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URETERAL STENTING AND URINARY STONE MANAGEMENT:A SYSTEMATIC REVIEW

Rizkia Amal Ramadhani
Banyumanik1General Hospital, Semarang, Indonesia
Corresponding Author *:*
ramadhani613@gmail.com

ABSTRACT

Introduction:*Urolithiasis is a burdensome condition impacting healthcare systems, has seen transformative advancements in ureteroscopy with smaller instruments and laser lithotripsy. While ureteric stenting after ureteroscopy lithotripsy is widely practiced, its necessity in uncomplicated cases remains controversial, with potential complications necessitating further comparative studies for conclusive recommendations.*
Method: *This study followed the 2020 PRISMA guidelines to ensure research alignment with necessary standards for accuracy. Articles were retrieved from databases including PubMed database in November 2023.*
Result: *The search strategy produced a total of 9 results. Upon reviewing the titles and abstracts, we identified 8 papers that met the criteria for inclusion. Initially, 8 articles were excluded from consideration as they were written in a review format. After a thorough evaluation of the full-text papers, we ultimately included five papers in the final analysis, consisting of prospective observational analysis, retrospective studies, and a randomized control trial.*
Conclusion:*Ureteral stents, crucial in urolithiasis treatment, present challenges due to patient discomfort and limited adoption of symptom-reducing strategies, hindered by knowledge gaps and the absence of well-powered trials. Postoperatively, unstented approaches are favored, and the double pigtail stent with an extraction string outperforms standalone stents, offering prompt relief and avoiding additional procedures. In the context of retrograde intrarenal surgery (RIRS) with a ureteral access sheath (UAS), routine preoperative stenting is unnecessary, with no significant impact on stone-free rates (SFR) or complications. Research into an ideal ureteral stent and the resolution of preoperative hydronephrosis after ureteroscopy continues.*

Keywords: *ureteral access sheath, ureteral stents, urinary stone, urolithiasis, stone-free rates*

INTRODUCTION

Urolithiasis poses a significant burden on healthcare systems, both clinically and economically. It is a prevalent condition with a high recurrence rate, adversely affecting the quality of life. The rising incidence and prevalence of stone disease are attributed to changes in nutritional and environmental factors. Over the past decade, advancements in instruments, such as smaller calibre semirigid and flexible ureteroscopes, along with intracorporeal lithotripsy using laser energy, have revolutionized the surgical management of ureteric stones. These improvements have transformed ureteroscopy into an outpatient procedure, making it less traumatic, safer, and more effective for treating stones throughout the ureter.[1,2]

The common practice of inserting a ureteric stent after ureteroscopic lithotripsy (URSL) is widely accepted, especially for patients who are pregnant, have a solitary kidney, a transplanted kidney, or renal impairment. While ureteric stenting is deemed necessary in complex ureteroscopies involving bleeding, ureteric trauma, or a large residual stone burden, there is no consensus on whether a ureteric stent is required after uncomplicated ureteroscopy for stone retrieval. The definition of uncomplicated URSL remains controversial. Despite this controversy, many urologists routinely insert ureteric stents, citing potential benefits such as promoting the passage of residual stone fragments, reducing the risk of stricture formation, preventing ureteric obstruction, and minimizing renal colic due to ureteric edema following stone retrieval.[1,3]

However, the insertion of a ureteric stent after ureteroscopy carries potential morbidity, including pain, infection, and irritative voiding symptoms. Serious complications such as upward stent migration, sepsis, 'forgotten stents,' or encrustation with stone formation may also occur, increasing both morbidity and costs. The use of a double pigtail ureteric stent with an extraction string attached has been suggested to reduce the frequency and severity of these complications, allowing for fast and non-invasive stent removal. Randomized prospective trials have indicated that routine stenting after uncomplicated ureteroscopy may not be necessary and could be associated with higher morbidity.[3,4,5]

Unfortunately, there is a lack of comparative studies between approaches. Furthermore, the lack of consensus on the definition of uncomplicated URSL in these studies leads to heterogeneous patient groups, making it challenging to draw definitive conclusions. In this review, we systematically evaluate the current studies regarding urethral stenting in urinary stone management.

