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Comparison of outcomes between laparoscopic ureterolithotomy and push back PCNL in the management of upper ureteric stone

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Conflicts of interest:
The authors declare that there is no conflict of interests regarding the publication of this paper.

Abstract:

Background: *Upper ureteral stones are a common issue. There are numerous treatment options available, including medical expulsive therapy, shockwave lithotripsy, ureteroscopic stone extraction, PCNL and laparoscopic ureterolithotomy. PCNL and laparoscopic ureterolithotomy are the main approaches for large upper ureteral stones.*

Objective: *To compare the outcome between laparoscopic ureterolithotomy and push back PCNL in the management of upper ureteric stone*

Methods: *In this prospective study 60 patients presenting with upper ureteric stone were selected. Patients with renal insufficiency (creatinine >2.5 mg/dL), morbid obesity, coagulopathy, concurrent renal and ureteric stones, pregnancy, sepsis, stone size more than 30 mm, orthopedic contraindications for prone position and those with a probability of inability to achieve safe access to the collecting system on pre-operative imaging were excluded from this study. Upper ureteric stones were removed from 30 patients by laparoscopic ureterolithotomy and by push back PCNL procedure from another 30 patient stones. Two procedures were compared based on stone clearance rate, complications, surgery time and postoperative hospital stay.*

Results: *The mean age of the laparoscopic ureterolithotomy group in this study was 41.83 ± 7.96 years and in push back PCNL group it was 42.23 ± 7.42 years (p = 0.841). Male patients were predominant than female patients in each group. Mean stone diameter of laparoscopic ureterolithotomy group was 22.90 ± 4.18 mm and in push back PCNL group it was 21.26 ± 3.85 mm (p=0.122). Mean operative time of laparoscopic ureterolithotromy patients was 1.42 ± 0.14 hours and in push back PCNL group it was 1.19 ± 0.09 hours, the difference between the procedures was statistically significant (p<0.001). In laparoscopic ureterolithotomy group postoperative prolonged urine leakage was found in 4 (13.3%) cases and postoperative fever in 1 (3.3%) case. Postoperative analgesic required in 6 (20.0%) cases in laparoscopic ureterolithotomy group and 7 (23.3%) cases in push back PCNL group. Transfusion required only in push back PCNL group (13.3%). Duration of post-operative hospital stay was significantly higher in laparoscopic ureterolithotromy group than push back PCNL group. In this study, stone clearance rate was 100.0% & 100.0% in both the groups.*

Conclusion: *Both laparoscopic ureterolithotomy and push back PCNL are similar in management of upper ureteric stone.*

Keywords: Laparoscopic ureterolithotomy, push back PCNL, upper ureteric stone.

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Introduction:

