



## Comparison Between Extracorporeal Shock Wave Lithotripsy and Ureteroscopic Stone Extraction in the Treatment of Ureteral Stones: An Observational Study

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#### ABSTRACT

Ureteral stones are a prevalent urological condition causing significant morbidity, including acute pain and urinary obstruction. Effective management is essential to alleviate symptoms, prevent complications, and restore normal urinary function. Among treatment modalities, extracorporeal shock wave lithotripsy (ESWL) and ureteroscopic stone extraction (URS) are widely used, offering distinct advantages and limitations based on stone characteristics and patient factors. This study aimed to compare the clinical efficacy, safety profiles and patient outcomes of ESWL and URS for the management of ureteral stones. The objective was to provide evidence-based insights to optimize treatment strategies. A longitudinal observational study was conducted at a tertiary healthcare center over one year, including 113 patients with upper and lower ureteral stones ranging from 5 mm to 20 mm in size. Patients underwent either ESWL or URS and outcomes were assessed through clinical evaluations, radiological imaging and follow-up X-rays. Data analysis utilized SPSS 16.0 with chi-square and Student's t-tests to determine statistical significance ( $p < 0.05$ ). URS demonstrated superior clearance rates for proximal stones and those larger than 10 mm, achieving complete clearance in 100% of cases compared to ESWL. ESWL was effective for smaller and distal stones, offering a non-invasive alternative. Postoperative complications were mild and comparable across both groups. Follow-up outcomes indicated a higher stone clearance rate for URS, reducing the need for repeat interventions. Both ESWL and URS are effective for ureteral stone management, with treatment selection dependent on stone size, location and patient preferences. URS is recommended for larger and proximal stones due to its higher efficacy, while ESWL remains viable for smaller, distal stones or non-invasive preferences. Individualized treatment planning is essential for optimal outcomes.

## INTRODUCTION

Ureteral stones are a common urological condition that can result in significant morbidity, including acute pain and obstruction of urinary flow. Effective management of these stones is critical to alleviate symptoms, prevent complications and ensure the restoration of normal urinary function. Among the various treatment modalities available, extracorporeal shock wave lithotripsy (ESWL) and ureteroscopic stone extraction (URS) are the two most widely utilized options. ESWL, a non-invasive procedure, employs high-energy shock waves to fragment stones into smaller pieces that can be naturally expelled via the urinary tract<sup>[1,2]</sup>. In contrast, URS is a minimally invasive endoscopic approach that allows direct visualization and retrieval or fragmentation of stones using advanced instruments, such as laser lithotripters or stone baskets<sup>[3]</sup>. Both modalities offer distinct advantages and limitations, with treatment selection often influenced by factors such as stone size, location, patient anatomy and the urgency of intervention. ESWL is typically preferred for smaller, mid-to upper-ureteral stones due to its non-invasive nature and minimal recovery time<sup>[4]</sup>. However, its efficacy may be limited in cases of larger or denser stones. Conversely, URS demonstrates higher success rates in managing complex or impacted stones regardless of size or location but is associated with a higher risk of procedural complications and longer recovery<sup>[5,6]</sup>. Hence this study was carried out to compare the Extracorporeal Shock Wave Lithotripsy Versus Ureteroscopic Stone Extraction in the Treatment of Ureteral Stones. The objectives of the study was to evaluate the clinical efficacy, safety profiles, patient outcomes, of ESWL and URS to provide insights into optimizing treatment strategies for ureteral stones.

## MATERIAL AND METHODS

The present study was conducted at a tertiary healthcare center after obtaining prior approval from the relevant authorities. This longitudinal observational study focused on cases of upper and lower ureteral stones treated using ureteroscopic stone extraction (URS) and/or extracorporeal shock wave lithotripsy (ESWL) for a comparative analysis of the effectiveness of both methods. The study was carried out over a period of one year, from [insert exact duration with month and year] and included 113 patients who met the inclusion and exclusion criteria. The inclusion criteria comprised patients of all age groups with stone sizes ranging from 5 mm-20 mm, located in the upper or lower ureter without distal obstruction. Stones were classified as upper or lower ureteral stones based on their position relative to the sacroiliac joint. Exclusion criteria included middle ureteral stones, pregnancy, cardiac pacemakers, bleeding diathesis, distal obstructions, uncontrolled hypertension and evidence

