

Evaluation of ureteroscopic pneumatic lithotripsy for ureteral stones

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ABSTRACT

Objective: To evaluate success rate, auxiliary procedures and complications associated with ureteroscopic pneumatic lithotripsy of ureteric stones.

Materials and Methods: The study was conducted among 100 patients between May 2011 and July 2013. The mean age of the patients was 32 ± 3 years. Ureteroscopic pneumatic lithotripsy was performed using rigid Wolf ureteroscope and Swiss Lithoclast devices. Stone diagnosis and localization was done by CT KUB without contrast. IVU was done in cases where indicated. Stone size ranged from 0.6 cm to 2.0 cm with mild to marked obstructive changes in collecting system. All patients had normal renal function test results.

Results: The majority of the patients (60%) presented with lower ureter calculi, 28% with upper ureter calculi and 12% with middle ureter calculi. The patients were followed up with plain X-ray KUB and USG for two months. Stone-free status was declared as complete clearance of stone fragments from the urinary tract. The overall success rate was 96%. Auxiliary procedures conducted included balloon dilatation of ureterovesical junction (67%) and of upper ureteric stricture (1%), retrograde urography (1%), dormia basket manipulation (88%) and D-J stent placement (87%). The complications encountered were mild transient hematuria (67%), migration of stone fragments (4%), urosepsis (2%), and residual stone fragments (4%), D-J stent associated discomfort (33%) and repeat procedure (2%).

Conclusion: Ureteroscopic Pneumatic Lithotripsy is an effective and safe treatment modality with unremarkable complications for ureteric stones.

Keywords: ureteroscopic, ureteric stone, pneumatic, auxiliary, balloon dilatation, stone migration.

INTRODUCTION

Urinary stones is a common and recurrent disease and as old as human civilization¹. Twelve percent of the population will have urinary stones during their life time and the recurrence rate reaches 50%². The oldest known urinary stone was found in a mummy dated 4800 BC¹. Urinary stone disease is most common in the people of Caucasian ancestry and those living in the stone belt of the subcontinent. Ureteral stones account for 54% of the urinary stones.

Ureteral calculi are a common disease in UAE. Endoscopic stone surgery is developing day by day and is highly popular among the people because of its minimal invasive nature. In this era open ureterolithotomy is a historical event. As

the stone sizes increase the chances of spontaneous passage of stone decrease³. Ureteral stones may cause interruption of urinary flow and progressive back pressure on the ureter and kidneys. It may lead to severe recurrent colicky attacks and hydronephrosis. If ureteral stones are left untreated impairment of kidney function may occur. There is a variety of treatment options available for ureteral stones such as extracorporeal shock wave lithotripsy (ESWL), ureteroscopic lithotripsy, percutaneous nephrolithotomy, laparoscopic ureterolithotomy and open ureterolithotomy⁴. All the procedures are reported with different efficacy rates and complications.

In our study we evaluated the

success rate, auxiliary procedures and complications associated with pneumatic lithotripsy for treatment of ureteric stones.

MATERIALS AND METHODS

The study was conducted among 100 patients between May 2011 and July 2013. Of these patients, 82 were male and 18 were female. Their age range was between 20 years to 70 years with a mean age of 32 years. Ureteroscopic pneumatic lithotripsy was performed with 8/9.5 rigid ureterorenoscope (R. Wolf Germany) and Swiss Lithoclast (Electromedical systems Switzerland). This device uses a 0.8 mm to 1 mm rigid probe connected to hand piece for stone fragmentation. Twenty patients were treated under general anesthesia and 80 patients under spinal anesthesia. Routine investigations performed included CBC, B.T, C.T, RBS, serum creatinine, serum urea, serum uric acid, and routine urinalysis. Urine culture and sensitivity was performed where indicated. Viral serology was done in all patients before surgery. Hydronephrotic changes were diagnosed by ultrasonography while stone diagnosis and localization were done by C.T KUB without contrast. Intravenous urography was done in one case where there was a history of ureterolithotomy. In the same patient retrograde urography was also performed during endoscopic surgery to locate the stenotic part of the ureter for balloon dilatation. Auxiliary procedures performed during endoscopic surgery were balloon dilatation of vesico-ureteric junction and of upper ureteric stricture, stone basket manipulation and Double-J stent placement after the end of the procedure. Foley catheter was inserted in all the patients at the end of the procedure. Stones were fragmented up to 2 mm to 3 mm size particles. Foley catheter was removed within 10-24 hours while Double-J stent was removed within 10-35 days. Prophylactic intravenous antibiotics were given to all patients at the time of anesthesia. Stone-free status was declared as the complete absence of stone

fragments from the urinary tract within two months of treatment. Fragmentation was considered successful when stones disintegrated into 2 mm to 3 mm size particles. All patients were discharged within 24 hours of treatment and were followed up at 15 day intervals up to two months with plain X-Ray KUB, urine analysis and abdominal ultrasound. Plain CT KUB without contrast was performed in patients where patients complained of persistent pain at operated site after removal of Double-J stent.

