells/high-power field, pyuria was defined as a white blood cell count greater than five cells/high-power field, and significant bacteriuria was defined as greater than 10^5 colony-forming units.[10] Stone size and location were determined by either noncontrast computed tomography (CT) or a kidney–ureter–bladder X-ray. The degrees of hydronephrosis and postoperative PRH were diagnosed based on ultrasonography results and further confirmed by CT findings in suspected patients. PRH was defined as hematoma resulting from a perirenal hemorrhage. The degree of hydronephrosis was mainly defined by ultrasound and classified into the following four groups: no urinary system dilatation, mild dilatation of the renal pelvis, and moderate and severe dilatation of the renal pelvis and calices. The stone and hematoma sizes were measured at the maximum diameter on the radiograph. The measurement of renal cortex thickness was taken over a medullary pyramid, perpendicular to the capsule as the shortest distance from the base of the medullary pyramid to the renal capsule.[1]

All FURSL procedures were performed under light intravenous or general anesthesia in the lithotomy position. The whole operation was monitored using c-arm fluoroscopy. First, ureteroscopy was established with a semirigid 6.5-F ureteroscope (Richard Wolf GmbH, Knittlingen, Germany). A 0.035-in. hydrophilic floppy Nitinol core guidewire (HiWire; Cook Medical, Bloomington, IN, USA) was inserted into the renal collecting system. Next, a 12-F ureteral access sheath (Cook Medical, Bloomington) was inserted into the proximal ureter along the guidewire under fluoroscopic guidance. The flexible ureteroscope (X2; Karl Storz, Tuttlingen, Germany) was then advanced via the ureteral access sheath. Any stones were identified and fragmented using the Ho:YAG laser with a laser fiber diameter of 200 μm (Sphinx 30 Litho; LISA Laser Products, Katlenburg-Lindau, Germany). The laser energy was set at 1.0–1.5 J and a pulse rate of 5–10 Hz was used based on the surgeon's judgment. Stone fragmentation was considered complete when a particle size of approximately 2–3 mm was visible on fluoroscopy. Stone fragments were not extracted to avoid ureteral injury and save time. During the operation, we performed FURSL with a perfusion pressure of up to 200 mmHg. After the procedure, an indwelling 6-F double-J ureteral stent (Bioteq, Yilan, Taiwan) was placed in the ureter of each patient. The stent remained *in situ* for 2–4 weeks postoperatively until the patients were stone-free on follow-up radiography. Image protocols included kidney–ureter–bladder plain X-ray and renal ultrasonography to confirm PRH formation and to verify stone passage. CT scan would be arranged for patients who were suspected to have PRH or other critical conditions (e.g., unstable hemodynamics, severe flank pain, and urosepsis).

2.1. Statistical analysis

Means with standard deviations were calculated for parametric, continuous variables. Categorical data were expressed as numbers and percentages. Median values of continuous variables were compared using the Mann–Whitney *U* test, whereas categorical variables were compared using the Fisher exact test. A value of $p < 0.05$ was considered statistically significant.

3. Results

Among the 45 patients who underwent FURSL with the Ho:YAG laser, postoperative PRH occurred in four (8.9%) patients. Table 1 shows that these four patients were female with a mean age of 62.3 ± 13.7 years (range 50–76 years). The median stone size was 2.85 cm (range 0.9–5 cm). Three patients had renal stones including two staghorn stones and one lower calyx stone, whereas the remaining one had a stone in the ureteropelvic junction. Three patients with PRH had CKD and a thin renal cortex. One patient had been using aspirin but stopped using it 1 week before FURSL. This 76-year-old female patient (BMI 18.3 kg/m^2) developed a progressive huge left PRH (Figure 1) and hemodynamic instability several hours after the operation. Her serum hemoglobin level decreased from 10.3 g/dL to 6.1 g/dL. Emergency angiography showed a small left renal artery without active bleeding point. However, her vital signs remained unstable even under vigorous resuscitation and inotropic agents. She underwent an emergency open left nephrectomy. The operative finding showed thin renal parenchyma and a renal laceration (approximately 3 cm) in the lower pole. However, multiple organ failure and urosepsis occurred despite vigorous resuscitation. She expired 2 weeks after the nephrectomy.

Table 2 compares the demographic data, underlying medical diseases, and preoperative and postoperative characteristics

Table 1
Demographic data and clinical outcomes of the four patients with perirenal hematoma after flexible ureteroscopic lithotripsy.

Case no.	Sex	Age (y)	Stone site, size	Underlying disease	Anticoagulant use	Cortex thickness (cm)	OP time (min)	Management/outcome
1	F	72	Left staghorn stone, 3.5 cm	HTN, CKD Stage V	No	0.92	95	Conservative treatment/spontaneous resolution
2	F	51	Right staghorn stone, 5 cm	DM, HTN, CKD Stage IV	No	0.80	89	ICU and blood transfusion/spontaneous resolution
3	F	76	Left renal stone, 2 cm	DM, HTN, CKD Stage V	Yes, aspirin[a]	0.40	81	Emergency left nephrectomy/expired
4	F	50	Left UPJ stone, 0.9 cm	No	No	1.40	78	Conservative treatment/spontaneous resolution

CKD = chronic kidney disease; DM = diabetes mellitus; HTN = hypertension; ICU = intensive care unit; OP = operation time; UPJ = ureteropelvic junction.
[a] *Aspirin:* The patient used aspirin but stopped using it 1 week before the surgery.