PERCUTANEOUS NEPHROSTOMY FOR REMOVAL OF LARGE IMPACTED UPPER URETERAL STONES

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The treatment for patients with large impacted proximal ureteral stone remains controversial. Extracorporeal shock wave lithotripsy and ureteroscopic lithotripsy are the most popular treatment options due to their minimal invasive nature. However, percutaneous nephrostoscopic ureterolithotripsy is still important. Between June 2004 and March 2006, a total of 24 patients underwent percutaneous antegrade nephrostomy for the removal of large impacted proximal ureteral stones of size >15 mm. Combined ultrasonic and pneumatic lithotripters were used for the stone fragmentation. Twenty-three (95.8%) of the 24 patients were stone-free after one session of surgery. The mean operation time was 125.4±49.5 minutes (range, 45–170 minutes) and the mean postoperative hospital stay was 4.7±2.0 days (range, 4–12 days). Among the 24 patients, six experienced transient postoperative fever that could be controlled with appropriate antibiotics and supportive treatment, and two had blood loss requiring blood transfusion. We suggest that percutaneous nephrostoscopic ureterolithotripsy is a safe and efficient treatment option for the removal of large impacted proximal ureteral stones.

Key Words: percutaneous nephroscopy, ureteral stone, ureterolithotripsy


With advancements in endourology, the management of proximal ureter stones has changed profoundly. Before the development of extracorporeal shock wave lithotripsy (ESWL), open ureterolithotomy and fluoroscopic basket extraction were the only available treatment options for proximal ureteral stones. Post 1980, ESWL became the preferred treatment for both renal and ureteral stones removal due to its minimal invasive nature and was recommended as a first line therapy [1]. Recently, with the introduction of a small-caliber semi-rigid and flexible ureteroscopy, and the development of laser lithotripsy, almost every stone in the upper tract can be treated with retrograde ureteroscopy by a skilled surgeon. However, the treatment of large and impacted proximal ureteral stones remain controversial. The failure of ESWL and ureteroscopic lithotripsy treatments may require open surgery or laparoscopic ureterolithotomy. Percutaneous nephrolithotomy was introduced as an alternative treatment for large renal stones, and the percutaneous approach for treatment of proximal ureteral stones has also achieved some success [2,3]. Herein, we report our experience with the antegrade percutaneous approach for the management of large and impacted proximal ureteral stones.
Material and Methods

Between June 2004 and March 2006, a total of 24 patients (17 men and seven women) underwent percutaneous antegrade nephrostomy for the removal of large impacted proximal ureteral stones at Kaohsiung Municipal Hsiao-Kang Hospital. The criteria for the treatment included: (i) radio-opaque upper ureteral stone of 15 mm or more in diameter; (ii) located between the ureteropelvic junction and the upper border of the L5 vertebral body; and (iii) intravenous pyelogram (IVP) confirmed impaction of the stone showing no visible contrast media below the calculus on any IVP film. However, patients with the following conditions were excluded from the study: (i) renal insufficiency with creatinine >3.5 mg/dL; (ii) history of previous irradiation or pelvic surgery; and (iii) a persistent S-shaped bend in the ureter above the calculus on any IVP film or nephrostogram.

Nephrostomy tract puncture and dilatation were performed on the day before surgery. Standard techniques of puncture and creation of the tract were used. A chiba needle puncture was made with injection of contrast media under ultrasonic guidance to opacify the calyceal system. The middle or lower posterior calyx was chosen for puncture. Once the needle entered the pelvicalyceal system, a core guide wire was negotiated into the renal pelvis and across the pelviureteric junction into the ureter. The guide wire was coiled into the renal pelvis so that it could not be pulled out of the kidney accidentally. A high-pressure balloon dilation catheter (BlueMax; Boston Scientific, Natick, MA, USA) of 10 mm in diameter and 8 cm in length was used to dilate the nephrostomy tract to 30F.

The patient was laid in prone position under general anesthesia and a 26F rigid nephroscope was introduced through a 30F Amplatz sheath along the guide wire. Once the proximal ureteral stone was visible, a Swiss LithoClast Master (EMS, Switzerland), which is a combination of ultrasonic and pneumatic lithotripter unit, was used to break the stone into fragments. The fragments were then removed. A 6F semi-rigid ureteroscope was used in cases with stone downward migration. A double-J catheter was inserted where possible, and a nephrostomy tube was left in place for a few days postoperatively.