METHODS

Protocol

By adhering to the guidelines outlined in the 2020 Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA), researcher of this study ensured its alignment with the necessary standards. This was carried out to guarantee the accuracy of the conclusions drawn from the investigation

Criteria for Eligibility

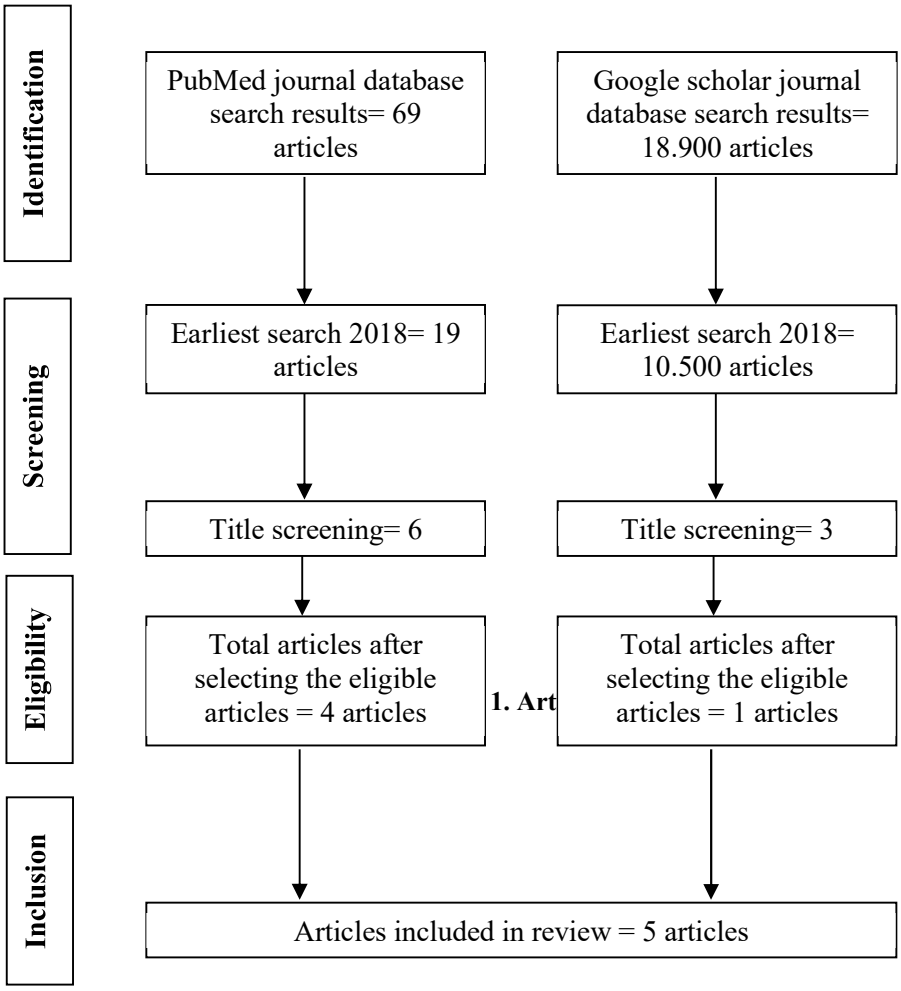
To be included in the research, published articles had to meet specific criteria. They had to be research papers written in English that specifically addressed urethral stenting in urinary stone management. The studies had to adhere to the following conditions: the research papers needed to have been published after 2018 but within the relevant timeframe for this systematic review. Articles falling into categories such as editorials, lacking a DOI, review articles that had already been published, or those duplicating previously published journal papers were excluded from consideration.

Search Strategy

We conducted a comprehensive literature search using PubMed and Google Scholar, focusing on studies published from 2018 to 2023. The search terms employed were as follows: ("urethra"[MeSH Terms] OR "urethra"[All Fields] OR "urethral"[All Fields] OR "urethrally"[All Fields] OR "urethritis"[MeSH Terms] OR "urethritis"[All Fields] OR "urethritides"[All Fields]) AND ("stent s"[All Fields] OR "stentings"[All Fields] OR "stents"[MeSH Terms] OR "stents"[All Fields] OR "stent"[All Fields] OR "stented"[All Fields] OR "stenting"[All Fields]) AND ("urinary calculi"[MeSH Terms] OR ("urinary"[All Fields] AND "calculi"[All Fields]) OR "urinary calculi"[All Fields] OR ("urinary"[All Fields] AND "stone"[All Fields]) OR "urinary stone"[All Fields]) AND ("urolithiasis"[MeSH Terms] OR "urolithiasis"[All Fields]). Additionally, we cross-referenced relevant articles to identify any additional studies. The evaluation of study quality, design, interventions, and results was carried out independently by researchers, with any discrepancies resolved through discussion and consensus. Additionally, both researchers extracted and compared results from all studies, with the potential for a meta-analysis if deemed feasible.

