Research Article

The Non-Accessible Ureter: Can History, Gender, Age, BMI, Radiology and Stone Size Predict the Requirement of Pre-Stenting in Narrow Ureters

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Abstract: Background: The difficulty in access to the ureter during stone removal surgery enhances the chances of redo-surgery, DJ stenting, and associated complications, this failure leads to mistrust in the doctor-patient relationship.

Objective: This study aims to provide a comprehensive evaluation of the incidence & management of narrow ureters after failure to negotiate retrograde access of rigid or flexible Ureteroscope (6/7.5 Fr).

Materials and Methods: This is a Prospective, cross-sectional study, conducted at the urology department of Tabba Kidney Institute, from June 2022 to June 2023. The minimum required sample size was 250. Patients aged between > 18 to <60 diagnosed with Unilateral and bilateral ureteric stones and hydronephrosis without ureteric stone obstruction were included in the study. SPSS 22 was used to analyze the data, the chi-square test was applied, with p-value <0.05 as significant.

Result: The overall mean age of the study population was estimated as 40.71 ± 12 years, while gender distribution indicated 138 (55.2%) male and 112 (44.8%) female patients. Group distribution identified 172 (68.8%) patients with negotiable ureter (Group A), while 78 (31.2%) with non-negotiable ureter (Group B).

Conclusion: We conclude that in our population there is a higher incidence of narrow ureters, as compared to other studies which are not accessible even using the same dilatation technique, so it is safe to counsel the patients pre-operatively about the possibility of the narrow ureter and need for pre-stenting. Tabba Ureter Accessibility (TUA) score can be used as a tool to predict the possibility of a narrow ureter.

Keywords: Narrow ureter, Ureteric stone, DJ stent, Ureterorenoscope, Dehydration, Hematuria.

INTRODUCTION

Being the most commonly reported benign urological disease, the increasing burden of urinary tract stones in developing countries requires safe, affordable, and effective treatment [1]. Determinants behind the increasing incident rate of renal stones are metabolic syndrome, low urine output, lifestyle changes, dehydration, and positive family history [2]. The geographical presence of Pakistan and neighboring countries over the stone belt is reportedly an independent risk factor for higher renal stone frequency in all age groups. Renal stone treatments range from medical expulsive therapy (METs) to percutaneous nephrolithotomy (PCNL) and Ureterostomy (URS) to remove renal stones and restore normal physiological functioning of renal systems as the primary goal to achieve [3].

Although the lengthy operative time causes more need for anesthesia, higher risk of bleeding, and longer hospitalization stays are still to be considered as post-operative complications.

According to available literature, small renal stones up to 0.4 cm in size are often expelled by renal physiology; stones bigger than this might stuck in the kidney or ureter and cause excruciating pain, hydronephrosis, hematuria, and obstructive uropathy [4]. Seventy to ninety percent of the 0.4 cm stones pass through with no negative consequences, however occasionally the patient has mild to moderate discomfort, but in our population, we commonly see 2-3mm and 4mm stones causing significant obstructive uropathy and stone not passed by conservative and METs therapy for the period of 2-4weeks, tested according to patient's symptoms [3, 4]. Following a thorough assessment of the size, position, and site of the stone, the urology surgeons determine whether or not an intervention is required, the type of intervention required to remove stones is also prearranged by the urologist, keeping associated determinants in consideration many of the patients in this category in which small stones having significant obstructive uropathy require surgical intervention and commonly found narrow ureters which are not accessible in first attempt and need pre-stenting [5, 6].

