Original Article

Impact of the position of the distal end of the ureteral stent and stent-related symptoms in patients with indwelling ureteric stent

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Position of ureteral stent, ureteral stent-related symptoms, questionnaires

Abstract

Objective: A ureteral stent is extensively employed to treat various urologic conditions including ureteral obstruction from external compression, stone, or post-urological procedures. Ureteral stent-related symptoms, such as lower urinary tract symptoms (LUTS), hematuria, and pain, have frequently been found in patients with indwelling ureteral stents. The impact of the position of the distal end of the ureteral stent on stent-related symptoms remains controversial.

Materials and Methods: Twenty-five patients with indwelling ureteral stents undergoing ureteral stent replacement or removal were recruited onto the study. A Thai USSQ was completed before stent replacement or removal. The position of the distal end of the ureteral stent was categorized into 2 groups by Fluoroscopic study or X-ray before stent replacement or removal. The relationship between the position of the distal ureteral stent and the USSQ score was analyzed.

Results: The mean USSQ score was 59 (range 28-112). The majority (60%) of participants had a distal ureteral stent that crossed the midline. The mean stent indwelling time was 2.18+/-1.14 months (range 0.5-4 months). The urinary tract symptoms did not differ significantly between the two groups (OR 1.05, 95%CI 0.92-1.2, p = 0.492). There were also no significant differences between the two groups with regard to the USSQ sub-scores for urinary symptoms (p = 0.509), pain (p = 0.957), general health (p = 0.443), working performance (p = 0.770), sexual symptoms (p = 0.716), and additional problems (p = 0.272). In the case of other factors, the female sex was significantly related to hematuria symptoms (IRR 1.90, 95%CI 1.09-3.73, p = 0.026). The cross-midline group also had significantly higher lower abdominal pain (p = 0.041). Patients with stents that did not cross the midline had significantly fewer symptoms of urinary tract infection (p = 0.035), but there was no significant difference in antibiotic use (p = 0.574) between the two groups.

Conclusion: The position of the distal end of the ureteral stent does not affect urinary symptoms. Discussion with the patient about stent placement, procedure, and related symptoms before and after stent placement remains crucial.

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Introduction

A ureteral stent placement is a common urologic procedure.[1,2] This procedure has been frequently employed to treat ureteral obstruction of any cause that leads to renal function deterioration, infection, and uncontrollable pain.[3] Other indications occur after surgical procedure and ureteral operation.[3] The most commonly used design has been a double pigtail design, enabling the stent to be maintained in its position in the upper and lower urinary tract system.[4] However, a ureteral stent may lead to some undesirable symptoms, including flank pain, hematuria, and lower urinary tract symptoms (LUTS), causing discomfort to patients.[1,5] These symptoms are usually treated by anti-cholinergic, alpha receptor blocker, or PDE inhibitor medication.[2,5,6]

In 2003, to objectively assess these symptoms, Joshi et. al. developed questionnaires known as Ureteral Stent Symptom Questionnaires (USSQ).[1] This questionnaire analyzed the effect of stent-related symptoms on multiple domains, including urinary tract symptoms, pain, general health, working performance, and sexual health. Recently, this questionnaire has been translated into multiple languages[2,7], including Thai.

The effect of the position of the distal end of the ureteral stent and stent-related symptoms remains controversial. In 2011, Giannarini et al. published a study that showed a significant relationship between the position of the ureteral stent and ureteral stent-related symptoms. The position of a distal ureteral stent that crossed the midline of the urinary bladder had a significant effect on urinary symptoms, pain, general health, working performance, and sexual symptoms.[8] The results of other studies have shown the same finding.[8-10] However, in 2009, Lingeman et. al. reported that the position of the distal ureteral stent does not affect ureteral stent-related symptoms.[5] Other studies also showed that the position of a distal ureteral stent that crosses the midline of the urinary bladder significantly affects urinary symptoms.[2]

In 2022, the Thai version of USSQ was developed and validated. This version of USSQ is now waiting for publication.

In this study, we hypothesized that the position of the distal ureteral stent that did not cross the midline of the urinary bladder did not significantly affect urinary symptoms. The aim of the study was to assess the effects of distal ureteral stent position on ureteral stent-related symptoms using the Thai version of the USSQ.

