ORIGINAL RESEARCH

Ureteral stricture after ureteroscopic treatment of ureteral stones: A hospital based observational study

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ABSTRACT

Background: Ureteral stone is a common disease entity among urolithiasis. Most certain issue of endourological treatment of impacted ureteral stones is the formation of ureteral strictures, with the reporting occurrence rate of 14.2% to 24% of cases.

Materials and Methods: A retrospective study designed including the ureteroscopic treatment for impacted ureteral stones removal. During the follow up period after 3 months, 6 months and 9 months the patients state analysis was done using a regular ultrasound. Following the evaluation using ultrasound, further computed tomography intravenous urogram was done if any signs of hydronephrosis was observed to confirm the occurrence of ureteral strictures.

Results: Among 90 patients included in the study, two of the patients developed ureteral strictures. Hence, the stricture occurrence was 3.3%. Overall assessment of intra-operative risk factors including location of impacted stone, mucosal injury and bleeding revealed that none of these factors contributed significantly to the formation of the ureteric strictures. Stone-related risk factors as stone size, stone impaction site and duration of impaction were considered and did not contribute significantly to the formation of the ureteral strictures.

Conclusions: This retrospective study failed to identify any predictable factors for ureteral stricture formation. It is proposed that patients who developed symptoms undergo a simple postoperative ultrasound screening 3 months, 6 months and 9 months after undergoing endoscopic treatment for impacted ureteral stones.

Keywords: Ureteral stone, post URS, Ureteral stricture, Ureter, Ureterolithiasis; Ureteroscopy.

INTRODUCTION

Ureteral stone is a universally prevalent disease with calculi impacted into the ureteral mucosa, causing ureteral stricture formation as a recognized complication of stone with high rates of almost 4-5% after instrumentation usage with a subsequent danger of renal deterioration.1,2,3 Recent advances in endoscopic technologies and refinement in stone-disintegration devices have developed the use and success of ureteroscopic procedures for

stone diseases, while decreasing associated complication rates as well.4 Therefore, follow-up radiographic studies after ureteroscopy have been the standard of care adopted by many urologists5. The treatment of impacted ureteral calculi can be challenging because the ureter may undergo various pathological changes, such as epithelial hypertrophy and oedema thus rendering the patient prone to fibrosis and stricture formation.6 Harmon et a1 reported the rate of stricture formation after ureteroscopy to be 0.5% in 1992 compared with 1.4% 10 years earlier.7 Restricted facts are observed with the occurrence of stricture development in patients who undergo endoscopic instrumentation and manipulation of impacted ureteral stone. In an effort to understand and identify potential predisposing factors for stricture formation better, 90 cases of impacted ureteral stones were retrospectively analysed.

MATERIALS AND METHODS

This case-series includes 90 adult patients who underwent URS for ureteral stones from January 2020 to January 2021 in our hospital. Patients with single and multiple ureteral stone <5 mm , total stone burden >35 mm, history of previous open surgery in ureter, and/or intraoperatively diagnosed ureteral stricture either during retrograde pyelography (RPG) or endoscopically were excluded from the study. Detailed history, clinical examination, abdominal ultrasonography (U/S), plain-kidney, ureter and bladder (KUB), non-contrast computed tomography (NCCT)/CT-IVP, urinalysis and urine culture, routine preoperative laboratory investigations and surgical fitness were done for all cases. Local ethics committee before conducting this study and written informed consent from all patients was taken. Stones were considered impacted when they were present at the same site for >2 months, caused moderate or severe hydronephrosis by preoperative U/S, caused obstructive anuria, and/or diagnosed intraoperatively as impacted stones where there was difficulty in passing a standard guide wire beyond the level of the stone at the first trial. Under spinal or epidural anaesthesia, together with prophylactic three-generation cephalosporin, the patient was placed in dorsal lithotomy position. When the ureteral orifice identified; the hydrophilic(terumo) guide wire was introduced. If the ureter was tight, it was dilated by either Teflon dilators. After that, a semi-rigid ureteroscope with an offset eyepiece, tip diameter of either 6 or 8.5 Fr, and length of either 31.5 or 43 cm was introduced. If the ureter is still tight, a ureteral stent was inserted and the procedure aborted for 2 weeks and re-URS performed. The stones were disintegrated by pneumatic lithotripter (PL) or laser lithotripter (LL). Larger Stone fragments were extracted either with ureteroscopic forceps or dormia. Ureteral stenting was done in all situation. Finally, fluoroscopic confirmation of correct stent position and stone clearance was done; then, a urethral catheter was inserted. The term “immediate clearance” was used when the final fluoroscopic shot showed that the ipsilateral ureter was either completely cleared of stones or had only insignificant residual fragments (≤ 3 mm in size). Intraoperative data including any complications were recorded in the patient sheet. The term mucosal abrasion was used to describe the small superficial mucosal tears that are not extending beyond mucosa. The term false passage was used when an instrument or accessory perforates the mucosa, without penetrating the whole ureteral wall. The ureteral catheter was removed before patient discharge while patients with double-J stent were instructed to come back for stent removal on a specific date. The patients were requested for postoperative follow-up at the outpatient clinic on 3 separate visits every 3 months after DJ stent removal .When U/S showed back pressure , CT urography (CTU) was done to show the cause and level of obstruction. Post-URS ureteral stricture in this study was defined as complete or partial ureteral obstruction as shown by the excretory phase of CTU, at least 3 months after stent removal. Data entry was done using Microsoft Excel 2015 and 2016 versions while data analysis was done using IBM SPSS Statistics for Windows, Version 19.0 (IBM Corp. Armonk, NY). Chi-square and Fisher’s exact tests were used to compare between qualitative

