SINGLE SITTING ENDOUROLOGICAL MANAGEMENT OF RETAINED URETERAL STENTS AT GROOTE SCHUUR HOSPITAL: A 4-YEAR RETROSPECTIVE STUDY

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DECLARATION

I, **Winstar Mokua Ombuki,** do hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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LIST OF ABBREVIATIONS

CLT- Cystolitholapaxy
CT- Computed Tomography
EKL- Electro Kinetic Lithotripsy
FECal- Encrusted, Calcified
FR- French Size
GSH- Groote Schuur Hospital
PCNL- Percutaneous nephrolithotomy
RIRS- Retrograde intrarenal surgery
SPSS- Statistical Package for Social Sciences
URS- Ureterorenoscopy

ABSTRACT

Introduction: Double J stents have become essential components in endourological and open urological procedures. The removal of severely encrusted and retained ureteral stents poses a management challenge for urologists as multiple procedures are often required to remove them.

Main Objective: To determine the proportion of patients with retained stents who can be rendered stent free with single-sitting endourological management

Secondary Objectives: To describe the number of procedures required to render patients with retained stents stent and stone free. To describe the demography and clinical variables of patients with retained ureteral stents at Groote Schuur Hospital

Materials and Objectives: A retrospective study was conducted between 1st February 2018 and 31st January 2022. All 30 patients that met inclusion criteria with retained and encrusted patients were reviewed. All patients were initially evaluated with radiographic imaging for assessment of stone burden. Treatment decisions were based on the FECAL classification of retained stents. Multimodal endourological procedures were used to achieve the stents and render the patient stone free.

Results: The average age of the participants was 39.4 years while the male participants were the most common, 66% (n= 19). A total of 47 Urological procedures were performed to render all 30 patients' stent and stone free. The average duration of indwelling time was 20.35 months and a range of 66 months with a minimum of 4 months and a maximum of 70 months. The main indication for stent placement was stone obstruction (55.56%). 41% (n= 12) of patients had PCNL while 48% (n= 14) patients received ureteroscopy and laser lithotripsy. The most common FECAL classification was IV at 59% (n= 17). The most common side affected by stent encrustation was the right (55.56%).

Conclusion: The endoscopic combined approached is safe and feasible technique that allows removal of retained and encrusted stents in a single procedure.

Keywords: FECal, retained, stent, encrusted, endourological, management, stone

1.0 CHAPTER ONE: INTRODUCTION

Ureteral stents have so far become a fundamental part of many urological procedures. They are mainly indicated after ureteral surgery to manage obstruction secondary to stone, uretero-pelvic junction obstruction, strictures, congenital anomalies and malignancy. They are also placed during complex abdominal pelvic surgeries to identify ureters and after iatrogenic ureteric injuries[1]. Urolithiasis accounted for 69.7% of cases that required stent insertion[2]. On the contrary, if the stents are left for prolonged time, the patients start experiencing complications which necessitate endourological techniques to resolve them. Retained stents were common challenge among the low socio-economic status, low education and those patients from rural areas[3,4]. Physician related factors like lack of proper counselling of patients was also a contributing factor for 'forgotten' retained stents[4]

Complication rates have been on the rise due to the increased rate of stent insertion globally. If left unmanaged, retained stents pose a real morbidity and mortality[5].Stent encrustation is recorded as one of the most common and serious complications of these indwelling stents and mostly in polyurethane double J stents as compared to those of silicone double J stent. The encrustation of stents is the process by which mineral crystals are deposited onto the lumen and surface of ureteral stents. The exact etiology of encrustation is unclear[6]. Multiple procedures may be required to removed encrusted stents and up to 16% of endourology law suits are related to stents[7]

2.0 CHAPTER TWO: LITERATURE REVIEW

2.1 Prevalence of Encrusted Stents

The prevalence of encrusted stents varies in different regions and several factors. Forgotten or retained stents can occur up to 13% of the cases[8] The United States reports an increase of 8.8% of cases over the last 40 years, in the United Kingdom cases have increased from 7.4% to 14% while Japan has a similar trajectory of encrusted cases[9]. In Kenya, the prevalence of encrusted stents is on the rise. Studies done in Nairobi Hospital and Aga khan Hospital have shown high annual encrusted stents[10,11]. Lifetime recurrence is between 10% - 75% thus creating a public crisis in affected regions and this has been witnessed worldwide[9]

2.2 Risk Factors for Stent Encrustation

Risk factors include the length of time the stent was in an indwelling position, bacterial colonization, patient-related factors and stent physical characteristics. Bacterial biofilm may play a big role as a study showed 90% of ureteral stents that the team retrieved had colonized pathogens while 55% presented adherent biofilms[12]. Risk factors for stent encrustation are, sepsis, pyelonephritis, residue stone formation, lithogenic history, chronic renal failure, and metabolic and congenital abnormalities[13]. Other risk factors associated in the elevated occurrence of encrustations are malignant predisposition and pregenancy[14] Encrustation rates vary with dwell time: - at 6 weeks dwell time encrustation is 26.8%, 56.9% between 6-12 weeks and 75.9% for more than 12 weeks dwell time[15] Minimal morbidity is associated with stent indwelling time of less than 6 weeks[15,16]

Low education levels and lack of patient compliance logically increase risk for retained stents[15]. Stent caliber size also matters as stents less than 6FR were at a more increased risk for encrustation than those more than 7FR diameter[15].