RESULTS

In our study among 100 patients, sixty (60%) had lower ureter calculi, twenty eight (28%) upper ureter calculi, and twelve (12%) presented with middle ureter calculi. The stone size range was between 0.6 cm and 2.0 cm, with a mean stone size of 1.50 cm. Successful fragmentation was achieved in 98% cases and stone-free status was observed in 96% cases. Stone fragment migration was observed in four cases (4%). However these patients were treated with Double-J stent and stone clearance was observed within two months. Stone-free status observed in the lower ureter was 59/60 (98.3%), in the middle ureter 11/12 (91.6%) and in upper ureter was 26/28 (92.8%) within two months of treatment. The main complications observed were transient mild hematuria in 67 cases that lasted for 1-4 days, stone fragment migration into the respective kidney in four cases and residual stone fragments in four cases at the end of two months. Residual stone fragments were observed in cases where stone size was around 2 cm. Urosepsis was observed in two patients. Clinically these patients presented with high grade fever with rigors. They were treated based on urine culture and sensitivity report. Double-J stent associated complications like urgency, frequency, terminal hematuria, pain in the corresponding flank at the time of voiding, painful micturition, heaviness in the perineum were observed in 33% patients. These

patients were treated symptomatically; however in two patients with urosepsis Double-J stent was removed early. Repeat procedure was performed in two patients. In these patients the stone migrated into the kidney. Following a Double-J stent and after one month the stone returned to the ureter, the procedure was repeated and complete stone clearance was observed within two months. Auxiliary procedures performed included balloon dilatation of ureterovesical junction in 67 cases (67%), stone basket manipulation in 88 cases (88%) and Double-J stent

placement in 87 cases (87%) at the end of the procedure. In one patient with history of ureterolithotomy retrograde urography was performed during the procedure and stricture was identified at operated site in the upper ureter. In this patient balloon dilatation of upper ureteric stricture was performed to get access to the stone. In our study no ureteric perforation was observed. ESWL treatment for residual stone fragments and percutaneous nephrostomy were also not required in any patient.

Table 1: Success rate according to stone location

STONE LOCATION	SUCCESSFUL FRAGMENTATION		STONE STATUS
	No. of cases	PERCENTAGE	No. of cases
LOWER URETER	60/60	100	59/60
MIDDLE URETER	12/12	100	11/12
UPPER URETER	26/28	92.8	26/28

Table 2: Complications

No.	COMPLICATIONS PERCENTAGE	No. of cases	PERCENTAGE
1.	Transient mild hematuria	67/100	67%
2.	Stone fragment migration into kidney	4/100	4%
3.	Complete stone migration into kidney	2/100	2%
4.	Residual stone fragments at the end of 2 months	4/100	4%
5.	Incomplete fragmentation	2/100	2%
6.	Urosepsis	2/100	2%
7.	Double-J stent associated complications	33/100	33%
8.	Repeat Procedure	2/100	2%

Table 3: Auxiliary procedures

No.	AUXILIARY PROCEDURE	No. of cases	PERCENTAGE
1.	Balloon dilatation of V-U Junction	67/100	67%
2.	Balloon Dilatation of Upper Ureteric Stricture	1/100	1%
3.	Retrograde Urography	1/100	1%
4.	Stone Basket Manipulation	88/100	88%
5.	Double-J stent Placement	87/100	87%

DISCUSSION

Two types of treatment modalities are popular for the treatment of ureteral stones: extracorporeal shock wave lithotripsy and intracorporeal (endoscopic) lithotripsy. The use of extracorporeal shock wave lithotripsy once approved by AUA as the treatment modality of choice⁵, is now progressively declining owing to its low success rate and advances and improvements in endoscopic instruments and fiber optics (intracorporeal lithotripsy)^{6,7}.

There are several intracorporeal lithotripsy alternatives such as electrohydraulic lithotripsy, ultrasonic lithotripsy, pneumatic lithotripsy and laser lithotripsy⁸ although the trend of laser lithotripsy is rising. The high treatment cost and ureteral tissue damage seem to be the main problems with this technique.

Among these treatment options we used pneumatic lithotripsy successfully for ureteral stone treatment.

According to the literature the overall success rate of ureteroscopic pneumatic lithotripsy varies from 90.6% to 92.3%^{8,10,11}. We achieved an overall success rate of 96%, which is relatively better than that reported in the literature. The mean stone size reported varies from 1 cm to 1.50 cm^{4,8,10,12}. In our study too, the mean stone size was 1.50 cm. These results show effectiveness of this ureteroscopic pneumatic lithotripsy for ureteric stones.

The success rate reported with upper, middle and lower ureteric stones is 84%, 89.7% and 95.6% respectively⁸. Our success rate for upper ureteric status is 92.8%, for middle ureteric stone 91.6% and lower ureteric stone 98.3%, which is relatively higher. Lutfi Tune et al⁸ described a low success rate in upper and middle ureter due to difficult access and associated complications. We did not have such experience of difficult access and associated complications as we used stone basket to engage especially upper and middle ureter stones, which

helped in adequate pulverization. Basket entrapment of stone also decreases upward stone migration.