Materials and Methods

The study was conducted in line with the guidance of The Declaration of Helsinki and was reviewed and approved by the Institutional Review Board (IRB) of King Chulalongkorn Memorial Hospital (IRB No.105/65).

Between February 2023 and December 2023, patients with an indwelled ureteral catheter, were aged 18-80 years, and able to communicate and read Thai at King Chulalongkorn Memorial Hospital were recruited. By reviewing medical records, patients with LUTS (lower urinary tract symptoms) or alpha receptor blocker or anti-cholinergic medication, or had incomplete USSQ, were excluded from the study.

The baseline data was obtained by reviewing medical records. This data included sex, weight, height, cause of ureteral stent placement, type, size, and length of ureteral stent, underlying diseases, underlying LUTS and medications.

The ureteral stent of choice, including Percuflex Plus (Boston Scientific, Natick, MA, USA), Universa (COOK Medical, Bloomington, IN, USA), and Inlay Optima (BD, Franklin Lake, NJ, USA), was determined by the surgeon. The size, ranging from 4.7 Fr to 7 Fr, the length of the ureteral stent, ranging from 14 cm, 24 cm, 26 cm, and the multi-length ureteral stent (22-32 cm), were all determined by the surgeon (Diagram 1).

Before ureteral stent replacement or removal, the participants were asked to complete a Thai USSQ questionnaire. Intravesical stent position was determined by X-ray or fluoroscopy before stent replacement or removal. Participants were divided into two groups, based on the position of the intravesical stent as shown in Fig. 1 and 2.

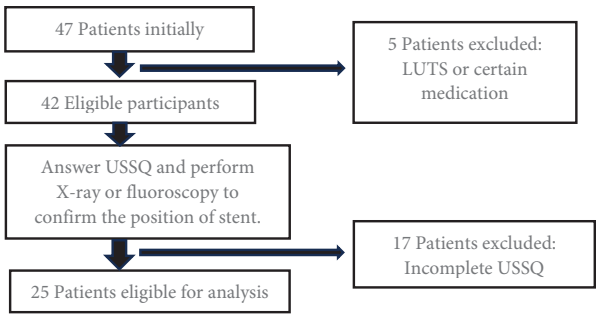

Diagram 1. Study protocol

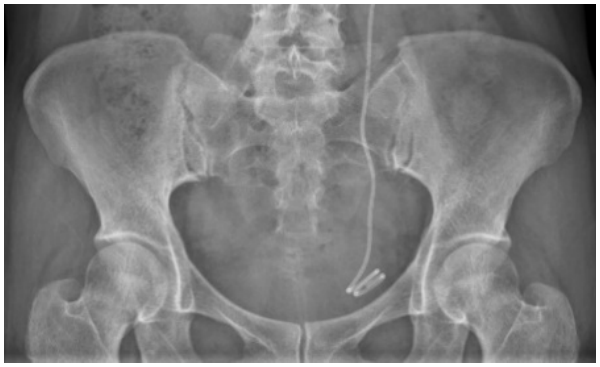

Figure 1. Position of ureteral stent considered not crossing the bladder midline.

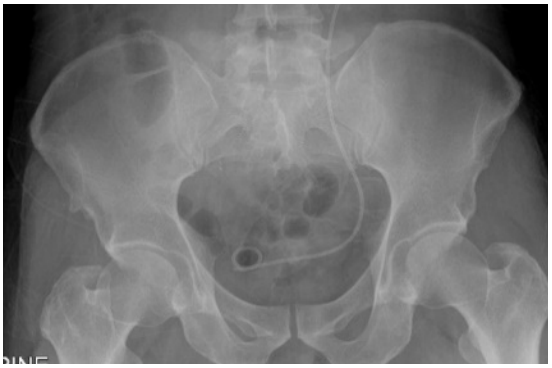

Figure 2. Position of ureteral stent considered to crossing the bladder midline.

If part or a complete loop of distal ureteral stent crossed a straight imaginary line at the pubic symphysis, it was considered to cross the midline (Fig. 2).

Categorial variables were reported as numbers and percentages. Continuous variables were reported as mean, SD. Variables were analyzed using Independent T-test and Univariate logistic regression. A significance level of 0.05 was applied. Data analysis was carried out using SPSS 29.0.1 (IBM SPSS, Chicago, IL USA).

