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Stented and Non-Stented Techniques in Extracorporeal Shock Wave Lithoplasty for Upper Ureteral Stones

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Abstract: Background and Objectives: Extra corporeal shock wave lithotripsy (ESWL) is a non-invasive technique for treating patients with renal calculi. It fragments the stone to smaller size which ease its passage through distal urinary tracts. The purpose of this matched-pair research was to examine patients with ureteric stones to identify the effect of a ureteric stent on the success rate of extracorporeal shockwave lithotripsy (ESWL). Upper ureteric calculus can be treated with extracorporeal shock wave lithotripsy; however, complications have been reported. **Method:** Prospective research was conducted in the Department of Urology, Bangabandhu Sheikh Mujib Medical University Dhaka. Bangladesh from June 2022 July 2023 with the patients who presented for treatment of upper ureteric calculus. Ethical standards set forth by the committee were adhered to. After being informed of the study's purpose and methods, each participant signed a consent form. Information was entered into a premade proforma. **Results:** In our study, there were a total of 118 males and 32 females in group A, and 115 males and 35 females in group B. There were 99 patients in the group whose stones were 8–13 mm and 51 patients in the group whose stones were 14–19 mm in size. ESWL success was defined as patients who had undergone three ESWL sessions and were stone-free, while ESWL failure was defined as patients who were not stone-free after three months or who required any extra treatments. Although 13 patients in the stented group did not have stones, 22 had difficulty clearing them with ESWL. Seven patients in the stent-free group had successful ESWL treatment, while eleven others did not. **Conclusion:** Low morbidity and excellent effectiveness are characteristics of ESWL treatment. Ureteral stenting prior to ESWL offers no advantages over ESWL performed in situ. Patients who receive ureteral stents often experience severe pain and morbidity. The use of ureteral stents to treat upper ureteric calculus led to fewer hospital readmissions than when no stent was used, despite the fact that they are linked to higher irritative symptoms.

Keywords: Extracorporeal Shockwave Lithotripsy, Ureteral Stones, Calculus.

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INTRODUCTION

Extra corporeal shock wave lithotripsy (ESWL) is a non-invasive technique for treating patients with renal calculi. It fragments the stone to smaller size which ease its passage through distal urinary tracts. It brings along with it a set of complications like those related to stone fragmentation, stone passage, and infection due to its effect on renal and extra renal tissues [1]. Incomplete fragmentation may cause the residual stones to block the ureters, a condition described by term “Steinstrasse” meaning "stone street" [1,2]. The aim of treating ureteral calculi is complete stone elimination with minimal patient morbidity. There are three main types of considerations to make when deciding how to treat patients with ureteric calculi: the patient's ability to tolerate symptomatic events, the patient's expectation, the presence of an associated infection, the presence of a single kidney, abnormal ureteral anatomy, and the technical factors (equipment available for treatment, costs). These elements might be thought of as therapeutic modulators. It is possible to remove stones from the upper ureter using one of several surgical procedures. Better ureteroscopes, novel intracorporeal stone fragmentation techniques, laparoscopic procedures, and current investigation into extracorporeal shock wave lithotripsy have revolutionized the treatment of ureteral stones. Large upper ureteral calculi have had varying degrees of success with ESWL [1, 2, 3]. Furthermore, these days patients tend to prefer less invasive surgical procedures. The use of stents during extracorporeal shock wave lithotripsy for renal or ureteral stones is still up for debate. The potential for problems is decreased when a stent is used to open the ureter and allow stone particles to pass through. While they may be effective in their intended function, stents are not without their own set of complications, including irritative sensations, bladder discomfort, and the possibility of stent migration, vesicoureteral reflux, and encrustation. It's concerning because there isn't any written guidance on how ureteric stents can influence ESWL outcomes. Although some writers have claimed that the insertion of ureteric stents does not alter the course of therapy, this does not mean that it is not considered a factor tied to the failure of ESWL or a factor linked to obstruction. There is a correlation between the stone's radio density on the plain X-ray KUB and its ESWL performance. Overall, the predictive accuracy of plain radiographs for the composition of calculi was only 39%, which is insufficient for clinical application [4, 5, 6]. Since Non Contrast Computed Tomography (NCCT) scans are so commonly used for evaluating flank discomfort, there has been a number of research comparing attenuation and stone composition in vitro. These results show that the NCCT's attenuation value can be utilised to evaluate different types of stone. The clinical outcome of ESWL is affected by the fragility of a calculus, as evaluated by the stone Hounsfield Unit (HU) of the NCCT, which changes with stone composition. Because of its ease of use, high sensitivity, and ability to provide crisp images, NCCT is a good method for evaluating stone density [7, 8, 9].