of sepsis. A complete clinical examination of participants was performed and diagnostic investigations such as X-ray KUB, ultrasonography (USG) and intravenous pyelography (IVP) were conducted to determine stone location and size. Kidney function was assessed using IVP. Patients underwent a thorough clinical evaluation, including history-taking and laboratory tests such as complete hemograms, blood sugar levels, renal function tests, coagulation profiles and urinalysis. Radiological assessments were utilized to localize stones and assess contralateral kidney function. For ESWL, patients were prepared with ECG monitoring and incremental energy application during the procedure, starting at 10 kV and increasing every 500 shock waves to a maximum of 3 kV. Fluoroscopy was used to monitor stone fragmentation. Patients received post-procedure care, including fluid intake, antibiotics, analgesics and follow-up X-rays at intervals to assess outcomes. In cases of URS, the procedure adhered to standard hospital protocols. Data were recorded on a predesigned questionnaire and analyzed using SPSS 16.0 and Primer software. Quantitative variables were compared using Student's t-test, while qualitative data were analyzed using the chi-square test, with a significance level of  $p < 0.05$ .

## RESULTS AND DISCUSSIONS

In the present study, the majority of the subjects in both groups were in the age group of 21-40 years (58.4%). Age distribution was similar across groups, with no significant difference. Most subjects were male, accounting for 74.3% of the total and males were more prevalent in the ESWL group (82.2%) compared to the URS group (69.1%). Pain was reported in 97.35% of the total subjects, with similar distribution across both groups. Haematuria was present in 52.21% of subjects, vomiting in 39.82% and fever in 14.16%. Gravelluria was reported in 20% of the ESWL group compared to 8.8% in the URS group, with an overall prevalence of 13.27% (Table 1). In the present study, proximal stones were more common (58.4%) compared to distal stones (36.3%). Stones larger than 10 mm were found in 57.5% of subjects, with a slightly higher prevalence in the URS group (60.3%) compared to the ESWL group (53.3%). A small proportion (5.3%) had stones not detectable on X-ray. There was no statistically significant difference between groups for the characteristics of ureteric stones on X-ray (Table 2). On USG, proximal ureteric stones were most common, seen in 60.2% of subjects overall, with no significant difference between groups. Stones larger than 10 mm were identified in 58.4% of the total population, with a higher prevalence in the URS group (61.8%) compared to the ESWL group (53.3%). Hydronephrosis was most often absent (63.7%), with mild to moderate grades present in 31% and severe hydronephrosis in

5.3% of cases (Table 3). In the present study, proximal stones accounted for 60.2% of the total cases. Stones larger than 10 mm were seen in 58.4% of cases, with similar distribution across groups. Hydronephrosis was absent in 42.5%, while Grade I and Grade II hydronephrosis were present in 27.4% and 23% of cases, respectively. Kidney function was compromised in 15% of subjects, with no significant difference between groups (Table 4). In distal ureteric stones, complete stone clearance was achieved in 88.9% of the ESWL group and 100% of the URS group, though the difference was not statistically significant ( $p=0.076$ ). Post-operative complications were observed in 77.8% of cases in both groups. The use of DJ stents was slightly higher in the ESWL group (61.1%) compared to the URS group (44.4%), but this was not statistically significant (Table 5). In proximal ureteric stones, complete stone clearance was significantly higher in the URS group (100%) compared to the ESWL group (81.5%) with a p-value of 0.04. DJ stent placement was similar between the groups ( $p=0.517$ ). Post-operative complications were reported in 18.5% of the ESWL group and 22% of the URS group, with no significant difference (Table 6). In ureteric stones  $\leq 10$  mm, complete clearance was higher in the URS group (100%) compared to the ESWL group (90.5%), though this difference was not statistically significant ( $p=0.108$ ). The use of auxiliary procedures and post-operative complications were comparable between groups, with no significant differences (Table 7). For stones  $>10$  mm, complete stone clearance was significantly higher in the URS group (100%) compared to the ESWL group (79.2%), with a p-value of 0.002. Post-operative complications were observed in 25% of the ESWL group and 28.6% of the URS group, with no significant difference. DJ stent usage was higher in the URS group (64.3%) compared to the ESWL group (58.3%), but the difference was not statistically significant (Table 8). At follow-up, complete stone clearance was significantly higher in the URS group (100%) compared to the ESWL group (84.4%), with a p-value of 0.003. Auxiliary procedure use was comparable between groups, with no significant difference ( $p=0.842$ ) (Table 10).

