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Novel Stanley Stent Symptom Status Score (s5 score) for predicting ureteral stent-related symptoms

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Abstract

Background It is a known fact that endourological procedures frequently require placement of double J (DJ) ureteral stent. These patients can have stent-related symptoms (SRS) after DJ stent placement which can be distressing with increased morbidity. Though intraoperative and postoperative factors for SRS have been studied, research work is deficient in preoperative prediction of these symptoms which is the need of the hour. Thus, we aim to find out the factors which can lead to SRS after ureteroscopic lithotripsy (URSL) surgeries. Further, we aim to establish a scoring system which will help us predict the possibility of SRS and take necessary actions to minimise them.

Materials and methods Our study includes 150 URSL cases with DJ stenting where we correlated various factors with the presence of SRS. Information regarding preoperative, intraoperative and postoperative factors which may lead to SRS were noted down. All patients completed Ureteral Stent Symptom Questionnaire (USSQ) to evaluate the symptoms at 1 and 3 weeks after stent placement and 1 week after removal of the stent. The statistical data were evaluated using SPSS 24 Statistics.

Results In our study, we found that SRS correlated statistically with factors namely body mass index (BMI) > 25 kg/m², loin pain, stone size > 1 cm, haematuria, bilateral stone disease, incomplete distal curl, distal end crossing mid-line and these could predict the occurrence of SRS. Based on the significant preoperative factors, we constructed the Stanley Stent Symptom Status Score (S5 Score) which predicts the possibility of developing SRS.

Conclusion Thorough understanding of factors which can lead to SRS can help us take steps to reduce the morbidity related with this frequent procedure. Stanley Stent Symptom Status Score (S5 Score) predicts the occurrence of these symptoms preoperatively. This score is first of its kind which will pave the way for deeper understanding and prediction of these symptoms preoperatively.

Keywords Stent-related symptoms, S5 Score, Ureteroscopic lithotripsy, Prediction

1 Background

Endourological procedures constitute a major share of urological procedure worldwide. Among the various procedures in urology ureteroscopic lithotripsy (URSL) is one of the most frequently performed surgeries [1]. A common occurrence in this procedure is placement of double J (DJ) ureteric stent which is needed to ensure patency and drainage of the ureter as well as the pelvicalyceal system. The concept of endoscopic ureteral stenting

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was first introduced by Paul D Zimskind and associates in 1967 [2, 3]. This step brings along with it the stent-related symptoms (SRS) which can be very distressing for the patients. Around 80% of the patients with ureteral stents can have these symptoms among which most of them have complaints of frequency, urgency, suprapubic pain, dysuria, haematuria and incontinence [1, 4]. These symptoms can severely affect the day to day activity of the patients adding to bothersome morbidity [5]. Various factors which can lead to these symptoms have been a part of research work in urology among which high body mass index (BMI), distal coiled end of the stent in the bladder crossing midline, distal incomplete coil of the stent in the bladder, length of the stent have been found to be the significant factors [4, 5]. Though many studies have been done to find out the factors which can lead to these symptoms in the immediate postoperative period after the stent has been placed not much have been done to study the factors before the placement of stent in these patients. With this key point in mind the aim of our study is to assess the factors which can lead to stent related symptoms in cases of uncomplicated ureteroscopic lithotripsy (URSL) surgeries and further to construct a scoring system to predict the chances of patients having these symptoms so we can mitigate in a timely manner and take steps to prevent and minimise the symptoms.

