

Complications of double pigtail stents after various urologic procedures and ways to reduce these complications

Khaid Kutub¹, Tamer A. Abouelgreed^{2*}, Nasser Ramadan³, Osama M. Ghoneimy⁴, Maha M. Elzamek⁵, M. Abdelwaddood⁶

¹Department of Urology, Alsharq hospital, Fujairah, UAE; Email: abanis35@gmail.com

²Department of Urology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt & Burjeel Royal Hospital, Abu Dhabi, UAE; Email: dr_tamer_ali@yahoo.com ORCID ID: <https://orcid.org/0000-0003-2640-3425>

³Department of Urology, Medcare Hospital, Dubai, UAE.

⁴Department of Urology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt; Email: elgendyosama787@gmail.com

⁵Department of Urology, Faculty of medicine, Al-Azhar University, Cairo, Egypt; Email: maha_201001@yahoo.com

⁶Department of Urology, Faculty of medicine, Ain shams University, Cairo, Egypt; Email: waddoodaref@gmail.com

*Corresponding author: Tamer A. Abouelgreed

Email: dr_tamer_ali@yahoo.com

ABSTRACT

Objective: To identify complications of the use of stent after various urological problems and try to demonstrate ways to decrease these complications. **Patients and Methods:** This prospective study included 120 patients, 80 males and 40 females ranged in age from 20 years to 68 years with an age of 44.5 ± 11.2 years. All patients were fully investigated prior to surgery. All patients underwent placement of a pigtail ureteric stent after procedures and were followed up postoperatively for symptom evaluation. **Results:** The indication for stent was hydronephrosis in 48 patients' post-ureteroscopy in 52 patients and post-ESWL in 20 patients. Symptom frequency for stent was recorded at 1 week, 2 weeks, 1 month immediately before stent removal and one month after stent removal. The difference between the prevalence of symptoms, pain and UTI associated with ureteric stent compared to post-stented status reached statistical significance ($p < 0.05$). Because of symptoms and pain associated with ureteric stent the work and general activity of patients were affected. Fifteen male patients (12.5%) could not return to work; five housewives (4.17%) found difficulty with home activities; and three students (2.5%) could not return to college. Out of 40 active patients of both genders, only 12 (10%) males reported an impairment in sexual function in the form of decreased libido, rapid and painful ejaculation. Before stent extraction urinary tract was. Showed encrustations in 16 (13.34%) patients. The stent indwelling time for those patients ranged between 3 months and 6 months with a mean of 4.5 months. **Conclusion:** Proper selection of patients in need of stent fixation is an important factor to decrease complications of ureteric stent. Using drugs and analgesics are effective, in decreasing irritative bladder symptoms. Also using alfuzosin 10 mg once daily improves function and general health.

Keywords: Complications, urological procedures, ureteral stents.

How to Cite: Khaid Kutub, Tamer A. Abouelgreed, Nasser Ramadan, Osama M. Ghoneimy, Maha M. Elzamek, M. Abdelwaddood, (2025) Complications of double pigtail stents after various urologic procedures and ways to reduce these complications, *Journal of Carcinogenesis*, Vol.24, No.1s, 149-155

1. INTRODUCTION

Ureteral stents are commonly placed after ureteroscopy. This is done to reduce the risk of flank pain caused by swelling in the ureter. It also helps with the passing of leftover stone pieces. Some believe stents can stop the ureter from becoming narrow and help it heal [1]. The main benefit of using a stent after surgery is to stop kidney pain from blockage. This blockage can come from stone fragments. Swelling in the part of the ureter that goes through the bladder. Also the stent gently stretches the ureter. This is thought to help move stone pieces out when the stent is taken out. Stents are also believed to prevent strictures and support healing in the ureter [2]. Disadvantages of ureteral stents include morbidity associated

