Original Article

Outcome of Pushback Stenting and ESWL Versus in Situ ESWL for Upper Ureteric Stone -A Comparative Study

Rahman MM[1], Ahmed M[2], Khan MR[3], Hossain MS[4], Islam KN[5], Alam MJ[6], Karmaker U[7], Ferdous B[8], Mallik AU[9]

Abstract

Background: *Urolithiasis is one of the most prevalent urological disorders and the prevalence of urinary stones has increased world wide[1]. The management of urinary calculi was revolutionized by the introduction of extracorporeal shockwave lithotripsy (ESWL) in 1980 and the first successful ESWL treatment was accomplished in Germany by Dr. Christian Chaussy using a Dornier HM1 lithotripter. ESWL is a safe, effective and non-invasive method[2].* ***Purpose:*** *To observe the outcome of pushback stenting and ESWL versus in situ ESWL for upper ureteric stone.* ***Materials and methods:*** *It was a quasi-experimental study. The study was under went in the department of urology, Dhaka Medical College and Hospital, between July'2012 to June'2014. Total 60 patients of single upper ureteric stone who satisfy inclusion and exclusion criteria were enrolled in this study. Selected patients were dived into two groups, group A and group B. Group-A for pushback stenting and ESWL and group-B for in situ ESWL. Results were compared in terms of clearance rates, number of shock waves, sessions, incidence of complications and failure rate.* ***Results:*** *Failure of ESWL was significantly higher in Group B (23.33%) than Group A (10%). These results were statistically significant.* ***Conclusion:*** *Pushback stenting and ESWL is better than in situ ESWL for upper ureteric stone.*

Key words: *ESWL, Steinstrasse.*

Date of received: *10.12.2016*
Date of acceptance: *05.05.2017*

Introduction

Urolithiasis is one of the most prevalent urological disorders and the prevalence of urinary stones has increased world wide[1]. The management of urinary calculi was revolutionized by the introduction of extracorporeal shockwave lithotripsy (ESWL) in 1980 and the first successful ESWL treatment was accomplished in Germany by Dr. Christian Chaussy using a Dornier HM1 lithotripter. ESWL is a safe, effective and non-invasive method[2]. Even with the innovation and refinement of current endourologial methods for stone removal, ESWL remains the primary treatment option for most patients with uncomplicated upper urinary tract calculi[3,4,7,8,9].

The major goal of ESWL in the treatment of renal stone is to achieve a maximal rate of stones free status with minimal morbidity to the patients[1,5,6]. Although ESWL is an effective treatment of urinary calculi and stone fragments produced after ESWL, usually pass spontaneously down the ureter, but it can cause some complications. As ureter has a limited capacity for discharging stones, larger residual fragments after ESWL can cause ureteric colic and obstruction.

1. Dr. Md. Mostafizur Rahman, Assistant Professor, Department of Urology, KYAMCH, Enayetpur, Sirajgonj.
2. Dr. Maruf Ahmed, Assistant Professor, Department of Urology, Sher-e Bangla Medical College, Barisal.
3. Dr. Md. Rokonuzzaman Khan, Assistant Professor, Department of Urology, Dinajpur Medical College.
4. Dr. Md. Shamim Hossain, Assistant Professor, Department of Surgery, Holy Family Red Crescent Medical College, Dhaka.
5. Dr. Khan Nuzrul Islam, Transplant Co-ordinator, National Institute of Kidney Diseases & Urology, Sher-e Bangla Nagar, Dhaka.
6. Dr. Md. Jahangir Alam, Assistant Professor, Department of Urology, Sheikh Saiera Khatun Medical College, Gopalganj.
7. Dr. Uttam Karmaker, Assistant Professor, Department of Urology, Dhaka Medical College, Dhaka.
8. Dr. Baikaly Ferdous, Assistant Registrar, Department of Urology, KYAMCH, Enayetpur, Sirajgonj.
9. Prof. (Dr.) Ashraf Uddin Mallik, Professor, Department of Urology, KYAMCH, Enayetpur, Sirajgonj.

Correspondence: Dr. Md. Mostafizur Rahman, Assistant Professor, Department of Urology, KYAMCH, Enayetpur, Sirajgonj.
E-mail: rashed.uro@gmail.com

The "Steinstrasse" (or Stone Street) is a well-known complication among them after ESWL. Steinstrasse refers to the column of stone fragments that can develop within the ureter which can be seen on plain abdominal radiography after ESWL. It may resolve spontaneously without producing any symptoms or may persist and cause loin pain, ureteral obstruction and urinary tract infection[14,15]. Success rates and complications are determined by the size, location and composition of the stone in the urinary tract, the type of lithotripter, shock wave energy and rate, and anatomical characteristics[12]. In this study we compared the success rate of stone breaking by pushback followed by stenting and without pushback before ESWL.