Inclusion and exclusion criteria

The study's inclusion criteria were: 1) Randomized Controlled Trials (RCTs), analytical studies, and case control studies 2) interventions explicitly focusing on urethral stenting in urinary stone management, as defined by the original study authors and confirmed during our review, 3) inclusion of individuals with urinary stone undergoing urethral stenting treatment, 4) provision of sufficient data for outcome evaluation and assessment of study quality, and 5) publication in English. Exclusion criteria comprised: 1) Studies that were not randomized or controlled, 2) studies involving participants without urolithiasis, and 3) studies lacking adequate data to assess changes among patients with urethral stone or urolithiasis.


Identification
Screening
Eligibility
Inclusion
PubMed journal database search results= 69 articles
Google scholar journal database search results= 18.900 articles
Earliest search 2018= 19 articles
Earliest search 2018= 10.500 articles
Title screening= 6
Title screening= 3
Total articles after selecting the eligible articles = 4 articles
Total articles after selecting the eligible articles = 1 articles
Articles included in review = 5 articles

1. Art

Data retrieval

The authors conducted a rigorous review of relevant studies, selecting those meeting specific criteria for inclusion. They focused on English-language, original, and unpublished papers, ensuring a narrowed, high-quality selection. The findings were analysed for key information, including study details, authors, dates, locations, and methodologies, aligning with the study's objectives.

Author	Origin	Method	Sample Size	Result
Al Demour et al., 2020.[6]	Jordan	Randomized controlled trial.	105 patients underwent uncomplicated URSL for ureteric stones.	The mean (SD) operative time was significantly greater in groups 1 and 2 in comparison to Group 3, measuring 22.2 (9.1), 20.2 (6), and 15.1 (7.1) minutes, respectively ($P < 0.001$). Throughout all follow-up time points, the VAS scores for flank pain, dysuria, urgency, frequency, hematuria, and suprapubic pain exhibited a noteworthy difference, consistently higher in groups 1 and 2 than in Group 3 (all $P < 0.001$). Further analysis revealed similar measured outcomes and analgesia requirements for groups 1 and 2, except at week 1 and 1 month, where Group 2 patients experienced fewer symptoms ($P < 0.001$).
Jeong et al., 2023.[7]	Yongin, Korea	Retrospective study	260 patients included in this study.	Out of the 260 patients included in this study, 106 did not undergo preoperative stenting (stentless group), while 154 had stenting (stenting group). Except for the presence of hydronephrosis and stone composition, patient characteristics were not statistically different between the two groups. Regarding surgical outcomes, the stone-free rate did not show a statistical difference between the groups ($p = 0.901$). However, the operation time for the stenting group was longer than that of the stentless group (44.8 24.2 vs. 36.1 17.6 minutes; $p = 0.001$). There were no discrepancies in the complication rate between the two groups ($p = 0.523$).
Yoshida, et al. 2021.[8]	Japan	Prospective, randomized, single-blinded (for participants), multicenter trial.	84 patients were randomly assigned to two ureteral stent placement groups (ITT population) from July 2019 to November 2019.	In the analysis of 82 patients, encrustation in the inner lumen of the stent was observed in 75 individuals (91.5%). The median volume of inner encrustation did not significantly differ between the Tria and Polaris Ultra stents (0.56 vs. 0.37 mm3, $P = 0.183$). No disparities were noted in the encrustation volume on the outer/total surfaces or in stent-related adverse events. Both ureteral stents exhibited notable inner luminal encrustation in the shaft body compared to the proximal or distal loop (all, $P < 0.05$). Encrustation formation was associated with dyslipidemia ($P = 0.027$), elevated urine pH ($P = 0.046$), and crystalluria ($P = 0.010$).
Widyokirono, et al., 2021.[9]	Indonesia	Prospective observational study using secondary data.	130 ureteral stone patients undergoing URS lithotripsy [99 patients (76.2%) with stent placement and 31 patients (23.8%) without stent].	The primary reason for ureteral stent placement post-URS lithotripsy was ureteral lesions, constituting 28.3%. The most prevalent discomforts included dysuria in 18 patients (18.2%), followed by frequency in eight patients (8.1%) and low back pain in six patients (6.1%). Effective treatment was achieved for all symptoms through oral medications. Hydronephrosis, present in 91.1% of pre-operative cases, showed significant resolution after stent placement, contrasting with 62.5% resolution in patients without stent placement ($p=0.027$).