with infection, dysuria, flank pain, hematuria, or stent migration [1]. The most common complication involving patients with indwelling stents is patient discomfort associated with irritative voiding symptoms, flank and abdominal discomfort, and hematuria. The etiology for lower urinary symptoms is the distal portion of the stent traversing the intramural ureter and impinging on the bladder floor [3]. The most common complication involving patients with indwelling stents is patient discomfort associated with irritative voiding symptoms, flank and abdominal discomfort, and hematuria. The etiology for lower urinary symptoms is the distal portion of the stent traversing the intramural ureter and impinging on the bladder floor [3]. Soft stents made from materials that are gentle, on the body and have low hardness, known as low durometer are likely to cause fewer problems [4]. This study looked at the complications that come with using JJ stents after different urological issues. It also explored ways to reduce these complications.

2. PATIENTS AND METHODS

This study involved 120 patients. The study took place from March 2023 to September 2024. All patients followed a set plan. The plan included checking the patient's history and doing a complete exam. The patients had urine tests to look for infections. For some patients they did urine cultures and sensitivity tests. They also did blood tests. The blood tests included a blood count, blood urea, creatinine coagulation tests, liver function tests and fasting blood sugar. These tests were done to prepare for surgery and check the kidney function. The patients had imaging tests. These included an x-ray of the tract an ultrasound of the abdomen and an IVU. All patients had a polyurethane stent placed through cystoscopy. The surgery was done under spinal anesthesia. The patients received antibiotics through a vein before surgery. The antibiotics were a third generation cephalosporin. They got the antibiotics half an hour before the operation. They continued to get the antibiotics for 12 to 24 hours, after the operation. After that, they took antibiotics by mouth for five days. The antibiotics were fluoroquinolone. All patients had an x-ray the day. The x-ray was a KUB film.

Operative procedure: Before the procedure patients who had infected urine were treated with, the antibiotic based on urine culture and sensitivity results. All patients also received a parenteral antibiotic about thirty minutes before anesthesia started. Spinal anesthesia was used, except for surgical cases that required general anesthesia. While in the position, cystoscopy was carried out with a 19 Fr cystoscopic sheath and a 30-degree telescope. A scout radiograph was taken to check positioning and landmarks. After a cystoscopy of the bladder, the cystoscope was moved close to the ureteral orifice and a 6 Fr Teflon ureteral dilator was inserted into the ureteral orifice. Air bubbles were cleared from the dilator before injecting a contrast medium that was diluted to than fifty percent while real-time fluoroscopy produced images of the ureter and collecting system. Then a 0.035-inch floppy-tipped guide wire was passed through the dilator into the renal pelvis, under fluoroscopic guidance. In some cases where retrograde uretero-pyelography was unnecessary, the guide wire was advanced directly through the orifice taking care not to damage the mucosa with fluoroscopic monitoring. If the straight guide wire could not pass, a 6 Fr Teflon ureteral dilator helped the J-curved guide wire to go through it. The guide wire stayed inside the ureter for the procedure. The ureteral orifice, the section and the stricture site were widened with graduated Teflon ureteral dilators that were moved into the ureter over the guide wire while watching under fluoroscopy, up to 11Fr. Larger dilators, those above 11Fr were inserted under fluoroscopic control while the guide wire was kept up to 16 or 18Fr. When dilation was not needed, for example when a DJ was used for ESWL the dilation was limited to 8 or 10Fr just to make it easier to pass the DJ stent. A rigid ureteroscope, 9.5Fr or 12.5Fr Karl Storz, 43 cm long angled 6 degrees with a 6Fr channel was used in patients with ureteric stones. It was slid over the guide wire into the orifice and moved through the ureter until the stone was seen. Large or impacted stones were broken apart under vision, with laser lithotripsy then the fragments were taken out with forceps. If ureteroscopy was hard if the ureteral wall was injured or if stone fragments moved up into the tract where the ureteroscopy could not reach or if the patient had only one kidney then a DJ ureteral stent was put in. Polyurethane 6Fr 24 cm DJ ureteral stents were then threaded over a 0.035 inch guide wire through the cystoscope while watching directly; a stent pusher was used to push the stent until its top part curled inside the renal pelvis. After that, the guide wire was pulled out. The bottom part of the stent curled in the bladder. Everything was done under fluoroscopic control. Finally the guide wire was taken out. A 16 Fr Foley urethral catheter was put in and kept for one to two days.