Among the several risk factors described for retained stents, prolonged indwelling time is the most important[17]. The indwelling time was influenced by factors like financial burden leading to forfeiting of scheduled day of removal of stent, illiteracy and ignorance of the patients, lack of proper stent registry leading to 'forgotten stents', and lack of timely referral of clients for stent removal[18]

The material and design for the stent also played a major role in encrustation. The hydrophilic-coated polyurethane stents despite being used to reduce the co-efficient of friction, encrusted faster and to a larger extend compared to silicone and non-hydrophilic ones. The hydrogel coating's permeability to inorganic salts accounts for the elevated risk of encrustation[19]. The

use of biodegradable or metallic stents reduced the complications of long dwelling stents by up to 21%[19,20] . Moreover, the stent's intraluminal part is at an angle this leads to reduction of encrustation at the distal side. The proximal end of the stent was involved more[21]. The peri and intraluminal sizes had effects on the rate of stent encrustation. 5FR stents the rate was 83%, 6FR had 61% while 7FR had 58%[22].

The rate of stent of encrustation is higher in pregnant women. In a study by Vanderbrick et al, pregnant women with stents had encrustation by 2 weeks after placement necessitating kidney decompression[19]. This is attributed to the increased incidence of underlying urinary tract infections, asymptomatic bacteriuria during pregnancy[23]. Additionally, pregnant women undergo physiologic changes to the urinary tract that predispose them to encrustation. Absorptive calciuria from placental production of 1, 25- hydroxyl vitamin D3 and decrease in parathyroid hormone secretion are some of the predisposing factors for pregnant women[19].

For patients with chronic kidney disease, retained ureteral stents for a period exceeding 6 months, there was marked increase of 30.6% for patients with retained stents compared to 8.3% with non-retained stents[24]. The patients who had glomerular filtrate of 60ml/min/1.73m^2 had significant decrease to below the initial rate. A few of the patients, 18.2%, had such reading persist for more than 3 months suggestive of permanent kidney disease. Furthermore, in patients who had other comorbidities like diabetes and hypertension, there was increased incidence of onset of chronic kidney disease 36.1% as compared to 23.4% those who did not have[24]. The results are in tandem with other studies that there is increased incidence of onset of kidney disease with retained stents.

2.3 Mechanism of Stent Encrustation

The encrustation mechanism is intricate and multidimensional. The three potential outcomes after insertion of a stent are for them to remain unchanged, become coated by a biofilm or become encrusted[25]. The relationship between bacterial biofilm and encrustation is not as well understood as it should be. While bacterial biofilms possibly aid in the crystal precipitation and resultant encrustation, encrustation may conversely may serve as a nidus for bacterial biofilm formation and growth[26]

Encrustation of stents is influenced by several factors including material of the stent, bacterial infections, urine PH and indwelling time. Bacterial action is not absolutely essential for stent encrustation but it play a significant role in accelerating the process. 85.7% of the stent encrustation had positive urine culture[21]. Film formation is a process. Shortly after stent is inserted, different organic molecules adhere leading to formation of struvite and

hydroxyapatite crystals. The common isolated bacteria from stent encrustations include enterococcus, *E.coli*, and *Proteus Mirabilis* species[26, 28]. These are urease-producing bacteria which increase urine PH. Increased PH led to formation of carboxyapatite and ammonium phosphate crystals. These are the most common stones[27,29]. The crystals then obstruct the inlet and outlet of the stents leading to urinary infection, pain and increase patient discomfort. The resultant infections are resistant to antibiotic action as lodge between organic matter and surface of the crystalline making them out of reach of antibacterial activity.

.The mechanism of encrustation in urinary tract infections are due to presence of organic components in the urine. These crystallize onto the exposed surface of the biomaterial and thus become integrated into a bacterial biofilm layer. Urease producing bacteria hydrolyze the urea to produce ammonia. This raises urinary pH, leading to precipitation of struvite and hydroxyl apatite[30, 31]. Urine PH plays a significant role in stent encrustation through formation of calcium and magnesium phosphate precipitates. A study showed that reduction of ureteral encrustation by modulating urine PH and inhibiting the crystal film found out that no bacteria was found in PH higher than 6.2 therefore there was little or no encrustation of stents, for PH between 5.5 – 6.2 there was small encrustation while for PH below 5.5 large crystals were formed[26].