Operative findings, operation time, postoperative complications, and postoperative hospital stay were analyzed. Stone clearance was evaluated using a plain film of the kidney, ureter, and bladder taken on the third postoperative day. Stone-free was defined as no residual stone visible on the plain film.

Results

The mean age of the patients was 48.2±11.2 years and the mean size of the stone was 20.1±5.4 mm with a stone burden of 232.8±113.2 mm². The demographic and clinical characteristics of patients are shown in Table 1. All stones could be reached and treated through the nephrostomy tract. A combined lithoclast and ultrasonic lithotripter unit was used for all patients. The lithoclast probe produced larger stone fragments, removed with graspers and the ultrasound lithotripter produced smaller sandy fragments, aspirated through the hollow ultrasound probe.

Twenty-three of 24 (95.8%) patients had complete calculus clearance through one session of surgery. One patient required ESWL for residual downward migrated ureteral stone. The mean operation time was 115.4±49.5 minutes (range, 45–170 minutes) and the average postoperative hospital stay was 4.7±2.0 days (range, 4–12 days). Six patients experienced transient postoperative fever, and all cases were controlled with appropriate antibiotics and supportive treatment. Two patients had blood loss requiring blood transfusion. One patient experienced delayed renal hemorrhage due to excessive working and thus super-selective transarterial embolization of traumatic aneurysm was performed for pararenal hematoma and massive blood loss. No urinary tract perforation or adjacent organ injury occurred during the procedures. The operation-related complications are shown in Table 2.
patients with available stone analysis data, calcium oxalate monohydrate with carbonate apatite was found in 10 patients, carbonate apatite in two, and carbonate oxalate dihydrate in one. Stone composition did not influence the efficiency of fragmentation, operation time, or operation-related complications.

**DISCUSSION**

Since the development of ESWL and the advent of the small caliber ureteroscope, ureteroscopic lithotripsy (URSL) and ESWL have become the predominant methods for treating ureteral stones. Although ESWL is a safe and effective treatment for ureteral stones, this modality has its limitations. ESWL does not successfully break cystine stones, as these are harder than others and ESWL usually splits rather than fragments them [4,5]. Large stones may require several sessions of ESWL treatment. For a proximal ureteral stone of size <10 mm, the stone-free rate for ESWL monotherapy was 69.3% and for size >10 mm, the stone-free rate dropped to 59% [6]. Park et al [7] also reported that, regardless of the stone size, after a single session of ESWL for proximal ureteral stone, the stone-free rate was 72.4% (size <1.0 cm) and 42.1% (size >1.0 cm). The size of the stones was the most important factor influencing the success rate of ESWL treatment [6–8].

With the development of smaller and more flexible ureteroscopes, URSL became another choice for the treatment of proximal ureteral stones [9]. The advantage of URSL was immediate decompression of the ureteral obstruction. However, for the treatment of large impacted proximal ureteral stones, the stone clearance rate was highly dependent on the experience of the surgeon, with possible problems being failure to approach the stone due to a tortuous ureter and the stone migrating upwards into the kidney during the procedure [8,10,11]. The stone-free rate for proximal ureteral stones of size >15 mm after one session of URSL ranged widely from 35% to 87% [8,11].

Despite the advances of ESWL and ureteroscope with holmium:yttrium-aluminum-garnet (Ho:YAG) laser lithotripsy, the percutaneous approach for removal of ureteral stone continues to be important. The advantages of percutaneous nephroscopic ureterolithotripsy include: first, most impacted proximal ureteral stones are combined with edematous and polypoid ureter wall, which need more skill for the surgeon to remove the stone with retrograde ureteroscopy [10]. The dilated ureter and renal pelvis proximal to the stone offer more space for nephroscopic manipulation. Second, almost all developed lithotripter probes can be used during percutaneous nephroscopic ureterolitohripsy, including electrohydraulic lithotripter, pneumatic lithotripter, ultrasonic lithotripter, and Ho:YAG laser lithotripter. Compared with the standard ultrasonic device, the combination instrument could disintegrate and remove stones almost twice as rapidly [12]. Third, percutaneous nephroscopic ureterolithotripsy has the advantage in that any associated renal stone could be removed simultaneously [13]. In our series, 10 (41.6%) patients had combined renal stones, and in all but one both the renal and ureteral stones were removed simultaneously in one session of operation. Percutaneous nephroscopic ureterolithotripsy could achieve a total stone-free rate of 86–98.5% for stone size >15 mm [1,13], which is superior to any other treatment. In this study, the stone-free rate was 95.8% after at least 3 months of follow-up.

