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ORIGINAL PAPER

An alternative treatment for high-burden ureteral stones: percutaneous antegrade ureteroscopy

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Abstract The treatment of large proximal ureteral stones continues to be controversial. We evaluated the antegrade percutaneous approaches for the proximal ureteral stones in our clinic. In this study, 73 percutaneous antegrade ureteroscopy (PAU) operations applied to proximal ureteral stones between February 2005 and December 2009 were included. The stones were located between ureteropelvic junction and 4th lumbar vertebra. PAUs were applied through appropriate calyx with the patients in prone position. During operations, amplatz dilatators were used for dilatation, and pneumatic lithotripter was used for stone fragmentation. Patients were evaluated according to their success rate, complications, hospitalization period, and preference of drainage tube etc. Patients' mean age was 52.21 years, the mean stone diameter was 19.47 mm (range 15–25), the mean stone burden was 283.76 ± 49.12 mm^2 (mean ± SD) (range 188.5–392.7) and the mean hospitalization time 1.69 days. Single access done in 68 patients and two accesses were needed in 5 patients. Sixty-eight patients (93.1%) became stone-free. Nephrostomy tubes were placed in 12 patients after operation, while tubeless approach was preferred in 61 patients. Complications were seen in five patients. There were not any complications reported during the follow-up period. PAU is an effective and safe treatment modality if appropriate calyx access was performed. The possibility of renal stone treatment in the same session is an important advantage of this modality.

Keywords Ureteral stone · Percutaneous antegrade ureteroscopy · Percutaneous nephrolithotomy

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Introduction

The goal of treatment of ureteral stones is achieving complete stone-free status with minimal morbidity. Shockwave lithotripsy (SWL) and ureteroscopy are welldefined and also popular minimally invasive treatment modalities for these stones. Despite their well-definition and popularity, there are many factors that affect the success of the treatment, such as stone location, stone size, renal or ureteral anomaly, sufficient equipment, and surgeon's experience. Proximal ureteral stones' treatment is still controversial because of the factors described above [1–5]. Besides these two methods, another treatment modality, percutaneous antegrade ureteroscopy (PAU) for ureteral stones must be kept in mind especially in impacted high-burden ureteral stones [6–9].

We have reviewed our PAU data and discussed its advantages and disadvantages according to the current literature.

Materials and methods

Between February 2005 and December 2009, we performed percutaneous nephrolithotripsy (PCNL) to a total of

1,037 renal-units, out of this, 970 patients received treatment for renal and/or proximal ureteral stones.

Seventy-three of these patients had proximal ureteral high-burden stones with concurrent renal stones or unsuccessful SWL treatment. We reviewed these patients' data after the approval of local ethics committee.

Before the surgery, all the patients were evaluated with complete blood count, creatinine levels, and urinary culture. Radiological evaluation was performed with intravenous urography (IVU) or non-contrast computerized tomography (NCCT) following KUB. Under general or spinal anesthesia with the aid of cystoscope, a 7F ureter catheter was entubed and attached to the urethral Foley catheter at lithotomy position. Subsequently, the patients were positioned to prone and all percutaneous accesses were performed in prone position. Visualization of the ureter with contrast medium was injected through ureteral catheter and accessed to the selected calyx with the aid of C-arm fluoroscopy and 18 G needle. Because of the impacted stones, we had difficulties during the visualization of the renal collecting system. We had to administer contrast medium with pressure to visualize the collecting system and when contrast medium could not pass to the collecting system, we used intravenous contrast medium to visualize the calyx or we performed blind access. The guide wire placed to the collecting system through the needle. The calyx was dilated with amplatz dilatators up to 30 F amplatz sheath. Twenty six F rigid nephroscope and 10 F ureteroscope (with a few patients) were used to perform the procedure, and then pneumatic lithotripter was used for the stone fragmentation. All fragments were quickly extracted to prevent migration to distal ureter or renal collecting system.

Peroperative residual stones and perforation of the collecting system were checked with fluoroscopy and pyelography at the end of the procedure. If there was a perforation in the collecting system and/or serious hemorrhage existed, a 14 F mallecot catheter was placed as a nephrostomy catheter and its localization was checked with antegrade nephrostography. Nephrostomy, double J stent, ureter catheter or totally tubeless method were chosen by the surgeon's preference, according to quantity of the hemorrhage, as draining catheter for the remaining patients. Urethral catheter was removed at the post-operative day 1.