Mechanism of encrustation in urine proven to be sterile is unclear, appears to be dependent on the pH, biomaterial hydrophobic properties ad ionic strength[26].

2.4 Presentation and Assessment

Presenting symptoms are usually made up of flank pain, hematuria, storage symptoms and infection. Positive urine cultures have been reported in up to 75.2% of stent encrustation[32] many patients are often asymptomatic and diagnosis may come incidentally during abdominal imaging for other reasons or cystoscopic removal in outpatient setting. While X-ray KUB is readily available and affordable, non-contrast Computerized Tomography is the modality of choice. Computerized Tomography scan is essential in evaluation of uric acid stones. In severe encrustation where renal function is questionable, radionuclide studies are done to estimate renal function. This enables the diagnosis to be confirmed, mapping of encrustations and grading the severity. Plain radiographs only often fail to identify the stent calcifications adequately[33]

2.5 Classification of Encrusted Stents

The Forgotten, Encrusted, and Calcified (Fecal) classification is commonly used and grades the level of encrustation into five grades and can be used for surgical planning. FECAL grading system makes use of metrics including the size of the stone, degree and location of stent encrustation and scored from grade 1 to 5[34]. Grade I is where there is minimal linear encrustation along either portion. Grade II there is circular encrustation that completely encases either portion. Grade III there is circular encrustation encasing either portion completely or linear encrustation of ureteral aspects. In Grade IV there are circular encrustations completely encasing both portions and in Grade V there are diffuse and bulky encrustations completely encasing proximal, distal, and ureteral portions[34].

2.6 Complications of Retained Stents

Stent encrustation is a serious complication and it can lead to renal impairement[35.] Other described complications of retained stents include the stent encrustation, fracture, migration, formation of the stone, adjacent organ penetration, ureteral erosion, urinary tract infection or formation of fistula[36, 37]. The most often-recorded post-operative complications include urosepsis (15.8%), a need for single or multiple blood transfusions (3.5%), and grade 1 ureteric injury (2.6%) [38] in a kidney with reduced glomerular filtration rate and is non-salvageable with a significant encrusted stent and stone burden, the team should considered nephrectomy [39, 40]

These complications not only impact the quality of life but also exert an economic burden. Up to 16% of endourology lawsuits are related to retained stents[41]

2.7 Management of Encrusted Stents

No definitive management recommendations are available. The removal of severely encrusted and retained ureteral stents poses a management challenge for urologists as multiple procedures are often required to remove them, lack of scientifically standardized procedures despite multiple case reports and case series[42] Currently, retained stents are managed by various endourological procedures and open surgery. Endourological procedures are widely accepted as they are efficient with less wound and short recovery time[28]. Endourological procedures have also shown great success rate of over 81% after single anesthetic session[27, 29]. The commonly used procedures include cystoscopic stent retrieval (CPE), percutaneous nephrolithotomy (PCNL), ureteroscopic lithotripsy (URSL), extracorporeal shockwave lithotripsy (ESWL) and nephrectomy. The choice of the procedures depends on the location of crusts, severity and effects of encrustation on kidney function. Open surgery is minimally used

in cases of severe encrustation. Open surgery was also utilized in management of encrusted stent in pediatric patients[43]. The open surgery also catered for stents with encrustation of more than 3mm which is widely spread over the stent (Somers, 1996).

Some institutional management algorithms have been published[44, 45, 46]. Shock wave lithotripsy has been employed with success in cases of linear encrustation < 3mm diameter over < 1/3 of stent length or bulbous encrustation < 1.5 cm in diameter (13, 14). For larger burden, endourologic operations are favored. Open surgery is last resort after failure of endourologic management[34] Therefore, treatment options include percutaneous, endoscopic, open or laparoscopic surgical approaches or a combination thereof. Patients should be counseled regarding endourological management of retained stent removal may necessitate more than one operative session[44]

Generally, encrustations in the bladder are fragmented first, then retrograde management of ureteric encrustations. Thereafter, stent is cut as high as possible in the ureter then percutaneous nephrolithotomy is done. Attempt to pull out the stent for upper end " fixed coil" and PCNL is backed instead[47] Retrieval of retained and severely encrusted ureteral stent and the stone burden associated with it poses a real management challenge because of the need for multimodal procedures and the lack of a standardized plan. This makes it one of the most difficult problems in urological practice[48]. Sick patients require acute management (such as antibiotics, urinary diversion, dialysis) as a priority till the patient is clinically stable then stent removal electively[34]