MATERIAL AND METHODS

Patients with upper ureteric calculi who had reported for treatment in the Department of Urology Bangabandhu Sheikh Mujib Medical University Dhaka. Bangladesh from June 2022 July 2023 were included in a prospective study. The rules set forth by the ethics committee were followed. Each patient signed a consent form after receiving information about the study and being given the opportunity to ask any questions. The data were entered into the proforma after it had initially been created.

The several treatment options for upper ureteric calculus, such as percutaneous nephrolithotomy, open surgery, ureteroscopy with intracorporeal lithotripsy, extracorporeal lithotripsy, and extracorporeal lithotripsy, were explained to all of the patients. All patients had baseline tests for complete blood count, blood sugar, urea, serum creatinine, and urine routine, including culture and sensitivity, after thoroughly reviewing their medical histories and undergoing a thorough physical examination. An ultrasound, KUB, and plain X-ray were all taken in each case. An intravenous urogram or a CT KUB with contrast was done as a functional study. Largest dimension was measured for stone size using plain X-ray, KUB, and ultrasound in the study.

Inclusion criteria

1. Patients with unilateral upper ureteric calculus willing for extracorporeal shockwave lithotripsy.
2. Patients with renal parameters that are normal.
3. No previous treatments for the same ureteric calculus.
4. No anatomical anomalies in the urinary tract.

Exclusion criteria

1. Not willing for ESWL
2. Bilateral ureteric calculi
3. Coagulation disorder/patients on anticoagulation drugs
4. Pregnancy
5. Sepsis
6. End stage renal disease

300 patients were chosen, and they were split into two groups of 150 each. Two groups, designated Group A and Group B, were formed from the patients. They were asked to choose one of two folded pieces of paper with the letter A or B that were handed to them. People who chose option A were placed in group A and administered in situ ESWL without DJ stent, while people who chose option B were placed in group B. Gentamycin 80 mg IM was administered as a preventative injection to the patients who were chosen for DJ placement, and then a 5 Fr 26 cm DJ stent was inserted under local, regional, or general anaesthesia before to ESWL [10, 11].

RESULTS

In our study, there were a total of 118 males and 32 females in group A, and 115 males and 35 females in group B. There were 99 patients in the group whose stones were 8–13 mm and 51 patients in the group whose stones were 14–19 mm in size. ESWL success was defined as patients who had undergone three ESWL sessions and were stone-free, while ESWL failure was defined as patients who were not stone-free after three months or who required any extra treatments. Although 13 patients in the stented group did not have stones, 22 had difficulty clearing them with ESWL. Seven patients in the stent-free group had successful ESWL treatment, while eleven others did not.

Table-1: Age distribution

Age (Yrs)	No. of patients	
	Stented	Non-stented
<20	4	5
21 to 40	92	94
41 to 60	41	46
>60	13	5
TOTAL	150	150

P=0.06 not significant

Table-2: Sex distribution

	No. of patients		**Total**
	Stented	**Non-Stented**	
Male	115	118	233 (77.6%)
Female	35	32	67 (22.4%)
Total	150	150	300

P=0.581 not significant

Table-3: Side distribution

Side	No. of patients		Total
	Stented	Non-stented	
Right	71	72	133 (44.3%)
Left	79	78	157 (56.7%)

P=0.817 not significant

Table-4: Stone size distribution

Size	No. of patients		Total
	Stented	Non-stented	
8 to 10mm	45	45	90 (30.0%)
11 to 13mm	54	54	108 (36.0%)
14 to 16mm	35	35	70 (23.4%)
17 to 19mm	16	16	32 (10.6%)

Table-5: Number of sittings

No. of sittings	No. of patients		Total
	Stented	Non-Stented	
1	79 (54.8%)	94 (62.2%)	173 (58.6%)
2	41 (28.4%)	50 (33.11%)	91 (30.8%)
3	11 (7.6%)	7 (4.6%)	18 (6.10%)
Total	145 (90%)	155 (99%)	300/300 (100%)