The primary treatment modality for ureteral stones remains a debated topic, with no definitive consensus. Currently, the most widely applied methods are extracorporeal shock wave lithotripsy (ESWL) and ureteroscopic stone extraction (URS). The choice between these two approaches often depends on the experience of the urologist and the availability of equipment [7,8]. While ESWL is non-invasive and does not require anesthesia, it demands more applications and follow-up visits to achieve satisfactory stone-free rates. Conversely, URS is typically a one-step procedure conducted under anesthesia with a higher initial success rate but involves a slightly increased risk of

procedural complications<sup>[9]</sup>. Ureteral stone prevalence has increased across all age groups, influenced by lifestyle changes and the rising prevalence of obesity. Women are particularly at risk due to factors such as hyperinsulinemia and hypertension. Preventative public health measures emphasizing lifestyle and dietary changes are critical<sup>[10]</sup>. In this study, most participants were aged 21-40 years (58.4%), consistent with findings that lithiasis peaks between the third and fourth decades<sup>[11]</sup>. Previous studies have also highlighted a higher prevalence of stones in males than females, with a male-to-female ratio of approximately 3:1<sup>[12,13]</sup>. Pain was the most common symptom, affecting 97.3% of participants, followed by haematuria (52.2%) and vomiting (39.8%). These findings align with literature that identifies pain as the hallmark symptom of ureteral stones. Other symptoms included fever (14.2%) and gravelluria (13.3%)<sup>[7,8]</sup>. Diagnostic imaging revealed varying efficacy. X-ray KUB failed to detect stones in 5.3% of cases, while ultrasonography had a false-negative rate of 2.7%. In contrast, intravenous pyelography (IVP) detected all stones. Kuuliala et al. demonstrated ultrasonography's limited sensitivity (79%) compared to urography<sup>[14]</sup>. Nevertheless, ultrasonography remains a valuable initial diagnostic tool due to its non-invasive nature. Stone size plays a pivotal role in treatment decisions. In this study, stones larger than 10 mm were found in 58.4% of participants. IVP detected compromised kidney function in 15% of cases. Hydronephrosis was present in 57.5% of participants, with significant associations between hydronephrosis and stone size or location. Grade I hydronephrosis was most common (27.4%), followed by Grade II (23%) and Grade III (7.1%). Proximal stones were more likely to cause hydronephrosis than distal stones (67.7% vs. 42.2%), and larger stones were more likely to cause hydronephrosis than smaller stones<sup>[7,8]</sup>. For distal stones, ESWL achieved an 88.9% clearance rate compared to 100% for URS. Both groups had comparable postoperative complication rates (22.2%), though URS required fewer sessions for complete clearance. Studies by Anderson et al. and Bozkurt et al. similarly reported higher clearance rates with URS<sup>[7,9]</sup>. However, other researchers, such as Bierkens et al., observed higher success rates with ESWL in selected cases<sup>[15]</sup>. Differences in clearance rates across studies may reflect variations in patient populations, stone characteristics, and operator expertise. For proximal stones, URS achieved 100% clearance compared to 81.48% with ESWL, a statistically significant difference. DJ stents were required more frequently in the URS group, though postoperative complications were comparable between groups. Findings from Bozkurt et al. corroborate the higher success rates of URS for proximal stones<sup>[9]</sup>. Lam et al. and Wu et al. also found URS to be superior for larger proximal stones<sup>[16,17]</sup>. In