Urinary stone disease/urolithiasis is a common cause of morbidity and a recurring disorder with a 50% lifetime recurrence risk.[1] It is regarded as a disease with a significant socioeconomic impact that affects the quality of life. The treatment of upper ureteric calculus has changed dramatically as a result of technological advances in urology. Before introducing shock-wave lithotripsy (SWL) in 1980, the mainstay of treatment was open ureterolithotomy or basket extraction of stones under fluoroscopic guidance.[2] However, the blind basket extraction technique is now obsolete, and open ureterolithotomy has been replaced by laparoscopic ureterolithotomy, which is limited to a few indications, such as a large, impacted calculus that cannot be treated with SWL or endoscopic procedures. Because open surgery prolongs hospitalization and necessitates additional analgesic treatment for the patient, laparoscopic ureterolithotomy (LU) has recently emerged as an alternative management method. It has been proposed that LU has a similar success rate to open surgery and that it is superior to open surgery in terms of analgesic requirement, hospital stay, recovery, and cosmetic outcome.[3-5] Because of technological advances in fiber optics, better radiographic imaging, and various types of lithotripsy modalities, the development of minimally invasive surgical techniques for treating renal stones has largely revolutionized. Upper ureter stones can be accessed via retrograde, antegrade, or laparoscopic approaches. Retrograde techniques include extracorporeal shock wave lithotripsy (ESWL), rigid ureteroscopy (R-URS) & lithotripsy (R-URSL), and flexible ureteroscopy (RIRS). The percutaneous nephrolithotomy (PCNL) and mini-percutaneous nephrolithotomy (MPNL) are antegrade approaches (MPCNL). Pushback PCNL is a procedure that combines retrograde and antegrade procedures.[6,7] The main advantage of PCNL is that it has a higher success rate for larger stones because it is not affected by stone weight or composition like ESWL.[8,9] The dilemma of selecting the best technique for the patient based on its size and location persists. The main difficulty with retrograde techniques is proximal stone migration into a dilated system and the subsequent difficulty in breaking the stone as the stone moves continuously. This can be overcome using antegrade techniques, in which the stone is accessed when it is in a fixed location. In the absence of comparative data, clinicians are hesitant to declare an optimal treatment option for proximal large ureteral stones. As a result, a prospective, nonrandomized comparative study of the two procedures designed to treat upper ureteral stones, laparoscopic ureterolithotomy (LU) and push back PCNL, is presented here.

Methods:

In this prospective study 60 patients presenting with upper ureteric stone were selected between January 2021 and June 2022 over a period of one and half year. Purpose of the study was to compare the effectiveness of Laparoscopic ureterolithotomy and push back PCNL in patients having upper ureteric stone. Institutional ethical committee approval was obtained before the commencement of the study. The advantages and disadvantages of both procedures were explained to the patients preoperatively and written consent was taken. Intravenous urography or computed tomography (CT)-urography was performed in all the patients with normal renal function. Patients with deranged renal function underwent non-contrast CT-scan. Patients with renal insufficiency (creatinine >2.5 mg/dL), morbid obesity, coagulopathy, concurrent renal and ureteric stones, pregnancy, sepsis, stone size 30 mm, orthopedic contraindications for prone position and those with a probability of inability to achieve a safe access to the collecting system on pre-operative imaging were excluded from the study. Thirty patients scheduled for push back PCNL and another thirty patients scheduled for laparoscopic ureterolithotomy were enrolled in this study. In Laparoscopic ureterolithotomy (UL), after antiseptic skin preparation 3 ports/4ports [1 port was 5mm and other 2 were 10mm] was made in the abdomen. After mobilization of the colon medially ureter was identified and through the guidance of the ureter proximal ureter was be reached. Then stone was identified to see the bulging in ureter. Then laparoscopic incision was made on the ureter just over the stone and stone was be retrieved by stone grasper. A double – J stent was inserted to the ureter over a guidewire through suction canula after flushing the ureter proximally and distally. In push back PCNL, after asepsis and draping, under fluoroscopic guidance stone was pushback by ureteric catheter. Then patient was turned into prone position and under fluoroscopic guidance puncture of appropriate calyx was made with a translumber angioplasty needle. The needle was removed after insertion of a floppy tip J guide wire. Then the tract was dilated over the guidewire up to 20

to 22 Fr by using dilators and an Amplatz sheath was introduced. Then nephroscope was placed through the sheath. Smaller stones were removed using forceps or a basket but larger stones were fragmented prior to extraction. At the end of the procedure, a nephrostomy tube was left within the tract and a D-J stent was kept in the ureter. Anaesthesia and operative time were recorded. Stone-free status was defined as no residual stones or the presence of residual stones d"4 mm size on X ray KUB, and ultrasound sonography performed 1 month after the procedure. The follow-up was performed at 1, 3, 6, and 12 months' intervals. The two groups were compared regarding the stone clearance rate, operative time, complication rate, and mean hospital stay. The results are presented as mean with standard deviation in the case of quantitative data and frequency with the percentage in the case of qualitative data. All parameters were analyzed statistically using the unpaired t-text, Fisher's exact, and Chi-square tests. $P < 0.05$ was considered statistically significant