P= 0.235 not significant

Table-6: Success rate after 3rd sitting of ESWL

Size of Calculus	**No. of patients**			
	Stented		**Non-stented**	
	Success	**Failure**	**Success**	**Failure**
8 to 10mm	2	3	0	0
11 to 13mm	3	7	2	2
14 to 16mm	3	7	2	5
17 to 19mm	5	5	3	4
TOTAL	13	22	7	11

Stented - P=0.686 not significant

Non Stended - P=0.969 not significant

Table-7: Complications

Complications	No. Of patients	Total

	Stented	Non-stented	
Hamaturia	15(4.6%)	4(1.2%)	19 (5.9%)
Fever	8(2.5%)	3(0.9%)	11(3.4%)
Stienstrasse	10 (3.1%)	9 (2.8%)	19 (5.9%)
Ureteric colic	2 (6.2%)	15 (4.6%)	15 (4.6%)

P=0.000 significant

DISCUSSION

ESWL has revolutionized the treatment of urolithiasis around the world, and it remains an important therapeutic option for the vast majority of stones found in the upper urinary system. Its non-invasive nature and high efficiency contribute to its high level of acceptance by both patients and surgeons. When it comes to removing stones from the upper ureter, both ESWL and ureteroscopy have both benefits and drawbacks. Proponents of ESWL argue that it is more effective than ureteroscopy, causes less complications, requires less anaesthetic, and can be performed with fewer incisions and fewer stents. Critics of the procedure argue that it has lower success rates than ureteroscopy, that the necessary equipment is not always readily available, that it can be difficult to see the stone, that it takes longer to achieve a stone-free condition and requires more follow-up, that the re-treatment rate is greater, and that it is more expensive. Overall, 90.6% of people didn't have any stones. This research highlights the fact that excellent stone-free rates can be achieved without ureteroscopy and is in line with previous findings [12-14]. Previous experiments utilising a variety of lithotriptors have success rates between 80% and 90%. According to Gnanapragasam et al.'s research, 90% of patients with upper ureteric stones did not have any stones present. Patients with stones larger than 1.3 centimetres were shown to be unsuccessful with ESWL. Similarly, Mogensen and Anderson analysed the outcomes of SWL for 199 people with ureteral stones. Three and six months after SWL, nearly nine in ten patients who had upper ureteral stones were stone-free. Upper ureteral stones were found to be successful 98% of the time in a study conducted by Hofbauer et al. The percentage of patients who needed extra therapy increased to 8%, and our retreatment rate was 59%. Fetner et al. found that the size of the stone was significantly correlated with the success rate. The American Ureteral Stones Clinical Guidelines Panel reported an 87% success rate for SWL for treating stones smaller than 1 cm in the proximal ureter. Our research found a 95% success rate even with 1 cm stones. This may be due to the fact that a conventional lithotripter (a Dornier Delta II) is being used in addition to improved stone localization techniques. We didn't use any "pushback" techniques on any of our patients. Without moving any of the stones from their original locations, we were able to cure them all. There is no discernible difference in success rates between in situ and pushback ESWL. The availability of macroscopic expansion space is not required for ureteric calculi to be successfully fragmented. There is a 5.1% perforation rate associated with ureteral manipulations using the pushback approach. We also found that when DJ stents are utilised, the success rates are drastically reduced [15-17]. Eight individuals (20%) required a further operation called a ureteroscopy after having DJ stents inserted preoperatively. Ryan et al. showed that in situ ureteric stents impede ureteric peristalsis and retain large fragments, which slow stone clearance. If a DJ stent is placed close to the stone, the shock wave may not penetrate it completely. Stents placed by a nephrologist (DJ) are required when stones are blocking a kidney or when only one kidney is functioning. Several authors have investigated the factors that contribute to the failure of ESWL treatment for ureteral stones. Predictors of ESWL failure identified by Abdel-Khalek et al. in a study of 938 patients included stent presence, stone placement, and stone transverse diameter more than 10 mm. Kim et al. analysed 369 patients to determine what characteristics affect the fragmentation of ureteric stones; they found that stone size, radio-opacity, and obstruction severity were significant predictors. High body mass index (BMI) and high Hounsfield units (HU) value were found to be independent predictors of the outcomes of ESWL for upper urinary tract stones in a study by Pareek et al. They also came up with an equation to determine the likelihood of treatment failure: 1/1 + 2.7(-z), where Z = 0.294 body mass index plus 0.13 body fat units minus 18 [18-20]. Treatment of disorders affecting the upper urinary tract often requires the use of a ureteral stent. When a single kidney is blocked, when the patient has a high temperature and is at risk for sepsis and protracted pain, and when