Materials and Methods

The present study was conducted in the department of urology of DMCH among 60 subjects. Subjects were diagnosed on basis of clinical features and confirmed on basis of laboratory with imaging features. They were selected who had upper ureteric stones. Previous unsuccessful attempts at ESWL or ureteral stones from prior endoscopic or open operation were not included in the series. Subjects with radiolucent stone, multiple stones, severely impacted stone, gross hydronephrosis, serum creatinine >2 mg/dl, bleeding diathesis, patient with severe skeletal malformation, morbid obese (BMI >30), pregnancy, aortic and renal artery aneurism and congenital urinary tract anomalies were also excluded. Among 60 subjects, 30 subjects were Group A comprised of subjects treated with pushback followed by stenting and Group B with 30 subjects treated with stone in situ before ESWL. Outcome of these two groups, treatment modalities were assessed on basis of stone clearance, steinstrasse and some other adverse effects.

General management (antibiotic, anti-spasmodic, I.V infusion if needed) was given before specific treatment was started. Before ESWL all selected patients were evaluated with excretory urography (IVU), complete blood count, urinalysis, urine culture, blood biochemistry assay with coagulation profile. Urine culture positive cases were treated with appropriate antibiotics before ESWL. They were advised nothing by mouth from the night before the procedure. Plain X-Ray KUB on the day of procedure to locate the exact position of stone. Push back and stent placement was performed in an endourology suite adjacent to the shock wave lithotripsy unit by standard procedure.

For ESWL all patients were placed on supine position. Stone location, proper patient positioning was confirmed by fluoroscopy. Proper acoustic coupling between the cushion of the treatment head and the patient's skin was adjusted. Patient whom push back and stenting was done under regional anesthesia, ESWL was done on same setting and no additional measures for pain management were taken. Inj. Pethidine I/M was given to all non-stenting patients for pain management during the procedure. On the subsequent sessions (when needed) Inj. pethidine was used to all patients. Ultrasonography gel was used as a lithotripsy coupling agent. The total number of shock waves delivered to the stone was recorded. Shock wave was 2000 - 3000 on each session. The mean kilo-voltage of the shock wave for each patient was kept constant. The rate of shockwave was 60 per minute. Initial ESWL energy was kept low which was increased gradually up to optimum level. Siemens multiline electromagnetic lithostar ESWL machine was used for all cases.

An immediate post shock wave stone fragmentation was assessed by fluoroscopy. All Patients were reviewed after two weeks of first session. History was taken regarding complaints and complications. Plain x-ray of the KUB was done to assess fragmentation. Urine routine examination was performed to every patient. Repeat treatment was done at the end of third weeks if inadequate stone fragmentation was observed. If there was no stone breakage after three sessions, the case was considered an ESWL failure. All patients were interviewed using a preformed questionnaire. Questionnaires were designed to determine symptoms such as pain, ureteric colic, fever, haematuria and dysuria or any other complaints. Patients were also questioned about the convalescence (i.e. time to full recovery. Dysuria was defined as painful or difficult urination. Bladder irritability/pain was defined as discomfort between voiding episodes.

Urine cultures were performed if patients experienced fever, significant lower urinary tract symptoms as well as before stent removal in group A. All patients were finally evaluated at 3 months after the last lithotripsy session by urinalysis, urine culture x-ray and ultrasonography of the KUB region to assess stone-free status and the degree of hydronephrosis. Successful stone clearance was defined as stone- free status or the presence of clinically insignificant asymptomatic residual stone fragments of ≤ 3 mm after three months of maximum three ESWL sessions. Steinstrasse was defined as column of stone fragments that could develop within the ureter which could be seen on plain abdominal radiography after ESWL.

Residual fragment ≥ 3 mm or no fragmentation or disappearance of stone on plain x-ray KUB region at 3 months after, up to three ESWL sessions was defined ESWL failure. A p-value <0.05 was considered as level of significance. Statistical analysis was performed by using computer based statistical software SPSS (Statistical Package for Social Sciences) for windows version 20.