variables. Mann–Whitney test was used to compare between two quantitative variables in case of nonparametric data. Multiple logistic regression analysis was done to measure the risk factors. P value was considered statistically significant when <0.05.

RESULTS

A total of 90 patients were selected for which URSs were performed for the management of ureteral stones. The mean (standard deviation) age was 37.70 (±14.40) years. Characteristics features are summarized in Table 1 with the duration of symptoms showing mean 11.7 months and standard deviation of 16.08.The CT mean of stone size is 10.30 mm and standard deviation of 2.22. The mean of Transverse diameter of stone was 7.77 mm and standard deviation of 1.57.

Table 1: Pre- operative Variables

Variable	Mean	S.D
Age (yrs)	37.70	14.40
Duration of symptoms (months)	11.77	16.08
CT- stone size (mm)	10.30	2.22
Transverse diameter of stone(mm)	7.77	1.57

Table 2 representing pre-operative patients characteristics as flank pain was seen in all 90 patients. Dysuria was seen in 21 patients with 23.3% haematuria was seen in 6(6.7%) cases. Graveluria in 9 (10%), oliguria in 9 (10%), lower urinary tract symptoms was seen in 6 (6.7%), previous history of intervention was in 18 (20%) patients. Raised serum creatinine was seen in 15 (16.7%) patients. Pre-operative DJs stunting was done in 18 (20%) patients. Stone was seen in various regions like in upper ureter 21 (23.3%), middle ureter 21 (23.3%), lower ureter 54 (60%). Single stones were observed in 69 (76.7%) patients and multiple stones in 21 (23.3%) cases. Mild, moderate and severe cases of hydrouteronephrosis were seen with 66 (73.3%),24 (26.7%) and 3 (3.3%) patients. Associated renal calculus on same side were observed in 33 (36.7%) patients.

Table 2: Pre-operative Patients Characteristics

	Number (%)
Gender	
Male	57 (63.3)
Female	33 (36.7)
Main Presentation	
Flank pain	90 (100.0)
Dysuria	21 (23.3)
Hematuria	6 (6.7)
Graveluria	9(10.0)
Oliguria	9 (10.0)
Lower urinary tract symptoms	6 (6.7)
Previous history of intervention	18 (20.0)
Serum creatinine Raised	15 (16.7)
Pre operation-DJs stunting	18 (20.0)
Location of stone	
Upper	21 (23.3)
Middle	21 (23.3)
Lower	54 (60.0)
Single	69 (76.7)

Multiple	21 (23.3)
Hydroureteronephrosis (hdun)	
Mild	66 (73.3)
Moderte	24 (26.7)
Severe	3 (3.3)
Associated renal calculus same side	33 (36.7)

Using the investigation modalities the exact location of stone was observed in upper, middle and lower ureter with 15(16.7%), 18 (20%) and 57 (63.3%) patients. The surrounding mucosa was unhealthy in 87 (96.7%) patients. Lithotripsy was used following laser in 36 (40%) and pneumatic in 54 (60%) patients. Stone fragments were removed using forceps in 84 (93.3%) patients and dormia in 6 (6.7%) patients. DJ stent or ureteric catheter was used in 87 (96.7%) patients. Second URS was used in 18 (20%) patients. Following with the procedures the intra- operative complications was observed like mucosal injury and bleeding in 42 (46.7%) and 39 (43.3%) patients.

Table 3: Intra-Operative variables

	Number (%)
Exact location of stone	
Upper ureter	15 (16.7)
Middle ureter	18 (20.0)
Lower ureter	57 (63.3)
Surrounding mucosa (unhealthy)	87 (96.7)
LITHOTRIPSY	
Laser	36 (40.0)
Pneumatic	54 (60.0)
Stone fragments extraction	
Forceps	84 (93.3)
Dormia	6(6.7)
DJ stent / ureteric catheter	87 (96.7)
Second URS	18 (20.0)
Intraoperative complications	
Mucosal injury	42(46.7)
Bleeding	39 (43.3)

Post-operative immediate complications were seen as fever, haematuria, pain and in short term follow up, stricture in 21 (23.3%), 9 (10%), 30 (33.3%) and 2 (3.3%) patients.