With recent advances in laparoscopic techniques, many urologic surgeries, including ureterolithotomy can be managed with the aid of a laparoscope. Recent series from various centers showed that both retropitoneal and transperitoneal approaches were feasible and safe [14]. Laparoscopic ureterolithotomy can achieve as high a success rate for large proximal ureteral stones as percutaneous nephroscopic ureterolithotripsy [15]. However, the long-standing impacted ureteral stones are usually accompanied by severe adhesion around the stone, increasing the difficulty of ureter identification and stone removal. The operative complication

<table>
<thead>
<tr>
<th>Operative findings</th>
<th>Patients, n (%)</th>
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<tbody>
<tr>
<td>Ureteral stenosis</td>
<td>7 (29.1)</td>
</tr>
<tr>
<td>Ureteral polyp</td>
<td>15 (62.5)</td>
</tr>
<tr>
<td>Postoperative complications</td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td>6 (25)</td>
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<tr>
<td>Significant blood loss</td>
<td>2 (8.3)</td>
</tr>
<tr>
<td>Perforation</td>
<td>0</td>
</tr>
<tr>
<td>Sepsis</td>
<td>0</td>
</tr>
<tr>
<td>Double-J catheter stenting</td>
<td>18 (66.7)</td>
</tr>
<tr>
<td>Stone-free</td>
<td>23 (95.8)</td>
</tr>
</tbody>
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most encountered in laparoscopic ureterolithotomy is urinary leakage, which is due to inflammatory local conditions and incomplete ureter closure [14,16]. The role of laparoscopic ureterolithotomy remains as a salvage procedure for failed ESWL or ureteroscopy and an alternative therapy to open ureterolithotomy.

The complications of percutaneous nephrosopic ureterolithotripsy are similar to those of percutaneous nephrolithotomy [13,17]. Bleeding is the main complication and fever is the most encountered complication [17]. During the procedure, bleeding from the renal parenchyma occurred due to the extremely vascular nature of the kidney. In most cases, bleeding can be managed conservatively, but about 2–5% of patients may require a blood transfusion and very rarely arterial embolization may be required [18]. In our series, delayed postoperative hemorrhage occurred in one patient 3 months after operation. Super-selective arterial embolization of the bleeding intrarenal vessel was performed. Infection, fever, or urosepsis are minimized by routine prophylaxis with broad-spectrum intravenous antibiotics. The incidence of transient fever was 25% in the present series and all cases could be managed conservatively with appropriate antibiotics, fluid supply, and bed rest. No patient experienced severe sepsis. Perforation of the collecting system is seen but major perforation is unusual. Most occur after advancement of dilators or sheath. Damage to various organs including liver, spleen, duodenum, or colon is reported in <1% of cases [19]. There were no injuries to surrounding organs or pneumothorax in our patients. We believe that this could be attributed to the appropriate puncture route under ultrasonic and fluoroscopic guidance.

In conclusion, we suggest that percutaneous nephrosopic ureterolithotomy remains a safe and efficient treatment option for proximal ureteral stone, especially when the stone size is >15 mm and the stone is impacted in the proximal ureter.

REFERENCES

經皮腎造瘻管處理大且箝閉在上端輸尿管的結石

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對於治療上端輸尿管結石的方法目前仍有爭議，體外震波碎石以及輸尿管鏡碎石術因為較不具有侵犯性，是最目前常使用的方法；然而經皮腎造瘻管碎石術仍然是個重要的手術方法。在 2004 年 6 月至 2006 年 3 月，共有 24 位患者因為上端輸尿管結石超過 15 公釐，並箝閉在上端輸尿管而接受經皮腎造瘻管手術處理。手術時使用合併超音波腎動脈碎石的震波頭來震碎結石。在 24 位患者中，有 23 位 (95.8%) 結石完全清除，平均手術時間為 124.5 ± 49.5 分鐘，範圍從 45 分鐘到 170 分鐘；平均手術後住院日為 4.7 ± 2.0 天，範圍從 4 天到 12 天。術後有六位患者有短暫發燒現象，利用抗生素以及支持性療法即可處理；兩位患者發生術中出血並需輸血的併發症。我們建議利用經皮腎造瘻管碎石術來治療大而箝閉在上端輸尿管的結石是一個安全而有效的方法。

關鍵詞：經皮腎造瘻管，輸尿管結石，輸尿管碎石
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