Hee Sung et al., 2019.[11]	Korea	Retrospective study	122 patients for RIRS procedure.	RIRS was conducted on 122 patients, with 73 having preoperative ureteral stents, while 49 did not. The median stone size was 14.5 mm, and the overall stone-free rate (SFR) was 87.7%. Patients who underwent preoperative stenting had a relatively higher preoperative estimated glomerular filtration rate (eGFR) compared to those without stents (68.18 vs. 79.01 mL/min/1.73 m2, P=0.042). Preoperative stenting contributed to an improved success rate of ureteral access sheath (UAS) insertion during surgery (97.3% vs. 87.8%, P=0.038). Analysis before and after propensity score matching revealed a significant difference in operation time for stones smaller than 1 cm (P=0.019 and P=0.004). However, there were no significant differences in operation time, postoperative urinary tract infection rate, additional treatment rate, or SFR.

RESULT

The search strategy produced a total of 9 results. Upon reviewing the titles and abstracts, we identified 8 papers that met the criteria for inclusion. Initially, 8 articles were excluded from consideration as they were written in a review format. After a thorough evaluation of the full-text papers, we ultimately included five papers in the final analysis, consisting of prospective observational analysis, retrospective studies, and a randomized control trial.

A total of 123 patients were initially included in the randomized controlled trial conducted by Al Demour. After undergoing URSL, 18 patients were excluded due to reasons such as mucosal injury, impacted stones, access failure, or stone migration. Group 1 (34 patients) with a double pigtail ureteric stent, Group 2 (35 patients) with a double pigtail ureteric stent with extraction string, and Group 3 (36 patients) with no ureteric stent placed after the procedure. The patients in the three study groups exhibited comparable characteristics and stone retrieval methods. The mean operating time differed significantly among the groups ($P < 0.001$). All patients were discharged two days post-procedure. Two patients from Group 3 required re-hospitalization three days after discharge due to severe flank pain and elevated serum creatinine; they were conservatively managed with antibiotics and analgesia. The stone-free rate was 100% for all groups at 3 months, and no cases of hydronephrosis were observed during follow-up.[6]

Results of the VAS pain score for flank pain and dysuria showed a significant difference at all follow-up time-points, with higher mean VAS scores in groups 1 and 2 compared to Group 3. Further analysis revealed similar scores between groups 1 and 2, except for less pain and dysuria in Group 2 at 1 week and 1 month compared to Group 1. [6]

Lower urinary tract symptoms (LUTS), including urgency, frequency, hematuria, and suprapubic pain, were less frequent in Group 3 compared to groups 1 and 2. Additionally, these symptoms were significantly less frequent in Group 2 at 1 week and 1 month compared to Group 1. There were statistically significant differences in the need for analgesia at all follow-up time-points, with groups 1 and 2 requiring more analgesia than patients in Group 3. Within 7 days post-procedure, 91.7% of patients in Group 1, 94.3% in Group 2, and 97.2% in Group 3 returned to normal physical activity. Within 1 month, all 105 patients resumed normal physical activity.[6]

A retrospective study by Jeong et al comprised 260 patients undergoing unilateral RIRS for intrarenal stones. The patients were divided into two groups: the stentless group, consisting of 106 patients without preoperative stent insertion before RIRS, and the stenting group, comprising 154 patients with preoperative ureteral stent insertion. In terms of patient and stone characteristics, there were no statistically significant differences between the two groups, except for the presence of hydronephrosis and stone composition group ($p = 0.015$ and $p = 0.025$, respectively). The prevalence of hydronephrosis on preoperative CT scans was higher in the stenting group than in the stentless group (62.3% vs. 46.2%). Although calcium oxalate stones were the most common in both groups, uric acid stones were more frequent in the stenting group than in the stentless group (28.6% vs. 15.1%).[7]

Concerning surgical outcomes, the operation time was longer for the stenting group than for the stentless group (44.8 24.2 vs. 36.1 17.6, $p = 0.001$). However, there were no statistically significant differences in the stone-free rate (SFR) and postoperative complications between the two groups ($p = 0.901$ and $p = 0.523$, respectively). [7]