Table 4: Postoperative Complications

	Number (Percentage)
Fever	21 (23.3)
Hematuria	9 (10.0)
Pain	30 (33.3)
Stricture	2(3.3)

Multivariable analysis using logistic regression test revealed that none of the pre-op and intra- operative factors are responsible for stricture formation, as shown in Table 5.

Table 5: Logistic Regression of pre-op and Intra operative variables

			Lower	**Upper**
Location of Stone	0.998	6.001E7	0.00	0.00
Surrounding Mucosa	0.999	1.807E23	0.00	0.00
Lithotripsy Used	0.998	9.664E14	0.00	0.00
Mucosal Injury	0.999	2.337	0.00	0.00

Bleeding	0.999	0.137	0.00	0.00

DISCUSSION

A ureteral stricture is gradual, progressive and serious complication of URS leading to ipsilateral renal function detoriation.8 Previous research into the rate of stricture formation following endoscopic treatment for impacted stones reported stricture rates of between 14.2% and 24% 9. In this retrospective study, the rate of formation of ureteral stricture following ureterolithotripsy for impacted stones was 3.3 %, which was lower than the rates in earlier studies mentioned. Stone impaction is the main predictor for thedevelopment of stricture. Tas found that ureteral stricture was observed in 13.3% of patients with impacted calculi and in 5% of patients who did not have impacted calculi ($P < 0.05$).10 In a retrospective study, Elashry et al., reported 12 cases (0.4%) of ureteral stricture out of 3215 ureteroscopies performed for treatment of distal ureteral stones; notably, all 12 strictures had impacted ureteral calculi.11 In the current study we found that all URS were done over impacted stone and was not found clinically significant. Larger stone size is another risk factor for stricture formation. El-Abd et al. found that large stone size is significantly related to increased incidence of stricture.12 In the current study, the mean stone burden found on CT was 10.30 mm with an overall incidence of stricture 3.3%. Kramolowsky and Robert et al reported 8%. Brito et al. reported an overall incidence of 14,15,16 stricture of 14.2% after pneumatic lithotripsy of impacted calculi. Strictures occurred in 2.9% of patients with no perforation. In this study in 60% patients the pneumatic lithotripsy was performed on impacted calculi and in 40%patients lasers were used, the stricture was observed in 3.3% patients with no any perforations. Ureteral stones cause persistent irritation that leads to oedema and fibrosis in the ureter mucosa. Microscopic studies have shown the occurrence of chronic interstitial fibrosis and urothelial hypertrophy at the stone impaction area. Decreased blood flow due to prolonged physical pressure or an immunological response towardstone material causes severe and chronic inflammation at the ureter mucosa.6 In this study mucosal injury was observed in 46.7%, from the analysis it proved that this injury caused from the stone pressure is not responsible for stricture formation. In our study, the use of forceps and dormia to remove stone fragments was 93.3% and 6.7%. No any perforations were seen following the removal of stone fragments but surrounding mucosa was found to be unhealthy. Postoperative complications were observed like fever was noticed in 23.3%, flank pain was observed in 33.3%, haematuria in 10%. Three out of Six of them developed stricture. Pain after stent removal was a significant predictor for stricture in one study which revealed 99.8% and 64.3% negative and positive predictive value for pain, respectively.In contrast, Adiyat et al. found that pain after stent removal was not a significant predictor for the development ofstricture.17After the procedure in this study the pain and fever was observed in some patients during 9 months of follow-up period. A postoperative follow- up with imaging for patients who complained pain and fever after a ureteroscopy was performed. The follow-up extended to 9 months after the ureteroscopic stone- extraction procedure. All patient with moderate to severe HDN followed with USG KUB till 9 months and diagnosis of stricture was made according to CT-IVP. In the present series, 6 out of 90 of these patients were diagnosed with stricture after radiological follow-up of 9 months. Two out of Six patients were diagnosed with ureteral strictures at 9 months according to a CT-IVU. KUB ultrasound performed on this patient showed moderate hydronephrosis 3 months after ureterolithotripsy. Thus, it was assumed that the ureteral stricture had formed then. The relatively small number of post-URS stricture in our retrospective study was so small that no significant results were found.

CONCLUSION

This present study concludes that post-URS ureteral stricture incidence is low provided that all the requirements for safe URS are available with advanced technologies. The impacted stone is the basic primary cause of URS complications and hence leading to the stricture formation, but still there's a of hour for large randomised controlled studies to define the risk factors responsible for stricture formation with deep knowledge and skilled practical interventions.

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