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Original Article

Metallic stent in the treatment of ureteral obstruction: Experience of single institute

Chien-Chang Li [a], Jian-Ri Li [a,c], Li-Hua Huang [a], Siu-Wan Hung [b], Cheng-Kuang Yang [a], Shiang-Shian Wang [a], Chuan-Su Chen [a], Yen-Chuan Ou [a], Hao-Chung Ho [a], Chung-Kuang Su [a], Wen-Ming Chen [a], Chen-Li Cheng [a], Chi-Rei Yang [a], Kun-Yuan Chiu [a,*]

[a] *Division of Urology, Department of Surgery, Taichung Veterans General Hospital, Taichung, Taiwan, ROC*
[b] *Department of Radiology, Taichung Veterans General Hospital, Taichung, Taiwan, ROC*
[c] *Institute of Molecular Toxicology, Chung-Shan Medical University, Taichung, Taiwan, ROC*

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Abstract

Background: The Resonance® metallic stent has been reported to be sufficient for the management of malignant extrinsic ureteral obstructions within a 12-month time period. To determine the effectiveness in each specific patient group, we report our experience using the Resonance® stent in the treatment of ureteral obstructions.

Methods: We retrospectively reviewed 20 patients (23 stents) who successfully received the Resonance® metallic stents and divided them into a patent group ($n = 19$) and an obstructive group ($n = 4$) according to the treatment results. Twenty-one stents were inserted via cystoscopy or ureteroscopy in a retrograde fashion. The remaining two were inserted via percutaneous nephrostomy in an antegrade manner. Follow-up serum creatinine measurements and sonography were performed. The overall ureteral patency rate and the risk of stent failure were evaluated.

Results: The overall ureteral patency rate was 82.6% (19/23). Patients with previous radiotherapy had a 50% (4/8) patency rate which was significantly lower than non-radiotherapy patients (100%, 15/15, $p = 0.028$). Malignant obstructions in those other than radiotherapy patients had a 100% patency rate (5/5). Benign obstructions in those other than radiotherapy patients had a 100% patency rate (10/10). In the radiotherapy patients, the mode of therapy did not dominate the stent outcome.

Conclusion: Patients with ureteral obstructions can be treated sufficiently with the Resonance® metallic stent. Patients who had gynecological malignancies and received radiotherapy had a higher failure rate after Resonance® metallic stent insertion.

Keywords: double-J stent; metallic stent; radiotherapy; ureteral obstruction

1. Introduction

Ureteral obstruction caused by malignancy or complicated benign entities is challenging for urologists, not only due to the hazard of deteriorating renal function, but also difficulty in treatment decision making. In patients who have malignant ureteral obstruction, permanent reconstruction of the obstructed ureter is not practical because of low life expectancy. In patients who have complicated benign ureteral obstruction, complicated and unpredictable surgical procedures usually make patients hesitate to proceed with intervention. Despite surgical reconstruction, ureteral stents and percutaneous nephrostomy (PCN) are common solutions for the treatment of ureteral obstruction.[1] A ureteral stent is beneficial for the convenience of patient activities. The indwelling stent avoids the hazards of catheter dislodgement and the inconvenience of foreign bodies resulting from PCN.[1,2] Various designs of ureteral stents have been reported, and the results have varied. Polymeric ureteral stents

* Corresponding author. Dr. Kun-Yuan Chiu, Division of Urology, Department of Surgery, Taichung Veterans General Hospital, 160, Section 3, Taichung-Kang Road, Taichung 407, Taiwan, ROC.
E-mail address: chiu37782002@yahoo.com (K.-Y. Chiu).

