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URETERAL WALL THICKNESS (UWT) AS A PREOPERATIVE INDICATOR OF IMPACTED STONE UNDERGOING URSL : A PROSPECTIVE STUDY

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ABSTRACT **Objective:** Evaluation of ureteral wall thickness (UWT) to predict the presence of impacted stones in patients with ureteral stones undergoing ureteroscopic lithotripsy (URSL).**Materials and Methods:** Prospective study has been carried out in a tertiary care hospital at Govt. Medical College, Kota (Raj.) between March 2021 to October 2022 . A Total of 80 patients above 15 years of age with ureteric calculus in whom URSL and preop NCCT done included. Patients with ipsilateral side preop DJ stent in situ and ipsilateral side ureter stone surgery in past were excluded. CT scan images have been used in the study to measure maximum ureteric wall thickness at the stone impaction site. Clinical predictors of impacted stones were assessed using the chi-square test and Receiver-operating characteristic (ROC) curve analysis was applied to determine the UWT cut-off value and evaluate its accuracy in predicting impacted stones. Ureter wall thickness (UWT) of 3.55 mm was taken as a cut-off value for dividing patients into impacted and non-impacted stone groups. We evaluated the association between UWT and endoscopic findings, as well as surgical outcomes. **Results:** 31 (38.8 %) patients out of 80 cases had impacted stones in our study. Significant differences in stone location, stone burden, hydronephrosis, and UWT in patients with and without impacted stones were seen using Chi-Square Test. ROC analysis showed that UWT 3.55 mm was taken as a cut-off value for dividing patients into impacted and non-impacted stone groups. Mean UWT of 3.99 mm and 1.78 mm were noted for the impacted and non-impacted stones, respectively. **Conclusions:** High UWT is associated not only with a higher risk of impacted stones but also with poor endoscopic clearance and adverse surgical outcomes and postoperative complications in patients with ureteric stones undergoing URSL.

KEYWORDS : Impacted stone, Ureteral wall thickness (UWT), Ureteroscopic lithotripsy (URSL).

INTRODUCTION :

Urolithiasis is a very common urological problem among the general population. Patient of obstructed ureteric calculi presents with acute agony require high priority treatment to avoid Renal function impairment. [1,2]. Impacted stones can cause ureteral edema, hypertrophy, and fibrosis which increases the adhesion of stone to the ureteral wall [3-6] . Risk of ureteric perforation high in impacted stones which leads to poor surgical outcome and high complications. Therefore, there is an urgent need to identify preoperative factors predictive of stone impaction and the need for immediate URSL or advanced surgical techniques [7,8]. This prospective study evaluated the ability of UWT to predict the presence of impacted stones, and the association between the degree of UWT and endoscopic appearance as well as surgical outcomes in patients with ureteral stones undergoing URSL.

Materials and Methods:

A prospective study has been carried out in a tertiary care hospital at Govt. Medical College, Kota (Raj.) between March 2021 to October 2022 in 80 patients with ureteric calculus in whom URSL and preop NCCT done included. Patients with ipsilateral side preop DJ stent in situ and ipsilateral side ureter stone surgery in past excluded.

At the time of the surgery, A surgeon blinded to the CT measurements of ureteral thickness determined whether or not a stone was impacted based on intraoperative findings. The operating surgeon was able to review the CT images before surgery but did not know the ureteral wall thickness. Stone impaction was determined by the surgeon based on four categories: 1) Stone mobility, 2) Level of edema, 3) Guidewire passage and 4) Contrast passage. Demographic data, CT imaging parameters, and intra-operative factors were used for comparison between the impacted and non-impacted stone groups. Factors recorded included patient Gender, stone side ureter (right/left), hydronephrosis (yes/no), stone location (proximal, middle, or distal), stone number and burden (diameter and volume), Hounsfield units of stone, UWT, the duration between initial identification of clinical signs related to stones and the day of operation, operative time, endoscopic stone-free rate (SFR), and intraoperative complications. The maximum UWT at the stone site was evaluated on axial NCCT images. X-ray KUB (kidney ureter bladder) was done on the morning of POD-1(post-operative day) of all the patients. Stone-free status was assessed using Endoscopic findings and X-ray KUB.

Surgical Technique

All URSL procedures were performed using a 6.5/7 - 7.5/8-Fr semi-rigid ureteroscope and a holmium laser lithotripsy system under anesthesia. Before starting URSL, stone impaction was evaluated by attempting to insert a guidewire from the ureteral orifice to the upper ureter under fluoroscopic guidance using a semi-rigid ureteroscope. Holmium laser settings used to disintegrate the target stones included an energy level of 0.8– 1.2 J and a rate of 5– 10 Hz. After 120 minutes of operative time, surgery discontinued to avoid complications. After the procedure, a ureteral DJ stent was inserted into all patients. All procedures were performed by same surgeon or under his guidance.

Statistical Analysis

Clinical variables are compared and Factors potentially predictive of impacted stones including patient Gender, hydronephrosis status, stone location, stone burden, and UWT were determined by the Chi-Square test. Receiver-operating characteristic (ROC) curve analysis was used to predict ideal UWT cut off to predict the stone impaction. All continuous variables are reported as medians and ranges. P-values <0.05 are considered statistically significant.

