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The efficacy and safety of ureteral dilation and long-term type ureteral stent for patients with ureteral obstruction

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ABSTRACT

Objective: This study was conducted to investigate the efficacy and safety of ureteral dilation and placement of a long-term ureteral stent for patients with various types of ureteral obstructions.

Methods: We retrospectively reviewed the records of 39 patients presenting with ureteral obstruction secondary to malignant strictures (n = 9) or nonmalignant strictures (n = 30). The mean age of these patients was 55.8 ± 16.1 years (range, 13–87 years). All patients underwent retrograde ureteral balloon dilation and placement of one to three ureteral stents. Stent patency rate and complications including febrile urinary tract infection, stent encrustation, and stent fragmentation were recorded.

Results: A total of 117 ureteral stents were implanted during the 83 procedures. Three stents were placed in seven patients and two stents in 20 patients. The patency rate was 95.2% with a mean 75-day follow-up. There was no encrustation in 104 stents and Grade 1 in 13 stents. The patency rate was similar in seven patients with malignant strictures and those with nonmalignant strictures (100% vs. 94.7%, p = 0.57). However, three episodes of febrile urinary tract infection were noted only in patients with malignant strictures. The improvement of hydronephrosis and complications were also comparable between those patients with ureteral stents indwelling for >90 days and those for <90 days. No stent fragmentation was found in any of the patients.

Conclusion: We demonstrated that ureteral dilation and placement of a single or multiple ureteral stents was effective and safe for patients with ureteral obstruction.

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1. Introduction

Most urologists have used double-J ureteral stents to treat ureteral obstruction from various causes for at least 3 decades.1,2 With improvements in modern endourological techniques and stent biomaterials, most obstructed ureters can be successfully stented. However, the long-term failure rate of stents has been high, especially in cases of malignant ureteral compression.1 Segmental metal mesh stents and Resonance metallic stents seemed promising at the beginning, but the long-term results were not outstanding.2–4 Although the exact cause of stent failure is not completely understood, stent lumen compressed by external tumors or occluded by mucus, debris, and stone may be the causes.5 Reviewing previous studies, it was noted that most authors managed ureteral obstructions by placing a stent for the ureteral stricture without dilation. In addition, some urologists advocated placing multiple ureteral stents to provide better drainage for patients who failed with a single stent.6 In 2001, Rotariu et al7 reported a simultaneous placement of two ipsilateral ureteral stents after ureteral dilation. However, this study was small, and only enrolled seven patients with malignant strictures. Thus, we applied this concept to a large-scale study to present our early experiences of performing ureteral dilation first, followed by placing additional stents as needed to treat the ureteral obstruction.

2. Materials and methods

The Institutional Review Board and Ethics Committee of En Chu Kong Hospital, Taipei, Taiwan approved this study (Identifier ECK-IRB1021006) and waived the informed consent requirement. Data were retrospectively obtained from the medical records of 39 patients who presented with unilateral and/or bilateral ureteral obstruction and received long-term-type double-J ureteral stent (Bioteq, Taipei, Taiwan) insertions from January 2009 to December 2013. Of these patients, 21 were men and 18 were women. The mean age of these patients was 55.8 ± 16.1 years (range, 13–87 years). All patients underwent retrograde ureteral balloon dilation and placement of one to three ureteral stents. Stent patency rate and complications including febrile urinary tract infection, stent encrustation, and stent fragmentation were recorded.

Results: A total of 117 ureteral stents were implanted during the 83 procedures. Three stents were placed in seven patients and two stents in 20 patients. The patency rate was 95.2% with a mean 75-day follow-up. There was no encrustation in 104 stents and Grade 1 in 13 stents. The patency rate was similar in seven patients with malignant strictures and those with nonmalignant strictures (100% vs. 94.7%, p = 0.57). However, three episodes of febrile urinary tract infection were noted only in patients with malignant strictures. The improvement of hydronephrosis and complications were also comparable between those patients with ureteral stents indwelling for >90 days and those for <90 days. No stent fragmentation was found in any of the patients.

