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ABSTRACT

EXPLORING EFFICACY OF INFANT FEEDING TUBE AS A LOW COST ALTERNATIVE TO STENTING IN LOWER URETERIC STONE MANAGEMENT

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Introduction. Routine DJ stenting following URSL (Ureteroscopic Lithotripsy) is associated with irritative voiding symptoms, pain, UTI and requires additional hospital visit for stent removal. Externally draining ureteric catheters and stents with strings for easy self-removal have been used to overcome these drawbacks, but a cost effective and practical solution is yet to be found. Aim of this study is to evaluate the efficacy of placing an infant feeding tube (IFT) in lower ureter for 24 hours following URSL for lower ureteric stones in overcoming the stent related morbidity and avoiding a subsequent cystoscopy for stent removal.

Methods. A prospective randomised study was conducted wherein 110 patients undergoing URSL for lower ureteric stones were randomised into 2 equal groups such that routine DJ (Double J) stenting using a 5Fr 26 cm DJ stent was done in group 1 and a 5Fr infant feeding tube mounted on a 0.032 inch guidewire was placed in the lower ureter and drained externally in the remaining 55 patients.

Results. The average stone size in the DJ stent vs IFT group was 7.6 mm and 8.2 mm. Patients in the DJ stent group had a higher analgesic requirement (30% vs 23.6%). Irritative voiding symptoms 35 (63.6%) vs 4 (7.2%) [P=0.000]; hematuria 6 (10.9%) vs 1 (1.81%) [P=0.012] and fever 11 (20%) vs 4 (7.2%) [P=0.0047] were all significantly less in the IFT group.

Conclusions. Use of infant feeding tube to drain the lower ureter will significantly reduce irritative voiding symptoms, hematuria and fever associated with usage of DJ stents while avoiding the need for any secondary procedures like DJ stent removal.

Keywords: double J stent, endoscopic management, distal ureteral stones.

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ABBREVIATIONS: URSL – Ureteroscopic Lithotripsy, DJ stent – Double J stent, IFT – Infant Feeding Tube, UTI – Urinary Tract Infection, PULS – Post Ureteroscopic Lesion Scale, LUTS – Lower Urinary Tract Symptoms

INTRODUCTION / ВСТУП

The estimated prevalence of ureteric calculi is about 12% in men and 7% among women [1]. URSL (Ureteroscopic Lithotripsy) using semi-rigid scopes has gained wide acceptance for management of ureteric stones. Further, the advent of smaller calibre scopes has improved the safety and efficacy of the procedures by lowering the intra- and post-operative complications [2]. Although placing a DJ stent after URSL is a commonly followed practice, several trials have suggested that it is not always necessary to place a stent after uncomplicated ureteroscopy [3]. It is recommended to place a stent whenever there is ureteric trauma, bleeding, infection or significant residual stone load, all of which can be considered as 'complicated ureteroscopy'. However, there has always been a debate regarding the placement of DJ stent following 'uncomplicated ureteroscopy' wherein there is minor ureteric trauma or very small residual stone burden [4, 5].

The use of ureteric stents has often been associated with irritative voiding symptoms, pain and UTI which may sometimes need early stent removal [6]. Further, stenting after URSL necessitates a subsequent procedure for DJ stent removal adding to the post-procedural expenses on the patient. Many patients have to be treated with alpha-blockers in order to address the stent-related symptoms [7]. Externally draining ureteric catheters and stents with strings for easy self-removal have been used in various studies, but their routine use needs to be evaluated. These alternatives to conventional DJ stenting need to be evaluated and their efficiency has to be established. Doersch et al. concluded that specially designed self-removable stents with a string are safe and effective and decrease the financial burden and hospital admissions [8]. However, these alternatives are not easily available, need special designing and manufacturing and are not cost effective as well.