**Table 1: Profile of Subjects in Two Groups**

		Treatment modality		Total (n-113) No (%)
		ESWL (n- 45) No. (%)	URS (n-68) No. (%)	
Age in years	<20	1 (2.2)	2 (2.9)	3 (2.7)
	21-40	26 (57.8)	40 (58.8)	66 (58.4)
	41-60	14 (31.1)	23 (33.8)	37 (32.7)
	61-80	3 (6.7)	3 (4.4)	6 (5.3)
	>80	1 (2.2)	0 (0)	1 (0.9)
Sex	Male	37 (82.2)	47 (69.1)	84 (74.3)
	Female	8 (17.8)	21 (30.9)	29 (25.7)
Pain	Yes	43 (95.6)	67 (98.5)	110 (97.35)
	No	2 (4.4)	1 (1.5)	3 (2.65)
Haematuria	Yes	26 (57.8)	33 (48.5)	59 (52.21)
	No	19 (42.2)	35 (51.5)	54 (47.79)
Vomiting	Yes	17 (37.8)	28 (41.2)	45 (39.82)
	No	28 (62.2)	40 (58.8)	68 (60.18)
Fever	Yes	7 (15.6)	9 (13.2)	16 (14.16)
	No	38 (84.4)	59 (86.8)	97 (85.84)
Gravelluria	Yes	9 (20)	6 (8.8)	15 (13.27)
	No	36 (80)	62 (91.2)	98 (86.73)

**Table 2: Characteristics of Ureteric Stone on X-Ray Between Two Groups**

Treatment modality		ESWL (n-45) No. (%)	URS (n-68) No. (%)	Total No. (%)
Laterality of stone in X-ray	Left distal	12 (26.7)	10 (14.7)	22 (19.5)
	Left proximal	12 (26.7)	23 (33.8)	35 (31)
	Right Distal	5 (11.1)	14 (20.6)	19 (16.8)
	Right Proximal	14 (31.1)	17 (25)	31 (27.4)
	No detection	2 (4.4)	4 (5.9)	6 (5.3)
Location of Ureteric stone	Distal	17 (37.8)	24 (35.3)	41 (36.3)
	Proximal	26 (57.8)	40 (58.8)	66 (58.4)
	Absent	2 (4.4)	4 (5.9)	6 (5.3)
Size of ureteric stone	<10 mm	19 (42.2)	23 (33.8)	42 (37.2)
	>10 mm	24 (53.3)	41 (60.3)	65 (57.5)
	No detection	2 (4.4)	4 (5.9)	6 (5.3)

**Table 3: Characteristics of Ureteric Stone on USG Between Two Groups**

Treatment modality		ESWL (n-45) No. (%)	URS (n-68) No. (%)	Total No. (%)
Laterality of stone in USG	Left distal	12 (26.7)	11 (16.2)	23 (20.4)
	Left proximal	12 (26.7)	23 (33.8)	35 (31)
	Right Distal	5 (11.1)	14 (20.6)	19 (16.9)
	Right Proximal	15 (33.3)	18 (26.5)	33 (29.2)
	No detection	1 (2.2)	2 (2.9)	3 (2.7)
Location of Ureteric stone in USG	Distal	17 (37.8)	25 (36.8)	42 (37.1)
	Proximal	27 (60)	41 (60.3)	68 (60.2)
	Absent	1 (2.2)	2 (2.9)	3 (2.7)
Size of ureteric stone in USG	<10 mm	20 (44.4)	24 (35.3)	44 (38.9)
	> 10 mm	24 (53.3)	42 (61.8)	66 (58.4)
	No detection	1 (2.2)	2 (2.9)	3 (2.7)
Hydronephrosis	Nil	31 (68.9)	41 (60.3)	72 (63.7)
	Mild	2 (4.4)	6 (8.8)	8 (7.1)
	Moderate	12 (26.7)	15 (22.1)	27 (23.9)
	Severe	0 (0)	6 (8.8)	6 (5.3)