In patients with no visible encrustation on plain radiography, one can attempt retrograde stent removal, ideally under fluoroscopy guidance. Ureteral calcifications can be managed by retrograde ureteroscopy and laser lithotripsy. For proximal ureteral stent encrustations less than 2cms, flexible ureterolithotripsy with laser is applicable while percutaneous nephrolithotomy preferred for larger encrustations. In instances of simultaneous large proximal and distal encrustations, both can be addressed with a modified Galdekao-Valdivia supine position[49]. Bladder encrustations can be managed minimally through cystolithotripsy or cystolitholapaxy. Large stone burdens often require open cystolithotomy[42] Bostanci et al proposed a combined endourological approach including cystolithotripsy, retrograde ureteroscopy with intracorporeal lithotripsy and PCNL to remove encrusted stents in a single session[50] Although PCNL is the most invasive procedure of the endourological options, it provides higher stone free rates and decreased the number of required procedures especially in large encrustation burdens[51]. In some series 43.7% of the cases were managed by PCNL, 37.5% by ureteroscopy, 18.7% by cystolithotrity[20] reported pneumatic lithotripsy was the preferred method[21].

Several factors determine the type of surgical intervention to be employed in the management of retained and encrusted. Imaging is critical in evaluating and determining appropriate surgical management. Contrast CT is helpful in the evaluation of renal function which also plays a critical role in determining the appropriate procedure to be used[10]. With the evolution in technology, new non-invasive procedures have been mostly adopted. Such procedures include ureteroscopy (URS) and laser lithotripsy; which are more agile, semi-rigid, and flexible. There are useful in the management of calcifications along the ureteral component of the stent. Percutaneous nephrolithotomy for instance is the most common procedure for grades IV and

V. In nonfunctional kidneys, laparoscopic total nephrectomy is used[52].

Nephrectomy is indicated when there is non-functioning kidney[20]. Studies which have been conducted on management of upper urinary encrustation have reported varied methods involved and different number of sessions required to achieve stone free as well as stent Free state for the patient. A team can remove stents in a solitary sitting with minimal morbidity and a demonstrably short stay in the hospital[53]

2.8 Outcomes of Retained Stent Removal

Achieving stent-free status while preserving maximum renal function is the main goal of management. A study by Huang et al concluded that the overall Stone Free Rate per renal unit for patients who had a preoperative stone burden ≤20mm and >20 mm were 100% and 85.7%, respectively after URS and laser lithotripsy[74]. This clearly indicated that the smaller the size of the stone the higher the stent and stone-free rate.

Stent management through endourological procedures is safe and efficient. Studies done on the number of sessions required for stent removal have suggested that one session was enough with combination of endourological procedures. Combined procedures achieved 75- 100% clearance with few complications[6, 43]. Lojanapiwat et al on his study on endourological management of severely encrusted ureteral stents suggested that retrograde ureteroscopy or a combination of PCNL and ureteroscopic procedures as the choice of management[55]. Additionally, 2.5 endourological procedures were required to make the patient stent free. Rabani et al found out that patients required 4.2 endourological procedures under one session to be stent and stone free[56]. In a study done by Vanderbrink et al. on evaluation and endourological management of encrusted urinary stents, one session was enough to remove encrusted stents[19]. The success rate was at 80.8% in one sitting endourological management study by Rana et al[22].

Notably only a few patients, 5.7%, required more than one session in management of retained stents[22]. Lojanapiwat et al reported that there was no complication of associated with removal of stent and there was also no need for another stent but only for PCNL which was indicated for 48 hours post-operatively[23]. There was also reduced post-operative admission. The post-operative hospital stay was averagely 3.5 days (1- 5 days admission). Few patients developed sepsis warranting broad spectrum antibiotic or intensive care management. In a study by Zheng and Wang 2019, patients who had undergone URS were followed up and reported no cases of stone recurrence for up to 5 years post-operatively (Zheng 2019). Similarly, Ali et al 2019 reported a stent-free rate of 81% among patients who had undergone URS. The major advantage of combined endourological stent removal techniques is that it can afford the complete clearance of all stone and stent fragments in a one operative session. A potential drawback of endourologic options in high risk patients is a risk for sepsis secondary to bacteremia arising from endoscopic manipulations of colonized stents and stone fragments despite negative urine cultures.

2.9 Prevention of Stent Encrustation

One of the best ways to manage retained stents is through patient education and proper patient- physician communication. This can be done by having an electronic stent registry on stent insertion and life span. Communication is done to the patient for timely removal (Ali et al 2010). The best treatment is prevention despite high success rate associated with endourological procedures. This can be done through use of computerized tracking system. It is a highly effective method which alerts the urologists when the stent need to be addressed. According to Vanderbrink et al this initiative reduced the incidence of retained stents from 12.5% to 1.2 %[19]. Furthermore, the underlying factors which contribute to increased prevalence of retained placenta need to be fully addressed.

2.10 Study Justification

Ureteral stent retention and encrustation is a serious and severe complication that can lead to patient morbidity and the resulting elevated cost to the patient. It is a management problem to the surgeon as there is no standardized treatment plan. This retrospective series will reveal that it is possible to combine multiple endourological procedures in one setting to avoid repeated anesthesia, morbidity and it will shorten hospital stay. This will directly benefit participants as most stone formers have recurrent stones and therefore may benefit from improved management strategies if their future stone management results in an encrusted stent.