In the complication category, two patients in each group experienced postoperative sepsis requiring inotropes, which improved with continued IV antibiotics. Additionally, two patients in the stenting group required postoperative blood

transfusion. A Clavien–Dindo grade 3a patient in the stentless group underwent a postoperative cystoscopic ureteral stent exchange under local anesthesia due to severe pain. [7]

Univariate logistic regression models identified a shorter mean stone length (MSL) and lower modified Seoul National University Renal Stone Complexity (mS-ReSC) score as statistically significant factors affecting the SFR ($p < 0.001$ for both groups). Multivariate analysis corroborated a shorter MSL ($p = 0.006$) and lower mS-ReSC score ($p < 0.001$) as independent significant factors for the SFR. [7]

A total 84 patients were randomly assigned to two ureteral stent placement groups (ITT population) between July 2019 and November 2019 in Yoshida et al prospective randomized trial. In the Polaris Ultra group, one patient did not undergo URS due to drug-induced anaphylaxis, and one was excluded from the final analysis because his ureteral stent was accidentally discarded before imaging evaluation. Finally, 82 patients were analyzed as a modified ITT population (Tria group, n = 41; Polaris Ultra group, n = 41). All clinical variables were well-balanced between the two groups (all $P > 0.05$), including bacteriuria and positive urinary culture ($P = 1.00$ and 0.239, respectively). [8]

Intra- and postoperative clinical data revealed no significant differences between the two groups in stone-free status, degree of hydronephrosis, incidence of specific stent-related complications, calls or visits to the medical centers, or duration of stent placement (all $P > 0.05$). The distribution of stone components was also similar between the two groups ($P = 0.51$). [8]

Encrustation evaluated by micro-CT, showing no statistical difference in the inner luminal volume between the Tria and Polaris Ultra groups (0.56 vs. 0.37 mm3, $P = 0.183$). Additionally, there were no significant differences in the outer/total surfaces and segmental encrustation volume in each stent portion between the two groups (all $P > 0.05$). [8]

The encrustation in the inner lumen was observed in 75 (91.5%) patients (Tria: n = 38, Polaris Ultra: n = 37), while outer surface encrustation was seen in only 5 (6.1%) patients (Tria: n = 3, Polaris Ultra: n = 2). Regarding the relative abundance rate of encrustation in the inner and total stent, the shaft body had a higher rate than the distal loop in the Tria group ($P = 0.010$ and $P = 0.023$, respectively), and the shaft body had higher rates compared to the proximal and distal loops in the Polaris Ultra group (inner: $P = 0.006$ and $P = 0.009$, respectively; and total: $P = 0.003$ and $P = 0.031$, respectively). Although statistical analysis could not be performed due to the small sample size with encrustation, outer stent encrustation tended to occur in the distal loop in both groups. [8]

Associated factors with encrustation formation were explored in post hoc analyses. Univariate analysis indicated that patients with higher encrustation were more likely to have dyslipidemia ($P = 0.040$) and the presence of urine crystals ($P = 0.048$). After adjusting for age, sex, and statistically relevant factors (P-value of < 0.1 in the univariate analysis), dyslipidemia ($P = 0.027$), higher urine pH ($P = 0.046$), and crystalluria ($P = 0.010$) were identified as independent risk factors for encrustation. [8]

Prospective study Widyokirono involved 130 patients with ureteric stones who underwent URS lithotripsy. Among those who used stents after URS, 85.9% were above 40 years old, with a mean age of 51.12 years. In the patient group with a BMI <25 kg/m2, 29.3% used stents, while 51.6% did not. A significant difference in patient BMI among stent users was observed ($p=0.039$). Of the patients, 47.5% with stones in the proximal ureter, 14.1% with stones in the middle ureter, and 38.4% with stones in the distal ureter underwent stent insertion post-URS. However, stone location did not significantly correlate with stent placement post-URS ($p=0.760$). Stent placement was observed in 68.7% of patients with one stone and 15.2% with more than one stone, with no significant relationship found between the number of stones and stent placement post-URS ($p=0.351$). Regarding stone size, 61.6% had ureteral stones less than 1 cm, 23.2% had stones of 1-2 cm, and 12.1% had stones larger than 2 cm. The analysis revealed a significant effect of stone size on stent placement after URS ($p=0.021$). Preoperative hydronephrosis was present in 53 patients, with 45 undergoing stent insertion.[9] 13 out of 130 patients (13.1%) experiencing intraoperative complications and undergoing stent placement. A significant difference in complications during surgery was observed between the stent and non-stent groups ($p=0.037$). Patients with stent insertion had a longer duration of surgery, with a statistically significant difference compared to the group without stents ($p=0.001$). All patients with remaining stones and retropulsion of stones during the URS procedure had stent insertion. The stone-free rate was 84.8% in the stent group and 100% in the non-stent group, showing a significant difference between the two groups ($p=0.022$).[9]

