UIJ UroToday International Journal®

www.urotodayinternationaljournal.com
Volume 3 - August 2010

Management of Kidney Stones After Failure of Extracorporeal Shock Wave Lithotripsy

Yehya H. ElShebiny
Department of Urology, Adan Hospital, Kuwait City, Kuwait
Submitted May 15, 2010 - Accepted for Publication June 24, 2010

ABSTRACT

INTRODUCTION: The purpose of the study was to compare the outcome of flexible ureteroscopy (URS) and percutaneous nephrolitripsy (PCNL) following failure of extracorporeal shock wave lithotripsy (ESWL) for patients with renal stones.

METHODS: Participants were 66 adult patients with renal stones 8-20 mm in diameter. All patients had failed ESWL after a maximum of 2 sessions. Patients were assigned to treatment groups according to their choice. A total of 39 patients chose URS and 27 patients chose PCNL. Group differences in outcome measures were determined using Mann-Whitney and chi-square tests.

RESULTS: URS was technically successful in 31 cases; conversion to PCNL was done for the remaining 8 cases. The mean (standard deviation) operative time of 65 (15) minutes for the PCNL procedure was significantly shorter than the operative time of 115 (16) minutes for URS ($P < .001$). Conversely, the mean hospital stay of 1.19 (0.4) days and 1.09 (0.3) postoperative analgesic injections for the patients receiving URS were significantly shorter than the hospital stay of 5.28 (1.1) days and 3.2 (0.6) injections for the patients receiving PCNL (both $P < .001$). Revision of URS was needed in 4 cases; 2 of these patients became stone-free. One month postoperatively, the stone-free rate was 61% and 77% after URS and PCNL, respectively ($P = .162$). No patient in either group had significant complications.

CONCLUSIONS: Although the operative time was shorter for PCNL, URS is superior in terms of hospital stay and postoperative pain. Stone-free rates were not significantly different. These results help justify the preference of URS for treatment of kidney stones after failure of ESWL.

INTRODUCTION

Extracorporeal shock wave lithotripsy (ESWL) has been established as the standard procedure for small renal stones (maximum diameter of 20 mm or surface area of 300 mm²) because it is noninvasive, has a low rate of complications, and requires no anesthesia [1-3]. However, not all stones are amenable to crushing. Treatment after ESWL failure may be either flexible ureteroscopy (URS) or percutaneous nephrolithotomy (PCNL). The choice is usually made according to the surgeon's preference and expertise and the patient's informed decision.

There is no universal agreement in the literature to guide the surgeon in choosing one treatment method over another when ESWL fails. The aim of the present study was to compare the outcome of URS and PCNL after failure of ESWL for patients with renal stones.

KEYWORDS: Kidney stones; Flexible URS; PCNL

CORRESPONDENCE: Yehya Hassan ElShebiny MD, Division of Urology, Department of Surgery, Adan Hospital, Fahaheel, PO Box 46496, Kuwait City, 64015, Kuwait (yshebiny@yahoo.com).

CITATION: *UroToday Int J*. 2010 Aug;3(4). doi:10.3834/uij.1944-5784.2010.08.13

Abbreviations and Acronyms

ESWL = extracorporeal shock wave lithotripsy
PCNL = percutaneous nephrolithotomy
URS = ureteroscopy

METHODS

The investigation was a prospective study. Patients provided informed consent to receive the surgical procedure.

Participants

The participants were 66 adult patients with a history of failed ESWL after a maximum of 2 sessions. All patients had kidney stones that were 8-20 mm in diameter.

The URS and PCNL treatment procedures, potential complications, estimated hospital stay, stone-free rate, and the possible need for retreatment were described to the patient. Patients were assigned to one of 2 treatment groups according to their choice. Patients who chose URS were informed that in case of technical difficulty, surgery would be converted to PCNL. Patients who preferred watchful waiting after failed URS because they did not want a more invasive technique were not included in the study.

A total of 39 patients chose URS and 27 patients chose PCNL. Characteristics of mean age, male:female ratio, right:left side ratio, average stone size, and stone location are contained in Table 1. Patient ages ranged from 19-58 years and 22-51 years for those receiving URS and PCNL, respectively. There was no significant group difference in mean patient age (P = .639). The mean stone size was 1.4 cm and 1.6 cm for patients receiving URS and PCNL, respectively; patients receiving PCNL had a significantly larger stone size (P = .011). The majority of the stones were on the right side in the lower calyx for both groups. Three patients receiving URS had a single kidney.

Procedures

All procedures were done under general anesthesia.

