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ORIGINAL PAPER

Is routine ureteral stenting necessary after uncomplicated ureteroscopic lithotripsy for lower ureteral stones larger than 1 cm?

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Abstract We evaluated the need for routine ureteral stenting after uncomplicated ureteroscopic lithotripsy (URSL) without dilation for lower ureteral stones larger than 1 cm. A total of 43 patients underwent URSL for lower ureteral stones larger than 10 mm. They were randomized into a stented (21) or an unstented (22) group. URSL was performed by using a semirigid ureteroscope and pneumatic lithotripter without ureteral dilation. Additional forceps application (AFA) was used to remove fragments ≥4 mm. Patients in each group were assessed for stone-free rate, stone size, operative time, AFA, hospitalization time, postoperative pain, irritative voiding symptoms, hematuria, re-hospitalization and stricture formation. The stone-free rate was 100% in each group. There were no statistical differences in the two groups regarding stone size, operative time, AFA, postoperative pain, hematuria and hospitalization time. However, irritative voiding symptoms of the stented group were significantly higher than those in the unstented group ($P < 0.05$). One patient (4.5%) in the unstented group required re-hospitalization for severe flank pain with fever (>38°C) compared to one patient (4.7%) in the stented group for proximal stent migration ($P > 0.05$). Stricture formation was not demonstrated in either group at 3 months follow-up excretory urography (EXU). Our results demonstrate that ureteral stenting after uncomplicated URSL without dilation for lower ureteral stones larger than 1 cm does not appear to be necessary if AFA is used to remove fragments ≥4 mm, thereby reducing morbidity of patients and risk of re-hospitalization.

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Introduction

Ureteroscopic lithotripsy (URSL) has been recognized as a highly effective, minimally invasive procedure for treating ureteral calculi [1]. Stenting after URSL for ureteral calculi is common practice to prevent possible ureteric stricture and reduce pain secondary to mucosal edema [2]. However, stenting is associated with considerable morbidity as stent-related complications are reported in 10–85% of cases [3, 4]. The other problems associated with stents are that it extends the operative time, increasing cost [5]. With the advent of smaller ureteroscopes and lithotripsy devices, many prospective randomized studies have evaluated the need to place a stent after uncomplicated URSL. All of these studies except that of Damiano and associates [6] included stones smaller than 1 cm and they have reported that routine stenting is not needed after uncomplicated URSL with or without dilation for ureteral stones [5, 7–11]. The stent is generally placed if there is accompanying ureteric injury or in patients with a large residual stone after URSL; however, the criteria for stentless ureteroscopy have not been well documented.

In the present study, we assessed the need for routine ureteral stenting after uncomplicated URSL without dilation for lower ureteral stones larger than 1 cm.

Patients and methods

This study was designed as a prospective, randomized controlled trial. From July 2004 to January 2007, 43 patients with lower ureteral stones larger than 1 cm were evaluated

in this study. Lower ureteral stone diagnosis was done when the stone was localized below the inferior part of the sacroiliac joint. All patients were assessed by whole blood count, BUN, serum creatinine, urinalysis, urine culture, a plain abdominal X-ray (KUB), excretory urography (EXU) and renal ultrasonography, or retrograde pyelography if needed. The stone size was determined by the sum of the maximum diameters of the calculi on plain abdominal X-ray. Patients with a history of sepsis, renal failure, bilateral ureteral stones, solitary kidney, multiple ureteral stones or pregnancy were excluded from our study. Patients detected intraoperatively with severe mucosal injury, ureteral perforation, migration of large stone fragment to the kidney and failed access were also excluded. The patients were randomized preoperatively into a stented (21 cases) and an unstented (22 cases) group. A 8/9.8 Fr Wolf semirigid ureteroscope with a 5 f working channel was used in all patients under general anesthesia. No patients required dilation of the ureteral orifice or intramural ureter. The stone was fragmented with a pneumatic lithotripter (Karl Storz, Calcusplit 276300 20,Germany). Additional forceps application (AFA) was used to remove fragments ≥4 mm. Endoscopic inspection was done at the end of the procedure to rule out any residual calculi ≥4 mm or trauma. The operative times were calculated from the time the cystoscope was introduced to the final removal of all endoscopes. In the stented group, a DJ stent (4.8 f) was placed through the ureteroscopic operative channel or over a guidewire via the cystoscope. All patients received intravenous first generation cephalosporin preoperatively, which was maintained for 7 days with an oral quinolone. All patients were evaluated by plain abdominal X-ray 2 weeks after the operation. Computed tomography was not performed in our patients due to economic reasons. The DJ stent was removed by rigid cystoscope after 3 weeks using local anesthesia. Follow-up EXU was performed 3 months postoperatively to evaluate ureteral stricture formation. Patients in each group were assessed for stone-free rate, stone size, operative time, AFA, hospitalization time, re-hospitalization, postoperative pain, irritative voiding symptoms, hematuria and stricture formation. Postoperative pain and irritative voiding symptoms were rated according to the study carried out by Jeong and associates [7]: absent (score 1), mild (symptoms within 0–3 days of operation, bearable with no medication; score 2), moderate (symptoms persisting for 3–7 days, painful enough for medication; score 3), and severe (symptoms for ≥7 days, requiring the use of analgesic; score 4).