renal function is declining, ureteral stents are often inserted. ESWL is commonly used to treat large stones (usually >20 mm), but they are also utilised to treat steinstrasse and/or obstruction following the treatment. The effects of placing a stent in an ESWL have been the subject of significant debate. It was originally thought that stents helped stones pass more easily. Bierkens et al randomised 64 patients with large renal stones (but no ureteric 55 stones) and found a difference in the stone-free rate in 3 months in favour of the stented population (44% vs 35%), whereas Pryor and Jenkins found a difference of 18% in the stone-free rate in favour of the unstented patients with ureteric stones. Later studies on the use of stents to treat ureteral stones found no difference in the stone-free rate. Discomfort and irritability are common side effects of stents, and there has been mixed research on the efficacy of ESWL in recent years [20, 21]. Musa found in 115 patients with renal stones that the unstented population had a stone-free rate of 91% vs 88% and that there was a slightly higher incidence of fever in stented patients, while El-Assmy et al. randomised 186 patients with ureteric stones and moderate to severe hydronephrosis, with better but not statistically significant results for the unstented patients (91% vs 85% stone-free rate, P = 0.25). This could be because patients who received DJ stents had to undergo two additional procedures and a foreign object was introduced into an otherwise sterile system. Khaled conducted research into the causes of steinstrasse following extracorporeal shock wave lithotripsy and found an overall incidence of 3.97%. Stone size and placement, renal shape, and the intensity of the shock wave are the primary risk factors for developing steinstrasse. Patients at high risk for steinstrasse should be monitored closely and given the option of early intervention or prophylactic ureteral stenting prior to ESWL. Stent- related symptoms are extremely prevalent, affecting over 80% of patients. Symptoms including frequency, urgency, dysuria, and incomplete emptying can be very frustrating, as can pain in the flanks and suprapubic area, incontinence, and blood in the urine. Assessment tools are crucial for measuring their severity and making comparisons throughout time. For this purpose, the Urinary Stent Symptom Questionnaire (USSQ) is the most useful tool available [21, 22]. Our results also show that ESWL for ureteral stones is less successful when a ureteral stent is present. Possible causes include the stent's effect on ureteric peristaltic movements, which reduces fragment clearance, and targeting difficulties. Patients with sepsis, those whose renal function is failing due to obstruction, and those whose pain is severe all benefit from ureteric stents. Patients receiving ESWL for ureteric stones should be cautious of routinely using ureteric stents, regardless of the size or location of the stone. Most SWL issues, such brief hematuria, pain, nausea, and vomiting, clear up on their own, but there are several case reports in the literature that depict potentially fatal scenarios. Study results by Nazim Mohayuddin et al. showed that lower urinary tract symptoms were more common in the stented group (45.5%, 12.5%, 47.5%, 57.5%, and 92.5%, respectively) compared to the non-stented group (7.5%, 2.5%, 10%, 15%, and 67.5%). Other studies found the same thing; for example, Perminger et al. found that there was a higher rate of LUTS in patients who received DJ stents compared to the control group (43% vs. 25%). In the study by Paramjit S et al., the incidence of frequency, urgency, and dysuria was higher in the stented group. Musa also noted that there was an increase in the frequency of lower urinary tract symptoms among the stented group by 85% compared to the non-stented group. It was hypothesised that stents caused LUTS by irritating the trigone and the bladder neck due to the presence of a foreign body in the urine bladder. In a study involving 60 people, Islam AG discovered no statistically significant difference in the percentage of people who did not have stones. Significant side effects were reported by patients in the stented group, however. These included dysuria, urgency, frequency, and suprapubic discomfort. Patients in our study who had lower urinary tract stenosis reported higher symptoms than those who did not [21, 22].

CONCLUSION

The ESWL treatment is highly effective with a minimal risk of side effects. Stenting the ureter before ESWL doesn't provide any noticeable benefits over doing it during the procedure. The use of ureteral stents is associated with a high probability of morbidity and significant patient suffering. It has been established that the use of ureteral stents reduces hospital readmissions, despite the fact that these devices are associated with an increase in irritating symptoms. This is in contrast to treatments in which a stent was not inserted to remove the upper ureteric calculus.

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