As URSL is a commonly performed procedure and 80-90% of the patients with DJ stents experience some sort of irritative voiding symptoms which are attributed to the stents [6]. We have considered using an infant feeding tube which is not only cost-effective but also easily available, to intubate the lower and mid ureter and drain it externally. Keeping the lower ureter intubated for a short duration of 24 hours post-operatively provides the benefit of reducing edema in the lower ureter, reduces clot colic, and ensures drainage of the upper tract. As the IFT (Infant Feeding Tube) can be removed by any trained medical personnel at the bedside on the day of discharge, the need for a secondary procedure in the form of cystoscopy and stent removal can be avoided. Secondly, the possibility of irritative voiding symptoms which are commonly associated with DJ stents will be eliminated to a great extent.

Hence, considering the potential advantages of an infant feeding tube over conventional stenting, we propose a technique of placing an externally draining Infant Feeding Tube in the lower-mid ureter for 24 hours with the aim of evaluating its efficacy to overcome stent-related morbidity and avoiding a subsequent cystoscopy for stent removal.

MATERIALS AND METHODS

A prospective, randomized controlled study was conducted from December 2023 to May 2024 to evaluate the efficacy of using an infant feeding tube as an alternative to DJ stent following uncomplicated URSL for lower ureter stones. Clearance was obtained from the Institutional Ethical Committee (IEC/1094/2023-24). A total of 110 patients undergoing URSL for lower ureteric stones were randomized into two groups (Group 1: DJ Stent group; Group 2: IFT group) using a computer-generated simple randomization table. Informed written consent was obtained from each participant.

Patients above 18 years of age with symptomatic unilateral lower ureteric stones up to 15 mm in size on CT scan and who underwent 'Uncomplicated URSL' were included in the study. URSL was considered uncomplicated if complete stone clearance was achieved without any ureteric injury.

Patients under 18 years of age, pregnant females, patients undergoing bilateral procedures or having any anatomical abnormality of the urinary tract (horseshoe kidney, pelvic kidney, solitary kidney) were excluded from the study.

All the patients underwent URSL under spinal anesthesia with a 6/7.5Fr semi-rigid ureteroscope. After passing a guidewire and proper visualization, the stone was fragmented using a pneumatic lithotripter. The ureteric mucosa was endoscopically assessed using Post Ureteroscopic Lesion Scale (PULS) grading system. Cases with a PULS grading of >2 were considered complicated and not included in the study.

The 55 patients in group 1 underwent conventional stenting with a 5 Fr, 26 cm DJ stent. In group 2, i.e., the IFT group, the female mount of the IFT was cut (Figure 1a) and the tube was introduced into the ureter through a cystoscope over a 0.032-inch guidewire (Figure 1b). The IFT tip was advanced retrograde till the level of the L4-L5 transverse process (Figure 2). The study protocol has been depicted in the flowchart (Figure 3). Urine efflux from the proximal end of IFT confirms its successful placement. Another way to confirm the IFT position is by plunging iodinated contrast into IFT and noting its efflux into the ureter under fluoroscopy. Since only the female end of the IFT is cut, the advancing tip of the IFT which has a smooth contour, does not cause any trauma to the ureter.