2.11 Objectives

2.11.1 Primary Objective

To determine the proportion of patients with retained ureteral stents that can rendered stent free with single sitting endourological management.

2.11.2Secondary Objective

To describe the number of procedures required to render patients with retained stents free of stent and stones as well.

To properly describe the clinical variables and demographics of subjects/patients with retained ureteral stents at Groote Schuur Hospital.

3.0 CHAPTER THREE: METHODOLOGY

3.1 Study Design

This was a retrospective folder review described the management of all retained ureteral stents over the last 4 years at Groote Schuur Hospital

3.2 Study Setting

This study was conducted at Groote Schuur Hospital is a large state funded teaching and referral hospital situated on the slopes of Devil's Peak in Cape Town City, South Africa. Founded in 1938, it is affiliated to the University of Cape Town and has a 893 bed capacity. The hospital has a dedicated stone clinic and hence manages stone cases in its drainage areas of referral facilities.

3.3 Inclusion Criteria

Retained double-J ureteral stent
Surgery for removal performed at Groote Schuur Hospital

3.4 Exclusion Criteria

Resonance ® metallic stents Stent not retained
Folder and/or imaging not available Ureteral stents in ileal conduits
Ureteral stents in cutaneous ureterostomies
Not retained double-J ureteral stents i.e., straight ureteral catheter/mono-J stent or feeding tube used as ureteral stent

3.5 Sample Size

All patients meeting inclusion criteria managed for retained stents at Groote Schuur hospital over the last 4 years between 2018 and 2022 were included.

3.6 Sampling Method

Convenience sampling method was used.

3.7 Screening and Recruitment

The principal researcher was the primary person involved in going through patient records and doing data entry for patients managed with retained stents at GSH.

3.8 Data Collection

All patients who underwent management of retained ureteral stents at Groote Schuur Hospital for the last 4 years (1 February 2018 – 31 January 2022) will be identified from an existing database (R003/2018). Retained stent is defined as a ureteral stent which cannot be removed under local or general unaesthetic without ancillary procedures to crush or remove encrustation or calcifications on any part of the stent. Based on number of cases per year it is estimated that approximately 40 cases will be available for inclusion

The following variables were collected from the patient folder and previous imaging:

- Age
- Gender
- Indication for stent insertion
- Stent dwell time prior to first procedure
- Laterality of stent
- Body mass index (BMI, if available)
- Co-morbidities (hypertension, diabetes, cardiac disease)
- American Society of Anesthesiologists Physical status classification (ASA) as recorded on the anesthetic record for the first procedure. If different over multiple procedures, the worst will be recorded.
- Forgotten-Encrusted-Calcified (FeCal) classification as follows(5):
    - Grade I -minimal linear encrustations along either portion
    - Grade II-Circular encrustation completely encasing either portion'
    - Grade III-circular encrustation completely encasing either portion or linear encrustation of the ureteral aspects
    - Grade IV Circular encrustations completely encasing both portions
    - Grade V Diffuse and bulky encrustations completely encasing the proximal, distal and ureters portions.
    - Number of procedures to stent removal
    - Number of procedures required to stone free (stone free defined as no fragments requiring further surgical intervention and or larger than 4mm)

3.9 Analysis and Presentation

Data was entered into Microsoft Access Data. SPSS software was used for data analysis. Continuous variables were reported with the appropriate measures of central tendency and categorical variables presented as proportions/percentages.

3.10 Reporting

Results will be presented in a thesis as part of an MSc thesis at the University of Cape Town. It will be presented at local and international urology meetings and will be published in a peer- reviewed journal.

3.11 Insurance

No identifiable research-related risk of injury was in this study

3.12 Re-imbursement

Participants were not reimbursed for participation

3.13 Funding

This study was not funded. Sundry administrative expenses did not exceed R1000 and was borne by the investigators.

3.14 Ethical Consideration

Individual consent was not sought from patients. Data was anonymized and secured on a password protected computer. There was minimal risk to participation as data was collected and managed by investigators who are part of the usual care of the potential participants and as the data will be anonymized. Patients were not contacted for study purposes. Consent was sought from the relevant hospital authorities once ethics approval had been granted by the Surgical Division Research Ethics Committee and University of Cape Town Human Research Ethics Committee. The Human Research Ethics Committee approval number for this study was 109/2022.

4.0 CHAPTER FOUR: RESULTS

We retrospectively engaged in an analysis of the data of 30 patients (19 males and 11 females) between 1st February 2018 and 31st January 2022 who required management of retained ureteral stents. All the 30 patients had functioning kidneys after standard evaluation with non-contrast CT and scintigraphy in suspicious cases. The average age of the participants was 39.4 years with men being more affected than women. The range of the patients was 20-58 years.