3. RESULTS

This study involved 120 patients, 80 men and 40 women. Their ages ranged from 20 year to 68 year. The average age was 44.5 ± 11.2 year. Loin pain that spread to the groin was the symptom in every patient. The pain in the loin was the symptom in 68 patients, which is 56.67% of the total. Loin pain combined with difficulty in passing urine was seen in 10 patients, which's 16.67%. Loin pain with blocked urine flow was found in 16 patients, which is 13.33%. Loin pain along with blood in the urine was reported by 12 patients, which's 10%. Two patients, which is 3.33% had stones found by chance during checkups for those with a kidney. The reason for putting in a stent was swelling of the kidney in 48 patients. It was done after a procedure called ureteroscopy in 52 patients. It was also done after a procedure called ESWL in 20 patients. The rate of symptoms from the DJ stents as reported by the 120 patients after one week two weeks, one month right, before removing the stent and one month after removing the stent are shown in (table 1).

Table 1: Frequent urinary symptoms one week, two weeks and one month after stent placement and before stent removal and one month after stent removal.

Symptom	1 st week (n=120)	2 nd week (n=120)	1 month (n=120)	Before removal (n=120)	1 month after removal (n=1200)
Dysuria	92(76.67%)	76(63.34%)	42(35%)	40(33.34%)	18(15%)
Urgency	34(28.34%)	30(25%)	16(13.34%)	16(13.34%)	4(3.34%)
Frequency	46(38.34%)	44(36.67%)	32(26.67%)	30(25%)	0
Incontinence	10(8.34%)	10(8.34%)	6(5%)	4(3.34%)	0
Hematuria	44(36.67%)	30(25%)	20(16.67%)	20(16.67%)	0
Loin pain	100(83.34%)	62(51.67%)	48(40%)	44(36.67%)	4(3.34%)
Suprapubic pain	28(23.34%)	24(20%)	20(16.67%)	18(15%)	6(5%)
Urethral&/or perineal pain	24(20%)	18(15%)	16(13.34%)	18(15%)	0
fever	16(13.34%)	14(11.67%)	2(1.67%)	4(3.34%)	2(1.67%)

For the same group of patients and at the same time, abdominopelvic ultrasonography was done to assess the degree of back pressure and the presence of stones, also urine analysis to check the presence of RBCs >3/hpf, pus cell > 5/hpf and crystals (table 2).

Table 2: U/S and laboratory investigations among studied patients.

Investigation	1 st week	2 nd week	1 month	Before	after
U/S for HN	78(65%)	68(56.67%)	58(48.34%)	48(40%)	22(18.34%)
U/S for stones	40(33.34%)	30(25%)	34(28.34%)	32(26.67%)	12(10%)
Urine for RBC	92(76.67%)	80(66.67%)	70(58.34%)	60(50%)	14(11.67%)
Urine for WBC	100(83.34%)	96(80%)	80(66.67%)	84(70%)	44(36.67%)
Urine for crystal	90(75%)	80(66.67%)	72(60%)	76(63.34%)	28(23.34%)

The following tables showed that the difference between the prevalence of urinary symptoms, pain and UTI, associated with stents compared to post-stented status reached statistical significance ($p < 0.05$).

Table 3: The difference between urinary symptoms one week after stent placement and after stent removal.