All continuous variables were expressed as mean ± standard deviation. Independent *t* test, Fisher's exact test and Mann–Whitney *U* tests were used for comparison of the continuous variables when appropriate, while chi-square test was used to compare categorical variables, with $P < 0.05$ considered significant. A statistics software (SPSS) was used for statistical analysis.

Results

The characteristics of the patients in the two groups are shown in Table 1.There were no statistical differences in the two groups regarding patient gender and age, stone size, operative time, re-hospitalization, AFA, or hospitalization time. The stone-free rate was 100% in each group at postoperative week 2. Operative time was not longer when a stent was placed ($P = 0.43$). AFA was done approximately in three out of four patients in each group. The postoperative pain, irritative voiding symptoms and complications are summarized in Table 2. The mean postoperative pain score ± SD was statistically similar in both groups ($P > 0.05$). However, the mean irritative voiding symptoms score ± SD in the stented group was significantly higher than those in the unstented group ($P < 0.05$). Hematuria was more prevalent in the stented group, although without statistical difference ($P > 0.05$). Hematuria lasted 10 days in one patient in the stented group and disappeared after removal of the stent. One patient (4.5%) in the unstented group required re-hospitalization for severe flank pain with fever (>38°C) compared to one patient (4.7%) in the stented group for proximal stent migration ($P > 0.05$). Patients who had severe flank pain with fever resolved after

Table 1 Characteristics of patients in two groups

	Stented	Unstented	*P* value
No. patients	21	22	
No. males:females	12:9	12:10	>0.05
Mean ages, years ± SD (range)	35.28 ± 9.0 (18–52)	36.09 ± 9.7 (19–56)	0.85
Mean stone size, mm ± SD (range)	13.28 ± 2.5 (11–22)	12.90 ± 2.4 (11–21)	0.49
Mean operative time, min ± S.D. (range)	40.19 ± 9.4 (25–66)	38.40 ± 10.0 (23–70)	0.43
No. AFA (%)	15 (71.4%)	16 (72.7%)	>0.05
Mean AFA, no. ± SD (range)	1.71 ± 1.1 (0–3)	1.81 ± 1.2 (0–3)	0.84
No. re-hospitalization (%)	1 (4.7%)	1 (4.5%)	>0.05
Mean hospitalization time, days ± SD (range)	1.76 ± 0.7 (1–3)	1.68 ± 0.7 (1–3)	0.68

AFA Additional forceps application

Table 2 Postoperative pain, irritative voiding symptoms and complications

	Stented	Unstented	*P* value
Mean flank pain score ± SD (range)	1.95 ± 0.8 (1–4)	1.77 ± 0.6 (1–4)	0.55
Mean lower abdominal pain score ± SD (range)	1.52 ± 0.6 (1–3)	1.54 ± 0.7 (1–3)	1.0
Mean dysuria score ± SD (range)	2.28 ± 0.7 (1–4)	1.54 ± 0.6 (1–3)	0.002
Mean frequency score ± SD (range)	2.23 ± 0.8 (1–4)	1.54 ± 0.7(1–3)	0.007
Mean urgency score ± SD (range)	2.05 ± 0.5 (1–3)	1.45 ± 0.5(1–2)	0.001
No. hematuria (%)	9 (42.8 %)	7 (31.8%)	>0.05
No. stent migration (%)	1 (4.7%)	–	
No. ureteral stricture (%)	–	–	

24 h with medical treatment. Proximal stent migration was determined on plain abdominal X-ray at postoperative week 2, and the DJ stent was removed, using a ureteroscope under general anesthesia. Stricture formation was not demonstrated in either group at the 3 months follow-up EXU.