**Table 4: Characteristics of Ureteric Stone on IVP Between Two Groups**

Treatment modality		ESWL (n-45) No. (%)	URS (n-68) No. (%)	Total No. (%)
Laterality of stone in IVP	Left distal	14 (31.1)	13 (19.1)	27 (23.9)
	Left proximal	12 (26.7)	23 (33.8)	35 (31)
	Right Distal	4 (8.9)	14 (20.6)	18 (15.9)
	Right Proximal	15 (33.3)	18 (26.5)	33 (29.2)
Location of Ureteric stone	Distal	18 (40)	27 (39.7)	45 (39.8)
	Proximal	27 (60)	41 (60.3)	68 (60.2)
Size of ureteric stone in IVP	≤10 mm	21 (46.7)	26 (38.2)	47 (41.6)
	>10 mm	24 (53.3)	42 (61.8)	66 (58.4)
Hydronephrosis in IVP	Nil	21 (46.7)	27 (39.7)	48 (42.5)
	Grade I	11 (24.4)	20 (29.4)	31 (27.4)
	Grade II	11 (24.4)	15 (22.1)	26 (23)
	Grade III	2 (4.4)	6 (8.8)	8 (7.1)
Kidney functions	Compromised	7 (15.6)	10 (14.7)	17 (15)
	Normal	38 (84.4)	58 (85.3)	96 (85)

**Table 5: Comparison of ESWL and URS in Distal Ureteric Stone**

Distal ureteric stone		ESWL (n-18) No. (%)	URS (n-27) No. (%)	Total	P-value
Auxillary procedure	DJ stent	11 (61.1)	12 (14.4)	23 (51.1)	0.273
	Nil	7 (38.9)	15 (55.6)	22 (48.9)	
Post-operative complication	Yes	4 (77.8%)	21 (77.8)	35 (77.8)	1.000
	No	14 (22.2%)	6 (22.2%)	10 (22.2)	
Clearance	Complete	16 (88.9)	27 (100)	43 (95.6)	0.076
	Incomplete	2 (11.1)	0 (0)	2 (4.4)	

**Table 6: Comparison of ESWL and URS in Proximal Ureteric Stone**

Proximal ureteric stone		ESWL (n-27) No. (%)	URS (n-41) No. (%)	Total	P-value
Auxillary procedure	DJ stent	15 (55.6)	26 (63.4)	41 (60.3)	0.517
	Nil	12 (44.4)	15 (36.6)	27 (39.7)	
Post-operative complication	Yes	5 (18.5)	9 (22)	14 (20.6)	0.732
	No	22 (81.5)	32 (78)	54 (79.4)	
Clearance	Complete	22 (81.5)	41 (100)	63 (92.6)	0.04*
	Incomplete	5 (18.5)	0 (0)	5 (7.4)	

\*Statistically significant

**Table 7: Comparison of ESWL and URS in Ureteric Stone <or Equal to 10 mm**

Ureteric stone ≤10 mm		ESWL (n-21) No. (%)	URS (n-26) No. (%)	Total	P-value
Auxillary procedure	DJ stent	12 (57.1)	11 (42.3)	23 (48.9)	0.312
	Nil	9 (42.9)	15 (57.7)	24 (51.1)	
Post-operative complication	Yes	3 (14.3)	3 (11.5)	6 (12.8)	0.779
	No	18 (85.7)	23 (88.5)	41 (87.2)	
Clearance	Complete	19 (90.5)	26 (100)	45 (95.7)	0.108
	Incomplete	2 (9.5)	0 (0)	2 (4.3)	

**Table 8: Comparison of ESWL and URS in Ureteric Stone >10 mm**

Ureteric stone >10 mm		ESWL (n-24) No. (%)	URS (n-42) No. (%)	Total	p-value
Auxillary procedure	DJ stent	14 (58.3)	27 (64.3)	41 (62.1)	0.517
	Nil	10 (41.7)	15 (35.7)	25 (37.9)	
Post-operative complication	Yes	6 (25)	12 (28.6)	18 (27.3)	0.754
	No	18 (75)	30 (71.4)	48 (72.7)	
Clearance	Complete	19 (79.2)	42 (100)	61 (86.4)	0.002*
	Incomplete	5 (20.8)	0 (0)	5 (13.6)	

