

# Semirigid Ureterscopy with Pneumatic Lithotripsy for Ureteral Stone

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## ABSTRACT

**Background:** Ureteral stones present with acute loin to groin pain. The objective of this study is to find out the outcome and safety of semi-rigid ureterscopy with pneumatic lithotripsy for treatment of ureteral stones of >30 mm<sup>2</sup> and to assess the impact of size and location on stone free (SF) rate.

**Methods:** Total 110 patients with isolated ureteral stone size >30 mm<sup>2</sup> were included in this study and treated with pneumatic lithotripsy using 8/9.8 Fr. Semi-rigid ureteroscope (Stiema Germany). Stones were fragmented into 2-3mm particles and removed. Outcome parameters assessed at 3 months follow up were stone free rate(SF), Efficiency Quotient (EQ), and impact of stone size and site on SF/EQ was also analyzed. Similarly, patient demographics, procedures, patient related parameters and complications were also noted.

**Results:** The overall SF rate at 3 months follow up was 69.33% and efficient Quotient (EQ) 52.52%. The SF/EQ for upper, middle and lower third of ureteral stone was 55/37.67, 61/43.57, 92/84.40 respectively (P-value < 0.001). The SF for stone size 30-110 mm<sup>2</sup> and >110mm<sup>2</sup> was 78% and 67% respectively. There were no major complications seen. Overall minor complication rate was 5.45 % (minor ureteral perforations-5, urinoma formation 1).

**Conclusions:** Semi-rigid ureterscopy with pneumatic lithotripsy is a safe, simple and effective procedure for ureteral stones with excellent success rate for distal ureteral stones. The stone free rate and EQ are statistically significant (P value < 0.001) between upper, middle and lower ureteral stones. Stone size has a direct impact on the SF rate and EQ.

**Keywords:** semirigid uereterscopy, pneumatic lithotripsy.

## INTRODUCTION

Ureteral stones present with acute loin to groin pain. Majority of patients with ureteral stones of 10mm<sup>2</sup> or more require surgical intervention because these stones usually do not pass with medical expulsive therapy. The treatment is based on factors such as size and location of stone, availability of fully equipped endourological setup and patients preferences.<sup>1</sup>

Extracorporeal Shockwave lithotripsy (ESWL) also plays an important role especially for proximal small ureteral

stone.<sup>2,3</sup> Open Ureterolithotomy is no longer considered a valid option in well equipped endourological centre.<sup>4</sup> Recently in a prospective nonrandomized study, Ziaee and Colleagues have noted that ESWL and retrograde ureteroscopy to be equally efficacious for 10-15mm ureteral stones although stone clearance rate is longer period for ESWL group.<sup>5</sup> ESWL may be considered as a reasonable alternative with outcomes similar to those of ureteroscopy in patients with smaller stones (less than 10mm).<sup>6-8</sup>

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The objective of this study was to find out the outcome and safety of semi-rigid ureteroscopy with pneumatic lithotripsy for treatment of ureteral stones of >30 mm<sup>2</sup> and to assess the impact of size and location on stone free (SF) rate.

## METHODS

A prospective cross sectional study was conducted in department of surgery, Kathmandu Medical College from April 2009 to Dec 2010. Those patients who require urteroscopic fragmentation were included in the study. The inclusion criteria were age >15yrs and stones >30mm<sup>2</sup> diagnosed on intravenous urogram (IVU), ultrasound (USG) and kidney, ureter and bladder (KUB) X-ray. Patients with coexistence of a kidney stone, post shock wave lithotropsy (SWL) steinstrasse, previous history of open renal/ureteral surgeries were excluded. Additional functional studies like radioisotope scans were done if there is concern about the functional status of the renal unit.

Preoperative assessment included complete clinical evaluation and lab work up including complete blood count, renal function tests, urinalysis and culture. The stone size was measured on a plain KUB in two dimensions- stone length and width. The stone surface area is thus calculated as

$$\text{Surface area} = \text{length} \times \text{width} \times \pi \times 0.25$$

All patients underwent URS under spinal anesthesia with 8/9.8 Fr. Semirigid ureteroscope (Stiema, Germany). Access to the stone was made by using 0.038 with straight tip guide wire over which the ureteroscope was introduced. Intramural ureteral dilation was carried out in 15 patients using serial ureteral dilators because of tight ureteral orifice. In 3 patients, only DJ stenting was done and uretersocopy carried out after 7 days successfully. Pneumatic Lithotripsy was performed using 1mm probe breaking stone into 2-3mm size particles, which were allowed to pass spontaneously. After completion of the procedure, 6Fr Double J stent was placed in patients with residual stones, incomplete fragmentations, significant mucosal edema or ureteral trauma. The DJ stent is removed in 3 weeks.

X-ray KUB is obtained after 24 hours to exclude migration and another at 2 weeks and 3 months to assess the stone free rate Efficiency Quotient (EQ) was calculated using standard formula taking into considerations the retreatment rate. In case of larger ureteral fragments or failed expectant management, it is treated by placement of DJ stent and Ureteroscopy in 2 wks or adjuvant SWL

in 2 weeks. Proximal migration of stone to Kidney is subjected to SWL treatment. The statistical analyzed in statistical package for social sciences (SPSS) version 13 for windows.

## RESULTS

There were 110 patients with ureteral stones. The patients' demographic details and stone related parameters are given (Table 1).