Discussion

Stents have routinely been placed after URSL to minimize the risk of flank pain secondary to ureteric edema, to facilitate the passage of residual stone fragments and decrease the risk of ureteric stricture [1, 2]. However, ureteral stenting may be associated with significant morbidity such as irritative voiding symptoms, pain, and hematuria. Furthermore, it may lead to various complications such as migration, stent fracture, ureteral erosion, encrustation, urinary infection, knotting and development of ureteral fistula [2]. In addition, experimental studies have also criticized the role of the stent in the ureter. Ramsay and associates [12] showed that the placement of a DJ stent in the unobstructed pig kidney actually causes high intrarenal pressure; the effect was more marked during the first day. Fine and associates [13] showed by fluoroscopy that reflux occured through the center of the stent. It is advisable that all patients be kept on a urethral foley catheter for the initial 24–48 h so as to minimize the inevitable vesico-ureteral reflux. Ryan and associates [14] in a canine experiment showed that ureteral stent placement reduced pelvic and ureteral motility, and delayed stone transit time. Clinical studies have also revealed that ureteral stenting impedes stone passage [15].

With the recent developments of small caliber ureteroscopes and with the advances in intracorporeal lithotripsy devices, it is now possible to perform URSL in most patients without dilation and most of the ureteric calculi, also large or impacted, can be fragmented successfully [16, 17]. As a result, URSL has become a minimally invasive and reliable technique for the management of ureteric calculi. Many urologists would agree that some morbidity of ureteroscopy is now not from the procedure itself but from the stent that is left indwelling afterwards. The question then becomes one of quality of life related to the well-known symptoms associated with stents and secondly one of the cost. A new validated quality of life and impact questionnaire has been developed and has shown that urinary symptoms and pain associated with stents have reduced the quality of life of up to 80% of patients [18]. Furthermore, removal of the stent using local anesthesia is more traumatic than the initial ureteroscopy procedure using general anesthesia. Routine placement of a ureteral stent after URSL adds to the overall cost of the procedure in addition to the cost of cystoscopic removal of the stent. Netto and associates [5] assessed the cost effectiveness of this and concluded that nonstented ureteroscopy is cheaper by 30%.

The desire to improve a patient's quality of life has encouraged investigations designed to eliminate the routine use of stents after uncomplicated URSL. There are 11 prospective, randomized trials in the recent literature which have re-examined use of stents after uncomplicated URSL, all showing no difference in stone-free status between stented and unstented groups. Conversely, stented patients were documented to have significantly higher pain scores [8, 9], more frequent voiding symptoms [9, 10], prolonged hematuria [7], longer operative times [5, 10] and substantial overall cost [5, 10, 11]. All of these studies except that of Damiano and associates [6] have shown that stenting after uncomplicated URSL is warranted. However, these studies excluding that of Damiano and associates included stones relatively smaller than 1 cm. In the study by Damiano and associates, postoperative pain in the unstented group was much higher than in the stented group on day 3, however similar at 7 and 15 days. Voiding urinary symptoms, hematuria were more prevalent in the stented group, although without a statistically significant difference. In our study, there was not any statistical difference between stented and unstented groups for postoperative pain and hematuria; however, voiding irritative symptoms were much higher in the stented group. All of the patients in our study had lower ureteral stones, and AFA was used in 73% patients without a stent, but in the study of Damiano and associates, 58% of patients without a stent had lower ureteral stones and AFA