Symptom	1 st week	After removal	p value
Dysuria	92(76.67%)	18(15%)	0.001
Urgency	34(28.34%)	4(3.34%)	0.001
Frequency	46(38.34%)	0	0.001
Incontinence	10(8.34%)	0	0.029
Hematuria	44(36.76%)	0	0.001
Loin pain	100(83.34%)	4(3.34%)	0.001
Suprapubic pain	28(23.34%)	6(5%)	0.004
Urethral&/or perineal pain	24(20%)	0	0.001
Fever	16(13.34%)	2(1.67%)	0.016

Table 4: The difference between ultrasonography and urinary finding one week after stent placement and after stent removal.

Investigation	1 st week	After removal	p value
U/S for HN	78(56%)	22(18.34%)	0.001
U/S for stones	40(33.34%)	12(10%)	0.002
Urine for RBC	92(76.67%)	14(11.67%)	0.001
Urine for WBC	100(83.34%)	44(36.67%)	0.001
Urine for crystals	90(75%)	28(23.34%)	0.001

Table 5: The differences between urinary symptoms before stent removal and after stent removal.

Symptom	Before removal	After removal	p value
Dysuria	40(33.34%)	18(15%)	0.016
Urgency	16(13.34%)	4(3.34%)	0.047

Complications of double pigtail stents after various urologic procedures and ways to reduce these complications

Frequency	30(25%)	0	0.001
Incontinence	4(3.34%)	0	0.248
Hematuria	20(16.67%)	0	0.001
Loin pain	44(36.67%)	4(3.34%)	0.001
Suprapubic pain	18(15%)	6(5%)	0.063
Urethral&/or perineal pain	18(15%)	0	0.001
Fever	4(3.34%)	2(1.67%)	0.50

Table 6: The differences between ultrasonography and urinary finding before stent removal and after stent removal.

Investigation	Before removal	After removal	p value
U/S for HN	48(40%)	22(18.34%)	0.008
U/S for stones	32(26.67%)	12(10%)	0.016
Urine for RBC	60(50%)	14(11.67%)	0.001
Urine for WBC	84(70%)	44(36.67%)	0.001
Urine for crystals	76(63.34%)	28(23.34%)	0.001

Because of the urinary symptoms and pain that associated with the stent, the work and the general activity of the patients were affected. Fifteen male patients (12.5%) could not return to their work, five housewives (4.17 %) found difficulty with the ordinary home activities and three (2.5%) students could not return to their colleges.

Table 7: Effect of ureteral stents on patient activity

Type of patients	No.	%
Male employees	30/120	25%
Housewives	10/120	8.34%
Students	6/120	5%
Total	46/120	38.34%

Out of 40 sexually active patients of both genders, only 12 (10%) males reported an impairment in sexual function in the form of decreased libido, rapid and painful ejaculation. Before stent extraction, PUT was asked and showed encrustations in 16 (13.34%) patients, and the stent indwelling time in those patients ranged between 3 months and 6 months, with the mean is 4.5 months. Cystoscopy at time of stent removal revealed hyperemic, trabeculated trigone with nodules in 38 (31.67%) patients, and the stent indwelling time in those patients ranged between 3 months and 6 months, with the mean is 4.4 months. Stent blockage occurred in 6 (5%) cases as evidenced by severe loin pain, vomiting, anuria with rising of creatinine up to 7mg/dl in one case and 4mg /dl in the other as each one of those two patients has solitary functioning kidney. Creatinine dropped to normal after removal of the stent or exchanged it. Stent blockage confirmed by ultrasonography. Stent removal was smooth in most patients except in 6 (5%) patients where cystoscopic lithotripsy was needed due to heavy encrustations.