Conclusion: We demonstrated that ureteral dilation and placement of a single or multiple ureteral stents was effective and safe for patients with ureteral obstruction.

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The mean age of the patients was 55.8 ± 16.1 years (range, 13–87 years). The underlying diseases causing the ureteral obstructions were stricture due to long-term impacted ureteral stones (n = 17, 43.6%), benign intrinsic strictures (n = 10, 25.6%), malignant tumors (n = 9, 23.1%), and iatrogenic ureteral injuries (n = 3, 7.7%). The upper ureteral stricture was noted in 25 (64.1%) patients, middle ureteral stricture in 11 (28.2%) patients, and lower ureteral stricture in three (7.7%) patients. The ureteral obstructions were detected using ultrasonography, intravenous urography, and/or computer tomography before and after stenting. Stent failure was defined as insufficient drainage, followed by redilation of the pelvocaliceal system based on comparative image assessment during the follow-up. In cases of reobstruction, percutaneous nephrostomy drainage was suggested to relieve the obstruction and improve renal function. Complications including febrile urinary tract infection (UTI), stent encrustation, and fragmentation of the indwelling catheter were recorded for analysis. The score of stent encrustation was quantified by the following visual analog score: 0 (no visible stent biofilm), 1 (visible stent biofilm), 2 (bladder coil encrustation), 3 (<50% of the entire stent encrusted), and 4 (>50% of the stent encrusted).

Fig. 1. Fluoroscopy shows middle ureteral stenosis (arrow) with proximal hydroureter.

Fig. 2. Fluoroscopy shows ureteral dilation using a balloon dilator. One indentation (arrow) was a previous stricture site.

Fig. 3. Plain kidney, ureter, and bladder radiograph shows two double-J stents placed in the left ureter.

The ureteral stents were inserted using retrograde techniques. Patients were placed in a lithotomy position with light intravenous anesthesia or general anesthesia. All procedures were performed under fluoroscopic guidance. First, a 21F cystoscopy (Richard Wolf GmbH, Knittlingen, Germany) was performed, and a 0.035-inch hydrophilic floppy Nitinol core guide wire, HiWire (Cook Medical, Bloomington, IN, USA), was inserted into the ureteral orifice. Next, using a 6.5F semirigid ureteroscope (Richard Wolf), a diagnostic ureteroscopy was performed to examine the constricted portion of the ureter. When the stricture location was identified, 10–20 mL contrast medium, Telebrix (Guerbet, Villeprintre, France) in a 1:1 mixture with normal saline was injected through the ureteroscope to confirm the length and severity of the ureteral stricture (Fig. 1). Then, a secondary floppy guide wire was inserted into the ureter. After removing the ureteroscope, a 5.8F balloon dilation catheter, UroMax Ultra (Boston Scientific, Natick, MA, USA), was inserted into the ureter through the guide wire. About 3 mL contrast medium was injected to inflate the balloon, and the stricture site was dilated for at least 10 minutes (Fig. 2). Another diagnostic ureteroscopy was examined, and in the case of inadequate lumen at the stricture site, ureteral dilation was repeated. We consciously tried to place two or three 6F double-J ureteral stents (Figs. 3 and 4) at the end of procedures depending on our clinical judgment. Because previous studies and our previous experiences have found that a single ureteral stent might not be sufficient to relieve obstruction for patients with ureteral obstruction, it became our routine procedure to place multiple stents if possible after 2009. The reason for placing more stents was to increase the theoretical space between the parallel stents (Fig. 5). In cases where we encountered difficulty inserting the second ureteral stent, only one ureteral stent was placed in the ureter. The position of the ureteral stents was checked finally by fluoroscopy.

