

Application of ureteroscopic pneumatic lithotripsy in patients with ureter calculi: Our five years experience

Ilhan Gecit¹, Necip Pirincci², Kerem Taken³, Erdal Benli⁴, Kadir Ceylan⁵

ABSTRACT

Objectives: To evaluate the efficacy and reliability of ureteroscopic pneumatic lithotripsy (URS-PL) in patients with ureter calculi.

Methodology: A total of 612 patients who were treated with URS-PL in Medical school of Yuzuncu Yil University, Van State Hospital and Bingol State Hospital in the period between April 2005-May 2010 were studied. Diagnoses of ureter stones were made with intravenous pyelography (IVP) or computerize tomography (CT). Ureteral balloon dilation was not performed on any patient. On the post-operative 1st, 7th and 21st days, control direct urinary system graphic (DUSG) was taken. The rates of stone free and complication were analyzed with the ki-kare test. $P < 0.05$ was accepted as significant.

Results: The mean age of the patients was 39 ± 10 (18-75). There were 417 males (68.13%) and 195 females (31.86%). The mean volume of calculi in patients was 10.1 ± 2.3 mm. Of these patients, 121 had proximal ureter stone, 169 medial ureter stones and 322 had distal ureter stones. In the first session of URS-PL, the calculi of 96 patients in proximal ureter (80%), those of 143 patients in medial ureter (85%) and those of 305 patients (95%) in distal ureter were cracked successfully. The mean stone free rate was 92.4% (79.4% in upper ureter, 94.1% in middle ureter and 93.7% in distal ureter ($P < 0.05$). Overall complication rate was 7.6% (7.7% in distal ureter, 3.9% in middle ureter and 11.8% in proximal ureter) ($P > 0.05$). Most common peroperative complications of the procedure were ureteral perforation 4,2% (n=26), infection 2.2% (n=14), and mucosal laceration 1.9% (n=12). The most common late complication was ureteral stricture in 1.3% (n=8) of patients.

Conclusion: Although URS-PL is a commonly used application for the treatment of patients with proximal and middle ureter stones, its common usage could also be extended to patients with distal ureter stones in the first stage of treatment, and it could be considered as an efficient and reliable procedure.

KEY WORDS: Ureterorenoscopy, Ureter stone, Pneumatic lithotripsy.

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INTRODUCTION

Ureteroscopy was first developed in the late 1970s for the detection & treatment of distal ureter pathologies.¹ The increase of experience and the rapid advancements in technologies have given rise to the intensity and frequency of these techniques. Although extra corporeal shock wave lithotripsy (ESWL) began to be used for the treatment of ureter stones in 1980s and the advent of this technology reduced ureteroscopic procedures for some period, majority of the patients with ureter calculi can now be treated successfully through ureteroscopic procedure.

Due to the difficulty of localization in distal and medial ureter stones and poor fragmentation, ESWL has a limited efficacy. The use of ureteroscopic lithotripsy has become more intense.^{2,3} The increasing benefit, efficacy and success due to ureteroscopy and intra-corporal lithotripsy in time has been credited to the development of efficient and flexible ureteroscopes, laser lithotriptors, and various other accessories.⁴ Pneumatic lithotriptors which were first introduced into the market in 1990s are now most intensely used in such procedures in our country due to the fact that they are cost efficient.⁴

This study was carried out in three different hospitals (2 public state hospitals and one university hospital) to demonstrate that ureteroscopic pneumatic lithotripsy (URS-PL) can be used commonly, efficiently and with a low complication rate in our country.

METHODOLOGY

A total of 612 patients who were treated with URS-PL in Medical School of Yuzuncu Yil University, Van State Hospital and Bingol State Hospital between April 2005-May 2010 were studied. Diagnoses of ureter stones were made with intravenous pyelography (IVP) or computerized tomography (CT). For the ureteroscopic examination, a rigid ureteroscope of 8.5 F/9.5 F (Karl-Storz, Germany) and for pneumatic lithotripsy a device branded as Elmed-Vibrolith (Ankara, Turkey) was used. Results were expressed as mean \pm standard deviation. Data were analyzed by using SPSS-13 for Windows (SPSS, Inc., Chicago, IL). The rates of stone free and complication were analyzed with the chi-square test. $P < 0.05$ was accepted as significant.

As part of the initial therapy URS-PL was applied to all patients. The volumes of stones were determined taking into consideration the widest diameter in direct urinary system graphic which was taken post-operatively. Total urine analysis of all patients together with urine culture and antibiogram were made preoperatively. Before the initiation of URS-PL, cystoscopy was routinely performed on the patients. During cystoscopy, guide wire was used. In those patients who were not feasible for the use of guide wire, the stone was accepted as impacted. Ureteral balloon dilation was not performed on any patient. Fortified forceps were used in the removal of fragmented pieces of calculi whereas pieces under three mm diameter were left for spontaneous fall. In those patients in whom laseration occurred in ureter and calculi migrated to proximal, double-J ureter catheter was implanted. The stone-free rates

in patients were determined by control direct urinary system graphic taken in the morning of the following day after operation and in the subsequent one week and one month.

