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Comparison of utility and efficacy of intracorporeal pneumatic lithoclast in the treatment of distal ureteric calculi versus open ureterolithotomy

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Author`s Contribution

[1,2]Drafting the work or revising it critically for important intellectual content, [3]Final approval of the version to be published [4,5]Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work.

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ABSTRACT

Objective: To compare the role of intracorporeal pneumatic lithotripsy with open ureterolithotomy in our local setup. We will be able to compare our results with other studies in other parts of our country and other countries.

Methodology: This study was conducted in the Department of Urology from 2014-2015, Mayo Hospital, Lahore. A total number of 60 patients with distal ureteric stones were taken. Out of the thirty (group A) were treated with intracorporeal pneumatic lithotripsy and thirty (group B) were treated with open ureterolithotomy. The quantitative variables, like age, several stone, stone size, and hospital stay were presented in the form of mean and standard deviation.

Results: The mean age of the patients in group A was 45.7±12.8 years and in group, B was 42.2±11.6 years. In group A, the number of patients was of 18 (60%) males and 12 (40%) females. In group B, the number of patients was of 16 (53.3%) males and 14 (46.7%) females. The mean of the stone size of the patients in group A was 8.7±4.2 mm and in group B was 10.2±4.9 mm (p value 0.04). The mean hospital stay in group A was 2.3±0.7 days and stay in group B was 4.5±1.1 days (p-value: 0.1).

Conclusion: It is concluded that pneumatic lithoclast, when compared with open ureterolithotomy, achieved better success rate and pneumatic lithoclast has advantages over open ureterolithotomy as far as hospital stay and complications are concerned.

Keywords: Pneumatic lithotripsy, open ureterolithotomy, ureteric calculi

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Introduction

Ureteral stones are accumulations that resemble rock and are formed from the mineral salts that are present in urine, resulting in the blockage of the ureter. If the stones are not removed and block the flow of urine for a prolonged duration, it can lead to serious complications such as damage of kidney, uremic poisoning and can even result in the death of that person.[1] Patients having this disease may present with classic symptoms of renal colic or hematuria. But others may either be asymptomatic or may present with atypical symptoms like nausea, vague abdominal pain, acute pain, difficulty in urination and even penile or testicular pain on the ipsilateral side.[2] Eighty percent of patients with nephrolithiasis form calcium stones, most of which are

composed primarily of calcium oxalate or less often calcium phosphate. The other main types include uric acid, struvite (magnesium ammonium phosphate), and cystine stones.[3] Various methods have been used for the removal of ureteric calculi. The advent of extracorporeal shock wave lithotripsy in the early 1980s and ultra thin ureteroscopes in the early 1990s have revolutionized the management of these calculi. Due to significant changes in treatment options, open surgical stone extraction is almost non existent now a days comprising only 0.5% of all cases of ureteric calculi.[4] Open stone surgery now holds a minor place in primary management, it is reserved for correction of associated anatomical deformity and removal of complex stones only. However, large impacted stones and those associated with the ureter that requires repair or reimplantations are best treated by open surgery.[5] The rapid development of smaller and more efficient scopes has facilitated the use of ureteroscopy for treatment of ureteric calculi. Although these advances have decreased the need for open surgery, iatrogenic injury can still occur with endoscopic technique.[6] Although the likelihood of spontaneous passage of stone is highest in distal ureter, intervention with intracorporeal lithotomy, ESWL, open ureterolithotomy is often necessary. Unlike intracorporeal lithotomy, open ureterolithotomy is not influenced by stone size. Overall the goals of open stone surgery should be to remove all calculi and fragments, to improve urinary drainage, to eradicate infection, to preserve and improve renal function.[7] There are various complications of ureterolithotomy, which include bleeding due to unrecognized injury to the adjacent gonadal vessels or IVC, urinary fistula, ureteral stricture, infection and stone migration.[8] Open surgery is generally indicated for failed endourological procedures and in patients with large stones greater than 3 cm, however, open stone surgery continues to represent a reasonable alternative for small segment of urinary stone population.[9] There are various forms of energy including electro hydraulic ultrasonic, laser and pneumatic energy that have been used for breaking stones.[10] Pneumatic lithotripsy is the most effective, safe and economical mode of treatment. The reason for this may be due to more fragmentation with pneumatic lithotripsy.[11] The complications encountered are minimal and include stone migration, hematuria, sepsis, post operative tenderness, and ureteric perforation.[12] A late complication of ureteric stricture has been reported but the incidence is decreasing through use of small diameter endoscope and because of active ureteric dilation.[13]