Results

In group A, 63.33% were male and the rest 36.67% were female. In group B, 60% were male and 40% were female. No significant gender difference was observed between these two groups. Mean BMI of group A and group B was 22.4 (±3.4) and 23.1 (±2.7) with non-significant difference. Stone size was 12.51 ±2.49 mm in group A and 12.56 ± 2.44 mm in Group B. In group A 60% stone found in right side and 40% on left. In group B stone found 53.33% and 46.67% respectively. No statistical differences in investigations were observed between two groups (Table-I).

Table-I: The patient characteristics

Variable	Mean ±SD and (%)
Total patients	60 (100%)
Mean ±(SD) age (years)	45.19 (±10.72)
Sex	
Male	37 (61.66%)
Female	23 (38.33%)
Side	
Right	34 (56.66%)
Left	26 (43.34%)
Mean ±(SD)	
BMI	23.11 (±04.32)
Stone size, mm	
Group A	12.51 ±2.49
Group B	12.56 ± 2.44

Multiple (up to three) sessions ESWL was needed in 8 (26.66%) patients in group A. Among them 5 (16.66%) patients were cleared from stone and remaining 3 (10%) were unsuccessful. On the other hand in group - B, 15 (50%) patients needed multiple session among them 7 (23.33%) remained unsuccessful. Mean shock waves in group B was 5200 (± 3200) and 5000 (± 2900) was in Group A. Failure of ESWL was significantly higher in Group B (23.33%) than Group A (10%). These results were statistically significant (Table-II).

Table-II : Variables regarding ESWL and outcomes

Variables	Group A	Group B	Statistical test
Multiple session ESWL	8 (26.66 %)	15 (50 %)	$< 0.05^{S}$
Average shock waves	5000 (±2900)	5200 (±3200)	$< 0.05^{S}$
Stone clearance	27 (90.00%)	23 (76.66%)	0.046^{S}
Failure of ESWL	03 (10.00%)	07 (23.33%)	$< 0.05^{S}$

Statistical test was performed by 't' test.
S = Significant, NS= Not significant.

Proportion of UTI was 10 % in both A and B after ESWL. Dysuria was more (33.33%) in push back ESWL than in situ ESWL (26.66%) but this difference was not statistically significant. Haematuria (gross and microscopic) was observed in 90% cases of push back ESWL and 86.66% cases of in situ ESWL. Ureteric colic was more (36.66%) in push back ESWL than in situ ESWL (30%). But these differences were not statistically significant. Proportion of stone clearance was statistically more (90%) in push back ESWL than in situ ESWL (76.66%). Steinstrasse was statistically less (3.33%) in push back ESWL than in situ ESWL (20%) (Table-III).

Table-III: Complications encountered after ESWL of both groups:

Outcome	Group A; n=30	Group B; n= 30	Statistical test
Dysuria	10 (33.33%)	08 (26.66%)	0.836^{NS}
Haematuria	27 (90.00%)	26 (86.66%)	0.164^{NS}
Ureteric colic	11 (36.66%)	09 (30%)	0.295^{NS}
Steinstrasse	01 (03.33%)	06 (20.00%)	0.033^{S}
UTI	03 (10%)	03 (10%)	

Statistical test was performed by 't' test.
S= Significant, NS = Not significant.

Discussion

The treatment options for upper ureteric calculi consist of conservative approach of spontaneous clearance of the stones, ESWL, endoscopic manipulation, laparoscopy and open surgery. Extracorporeal shock wave lithotripsy has revolutionized the treatment of urinary stones. The concept of using shock waves to fragment stones was noted in the 1950s in Russia. The first clinical application with successful fragmentation of renal calculi was in 1980.

The HM-1 (Human Model-1) lithotripter underwent modifications in 1982 leading to the HM-2 and, finally, to the widespread application of the HM-3 in 1983. Since then, thousands of lithotripters have been put into use around the world, with millions of patients successfully treated. Urinary obstruction caused by an stone is a serious problem as it may lead to kidney dysfunction or severe complications, including pyonephrosis and sepsis. This fear has led many urologists to recommend JJ stenting before ESWL to create an artificial chamber, with an improved stone-fluid interface, for better fragmentation during ESWL and to relieve the obstruction. The Working group on urolthiasis of the European Association of Urology recommended pre-ESWL stenting or endoscopic treatment for these stones[19]. However, this view has been challenged by somebody, who showed that the results of treatment are similar whether the stone is pushed back or treated in situ, with or without a stent [20]. The primary goal of ESWL in the treatment of renal and upper ureteric calculi is to achieve a maximam rate of stone free status with minimum complications of the patients. Among many advantages of ESWL, the "Steinstrasse" (or Stone Street) is a well-known complication. But no agreement has yet been reached that ureteral stenting could be used to prevent steinstrasse and other post-ESWL complications[1].