2 Materials and methods

Our study is a prospective analytical study which included 150 patients who underwent URSL with DJ stenting in Department of Urology, Govt Stanley Medical College, Chennai, India, from June 2020 to August 2021 after taking written informed consent from the patients. Study was done in accordance with the Declaration of Helsinki as revised in 2013. The indications of DJ stenting in our cases were cases with multiple residual fragments, significant mucosal oedema, impacted stones, bleeding, mucosal trauma. Exclusion criteria consisted of renal stones, residual stones on postoperative X-ray or

ultrasound KUB, diseases with lower urinary tract symptoms (LUTS) such as BPH, prostatitis, overactive bladder, urinary tract infection, cases associated with complications such as stent malposition on postoperative X-ray, stone fragment migration to kidney, ureteral perforation. Standard URSL with DJ stenting procedure was followed and stones were broken using pneumatic lithotripter. Various preoperative, intraoperative and postoperative factors were included in the proforma as given in Table 1 and information was noted down according to the proforma. All surgeries were performed by the same experienced surgical team. All patients were given Ureteral Stent Symptom Questionnaire (USSQ) version English and their symptoms were assessed at 1 and 3 weeks after stent placement. X-ray KUB was done to see the placement of stent. USSQ assessment was done after 1 week after stent removal too.

2.1 Statistical methods

Descriptive and inferential statistical analysis were carried out in the present study. Results on continuous measurements were presented on mean \pm SD (min–max) and results on categorical measurements were presented in number (%). Significance was assessed at 5% level of significance.

Logistic regression analysis was employed to find the correlation of positivity with clinical variables (Adj OR=1, no relationship, Adj OR>1, positive association and Adj OR<1: negative association). *P* value \leq 0.05 was considered significant. *P* value of 0.05–0.10 was considered as suggestive significance.

2.2 Statistical software

The Statistical software namely SPSS 24.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel were used to generate graphs, tables, etc.

Table 1 Factors studied for predicting stent-related symptoms

Preoperative				Intraoperative	Postoperative
Demographic data	History	Laboratory variables	Imaging variables		
Age	UTI	Urea/creatinine	Stone size	Time taken	Proximal end position
Sex	Loin pain	TLC	Stone position	Stone side	Proximal curl
Height	Haematuria	Urine culture	Stone side	Position of stone	Distal curl
Weight	CKD		HUN	Difficult entry	Distal curl crossing midline
BMI	PUJO			Orifice position	Haematuria
					Intravenous analgesic

h/o history of, UTI urinary tract infection, CKD chronic kidney disease, PUJO pelviureteric junction obstruction, TLC total leucocyte count, HUN hydroureteronephrosis

3 Results

Our study included 150 patients out of which 82 (55.7%) were male and 68(45.3%) females.

On analysis mean age was 40.73 ± 13.56 years, mean height was 164.53 ± 6.69 cms, mean weight 68.37 ± 7.01 kg, mean body mass index (BMI) 25.24 ± 2.00 kg/m² with 104 (69.3%) patients having BMI > 25 kg/m². Among the preoperative clinical factors studied before the placement of stent 63 (42%) of patients had history of (h/o) urinary tract infection (UTI), 68 (45.3%) had h/o haematuria, 92 (61.3%) patients had h/o of loin pain, 12(8%) patients had h/o chronic kidney disease (CKD).

As far as stone characteristics were concerned 24 (16%) were bilateral stone cases 126 (84%) were unilateral stone cases. Out of 150 cases, 131(87.3%) had stone size more than 1 cm. with mean \pm SD of 1.42 ± 0.40 . 79 (52.7) were upper ureteric stone and 71 (47.3%) were lower ureteric stone. 21(14%) cases had moderate to severe hydronephrosis (HUN) on evaluation. Table 2 shows the analysis of preoperative factors.

Moving onto intraoperative factors of 150 URSL cases where DJ stent placement was done the mean operative time taken was 37.67 ± 10.94 (min). All cases stone side and position correlated with preoperative evaluation. Difficult entry at vesicoureteric junction (VUJ) was encountered in 17 (11.3%) cases. Medially facing ureteric orifice was present in 15 (10%) cases. Impacted ureteral stone was present in 64 (42.66%) cases. The cases associated with intraoperative bleeding were 87 (58%) in number. Ureteral mucosal oedema was present in 72 (48%)

cases. Mucosal trauma during procedure was reported in 78 (52%) cases.

