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Outcome of Upper Ureteric Stone Management by in Situ Extracorporeal Shock Wave Lithotripsy and Intracorporeal Pneumatic Lithotripsy

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Abstract **Original Research Article**

Background: Ureteric stone disease is a common urological problem throughout the world. Treatment of ureteral stones depends on stone size, composition and degree of obstruction, pain, presence of infection, single kidney and abnormal ureteral anatomy. The aim of the present study is to evaluate and compare in situ ESWL and URS with pneumatic lithotripsy in terms of Stone clearance, duration of procedural time, duration of hospital stay and complications (fever, haematuria, ureteral injury, stone migration, stone clearance, steinstrasse, UTI, ureteral perforation)**.** ***Methods:*** A total of 80 patients were included in the study. 42 of them enrolled in ESWL group and 38 in pneumatic lithotripsy group. This is a Prospective Observational study. ICPL were done as day case surgery and ESWL were done as outpatient basis. ***Results:*** Intracorporeal pneumatic lithotripsy is better than in situ ESWL for the treatment of small non-impacted upper ureteric stone because it has more stone clearance rate and less complication like fever, haematuria, steinstrasse, UTI, ureteral injury and ureteral perforation. ***Conclusion:*** At the end of the study, it can be concluded that for the management of upper ureteric stones ICPL is a better option than in situ ESWL considering its greater stone clearance and less complications.

Keywords: Ureteric stone, pneumatic lithotripsy, haematuria, steinstrasse.

INTRODUCTION

Ureteric stone disease is a common urological problem throughout the world. Treatment of ureteral stones depends on stone size, composition and degree of obstruction, pain, presence of infection, single kidney and abnormal ureteral anatomy [1].

Urinary stones require active treatment due to its high prevalence, high recurrence rates and various complications [2].

Over the last two decades the management of urinary stone disease has radically changed. Open surgery has been almost completely replaced by minimally invasive and non-invasive procedure, mainly extracorporeal shock wave lithotripsy (ESWL) and ureteroscopy with lithotripsy. For both modalities stone free rates of more than 90%have been reported. ESWL and URS are regarded as effective modalities with low complication rate for upper ureteric stone.

ESWL is noninvasive procedure requires fewer anaesthesia than other treatment for ureteric stones, and may render patients stone free without surgical intervention or endoscopic procedures [3].

In situ extracorporeal shock wave lithotriosy for treatment of large ureteral stone has a stone free rate of 76% [4].

Improvement in ureteroscopic equipment has increased emphasis on the need for appropriate miniaturized and effective intracorporeal lithotripsy devices. Rigid ureteroscopy is primarily utilized in the distal ureter; whereas flexible ureteroscope is used in the upper ureter [5].

But in our subcontinent we frequently use rigid or semi rigid ureteroscope for dealing upper ureteric stone in selective patient. Ureteroscopy is a common procedure in Bangladesh and most of the urologists use pneumatic lithotripsy. Among ESWL and URS, there is

controversy as to which form of therapy is better suited to the management of upper ureteric stone. Some authors favour ESWL (El- Fagih *et al.,* 1988) while others prefer URS (Kapoor *et al.,* 1992) [6, 7].

The rational approach to management of upper ureteric calculi requires-assessment of efficacy, morbidity and cost associated with various treatment options [8].

OBJECTIVE

General

To evaluate and compare the outcome of in situ ESWL and ureteroscopic pneumatic lithotripsy for the treatment of upper ureteric stone.

Specific

To evaluate and compare in situ ESWL and URS with pneumatic lithotripsy in terms of:

- Stone clearance according to size of the stone.
- Immediate complications (fever, haematuria, ureteral injury, stone migration, ureteral perforation).

METHODOLOGY

Type of Study

This is a Prospective Observational study.

Place of Study

Department of Urology, National Institute of Kidney Diseases & Urology. Sher-e-Banglanagar, Dhaka.

Period of Study

July 2015 – July2016.

Study Population

Patients with upper ureteric stone age above 18 years of both sex admitted in the department of urology underwent URS. It was also done as Day case surgery. ESWL were done as outpatient basis.

Sampling Technique

Purposive sampling, the patients were purposively included in the study. Two cards were marked as group A (In situ ESWL) &group B (Pneumatic lithotripsy). All patients enrolled after considering all selection criteria.

Determination of Sample Size

A total of 80 patients were included in the study.42 of them enrolled in ESWL group and 38 in pneumatic lithotripsy group.

Selection Criteria

Inclusion Criteria

- Upper ureteric stone.
- Good renal function that is well excretion on both sides.
- Stone size 7mm to 1cm.
- Without any distal ureteric obstruction.

Exclusion Criteria

- Stone with infection.
- Multiple ureteric calculi.
- Pyonephrosis, bleeding disorder& pregnancy.
- Renal failure.
- Impacted stone.
- Diabetes and other comorbidities.