RESULTS

Of 80 patients, 31 (38.8 %) patients had impacted stones and 49 (61.2%) were without impacted stones. Patient and stone characteristics are shown in Table 1. Hydronephrosis (P = 0.002, stone location (P = 0.014), stone diameter (P = 0.002) and UWT (P = 0.004) were significantly different in these two groups. ROC analysis

showed that UWT of 3.55 mm was the optimal cut-off value predictive of impacted stone, with an area under the curve (AUC) of 0.87 (95% confidence interval [CI], 0.82–0.94). This cut-off had a sensitivity of 74.0% and a specificity of 87.5% in predicting impacted stones. Applying UWT of 3.55 mm as the cut-off value, we divided all procedures into two groups. Those with high (≥3.55 mm) and low (<3.55 mm) UWT, and compared endoscopic findings and surgical outcomes in the two groups (Table 2). In evaluating endoscopic findings, we found that the rates of ureteral edema (89.7% vs 55 %, P < 0.001) and stone fixation (65.5% vs 33.3%, P < 0.001) were significantly higher in the high UWT (≥3.55 mm) group than the low UWT group. Similarly, we found that operation time was significantly longer (89 min vs 60 min, P = 0.002) and the endoscopic stone-free rate significantly lower (89.6% vs 98%, P = 0.041) in the high UWT group than the low UWT group.

Table 1. Patient and preoperative characteristics of our cohort

Variable	Overall (N= 80)	Patient With impacted stones (N= 31)	Patient without impacted stones (N=49)	P Value
GENDER				0.25
Female	34 (42.5%)	11 (35.5%)	23 (47%)	
Male	46 (57.5%)	20 (64.5%)	26 (53%)	
URETER SIDE				
Left	41 (51.2%)	17 (54.8%)	24 (49%)	
Right	39 (48.8%)	14 (45.2%)	25 (51%)	
HYDRONEPHROSIS				0.002
Absent	14 (17.5%)	3 (9.7%)	13 (26.5%)	
Present	66 (82.5%)	28 (90.3%)	38 (78%)	
STONE LOCATION				0.014
Proximal ureter	46 (57.5%)	20 (64.5%)	26 (53.1%)	
Middle ureter	18 (22.5%)	10 (32.3%)	8 (16.3%)	
Distal ureter	16 (20%)	1 (3.2%)	15 (30.6%)	
STONE NUMBER	1(1-4)	1(1-2)	1(1-4)	
STONE Diameter (mm)	10.0 (1.0–20.0)	13.0 (5.1–20.0)	7.0 (1.0–18.0)	0.002
Hounsfield units of stone (HU) NCCT KUB	870 (132-1432)	840 (405–1432)	876 (132–1232)	0.42
Duration between initial clinical signs and surgery, (Months)	1.6 (0.4–15.9)	2.1 (0.5–12.2)	1.5 (0.4–15.9)	0.18
UWT (mm) URETER WALL THICKNESS	3.15 (0.10–6.90)	3.99 (2.08–6.90)	1.78 (0.10–4.60)	0.004

Table 2. Associations of UWT with endoscopic findings and surgical outcomes.

Variable	UWT < 3.55 mm	UWT ≥ 3.55mm	P Value
(A Endoscopic findings at the stone site	(N=51)	(N=29)	
1. Ureteral edema	28(55%)	26(89.7%)	<0.001
2. Fixation of stone	14(27.45%)	21(72.41%)	<0.001
(B)Surgical outcomes*	(N=51)	(N= 29)	
1. Operation time (min), Mean (Range)	60 (15-120)	89 (20–120)	0.002
2. Intraoperative complications			
(a) Ureteral injury	3(5.8%)	2 (6.9%)	0.48
(b) Ureteral perforation	0 (0.0)	0 (0.0)	
3. Endoscopic Stone free	50(98%)	26 (89.6%)	0.041
4. Stone-free based on Xray-KUB	50(98%)	28 (96.6%)	0.70

DISCUSSION

Impacted stones can cause ureteral edema, hypertrophy, and fibrosis which increases the adhesion of stone to the ureteral wall [3,9,10]. In our study, we found UWT at the stone site was significantly associated and independent predictor of stone impaction. Applying a cut-off of 3.55 mm, incomplete stone clearance associated with high UWT.

These predict presence of impacted stones and adverse clinical outcomes of patients with ureteral stones undergoing URSL with high UWT [11,12]. Large stone & longer stone impaction duration cause inflammation of ureteric mucosa at impacted site [4,13,14].

CONCLUSION

UWT in NCCT KUB finding is a reliable predictor of impacted stones and subsequent poor endoscopic findings and surgical outcomes in patients with ureter stones undergoing URSL. Predict impacted ureteral stones before surgery which is advantageous for preoperative patient counseling about their treatment options and likely perioperative clinical course and hence surgical technique planning.

CONFLICTS OF INTEREST - None

INFORMED CONSENT - Informed consent was obtained from all participants included in study.

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