Results:

Table I. *Baseline characteristics of the study subjects (N=60)*

	Laparoscopicureterolithotomy	Push back PCNL	p-value
Age (years)			
30 - 39	10 (33.3)	11 (36.7)	0.866
40 - 49	12 (40.0)	10 (33.3)	
50 - 59	8 (26.7)	9 (30.0)	
Mean ± SD	41.83 ± 7.96	42.23 ± 7.42	0.841
Gender			
Male	20 (66.7)	18 (60.0)	0.592
Female	10 (33.3)	12 (40.0)	
HTN	9 (30.0)	11 (36.7)	0.584
DM	5 (16.7)	5 (16.7)	1.000
BMI (kg/m^2)	22.37 ± 5.27	25.76 ± 6.47	0.030
Stone size (mm)	22.90 ± 4.18	21.26 ± 3.85	0.122

Mean age of the study subjects was 41.83 ± 7.96 years and 42.23 ± 7.42 years in Laparoscopic ureterolithotomy and push-back PCNL group. There was no significant difference between the groups. Males were predominant in both the groups, and no statistical significance was between the two groups. HTN and DM were almost similar in both groups. BMI was significantly higher in Push back PCNL group than Laparoscopic ureterolithotomy.

Table II. Demographic profile of the study subjects (N=60)

	Laparoscopicureterolithotomy	Push back PCNL	p-value
Serum creatinine (mg/dl)	1.24 ± 0.12	1.28 ± 0.12	0.188
Preoperative Hb (mg/dl)	12.47 ± 1.20	12.77 ± 1.10	0.317
Postoperative Hb (mg/dl)	11.63 ± 0.99	11.53 ± 1.09	0.693

Serum creatinine, pre and postoperative hemoglobin was almost similar in both the procedures.

Table III. Post-operative complications of the study subjects (N=60)

Complications	Laparoscopicureterolithotomy	Push back PCNL	p-value
Prolonged urine leakage	4 (13.3)	0 (0.0)	0.059
Temporary fever	1 (3.3)	0 (0.0)	
Postoperative analgesic	6 (20.0)	7 (23.3)	
Transfusion	0 (0.0)	4 (13.3)	
No complication	19 (63.3)	19 (63.3)	

Urine leakage was found higher in Laparoscopic ureterolithotomy group and Postoperative analgesic and transfusion were required more in push back PCNL group.

Table IV. *Comparison between two procedures according to time of surgery, blood loss, post-operative hospital stay, time of catheterization of the study subjects (N=60)*

Complications	Laparoscopicureterolithotomy	Push back PCNL	p-value
Duration of surgery (hours)	1.42 ± 0.14	1.19 ± 0.09	<0.001
Blood transfusion	2.00 ± 0.00	1.97 ± 0.18	0.321
Blood loss (ml)	70.00 ± 26.12	240.66 ± 127.46	<0.001
Peroperative complication	2.00 ± 0.00	1.87 ± 0.35	0.039
Duration of postoperative hospital stay (days)	5.93 ± 0.83	2.70 ± 0.70	<0.001
Time of catheterization (days)	3.00 ± 0.00	1.47 ± 0.51	<0.001

Mean time of surgery, per-operative complications, postoperative hospital stay and time of catheterization was found to be significantly higher in Laparoscopic ureterolithotomy than push-back PCNL, whereas blood loss was found significantly higher in push back PCNL than Laparoscopic ureterolithotomy procedure.

