

ORIGINAL ARTICLE

pISSN: 1907-3062 / eISSN: 2407-2230

Outcomes of ureteral stent placement for hydronephrosis in patients with ureteral stone

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ABSTRACT

BACKGROUND

Routine ureteral stent placement after ureteroscopy (URS) for ureteral stone treatment is arguable due to the possible stent-related symptoms. Several studies claimed that its use is necessary, while others reported that its use is excessive. Hydronephrosis occurs when urine cannot drain out from the kidney to the bladder due to blockage or obstruction. We aimed to evaluate the role of ureteral stents in hydronephrosis resolution in ureteral stone patients following URS lithotripsy.

METHODS

This was a prospective observational study using secondary data involving 130 ureteral stone patients undergoing URS lithotripsy [99 patients (76.2%) with stent placement and 31 patients (23.8%) without stent]. Data consisting of baseline characteristics, pre-operative status, intraoperative characteristics, and postoperative complications were collected from the medical record database and presented descriptively. The patients were divided into two groups based on stent placement. Comparison of hydronephrosis resolution between the groups was analyzed with Chi-square.

RESULTS

Ureteral lesions were the most common indication of ureteral stent placement following URS lithotripsy (28.3%). The most bothersome symptoms were dysuria in 18 patients (18.2%); followed by frequency in eight patients (8.1%) and low back pain in six patients (6.1%). All symptoms were successfully treated with oral medications. There were 41 patients (91.1%) with pre-operative hydronephrosis significantly resolved after stent placement compared to 5 (62.5%) patients without stent placement ($p=0.027$).

CONCLUSION

Ureteral stenting significantly resolves pre-operative hydronephrosis after URS lithotripsy in patients with ureteral stone. Ureteral stent placement is the preferred method for the treatment of pre-operative hydronephrosis.

Keywords: Ureteral stent, ureteral stenting, ureteroscopic lithotripsy, ureteral stone

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Date of first submission, August 14,
2021

Date of final revised submission,
November 2, 2021

Date of acceptance, November 4, 2021

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Cite this article as: Widyokiriono DR,
Kloping YP, Rahman ZA, Hakim L.
Outcomes of ureteral stent placement
for hydronephrosis in patients with ure-
teral stone. Univ Med 2021;40:226-33.
doi: 10.18051/UnivMed.2021.v40.
226-233.



INTRODUCTION

Urinary tract stones are the third most common disease of the urinary tract, apart from urinary tract infections and pathological conditions of the prostate.⁽¹⁾ The prevalence of urinary tract stones is estimated to be between 1% and 15% depending on age, gender, race, and geography.⁽²⁾ Ureteral stones may cause several complications such as renal colic, ureteric obstruction, hydronephrosis and infection. The management of ureteral stones varies from extracorporeal shock wave lithotripsy (ESWL), ureteroscopy (URS), medical expulsive therapy (MET), and laparoscopic surgery.⁽³⁾ URS has been used to treat lower urinary tract stones as well as those in the upper tract.^(1,2) It is a method of treating ureteric stones besides ESWL. Compared to ESWL, URS has a greater stone free rate in four weeks and is a safe option for obese patients.⁽³⁾

The technological advancements of URS lithotripters, such as the development of smaller and more flexible URS and the use of laser lithotripsy have made this procedure more effective and safer for urinary stone treatment. Indications for ureteric stone removal include persistent pain or obstruction, renal insufficiency, and low chance of spontaneous discharge, comorbidity profile, social situation and patient preferences.⁽³⁾ Treatment after stone treatment varies depending on patient characteristics and comorbidities, residual stones, complications, and the decision of the surgeon. Stent placement after URS is recommended by the latest European Association of Urology (EAU) guidelines if there is an increase in postoperative complications; in case of ureteral lesions, bleeding, residual fragments, perforation, urinary tract infection and pregnancy; and in patients who are at increased risk of complications.⁽³⁾ Ureteral stent insertion after URS reduces the risk of ureteral stricture, which can lead to ureteral obstruction and obstructive nephropathy.⁽⁴⁾ The stents sustain the patency of the ureter for drainage of stone

fragments to prevent stricture formation and simultaneously resolve hydronephrosis. However, ureteral stent insertion for the treatment of ureteral stone is still debatable, considering the stent-associated symptoms including hematuria, dysuria, and other discomforts such as stent fragmentation and encrustation.^(4,5) Symptoms associated with stenting cannot be ignored and it is still controversial whether the patient should have a stent inserted after surgery.^(6,7)