In postoperative period 57 (38%) cases had mild hematuria which resolved subsequently. 116 (77.3) patients had requirement of intravenous analgesics (paracetamol infusion) only for 1 day. The stent-related symptoms were assessed at 1 week along with questionnaire. Proximal coil was in renal pelvis in all cases with complete coil in 122 (81.3%) cases and incomplete on 28 (18.7%) cases. Distal loop was completely coiled in 114 (76%) cases and incomplete in 11 (7.33%) cases. Distal loop was crossing midline in 66 (44%) cases. 111 (74%) of the patients had stent-related symptoms (SRS) which was our outcome variable against which all other factors were statistically studied.

Univariate analysis showed BMI > 25 kg/m² ($p < 0.001$), h/o loin pain (p 0.041), h/o hematuria (p 0.046), stone size > 1 cm (p 0.035) to be significant statistically. Bilateral stone disease (p 0.073) showed suggestive significance among the preoperative factors. Among the intraoperative and postoperative factors distal end of stent crossing midline (p 0.048) had a significant p value while distal end of stent with incomplete curl showed p value of 0.081 (suggestive significance).

Further multivariate analysis was done and the significant factors are shown in Table 3.

Thus we found that overall BMI (> 25 kg/m²), h/o haematuria, h/o loin pain, Stone size > 1 cm, bilateral stone disease, distal incomplete curl, distal end crossing midline are the factors which correlates significantly in the multivariate analysis.

Further analysis to find the preoperative factors and construct a scoring system was done. Here five factors namely BMI > 25 kg/m², h/o haematuria, h/o loin pain, stone size > 1cm, bilateral stone disease were taken into consideration and weighted score was calculated for these as shown in Table 4. For these preoperative factors we calculated the weighted score for development of scoring system for prediction of SRS. BMI > 25 kg/m², h/o of hematuria, h/o loin pain, stone size > 1 cm, B/L stone disease had a weighted score of 38.2, 12.4, 19.7, 18.2, 11.5, respectively (Table 4).

Accordingly, **Stanley Stent Symptom Status Score (S5 Score)** was constructed according to the weighted score of each of these factors as shown in Table 5. BMI > 25 kg/m² was allotted a score of 4 while history of loin pain and stone size > 1cm got a score of 2 each.

History of haematuria and bilateral stone disease were given a score of 1 each, making it a total score of 10 (Table 5).

We did a ROC curve analysis for this scoring system which showed the area under curve of 0.749 as shown in Table 6. Thus our scoring system had a fair predictive

Table 2 Analysis of preoperative factors

Preoperative factor	Value
Male	82 (55.7%)
Female	68(45.3%)
Age (years)	40.73 ± 13.56
Height (cm)	164.53 ± 6.69
Weight (kg)	68.37 ± 7.01
BMI (kg/m ²)	25.24 ± 2.00
BMI > 25 kg/m ²	104 (69.3%)
H/o UTI	63 (42%)
H/o haematuria	68 (45.3%)
h/o loin pain	92 (61.3%)
h/o CKD	12(8%)
Bilateral stone disease	24(16%)
Stone size mean	1.42 ± 0.40
Stone size > 1 cm	131(87.3%)
Upper ureteric stone	79 (52.7)
Lower ureteric stone	71 (47.3%)
Moderate-to-severe HUN	21(14%)

Table 3 Multivariate logistic regression analysis to assess the risk factors of stent symptoms

Variables	Logistic regression results to predict the stent symptoms					95%CI	
	Logit co-efficient	SE	Wald	P value	Adj OR	Lower	Upper
BMI (kg/m ²)	2.47	0.98	6.42	0.001	11.88	1.75	80.62
H/o haematuria	- 1.80	1.54	1.36	0.043	4.17	0.01	3.39
H/o loin pain	1.99	1.85	1.16	0.038	7.30	0.20	271.87
Stone size > 1.0 cm	2.22	1.75	1.60	0.036	9.17	0.30	284.83
Laterality-bilateral	1.30	2.40	0.29	0.049	3.67	0.03	403.93
Distal curl-incomplete	3.61	1.87	3.73	0.043	36.92	0.95	1436.25
Distal curl crossing midline	3.01	1.78	2.87	0.040	20.22	0.62	655.88