All patients' hemoglobin and creatinine levels were checked in the first post-operative day in the morning. If there was a suspicion for perinephric collection, ultrasonography was performed. Patients were compared according to age, stone burden, operation time, post-operative hemoglobin change, blood transfusion rates, analgesic need, and hospitalization time. Statistical analysis was done by SPSS (Statistical Package for the Social Sciences) version 15.0. The *t* test is applied in the comparison of the data.

Results

The mean age of the patients was 51.5 years (range 29–75). The mean stone diameter was 19.47 mm (range 15–25) and the mean stone burden was 283.76 ± 49.12 mm^2 (mean $\pm$ SD) (range 188.5–392.7). A second access to collecting system was required for five patients because of the concurrent renal stones, while one access was sufficient for the remaining patients. The mean operation time was 58.06 ± 34.26 min (range 14–180) and mean hospitalization time was 1.69 ± 1.31 days (range 1–9). The creatinine levels were decreased insignificantly after the post-operation when compared with pre-operation ($p = 0.06$). Stone-free status was accepted as success, excluding the clinically insignificant residual fragments, and the success rate was 93.1% (68/73 patients). Five patients had residual stones; therefore, SWL was performed to one of them. Retrograde ureteroscopy was performed during the procedure to two out of five patients whose residual stones that migrated to distal ureter. The stone-free status was achieved for all the patients after these auxiliary procedures. The remaining patients' residual stones had passed spontaneously.

The nephrostomy catheter was removed after antegrade nephrostography following the normalization of the urine color. If it was placed, double J stents were removed at post-operative day 15 with cystoscopy under local anesthesia. If a ureteral catheter was placed, it was removed with Foley catheter in the morning following the procedure day. All results in details are shown in Table 1.

Complications occurred in five patients. Three patients had prolonged drainage (>24 h) after the removal of nephrostomy catheter, one patient had high fever (>38°C) and hematuria was seen in another one. Double J stents were placed in patients with prolonged drainage with cystoscopy and they were discharged after drainage stop. The patient with high fever recovered without any problems after administration of parenteral antibiotics for 3 days. The patient with hematuria, which had started on post-operative day 4, had a decrease on hemoglobin levels and hematuria stopped after angioembolization of A-V fistula determined by renal angiography.

Discussion

The treatment of urolithiasis has definitely changed during last 2–3 decades. SWL has been used as the first-choice treatment for ureteral and renal stones. Its advantages are: having an outpatient procedure, causing minimal loss of

Table 1 Characteristics and results of the patients

Age	52.21 ± 14.72 (24–79)
Sex (male/female)	22/51
Stone surface area	283.76 ± 49.12 mm^2 (range 188.5–392.7)
Stone diameter	19.47 mm (range 15–25)
Concurrent renal stone	29 patients (39.7%)
Only proximal ureter stone	44 patients (60.3%)
Impacted ureteral stones	38 (52%)
Unsuccessful retrograde ureterorenoscopy treatment	16 (21.9%)
Patients with previously open surgery	6 (8.2%)
Pre-operative creatinine level	1.13 ± 0.43 mg/dl (0.5–3.7)
Post-operative creatinine level	1.11 ± 0.37 mg/dl (0.5–2.6)
Access localization	36 (46.1%) middle calyx
	36 (46.1%) upper calyx
	6 (7.6%) lower calyx
	23 (29.4%) intercostal (above 12th rib)
	55 (70.6%) subcostal
Number of accesses	1.06 ± 0.25 (1–2) (total 78 accesses)
Access by guidance of IV contrast medium	4 (5.4%)
Blind access	2 (2.7%)
Nephrostomy (14 F)	12 patients (16.4%)
Tubeless (double J stent)	39 patients (53.5%)
Tubeless (ureter catheter)	19 patients (26%)
Totally tubeless (neither nephrostomy nor ureter catheter)	3 patients (4.1%)
Fluoroscopy time	3.35 ± 1.88 min (0–10)
Operation time	58.09 ± 34.26 min (14–180)
Hospitalization time	1.69 ± 1.31 days (1–9)
Complications	2 prolonged drainage, 1 hematuria (A–V fistula), 1 high fever (>38°C)
Exchange value of hemoglobin	1.71 ± 0.91 g/dl (0.4–4.6)
Success rate	68 patients (93.1%)

The values are in form of mean value ± SD

labor force, low complication rates, and having minimal invasive treatment. The success of SWL is strictly related to some factors, such as stone localization, burden, density, and number of the stones, renal, and ureteral anomalies. Impacted and high burden stones are especially resistant to SWL. This kind of stones may require multi-session treatment and long time to recovery [1–3].