The European Association of Urology (EAU) guidelines state that routine stenting after an uncomplicated URS procedure with clean stone removal is unnecessary.⁽³⁾ A meta-analysis showed that stenting failed to improve the stone-free rate, and instead, it generated complications such as hematuria, irritative urinary symptoms, urinary infection, and dysuria, which were significantly higher in the stented group.⁽⁸⁾ These symptoms may reduce the quality of life of affected patients. Despite the recommendations made by the EAU and American Urological Association (AUA) guidelines, recent studies reported that there is an excessive use of ureteral stents among patients undergoing URS lithotripsy.⁽⁹⁾ Stent placement is indicated in patients with symptomatic hydronephrosis and patients with renal dysfunction. One study reported that 85.2% of patients with symptomatic hydronephrosis showed symptom improvement after stent placement,⁽¹⁰⁾ while the failure rate of ureteral stent placement was reported to be 16–58%.⁽¹¹⁾ In view of this, we aimed to evaluate the role of ureteral stents in hydronephrosis resolution following URS lithotripsy in ureteral stone patients.

METHODS

Research design

This was an analytical study with a prospective approach utilizing secondary data taken from the medical records of Dr. Soetomo General-Academic Hospital from January 2018 to December 2019.

Study subjects

Total sampling was performed in this study; thus, the sample size represents the whole population of all eligible patients admitted to the hospital. A total of 130 patients who had ureteral stones and underwent URS lithotripsy were included in this study. The inclusion criteria of this study were male and female patients with ureteral stones who underwent URS lithotripsy, and were aged 18 years or above. The exclusion criteria of this study were patients with comorbidities, history of malignancy, abnormal laboratory results, and patients with incomplete data.

Patient assessment

All patients were admitted to the hospital and assessed preoperatively by history and physical examination. Laboratory data collected included full blood counts; kidney function tests including serum creatinine, urea, sodium, and potassium; urine analyses; and urine cultures. Stone size and location were assessed preoperatively by plain abdominal radiographs of the kidneys, ureters, and bladder (KUB) and by non-enhanced computed tomography (CT). Upper ureteric stones were defined as those located above the superior border of the sacroiliac joint. Mid-ureteric stones were defined as those located between the superior and inferior borders of the sacroiliac joint, and distal ureteric stones as those located below the inferior border of the sacroiliac joint.

Statistical analysis

All statistical values were presented as frequency and percentage. Comparison of variables between groups with and without stent placement was analyzed using the Chi-square test. A p value of <0.05 was considered statistically significant. All statistical analyses in this study were performed using SPSS ver. 21 software.

Ethical clearance

This study was approved by the Health

Research Ethical Committee, Medical Faculty of Airlangga University (1895/KEPK/III/2020). All subjects participating in this study were informed about the aims and benefits of the study and signed informed consent during admission.

RESULTS

There were 130 patients with ureteric stones who underwent URS lithotripsy. Table 1 displays the baseline characteristics of subjects, as well as their pre-operative status and stone characteristics. Many patients who used stents after ureteroscopy (URS) were above 40 years old (85.9%) with a mean age of 51.12 years. In the patient group with a body mass index (BMI) <25 kg/m² there were 29 patients (29.3%) using stents and 16 patients (51.6%) not using stents. There was a significant difference in patient's BMI among the stent users ($p=0.039$). A total of 47 patients (47.5%) with stones in the proximal ureter, 14 patients (14.1%) with stones in the middle ureter and 38 patients (38.4%) with stones in the distal ureter underwent stent insertion post-URS. Stone location did not have a significant correlation with stent placement post URS ($p=0.760$). There were 68 patients (68.7%) with one stone and 31 patients (15.2%) with more than one stone that had stent placement; however, the analysis results showed that there was no significant relationship between the number of stones and stent placement post-URS ($p=0.351$). There were 61 patients (61.6%) with ureteral stones less than 1 cm in diameter, 23 patients (23.2%) with ureteral stones of 1-2 cm in diameter, and 15 patients (12.1%) with stones of more than 2 cm. The analysis results showed that the size of the stone had a significant effect on stent placement after URS ($p=0.021$). Preoperative hydronephrosis was present in 53 patients, with 45 patients undergoing stent insertion.