Table 4 Multivariate logistic regression analysis to assess the preoperative risk factors and calculation of weighted score

Variables	Logistic regression results to predict the stent symptoms					95%CI		Weighted score
	Logit co-efficient	SE	Wald	P value	Adj OR	Lower	Upper	
BMI (> 25 kg/m ²)	2.41	0.63	14.44	<0.001	11.17	3.22	38.75	38.2
H/o Haematuria	-2.60	1.08	5.83	0.039	4.07	0.01	0.61	12.4
H/o loin pain	2.22	1.02	4.75	0.019	7.08	1.25	68.10	19.7
Stone size > 1.0 cm	1.80	1.00	3.23	0.012	9.23	0.85	43.41	18.2
Laterality-bilateral	3.20	2.00	2.57	0.044	3.60	0.49	1231.07	11.5

Table 5 Stanley Stent Symptom Status Score (S5 score)

Parameters	Score
BMI (> 25 kg/m ²)	4
H/o loin pain	2
Stone size > 1 cm	2
H/o haematuria	1
Bilateral stone disease	1

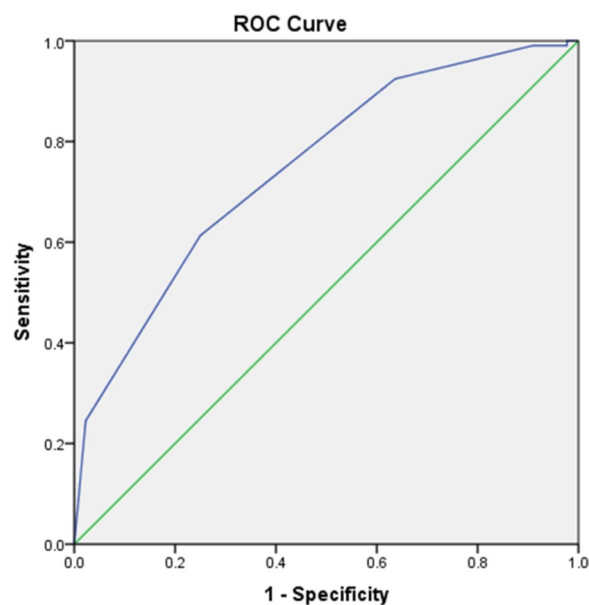
A score of more than 5: >50% chance of having stent symptoms

validity in predicting stent symptoms, as indicated by area under the curve of 0.749 (95% CI 0.665 to 0.833, p value: <0.001).

4 Discussion

Ureteral stent placement has become an integral part of various endoscopic urological surgeries [6]. Although double J ureteral stent keeps the ureter patent and helps to drain it well, it has its own drawback among which the stent-related symptoms are the most notorious ones which translates into bothersome morbidity for the patients. Aggarwal et al. noted that among these symptoms the most pronounced symptoms were frequency, urgency, dysuria, suprapubic pain and flank pain. These symptoms can be present in as much as 80% of patients undergoing ureteral stent placement [1, 7]. Nabi et al.

Table 6 ROC analysis of predictive validity of total score in predicting stent symptoms



Test result variable(s): total score

Area under the curve	Std. error	P value	Asymptotic 95% confidence interval	
			Lower bound	Upper bound
0.749	0.043	< 0.001	0.665	0.833

also noted a significant occurrence of frequency, dysuria and haematuria in patients with indwelling ureteral stent [8]. Ureteral Stent Symptom Questionnaire (USSQ) has become one of the important tools to assess these symptoms [9]. Giannarini et al. study showed male sex, high BMI, large calibre stents and distal end crossing midline to be the most important associated factors for stent-related symptoms [6].