Results

47 patients were initially enrolled onto this study. Five patients were excluded due to having underlying LUTS or were taking specific medications (three patients were taking alpha-blockers due to stent-related symptoms, and two patients alpha-blockers due to underlying LUTS). Seventeen patients were also excluded due to incomplete questionnaires. In total, 25 patients were eligible for analysis. During the study, no stent displacement or malposition was reported.

Demographic data and position of distal end of ureteral stent

72% (n = 18) of participants were female, while 28% (n = 7) were male. The most common cause of ureteral stent placement was external compression from tumor (40%, n = 10), followed by ureteral calculi (36%, n = 9), ureteral stricture (20%, n = 5), and post-kidney transplantation (4%, n = 1). The mean duration of stent indwelling time was 2.68±1.14 months (range 0.5-4 months). There was no difference between the two groups with regard to demographic data and stent indwelling time before replacement or removal. The most common type of stent used was Percuflex Plus (6 Fr, 26 cm) (56%, n = 14). Proportion employed was 60% (n = 15) with 40% (n = 10) being unemployed or retired. 9 (36%) of the patients had a history of previous pelvic radiation, and all of these were female (Table 1).

Of the enrolled patients, 60% (n = 15) had a distal ureteral stent that crossed the midline, while 40% (n = 10) did not (Table 1).

Table 1. Demographic data

Sex, n (%)	
Male	18 (72)
Female	7 (28)
Age (year) SD	54.28±11.65
Height (meter) SD	1.57±0.15
Cause, n (%)	
External ureteral compression	10 (40)
Ureteral stone (treatment or obstruction)	9 (36)
Ureteral stricture	5 (20)
Post kidney transplantation	1 (4)
Stent indwelling duration (months) SD	2.68±1.14
Stent type, n (%)	
Percuflex plus	14 (56)
Inlay optima	8 (32)
Universa	3 (12)
Working status, n (%)	
Employed	15 (60)
Unemployed	5 (20)
Retired due to age	4 (16)
Retired due to health issues	1 (4)
History of previous pelvic radiation n (%)	9 (36)
Position of the distal end of ureteral stent, n (%)	
Cross the midline	15 (60)
Not cross the midline	10 (40)

SD = standard deviation

There was no significant difference between the two groups in terms of demographic data, duration of stent indwelling time, stent size (French, Fr), and length (cm) (Table 2).

USSQ Subscore analysis

The median total USSQ Score was 59 (range 28-112). There was no significant difference in total USSQ score between the two groups (OR 1.05, 95%CI 0.2-1.20, p = 0.492). Concerning the USSQ sub-scores, there were no significant differences between the two groups in the section pertinent to urinary symptoms (represented by U, p = 0.509), pain (P, p = 0.957), general health (G, p = 0.443), working performance (W, p = 0.770), sexual matters (S, p = 0.716), and additional problems (A, p = 0.272) (Table 2).

Each item of the USSQ subscore was analyzed. There were no significantly higher scores in the cross-midline group including urinary frequency (represented by U1, p = 0.738), nocturia (U2, p = 0.943), urgency (U3, p = 0.620), urgency incontinence (U4, p = 0.371), hematuria (U8, p = 0.071), pain during urination (P6, p = 0), and bothersome of pain (P9, p = 0.566). There was no significant difference in the pain in the kidney area between the two groups (P7, p = 0.812). (Table 3) There was a significant relationship between being female and symptoms of hematuria (U8, p = 0.026). There were no significant correlations between other parameters and urinary tract symptoms.

60% (n = 15) of participants experienced pain, with 73% (n = 11) reporting flank pain. Flank pain did not differ significantly between the two groups (p = 0.601). The mean pain score was 4.63 (range 0-10). Only 26.7% of patients (n = 4) had lower abdominal pain, all of these had distal ureteral stent crossing the midline. The cross-midline group experienced significantly

Table 2. Comparison between 2 groups

Demographic data	Crossing-midline group (n=15)	Not crossing-midline group (n=10)	P-value
Age years±SD	55.93±10.46	55.93±10.46	0.396
Weight (kg)±SD	61.65±13.90	60.02±13.74	0.776
Height (meter)±SD	1.54±0.18	1.60±0.07	0.396
Duration (months)±SD	2.60±1.23	2.80±1.06	0.678
Stent size (Fr)±SD	5.84±0.68	5.86±0.38	0.935
Stent length (cm)±SD	25.80±0.63	26.57±2.51	0.454