In our study, 37 patients out of a total of 60 patients (61.66%) required single session for complete stone fragmentation. Among them 22 out of 30 (73.33%) was in the stented group and 15 out of 30 (50%) was in the non-stented group. Multiple ESWL sessions (re-treatment rate) were required in 23 patients, including 8 out of 30 (26.66%) in the stented group and 15 (50%) in the non-stented group. Among them in push back and stented group 5 patients with multiple (maximum three) sessions of ESWL were successfully cleared from stone and 3 ultimately failed. In group-B non-stented group 8 patients were clinically stone free with multiple sessions of ESWL and 7 failed. Average shockwaves in push back stenting and ESWL group was 5000 (±2900) and in patients of in situ ESWL group was 5200 (±3200) $p< 0.05$. The difference was found to be statistically significant. Our study agreed in respect with the results previously published by authors regarding the total number of shockwaves needed for fragmentation between stented and non-stented group[5,23]. In this present study failure in both groups may be due to another additional factor like Houns field units of stone, which was not included in this study.

In this study, after 3rd month, the stone-free rate was 90% in the stented group and 76.66% in the non-stented group. This difference was statistically significant, which shows that insertion of a stent added to the results and that this additional procedure may be necessary. This was found to be comparable to previous results published by other working groups[5,10,22]. Mueller, et. al.[21] observed ESWL in situ fragmented 62% compared with 97% for stones that were pushed backed to the renal pelvis. Graff, et. al. showed same result that retrograde manipulation of proximal ureteral stone yields better results for ESWL[10]. In their series, success rate was 95% of pushed backed stone and 83% of in situ non-obstructing stone.

Alexander et. al. experienced that stones treated with ESWL in situ successfully fragmented 62% of the time compared with 97% for stones that were pushed back to the renal pelvis. In current study steinstrasse was observed in both treatment groups but steinstrasse was statistically less (3.33%) in push back ESWL than in situ ESWL (20%) which agreed with the results previously published by Al-wadi et. al.[11]. Their observation was out of the 400 patients, of renal stone 38 developed steinstrasse, and comprising 12 patients (6%) in stenting group and 26 (13%) in non-stented group ($P <0.05$).

In present study the age ranged from 31-65 years and the maximum number of incidence of ureteric stone was found in 41 to 50 years age group. No significant age difference was seen between two groups. In both treatment groups there were slight male preponderance. The other significant predictor of disintegration failure is higher BMI. Many studies revealed that the stone free rates to be inversely proportional to the BMI. Patients in whom ESWL failed had a high BMI and in whom ESWL success had a relatively low mean BMI. The consequences of these findings are significant and may aid in counselling patients concerning the various treatment options for renal stones. The same was reported by Pareek et. al. who observed a significant negative impact of higher BMI on stone free rate after ESWL[16]. ESWL failure in patients with higher BMI may be explained by hampered targeting of the stone or dampened shockwaves.

In our study no significant difference of BMI was found which might be impact on ESWL outcome. Stone fragments caused ureteral irritation and injury in both treatment processes which subsequently causes haematuria. In our study haematuria (gross and microscopic) was observed in 90% cases of push back stenting ESWL and 86.66% cases of in situ ESWL. This difference was not found statistically significant. Dysuria was more (33.33%) in push back ESWL than in situ ESWL (26.66%). Ureteric colic found in our study in push back and stented group was 36.66% and in non-stented group 30%, both were not statistically significant. Previously published data support these points. Pryor and Jenkins, Mustafa and Ali-El-Dien reported that although haematuria, dysuria, UTI slightly higher in stented group but they were not statistically significant[17,18].

Conclusion

It could be concluded that there was significant advantages of pushback stenting followed by ESWL compared to in situ ESWL for upper ureteric stone in terms of steinstrasse and success rate. Stents are not associated with significant patients discomfort and morbidity like dysuria, haematuria, ureteric colic. More high quality, well designed, randomized controlled multicenter trials are needed to address this issue.

Acknowledgment

We would like to thank those who actively participated in this study and Dhaka Medical College authority for there permission and support to carry out this research work.