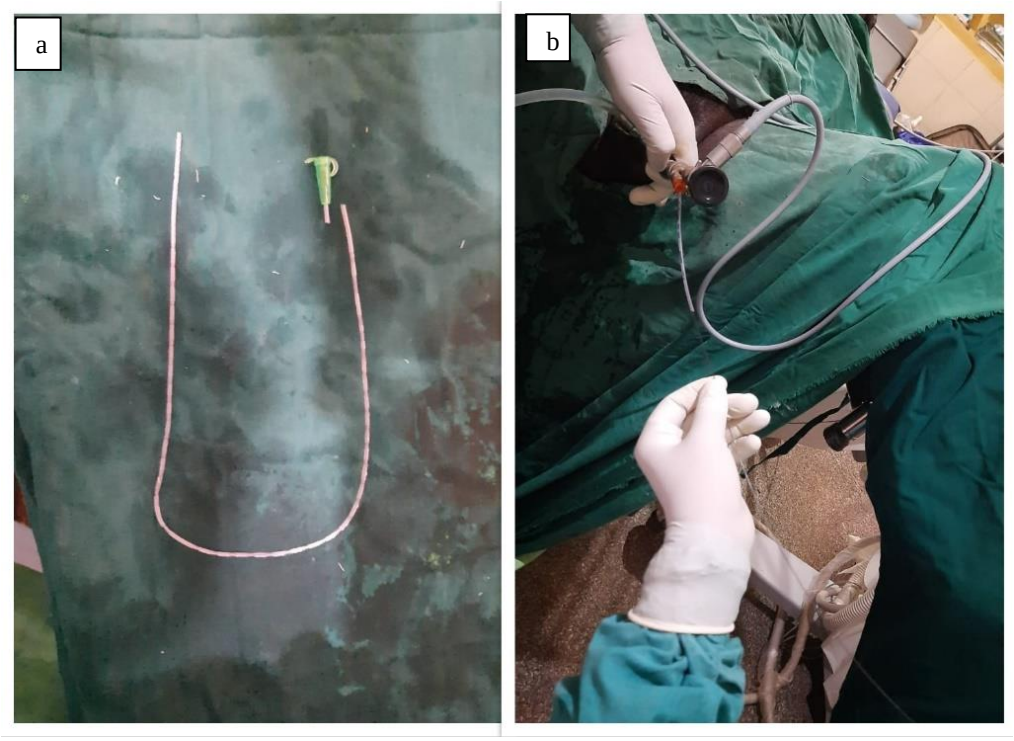

Figure 1 – a) Infant feeding tube with its female mount cut; b) IFT mounted on a 0.032 inch guidewire being introduced into the ureter through the cystoscope

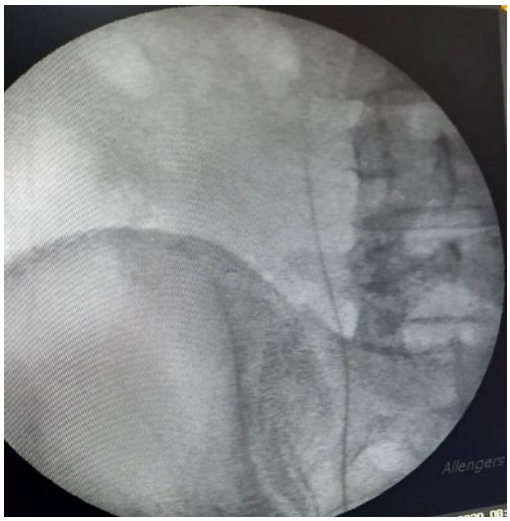

Figure 2 – IFT mounted over guidewire advanced retrograde till the level of L4–L5 transverse process