Methods of Data Processing and Statistical Analysis

All collected questionnaire were checked very carefully to identify the error in the data. Data processing work was consisting of registration schedules, editing computerization, preparation of dummy table, analyzing and matching of data.

RESULTS

Distribution of Cases According to the Size of Stone among 2 Groups

Total number of stones <8mm were 10. ESWL was done for 8 and Pneumatic lithotripy was done for 2 cases. 70 stones were >8mm. 34 of them went for ESWL and 36 of them went for Pneumatic lithotripsy.

Table-I: Distribution of cases according to the size of stone among 2 groups

Stone Size	ESWL	Pneumatic lithotripsy	p-value
<8mm	8(19%)	2(5.3%)	
>8mm	34(81%)	36(94.7%)	0.92

*Data were analyzed using Fisher's Exact Test.

Stone Clearance according to the Size in ESWL Group

All of the 8 stones of <8mm group show clearance but among the 34 stones of >8mm group, 24 show clearance and 10 show no clearance.

Table-II: Stone clearance according to the size in ESWL group

Stone Size	Yes	No	p-value
<8mm	8(21.1%)	0(0.0%)	0.572
>8mm	24(78.9%)	10(100%)	

*Data were analyzed using Fisher's Exact Test.

Stone Clearance according to the Size of Stone in Pneumatic Lithotripsy Group

Higher stone clearance rate was observed in less than 8mm group in both procedures. 2 stones of <8mm group showed clearance whether 30 of >8mm group showed clearance but 6 of this group showed no clearance.

Table-III: Stone clearance according to the size of stone in pneumatic lithotripsy group

Stone Size	Yes	No	p-value
<8mm	2(100%)	0(0.0%)	0.706
>8mm	30(83.3%)	6(16.7%)	

*Data were analyzed using Fisher's Exact Test.

7.1. Immediate Complications

Immediate complications of the procedure show that, fever occurred in 14 (33.3%) patients in ESWL groups whereas in 10 (26.3%) patients in pneumatic lithotripsy group. Severe haematuria occurred in 8(21.3%) patients of ESWL group and in 5(14.3) patients in pneumatic lithotripsy group. No ureteral perforation occurred in the ESWL and URSL group but ureteral injury occurred in 0(0.0%) and 2(21.3%) patients respectively in the in situ ESWL and the pneumatic lithotripsy group.

Table-IV: Comparison of immediate complications between groups

		Group	
Immediate complications	ESWL (n=42)	Pneumatic lithotripsy (n=38)	**p value**
fever[#]	14(33.3)	10(26..3)	o.494
Haematuria[#]	8(21.3)	5(14.3)	0.373
Ureteral injury[#]	0(0.0)	2(4.8)	0.272
Stone migration[#]	0(0.0)	2(4.8)	0.272
Ureteral perforartion*	0(0.0)	0(0.0)	0(0.0)

Figures in the parenthesis denote corresponding %; #X^2 Test was employed to analyze the date; *Fisher's Exact Test was employed to analyze the date.

Procedural Time between Two Groups

Procedural time was shorter in ESWL group than pneumatic lithotripsy group. 37.8±13.3 minutes were in ESWL group. Highest time was 51 minutes and lowest time was 24 minutes. Procedural time was 46.1±11.8 minutes in pneumatic lithotripsy group. Highest time was 58 minutes and lowest time was 34 minutes.

Table-V: Comparison of procedural time between two groups

		Group	
Variable	**ESWL (n=42)**	**Pneumatic lithotripsy (n=38)**	**p-value**
Procedural time(minutes)	37.8±13.3	46.1±11.8	0.005

*Data were analyzed using Student's t-Test and were presented as mean ± SD

Stone clearance rate after single session was somewhat higher in the pneumatic lithotripsy group, 32 (85.97%) than that in ESWL group 32(78.9%), (p=0.426). UTI developed 8(21.3%) in ESWL group and 5(14.3%) in ICPL group after one month of intervention (p=0.373). Stenistrasse was observed in 2(4.8%) patients of ESWL group, none in Pneumatic lithotripsy group. Pyelonephritis occured in 2(4.8%) patients of ESWL group.

Table-VII: Comparison of outcome after intervention.

Group			
Outcome variables	**ESWL (n=42)**	**eumatic lithotripsy (n=38)**	**p-value**
Stone clearance[#]	32(78.9)	32(85.7)	0.426
stenistrasse*	2(4.8)	0(0.0)	0.272
UTI#	8(21.3)	5(14.3)	0.373
Pyelonephritis*	2(4.8)	0(0.0)	0.272

Figures in the parenthesis denote corresponding %; # X^2 Test was employed to analyze the data; *Fisher's exact test was employed to analyze the data.

DISCUSSION

The present study has been designed to compare the outcome of ESWL and semirigid ureterorenoscopic pneumatic lithotripsy for the management of upper ureteric calculi.

The finding derived from data analysis leaves some scopes for discussion to arrive at a conclusion. All the variables of interest are discussed chronologically. Before comparing the outcome of interest both the groups should be compared in respect to demographic and baseline characteristics that might influence the outcome of treatment.