The main indications for stent placement were ureteral lesions in 28 patients (28.3%) and impacted stones in 20 patients (20.2%). Postoperative complications were significantly different between the stent and non-stent groups ($p=0.016$). Dysuria was the most frequent symptom in patients with stent insertion (18 patients), while 4 patients without stents reported major complaints of low back pain. After URS, 91.1% of patients with stents had resolved hydronephrosis compared to 62.5% without stents ($p=0.027$). However, stent placement significantly affected the incidence of postoperative hydronephrosis in patients with preoperative hydronephrosis. All patients used a 6 French stent, with 91.9% having a stent indwelling time of less than 90 days and 8.1% having a stent indwelling time of more than 90 days. After stent placement, 41 patients (91.1%) had their hydronephrosis significantly resolved compared with 5 (62.5%) patients without stent placement ($p=0.027$).[9]

A total of 122 patients were examined in retrospective study conducted by Hee Sung et al. with 49 in the nonstented group and 73 in the prestented group. The mean age for patients was 54.6±14.6 years in the non-stented group and 56.7±14.0 years in the prestented group. There were no significant differences in age (P=0.440), gender (P=0.579), diabetes mellitus (P=0.914), hypertension (P=0.239), cardiovascular disease (P=0.707), cerebrovascular event (P=0.348), preoperative Cr level (P=0.966), or preoperative hemoglobin level (P=0.570) between the two groups. However, the eGFR value in the non-stented group was significantly lower than that in the prestented group (68.18±32.87 vs. 79.01±25.12, P=0.042). In the prestented group, the mean Cr level was 1.4 mg/dL, and the mean eGFR was 55.31 mL/min/1.73 m² at the time of preoperative ureteral stent indwelling.[10]

There were no significant differences in stone characteristics such as laterality (P=0.461), density (P=0.262), size (P=0.662), number (P=0.206), or accompanied hydronephrosis (P=0.424) between the two groups. Intraoperative ureter injury and bleeding were not associated with preoperative ureteral stent indwelling (P=0.151). In the prestented group, there were 4 (5.5%) intraoperative complications, including one intrarenal bleeding and three ureteral injuries. For the intrarenal bleeding case, intraoperative transfusion was performed, but no additional procedures such as embolization were required. Postoperative UTI occurred in 3 (6.1%) cases in the nonstented group and in six cases (8.2%) in the prestented group (P=0.664). All eight cases of postoperative UTI were treated with antibiotics, and one case required intensive care unit treatment. [10]

There was no significant difference in intraoperative ureter injury and bleeding (P=0.151 and 0.411), postoperative UTI (P=0.664), stone-free rate (P=0.700), clinically significant stone-free rate <4 mm (P=0.827), operative time (P=0.664), additional treatment (P=0.991), hospitalization period (P=0.678), or postoperative period with a stent (P=0.471) between the two groups. After propensity score matching, there were no significant differences in intraoperative and postoperative complications between the two groups. However, a significant difference in the success rate of UAS insertion according to the presence of preoperative ureter stent insertion was observed. The success rate of UAS insertion was 87.8% in the non-stented group and 97.3% in the prestented group (P=0.038). This difference was also observed after propensity score matching (P=0.035). [10]

Perioperative complications did not significantly differ between the two groups. Operation time was 65.2±46.4 minutes in the prestented group and 68.8±40.8 minutes in the non-stented group, showing no significant difference. The stone size was categorized into 1 cm intervals. For patients in the prestented group with a stone size of 1 cm or less, the operation time was significantly shorter (40.3±23.3 minutes) compared with patients in the nonstented group (48.6±24.5 minutes). However, there was no significant difference in operative time between the two groups with a stone size of more than 1 cm. Even after correcting for age, BMI, sex, Cr level, eGFR, hydronephrosis, and stone characteristics through propensity matching, the operation time in patients with a stone size of more than 1 cm was shorter in the pre-stented group compared with the non-pre-stented group. [10]

DISCUSSION

Ureteric stent placement post-URSL is a common practice, traditionally advocated to prevent morbidity. However, its necessity remains controversial, leading to the use of stents with extraction strings to mitigate complications and reduce overall procedural costs. Comparative studies on stent, no stent, and stent with extraction string in uncomplicated URSL are lacking, and this study compared cases.