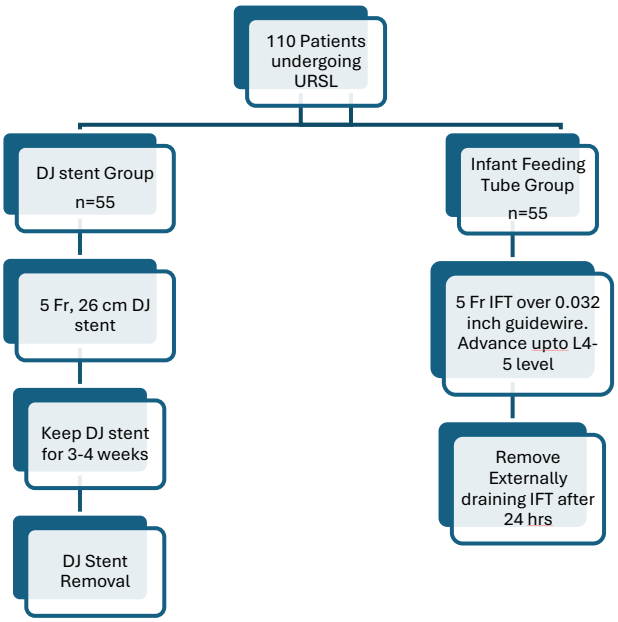

Figure 3 – Flowchart showing the study protocol

The cystoscope sheath and telescope were then removed. A 14/16fr foley's catheter was introduced by the side of the IFT (Figure 4a), with the IFT tightly held at the tip of the penis to prevent its dislodgement from the ureter. Using tonsillar artery forceps, a small rent is made into the outlet channel of foley's catheter (Figure 4b). Through this rent, the outside part of IFT is inserted into the foley's catheter to drain urine into the urine collecting bag (Figure 4c, 4d).

A stepwise pictorial description of the method of inserting the infant feeding tube is shown in Figure 5.

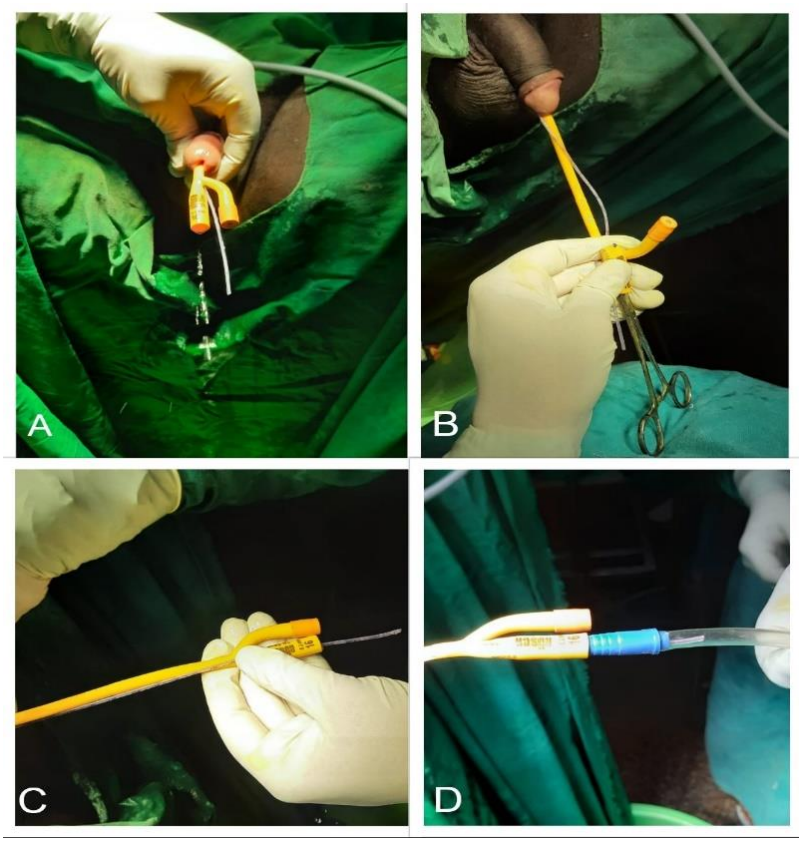

Figure 4 – a) foley's catheter introduced by the side of IFT; b) small rent is made into the outlet channel of foley's catheter; c) d) IFT inserted into the foley's catheter to drain urine into the urine collecting bag