All cases were selected after evaluating renal functional status and IVU and observed per operatively for complications. Exclusion criteria for all cases were stone with infection, stone impaction, multiple ureteric calculi, bleeding disorder, pregnancy, renal failure and diabetes with other co morbidities.

Stone size, in a study conducted by Grasso *et al.,* (1994) was 10.2 mm in ESWL group but it was 9.8 mm for URSL group [3].

Parker *et al.,* (2004) divided the two groups of their study population into patients with less than 1 cm in size and patients with more that 1 cm in size.

Lam *et al.,* (2001) again divided their group of study into less than 1 cm and more than 1 cm group.

Immediate complications of the procedures in my study show no ureteral perforation in ESWL group and in URS group. Ureteral injury was 0(0.0) in in situ ESWL and 2(4.8%) in URS group. No stone migration was there in ESWL group, but 2 (4.8 %) cases were there in pneumatic lithotripsy group, Fever occurs more in ESWL group 14 (33.3%) but 10 (26.3 %) cases were in pneumatic lithotripsy group, p value 0.494 (not significant).

In a study, total 80 patients were enrolled 2 patients were excluded from the study due to open surgical conversion. So in ESWL group there were 41 and in URSL group there were 39 patients respectively. URS was performed with 6/7.5 Fr semirigid ureterorenoscope and energy source was pneumatic. In this study immediate complications were ureteric injury 5/39 (URSL), perforation 2/39 or sepsis 1/39. Two main complains were gross haematurea 6/41 (ESWL) and flank pain 5/41. (ESWL) (Fang *et al.,* 2004) [9].

In another study, out of 197 patients with 10-15 mm upper ureteric stone, URSL was conducted using a 7 Fr and 8.9 Fr semirigid ureterorenoscope and pneumatic lithotripsy was used. Here, major complications were ureteric injury 3/40 (URSL) or perforation 2/40 (URSL) or urosepsis 2/40 (URSL). Minor complains were flank pain 5/l26 (ESWL) and gross haematuria 7/126 (ESWL) were there, and were treated conservatively [10].

In many other studies conducted by different authors in different parts of the world for the treatment of upper ureteric stone by ESWL and ureterorenoscopy using Holmium: YAG laser, the stone clearance rate is much higher and complications are few than that of pneumatic source of energy.

Stone clearance after intervention (single session) in my study was 32 (78.9 %) in ESWL group & 32 (85.7%) in pneumatic lithotripsy group, p value = 0.426 (non-significant).

Stone clearance rate in a multicentered review study where different treatment categories were used, was 81%, 87% and 57% for push back, bypass and insitu ESWL group. And for URS it was 74 %. According to the author's transureteral stone manipulation before ESWL is of value. The possible explanation for this may be presence of stent which allows space for separation of the ESWL produced stone fragments as well as an increase in the stone fluid interface, thereby allowing more effective shock wave disintegration of stone and stent also allow for ureteral dilatation and further enhances the passage of stone remnants upon removal of the stent [11].

In a prospective randomized trial, a total 35 male patients and 7 female patients with a solitary 15 mm or more in diameter upper ureteric stone were delt with. Out of 22 patients 14 (63.6%) were made stone free by ESWL after single session treatment. But in URS group out of 20 patients 7 (35%) were stone free after one session of URS. 8 patients underwent auxiliary ESWL for residual renal (resulting from upward migration) or ureteral stone. 2 patients were converted to open ureterolithotomy immediately because of ureteral perforation in 1 and an inaccessible stone in the other. The remaining three with residual stone refused further treatment and excluded from the study [12].

To compare the safety and cost effectiveness of ureteroscopic pneumatic lithotripsy with ESWL for proximal ureteric stone 220 patients were enrolled in the study. Stone free rate after single session treatment with semirigid ureteroscope was 83.2% but in case of ESWL it was 63.9% [9].

In my study, comparisons of complication after intervention show steinstrasse in only 2 (4.8%) patients of ESWL group whereas no patient in pmeumatic lithotrypsy group. P value 0.272 (non-significant). Pyelonephritis was somewhat lower in URS group 0(0.0%), but in ESWL group it was 2(4.8%), p value 0.272 (non-significant). UTI in ESWL

group was 8 (21.3%) & in pneumatic lithotripsy group it was 5 (14.3%), p value 0.358 (non-significant).

Considering the outcome it is seen that both study group experienced a favorable outcome. But the clinical outcome of in situ ESWL group did not differ significantly (statistically) from that of semirigid ureterorenoscopy with pneumatic lithotripsy group. Some complications like fever, haematuria, UTI, pyelonephritis occurred more in in situ ESWL group. But there is no significant difference in results of complications.

CONCLUSION

From the present study, it can be concluded that for the management of upper ureteric stones ICPL is a better option than in situ ESWL considering it's greater stone clearance and less complications.

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