Table 2 displays the details regarding the intraoperative characteristics of the subjects, in which there were 13 out of 130 patients (13.1%) who experienced intraoperative complications and

Table 1. Patients demographic, stone characteristics and pre-operative status

Characteristics	Stent (n,%)	Non Stent (n,%)	p value
Age (years)			
< 40	14 (14.1)	7 (22.6)	0.494
≥ 40	85 (85.9)	24 (77.4)	
Gender			
Male	70 (70.7)	23 (74.2)	0.883
Female	29 (29.3)	8 (25.8)	
BMI (kg/m ²) *			
< 25	29 (29.3)	16 (51.6)	0.039 *
≥ 25	70 (70.7)	15 (48.4)	
Stone size			
< 1 cm	61 (61.6)	18 (58.1)	0.021*
1-2 cm	23 (23.2)	13 (41.9)	
> 2 cm	15 (12.1)	0 (0.0)	
Stone quantity			
1	68 (68.7)	18 (58.1)	0.351
≥	31 (15.2)	13 (41.9)	
Pre-operative hydronephrosis			
No	54 (54.5)	23 (74.2)	0.052
Yes	45 (45.5)	8 (25.8)	

*BMI : body mass index

underwent stent placement. There was a significant difference in complications in the stent group and the non-stent group during surgery (p=0.037). Patients that underwent stent insertion had longer duration of surgery and there was a statistically significant difference when compared with the group without stents (p=0.001). There were four patients with remaining stones and eleven patients with retropulsion of stones during the URS procedure and all of these patients had stent insertion. The stone-free rate in the stent and non-stent groups was 84.8% and 100%, respectively, and there was a significant

difference between the two groups (p=0.022) (Table 2).

Table 3 shows the postoperative characteristics of the subjects. Most of the indications for stent placement in this study were the presence of lesions in the ureter, which occurred in 28 patients (28.3%), followed by impacted stones in 20 patients (20.2%). There were also 16 patients (16.2%) with residual stones, 14 patients (14.1%) with a duration of surgery of more than 60 minutes, and 14 patients (14.1%) in whom stent placement was the surgeon's preference.

Table 2. Intraoperative characteristics during ureteroscopy procedure

Characteristics	Stent (n,%)	Non-Stent (n,%)	p value
Intraoperative complications			
None	86 (86.9)	31 (100.0)	0.037*
Present	13 (13.1)	0 (0)	
Duration of surgery (min)†			
> 60	82 (82.8)	7 (22.6)	0.001*
< 60	17 (17.2)	24 (77.4)	
Stone free rate			
Free of stones	84 (84.8)	31 (100.0)	0.022*
Residual stone	4 (4.0)	0 (0.0)	
Retropulsion	11 (11.1)	0 (0.0)	

†min : minutes

Table 3. Characteristics of stent placement post- ureteroscopy

Characteristic	Stent (n,%)	Non-Stent (n,%)	p value
Post-operative complications			
None	61 (61.6)	25 (80.6)	.016*
Hematuria	5 (5.1)	1 (3.2)	
Dysuria	18 (18.2)	0 (0.0)	
Urinary retention	1 (1.0)	0 (0.0)	
Low back pain	6 (6.1)	4 (12.9)	
Frequency	8 (8.1)	1 (3.2)	
Indications			
Ureteral lesions	28 (28.3)	-	0.130
Impacted stones	20 (20.2)	-	
Residual stones	16 (16.2)	-	
Duration >60 mins	14 (14.1)	-	
Surgeon preferences	14 (14.1)	-	
Ureteral edema	4 (4)	-	
Ureteral stricture	3 (3)	-	
Postoperative follow up			
None	92 (92.9)	31 (100.0)	
PNL *	4 (4.0)	0 (0.0)	
ESWL **	3 (3.0)	0 (0.0)	
Stent size			
6 French	99 (100.0)	-	
Stent indwelling time (days)			
<90	91 (91.9)	-	0.027*
>90	8 (8.1)	-	
Hydronephrosis resolution after stenting			
	n=45	n=8	
Persisted	4 (8.9)	3 (37.5)	
Resolved	41 (91.1)	5 (62.5)	