4. DISCUSSION

Finney, Hepperlen and colleagues [5] first described the double-J stent and the single-pigtail stent in 1978 marking the beginning of stents as an important part of modern urologic practice [6]. These stents can safely remain in place for days or even several months with the main purpose being to provide drainage from the upper urinary tract into the bladder [7]. However many studies show that ureteral stents still cause irritative symptoms. These include frequency, urgency, flank pain, dysuria and hematuria [8, 9]. In our study, we placed DJ-ureteral stents in 120 patients for different reasons. These included hydronephrosis after ureteroscopy for stone treatment or in cases where patients were scheduled for extracorporeal shock wave lithotripsy (ESWL). The results from our study showed that ureteral stents were linked to a range of urinary symptoms, such as dysuria, urgency and frequency. These symptoms were most noticeable after surgery and gradually improved over time. Other troubling symptoms included hematuria, pain in the loin, suprapubic pain and pain in the urethra and perineal area. These symptoms were also most intense, in the post-operative phase then tended to fade with time. Many researchers have carried out studies on the complications and side effects of DJ stents. These studies focus on how these stents affect health and quality of life [1, 3 9 10]. Our results were similar to those of Irani, et al. [11]. They looked at the symptom patterns of 39 patients after DJ-stent placement. They found that dysuria and hematuria tended to get better over

time. These symptoms were significant at the end of the week. They seemed to improve during the time the stent was in place in younger people. In contrast, Joshi, et al. [9] found that dysuria continued to be a problem until the stent was removed. They did not see any link between symptoms and patient age or sex. Stenting was clearly linked to irritative symptoms in patients who had a ureteral stent after ureteroscopy for lower ureteral stones. This was compared to the group that did not have a stent [12]. Damiano, et al. [13] said that 37% of patients had voiding symptoms. They also had 18% hematuria and 9.5% risk of stent migration. Joshi and their team (2001) reported issues in stented patients. They also found a 40% risk for dysfunction. There was a 80% impact on quality of life. Our study showed that by the end of the week urgency was a problem for 28.34% of patients. It slowly went down to 13.33% before the stent was removed. After the stent was removed it was 3.34%. Urgency was linked to urge incontinence in 8.34% of cases by the end of the week. This went away completely after the stent was removed (Table 3). We looked at all of dysuria, urgency, frequency, hematuria and pain from stents. We checked before. One month after the stent was removed. We wanted to make sure these symptoms were because of the stent. Our results were similar to those of Joshi, et al. [1] who found that urinary symptoms from stent placement, especially pain had a negative effect on physical and mental health. This was worse than symptoms and quality of life in patients with urinary tract symptoms or urinary stones without stents. Stented patients have symptoms and side effects. Most of these lasted for the time the stent was in. Stented patients had problems in parts of daily life. These included anxiety, sleep issues, sexual problems losing work time and a big effect, on quality of life [10]. Lower urinary tract symptoms and hematuria are occurrences. Frequently stents were linked to a risk for infection, encrustation or migration all of which may require further invasive manipulations and hospitalization [10]. The stent-related complication can be directly or indirectly lethal for the patient. Can cause death because of complications related to operative intervention [14]. Our prospective study revealed that loin pain was reported by patients and some of those patients stated that loin pain increased during voiding. Suprapubic pain, perineal pain and urethral pain were also reported by a proportion of those patients and this pain interfered with daily activities and affected the quality of life. Pain associated with stents was unpredictable in terms of location, severity and frequency. This pain affected health, sleep, daily activities and general health. Therefore, a high proportion of those patients required analgesia. Assessment of these aspects of stent-related pain would help to evaluate stent designs. It appeared that the impact of stent-related pain on quality of life worsened as the stent indwelling time increased [1, 10]. The presence of pain in the kidney region while voiding which seemed to be a symptom to stents may indicate reflux as observed in other studies. In our study, there were 80 sexually active patients of both genders. Of those patients, 16 (20%) males reported an impairment in sexual function in the form of decreased libido, erectile dysfunction, rapid ejaculation and painful ejaculation. These results appeared to be less than those reported by Leibovici et al. [10] who studied the effect of stent on life and found impairment in sexual function in 42-47 % of patients in the form of decreased libido, erectile dysfunction, dyspareunia and painful ejaculation. In men, the important distress was about erectile function probably related to lower urinary tract symptoms. Conversely, female sexuality appeared to be impaired due to stent-related psychological concerns [15]. Sexual health was not a problem with short stent indwelling time (week 1) but it became important as the stent indwelling time increased. The impact of stents was not related to pain during sexual activity but also appeared to be more widespread affecting overall sexual satisfaction [3]. In our study before stent extraction PUT was asked and showed encrustations in 16 (13.34%) patients and the stent indwelling time for those patients ranged between 3 months and 6 months with a mean of 4.5 months. Stents become covered with a biofilm that subsequently calcifies, leading to incrustation and frank stone formation because of continuous exposure, to urine [16]. Lower urinary tract symptoms and hematuria happen often. Sometimes stents are linked with a risk for infection, encrustation or movement all of which can lead to invasive procedures and a trip to the hospital [10]. The problems caused by stents can be directly or indirectly deadly for the patient. Can cause death because of issues that come from surgery [14]. Our study showed that most patients reported loin pain and some said it got worse when they urinated. Suprapubic pain, perineal pain and urethral pain were also reported by patients and this pain made it hard to do everyday things and lowered their quality of life. The pain from stents was hard to predict in terms of where it was how bad it was and how often it happened. This pain led to stent entrapment which needed procedures to take the stent out. Encrustation is a factor in the problems and the health issues from ureteral stents [17]. In our study, we saw that stent blockage happened in 6 (5%) cases. It was shown by loin pain, vomiting and no urine with higher creatinine levels in two patients who had only one working kidney. Creatinine went back to normal after taking out the stent or replacing it. Stent blockage and the pressure it caused were also shown by ultrasound. In our study taking out the stent went smoothly for patients except for 6 (5%) patients who needed a cystoscopic lithotripsy because of a lot of encrustations. Even though many patients had symptoms from the stent some didn't have any symptoms. It is possible that the patients without symptoms are more likely to forget about their stent and so they might get problems that happen over time like encrustation breaking into pieces and blockage [10]. Our study found that side effects might have been caused by the illness and not the stent. However most of the time the symptoms got better when the stent was taken out no matter what the original illness was. Also most of the symptoms lasted during the time the stent was, in which suggests that the stent itself not the illness was the cause of the symptoms.