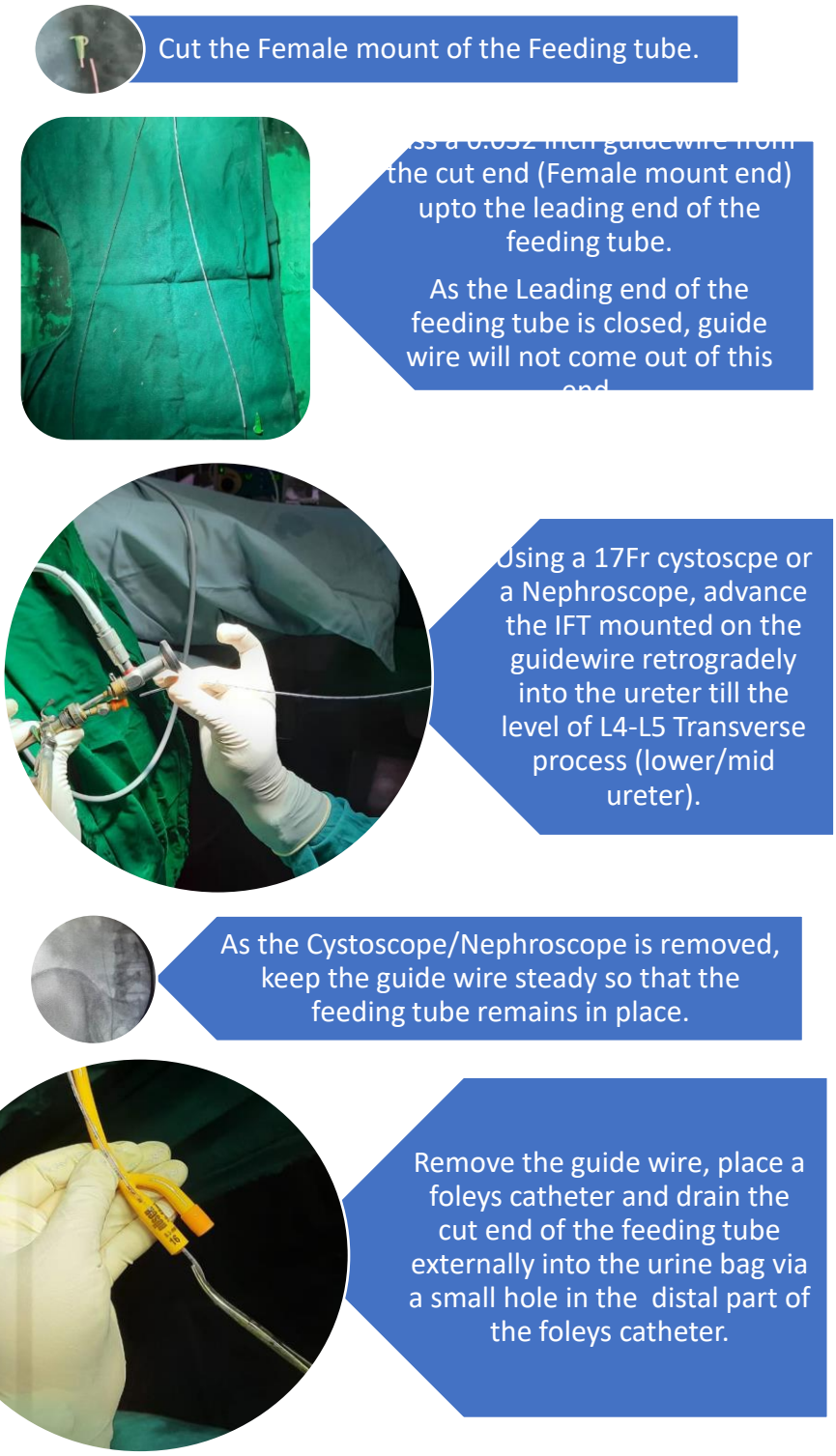

Figure 5 – A stepwise description of the technique of placing the Infant Feeding Tube

All patients were given intravenous third-generation cephalosporins 30 minutes prior to starting the procedure. The patients in both groups were monitored and the analgesic dose requirements, fever, and hematuria were recorded. The Foleys catheter and the infant feeding tube were removed on the post op day 1 and patients were discharged on the subsequent day, i.e. post op day 2. The patients with DJ stent in situ were called for stent removal after 3 weeks. During the follow-up, patients' symptoms like pain, irritative urinary symptoms, hematuria, number of emergency room visits, readmission and requirement for any secondary intervention were recorded.