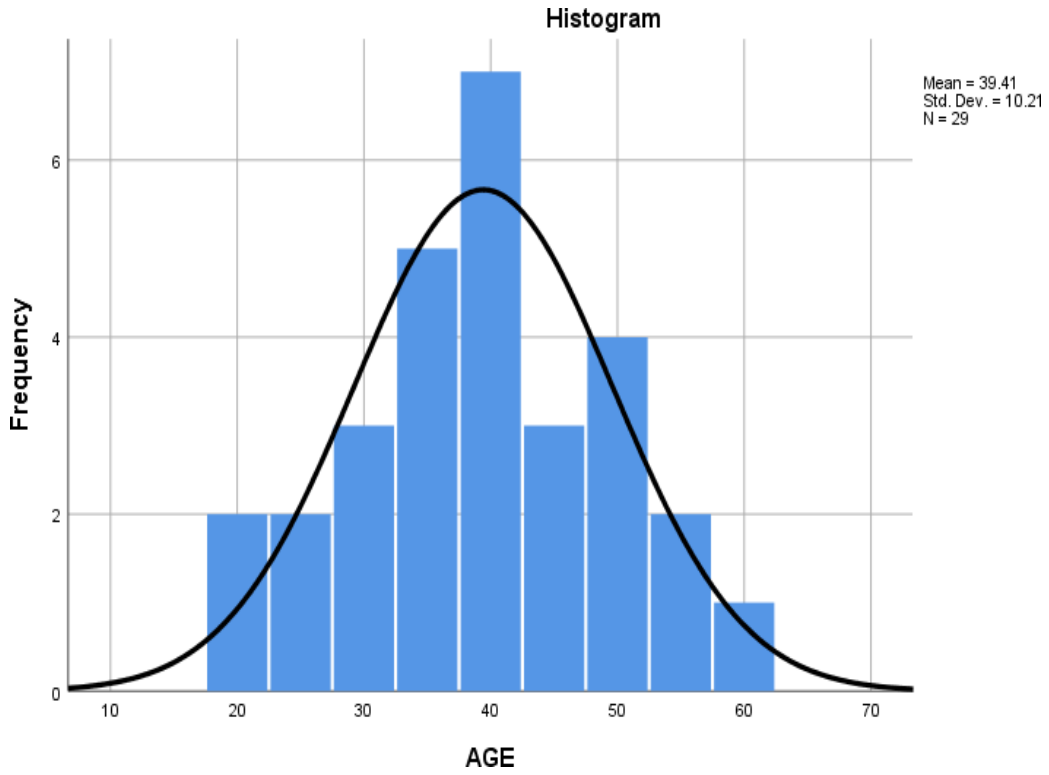

Figure 1:Histogram for Age distribution

The patient demographics, indications for primary stenting, FECal grade, laterality, indwelling time and type and number of procedures done to render the patient stent and stone free. 27 of the 30 patients had combined endourogical approaches except 3 patients who had open cystolithotomy to get rid of bladder stent encrustations. 90 % of the patients were done in 1 combined operative session.

Table 1:Demographic data

	FeCal classification			
	I	II	III	IV
Number of patients	9	0	3	17
Age (mean)	39.68	0	38.89	37.94
Gender (M:F)	7 (77.78%) : 2 (22.22%)	0	2 (66.67%) : 1 (33.33%)	10 (58.82%): 7 (41.18%)
Laterality				
Left	4 (44.44%)	0	3 (100%)	11 (64.71%)
Right	5 (55.56%)		0	6 (35.29%)
Indwelling time (months)	19.3	0	11.7	16
Reasons for stents				
Urolithiliasis/stone Obstruction	5 (55.56%)	0	2 (66.67%)	10 (58.82%)
Post-surgery endoscopic	4 (44.44%)		0	3 (17.65%)
Ureteric stricture	0		1 (33.33%)	4 (23.53%)
Procedures done				
URS+ RIRS	4 (44.44%)	0	2 (66.67%)	1 (5.88%)
PCNL= RIRS	0		1 (33.33%)	3 (17.65%)
PCNL+ URS +RIRS	0		0	0
CLT+ URS+ RIRS	5 (55.56%)		0	5 (29.41%)
CLT+PCNL+ RIRS	0		0	8 (47.06%)
CLT+URS+PCNL+RIRS	0		0	0