In Al Demour prospective, randomized controlled study, Group 3 exhibited the lowest flank pain and dysuria scores at all time-points, with pain scores for Group 2 becoming comparable to Group 3 by the end of the first week. Dysuria scores for Group 2 significantly dropped compared to Group 1 by the end of the first week and remained lower at 1 month. Group 3 consistently reported fewer urgency, frequency, suprapubic pain, and haematuria symptoms, with a significant drop in LUTS after stent removal.[6] Patients in Group 3 required less analgesia, and Group 2 showed a sharp decline in analgesia requirements after stent removal. The study found no residual stones at 3 months, indicating a 100% success rate for URSL in all groups. The unstented approach had the advantage of faster operating time (mean 15.1 min), while the stent with an extraction string group had faster total operating times and lower costs, despite a higher readmission rate. Despite limitations, such as the lack of standardized pain assessment methods and potential biases in determining stone-free status, our real-life patient data provide valuable insights for urologists in decision-making and patient counseling. [6]

A ureteral stent is commonly used to maintain urine drainage in obstructive uropathy, consisting of a flexible tube with side openings inserted into the ureter. The stent induces reversible ureteral dilation, possibly due to physiologic relaxation, cytotoxic effects, or an inflammatory response. While studies suggest benefits of preoperative stenting for retrograde intrarenal surgery (RIRS), our analysis found no statistical difference in stone-free rate (SFR) or postoperative complications. The study focused on unilateral RIRS using the same ureteral access sheath, addressing potential confounders.[7]

Contrary to studies favoring preoperative stenting, our results suggest that stone characteristics, not preoperative stenting, influence SFR. Logistic regression modeling revealed no independent predictive power of preoperative stenting for SFR. Operative time was longer in the stenting group, consistent with some studies, but conflicting with others. The study

considered factors such as stone composition, scope movement, and hydronephrosis, aiming to reduce bias. The retrospective nature and non-randomized stent insertion are acknowledged limitations. [7]

The study data spanned from January 2016 to May 2019, and our institution gradually reduced preoperative stenting due to increased experience and recommendations to limit stent dwell time. Despite limitations, the study aimed to provide nuanced insights into preoperative ureteral stenting, emphasizing the need for a well-designed randomized controlled trial to address existing gaps and validate findings. [7]

Despite advancements in the design and technology of ureteral stents, their actual functions and efficacy in preventing encrustation remain unclear in clinical settings. While hydrophilic gel coatings, such as Hydroplus on the Polaris Ultra stent, are commonly used to prevent encrustation, the Tria ureteral stent employs PercuShield technology, featuring a nonionic, super-smooth, hydrophobic inner lumen and outer surface to reduce urine crystal adhesion. Bench-top tests suggested a significant reduction in encrustation for Tria compared to a competitor stent in artificial sterile and infected urine. However, clinical results with a 2-week indwelling time showed Tria to be comparable to Polaris Ultra in encrustation reduction, contrary to in vitro findings. Possible explanations include differences in the stent environment, concentration of minerals, urine flow dynamics, and bacterial types.[8]

Encrustation was predominantly seen in the inner lumen, with contact during stent removal potentially associated with outer surface reduction. Thus, using inner encrustation volume as a primary endpoint in short-term clinical trials may be reasonable. Key risk factors for encrustation include stent indwelling time, bacterial biofilm, elevated urinary pH, and patient-specific factors. Higher urine pH, crystalluria, and dyslipidemia were identified as independent factors for encrustation formation in this study. The absence of significant bacteriuria and positive urinary culture may be attributed to intra- and post-operative antibiotics restricting bacterial biofilm formation. Encrustation-related complications should consider these risk factors in clinical decision-making, guiding patients who should avoid stent placement or have a shortened indwelling time. [8]