To lessen ureteral stents complications: To reduce complications from stents it is recommended that recurrent stenting should be avoided in patients who have risk factors for encrusted ureteral stents. These risk factors include compliance, long indwelling time, sepsis, pyelonephritis, chronic renal failure, recurrent or residual stones a history of stone formation, metabolic abnormalities, congenital renal abnormalities and malignant ureteral obstruction with associated chemotherapy and hyperuricosuria [14]. There is a range of medical treatments available to manage irritative bladder symptoms, such as

analgesics and anticholinergic drugs. However, these medications often come with side effects, which can affect patient quality of life. Because of this ongoing research into stent, development in stent biomaterials and stent designs may offer better long-term solutions to these issues. The tail stent has shown to be less irritating, to the bladder compared to pigtail stents [3]. Another promising advancement is eluting stents, which can help prevent infection, encrustation and stent-related symptoms. An example of this is the triclosan-loaded Trimph stent [18]. A prospective study found that alfuzosin; an alpha-1 blocker at a dose of 10 mg daily improved a group of stent-related urinary symptoms and pain. Patients who received alfuzosin also maintained sexual function and general health [15].

5. CONCLUSION

We found that choosing patients carefully for stent fixation helps reduce problems with ureteral stents. Anticholinergic drugs and pain relievers work well to ease bladder irritation. Taking alfuzosin 10 mg once a day also helps with health and overall well-being. To make DJ stents safer doctors use materials, special coatings, better stent shapes and try to keep the stent in place for less, than three months. The future of science looks bright and it could cut down stent issues even more.