Mean and standard deviations were used for parametric, continuous variables. Categorical data were expressed as numbers and percentages. Mean values of continuous variables were compared using the Mann–Whitney U-test, whereas categorical variables were compared using the Fisher exact test. A p value <0.05 was considered statistically significant.
3. Results

A total of 117 double-J ureteral stents were placed during the 83 procedures in the 39 patients. We changed the ureteral stents in nine patients with malignant strictures regularly until they passed away. Three ureteral stents were inserted in seven patients and two stents in 20 patients. The mean length of the ureteral stricture was 1.2 ± 0.5 cm (range 0.4–2.5 cm). The mean placement duration was 75.3 ± 15.6 days (range 55–140 days). Improvement of hydronephrosis was found in all patients with three stents and in 19 (95%) of the patients with two stents. Persistent hydronephrosis was only noted after three procedures (4.8%) in two patients with a single stent. Among the 30 patients with nonmalignant strictures, one (3.3%) patient underwent open repair of the ureteral stricture because of persistent hydronephrosis after two times of endoscopic management. Three patients (7.7%) had postoperative febrile UTIs, and all patients recovered after adequate treatment with broad-spectrum antibiotics. Grade 0 encrustation was noted in 108 ureteral stents, Grade 1 was noted in 13 (11.1%) ureteral stents, and no encrustation was noted at Grades 2–4 was noted. No fragments of the ureteral stent were noted at Grades 2–4.

Table 1 compares the patency rate and safety of stents in patients with malignant and nonmalignant strictures. In nine patients with malignant strictures, 21 procedures with 24 ureteral stents were performed. In the other 30 patients with nonmalignant strictures, 62 procedures with 93 stents were performed. Patients with malignant strictures had a borderline significantly longer duration of indwelling ureteral stent (81.2 ± 15.0 vs. 73.4 ± 14.2, p = 0.06) and significantly more episodes of febrile UTIs (14.3% vs. 0%, p = 0.01) than those with nonmalignant strictures. However, the stent patency rate and stent encrustation were comparable between the two groups.

We further analyzed the data for 21 procedures in 10 patients where the double-J ureteral stents remained for more than 90 days. Table 2 shows the comparison of efficacy and safety between patients with indwelling ureteral stents for >90 days and <90 days. The improvement rate of hydronephrosis was comparable in both groups. In addition, the complication rate including febrile UTIs and stent encrustation was not significantly different between the two groups.

4. Discussion

In this retrospective study, we demonstrated the efficacy and safety of mid- to long-term indwelling ureteral stents in patients with various etiologies of ureteral obstruction. A highly successful patency rate (95.2%) was noted during the mean 75-day follow-up. Excellent results were also noted in some patients with multiple stents. Only very mild stent encrustation and a few febrile UTIs occurred.

In our study, the patency rate was comparable between the malignant strictures and nonmalignant strictures. This result was similar or superior to the results of other studies using conventional stents or even metallic stents.3,4,6,9,10 This good outcome may be attributable to our additional step of ureteral dilation using a high-pressure balloon dilator instead of simply placing a stent. We also routinely used fluoroscopy to confirm the stent site. These
sophisticated and time-consuming procedures are important to resist the progressive extrinsic compression of metastatic cancer. However, a higher febrile UTI rate was noted in our cancer patients. These patients were concomitantly treated by chemotherapy and/or radiotherapy. Poor nutrition and lowered immunity may increase the higher infection rate in these compromised patients. Thus, prophylactic strong broad-spectrum antibiotics were suggested prior to the ureteral stent placement.

We also noted ongoing long-term efficacy and safety in patients with placement durations of >90 days. No stent encrustation or UTI was noted in one case with the highest indwelling period of 140 days. This finding is important because our experience has indicated that inserting ureteral stents for only a few weeks is insufficient for some patients with refractory benign ureteral stricture. Long-term indwelling ureteral stents are necessary to resolve the stricture completely. One in vitro encrustation study showed that polyurethane stents, our stent material, had a low encrustation rate.\(^\text{11,12}\) Thus, our preliminary result suggests that implanting ureteral stents for more than 3 months can be safe and effective.