The treatment of choice for pregnant women with ureteric stone is observation and appropriate analgesic treatment as stone passes spontaneously in most cases. However, ureteroscopy for distal ureteric stone is considered a safe procedure with high rate of success but to be performed by expert.[14] Typically reterograde rigid ureteroscopy is advocated for the evaluation and treatment of distal ureteral disease and flexible ureteroscopy is reserved for proximal ureter and renal pelvis. The concern with performing reterograde rigid ureteroscopy in the adult is the risk of trauma to the urinary tract and also damage to ureteroscope.[15]

This study was conducted to compare the role of intracorporeal pneumatic lithotripsy with open ureterolithotomy in our local setup. We will be able to compare our results with other studies in other parts of our country and other countries.

Methodology

This comparative study, nonprobability purposive sampling study was carried out in the Department of Urology from 2014-2015, Mayo Hospital, Lahore after taking the ethical approval from the Institutional review committee. A total number of 60 patients with distal ureteric stones were taken. Out of the thirty (group A) were treated with intracorporeal pneumatic lithotripsy and thirty (group B) were treated with open ureterolithotomy. Patients, more than 18 years of age from both sexes and patients with ureteric stones that failed to pass spontaneously over a minimum period of two weeks were included in this study. Patients with co morbid conditions like uncontrolled diabetes mellitus, severe hypertension, and uncorrected coagulopathy were excluded from this study.

All investigations of full blood count, urine analysis, ultrasonography, plain radiography of the abdomen and intravenous urography were taken, unless contraindicated. Number, site, size and laterality of ureteric stones were noted. Thirty patients were treated with intracorporeal pneumatic lithotripsy (Swiss lithoclast). It is a mechanical intracorporeal lithotripter which works according to the principle of "jack hammer". Pneumatic energy is generated in the hand piece. This is generated by the movement of a bullet facilitated by air pressure control in the form of pulses from the generator. This pneumatic energy is directly transmitted to the stone by a direct contact rigid probe hand piece, that results in the breakage of stone. The

purpose is to fragment stones into small pieces (1-2 mm in size) which can pass spontaneously in the urine. The other thirty patients were treated with open ureterolithotomy. Ureterolithotomy in distal ureter is performed by muscle splitting Gibson incision in the lower quadrant, once the peritoneum is reached, it is pushed medially and remains in reteroperitoneal and ureter is identified and dissected towards the bladder, ureterotomy is performed over the stone and removed. Ureterolitotomy site is drained and the incision is closed in 2 layers.

A plain radiograph of the abdomen and/or retrograde pyelography was performed the next day to document any stone fragmentation and large residual or migrated fragments. The results were analyzed as for lithotripsy time, fragmentation in respect of site and size of stones, stone migration, stone clearance, success rate and hospital stay. The patient was discharged after the procedure: open ureterolithotomy / pneumatic lithotripsy.

The data was generated on computer software SPSS version 10 and analyzed accordingly. The quantitative variables, like age, several stone, stone size and hospital stay were presented in the form of mean and standard deviation. The variables that were qualitative, such as sex, stone clearance, and complications were presented in the form of frequency and percentages. The quantitative variable like stone size, hospital stay were compared by using paired 't' test, and qualitative variables like success rate and postoperative complications were compared by using Chi Square test. P-value of <0.05 was considered significant.

Results

The mean age of the patients in group A was 45.7±12.8 years and in group, B was 42.2±11.6 years.