Higher BMI and LUTS has a positive correlation in few of the studies [4, 10]. This is a major preoperative predictive factor which was found to be significant in our study too. Again, length of the stent and distal end crossing midline was found to have significant effect on occurrence of stent symptoms in various studies [2, 11, 12]. Proper technique of placement of stent has been a topic of debate in many studies. However despite following the correct technique of stent placement, patients continue to have stent-related symptoms [13, 14]. This brings us to the question whether other preoperative factors could play a role in prediction of these factors. This was the major objective of our study. We found BMI (>25 kg/m²) to be one of the most significant factors for stent related symptoms. History of loin pain and haematuria were found to be significant too in our study. Further stone size >1 cm and bilateral stone disease were among the significant factor in our analysis. Among the postoperative factors incomplete distal coil of stent and distal end crossing midline were found to be significant. We took the preoperative significant factors into account and calculated weighted score of them and formulated the Stanley Stent Symptom Status Score (S5 Score) where each factor was assigned a score according to the weighted score with a total score of 10. Probability of patient having this score can be calculated out of 100% according to the score out of 10 (example: 7/10 score has 70% chances of getting SRS). This is the first such attempt to predict preoperatively the chances of patients have stent symptoms.

There are various management strategies to mitigate the stent symptoms. Our study shows BMI to be one of the modifiable factors which might help in prediction of the SRS. Routine stenting of uncomplicated cases can be avoided as a measure to reduce these symptoms [6, 15]. Proper selection of stent length, design and material can also pave way to minimise these symptoms [16]. Medications in the form of anticholinergics and alpha blockers can be used to alleviate the symptoms too [17]. Research work into material of the stents, design of the stents, coating of the stents are the future pathways to minimise these symptoms [18–20]. Further early removal of the stent can also solve the issue of these debilitating stent symptoms. There is debate regarding the appropriate timing of removal of stent

and most agree removal around 10 days in uncomplicated URSL surgeries [21, 22]. And last but not the least, patient education regarding SRS is an important tool to minimise the anxiety and effect of SRS and the urologist should be able to address the concerns of the patients regarding SRS [23].

5 Conclusion

Prevention is better than cure is a well-tested saying. Our world is moving towards the idea of preventive medicine and the field of urology is not behind in this aspect [24]. Knowing the probability of having the stent-related symptoms using the novel Stanley Stent Symptom Score (S5) would help urologists to identify the high-risk cases and preventive steps to mitigate these symptoms. BMI reduction, precise indication, proper stent selection and placement, expert guidance, optimised postoperative care and patient education should be the corner stones to address this distressing complication. S5 score will bring the attention of the urologists world over on the preoperative factors for prediction of stent-related symptoms and take preventive steps which would definitely translate into reducing the morbidity related to a very common urological procedure.

Abbreviations

DJ	Double J
SRS	Stent-related symptoms
URSL	Ureteroscopic lithotripsy
USSQ	Ureteral Stent Symptom Questionnaire
SPSS	Statistical Package for the Social Sciences
LUTS	Lower urinary tract symptoms
h/o	History of
UTI	Urinary tract infection
CKD	Chronic kidney disease
PUJO	Pelviureteric junction obstruction
TLC	Total leucocyte count
HUN	Hydroureteronephrosis
Adj OR	Adjusted odds ratio
SE	Standard error
BMI	Body mass index
VUJ	Vesicoureteric junction

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Author contributions

JVS P analysed and interpreted data, PVT analysed data and helped in drafting, AKP analysed data and helped in drafting, GS analysed, interpreted and drafted data. SV helped in drafting and analysis, KVA analysed and helped in drafting, VN helped in drafting.

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Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to institutional policy but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki. Approved by the Institutional Ethics Committee of Stanley Medical College and Hospital, Chennai-01. EC registration number ECR/131/Inst/TN/2013/RR-19.

Consent for publication

Institutional consent for publication was obtained from the patients and individual details were kept confidential in the study.

Competing interests

The authors declare that they have no competing interests.

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