Retrograde ureteroscopic lithotripsy is a minimally invasive treatment method for ureteral stones. It is a first-choice treatment method for distal ureter stones with high success rates [2]. In recent years, innovations such as small caliber ureterescops and laser lithotripters have increased its success rates. However, the success rates are still low for high burden and proximal stones [3]. In literature, the success rates of proximal ureteral stones greater than 1 cm ranges between 35 and 90%. The known complications of ureteroscopy are ureteral injury, post-operative fever, ureteral stricture and push-up of the stone. These complications are reported as 2–25% in literature [1–3]. In our opinion, percutaneous procedures have to be chosen for proximal ureteral stones with renal stones or dilated urinary system because of these factors. According to EAU 2009 urolithiasis guideline, SWL or ureteroscopy is first-line treatment for ureteral stones, but PNUL is an acceptable first-line treatment for four groups of patients: (1) high burden impacted ureteral stones, (2) ureteral stones with renal stones, (3) urinary diversion patients, and (4) unsuccessful retrograde ureteroscopic removal of high burden impacted stones [10]. The patients included in this study were carefully selected and had one or more requirements that mentioned above. Juan YS et al compared the stone-free rates of percutaneous ureterolithotripsy and retrograde ureteroscopic ureterolithotripsy. They reported them as 95.4–58%, respectively [11]. The stone-free rates of percutaneous ureterolithotripsy are reported between 86 and 98.5% in literature [2–9, 12]. Our data revealed the success rate of 93.1% for percutaneous ureterolithotripsy for proximal ureteral stones. The other and the most important advantage of PAU is the intervention to concurrent renal stone or other intrarenal pathology.

The impacted ureteral stones interrupt the urine flow; causing intrarenal/ureteral pressure to increase progressively, thus hydronephrosis occurs [11]. In our cases, majority of the patients had hydronephrosis because most of the stones (52%) were impacted, and the stone burden was high so that we did not have any difficulty in accessing to proximal ureter with the antegrade approach. But in two patients, we were unsuccessful to pass the nephroscope through ureteropelvic junction. Therefore, we had to use 10 F ureteroscope to access the stone. Some authors used ureteroscope routinely for percutaneous access [3, 4]. In our opinion, ureteroscope was not needed routinely because ureterohydronephrosis was developed in most of the patients. To have a clear view with an ureteroscope, there must be very few bleeding.

Percutaneous procedures can be performed safely even to collect system anomalies. Its only contraindications are bleeding disorders and pregnancy. Before the procedure, infections must be eradicated. The procedure can be performed under general, spinal or local anesthesia [2, 3, 13]. In recent years, there is an aim to make over the percutaneous renal surgery to less invasive. For this purpose, placing small caliber nephrostomy catheter, use of miniperc and tubeless percutaneous nephrolithotomy were experienced and there

were successful results with these. It has been reported that there were significant less hospitalization time and post-operative pain with tubeless percutaneous nephrolithotomy in selected patients. It can even be performed bilateral simultaneously [13, 14]. We performed tubeless percutaneous nephrolithotomy to 61 patients. Any kind of drainage catheter was placed to three of these patients, 19 of them had ureter catheter for a day and 39 of them had double J stents.

The other treatment modalities for ureteral stones are open ureterolithotomy and laparoscopic ureterolithotomy. Today open ureterolithotomy is very rarely used. It is used for very high-burden stones or if there are insufficient technical equipments. Muslumanoglu et al reported that they performed 56 open ureterolithotomy in a series of 654 ureteral stone treatments. Most of these were treated with minimally disabled invasive procedures. They concluded that the absence of flexible ureteroscope and laser lithotripter, have an effect on this [15]. In our study, some of the cases might be treated by flexible ureteroscope and laser lithotripter but our clinic does not have flexible ureteroscope and laser lithotripter. Laparoscopic ureterolithotomy, is the other modality. Basiri et al compared the three different treatment options with 150 patients, for each group of 50 patients; they performed retrograde ureteroscopic lithotripsy, laparoscopic ureterolithotomy and percutaneous ureterolithotripsy. They found the success rates as 76, 90 and 86%, respectively. Success rates were insignificant, but 17 patients from the groups of laparoscopy or percutaneous had prolonged drainage [16]. We believe that laparoscopy for the treatment of urolithiasis is very limited. The 2009-urolithiasis guideline of EAU indicates that laparoscopy has more morbidity and more complication rates than ureteroscopy and PAU. Laparoscopy is preferred in the cases suitable for open ureterolithotomy and must be kept in mind for renal anomalies, such as ectopic kidney [10].

Conclusion

PAU is a safe and easy to perform with low complication rates for high-burden proximal ureteral stones. PAU can be chosen especially for the patients with concurrent renal stones.

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