SD = standard deviation

Table 3. Ureteral Stent Symptom Questionnaires subscore analysis

Subscore n±SD	Crossing midline	Not crossing midline	P-value
Urinary symptoms	26.87±6.84 (14-39)	25.10±5.78 (18-35)	0.509
Pain	7.47±7.25 (0-20)	7.30±8.06 (0-24)	
	12.33±5.50 (6-26)	10.80±3.49 (8-17)	0.957
General health	4.8±3.55 (0-10)	5.30±4.92 (0-12)	0.443
Working performance	1.27±0.46 (1-2)	1.20±0.42 (1-2)	0.770
Sexual matters	9.67±2.53 (7-15)	8.60±1.96 (5-12)	0.716
Additional problems	9.67±2.53 (7-15)	8.60±1.96 (5-12)	0.272

higher levels of lower abdominal pain (p 0.041) (Table 4). Other pain symptom parameters (P6, P7, P9) did not different significantly between the two groups (Table 5).

In terms of the general health domain, there was no difference between the two groups in terms of light activity (G1, p = 0.174), and heavy activity (G2, p = 0.416) (Table 3). The position of the stent also did not significantly affect working performance. Between the two groups, the days off from work after stent insertion or replacement did not differ significantly (W2 p = 0.051, W3 p = 0.529). With regard to sexual matters, all of the participants (100%, n = 25) were already sexually inactive before stent placement, and their reasons were not related to stent placement.

Discussion

The ureteral stent has been widely used to treat multiple urological problems. Even with its undoubted benefits, an indwelling stent usually leads to undesirable symptoms, such as LUTS, hematuria, dysuria, abdomen, and flank pain.[1,2,5] Since the development of the USSQ (Ureteral stent symptom questionnaires) in 20031, the morbidity of the ureteral stent has been more clearly defined.

With regard to the overall and sub-score, there were no significant differences between the two groups. These results did not differ from the studies by Abt et. al.[2] and Lingeman et. al.[5] as both studies reported that all domains in the USSQ did not significantly differ.

Table 4. Ureteral Stent Symptom Questionnaires subscore analysis

Subscore n±SD	Crossing midline	Not crossing midline	P-value
U1 (Urinary frequency, range 1-5)	2.73±1.03 (1-5)	2.60±0.84 (1-4)	0.738
U2 (Nocturia, range 1-5)	3.53±0.83 (2-5)	3.5±1.27 (2-5)	0.943
U3 (Urinary urgency, range 1-5)	2.73±1.16 (1-5)	3.00±1.49 (1-5)	0.620
U4 (Urge incontinence, range 1-5)	1.80±0.86 (1-4)	1.50±0.71 (1-3)	0.371
U8 (Urinary incontinence, range 1-5)	1.87±1.25 (1-5)	1.2±0.42 (1-2)	0.071
P6 (Pain or discomfort during voiding, range 1-5)	1.33±1.45 (0-5)	1.20±1.14 (0-4)	0.809
P7 (Hematuria, range 1-5)	0.80±0.77 (0-2)	0.90±0.88 (0-2)	0.767
P9 (Flank pain during voiding, range 1-2)	1.4±1.45 (0-4)	1.40±1.78 (0-5)	1.000
G1 (Discomfort during light activity, range 1-5)	1.60±0.83 (1-4)	1.20±0.42 (1-2)	0.174
G2 (Discomfort during sternous activity, range 1-5)	2.07±1.1 (1-4)	1.70±1.06 (1-4)	0.416
W2 (Time spend on bed, days)	0.67±1.98 (0-3)	0.10±0.32 (0-1)	0.051
W3 (Decrease activity after stenting, days)	0.8±1.37 (0-5)	1.30±2.54 (0-5)	0.529
A1 (UTI-liked symptoms)	2±1 (1-5)	1.20±0.63 (1-3)	0.035*
A2 (ATB use)	1.67±0.62 (1-3)	1.70±0.48 (1-2)	0.887
GQ	3.67±1.76	3.700±2	0.965