**Table 1. Demographic and stone-related parameters.**

Age	36±12.1(16-71)
Sex	
Male	67%
Female	33%
Imaging studies	
IVU	71%
USG+ X-ray KUB	29%
Stone side	
Right	67%
Left	33%
Bilateral	0%
Stone site in the ureter	
Upper	22%
Middle	16%
Lower	62%

The mean surface area of stone was 70.5±14.1(30-142mm) 71% of the population had stone 30-110mm whereas 29% had stone >110mm. The mean stone clearance at 48hrs was 41%, 53% and 85%, at 2 weeks 48%, 59%, 90% and at 3 months 55%, 61% and 92% for upper, middle and lower ureteral stones respectively. The results were statistically significant for upper versus lower and middle ureteral stones. At three months, the overall SF rate was 69.33% and efficiency Quotient (EQ) 52.52% in single session of ureteroscopy. It was found that upper and mid ureteral stones have poor clearance than lower ureteral stones (P<0.0001). Similarly size of stone also affects the stone clearance. There was significant difference in the clearance of 30-110mm versus >110mm stones (P<0.004)

The mean operation time was 50± 12.7 minutes (13-105 minutes). Intramural dilatation was done in 15 patients using serial ureteral dilators because of tight vesico-ureteric junction. Proximal migration of stones into the kidney was noted in 8 patients where DJ stenting was done and treated by ESWL. In 69% of patients, DJ stenting was done at the end of procedure where mucosal edema, mucosal raised flap, ureteral perforations etc were noted.

**Table 2. Relationship of stone free rate and efficiency quotient with stone size and stone location.**

	SF rate	EQ	P-value
<b>Stone location</b>			
Upper			
Middle	55%	37.67	0.001
Lower	61%	43.57	
	92%	84.4	
<b>Stone surface area</b>			
30-110	78.2%	63.57	0.004
>110	67.5%	49.70	

Stone free= SF, Efficient quotient= EQ

## DISCUSSION

Ureteroscopy (URS) has gained widespread use for the treatment of ureteral stones >10mm although medial expulsive therapy using  $\alpha$  antagonists or calcium channel blockers augments increased stone expulsion rate of smaller stones.<sup>9</sup>

AUA guidelines suggest that both ESWL and URS be considered as initial treatment options for majority of the patents with ureteral stones requiring surgical treatment. However, patients should be informed that URS has better SF rate in a single procedure though complications rates are higher.<sup>10,11</sup>

ESWL is the least invasive treatment. However, its success rate is influenced by many factors such as stone size, fragility, chemical composition, impaction and radio density. In a study of 589 patients by Hyungkeun et al, SF after ESWL for stone <1cm is 83.6% but it dropped to 42.1% for stones >1cm.<sup>12</sup> They also stated that stone free rate with ureteroscopic manipulation was not affected by the size of stone: 88.9% for stones <1 cm and 86.6% for those >1.0 cm. Similarly in a comparative analysis of ureteroscopic holmium: YAG laser lithotripsy with ESWL for large impacted proximal ureteral stones, Wu and Colleagues found a significant (P<0.003) difference in SF rate and EQ of URS 92% and 59 versus 61% and 0.53 of SWL respectively.<sup>5</sup> In another study by Ziaee and Colleagues, SF rate for stones 10-15 mm in SWL and URS groups was found to be 72.5% and 78.6% respectively. Segura et al noted that SF rate for URS and SWL was 72% and 44% respectively for proximal ureteral stones > 1cm.<sup>10</sup> In a recent study by Tiselius, through SF rate in SWL group was 97.1%, average number of SWL sessions needed was 1.31.<sup>3</sup>

With advances in the development of fiber optic technology and smaller caliber ureteroscopes and

introduction of pneumatic and holmium: YAG lasers, SF rates after URS have greatly improved thereby decreasing the risk of complications. In a number of recent studies, it is recommended that ureteral stones especially the lower third are best treated with ureteroscopic fragmentation. Despite availability of several ureteroscopic fragmentation modalities, pneumatic lithotripsy remains most attractive and has proved to be safer as compared to electrohydraulic and laser lithotripsy. It is effective, affordable and simple to perform. The overall SF rate after URS using pneumatic lithotripsy in our series was 69.33% whereas for distal ureteral stones it was 92%. In a series by Hammad Ather M et al it was 74% and 92% respectively.<sup>9</sup> Stone free rates after URS using pneumatic lithotripsy in a study of 500 patients by Sozen S and Colleagues, was found to be 90.9% and 71.4% for stones of 1cm and >1cm respectively.

Improvements in Ureteroscopic instrumentation and techniques have resulted in a decreased incidence of serious complications. Complete ureteral avulsion is one of the most serious complications during URS. However, in a study of 1059 patients by Grasso M et al, no avulsions were reported. Ureteral perforation is the most reported complications of URS.<sup>15</sup> Overall perforation rates of less than 2% have been reported in a study by Johnson DB et al.<sup>16</sup> No ureteral avulsion was seen in our study. However, Ureteral perforations were seen in 5 patients with no postoperative morbidity in patients while urinoma was seen in one patient. The urinoma drained by USG guided pigtail catheter placement.

## CONCLUSIONS

Semirigid ureteroscopy with pneumatic lithotripsy is a safe, simple and effective procedure for ureteral stones with excellent success rate for distal ureteral stones. With increasing experience and in expert hands, serious complications are rarely seen.

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