ORIGINAL ARTICLE

Journal of Contemporary Medicine and Dentistry
www.jcmad.com
ISSN [P-2347-4513]
ISSN [O-2349-0799]
Year: 2019
Volume: 7
Issue: 3
70-73

A Study of Fluoroless Ureteroscopic Lithotripsy for the management of Ureteral Stones

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Abstract

Background: *The conventional ureteroscopy utilizes fluoroscopy guidance which can cause problems because of radiation exposure to the patients, physician and operating room staff. In the present study, we tried to evaluate the effect of fluorolessureteroscopic lithotripsy for the treatment of ureteral stones.* ***Methods:*** *The present study was carried in the Department of urology, Chalmeda Anand Rao Institute of Medical Sciences, Bommakal, Karimnagar. N=76 consecutive patients with ureteral stones underwent ureteroscopic lithotripsy using flouroless technique. The Outcomes were analyzed with appropriate statistical tests.* ***Results****: The mean age of the patients in males was 28.5 ± 5.5 years and the mean age in female patients was 26.12 ± 5.1 years. The stone laterality showed the left side involved n=33 and n=41 right-sided stones, n=2 cases had bilateral stones out of total n=76 cases. The mean stone size in males was 12.5 ± 3.05 mm and in females, the mean stone size was 11.90 ± 2.90 mm. In 72.72% of males, associated hydronephrosis was present and in females, 62.5% showed the presence of hydronephrosis. The success rates were 95.45% in males and 96.87% in female patients. Stone fragment migration in 6.8% male and 3.12% of female cases. Mucosal injury 2.27% in male and no case of mucosal injury was found in female* ***Conclusion:*** *Fluoroless ureteroscopic lithotripsy is gaining popularity recently because of no risk of radiation exposure. It is safe and effective for the treatment of ureteral stones. The placement of guide wires, ureteral stent, and dilation can be done under direct visualization. However, it requires the adequate skill of the operator. If circumstances necessitate the use of fluoroscopy it must be done without any hesitation to prevent complications.*

Keywords*: Lithotripsy, Ureteral Stones, Fluoroless Ureteroscopic Lithotripsy*

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Date of Acceptance: 30/12/2019

Introduction

Ureteroscopic lithotripsy is now considered first-line therapy for the treatment of ureteral stones. Fluoroscopic imaging is used often for visualization guide wire placement, ureteral dilatation by coaxial dilators or balloon dilatation and ureteral stenting there by subjection both the patients and operative staff to harmful effects of radiation [1]. Although intraoperative exposure is less as compared to the radiation exposure of CT scan however, the effects can be cumulative [2]. Since radiation exposure of any levels can cause genetic mutations no amount of radiation can be expected to safe [3]. The increasing awareness of radiation exposure and its deleterious effects has lead urologists to adopt the principle of as low as reasonably achievable exposure to decrease the risk for the doctor and the staff [4]. Several protocols have been established to reduce the hazards of radiation during the procedure of ureteroscopic lithotripsy [5, 6]. Fluoroscopy time and radiation doses have been reduced with the application of new digital fluoroscopic devices and radiation exposure during a standard procedure are estimated to range from 2.5 to 100mSv [7]. Interest in the area of feasibility and

management of ureteral calculi with fluorolessureteroscopy is increasing since the time it was first used in 2007 [8-10]. We in the present study tried to evaluate the feasibility, safety and success rates of radiation-free ureteroscopic lithotripsy for the treatment of ureteral stones.