Table 5. Pain score and pain location

Subscore	Crossing midline	Not crossing midline	P-value
P2 (Flank pain)	n = 6	n = 5	0.622
P3 (Pain score) n ± SD	1.8±2.57	2.4±3.06	0.601
P2 (Lower abdominal pain)	n = 4	n = 0	0.041*
P3 (Pain score) n ± SD	1.2±2.48	0+/-0	N/A

SD = standard deviation

The pathophysiology of ureteral stent-related symptoms was divided into two areas, the first part concerning trigonal area irritation near the distal end of the ureteral stent. Since the trigonal area has the highest density of sensorium nerve ending in the urinary bladder[11], one could assume that the longer the distal end of the ureteral stent, the greater the irritation leading to higher stent-related symptoms. This may explain our finding as to why the patients who had a distal end of the ureteral stent that crossed the midline of the urinary bladder had significantly higher lower abdominal pain, a finding also in line with other studies.[8,9,12,13] However, those studies[8,9,12,13] showed other parameters associated with LUTS, such as urinary frequency (U1), urgency (U3), urgency incontinence (U4), and dysuria (U7) to be significantly higher in crossed midline groups, while ours showed no difference. Other factors, such as differences in bladder sensitivity and pain tolerance, might play a role in this situation.

The second explanation was that refluxing of urine into the renal pelvis may cause flank or back pain[12-14] In 1991, Mosli showed that reflux happened in the majority of patients who had an indwelling ureteral stent, and reflux was higher during the voiding phase.[14] Since flank pain was the most frequently reported pain symptom, reflux into the renal pelvis was the most likely cause. Nevertheless, there was no difference in flank pain during micturition (P6, P7), findings similar to those previously reported by Abt[2] and Lingeman.[5] In this regard, other factors may play a role in this issue, such as differences in bladder capacity, compliance, and pressure during the micturition phase in each patient.

There was a significant difference in suprapubic pain, patients in the crossing midline group reporting higher levels of this type of pain, supporting the idea that bladder irritation by the distal end of the ureteral stent was the primary cause of the symptoms. However, this symptom was not the most reported flank pain being experienced the most. These findings waere in line with a study by Lingeman[5], and Abt[2] that reported patients experiencing flank pain more frequently than suprapubic pain.

Regarding additional matters, patients who had a distal coil that crossed the midline had significantly higher symptoms of urinary tract infection (A1, p = 0.01). Of 15 patients that had a distal coil crossing the midline, 73% (n = 11) had symptoms of urinary tract infection, while only 10% (n = 1) in the other group had symptoms of urinary tract infection. In terms of antibiotic use, there was no significant difference between the two groups (A2, p = 0.574). Finally, there was no significant difference in overall satisfaction level (GQ)between the two groups (p = 0.965).

A possible explanation of the difference in reported pain may be that reflux can occur in patients with indwelled ureteral stents.[14] Another is that each patient might have a different pain perception. Furthermore, underlying causes, such as prior pelvic radiation and post-renal transplantation, could lead to impaired bladder sensation, which in turn leads to lower levels of suprapubic pain and irritative symptoms.

With regarding to working performance, Giannarini8 reported that the crossed-midline group had a higher score in working performance. Even though our study found no difference, there was a trend toward higher days off after stent placement (W1) in the crossed-midline group. This may be as a consequence of lower abdominal pain (P2, P3), which was higher in the crossed-midline group. Albeit this explanation, since other parameters such as urinary symptoms, pain and discomfort did not differ, other factors, such as waiting time, procedure, or type of stent used might play role in this finding.

In terms of the additional problems domain, the results showed significantly higher UTI-like symptoms in the crossed-midline group. El-

Nahas12 reported that a positive urine culture was related to higher urinary symptoms. However, since our study did not perform a urine culture to confirm infection, these symptoms cannot be judged as infection. Due to stent-related symptoms potentially mimicking UTI symptoms and the lack of urine culture, having UTI-like symptoms could not be entirely attributed to infection. Also, as we found that both groups have the same scores for urinary tract symptoms, these UTI-like symptoms may be caused by the procedure itself, or stent-related symptoms.