Since Borin et al.\(^\text{13}\) reported the first case of Resonance stents to relieve malignant ureteral obstruction in 2006, some studies have reported that the metallic stent, with its unique alloy design, has the benefit of offering longer resistance against extrinsic compression. In many studies, the median duration ranged from 3.5 months to 11 months, depending on the patient’s characteristics and the etiology of the obstruction.\(^\text{3,4,13,14}\) Recently, Chow et al.\(^\text{4}\) reported the largest series (involving 117 stents), indicating that the median duration was 5.8 months and suggesting that the preoperative serum creatinine level and presence of lower gastrointestinal tract cancer were significantly associated with stent failure. The 3-month and 6-month patent rates were 65% and 44.4%, respectively. Because of the varying etiologies, different follow-up period, and stent numbers among these studies, we cannot conclude which method is better, although our patent rate was high at 95% with 75 days of follow-up.

The use of two ipsilateral ureteral stents for relief of ureteral obstruction was first proposed by Liu and Hrebinko\(^\text{1}\) in 1998. They placed two 4.7 F parallel stents in four patients who had persistent azotemia and hydropnephrosis after a single 6F double-J stent. They declared that the main advantages were the increased stiffness of two stents to reduce kinking and the increased potential space between the stents to preserve flow passage. In 2002, Froemer et al.\(^\text{15}\) used two double pigtail stents for malignant ureteral obstruction and found that the simultaneous placement of two ipsilateral stents provided more resistance against lumen compression. As for the safety concerns regarding multiple stents, to our knowledge, there is no in vivo or ex vivo report of single or multiple ureteral stents inducing ureteral mucosal ischemia. In our series, we further increased up to three stents in seven cases. All seven patients had hydropnephrosis improvement, and the mean placement duration was 69.9 days. Interestingly, they had few irritative symptoms and noted that the stent-related flank pain was tolerable.

It is not difficult to resolve the technique problem, wherein the first ureteral stent would be pushed upward during the insertion of the second stent. First, we would try to change the insertion angle to avoid push-back. Second, in case of invisible bladder coil, we would not perform ureteroscopy to grasp the stent downward using ureteral forceps because many stents would slip downward spontaneously during the follow-up period. Third, the invisible ureteral stent might be removed simultaneously during the procedure of removing a ureteral stent. Finally, if all of these procedures failed, we could perform ureteroscopy and use ureteral forceps to remove the ureteral stent.

The study has several limitations. First, this is a retrospective study. Second, the number of indwelling ureteral stents was not fixed and depended on the clinical conditions. A prospective randomized trial is still needed to decide whether more stents can bring more benefits to these patients. Third, the timing of removing or changing the ureteral stent was based on clinical judgment, not on a fixed interval. We did find that the time interval of stent change was every 3–6 months in several studies. However, because the efficacy and safety of ureteral stents (Bioteq) had not been completely understood in our preliminary study, we chose a slightly shorter duration than that used in other studies for safety considerations. In addition, in case of persistent hydropnephrosis or febrile UTI, we changed the ureteral stents early. Thus, the mean period of stent change was shortened (mean 75 days). Finally, because some urologists have advocated the efficacy and safety of metallic stents in single-center observations, future prospective, multicenter, randomized trials to compare the cost and benefit between metallic and polyurethane stents are needed.

5. Conclusion

Our study demonstrated that benign or malignant ureteral obstructions could be treated effectively and safely with single or multiple ureteral stents. Long-term use, i.e., >3 months, is sufficient for some selected patients and appears feasible. Careful ureteral dilatation prior to stenting is suggested for better results.

Conflicts of interest

The authors declare that they have no financial or non-financial conflicts of interest related to the subject matter or materials discussed in the manuscript.

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