Kurtulus et al⁹ reported in their study that stone-free rate after ureteroscopy was low in patients who underwent previous intraureteral manipulation. We have not noticed such a relationship in our study. The auxiliary procedure performed in our study included balloon dilatation of V-U junction in 67% cases. Balloon dilatation of upper ureteric stricture and retrograde urography was performed in 1 case (1%). This case had undergone uretholithotomy five years previously and had developed stricture at operated site. So urography and balloon dilatation were performed to get access to the stone. Other auxiliary procedure included stone basket manipulation in 88% and D-J stent placement in 87% cases. As we review literature the auxiliary procedures performed during ureteroscopy vary from study to study and include secondary ESWL 47%, second URS 5%, double-J catheter placement 33%, ureteral catheterization 69.2%, guide were stretching of U-V junction 14%^{8,13,14}. We feel that the difference in the use of auxiliary procedures is due to personal experience of the surgeon and the practice at the associated institution. The common things between our study and others is double-J catheter placement but we inserted double-J stent in 87% of cases while in the other studies it was around 33%; this difference is likely related to the personal experience of the surgeons. Double-J catheter insertion, although associated with complications, causes ureteral dilatation and also bypasses the ureteral obstruction secondary to post-operative ureteral edema and stone fragments following pneumatic ureteroscopic lithotripsy. This is the reason why evidence of post-operative ureteric colic is non-existent in our study while its reported incidence is 23%^{8,15}. Ureterovesical junction is a narrow point and it sometimes requires dilatation to get access to the ureter. We did balloon

dilatation of ureterovesical junction for easy access to the ureter in 67% of cases while others reported vesicoureteral junction stretching with two guide wires to get access to the ureter¹⁴. Dormia basket entrapment of upper and middle ureteric stone is the most important aspect of our study, which may explain why our results are comparatively better than others^{8,10,11}. Stone engagement in the basket has two important effects:

1. It reduces the chances of stone or stone fragment migration into the kidney.

1. It reduces the stone mobility in the ureter and the stone can be adequately disintegrated into 2-3 mm particles.

The complications encountered in our study associated with ureteroscopic pneumatic lithotripsy were transient mild hematuria (67%), stone fragments migration (4%), stone migration (2%), residual stone fragments (4%), urosepsis (2%) repeat procedure (2%) and D-J stent associated complications (33%). D-J stent associated complications were urgency, frequency, terminal hematuria, and flank pain during the micturation act, perineal heaviness and painful voiding. The reported complications associated with ureteroscopy and pneumatic lithotripsy were ureteral perforation (0.65%-1.3%), complete stone migration (3.8%), migration of fragments (3.2%), unsuccessful access to the stone with URS (2-5%), urosepsis (1.13% -4.5%), persistent hematuria (2.04%), renal colic (2%-23%), Ureteral stent migration (0.66%) ureteral avulsion (0.11%-3.75%), false passage formation (15%) and ureteral mucosal trauma (41.5%)^{5,8,14}.

In our study we did not encounter severe form of complications like ureteral perforation, ureteral avulsion, false passage formation and loss of ureteral segment. We feel that this is because of our long experience in endourology, and the use of adequate auxiliary procedures at the appropriate time. We also maintained high irrigation pressure during ureteroscopy. High irrigation

pressure keeps the ureteral mucosa away from the forward moving ureteroscope and gives good vision, with less evidence of false passage and ureteral perforation and ureteral avulsion. This is also reported by Taie K et al 2012⁷.

High irrigation pressure leads to increase intrarenal pressure which may lead to forniceal tear and hematuria⁷ (3). This would have resulted in the mild and transient hematuria which was found in 67% of cases. High pressure irrigation may not only be the cause of transient hematuria but ureteral mucosal trauma incurred during pneumatic lithotripsy is another cause of hematuria observed after treatment^{8,10}.

A limitation of this treatment modality is that ureteral stones could not be analyzed biochemically in all the patients. The stones pass in 2-3 mm particles during micturition. The patient does feel that something has passed but cannot collect it. Hence stone analysis is not possible. Thus the goal of taking prophylactic steps to prevent stone recurrence is difficult to achieve.

CONCLUSION

Ureteral stones account for 54% of the urinary stones and it is a common disease in UAE. Endoscopic stone surgery is popular among the people because of its minimal invasive nature. Although intracorporeal lithotripsy (ESWL) is noninvasive in nature, it has a significantly low success rate as compared to intracorporeal lithotripsy. Although the trend of laser lithotripsy is rising, its high treatment cost and inadvertent ureteral tissue damage seem to be the main limiting factors. In our opinion because of its cost effectiveness, adequate stone fragmentation, early stone clearance and high success rate, pneumatic lithotripsy could be considered as a first line treatment modality for ureteral stones that are up to 1.5 cm, in patients who need safe and early stone removal even in long term infection and obstruction. Furthermore physician expertise must also be considered.

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