RESULTS

All data was analyzed using a statistical package for social sciences (SPSS) (Version 20). Results are presented as Mean, SD, counts and percentages, and

diagrams. Normality was checked using Shapiro-Wilk, the Mann-Whitney U test was used to see a significant difference between the DJ stent group and IFT group for Age, Stone size, and Operative time. For Gender and postoperative complications between the DJ stent and IFT groups were compared using the Chi-square test/Fisher's exact test. P<0.05 will be considered statistically significant. All statistical tests were performed as two-tailed tests.

The two study groups were comparable in terms of patient demographics: age, sex, stone size (p=0.239, 0.409, 0.063, respectively). The duration of the procedure was recorded from the time of initiating cystoscopy to the placement of per urethral Foleys catheter. The mean operative time was 37.7 minutes (range 25-62) in the DJ stent group compared to 42.36 minutes (range 30-70) in the IFT group. This difference in the operating time was statistically significant. The prolonged duration of the procedure in the IFT group is probably attributable to the difficulty in maneuvering the IFT mounted over the guide wire and adaptation to the new technique. (DJ stent vs IFT; 37.7min vs. 42.6 min, p=0.007) (Table 1).

Table 1 – Patient characteristics in two groups

	DJ STENT GROUP	IFT GROUP	Mann-Whitney U test / Chi-square test value	P VALUE
No. Of patients	55	55		
Average age	38.4 (range 18-58)	41.6 (range 18-64)	1315	0.239
Male:female*	36:19	40:15	0.681 (Chi-Square value of ratio of male:female)	0.409
Average stone size (mm)	7.9 (6mm-14mm)	8.2 (6mm-12mm)	1017	0.063
Operative time (min)	37.7 min (range 25-62 min)	42.36 min (range 30-70 min)	1958	0.007**

Note: *Chi-square Test, **Statistically significant

Postoperative pain was assessed by estimating the requirement for oral analgesics and the need for hospitalization for pain management. In the DJ stent group, 17 patients (30.1%) required more than one tablet of analgesic per day, 7 patients (12.72%) attended the emergency room due to renal colic that was not responding to oral analgesics & 5 of them (9.1%) required hospitalization for pain control. In the IFT group, 13 patients (23.63%) required more than one tablet of oral analgesic (Diclofenac 50 mg) a day, 5 patients (9.1%) attended emergency room due to renal colic that was not responding to oral analgesics, and 4 (7.2%) of them required hospitalization for pain control, 2 (3.63%) out of them required DJ stenting (Table 2).

Table 2- Post-operative pain, analgesic requirements, emergency room visits, hospitalization for pain control

	DJ STENT GROUP	IFT GROUP	Chi-square Value	P VALUE
More than 2 analgesic dose requirement per day	17 (30.1%)	13 (23.63%)	0.733	0.392
Symptoms needing emergency room/opd visits	7 (12.7%)	5 (9.1%)	0.374	0.541
Patients needing re-hospitalisation for pain	5 (9.1%)	4 (7.3%)	0.121	0.728

Irritative voiding symptoms were more common in the DJ stent group, as 35 patients (63.6%) from this group experienced dysuria and frequency, as compared to only 4 patients (7.27%) from the IFT group (p=0.000). Ten days postoperatively, macroscopic hematuria was noticed by 6 patients (10.9%) in the DJ stent group, compared with no hematuria in the IFT group (p = 0.012) (Table 3). Regarding post-operative complications, 11 patients (20%) from the DJ stent group developed a fever after ureteroscopy, without signs of septicemia and were admitted for intravenous antibiotics for the next 3 days and were discharged on oral antibiotics without sequel but in the IFT group only 4 patients (7.27%) developed fever (p=0.047). Two patients (3.6%) in the infant feeding tube group required DJ stenting as a secondary procedure. Other complications like stent migration, stent fracture, knotting of stent were not observed.