In group A, there were 18 (60%) male and 12 (40%) female patients. In group B, there were 16 (53.3%) male and 14 (46.7%) female patients.

The mean stone size of the patients in group A was 8.7±4.2 mm and in group, B was 10.2±4.9 mm. The distribution of patients according to the stone size is shown in Table I

The mean hospital stay of the patients in group A was 2.3±0.7 days and in group, B was 4.5±1.1 days. In group A, there were 20 (66.7%) patients in the hospital stay range of 1-2 days and 10 (33.3%) patients in the hospital stay range of 3-4 days. In group B, there were 3 (10%) patients in the hospital stay range of 1-2 days, 10 (33.3%) patients in the hospital stay range of 3-4 days and 17 (56.7%) patients in the hospital stay range of 5-6 days.

In the distribution of patients by success rate, in group A, the success rate was achieved in 86.7% patients and not achieved in 4 (13.3%) patients. In group B, the success rate was achieved in 28 (93.3%) patients and not achieved in 2 (6.7%) patients (Table II). The distribution of patients according to the postoperative complications is shown in table III.

Table I: Distribution of patients according to stone size

Stone size (mm)	Group A (n=30)		Group B (n=30)	
	No.	%	No.	%
1-5	8	26.7	10	33.3
6-10	14	46.7	8	26.7
11-15	6	20.0	7	23.3
16-20	2	6.7	5	16.7
Mean±SD	8.7±4.2		10.2±4.9	

P value: 0.04

Table II: Distribution of patients according to success rate

Success rate	Group A (n=30)		Group B (n=30)	
	No.	Percentage	No.	Percentage
Yes	26	86.7	28	93.3
No	4	13.3	2	6.7
Total	30	100.0	30	100.0

P value: 0.1

Table III: Distribution of patients according to postoperative complications

Postoperative complications	Group A (n=30)		Group B (n=30)	
	No.	Percentage	No.	Percentage
Stone migration	2	6.7	3	10.0
Fever/infection	2	6.7	4	13.3
Bleeding	0	0	2	6.7
Hematuria	2	6.7	5	16.7
Perforation of ureter	1	3.3	3	10.0

P value 0.08

Discussion

Ureteral and renal stones are one of the commonest problems in primary care practice. Patients can have classic symptoms such as hematuria or renal colic but others can present as asymptomatic or can have

atypical symptoms like nausea, acute abdominal pain, difficulty in urination, testicular, or penile pain.[2] Around Eighty percent of patients that have nephrolithiasis are found to have calcium stones, mostly comprising of calcium oxalate and less likely calcium phosphate. The other causes leading to nephrolithiasis are mainly due to uric acid, cystine stones and struvite (magnesium ammonium phosphate) stones.[3]

Various methods are being used for the treatment and removal of renal and ureteric calculi. The advent of a method known as extracorporeal shock wave lithotripsy, in the early 1980s and another method by ultrathin ureteroscopes, in the early 1990s has revolutionized the treatment and management of renal and ureteric calculi. Due to significant changes in treatment options, open surgical stone extraction is almost nonexistent now a days comprising almost 0.5% of the cases presenting with ureteric calculi.[4] Open stone surgery now holds a minor place in primary management and it is reserved for the removal of stones from poorly or nonfunctioning kidney, correction of associated anatomical deformity and removal of complex stones only. In the ureter, large impacted stones and those cases that require repair or reimplantation are best treated by open surgery.[5] The rapid development of smaller and more efficient scopes has facilitated the use of ureteroscopy for treatment of ureteric calculi although these advances have decreased the need for open surgery, iatrogenic injury can still occur with endoscopic technique.[6]