Declarations

Statement of Ethics: The protocol of this study was approved by the Institutional Review Board of Burjeel Royal hospital before initiation of recruitment (approval no. BURJ/RERC/2023/031). The study was conducted in accordance with the Declaration of Helsinki and applicable institutional requirements. Written informed consent was obtained from all participants before enrollment.

Author Contributions: KK, TA: manuscript preparation, protocol, data collection and management, manuscript editing. NR, OM: Data acquisition, data analysis and management, manuscript editing. MM, MA: Manuscript editing, project development, data analysis, and project development. All the authors have read and approved the manuscript.

Consent: Written informed consent obtained from all participants.

Sources of funding: The authors have no financial interests linked to this work.

Conflicts of interest disclosure: The authors have no competing interests to declare.

Data availability statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

- [1] Joshi HB, Newns N, Stainthorpe A, et al. Ureteral stents symptom questionnaire: development and validation of a multidimensional quality of life measure. *J Urol* 2003; 169:1060-1064.
- [2] Bartel P, Hallmann S and Ruttlof J. Evaluation of symptoms and patients comfort for JJ-ureteral stents with without antireflux membrane valve. *J Urol* 2010; 75(1):1-8.
- [3] Dunn MD, Portis AJ, Kahn SA, et al. Clinical effectiveness of a new stent design: Randomized single blinded comparison of tail and double pigtail stents. *J Endourol* 2000; 14: 195-202.
- [4] [Joshi HB](#), [Stainthorpe A](#), [Keeley FX](#), et al. Indwelling ureteral stents: evaluation of quality of life to aid outcome analysis. *J Endourol*. 2001;15:151-154
- [5] Darren T, Bodo Knudsen and John D. Denstedt. Advances in Ureteral Stent Design. *Journal of Endourology* 2003; 17: 195.
- [6] [Candela JV](#) and [Bellman GC](#). Ureteral stents: impact of diameter and composition on patient symptoms. *J Endourol* 1997; 11:45-47.
- [7] Pryor JL, Langley MJ and Jenkins AD. Comparison of symptom characteristics of indwelling urethral catheters. *J Urol* 1991; 145: 719-722.
- [8] Joshi HB, Okeke A, Newns N, et al. Characterization of urinary symptoms in patients with ureteral stents. *Urology* 2002; 59:511-516.
- [9] Leibovici D, Cooper A, Lindner A, et al. Ureteral stents: morbidity and impact on quality of life. *Isr Med Assoc J*. 2005; 7:491-499.
- [10] Irani, siquier, Pires, et al. Symptom characteristics and the development of tolerance with time in patients with indwelling double-pigtail ureteric stents. *BJU Int* 1999; 84:276 –279.
- [11] Bickerton MW and Duckett JE Jr. Suture materials and Wound healing, an overview. *AUA Update Series* 1984; Vol XI: 82-88.
- [12] Damiano R, Oliva A, Esposito C, et al. Early and late complications of double-pigtail ureteral stents. *Urol Int* 2002; 69:136.
- [13] Singh V, Srinivastava A, Kapoor R, et al. Can the complicated forgotten indwelling ureteric stents be lethal? *Int Urol Nephrol* 2005; 37:541-546.

- [14] Sighinolfi MC, Micali S and De Stefani S. Indwelling Ureteral Stents and Sexual Health: A Prospective, Multivariate Analysis. *JUrol*2007; 11.
- [15] Reid G, Denstedt JD, Kang YS, et al. Microbial adhesions and biofilm formation on ureteral stents in vitro and in vivo. *J Urol*1992; 148:1592-4.
- [16] Choong SKS, Wood S and Whitfield HN. A Model to quantify encrustation on ureteral stents, urethral catheters and polymers intended for urological use. *Brit J Urol*2000; 86: 414-421.
- [17] Finney RP. Experience with new double J Ureteral catheter stent. *J Urol*1978; 120: 678-681.
- [18] Chew BH and Denstedt JD. Novel ureteral stent materials and designs. *Nat Clin Pract Urol*2004; 1:448.