Table 3 – Postoperative symptoms and complications

PARAMETER	DJ STENT GROUP	IFT GROUP	Chi-square Value	P VALUE
Irritative voiding symptoms (dysuria,frequency)	35 (63.6%)	4 (7.2%)	36.176	0.000**
Hematuria	6 (10.9%)	0	6.346	0.012**
Fever	11 (20%)	4 (7.2%)	3.782	0.047**

Note. **Statistically significant

The cost of the infant feeding tube is significantly lower than a DJ stent or an externally draining open-tip ureteric catheter. Although a detailed cost benefit analysis in terms of the number of workdays lost due to stent related symptoms and hospitalisation for DJ stent removal was not performed as a part of our study, we have done a simple cost analysis to suggest IFT as a low-cost alternative to DJ stent or open tip ureteric catheters (Table 4).

Table 4 – Cost analysis

DJ stent	Ureteric Catheter	Infant Feeding Tube
Rs. 790 (~10 US dollars)	Rs. 800 (~10 US dollars)	Rs. 61 (~1 US dollar)

DISCUSSION

Traditionally, it has been thought that the placement of stents would help to reduce complications such as ureteric stricture, flank pain and renal failure due to ureteric edema or passage of stone fragments and clots [9]. Avoiding stents also reduces the operative time. In our study, we observed that the duration of surgery was significantly shorter in the patients where Infant feeding tube was placed compared to the DJ stent placement (37.7 min vs 42.36 min; p= 0.007). This was in line with similar data from a study by Byrne et.al. who reported an operating time of 54.7 min and 42.6 min (p=0.013) for stented and non-stented group respectively [10].

Daniel Pérez-Fentes et al. have stated that stenting after ureteroscopy is a cause for morbidity manifesting as irritative voiding symptoms, pain and hematuria. Further, placement of DJ has no effect on stent stone-free rate, rate of urinary tract infection, requirement for analgesia, or long-term ureteric stricture formation [11]. In our study, we observed that the incidence of irritative lower urinary tract symptoms (Frequency, Dysuria) was higher in the DJ stent group compared to the IFT group (63.6% vs 7.27%, respectively, p=0.000). Similar observations were made by Khan et.al. who reported frequency in 51.4% of stented patients vs 14.2% of non-stented patients (p=0.001) [12].

Our study also revealed a significantly lower incidence of hematuria in patients of the IFT group (10.9% vs 0; p=0.012). Demour et.al in their study have reported an incidence of hematuria in 2.94% of patients with DJ stent as against 0% of those without stent as recorded at 1 month after the procedure [13].

There was no significant effect on pain in our study which was indirectly assessed based on analgesic dose requirement. About 30.1% (n=17) of the stented patients and 23.63% (n=13) of the patients with IFT required more than 2 doses of analgesic (Tab. Aceclofenac + Paracetamol) per day (p=0.392). However, a similar study by Prasad D et al. showed that on Post-operative day 2, 40% of patients of URSL with DJ vs. 16% of URSL patients without stenting required supplemental analgesia (inj. paracetamol 150 mg OD) dose (p=0.0138) [14].

In the present study, a post-operative complication in the form of fever was noted in 20% (n=11) in the DJ stent group as against 7.2% (n=4) in the IFT group (p=0.047). Thus, avoiding stenting significantly reduced post-operative pyrexia. A prospective study by Harrech et al. did not find any significant reduction in incidence of post-operative fever among the stented and non-stented group of patients (7.1% vs 7.8% respectively; p= 0.5) [15].