Over the past several decades, the management of ureteric calculi has advanced from extracorporeal shockwave lithotripsy (ESWL), which treated pushed-back stones, to ureteroscopy (URS) [7]. Following the advent of various ureteroscopy techniques and lithotripters, ureteric calculi have undergone signif-

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icant changes, particularly in the management of the proximal, mid, and distal ureteric stones [8]. The available research backs up laser therapy, showing 92% laser and 82.1% lithoclast effectiveness. Some researchers determined that there was a greater fragmentation and shorter lithotripsy period in the laser group by comparing the mean differences in stone fragmentation time and stone-free rates between the two lithotripters [9]. With the advancement of endoscopic surgery in the field of urology for the treatment of stone removal with the help of rigid, semi-rigid, and flexible retrograde ureterorenoscopes of varying sizes 6/7.5, 8/9.8, and 9Fr respectively [4, 6, 7]. Even with these advanced technologies, sometimes it becomes difficult to access the upper tract for the treatment of stone retrieval. The difficulty in the access to the upper tract may be due to anatomical abnormalities, narrow or stenotic ureteric orifice, lumen, or stricture due to previous instrumentation injury or malignancies [5, 9]. There are different techniques also available for the active dilatation of the ureter i.e. tapered dilators and balloon dilators, but still have the chance of failure and need for pre-stenting. This failure led to mistrust in the doctor-patient relationship and became an embarrassment for the urologist due to the lack of counseling for narrow ureters and the need for pre-stenting [10].

This study aims to provide a comprehensive evaluation of the incidence & management of narrow ureter with clinical assessment, Demographics details, Radiography, and stone size causing obstruction and per-op findings including ureteric size calibration and need for pre-stenting during the procedure after failure to negotiate retrograde access of rigid or flexible ureteroscope (6/7.5 Fr).

MATERIALS AND METHODS

This is a Prospective cross-sectional study, conducted at the urology department of Tabba Kidney Institute. From 2022 August to 2023 August. After getting approval from the institutional review board for research having IRB number (TKI-HEC 025), the adult population aged between 18-60, presented with complaints of flank pain, hematuria, dysuria, lower urinary tract symptoms, or/and polyuria underwent radiological investigations to identify renal stones, ultrasound KUB, and/or CT Kub was performed and patients with a confirmed diagnosis of ureteric stones and required surgical management were requested to sign an informed consent in the language of understanding. To calculate the sample size, the WHO sample size calculator was used, the population of the age group 18 – 60 years, 139765500 (60.97%) of the total population in 2021 was used as the population, keeping a confidence level of 95% and an error margin of 5%, the minimum required sample size was 250. Patients aged between > 18 to <60 diagnosed with Unilateral and bilateral ureteric stones and hydronephrosis without ureteric stone obstruction were included in the study. Anatomic, inflammatory, and active infective anomalies, ureteral stricture, Posterior urethral valve, Vesico ureteral Reflux, Bladder outlet obstruction, Benign Prostate Hyperplasia, and Genitourinary tuberculosis were excluded from the study. After successful enrollment in the study, demographic history including age, gender, family history, and personal history was documented. The surgeon's assessment of the patient, radiological investigation, stone characteristics, and other details were also recorded.

All patients included in the study with ureteric stones that required surgical intervention, URS (6/7.5Fr) was used to access ureteric stones, and patients were divided into two groups, group A had patients with normal ureter and easy access to ureteric stones, while group B had patients with narrow ureter and need of pre-stenting before stone removal.

To develop a score to evaluate the chances of a tight ureter before the procedure, our urologists identified the risk factors and made scorekeeping parameters including age category of patients, gender, BMI, family history of urolithiasis, stone size (cm), and, stone location as determinants for tight ureter presentation names as Tabba Ureter Accessibility Score (TUA). The scale was disseminated in numeric scores of 1, 2, and 3, BMI of < 24.9, 25-29.9 and > 30 were used as 1, 2, and 3 numeric scores respectively. Similarly, > 35 years of age and 18.35 years of age were counted as 1 and 2 of a numeric score. The female gender had 1 score while the male gender contained 2, the stone size and location also had numeric representations in the Tabba Ureter Accessibility (TUA) score. TUA scores <6 have a very low possibility of a narrow ureter, TUA scores 6-10 have a moderate chance of a narrow ureter, and >10 scores have a high possibility of a narrow/non-accessible ureter (Table **1**).

Table 1. Representation of Tabba Ureter Accessibility (TUA) Score for the Possibility of Narrow Ureter.