**Table 9: Postoperative Complications Comparison Between Two Groups**

Post-operative complications	ESWL (n-45)	URS (n-68)	Total (n-113)
Haematuria	1 (2.22)	3 (4.4)	4 (3.54)
Pain	6 (13.32)	6 (8.8)	12 (10.62)
Stein strass	2 (4.4)	0 (0)	2 (1.8)
Ureteral injury	0 (0)	3 (4.4)	3 (2.7)
UTI	2 (4.4)	2 (2.94)	4 (3.6)
Overall Complications	11 (24.44)	14 (20.59)	25 (22.12)

Chi-square value: 0.069., p value: 0.793., non-significant

**Table 10: Outcome Comparison at Follow-Up Between Two Treatment Modalities**

		ESWL No. (%)	URS No. (%)	Total	P-value
Follow-up X Ray	Complete stone clearance	38 (84.4)	68 (100)	102 (93.81)	0.003*
	Incomplete stone clearance	7 (15.6)	0 (0)	7 (6.19)	
Auxillary procedure	DJ stent	26 (57.78)	38 (55.88)	64 (56.63)	0.842
	Nil	19 (42.22)	30 (44.12)	49 (43.37)	

stones ≤10 mm, both ESWL and URS achieved high clearance rates (90.47% and 100%, respectively). Postoperative complications were low and similar between groups. For stones >10 mm, URS demonstrated a higher clearance rate (100%) than ESWL (79.2%), consistent with Parker et al., who reported superior efficiency quotients for URS in managing larger stones<sup>[18]</sup>. Postoperative complications were mild and predominantly included pain, haematuria and urinary tract infections. ESWL had slightly higher complication rates than URS (24.44% vs. 20.59%), though this difference was not statistically significant. Wu *et al.* and Bozkurt *et al.* reported similar findings, highlighting manageable complication profiles for both modalities<sup>[9,17]</sup>.

## CONCLUSIONS

From the study it can be concluded that both treatment approaches were effective, but their efficacy varied depending on the location and size of the stones. ESWL showed good outcomes for smaller and distal stones, though URS achieved superior clearance rates across all subgroups, especially for larger and proximal stones. While ESWL is less invasive, it often

required auxiliary procedures like DJ stent placement, particularly for proximal stones, to ensure optimal outcomes. Postoperative complications were observed in both groups but were generally mild and manageable. The types and frequencies of complications did not differ significantly between ESWL and URS, suggesting that both procedures are relatively safe when appropriately indicated. URS demonstrated a higher complete clearance rate, making it more favorable for proximal stones and those larger than 10 mm. However, ESWL remains a viable option for patients with smaller, distal stones or those who prefer a non-invasive procedure. Follow-up results reaffirmed that URS achieves higher stone clearance, minimizing the need for repeated interventions. Although ESWL is associated with a slightly lower clearance rate, it offers the advantage of being non-invasive and well-tolerated, which may be preferable for selected patients. The choice of treatment should therefore be tailored based on stone characteristics, patient preferences and clinical judgment. This study underscores the importance of individualized treatment planning to optimize outcomes in ureteric stone management.

**Recommendations and Limitations:** Based on the findings, it is recommended that treatment modality selection for ureteric stones be tailored to stone characteristics, including size, location and patient-specific factors. URS is strongly advised for proximal stones and those larger than 10 mm due to its superior clearance rates and efficacy. ESWL, while less invasive, is best suited for smaller, distal stones or patients who prefer non-invasive options. Proper patient counseling regarding expected outcomes, potential need for auxiliary procedures, and postoperative care is essential to ensure informed decision-making. Despite its advantages, this study has limitations. The relatively small sample size and the lack of long-term follow-up may limit the generalizability of the results. Additionally, factors such as operator expertise, variations in equipment and patient comorbidities were not fully addressed, which could influence outcomes. Future research with larger, multicenter studies and extended follow-up is recommended to validate these findings and further refine treatment guidelines for ureteric stone management.