Study limitations include the potential for technique bias in surgery, lack of evaluation of 24-hour urine compositions, and the trial not being powered for encrustation-related complications as an endpoint. Additionally, ureteral stent discoloration was not evaluated due to findings suggesting it doesn't increase encrustation levels. [8]

This study included 130 patients with ureteric stones who underwent URS at Dr. Soetomo Hospital, Surabaya, between 2018 and 2019. Of these, 76.2% had stents post-URS, and 23.8% did not. Most patients with post-URS stents were over 40 years old (85.9%). Age and gender did not significantly differ between those with and without post-URS stents, aligning with findings in previous studies. [9]

Factors influencing URS success and post-URS stent necessity include gender, age, BMI, congenital disorders, solitary kidney, previous stone surgery, anticoagulant use, stone location, stone number, and hydronephrosis. Solitary kidney, anticoagulant use, and preoperative double-J stent were associated with a lower likelihood of postoperative double-J stent placement. Operative duration, calculated from ureteral opening to stone removal, significantly increased when stent insertion was performed, in contrast to some previous studies. Stent placement indications included ureteral lesions, with dysuria and frequency being common complications. Complication rates did not significantly differ between stent and non-stent groups, consistent with several randomized trials. However, caring for patients with stents incurred higher costs.[9]

Among patients with stents, 8.1% had indwelling times exceeding 90 days, associated with increased morbidity due to encrustation, urinary infection, secondary stone formation, obstruction, and hematuria. Forgotten stents can lead to upper tract obstruction, fragmentation, and encrustation, emphasizing the importance of urine acidification. Stent placement significantly increased the resolution of hydronephrosis, potentially reducing the risk of urethral stricture, edema, or mucosal inflammation.[9]

Flexible RIRS, introduced by Bagley et al. in 1987, has evolved with advancements in optical technology and surgical methods. The use of UAS in RIRS facilitates quick and repeated access to the ureter and kidney, preventing pyelovenous backflow and reducing renal pressure, thereby minimizing renal injury and improving visibility. However, UAS insertion can fail due to narrow ureter dimensions. In this study, the prestented group demonstrated a significantly higher success rate of UAS insertion (97.3%) compared to the non-stented group (87.8%).[10]

Preoperative ureteral stenting significantly reduced the operation time for patients with stones ≤1 cm. The prestented ureteral stent contributed to ureteropelvic junction extension and ureter dilation, facilitating easier access, basket stone retrieval, and a clearer view. For stones <1 cm, fragmentation was performed in larger pieces, affecting the operation time positively. A significant difference in preoperative eGFR was observed, suggesting that the ureteral stent might alleviate obstruction caused by renal and upper ureter stones.[10] While this study has limitations, such as its retrospective nature and potential selection bias, the results highlight the positive impact of preoperative ureteral stenting on UAS insertion success, operation time, and renal function.

CONCLUSION

In conclusion, ureteral stents play a vital role in the treatment of urolithiasis, yet they can lead to significant patient discomfort. Despite advancements and evidence supporting strategies to mitigate stent-related symptoms, widespread adoption remains a challenge, partly due to knowledge gaps and a lack of well-powered, prospective randomized controlled trials (RCTs). Ongoing research into biomaterials, coatings, and designs seeks to develop an ideal stent, with the goal of reducing symptoms over time.

For postoperative management, the unstented approach results in a smoother course, and stent placement is deemed unnecessary in procedures considered uncomplicated by operating urologists. The double pigtail ureteric stent with an extraction string offers advantages over the stent alone, including earlier relief of symptoms, less analgesia requirements, and avoidance of a second procedure for stent removal. In the context of retrograde intrarenal surgery (RIRS) with a ureteral access sheath (UAS), preoperative ureteral stenting did not significantly impact stone-free rates (SFR) or complication rates compared to unstented cases. Routine preoperative stenting in RIRS is deemed unnecessary unless there is a specific need to address obstructive uropathy or renal colic.

A randomized controlled trial demonstrated similar efficacy between the Tria and Polaris Ultra ureteral stents in preventing encrustation in the short term. Further research is needed to develop an ideal ureteral stent through a deeper understanding of encrustation pathophysiology and high-quality comparative studies. Additionally, preoperative ureteral stenting was found to significantly resolve preoperative hydronephrosis after ureteroscopy (URS) lithotripsy in patients with ureteral stones.

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