RESULTS

A total of 612 patients underwent ureteroscopic procedure. The mean age of the patients was 39 ± 10 (18-75). Gender distribution ranged between 417 males (68.13%) and 195 females (31.86%). Male/female proportion was found to be 2.13. In 121 of them the calculi were seen in proximal ureter, 169 of them in medial ureter and in 322 the calculi were seen in distal ureter. The stone size was 5 mm on minimum and 21 mm on maximum, the mean size of calculi was found to be 10.1 ± 2.3 mm. In all of the patients, URS-PL was applied as part of the initial therapy. Stones were found to have been successfully cleared up after the first session URS-PL in the first month of follow-up in 96 of patients who had proximal ureter calculi (80%), in 143 of those who had medial ureter calculi (85%) and in 305 (95%) of those who had distal ureter calculi (Table-I). The mean stone free rate was 90% (80% in upper ureter, 85% in middle ureter and 95% in lower ureter ($P > 0.05$)). Seventy six proximal ureter stones (62.8%) were found to have been removed in the follow-up radiologic examination conducted next morning, together with 15 of them seen to have been cleared up (12.3%) in the first week control films and five of them in the first month control films. Overall complication rate was 7.2% (7.4% in distal ureter, 3.6% in middle ureter and 11.2% in upper ureter, ($P > 0.05$)). Most common perioperative complications of the procedure were ureteral perforation 4.2% ($n=26$), infection 2.2% ($n=14$), and mucosal laceration 1.9% ($n=12$). The most common late complication was ureteral stricture in 1.3% ($n=8$) of patients.

ESWL was performed on 15 patients (12.3%) who had proximal ureter calculi. Since calculi migrated to the kidney in 10 of these patients, and in five of these patients no access was made to the stone. The application of ESWL was considered to be imperative. Double J (DJ) stent was placed in seven of the patients (5.7%); and second session URS-PL was conducted. DJ stent was placed in a total of 38 patients (31.8%) only the three patients underwent open surgical procedure. Percutaneous nephrolithotripsy (PCNL) was applied to three patients whose calculi could not be cleansed in ESWL. In the control films taken in the following morning 102 (60.3%) of the patients who had medial ureter stones were found to have been cleansed from their calculi, 28

Table-I: The Localization and Stone-Free Rate of Ureter Stones Treated with Ureteroscopic Pneumatic Lithotripsy (URS-PL), Application of ESWL and the Replacement of DJ Stent.

The localization of calculi	Proximal	Middle	Distal	P
Stone-free rate (%)	80%	85%	95%	0.080
Complication rate(%)	11.2%	3.6%	7.4%	0.413

of them (16.5%) were cleared up from their calculi in the first week, and 13 of them (7.6%) in the first month of control films.

Radiologic examination revealed that in five patients who had medial ureter calculi, stones migrated to the kidney. A total of 20 patients (11.8%) underwent ESWL. Also, in one patient, access to proximal could not be made because of ureteral kink; and since DJ stent could not be placed, this patient underwent open surgical procedure. In five of the patients who did not respond to the procedure in the first session or when the first procedure became unsuccessful, second session URS was applied. DJ stent was placed in a total of 25 patients (14.7%). In the control films taken in the following morning, 215 of ureter calculi (66.7%) were found to have been cleansed from ureter, 75 of the calculi (23.2 %9 in the first week control films and 15 of the calculi (4.6%) in the first month control films. Seven of the cases (2.1%) who had distal ureter calculi underwent ESWL. In four of these patients, the calculi migrated to the kidney. Also, in one case, ureteroneocystostomy was applied due to ureter evulsion. Second session URS-PL was applied to 11 of the cases and two of them were post-ESWL cases. DJ stent was placed in 14 (4.3%) patients who had distal ureter stones.

DISCUSSION

Ureteroscopy is increasingly used nowadays in the diagnosis and therapy of many pathologies related with upper urinary system (Table-I). There have been many advances in the diagnosis and treatment of ureter calculi in the last two decades. At present, ureteroscopic extraction and ESWL are modalities evaluated as minimally invasive. Compared to each other, both of these modalities have interrelated advantages and disadvantages. The most important advantage of ESWL is that it does not require anaesthesia except for the children. However, the fact that calculi which can not be cracked by ESWL are easily cracked by URS-PL, and that URS-PL is not only used in the treatment of calculi but can be used for different purposes increases the efficacy of URS in a number different practices.⁵

The success rates of URS-PL up to 100% in the treatment of distal ureter calculi realized by experienced specialists and the fact that URS-PL in

Table-II: Comparative results according to stone localization of ESWL and URS series of ureter stones.