CLT= Cystolitholapaxy,

PCNL= Percutaneous nephrolithotomy,

URS= Ureterorenoscopy,

RIRS= Retrograde intrarenal surgery

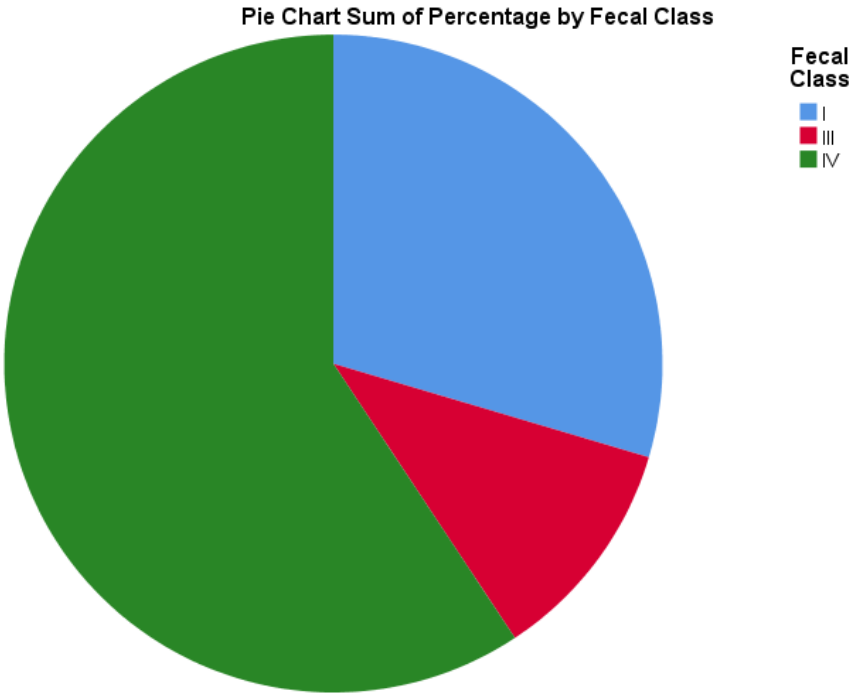

Figure 2:Fecal Class distribution

The team performed a total of 87 urological procedures in order to render all 30 patients, free of stents and stones. Average of 2.9 procedures were necessary, the records show, to make the patients stone and stent free. The range was 1-9 procedures per patient. The range of ureteral stent indwelling time was 4-70 months. 41% of the patients had PCNL while 48% (n=14) patients underwent cystolitholapaxy. PCNL was the most cited intervention for grades IV. PCNL was not offered to FECal grade I and II encrustations. URS laser lithotripsy and Electro kinetic lithotripsy (EKL) was commonly used for ureteral stent encrustations especially in groups with lower stone burden (grade I to III)/ RIRS was performed in all cases after stent and stone removal to check for clearance. In addition, radiography via Plain X-ray and CT scan in select cases to check for stone clearance. Majority of the patients (60%) with encrusted stents had a history of urolithiasis.