* PNL: percutaneous nephrostolithotomy; ESWL: extracorporeal shock wave lithotripsy

On post-operative evaluation, the most frequent symptom that occurred in patients undergoing stent insertion was dysuria with a total of 18 patients and 4 patients without stents had the major complaint of low back pain. There was a significant difference in postoperative complications between the stent and non-stent groups ($p=0.016$). The majority of patients did not require further follow-up after URS, but four patients were planned for percutaneous nephrostolithotomy (PNL) and three patients needed ESWL afterwards. All patients requiring ESWL and PNL after URS had stent placement. In this study all patients used a 6 French stent. A total of 91 patients (91.9%) had a stent indwelling time of less than 90 days, whereas in 8 patients (8.1%) the stent indwelling time was more than 90 days, as shown in Table 3. After stent placement, 41 patients (91.1%) had their hydronephrosis resolved significantly compared

with 5 (62.5%) patients with non-stent placement ($p=0.027$). However, the analysis showed that stent placement had a significant effect on the incidence of postoperative hydronephrosis in patients who had preoperative hydronephrosis.

DISCUSSION

In this study, there were 130 patients with ureteric stones who underwent URS procedure at Dr. Soetomo Hospital, Surabaya for the period 2018 to 2019. The patients comprised 99 (76.2%) with stents and 31 (23.8%) without stents. Most patients who used stent post-ureterorenoscopy (URS) were over 40 years old (85.9%) with a mean age of 51.12 years. There were no significant differences in age group as well as gender regarding the use of post-URS stents. This result is similar to that of a study conducted by Muslumanoglu et al.⁽¹²⁾ who found that about 60%

of patients with ureteral stones had a stent attached post URS. However, there are many factors influencing the success of URS and whether or not stent placement is necessary after URS.^(5,12) Various parameters have been used, such as gender, age, BMI, and medical history of congenital disorders, solitary kidney, previous stone surgery history, and the use of anticoagulants. In addition, stone location, number of stones, and presence/absence of hydronephrosis before surgery have also been used as basic patient characteristics. This data is important for predicting postoperative stent placement after URS. One study stated that patients with a solitary kidney or on anticoagulant use and with preoperative double-J stent were less likely to have a postoperative double-J stent placed.^(12,13) The operative duration was calculated from ureteral opening until the stone was removed or crushed. The duration of URS surgery increased when stent insertion was performed; in this case there was a statistically significant difference in the duration as compared with no stent insertion. This result is similar to that of research conducted by Netto et al.,⁽¹⁴⁾ but contrary to a study conducted by Jeong et al.⁽¹⁵⁾ which stated that there was no significant difference in the duration of URS with and without stents. Another study also stated that if the duration of URS with lithotripsy is more than 45 minutes, it can potentially cause postoperative complications in the stent-free group.⁽¹⁶⁾ However, stent placement after URS may also cause complications. In our study, the most frequent indication for stent placement was ureteral lesions in 28 patients (28.3%) and the most frequent complications after stent placement were dysuria in 18 patients and frequency in 8 patients. Symptoms that arise after stent insertion include hematuria, dysuria, urinary retention, low back pain and frequency.^(17,18) A different outcome was found in patients who did not use stents, where the main complaint was low back pain in four patients. A similar result was found in the study by Abdelaziz et al.,⁽¹⁷⁾ who reported that all patients who had stent insertion experienced