PARAMETER	1	2	3
BMI (kg/m^2)	<24.9	25-29.9	>30
Age (years)	>35	18-35	
Sex	Female	Male	
Family Hx of Urolithiasis	Negative	Positive	
Stone Size (cm)	>1	0.7-1	<0.7
Stone Location	Distal	Mid	Proximal

After completing the sample size, all patients' data was sorted, analyzed, and associated to get the best determinants of a narrow ureter and a pre-structured scale was made to assess the chances of a narrow ureter before surgery in patients.

STATISTICAL ANALYSIS

Statistical Package of Social Sciences (SPSS) version 22 was used to enter, sort, and analyze the data, for continuous variables such as age, stone size, and weight mean and standard deviation were used while for categorical variables frequency and percentages were used. The chi-square test was used to identify the significance between two mean values, keeping the p-value <0.05 as significant. The odds ratio test was applied to assess risk estimation of the narrow ureter in the study population.

RESULT

A total of 250 patients were enrolled in the study after signing informed consent. The overall mean age of the study population was estimated as 40.71 ± 12 years, while gender distribution indicated 138 (55.2%) male and 112 (44.8%) female patients. Group distribution identified 172 (68.8%) patients with negotiable ureter (Group A), while 78 (31.2%) with non-negotiable ureter (Group B). Upon assessing mean age within groups, group A participants had 38.7 ± 10.9 years of mean age, while group B had 41.2 ± 9.4 years of mean age. the age of study participants was categorized into 05 groups, the 16-25 years group had 23 (9.2%) patients, while the 26-35 group had 73 (%) patients, similarly 36-45-, 46-55- and 56–65-year groups had 56 (%), 54 (%) and 44 (%) patients respectively. Patients were divided into two groups according to URS negotiation success, group A had patients with accessible URS, while group B had non-negotiated URS patients who needed pre-stenting to support renal function. To assess the risk factors of non-negotiated URS variables such as age, gender, stone size, stone location, and other associated factors were correlated and a few determinants were identified. Non-negotiated group B with the frequency of 78 (31.2%) patients, reported 40/78 (51.2%) incident in male patients, positive family history was reported in 41/78 (52.5%), 34/78 (43.5%) had BMI of >30, reported stone size of<7mm in 53/78 (67.9%), 26-35 years old patients were 22/78 (28.2%), while proximal stones were identified in 44/78 (56.4%) patients (Fig. **1**).

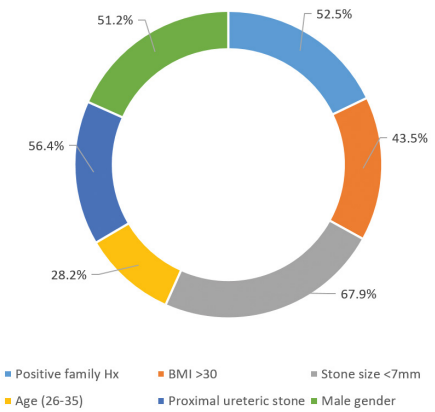

Fig. (1). Reported Risk Factors for Tight Ureter in the Study Population.

Upon evaluating the correlation of demographic details with both groups A (negotiated) and B (not negotiated) we have identified that the highest narrow ureter frequency was reported in age categories of 26-35 years with 22 (28.2%), followed by 16-25 years old age category with 17 (21.7%) respectively. While male and female genders reportedly had a comparable frequency of narrow ureters with 40 (51.2%) and 38 (48.7%) in male and female gender respectively. BMI of > 25 has a remarkably higher incidence of narrow ureter with 34 (43.5%), followed by 23-24.9 BMI with 28 (35.8%) patients. A positive family history of urolithiasis had a higher frequency at 44 (56.4%), while a stone size of <0.7cm had a higher incidence at 53 (67.9%). Similarly, the stone location of the proximal ureter had 44 (56.4%) frequency (Table **2**).

Table 2. Association of Variables with Narrow Ureter Incident in the Study Population.