Materials and Methods

The present study was conducted in the Department of Urology, Chalmeda Anand Rao Institute of Medical Sciences, Bommakal, Karimnagar. Institutional Ethical committee permission was obtained for the study. Written consent was obtained from all the patients of the study after explaining the nature of the study and possible outcomes in their local language. Successive patients diagnosed with ureteric calculi were included in the study. Diagnosis evaluation of ureteral calculi was done by complete history taking, physical examination and laboratory investigations which included CBP serum creatinine, bleeding time and clotting time, urine tests and culture and radiological evaluation. The measurement and location of the stone and associated hydronephrosis was done by ultrasonography. The kidneys, ureters, and bladder were examined by KUB radiography. Intravenous urography (IVU) or non-contrast CT was done. Preoperative variables were reviewed including age and time of surgery, gender, stone size, locations treatment outcomes, and complications were recorded. The postoperative variables were the length of postoperative hospital stay was also recorded. The operative procedure was performed in a lithotomy position under Spinal Anesthesia. The 7fr/8fr (depending on requirement) semi-rigid ureteroscope was inserted into the bladder and the desired ureteral orifice was engaged and the safety guide wire was gently manipulated into the ureteral orifice with endoscopic visualization until resistance was obtained. The resistance was due to stone the guide wire was slightly moved back. The ureteroscope was inserted through the orifice under direct vision with aid of safety guide wire. One stone was visualized pneumatic lithotripsy was used to treat the stone and lithotomy was considered to be complete when the stone was reduced to small fragments and easily and spontaneously passed. Ureteral inflammation or edema after the operation is seen usually hence ureteral stent was temporarily placed in all the patients undergoing fluoroless technique. The ureteroscope was moved forward up to the ureteropelvic junction to ensure no residual stone is present. Ureteroscope is next re-introduced into the bladder along the safety guide wire the estimation of proper stent length was done using baseline imaging. The stent was passed over the flexible guide wire using a stent advancer under ureteroscopic observation. The distal end of the stent when reaches the orifice the stent stopped and the stent advancer is used to stabilize the stent and guide wire is then removed allowing the distal coil to form in the bladder. The ureteroscope was positioned in the bladder neck to confirm the distal coil is in the right position. Radiological evaluation was performed after 2 weeks of operation to assess the location and passage of stone fragments. Once satisfied the ureteral stent was then removed. The data obtained was recorded on the MS Excel spreadsheet and analyzed by SPSS version 17 on the Windows platform.

Results

In the present study, a total of n=76 patients were included out of which n=44 were males and n=32 were females. The most common age group was the 15-20 years which had n=27(35.52%) patients of both groups combined. The next common age group was 31–40 years with n=17(22.37%) of patients. The mean age group of the male patients was 28.5±5.5 years and the mean age in female patients was 26.12±5.1 years other details are shown in table 1.

Table 1: Age and sex-wise distribution

Age group years	Male	Female	Total	Percentage
15–20	15	12	27	35.52
21–30	09	07	16	21.05
31–40	11	06	17	22.37
41–50	05	03	08	10.53
> 50	04	04	08	10.53
Total	44	32	76	100

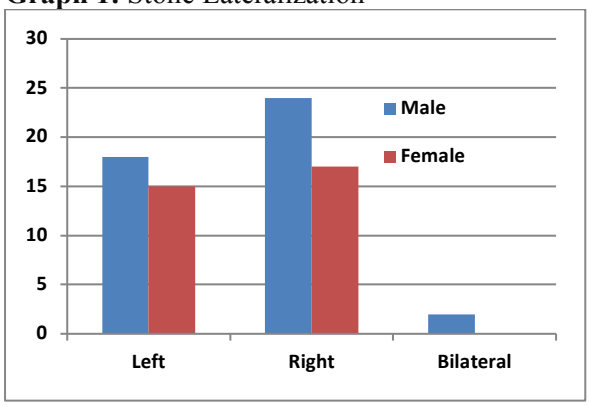
The location of the stone in the ureter shows that in n=35(46.05%) cases had the location of the stone in the distal third of the ureter. N=21(27.63%) were located in the mid ureter and n=20(26.63%) were found to be located in

the proximal ureter given in table 2. N=24 males and n=17 females were found with stone located on the right side of the ureter and n=18 male and n=15 females had stone located on the left ureter and in n=2 males had stone located bilaterally shown in graph 1.

Table 2: Anatomical location of stone in ureter

Stone Location	Male	Female	Total	Percentage
Proximal ureter	13	07	20	26.31
Mid ureter	11	10	21	27.63
Distal ureter	20	15	35	46.05
Total	44	32	76	100

Graph 1: Stone Lateralization



The mean stone size in males was 12.5±3.05 mm and in females, the mean stone size was 11.90±2.90 mm. In 72.72% of males, associated hydronephrosis was present and in females, 62.5% showed the presence of hydronephrosis. The success rates were n=42(95.45%) in males and n=31(96.87%) in female patients. Fluoroscopy was employed in n=2(4.5%) of male and n=1(3.1%) females. one male had an anatomical abnormality of the double collecting system. The other details are shown in table 4.

