

Association of Complications in Retained Ureteral Stents

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ABSTRACT

Introduction: One of the most frequent complication of ureteral stent and difficult case management is stent encrustations resulting in morbidity and financial burden to patient. The primary aim of this study is to evaluate the complications incidence associated to patients and understanding different management techniques and other factors includes stent *in situ* duration, patient literacy level and socioeconomic level.

Material and methods: In this study, there are 48 patients presented with retained DJ stents to Urology Department, Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, Andhra Pradesh, India between August 2009 and January 2016 were included.

Results: The mean age of the patients in the cohort is 42.46 years and with highest percentage (37.5%) of the patients in age group of 40 to 50 years. Most of the patients in the cohort are from poor socio-economic status (66.7%) and illiterate (54.2%). Most of the patients (58.3%) are not aware of stent placement in their body and majority of the patients (83.3%) are unilateral cases. In this study, 31.2% of patients experienced multisite encrustations. Stents are placed most commonly for ureteric stones following the ureteroscopic lithotripsy and percutaneous nephrolithotomy procedures in our study. Stone composition revealed predominantly Calcium oxalate.

Conclusion: Retained DJ stents results in morbidity and complications like encrustation and stone formation which can be treated using combined endo urological procedures. Our study stress the prominence of regular follow up, and explaining patient about complications, prompt and timely stent removal and change of stent and proper documentation. Maintenance of stent register, is another important measure to avoid potential complications.

Keywords: Forgotten DJ Stents, Complications Associated, Prevention Measures.

INTRODUCTION

One of the widely urological practice used after the ureteric surgery is ureteral stents (DJ stents). Ureteral stents are also used in dealing ureteric obstruction due to stones disease and followed by iatrogenic injuries and prophylactically before reconstructive surgeries. One of the common problem in the urological practice is forgotten DJ stents. These forgotten DJ stents present with moderate to severe complications. Some of the common complications are hematuria, stent occlusion, migration, fragmentation, encrustations, and stone formation. Recurrent urinary tract infections (UTI), urinary tract obstructions, and renal failure are frequently observed complications in these patients. Recent years, there are several advancements in this field such as usage of biomaterials in stents and design of stents minimized the risk

of forgotten DJ stents. The primary focus of this study was to understand and minimize the risk of forgotten DJ stents.

MATERIAL AND METHODS

This study was conducted at Urology Department, Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, Andhra Pradesh, India. Period of this study is between August 2009 and January 2016 and considered patient population (total of 48 patients) are the ones with forgotten ureteral stents. Received informed consent from all the patients and approval from ethical committee.

Collected clinical and pathological data from all patients and analyzed for the duration of DJ stent. Data includes complaints / complications presented, history of previous and current procedures performed, renal functional tests, urine microscopy and culture with sensitivity.

All patients were under gone Ultrasound kidney ureter and bladder, X-ray kidney ureter and bladder, and Computed tomography scan kidney ureter and bladder, intravenous pyelogram, to evaluate stent encrustations. Based on investigations, stent encrustations are classified into upper coil, lower coil and stent body (ureteric portion), or entire stent involved based on its confinement.

Under local anaesthesia with antibiotic cover preoperative placement of Per-Cutaneous Nephrostomy (PCN) was done for cases with infected hydronephrosis. Preferable antibiotic drug is chosen based on patient's urine culture and sensitivity. In case of uncomplicated cases, presented with minimal encrustations, implanted stents are removed under guidance of fluoroscopy. If not possible or any resistance is encountered, alternate procedures such as ureteroscopy (URS) or percutaneous methods are performed under anesthesia. Patients with encrustations and stone burden involving ureter undergone retrograde ureteroscopy and intracorporeal lithotripsy using 8/9.8Fr and 6/7.8Fr semi rigid ureteroscope under fluoroscopy guidance using pneumatic lithotripter. Ureteroscope advanced besides stent, encrustations are broken and gently stent is removed using grasper.

In cases of uncoiled stents, retrograde pyelography (RGP) was done and percutaneous nephrolithotomy (PCNL) is

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performed after patient shifted to prone position. Patients with encrustations involving stent upper coil under gone PCNL using 24 Fr rigid nephroscope. This approach can be made through middle or lower calyx.

In cases of encrustation involving stent lower coil fragmentation done with transurethral cystolithotripsy and extraction with grasper is done. There are no significant intraoperative complications. New DJ stent placed into manipulated ureter and stent removal done after 3 weeks without fail. Assessment of stone free status is done in all patients by stone analysis and post procedure X-ray KUB.

RESULTS

Of the total 48 stent patients, there are 36 patients stented and

Epidemiological Factor	Details	No. of Patients
Age	21 < Age <=30 Years	6
	30 < Age <= 40 Years	12
	40 < Age <= 50 Years	18
	51 < Age <= 60 Years	9
	Age > 60 Years	3
Gender	Male	22
	Female	26
Education Level	Illiterate	22
	Educated	26
Income Level	Poor	32
	Middle Class	16

Table-1: Epidemiological factors of patient cohort

referred from outside and 12 patients are stented at SVIMS institute with no follow up contact even after informing them about stent removal.