Variables		Negotiated (n=172)	Not negotiated (n=78)	P-Value
Age	16 to 25 years	11 (6.3%)	14 (17.9%)	0.005
	26 to 35 years	61 (35.4%)	22 (28.2%)	
	36 to 45 years	42 (24.4%)	14 (17.9%)	
	46 to 55 years	36 (20.9%)	17 (21.7%)	
	56- 65 years	22 (12.7%)	11 (14.1%)	
Gender	Male	98 (56.9%)	40 (51.2%)	0.214
	Female	74 (74%)	38 (48.7%)	
BMI	Normal (18.5-22.9)	4 (2.3%)	16 (20.5%)	0.021
	Overweight (23-24.9)	27 (15.6%)	28 (35.8%)	
	Obese (>25)	50 (29%)	34 (43.5%)	
Family History of Urolithiasis	Positive	41 (23.8%)	44 (56.4%)	11
	Negative	131 (76.1%)	34 (43.5%)	
Stone Size	> 1 cm	38 (22%)	10 (12.8%)	0.017
	0.7-1 cm	87 (50.5%)	15 (19.2%)	
	< 0.7 cm	47 (27.3%)	53 (67.9%)	
Stone Location	Distal ureter	71 (41.2%)	18 (23%)	0.728
	Mid ureter	29 (16.8%)	16 (20.5%)	
	Proximal ureter	72 (41.8%)	44 (56.4%)	

The risk of a narrow ureter was evaluated with an odds ratio test, keeping a confidence interval of 95%, and the significance of OR. The highest odds of having a narrow ureter were identified in the age group of 26 to 35 years and 16 to 25 years with OR of 1.233 and 2.457 (CI95% - 0.104 – 2.044, 0.154 – 4.353)

respectively. The higher odds ratio was reported in male gender (CI 95%, Upper bound -1.895), BMI of > 25 (CI 95%, Upper bound -1.412), positive family history (CI 95%, Upper bound -1.347), stone size < 0.7 cm (CI 95%, Upper bound -1.37) and stone location of the proximal ureter with OR of 1.281 (CI 95%, Upper bound -3.512). All patients in Group A had a TUA score of ≤ 9 while Group B members had a score of ≥10 (Table **3**).

Table 3. Univariate Odds Ratio Assessment of Variables with Narrow Ureter in the Study Population.

Variables		Odds Ratio	95% CI - Lower Bound	95% CI - Upper Bound	P-value
Age	16 to 25 years	1.233	0.894	1.213	0.624
	26 to 35 years	2.457	0.104	2.044	0.064
	36 to 45 years	0.271	0.154	1.353	0.059
	46 to 55 years	0.627	0.203	1.91	0.157
	56- 65 years	0.108	0.028	1.871	0.411
Gender	Male	0.816	0.351	1.895	0.128
	Female	0.635	0.179	1.471	0.635
BMI	Normal (18.5-22.9)	0.24	0.241	6.391	0.017
	Over-weight (23-24.9)	0.206	0.063	0.678	0.797
	Obese (>25)	0.189	0.171	1.412	0.009
Family History of Uro-lithiasis	Positive	0.837	0.218	1.347	0.414
	Negative	0.431	0.052	0.942	0.624
Stone Size	> 1 cm	0.606	0.588	1.217	0.017
	0.7-1 cm	0.568	0.144	1.357	0.157
	< 0.7 cm	1.052	0.568	1.916	0.411
Stone Location	Distal ureter	0.121	0.430	1.213	0.635
	Mid ureter	0.971	0.837	1.416	0.797
	Proximal ureter	1.281	0.606	3.512	0.009