URS Procedure. A 7 Fr flexible URS (Flex X2; Karl Storz GmbH Co, Munich, Germany) was threaded over a 0.038 inch hydrophilic wire. Its tip was coiled in the collecting system after the initial balloon dilatation of the lower ureter, if needed. Once the URS was in the kidney, the guidewire was removed. No other wires were used because while the URS is in the kidney it acts like a *safety wire* by itself. A 365 µm diameter holmium laser was used to crush the majority of stones; a 200 µm fiber was used for lower calyceal stones. If the stone was inaccessible because of the reduced maneuverability of the scope due to the presence of the laser fiber inside it, a grasper or tipless nitinol dormia basket was used to extract the stone from the lower calyx into a more accessible site, preferably in the renal pelvis or upper calyx. Stones were fragmented to gravel ≤ 2 mm in diameter. No attempt was made to extract stone particles. After complete fragmentation of the stone, a guidewire was passed to the kidney through the URS, and a double-J ureteral catheter was fixed routinely at the end of the procedure.

PCNL Procedure. Initially, an open-tip ureteric catheter was placed into the renal pelvis. Puncture into the desired calyx was completed under fluoroscopic guidance with the patient in the prone position. Stone crushing was done using pneumatic energy or a holmium laser, if a flexible nephroscope was needed. At the end of the procedure, a 20 Fr Malecot nephrostomy tube was inserted. The tube was removed when the urine was clear, the postoperative nephrostogram showed no extravasation, and there was free flow of contract down the ureter.

Table 1. Characteristics of Age, Sex, and Location and Size of Kidney Stones for Patients in Both Treatment Groups (N = 66).
doi: 10.3834/uij.1944-5784.2010.08.13t1

Characteristic	Patients Receiving URS (n = 39)	Patients Receiving PCNL (n = 27)
Age, mean (SD) years	37.4 (10.7)	35.7 (7.6)
Male:female (n ratio)	27:12	17:10
Right:left (n ratio)	16:23	12:15
Stone size, mean (SD) (cm)	1.4 (0.3)	1.6 (0.2)
Stone location		
Upper calyx	7	0
Middle calyx	9	6
Renal pelvis	9	5
Lower calyx	14	16

Abbreviations: URS, ureteroscopy; PCNL, percutaneous nephrolithotomy

A postoperative pain killer (pethidine 50 mg 1 M) was given according to patient demand following both surgical procedures. Stone-free status was determined by endoscopic view at the end of the PCNL procedure and by plain X-ray (or plain computed tomography for radiolucent stones) taken 4 weeks postoperatively.

Data Analysis

The Mann-Whitney test was used to compare the groups for measures of age, stone size, operative time, hospital stay, and number of postoperative analgesic injections. The chi-square test was used to compare the number of complications and the stone-free rate. Probability < .05 was considered statistically significant.

RESULTS

Of the 39 patients receiving URS, 31 patients had a successful procedure. URS was aborted and converted to PCNL for the remaining 8 patients because of technical difficulties in reaching or fragmenting the stones; all of these patients had lower calyceal stones. Therefore, PCNL was performed in 27 original cases plus the 8 conversion cases.

The outcome measures of operative time, length of hospital stay, need for postoperative analgesic, complications, need for retreatment, and stone-free rate after 1 month are contained in Table 2. The mean (standard deviation) operative time of 65 (15) minutes for the PCNL procedure was significantly shorter than the operative time of 115 (16) minutes for URS (P < .001). Conversely, the mean hospital stay of 1.19 (0.4) days and 1.09 (0.3) postoperative analgesic injections for the patients receiving URS were significantly shorter than the hospital stay of 5.28 (1.1) days and 3.2 (0.6) injections for the patients receiving PCNL (both P < .001).

Only 2 cases (6%) had a low-grade fever (38.2°C) after URS; no other complications were recorded. Complications of hematuria (not necessitating blood transfusion) and continuous urine leakage for more than 2 days after removal of nephrostomy tube were reported in about 12% of cases receiving PCNL. The group difference in the total number of complications was not statistically significant (P = .483).

Revision of URS was needed in 4 cases; 2 of these patients were rendered stone-free. When the patients were assessed 1 month postoperatively, the stone-free rate was 61% and 77% after URS and PCNL, respectively. The group difference in stone-free rate was not statistically significant (P = .162).