Although the likelihood of spontaneous passage of stone is highest in distal ureter, intervention with ureteroscopy, ESWL, open ureterolithotomy is often necessary. Unlike ureterorenoscopy open ureterolithotomy is not influenced by stone size. Overall the goal of open stone surgery is to remove all calculi and fragments, to improve urinary drainage, to eradicate the infection, to preserve and improve renal function.[7] Mostly, urinary stones pass spontaneously but in around 10 to 20% of cases, surgical intervention is required. There are various reasons for surgical intervention such as failure of stone to pass, large size of stone, infection cases, renal failure and intractable pain. The techniques used to surgically manage the removal of stones are shockwave lithotripsy, medical expulsive therapy, URS or percutaneous nephrolithotomy. Recently the modern stone surgical techniques have made ureterolithotomy and nephrolithotomy rare, although decades ago these were commonly done.[16]

Intracorporeal pneumatic lithotripsy is a safe and effective treatment modality used as endoscopic treatment of ureteric stone. However, there are limitations especially in the treatment of upper ureteric hard stones, those cases in which the stone is close to the pelviureteric junction and has a risk of retropulsion into the kidney.[17]

Regarding the stone disease management, the urologist must be facile with predicting the management based on the chances and probability of ureteral stone passage. A well-trained urologist has options and choices that can be offered to patients having a stone disease, such as URS with laser lithotripsy and SWL. For complex cases PCNL can be used and even laparoscopic or robotic surgery in rare cases.[18]

In our study, the mean age of the patients in group A was 45.7±12.8 years and in group, B was 42.2±11.6 years. According to Sharma et al[19] the patient's mean age was 38 years, which is similar to that in our study. According to the study of Sharma et al[19] the mean stone size in the open ureterolithotomy group was 12mm, which is comparable with our study. In our study, group A had 60% male and 40% female patients and group B had 53.3% male and 46.7% female patients. According to the study of Razaghi et al[20] there were 62% male and 38% female patients, which is similar to our study. In our study, the mean stone size of the patients in group A was 8.7±4.2 mm and in the group, B was 10.2±4.9 mm. In our study, the mean hospital stay of the patients in group A was 2.3±0.7 days and in the group, B was 4.5±1.1 days. This is comparable with the study of Razaghi et al[20] the mean hospital stay in pneumatic lithotomy group was 2.2±0.3 days. The success rate in this study was 86.7% patients in group A. This is comparable with the study of Razaghi et al[20] the success rate in the pneumatic lithotomy group was found in 85.7%. The success rate in this study was 93.3% in group B. The complication of hematuria in our study was observed in 6.7% of patients in group A and 16.7% of patients in group B. According to a study, Ureterorenoscope followed by Lithoclast was observed as the most useful and safest procedure regarding clearance of stone. 96% efficacy in cases having stone size of 1-

1.5cm and 92% efficacy in stone size of 1.6-3cm.[21] As compared with the study of Goel and Hemal[22] in open ureterolithotomy group, hematuria was observed in 7.7% patients, which is comparable with our study. The complication of fever/infection was observed in 6.7% of patients in group A and 13.3% patients in group B. As compared with the study of Sharma et al[19] in open ureterolithotomy group, fever/infection was observed in 7.7% patients, which is comparable with our study.

According to another study, the Success rate by experiencing pneumatic lithoclast in areas of upper, middle and lower ureter was 83.3%, 83.3%, and 96.1% respectively and there was no major complication. Total 10 patients underwent Extracorporeal shock wave lithotripsy (ESWL) and 2 patients underwent open ureterolithotomy as an additional treatment.[23]

It has been observed in a study that URS has proved to be a better option in cases of large ureteral stones (>1.1 cm) in the upper third area, with high density (>1100 HU), mostly in obese patients.[24]

In a study it was observed that, although laparoscopic ureterolithotomy(TLU) results in longer hospital stays, longer operation time and longer duration of ureteral stent indwelling, when we compare it with ureteroscopic lithotripsy, but still TLU achieves a greater rate of stone clearance as compared to UL-RIRS without any additional procedures.[25]

Conclusion

It is concluded that pneumatic lithoclast, when compared with open ureterolithotomy, achieved better success rate and pneumatic lithoclast has advantages over open ureterolithotomy as far as hospital stay and complications are concerned. However, both techniques were successful

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