Table 1 illustrates the epidemiological factors of the patient cohort. The mean age of the patients in the cohort is 42.46 Years and with highest percentage (37.5%) of the patients in age group of 40 to 50 years. In this cohort contains 22 male and 26 female patients with mean hospital stay of 3.8 days. Most of the patients in the cohort are from poor socio-economic status (66.7%) and illiterate (54.2%).

Table 2 shows all the factors related to stents and its placement. The mean duration of stent retention was 3.25 years with a range 6 months to 12 years. Most of the patients (58.3%) are not aware of stent placement in their body and majority of the patients (83.3%) are unilateral cases. DJ stent placed in 34 patients [70.8%] due to obstruction due to stone disease. Percutaneous nephrolithotomy (PCNL) and Ureteroscopic lithotripsy (URSL) are the most common indications for DJ stent placement in this cohort. In this cohort, 37.5% of patients experienced dysuria and frequent urination as the common symptoms.

In single site encrustations, bladder and ureter are common site of encrustations. 31.2% of patients experienced multisite encrustations. 37.5% of the patients showed elevated levels of creatinine (> 1.5).

Grasper was used cystoscopically to remove stent in 9 patients. PCNL was done in 10 patients with encrustations in upper coil and stent body, URSL was done in 13 patients to remove encrustations. In addition, transurethral cystolithotripsy was

Factors related to Stent	Details	No. of Patients
Patients know about stent placement	Yes	20
	No	28
Duration of Stent	Duration <= 1 Year	20
	1 < Duration <= 5 Years	16
	5 < Duration <= 10 Years	9
	Duration > 10 Years	3
Laterality	Unilateral	40
	Bilateral	8
Indication	Percutaneous nephrolithotomy (PCNL)	18
	Ureteroscopic lithotripsy (URSL)	12
	Open pyeloplasty	8
	Malignancy [carcinoma cervix]	4
	Extracorporeal shock wave lithotripsy (ESWL)	4
	Ureteric Reimplantation	2
Clinical Presentation	Dysuria and urinary frequency	28
	Haematuria	12
	Recurrent UTI	8
Creatinine	Creatinine >= 1.5 (Raised)	18
	Creatinine <1.5 (Normal)	30
Site of encrustations	Kidney	8
	Ureter	11
	Bladder	14
	More than one site	15
Stone composition	Calcium oxalate	28
	Calcium phosphate	14
	Infection stones	6

Table-2: Factors related to Stent placement

done to remove encrustations in lower coil in 14 patients. In 2 cases, open method of extraction under c-arm guidance was done where stent extruded outside from ureter into right iliac fossa. However, in 4 patients stent was broken at time of removal for which staged procedure was done. Poly urethane material is used in majority of stents.

Calcium oxalate monohydrate (in 28 patients) is the most common stone composition observed in stone analysis followed by calcium phosphate (in 14 patients) and struvite (in 6 patients). Large percentage (70.8%) of patients were rendered stone-free and 29.2% of patients have clinically insignificant fragments of stones (4 mm or less) are seen.

DISCUSSION

Ureteral stent usage first reported in 1967.¹ Finney introduced double J type of stent design in 1978. Features of ideal ureteral stent are, it should be biocompatible, radiopaque and cost-effective but there are no ideal double J stents available. Double J stent relieve intra/extra ureteral obstruction, resist encrustations and resist infection. Serious complication of prolonged forgotten ureteral stent is stent encrustations which needs prompt clinical management. However, exact mechanism of encrustation still unknown.

Moreover, Urinary tract infections, Stone disease history, Malignancy, Metabolic disorders, Pregnancy, Congenital anomalies of urinary tract, and Duration of stent in situ are associated risks with encrustation of stent.² Bacteria produce urease enzyme which, hydrolyses urea to ammonia in the urine resulting in elevated urinary pH, magnesium and calcium salts precipitate as struvite and hydroxyapatite on stent surface.³ As the duration of stent placement increases complications will also increase. However, there are numerous studies suggest that safe indwelling period for stents is 2 to 4 months in addition to antibiotic prophylaxis treatment during stent exchange.^{4,5,6,7}

Encrusted ureteral stents management depends on encrustation site, size of stone burden and the function of affected kidney. Various procedures like extracorporeal shockwave lithotripsy (ESWL), Ureteroscopic lithotripsy (URSL), percutaneous nephrolithotomy (PCNL), and open techniques are used depending on site and severity of encrustations.^{4,8,9}

Extracorporeal shockwave lithotripsy is often used as the first line non-invasive treatment for renal stones that are small localized and encrustations that involves upper coil and ureter.^{10,11} In cases of ureteric encrustations and ESWL failed cases, ureteroscopy using pneumatic or ultrasonic / laser lithotripsy can be as first option.^{6,8,12} In cases with encrustations involving lower coil of stent cystolithotripsy / cystolithopaxy can be used.^{10,13}