was used in 46% of patients. They advocated routine stenting primarily on the basis of 12% without a stent who return to hospital with pain, and half of this group then required stenting. They believe that the technique of ureteroscopy based on stone fragmentation with a Swiss lithoclast ballistic lithotripter produces larger fragments that potentially may cause more problems in terms of spontaneous passage. Teichman and associates [19] showed that fragments ≥4 mm are produced by all types of endoscopic lithotrites, with the exception of holmium: YAG laser. They found that patients with fragments ≥4 mm after ureteroscopy have an unacceptably high requirement for repeat ureteroscopy [19]. Ureteroscopic Ho: YAG laser lithotripsy is regarded as the "gold standard" in ureteroscopic stone treatment; the ESUT survey however showed that the most common intracorporeal lithotripter is the pneumatic lithotripter (69.8%) followed by the laser lithotripter (24%) and electrohydraulic instruments [20]. The pneumatic ballistic lithotripter uses an extremely simple method with compressed air, at lower cost, providing good results [16, 17, 21]. Matthew and associates [1] favor the use of basket or graspers for stone extraction, especially in the passively dilated ureter. Keeley and associates [22] recommended using baskets or graspers to remove fragments produced by the ballistic lithotripter to reduce the need for repeat ureteroscopy. Similarly, we used AFA in most of the patients to remove fragments ≥4 mm after lithotripsy and no patient required repeat ureteroscopy or stenting due to remnant stone in each group. Only one patient (4.5%) in the unstented group required hospitalization due to severe flank pain with fever. However, in the stented group, one patient (4.7%) required ureteroscopic stent removal due to proximal migration, and one patient required stent removal due to prolonged hematuria. We believe that the use of AFA to remove the fragments ≥4 mm may decrease the risk of postoperative morbidity and the need for re-hospitalization after uncomplicated URSL with a pneumatic lithotripter for large distal ureteral calculi.

The development of ureteral stricture is a well-established complication of ureteroscopic procedures. However, the incidence of ureteral stricture has been dramatically decreased in recent years due to the advances achieved in endourologic technology. Harmon and associates [23] reported the rate of stricture formation after ureteroscopy to be 0.5% in 1992 compared to 1.5% 10 years earlier. In a recent study, Krambeck and associates [24] reported the rate of stricture formation to be only 0.2% in their large series. The mechanism of stricture formation has not yet been completely elucidated, and it is likely to be multi-factorial. However, direct mechanical trauma (perforation or avulsion), relative ischemia from the use of large diamater ureteral instruments and thermal injury have been implicated as contributing factors in stricture formation [25]. Furthermore, removal of all the stone fragments is important to prevent additional chronic mucosal inflammation leading to stricture formation [26]. Some authors have suggested that stenting after ureteroscopy may decrease the incidence of postoperative stricture formation [23, 27]. However, no study has examined whether stenting can actually prevent a ureteral stricture. Denstedt and associates [8] examined 58 patients in their randomized series with ultrasound at 3 months of post-ureteroscopy follow-up; no stricture formation was identified in either group. None of the patients in this series underwent balloon dilation of the distal ureter. In another randomized trial, Chen and associates [28] used a 6-F rigid ureteroscope in all patients without balloon dilation of the distal ureter. An ultrasound performed 4 weeks post-ureteroscopy did not reveal any evidence of stricture formation. Similarly, in our study, none of the patients underwent balloon dilation and stricture formation was not demonstrated in either group at the 3 months follow-up EXU. In contrast, Damiano and associates [6] reported that the ureteral stricture rate was 3.8% in each group at the 6 months follow-up EXU. However, they did not find any statisticial difference between stented and unstented groups. The rate of stricture formation in our study is much lower than that in their study. This situation may be explained by the following reasons: first, patients who had severe mucosal damage in the ureter during operation were excluded in our study; second, we used AFA in most of the patients to remove the fragments ≥4 mm to prevent additional chronic mucosal inflamation leading to stricture formation.

Recently, the AUA ureteral stones clinical guidelines panel and EAU guidelines on urolithiasis reported that stenting after uncomplicated ureteroscopy is optional. In this report, the indications for stenting after the completion of URSL were noted. These include ureteral injury, stricture, solitary kidney, renal insufficiency, or a large residual stone burden [29]. Our findings do not show any controversy with those in this report; we share this view and even suggest that DJ stenting after uncomplicated URSL may not be necessary in distal ureteral stones larger than 1 cm.

Conclusions

Routine ureteral stenting after uncomplicated URSL without dilation using a pneumatic lithotripter for lower ureteral stones larger than 1 cm does not appear to be necessary if AFA is used to remove fragments ≥4 mm, thereby reducing morbidity of patients and the risk of re-hospitalization. However, the exact management of the routine need for stenting after uncomplicated URSL for lower ureteral stones larger than 1 cm should be determined in larger randomized studies.

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