DISCUSSION

Currently, stone size is one of the most important factors in determining management of upper urinary calculi. According to European guidelines, ESWL is the first choice of treatment for renal stones < 20 mm [3]. However, other treatment options are needed if ESWL fails. Pardalidis et al [4] believe that PCNL should be considered the primary method for the treatment of lower pole stones after a single unsuccessful ESWL session. They reported a stone-free rate over 95% for stones < 10 mm to > 20 mm in size. Schilling et al [5] found that minimally invasive PCNL is justified for small lower pole stones, and Probst et al

Table 2. Outcome measures of Operative Time, Length of Hospital Stay, Postoperative Analgesic Usage, Complications, and Stone-Free Rate for Patients in Both Treatment Groups (N = 66). doi: 10.3834/uij.1944-5784.2010.08.13t2

Outcome Measure	Patients Receiving URS (n = 31)	Patients Receiving PCNL (n = 35)	*P*
Operative time, mean (SD) minutes	115 (16)	65 (15)	<.001
Hospital stay, mean (SD) days	1.19 (0.4)	5.28 (1.1)	<.001
Postoperative analgesic (No. injections)	1.09 (0.3)	3.2 (0.6)	<.001
Complications (n)			
Low-grade fever	2	0	
Hematuria	0	2	
Urine leakage[a]	0	2	
Total	2	4	<.001
Retreatment	4	0	
Stone-free rate after 1 month, n (%n)	19 (61%)	27 (77%)	.162

[a]More than 2 days after nephrostomy tube removal
Abbreviations: URS, ureteroscopy; PCNL, percutaneous nephrolithotomy

[6] showed that PCNL is superior to URS for the management of stones in the 1 cm to 2 cm range. Similar results were found by Chung et al [7], who compared PCNL with flexible URS and reported a stone-free rate of 87% and 67%, respectively. They also found minimal blood loss and a 10-minute shorter median operative time for PCNL. The complication rate was higher in the PCNL group, and there was a 48-hour difference in length of hospital stay.

Some authors have criticized the use of flexible URS with laser lithotripsy because it is a relatively expensive procedure when operation room time, repair cost, and expenditures for the laser fiber, guidewire, and stone baskets are considered. Lower stone-free rates with increasing stone size may indicate retreatment, with further increased costs [5]. Some authors also believe that the advantages of URS have been questioned because the procedure carries the morbidity of almost universal ureteral stent placement and secondary removal, which might offset its perceived benefits as the least invasive procedure [7]. Many authors believe that the choice of treatment ultimately depends on the individual surgeon's preferences and expertise.

In the present study, the author offered both treatment options to the patients without bias and found that flexible URS was chosen by almost 60% of the patients. This was somewhat surprising because of the shortcomings of lower expected stone-free rates, the possible need for retreatment, and the necessity of double-J stenting of the ureter, which were explained to the patients during preoperative counseling. One month postoperatively, 61% of the patients were stone free after URS, with only 10% (2 cases) requiring a second treatment. Successful URS spared the patients the risks associated with PCNL in creating and then dilating an artificial tract with the potential complication of bleeding, pleural or colonic injury, or postoperative urine leak. Other complications such as urinary tract infection, ileus, sepsis, hematoma, obstruction, perforation, transfusion, or arteriovenous (AV) fistula have been reported [8]. Obviously, renal complication would be more significant and even life-threatening in patients with a single kidney. In the present study, there were no significant intraoperative complications during URS, and only 2 patients (6%) had minor postoperative complications (low grade fever). This relatively low complication rate is probably due to the low threshold of conversion to PCNL once difficulty was encountered. In this study, failed access to the kidney was not considered a complication. In contrast, Pearl et al [9] added it to their complication list, raising their complication rate to 20%.

Although only 61% of the present patients were stone free following URS, the short postoperative hospital stay, relatively less patient inconvenience and postoperative discomfort, and minimum postoperative morbidity made these patients willing to have another URS procedure if they had recurrent stone. The short hospital stay is a major advantage for URS, and Pearl et al [9] reported that it can be reduced to a period as short as 0.06 day. The mean duration of hospital stay in the present study was 1.2 days, because the patients were routinely kept overnight in the hospital and were discharged the next morning if they were afebrile. With improvement in technology and refinement of the technique, the mean (SD) hospital stay after PCNL has also been reduced from 7.4 (4.5) days as reported by Carlsson et al in 1992 [10], to shorter periods like the 2.66 days (range, 1-7 days) reported by Albala et al in 2001 [8]. The mean duration of hospital stay after PCNL in the present study was 5.3 (1.1) days. Patients were kept in the hospital until the urine was completely clear.