In patients with large stone burden involving upper coil PCNL can be done. In endo urological techniques failure patients and patients with large stone burden open surgery is performed. The common complications associated to retained stents are migration, perforation of urinary tract, urinary tract infection, adjacent organ penetration, stent malposition, encrustations, stone formation, fractured stent,

ureteral erosion and fistula formation. In majority of patients for retained double J stents, endourological management is successful. Proper patient counseling about removal date of stents or stent exchange can be used as complication prevention. Up to date stent registry and stents should be selectively placed with proper documentation aid in complication prevention.^{2,14} There is significant difference in encrustation rate (i.e. 9.2% versus 76%) between ureteral stent removed within 6 weeks to over 12 weeks.¹⁵ El-Faqih et al. (1991) also concluded that computer stent register is important factor for complication prevention and for heavily encrusted stents Multi modal endo urological procedures are preferred modes of treatment.

There are several reports published in the literature that shows lower encrustation rates at shorter duration ureteral stent. One such example is reported in Kawahara et al. (2012) with encrustation rates of 26.8% in < 6 weeks, 56.9% at 6 to 12 weeks and 75.9% > 12 weeks of retained double J stents). Kawahara et al. (2012) reported the main cause of ureteral stent encrustation is indwelling time of stent. Additional procedures need to employ for removal of heavily encrusted ureteral stents. It is very difficult to provide an exact interval to avoid additional procedures for removal of an indwelling ureteral stent. Patients with large stone burden severely encrusted ureteral stents are managed by endo urological methods requiring two to six (on average 4.2) endourological approaches in single or multiple sessions.¹³ Borboroglu and Kane (2000) concluded that for successful management of a retained encrusted stent with large stone burden combined endourological approaches like PCNL and ureteroscopy are required. Singh et al. (2001) reported management and analysis of potential risk factors in severely encrusted polyurethane ureteral stents. Bukkapatnam et al. (2003) reported one-step removal of encrusted retained ureteral stents. In this study, 11/ 12 patients were managed by ureteroscopy alone and remaining patient by percutaneous approach which suggests that single step removal of stents can result in minimal morbidity and shorter hospital stay. In the same study, Bukkapatnam et al. (2003), they reported clearance rates of 75% to 100% using combination of Shock wave lithotripsy, Percutaneous nephrolithotomy (PCNL), Cystolithotripsy (CLT), Ureteroscopy with intra corporeal lithotripsy.

There are several methods published in literature to prevent or minimize forgotten stents which includes electronic stent extraction reminder facility¹⁶, stent registry¹⁷ and computer trackers which send messages/reminders to patients and urologist.^{18,19,20} These forgotten stents are the main source of severe morbidity and financial strain. In addition, there are several manuscripts published on endourological management which gives higher success with minimal number of complications in majority of cases (Ex. Rabani et al. 2012). In summary, the best strategy is prevention of this complication.

Recent advancements in techniques and materials and coatings used in double J stent manufacture minimized the complications associated with forgotten double J stents.

Polyurethane stents have significantly higher encrustation incidence and have four time higher fragmentation risk compare to silicone double J stents.

In literature, there are several coatings material such as hydrophilic polymers, heparin, pentosan polysulfate, or enzymes degrading oxalates have been used to minimize encrustations. There are studies that described novel biodegradable ureteral stent in a porcine model in the literature.²¹ This bio-degradable compound of glycolic acids and poly L lactic acids are designed to disintegrate which in turn eliminate the problems of retention and encrustation of the stents in near future.

Daptomycin, Linezolid, Tigecycline, Rifampicin, Temporin A, RNAIII-inhibiting peptide, Oxacillin, Cefotaxime and Vancomycin are antibiotics used as stent coating to prevent bacterial growth.^{22,23,24} Triclosan and Silver are antimicrobial agents which help to reduce biofilm formation and encrustation.²⁵ Chitosan and Poly vinyl alcohol (PVA) are also used to prevent bacterial growth.²⁶

In our study, we have seen that retained DJ Stent will cause significant morbidity to the patients which includes flank pain, hematuria, recurrent UTI and dysuria. Also observed multiple site encrustations in most of the patients. In addition, there is stone-free rate of 70.83% of patients and clinically insignificant residual stones (4 mm or less) are seen in 29.2% of patients. In most of the patients proper counselling is not done regarding the stent placement and need for stent removal in due course of time and stent exchange. These observations are comparable to other studies published in literature and stresses on importance of educating patients, need for computer based reminder system for prompt stent removal and maintaining a good stent register.

CONCLUSION

One of the most frequent complication of ureteral stent and difficult case management is stent encrustations resulting in morbidity and financial burden to patient. It is vital to determine the stent location and degree of stent recrustation in pre-operative period. Minimally invasive endoscopic techniques are employed in most of encrusted and retained stents removal. The most preferred approaches in our experience is to provide proper education to patients about the complications and associated risks. However, factors such as level of patient education and patient counseling plays a critical role in retained stent avoidance and patient morbidity. In our experience, patient counselling before and after the stent placement procedure is the most effective method. In addition, a proper stent registry and its maintenance will aid in timely removal of stents and reduction of patient morbidity.

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