References

1. Pengfei S, Min J, Jie Y, Xiong L, Yutao L, Wuran W, et al. Use of ureteral stent in extracorporeal shock wave lithotripsy for upper urinary calculi: a systematic review and meta-analysis. J Urology 2011; 186: 1328-1335

2. Ghafoor M, Halim A. Extracorporeal shock wave lithotripsy in the treatment of ureteric stones. Annals Saudi Med 2002; 22(1-2):18-21

3. Albala D, Clayman R, Meretyk S. Extracorporeal shock wave lithotripsy for proximal uretral calculi: to stint or not to stint? J Endourology 1991; 5(4): 277-281

4. Bach C, Buchholz N. Shock wave lithotripsy for renal and ureteric stones. European Association of Urology 2011; 10: 423-432

5. Singal RK, Denstedt JD. Contemporary management of ureteral stones. Urologic Clinics of North America 1997; 24(1): 59-70

6. Middela S, Papadopoulos G, Srirangam S, Rao P. Extracorporeal shock wave lithotripsy for ureteral stones: do decompression tubes matter? Urology 2010; 76 (4): 821-825

7. Islam AG, El-Ghoneimy MN, El-Naggar AE, Hammoud MK, El-Gammal YM, Morsi AA. Extracorporeal shock wave lithotripsy in impacted upper ureteral stones: a prospective randomized comparison between stented and non-stented techniques. Urology 2010; 75 (1): 45-50

8. El-Assmy A, El-Nahas A, Sheir K. Is pre-shock wave lithotripsy stenting necessary for ureteral stones with moderate or severe hydronephrosis? J Urology 2006; 176: 2059-2062

9. Resit-Goren M, Dirim A, Ilteris-Tekin M, Ozkardes H. Time to stone clearance for ureteral stones treated with extracorporeal shock wave lithotripsy. Urology 2011; 78: 26-31

10. Graff J, Diederichs W, Schulze H. Long-term followup in 1,003 extracorporeal shock wave lithotripsy patients. J Urology 1988; 140(3): 479-483

11. Al-Awadi KA, Halim HA, Kehinde EO, Al-Tawheed A. Steinstrasse: a comparison of incidence with and without J stenting and the effect of J stenting on subsequent management. BJU International 1999; 84: 618-621.

12. Naidich JB, Greenberg RW, Benetos FC, Badillo FL, Waldbaum RS. Extracorporeal shock wave lithotripsy for in situ ureteral stones: comparison of two catheter strategies. J Endourol 1991; 5(3): 197-200

13. Alexander S. Extracorporeal shock wave lithotripsy for mid and lower ureteral stones. J Endourol 1992; 6(5): 323-327

14. Danuser H, Ackermann DK, Marth DC, Studer UE, Zingg EJ. Extracorporeal shock wave lithotripsy in situ or after push-up for upper ureteral calculi: a prospective randomized trial. J Urology 1993; 150(3):824-826

15. Ghafoor M, Halim A. Extracorporeal shock wave lithotripsy in the treatment of ureteric stones: experience from Tawam hospital, United Arab Emirates. Annals Saudi Med 2002; 22(1): 18-21

16. Pareek G, Armenakas NA, Panagopoulos G, Bruno JJ, Fracchia JA. Extracorporeal shock wave lithotripsy success based on body mass index and Hounsfield units. Urology 2005; 65(1): 33-36

17. Pryor JL , Jenkins AD Use of double-pigtail stents in extracorporeal shock wave lithotripsy. J Urol 1990; 143(3): 475-478

18. Mustafa M , Ali-El-Dein B Stenting in extracorporeal shockwave lithotripsy; may enhance the passage of the fragments! JPMA. J Pakistan Med Assoc 2009; 59(3): 141-143

19. Tiselius HG, Ackermann D, Alken P, et al. Guidelines on urolithiasis. Eur Urol. 2001; 40: 362-371

20. Haleblian G, Kijvikai K, Rosette J, Preminger G. Ureteral stenting and urinary stone management: a systematic review. J Urol. 2008; 179: 424-430

21. Mueller S, Wilbert D, Thueroff J, et al. Extracorporeal shock wave lithotripsy of ureteral stones: Clinical experience and experimental findings. J Urol. 1986;135: 831-834

22. Graff J, Pastor P, Funke PJ, Mach P, Senge T. Extracorporeal shock wave lithotripsy for ureteral stones: A retrospective analysis of 417 cases. J Urol.1988; 139(3): 513-516

23. Fetner CD, Preminger GM, Seger J, Lea TA. Treatment of Ureteral Calculi by Extracorporeal Shock Wave Lithotripsy in a Multi-Use Center. Springer 1988; 19-24