Another significant finding was that female patients had higher levels of hematuria (U8) compared to males. From our data, patients with a history of previous radiation were all female and radiation cystitis in combination with bladder irritation from the ureteral stent and stent migration may lead to a higher rate of hematuria.

One could argue that the longer the stent, the more likely it is to cross the urinary bladder midline. Our results showed no difference in length and size between the two groups. From these findings, we could imply that they did not contribute to stent-related symptoms in this study. Furthermore, stent migration might play a role in stent-related symptoms, even though there were no differences in stent length.

To our knowledge, this was the first study to utilize a standardized Thai version of USSQ. Before the development of USSQ stent-related symptoms were frequently assessed using OABSS questionnaires.[13] Even though USSQ was translated into multiple languages[2,7], multiple studies still use the OABSS questionnaires[9,10] or even develop a simpler version.[12]

Whilst USSQ was the only standardized tool used for the assessment of stent-related symptoms and quality of life, it also had limitations. As discussed by El-Nahas[12] and Lingeman[5], USSQ is a very sophisticated questionnaire, and from the point of view of the patient, can be very demanding and confusing, and time consuming. As we conducted the study by completing the USSQ before stent replacement or removal, the psychological, medical conditions and time constrain may affect the focus of the patient as they answer the questionnaire. This may explain the high dropout rate in our study. In their study, El-Nahas et. al. had developed simpler questionnaires, which had only 6 questions. They stated that the simple version could make answering the questionnaires more quickly, require less recall, and be easier for patients.[12] Alternatively, handing over the USSQ to patient and asking them to return the questionnaires during their next visit may be a viable option.

Since the number of enrolled patients in our study was less than in other studies[2,5,8,9] due to the high dropout rate, generalization of these results to the general population with indwelling ureteral stent may be difficult. A future study with a larger sample size could provide more accurate results.

Stent movement can occur as a result of the movement and position of the patient[15], and the stent-related symptoms may also vary from immediately after stent placement until later. Lingeman[5] demonstrated that the USSQ score had changed over the course of 30 days after stent placement. The symptoms were highest immediately after stent placement and gradually improved over time. In our study, the USSQ was administered before stent replacement or removal, therefore these symptoms may be less severe compared to immediately after stent placement. Furthermore, our study did not collect USSQ before and after stent placement, since the majority of our patients had undergone stent placement before. By comparing USSQ before and after stent placement, these data can provide valuable insights into how stent-related symptoms cause problems to the patients, and how each cause of stent placement affects stent-related symptoms before and after stent placement. Conducting a study using the USSQ and performing an X-ray to assess the position of the DJ stent during stent indwelling, even though time and resource-consuming, will give more accurate information in this regard.

In this study, the cause of stent indwelling was different from many previous studies. While external ureteral compression was the most common cause followed by ureteral obstruction from stone or stone-related treatment, other studies[2,5,8,9] usually enrolled patients undergoing stone treatment. One might imply that differences in the causes of stent placement may affect stent-related symptoms. However, since our findings were similar to Abt[2] and Lingeman[5], the relationship between the causes of stent placement and stent-related symptoms may be less clear.

Double J ureteral stents were used in all patients in this study. Lingeman showed that different stent types do not affect stent-related symptoms.[5] Although we can infer from Lingeman5 and our result that the ureteral stent of double J design does not affect stent-related symptoms, there may be other factors to consider. These factors are the material of the ureteral stent and their coating. Stent type was left to the discretion of the surgeon, and as these were all the same in this study it is unclear as to whether differences in material and coating may play a role in stent-related symptoms. Further studies comparing the effects of different stent materials and coating on stent-related symptoms may be needed to answer this question.

Our study had some limitations. First, our study had a high dropout rate and limited numbers of patients enrolled. Second, our study was designed as a cross-sectional study and did not perform randomization. Performing a prospective randomization study by randomizing patients into two groups, one with the distal end of the ureteral stent crossed and a second with the stent not crossed midline could give more robust data. Third, since our study was a cross-sectional study design, we did not evaluate the USSQ score before and after stent placement which would add weight to the findings of the study.

Conclusion

The results of this study show that the position of the distal end of the ureteral stent does not affect urinary symptoms. Discussion with the patient about stent placement, procedures, and related symptoms before, and after stent placement remains crucial.

Conflict of Interest

The authors declare no conflict of interest.

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