About 12.7% (n=7) of patients in the stented group needed emergency room visits vs 9.1% (n=5) in the IFT group due to pain or stent-related symptoms. Further, 9.1% (n=5) of the stented patients required re-admission as against 7.3% (n=4) in the IFT group. The difference was not statistically significant (p= 0.541, 0.728 for emergency visits and re-admission, respectively). Reddy et al. also observed that the emergency room visits (14.3% vs 11.6%; p= 0.76) and re-admission (8.2% vs 2.3%; p= 0.367) for stented and non-stented patients respectively were not statistically significant, which was consistent with our study [16].

URSL has become less invasive in recent times. The most commonly encountered morbidity after ureteroscopic lithotripsy is due to stent-related symptoms. It has been observed that avoiding the use of DJ stents in uncomplicated cases is safe and reduces mean hospital stay and mean operative time [17]. Therefore, routine stenting after ureteroscopic lithotripsy remains controversial.

Since removal of the stents entails a subsequent cystoscopy, endourologists have used modified stents with extraction strings attached to them which facilitate easy removal. However, there remain concerns regarding

certain risks, such as aggravation of LUTS due to string irritation, dislodgement of stents, infection, and lack of supporting evidence regarding its safety and efficacy [18]. Routine DJ stenting after ureteroscopic procedures adds to the financial burden on the patient as subsequent cystoscopy and stent removal becomes mandatory, unless modified stents with a string attached to the distal end are used [19]. Regular stenting in all cases after URSL not only adds to the operating time but also increases the overall cost of treatment by up to 30% [20]. In our study, all the patients in the infant feeding tube group (n=55, 100%) had their IFT removed at the bedside at the time of discharge and there was no need for any additional procedure without additional financial burden. The use of an infant feeding tube instead of a DJ stent facilitates early and non-invasive removal and also reduces procedural costs. A simple cost analysis performed shows that IFT costs 1/10th of a DJ Stent or an open-tip ureteric catheter (Table 4.). This low-cost alternative to stenting along with the advantage of being able to completely avoid the secondary procedure of DJ stent removal can have a wide impact on the management of lower ureteric stones, especially in resource-poor countries.

It is extremely important for the operating surgeon to assess the procedure associated with ureteric mucosal injury to make a decision regarding the omission of a DJ stent. We have performed this study to evaluate the use of IFT as a substitute for DJ stenting in uncomplicated lower ureteric URSL on a small group of patients. A larger study and a long-term follow-up, especially for ruling out ureteric stricture formation, is necessary in our view.

The basic implications of using an IFT instead of the routinely used DJ stent, especially for resource-poor countries, are: (1) Easy removal of the infant feeding tube at the bedside by any trained medical personnel and not necessarily a urologist; (2) Avoiding secondary procedure, i.e., stent removal; (3) Reducing the overall cost of treatment.

LIMITATION OF THE STUDY. Long-term follow-up of the patients was not done to look for the possibility of developing ureteric stricture.

CONCLUSIONS

Intubating the lower ureter with an Infant feeding tube is a novel and cost-effective substitute for DJ stents in lower ureteric stone management. The use of IFT not only reduces the overall treatment cost, irritative voiding symptoms, hematuria and fever, but also alleviates the need for a second procedure in order to remove the stent. At the same time keeping IFT for 24 hours fulfils all the purported benefits of DJ stenting like reducing ureteral wall edema and facilitating passage of clots and residual fragments. Thus, IFT for a short duration may be considered as a viable and cost-effective substitute for DJ stenting in uncomplicated URSL.

AUTHOR CONTRIBUTIONS / ВКЛАД АВТОРІВ

- **Author 1 –** Acquisition, analysis, or interpretation of data for the work.
- **Author 2, 3 –** Revising the work critically for important intellectual content
- **Author 4, 5 –** Drafting the work
- **Author 1, 2, 3, 4, 5 –** Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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CONFLICT OF INTEREST / КОНФЛІКТ ІНТЕРЕСІВ

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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