dysuria, while a few of them had hematuria and recurrent fever. However, there was no significant difference in the complication rate between the stent and non-stent groups after URS. Several randomized, prospective trials also reported that there was no significant difference in complications and postoperative pain between the stent and non-stent groups.⁽¹⁷⁻¹⁹⁾ However, there is a significant difference in the cost of caring for patients with a stent attached which is more expensive than caring for patients without a stent.^(14,15,18) In the present study, among the patients who used stents, there were 8 patients (8.1%) whose stent indwelling time was more than 90 days. This may increase morbidity because the longer stent indwelling time is associated with increased stent encrustation frequency, urinary infection, secondary stone formation, obstruction, and hematuria. The study conducted by Abdelaziz et al.⁽²⁰⁾ has also found that post-operative imaging showed that forgotten stents can cause an upper tract obstruction, and fragmentation and encrustation of the stent. This condition occurred as a result of various risk factors such as decreased acidification of urine which may lead to risk for infection and non-acidified urine, which was associated significantly with stent fragmentation. Therefore urine acidification is important to prevent stent fragmentation. This condition may require further investigation regarding different types of stent biofilms. There was also a significant difference in the incidence of resolved hydronephrosis. In the group of patients who had a stent inserted, among the 45 out of 130 patients who had pre-operative hydronephrosis, 41 (91.1%) patients had their hydronephrosis resolved compared to the 5 (62.5%) patients without stent placement, the difference being statistically significant. The possible benefits of stent placement may be seen from several studies stating that stents reduce the risk of urethral stricture, edema, or mucosal inflammation at the site of the stone.⁽²¹⁻²⁴⁾

The limitation of our study lies mainly in the use of secondary data, in which there is limited information including stone density, the use of

URS lasers or pneumatics and the biomaterial of the stent. These data can help further analyze the predicting factors for stent placement and the symptoms that occur after stent insertion. The study implies that ureteral stents are necessary in preventing and resolving hydronephrosis. Future studies are needed, using an experimental design which may contribute to evaluate the stent placement indications and to reduce complications due to stent insertion. However, as to the conduct of this study, these findings are beneficial toward adding data regarding ureteral stent use in the Indonesian population.

CONCLUSIONS

In this study, ureteral stenting significantly resolved pre-operative hydronephrosis after URS lithotripsy in patients with ureteral stone. The stenting procedure is necessary and safe, especially in patients with pre-operative hydronephrosis, as it shows significant resolution and has only treatable mild associated symptoms.


CONFLICT OF INTEREST

Competing interests: No relevant disclosures.

ACKNOWLEDGEMENT

We would like to thank the subjects who participated in this study and our colleagues in the Soetomo General Hospital. Special thanks are also due to my supervisor for the advice to improve the manuscript.

CONTRIBUTORS

This study was conceived and designed by DRW, YPK, ZAR, and LH. DRW and YPK implemented the study and analyzed the results. LH drafted the manuscript. DRW and LH contributed to the acquisition of data and critical revision. All authors read and approved the final manuscript. All authors contributed equally. 

REFERENCES

1. McAninch JW, Lue TF, editors. *Smith & Tanago's general urology* 19th ed. San Francisco: Lange; 2020.
2. Pearle MS, Antonelli J, Lotan Y. Urinary lithiasis: etiology, epidemiology, and pathogenesis. In: Partin AW, Dmochowski RR, Kavoussi LR, Peters CA, Wein AJ, editors. *Campbell Walsh Urology*. 12th ed. New York: Elsevier Health Sciences; 2020 p.2005–35.
3. Türk C, Petróik A, Sarica K, et al. EAU guidelines on interventional treatment for urolithiasis. *Eur Urol* 2016;69:475–82. doi: 10.1016/j.eururo.2015.07.041.
4. Wang H, Man L, Li G, Huang G, Liu N, Wang J. Meta-analysis of stenting versus non-stenting for the treatment of ureteral stones. *PLoS One* 2017;12:e0167670. doi: 10.1371/journal.pone.0167670.
5. Chew BH, Seitz C. Impact of ureteral stenting in ureteroscopy. *Curr Opin Urol* 2016;26:76-80. doi: 10.1097/MOU.0000000000000234.
6. Shi YF, Ju WL, Zhu YP, Xia SJ, Sun XW. The impact of ureteral stent indwelling time on the treatment of acute infection caused by ureteral calculi. *Urolithiasis* 2017;45:579–83. Doi: 10.1007/s00240-017-0964-3.
7. Beysens M, Tailly TO. Ureteral stents in urolithiasis. *Asian J Urol* 2018;5:274–86. Doi: 10.1016/j.ajur.2018.07.0028.
8. Wang W, Fan J, Huang G, et al. Meta-analysis of prevalence of erectile dysfunction in mainland China: evidence based on epidemiological surveys. *Sex Med* 2017;5:e19–30. Doi:10.1016/j.esxm.2016.10.00110.1016/j.esxm.2016.10.001.
9. Pereira JF, Bower P, Jung E, et al. Ureteral stenting practices following routine ureteroscopy: an international survey. *World J Urol* 2019;37:2501–8. Doi: 10.1007/s00345-019-02660-7.
10. Joshi HB, Stainthorpe A, MacDonagh RP, Keeley FX, Timoney AG. Indwelling ureteral stents: evaluation of symptoms, quality of life and utility. *J Urol* 2003;169:1065–9. doi: 10.1089/089277901750134421
11. Wong LM, Cleeve LK, Milner AD, Pitman AG. Malignant ureteral obstruction: outcomes after intervention. Have things changed? *J Urol* 2007;178:178–83. DOI: 10.1016/j.juro.2007.03.026
12. Muslumanoglu AY, Fuglsig S, Frattini A, et al. Risks and benefits of postoperative double-J stent placement after ureteroscopy: results from the Clinical Research Office of Endourological Society Ureteroscopy Global Study. *J Endourol* 2017;31:446–51. Doi: 10.1089/end.2016.0827.