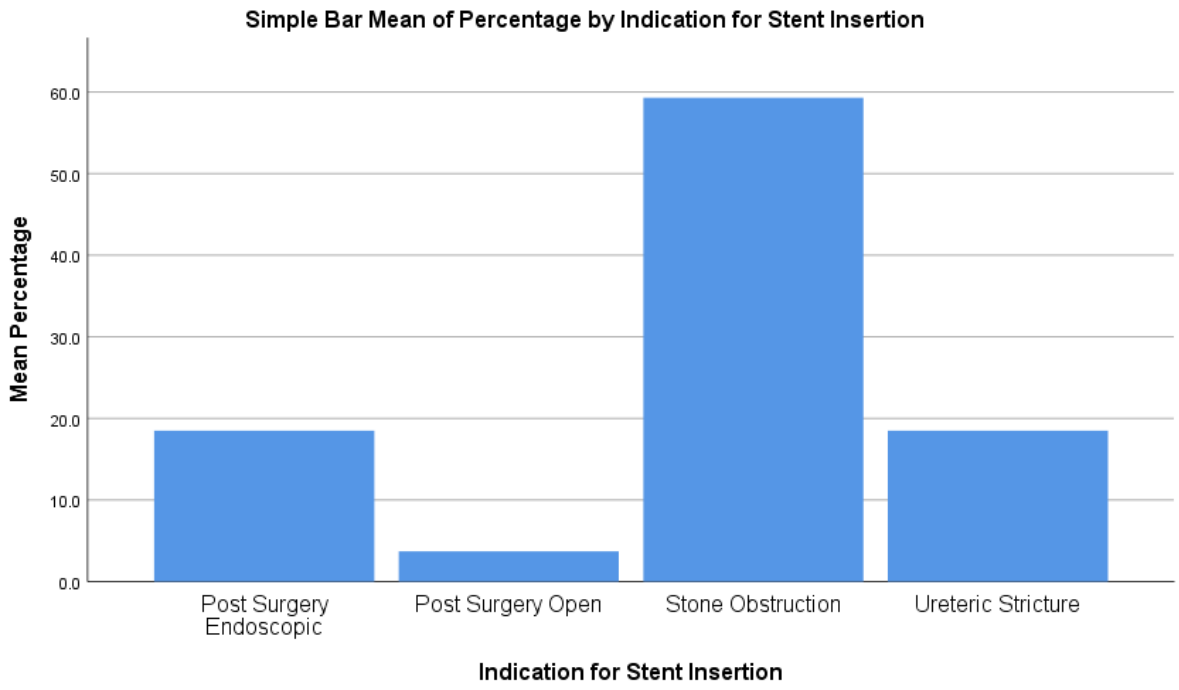

Figure 3:Bar Chart Indicating reasons for stenting

5.0 CHAPTER FIVE: DISCUSSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

The deployment of ureteral stents for the relieving of ureteral obstruction was first reported and recorded in 1967[19] Stent encrustation remains among the most serious/severe complications of double J ureteral stents. Stents play a pivotal role in managing various urological conditions, however, without timely change are prone to various complications such as hematuria, stent occlusion, migration, fragmentation, encrustation, urinary tract infection and renal impairment [57,58] . It has been shown that stent encrustation is directly correlated and related to the duration of indwelling time[19,59]. In our study, the verified mean indwelling time for a stent was approximately 20 months (80 weeks). These findings are comparable to 22.7 months reported by Monga et al [5] El Faqih et al showed that when stents stayed more than 12 weeks, they had more than 76.3% chance of encrustation[16].

Prolonged indwelling periods is the most critical factor for encrustation but other factors implicated are history of stone disease, pregnancy, urinary sepsis, chronic kidney disease and congenital or metabolic abnormalities [15, 60.] In our series, majority of the patients (60%) had a recorded history of stone disease as a risk factor for encrustation of the stent.

Some researchers have reported good success rates in managing stent encrustation by employing endourological procedures in a single setting[42, 50, 61] However, often more than one operative session is required to successfully make the subjects/patients stone and stent free. Only 2 patients required open cystolithotomy due to large bladder stone burden making endourological intervention unsuccessful. 3 patients required more than 1 operative session to render the patient stone and stent free.

In our hospital, patients with reduced glomerular filtration rate underwent a renogram to quantify renal function objectively. It is prudent to offer and administer nephrectomy instead of performing multiple procedures and processes to remove all stones in a non-functional kidney [20].

In our hospital, retrograde removal of stent is attempted under fluoroscopy guidance if a lack of encrustation is seen on plain radiography. If resistance is encountered ad there is failure of proximal curl to uncoil, ureteroscopy is done after insertion of two guidewires, leaving one in place as a safety guidewire. Bladder encrustations are tackled first with cystolithopaxy. Ureteric encrustations in our series were dealt with by electrokinetic lithotripsy or laser lithotripsy. Proximal encrustations were managed by laser lithotripsy and PCNL for larger stone burdens.

Solving the ureteric and bladder components of stent encrustations always preceded PCNL. PCNL was done via the Galdakao-Valdivia supine position after ultrasound guided puncture. The main advantage of this position is ability to address both encrustations in the proximal and distal ends concomitantly[17] additionally, the anesthetist has better control of the airway and the surgeon is able to operate while sitting. This technique is similar to the most voluminous experience by a single surgeon as described by Roberto Iglesias et al who managed 50 patients in a single session combined endourological approach [62]. All the procedures were conducted in the absence intraoperative complications and there did not appear to be significant post op complications.

The FECal classification system, created and developed by Acosta-Miranda et al, despite being limited by a small size during its development of 9 patients is simple to utilize and it incorporates stone location and size[34].

In our series, we make use of a recorded average of 2.9 urologic procedures for every subject/ patient to render our subjects/patients stone and stent free. This average is similar with the results reported in other studies of 2.7 and 2.28 procedures to remove stents and clear associated stones[22, 29]

5.2 Conclusion

Forgotten/ retained stents pose a real management challenge often requiring multiple staged endourological procedures to render the patient stone and stent free. This retrospective series showed that it is feasible to combine endourological methods in one sitting to leave the patient stone and stent free. We found the FECal classification to be essential in surgical decision making.

5.3 Recommendations

Patients with retained ureteral stents can be rendered stent and stone free in a single combined endourological sitting whenever possible, endourological techniques should be attempted instead of open surgery This study can be replicated in other centers to manage similar complications.

5.4 Limitations

This was a retrospective folder review study hence inability to get some information from patients and occasionally missing data that could not be captured in the data collection tool.

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APPENDIX

Appendix I: Data Sheet

Participant number	
Date of birth	
Gender	Male Female
Indication for stent insertion	Renal stone-obstruction Renal stone-pre scope post-surgery-endoscopic post-surgery-open Ureteric stricture Other: (define)
Stent dwell time (in months)	
Laterality of stent	Left Right
Weight (in kilograms)	
Height (in meters)	
Co-morbidities	Hypertension Diabetes Cardiac disease Other: (define)
ASA	
(FeCal) classification	I II III IV V
#procedures to stent removal	
#procedures to stone free	