	ESWL			URS		
	Distal	Proximal	Author	Distal	Proximal	Author
Stone-free Rate	80%	72%	Park 1998 Cos 2000 Pace 2000	100%	92%	Gould 98 Peh 2001 Sozen 2003 Akhtar 2003
Mean stone free-rate	77%	70%		99%	71%	

those cases proved unsuccessful in ESWL should be taken into consideration.^{6,7} In a previous study, it was reported that the calculi of lower end ureter were treated with a success rate of 78% with ESWL and 93.3% with URS-PL; and in this study URS was defined as optimal treatment in the calculi of lower ureter.⁸ Consistently in our study, 305 of 322 patients (95%) were found to have been successfully cleansed from calculi through the application of URS-PL without a need of a second treatment.

Whereas URS-PL is superior to ESWL with its higher success rate in a single application, it has disadvantages like general anaesthesia, hospitalization and higher complication rate.⁹ Though flexible ureteroscopes have been technologically advanced in recent years, their visualizations are not as clear as the rigid ones. Besides, their basket, probe and irrigation channels make instrumentation restricted. The fact that they can be used in kinked-curved ureter where rigid ureteroscopy is unsuccessful and that they can visualize the whole intrarenal accumulating system make them more advantageous. However, the higher cost and fragility of these devices prevents them from being intensified in practical uses. Therefore, rigid ureteroscopy maintains its superiority especially in therapeutic interventions.¹⁰ Among the complications that may occur during URS-PL are escaping of the stone to the proximal, perforation, infection, mucosal laceration, false-road formation, escape of the stone to the outside of ureter and ureter evulsion. In our study, overall complication rate was 7.2% (7.4% in distal ureter, 3.6% in middle ureter and 11.2% in proximal ureter). Our complications were in accordance with the other clinical studies.^{11,12}

In one of our patients, evulsion developed; thus ureteroneocystostomy was performed. The reduction in complication rates is related with a much more adequate understanding of endoscopic anatomy, accurate detection and diagnosis as well as with the experience of endoscopists.

The use of routine DJ stent has only been recommended for those patients having ureter perforation.¹³ In the distal ureter calculi, we used this stent

in 14 patients (4.3%). In our clinic, we use ureteral stent only for those patients having ureteral laseration, perforation and excess of edema. The timing of URS application has changed since Leahy et al reported in 1989 that ureter obstruction effected renal functions.¹⁴ The commonly-held approach of spontaneous fall of stone shifted to the removal of the stone with an early detection and intervention in our days. Based on our experiences in the clinic, it would be much more tempting to say that URS-PL can be recommended as a first option with its higher success rate, cost-efficient benefit, availability and lower complication rate in the treatment of the lower ureter calculi.

According to the results obtained in literature, the effect of stone size on ureteroscopic results is getting smaller, whereas it effects ESWL results.⁴ URS-PL was shown to have a higher efficacy depending on the localization of calculi compared with ESWL (Table 2).¹⁵⁻¹⁸ In our study, a successful stone-free rate of 80, 85, 95% (mean 90%) in proximal, medial and distal stones were obtained through URS-PL application. Our results are in agreement with those in Table-II. It shows the distribution of success rates of URS series for ureteral calculi. The treatment options of those patients with morbidly excessive weight and having urinary system stone disease are limited. In this group of patients, ESWL and PNL may prove to be difficult or even impossible, and thus ureteroscopy is generally considered to be a treatment strategy of choice. In a study reported by Dash et. al. no difference was reported between patients having morbidly excessive weight and those with normal weight and having undergone ureteroscopy in terms of overall results.¹⁹ Similarly in our study, no difference was observed between patients with normal weight and those with heavy weight. In a previous study, the feasibility of semi rigid ureteroscopy was evaluated in major (>2cm) and impacted proximal ureter calculi.²⁰ These researchers reported a stone-free rate of 84% after a single session. The rest of the group which comprised 16% and which had artefacted stones were left stone-free with additional treatments. Thus, the total stone-free rate reached to 100%. As for our study, the size of the greatest ureter stone was 21 mm. A stone-free rate of 80% was obtained through a single session URS-PL.

CONCLUSION

Since URS-PL is an application efficiently used as a primary treatment modality in distal ureter stones, its use can also be extended to medial and proximal ureter stones reliably.

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Authors Contribution: This study was carried out in three different hospitals (two public state hospitals and one university hospital). Dr. İlhan Geçit, Dr. Necip Pirinççi and Dr. Kadir Ceylan work in same institution and together they have operated upon 312 out of 612 surgical cases. Dr. Kerem Taken works in another institution and operated upon 180 of these cases. Dr. Erdal Benli works in a different institution and has managed 120 of these cases. Dr. İlhan Geçit prepared the final manuscript.