DISCUSSION

During stiff URS procedures, the ureter is a thin, muscular tube that needs to be handled carefully and advanced sparingly to prevent problems [11]. Examining diseased ureteral features can yield valuable information for improving URS procedures [12]. Urinary strictures are most frequently caused by impacted stones. Calculus impaction is commonly defined as the inability to introduce a wire or catheter past the stone on the first try or the stone staying in the same place in the ureter for longer than two months. One of the hardest stones in urinary tract stone illness to treat is proximal ureteral stones [8, 9, 12]. Larger proximal ureteral stones present a problem for minimally invasive treatment, even with technological advancements, and the best course of action is still up for debate [13]. Proximal ureteral stones can be treated conservatively, with varying success rates and problems, or with extracorporeal shock wave lithotripsy (SWL), semi-rigid URS, flexible URS, antegrade URS, PCNL, or open ureterolithotomy [13-15]. Selecting the optimal course of action for a certain patient presents a significant obstacle for a treating surgeon. For proximal ureteral stones, ureteroscopic laser lithotripsy, or SWL, is advised by the European Association of Urology (EAU) guidelines.16 In industrialized nations, the tide has increasingly moved in favor of flexible URS (with the laser) because of recent advancements in the field of endo-urology [11, 13]. However, this method necessitates pre-procedure stenting and instrument handling experience. Furthermore, the expense of this equipment is further increased by their high cost, fragility, and need for frequent maintenance. Less expensive, successful, and safe alternatives are favored in developing nations where costs and availability are major concerns [16, 17].

Lavoie CA, *et al*. [18] conducted a study in Canada about the incident rate of tight ureter during URS and reported 18.5% of non-accessible ureter in proximal ureteric stones, while for distal and mid ureteric stones the incident rate was 8%. Similar results were obtained in a retrospective study by Yuma W, *et al*. [19] total 1010 renal units were documented for URS, and incident rate of tight ureter was reported in 7.8% of the ureteric stone group. Multivariate regression analysis identified risk factors for tight ureter including an absence of stone history, and age ≤45 years. 90 patients with proximal ureteral stones less than 2 cm were compared between semi-rigid URS and SWL by Kumar A, *et al*. [20]. Twelve in the URS group, the mean stone size was 12.5 mm, with a 3-month SFR of 86.6% and a 17.7% requirement for an auxiliary treatment. Their marginally greater stone-free rate may be attributable to the fact that they employed a holmium laser instead of the pneumatic lithoclast used in this investigation, which may have reduced the possibility of stone retropulsion.

According to Sancak EB, *et al*. [21] ureteric strictures needing dilatation, stone size, and impaction are factors linked to the failure of semi-rigid URS for proximal ureteral stones. The study found that patients with larger stones ($p < 0.01$) did not obtain stone clearance.

The primary purpose of a ureteral stent is to support urine flow in obstructive uropathy patients. This medical device consists of a flexible tube that is placed into the ureter and has tiny holes on either side [22]. The implantation of ureteral stents also causes passive ureteral dilatation, a reversible process [23]. Although the precise mechanism is still unknown, it could be either a

result of direct cytotoxic effects or physiological relaxation. The ureter's dilation appears to occur when the ureter contains foreign objects, like a stent, while dilatation may be connected to changes brought on by the stent in the renal pelvis or ureteral peristalsis, hence delaying the transit of pee [23, 24]. Preoperative ureteral stenting has been shown in prior research to potentially induce passive dilatation during RIRS surgery [25]. Routine preoperative ureteral stenting is not recommended by current EAU urolithiasis recommendations, and there aren't enough randomized controlled trials on the subject. To investigate the impact of preoperative stenting on RIRS, we examined the data from our institution and discovered that there was no statistically significant difference in the rate of postoperative complications or SFR [26-28].

CONCLUSION

We conclude that in our population there is a higher incidence of narrow ureters which are not accessible even using the same dilatation technique, so it is safe to counsel the patients pre-operatively about the possibility of the narrow ureter and the need for pre-stenting. Tabba Ureter Accessibility (TUA) score can be used as a tool to predict the possibility of a narrow ureter.

AUTHORS' CONTRIBUTION

- **Anil Kumar Utraadi**: Objective, Write up.
- **Sharjeel Saulat**: Final approval, Surgery.
- **Syed Saeed-uddin Qadri**: Final editing, Surgery.
- **Ashba Mushtaque**: Ethical considerations, Data collection.
- **Muhammad Osama**: Data collection, Data entry.
- **Umber Rasheed**: Data analysis, Results interpretation.

CONFLICT OF INTEREST

Declared none.

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