Table V. *Comparison of pain between two procedures according to VAS of the study subjects (N=60)*

VAS score	Laparoscopicureterolithotomy	Push back PCNL	p-value
At 1 Hour	8.17 ± 1.18	8.50 ± 0.51	0.160
At 4 hour	6.87 ± 0.82	7.27 ± 0.45	0.023
At 8 hour	5.47 ± 0.63	5.70 ± 0.84	0.227
At 12 hour	4.10 ± 0.80	4.40 ± 0.62	0.111
At 24 hour	2.63 ± 0.56	2.97 ± 0.56	0.024
At 48 hour	1.50 ± 0.57	1.63 ± 0.72	0.430

Pain was little bit higher in push back PCNL procedure than aparoscopic ureterolithotomy procedure but at 48 hours there was no significant difference between the two procedure.

Discussion:

The mean age of the laparoscopic ureterolithotomy group in this study was 41.83 ± 7.96 years and in push-back PCNL group it was 42.23 ± 7.42 years (p = 0.841). Almost comparable result was found in the study done by Ahmed et al.[10] Male patients were predominant than female patients in each group. In laparoscopic ureterolithotomy group 66.7% patients were males and in push back PCNL group 60.0% patients were male (p=0.592). Similar male predominance was observed in the study of Ahmed et al. (2018). In the present study, the mean stone diameter of the laparoscopic ureterolithotomy group was 22.90 ± 4.18 mm with a range of 15 mm to 30 mm, and in push back PCNL group, it was 21.26 ± 3.85 mm with a range of 15 mm to 30 mm (p=0.122). Ahmed et al. revealed a mean stone diameter of laparoscopic ureterolithotomy patients it was 1.97±0.42 cm with the range of 1.20 cm to 2.60 cm and in PCNL group was 1.88±0.39 cm with the range of 1.06 cm to 2.45 cm (P=0.425).[10] Mean operative time of laparoscopic ureterolithotromy patients was 1.42 ± 0.14 hours and in push back PCNL group it was 1.19 ± 0.09 hours, the difference between the procedures was statistically significant (p<0.001). Ahmed et al. revealed that mean operative time of laparoscopic ureterolithotromy patients was 121.43 ± 19.91 minutes and in PCNL patients it was 94.13 ± 17.34 minutes (p= 0.001).[10] In this study, in laparoscopic ureterolithotomy group postoperative prolonged urine leakage was found in 4 (13.3%) cases and postoperative fever in 1 (3.3%) case. Postoperative analgesic required in 6 (20.0%) cases in laparoscopic ureterolithotomy group and 7 (23.3%) cases in push back PCNL group. Transfusion required only in push back PCNL group (13.3%). In the study of Ahmed et al., postoperative fever was observed in 2(6.7%) patients and 1(3.3%) in laparoscopic ureterolithotomy and PCNL group respectively.[10] Harewood et al. reported post-operative urine leakage in their 55.5% of laparoscopic ureterolithotomy patients.[11] In the study of Ahmed et

al.[10], 2(6.7%) PCNL patients & 1(3.3%) laparoscopic ureterolithotomy patients required blood transfusion in post-operative period, the difference of which was not statistically significant (p =0.573). Duration of post-operative hospital stay was significantly higher in laparoscopic ureterolithotromy group than push back PCNL group. Ahmed et al. revealed that mean hospital stay of laparoscopic ureterolithotromy group was 4.80 ± 1.71 days and in PCNL patients it was 3.73 ± 1.20 days, (p=0.017).[10] Goel et al. reported almost similar days of hospital stay in their laparoscopic ureterolithotromy patients, the mean of which was 3.3 days.[12] In this study, stone clearance rate was 100.0% & 100.0% in laparoscopic ureterolithotromy groups & push back PCNL group respectively. Similar finding was observed in the study of Ahmed et al.[10]

Conclusion:

Large upper ureteral stones can be treated with both laparoscopic ureterolithotomy and push-back PCNL. These two modalities are similar in many ways, such as success rate and complication rate, but differ in others, such as duration of surgery and hospital stay, which affects treatment cost indirectly. As a result, push-back PCNL appears to be slightly superior to laparoscopic ureterolithotomy for treating large upper ureteral stones.

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