Table 3: Important operative characteristics

Operative characteristics	Male (n==44)	Female (n=32)
Stone size in mm	12.5 ± 3.05	11.90 ± 2.90
Hydronephrosis present	n=32(72.72%)	n=20(62.5%)
Mean operative time (min)	32.22 ± 5.5	35.95 ± 6.5
Success rate	n=42(95.45%)	n=31(96.87%)
Need for fluoroscopic screening	n=2(4.5%)	n=1(3.1%)

Postoperative complications were recorded in the cases which showed stone fragment migration in n=3(6.8%) males and n=1(3.12%) of female cases. Mucosal injury n=1(2.27%) in male and no case of mucosal injury was found in females. Urinary tract infection postoperative was seen in n=2(4.5%) of males and n=2(6.25%) of female patients and stent migration was found in N=1(2.27%) of males table 4.

Table 4: Complications recorded

Complications	Male (n=44)	Female (n=32)
Stone migration	N=3(6.8%)	N=1(3.12%)
Musocal injury	N=1(2.27%)	0.0%
Ureteral perforation	0.0%	0.0%
UTI	N=2(4.5%)	N=2(6.25%)
Stent migration	N=1(2.27%)	0.0%

Discussion

Fluoroscopy is widely used during the ureteroscopic lithotripsy to act as a guide during the procedure and it enhances the safety of operation. However, radiation exposure to the medical staff and patients is the consequence of this method [1]. Recent trends are towards the decreased use of fluoroscopy during ureteroscopic lithotripsy is being studied to reduce the radiation exposure. A cadaveric study by Krupp et al; to measure organ-specific and tissue-specific doses during simulation of ureteroscopy with fluoroscopy found 0.2 – 7.4% per 100000 patients as a result of radiation-induced cellular injury [2]. The other risk factor along with radiation exposure during ureteroscopy found obesity. It was found that obesity is associated with a three-fold higher radiation dose rate [11]. Another risk factor was the usage of the balloon for dilatation during the operation [12]. Weld et al; started a program (SMART) for safety Minimization and Awareness Radiation Training which included radiation safety and instruction of minimizing fluoroscopy during ureteroscopy. Urology residents with or with smart training were compared for mean fluoroscopy time which showed the SMART attendees utilized 56% reduced time for the same procedure [13]. Pulsed fluoroscopy delivered less radiation compared to continuous fluoroscopy at each site by approximately 64%. The other advantage of pulsed fluoroscopy is it reduces the fluoroscopy

time by 76%. Studies suggest that 90% of urologists pulsed fluoroscopy images as adequate for most of the tasks of ureteroscopy [14]. In the present study, we found the success rates were n=42(95.45%) in males and n=31(96.87%) in female patients. Fluoroscopy was employed in n=2(4.5%) of male and n=1(3.1%) females due to stone migration to the pelvis and further ureteroscopy was necessary one male had an anatomical abnormality of the double collecting system. The results of this study show that complete clearance of distal ureteral stone was achieved in n=34 of total n=35 patients with distal ureteral stone. Fluoroscopy was employed in n=3 out of total n=76 cases. Fluoroscopy should be employed if urologist feels it is necessary during the dilation procedure. Hsi et al; [15] using two taps of fluoroscopy at the time of procedure limited fluoroscopy was required for stent placement only and no fluoroscopy was used for ureteroscopy. Wayne B et al; [16] found a technique for placing ureteral stent without image guidance and they concluded that ureteral stent placement without fluoroscopic guidance is practicable. In our study, we found stent migration in only one case after one month of surgery when stents were placed under direct visualization. This shows that stent placing is reliable without fluoroscopic guidance provided the operator has adequate skill [8]. The complications seen in the study were Mucosal injury n=1(2.27%) in males. Urinary tract infection postoperative was seen in N=2(4.5%) of males and n=2(6.25%) of female patients and stent migration was found in N=1(2.27%) of males. They were managed adequately.

Conclusion

Fluorolessureteroscopic lithotripsy is gaining popularity recently because of no risk of radiation exposure. It is safe and effective for the treatment of ureteral stones. The placement of guide wires, ureteral stent, and dilation can be done under direct visualization. However, it requires the adequate skill of the operator. If circumstances necessitate the use of fluoroscopy it must be done without any hesitation to prevent complications.

Conflict of Interest: *None declared*
Source of Support: *Nil*
Ethical Permission: *Obtained*

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