#### REFERENCES

1. Chaussy, C., E. Schmiedt, D. Jocham, J. Schüller, H. Brandl and B. Liedl, 1984. Extracorporeal shock-wave lithotripsy (ESWL) for treatment of urolithiasis. *Urology*, 23: 59-66.
2. Skolarikos A., and A. Papatsois., 2010. Advances in extracorporeal shock wave lithotripsy for urinary stone disease. *Expert, Rev. Med. Devices.*, 7: 599-607.
3. Traxer O. and A. Thomas., 2013. Advances in ureteroscopy: New technologies and techniques. *Nat. Rev. Urol.*, 10: 102-111.
4. Turk C.,T. Knoll and A. Petrik., *et al.* 2015. Guidelines on urolithiasis. *Eur Urol.*, 69: 475-482.
5. Matlaga B.,R. and D.G. Assimos., 2002. Ureteroscopic management of ureteral and renal stones. *J. Urol.*, 167: 1611-1619.
6. Zhang J., Q. Chen,H. Li, *et al.*, 2014. Comparison of ureteroscopy and extracorporeal shock wave lithotripsy for distal ureteral calculi: A meta-analysis. *Urology.*, 83: 797-802.
7. Anderson, K.R., D.W. Keetch, D.M. Albala, P.S. Chandhoke, B.L. McClennan and R.V. Clayman, 1994. Optimal Therapy for the Distal Ureteral Stone: Extracorporeal Shock Wave Lithotripsy Versus Ureteroscopy. *J. Urol.*, 152: 62-65.
8. Turk T.M. and A.D. Jenkins., 1999. A comparison of ureteroscopy to in situ extracorporeal shock wave lithotripsy for the treatment of distal ureteral calculi. *J Urol.*, 161: 45-46.
9. Bozkurt, Y., A.A. Sancaktutar, Y. Bostanci, M. Kapan and H.M. Çayci, 2010. Comparison of Extracorporeal Shock Wave Lithotripsy Versus Ureteroscopic Stone Extraction in the Treatment of Ureteral Stones. *Electron. J. Gen. Med.*, 7: 29-34.
10. Seitz, C. and H. Fajkovic, 2013. Epidemiological gender-specific aspects in urolithiasis. *World J. Urol.*, 31: 1087-1092.
11. Fetter, T.R. and P.D. Zimskind., 1961. Statistical Analysis of Patients with Ureteral Calculi. *JAMA.*, Vol. 186 .10.1001/jama.1963.03710010055008.
12. Stamatou, K.N., V.I. Karanasiou, R.E. Lacroix, N.G. Kavouras, V.T. Papadimitriou and Chlopsios., 2006. Prevalence of urolithiasis in Rural Thebes, Greece. *Ru. Rem. Hea.*, Vol. 6.
13. Ljunghall, S. and H. Hedstrand, 1975. Epidemiology of Renal Stones in a Middle-Aged Male Population. *Acta Med. Scand.*, Vol. 197 .10.1111/j.0954-6820.1975.tb04948.x.
14. Dall'Era, J.E., F. Kim and P.S. Chandhoke, 2005. Gender Differences among Hispanics and Caucasians in Symptomatic Presentation of Kidney and Ureteral Stones. *J. Endourology*, 19: 283-286.
15. Bierkens A.F., A.J. Hendriks and J.J. De La Rosette, et al., 1998. Treatment of mid and lower ureteric calculi: extracorporeal shock-wave lithotripsy vs laser ureteroscopy. A comparison of costs, morbidity and effectiveness. *Br J Urol.*, 81: 31-35.
16. Lam J.S., T.D. Greene and M. Gupta., 2002. Treatment of proximal ureteral calculi: holmium: YAG laser ureterolithotripsy versus extracorporeal shock wave lithotripsy. *J Urol.*, 167: 1972-1976.
17. WU, C.F., J.J. Shee, W.Y. Lin, C.L. Lin and C.S. CHEN, 2004. Comparison between extracorporeal shock wave lithotripsy and semirigid ureterorenoscope with holmium: yag laser lithotripsy for treating large proximal ureteral stones. *J. Urol.*, 172: 1899-1902.
18. Parker, B.D., R.W. Frederick, T.P. Reilly, P.S. Lowry and E.T. Bird, 2004. Efficiency and cost of treating proximal ureteral stones: Shock wave lithotripsy versus ureteroscopy plus holmium:yttrium -aluminum-garnet laser. *Urology*, 64: 1102-1106.