The 61% stone-free rate after URS reported in the present study is relatively low, compared with others who reported success rates varying from 64% [11] to 84% [12]. This may be explained by the smaller number of cases in the current investigation. Another explanation is that there was no attempt to remove stone fragments during the present procedures for URS. Instead, fragmentation was continued until all stone particles were ≤ 2 mm. This also explains the long mean procedure duration of 115 (16) minutes in the present study, compared with the mean of 90 (43) minutes reported by Pearl et al [9]. The relatively long operation time as well as the frequent use of ureteric dilators before URS mandated the routine insertion of the double-J stent after the procedure in the present cases. Finally, the mean PCNL operation time was 65 (15) minutes, which is comparable to others such as the 79 (40) minutes reported by Carlsson et al [10] in 1992.

Many authors agree that the success of PCNL depends on factors like stone size and location. For example, Albala et al [8] reported a 95% success rate for PCNL, but this rate varied according to stone size; the rates were 100%, 93%, and 86% for stones 1-10 mm, 11-20 mm, and 21-30 mm, respectively. In the present study, PCNL completely cleared renal stones in 77% of cases, including those that were converted from URS. This figure is lower than the success rates reported by several authors [4,7,8] and it was not significantly different from the stone-free rate following URS. The higher stone-free rates reported by others may be at the expense of more postoperative patient discomfort and inconvenience.

CONCLUSIONS

After failure of ESWL for kidney stones 8-20 mm in size, URS has

the advantage of shorter hospital stay and less postoperative patient discomfort, but PCNL has the advantage of shorter intraoperative time. These results help justify the preference of URS for treatment of kidney stones after failure of ESWL, although PCNL is justified for lower calyx stones and can be the primary treatment choice without first attempting URS.

Conflict of Interest: none declared.

REFERENCES

[1] Srisubat A, Potisat S, Lojanapiwat B, Setthawong V, Laopaiboon M. Extracorporal shock wave lithoitripsy (ESWL) versus percutaneous nephrolithotomy or retrograde intrarenal surgery for kidney stones. *Cochrane Database Syst Rev*. 2009 Oct 7(4): CD007044.

[2] Tiselius HG, Ackermann D, Alken P, et al. Guidelines on urolithiasis. *Eur Urol*. 2001;40(4):362-371.

[3] Turk C, Knoll T, Petrik A, et al. Guidelines on Urolithiasis. European Association of Urology, 2010. http://www.uroweb.org/gls/pdf/Urolithiasis%202010.pdf. Updated April, 2010. Accessed July 12, 2010.

[4] Pardalidis NP, Andriopoulos NA, Sountoulidis P, Kosmaoglou EV. Should percutaneous nephrolithtripsy be considered the primary therapy for lower pole stones? *J Endourol*. 2010;24(2):219-222.

[5] Schilling D, Gakis G, Walcher U, Germann M, Stenzl A, Nagele U. Minimally invasive percutaneous treatment of lower pole stones with a diameter of 8 to 15 millimeters [in German]. *Aktuelle Urol*. 2009;40(6):351-354.

[6] Probst CE, Denstedt JD, Razvi H. Preoperative indications for percutaneous nephrolithotripsy in 2009. *J Endourol.* 2009;23(10):1557-1561.

[7] Chung BI, Aron M, Hegarty NJ, Desai MM. Ureteroscopic versus percutaneous treatment for medium-size (1-2 cm) renal calculi. *J Endourol*. 2008;22(2):343-346.

[8] Albala DM, Assimos DG, Clayman RV, et al. Lower pole I: a prospective randomized trial of extracorporeal shock wave lithotripsy and percutaneous nephrostolithotomy for lower pole nephrolithiasis-initial results. *J Urol*. 2001;166(6):2072-2080.

[9] Pearle MS, Lingman JE, Leveillee R. Prospective, randomized trial comparing shock wave lithotripsy and ureteroscopy for lower pole caliceal calculi 1 cm or less. *J Urol*. 2005;173(6):2005-2009.

[10] Carlsson P, Kinn AC, Tiselius HG, Ohlsen H, Rahmqvist M. Cost effectiveness of extracorporeal shock wave lithotripsy and percutaneous nephrolithotomy for medium-sized kidney stones. A randomised clinical trial. *Scand J Urol Nephrol*. 1992;26(3):257-263.

[11] Fabrizio MD, Behari A, Bagley DH. Ureteroscopic management of intrarenal calculi. *J Urol.* 1998;159(4):1139-1143.

[12] Sofer M, Watterson JD, Wollin TA, Nott L, Razvi H, Denstedt JD. Holmium:YAG laser lithotripsy for upper urinary tract calculi in 598 patients. *J Urol.* 2002;167(1):31-34.

doi:10.3834/uij.1944-5784.2010.08.13
ISSN 1944-5792 (print), ISSN 1944-5784 (online)