13. Kim SW, Ahn JH, Yim SU, et al. Clinical factors associated with postoperative hydronephrosis after ureteroscopic lithotripsy. *Investig Clin Urol* 2016;57:343–50. Doi: 10.4111/icu.2016.57.5.343.
14. Merlo F, Cicerello E, Mangano M, Cova G, Maccatrozzo L. Stenting after ureteroscopy for ureteral lithiasis: results of a retrospective study. *Arch Ital Urol Androl* 2011;83:57–9.
15. Al Demour S, Alrabadi A, Al Sharif A, et al. Ureteric stenting vs not stenting following uncomplicated ureteroscopic lithotripsy: a prospective randomised trial. *Arab J Urol* 2020;18:169–75. Doi: 10.1080/2090598X.2020.1762280.
16. Inoue T, Hamamoto S, Okada S, et al. Evaluating predictive factor of systemic inflammatory response syndrome and postoperative pain in patients without ureteral stent placement after ureteral access sheath use in flexible ureteroscopy for stone management. *J Endourol* 2021. doi: 10.1089/end.2021.0515.
17. Ordonez M, Hwang EC, Borofsky M, Bakker CJ, Gandhi S, Dahm P. Ureteral stent versus no ureteral stent for ureteroscopy in the management of renal and ureteral calculi. *Cochrane Database Syst Rev* 2019;2019. Doi: 10.1002/14651858.CD012703.pub2.
18. De Grazia A, Somani BK, Soria F, Carugo D, Mosayyebi A. Latest advancements in ureteral stent technology. *Transl Androl Urol* 2019; 8(Suppl 4):S436. doi: 10.21037/tau.2019.08.16.
19. El-Abd AS, Suliman MG, Abo Farha MO, et al. The development of ureteric strictures after ureteroscopic treatment for ureteric calculi: A long-term study at two academic centres. *Arab J Urol*. 2014;12:168–72. Doi: 10.1016/j.aju.2013.11.004.
20. Abdelaziz AY, Fouda WB, Mosharafa AA, Abelasoul MA, Fayyad A, Fawzi K. Forgotten ureteral stents: risk factors, complications and management. *African J Urol* 2018;24:28–33. Doi: doi: 10.1016/j.afju.2017.09.005.
21. Tas S, Tudcu V, Mutlu B, et al. Incidence of ureteral stricture after ureterorenoscopic pneumatic lithotripsy for distal ureteral calculi. *Arch Ital Urol Androl* 2011;83:141–6.
22. Fam XI, Singam P, Ho CCK, et al. Ureteral stricture formation after ureteroscope treatment of impacted calculi: a prospective study. *Korean J Urol* 2015;56:63–7. Doi: 0.4111/kju.2015.56.1.63.
23. Türk C, Skolarikos A, Neisius A, et al. EAU guidelines on urolithiasis. *European Association of Urology*; 2019.
24. Bader MJ, Eisner B, Porpiglia F, Preminger GM, Tiselius HG. Contemporary management of ureteral stones. *Eur Urol* 2012;61:764–72. doi: 10.1016/j.eururo.2012.01.009.