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have been reported to achieve successful patency rates from 59% to 84% in malignant extrinsic compression.[3,4,5,6] Owing to the strong compression forces of tumors, ureteral obstruction is still inevitable in some cases. Metallic mesh stents were developed for long-term ureteral stents in either malignant extrinsic compression or intrinsic stenosis, and the patency rate reached 100% in some studies.[7,8,9,10] However, once complications develop (including tumor ingrowth, migration and encrustation), management is difficult because of the mesh fixation design.[1,2] The Resonance® metallic stent (Cook Medical, Bloomington, IN, USA) has been introduced with a high success rate in the treatment of malignant extrinsic compression other than benign intrinsic stenosis.[11,12] It is lumenless and solid, with a spiral design so that it can withstand strong external compression forces and allow urine passage from its grooves. The nickel–chromium–cobalt metal composition also has a low stone encrustation rate, resulting in a long period of maintenance.[11,12] However, the patients that might be at high risk of ureteral stent failure have not been studied. Here, we report our experience using the Resonance® metallic stent in the treatment of malignant extrinsic ureteral compression and benign intrinsic ureteral stenosis.

2. Methods

From January 2008 to August 2009, 22 patients with upper urinary tract obstruction were treated with Resonance® metallic stent insertion. All patients gave informed consent before the operation. The definition of obstruction is based on new onset of dilated renal pelvicalyceal system, from even ultrasound or computed tomography scan, with or without the assistance of diuretic renography using nuclear medicine.

The procedures failed in two patients with cervical cancer after radiotherapy. The other 20 patients (5 male and 15 female) were included. Patients who were 170 cm or taller were treated with 24–26-cm Resonance® metallic stents, and those less than 170 cm tall were treated with 22–24-cm stents. All Resonance® metallic stents were 6 Fr in diameter. No patients received balloon dilatation before stent placement. The patients' characteristics and disease etiologies are listed in Table 1. In the malignancy patients, seven out of 14 (5 cervical cancer, 1 endometrial cancer, and 1 leiomyosarcoma) were in a disease-free condition, and no definite retroperitoneal tumor external compression was identified from computed tomography before stent insertion.

Resonance® metallic stents were inserted using a retrograde or antegrade approach. With either approach, a hydrophilic guidewire must initially be inserted through both ends of the renal pelvis and the bladder, followed by the placement of a stent outer sheath along the guidewire. The outer sheath contained two components: a 6 Fr ureteral dilator and an 8.3 Fr introducer sheath. After removal of the ureteral dilator, the stent could be pushed through the introducer sheath to obtain double-coiler positioning. The retrograde approach was performed in patients who already had a ureteral stent or those for whom ureteroscopy could be accessed under fluoroscopy with either local or laryngeal mask anesthesia. Antegrade insertion from PCN was performed by a radiologist under fluoroscopic guidance.

Table 1
General information of patients receiving Resonance® metallic stents

	No. of patients	
Age	20	53.9 ± 3.5 (years)
Follow-up	20	5.1 ± 1.0 (months)
Sex		
Female	15	75%
Male	5	25%
Stent site		
Left	7	35%
Right	10	50%
Bilateral	3	15%
Obstruction site		
UPJ	2	10%
Upper	2	10%
Middle	2	10%
Lower	14	70%
Etiology of obstruction		
Malignant external compression	7	35%
Benign stenosis	13	65%
Disease etiology		
Cervical cancer	6	30%
Colon cancer	3	15%
Endometrial cancer	2	10%
Gastric cancer	1	5%
Cholangial cancer	1	5%
Retroperitoneal leiomyosarcoma	1	5%
Endometriosis	2	10%
UPJO	2	10%
Chronic cystitis	1	5%
Retroperitoneal fibrosis	1	5%
Radiotherapy		
Yes	8	40%
No	12	60%
Operation method		
Retrograde	18	90%
Antegrade	2	10%
Anesthesia		
LA	11	55%
LMA	9	45%

UPJ = ureteropelvic junction; UPJO = ureteropelvic junction obstruction; LA = local anesthesia; LMA = laryngeal mask anesthesia.

All patients received follow-up with transabdominal ultrasonography and serum creatinine level measurements until the end of life or stent failure. Stent patency was defined as remission of dilated renal pelvicalyceal system or stable condition without clinical symptoms and improved serum creatinine level. The diagnosis of radiological remission was according to the results of sonography recorded by a radiologist. The stent-related symptoms after procedures were recorded during outpatient follow-up. Symptoms were graded on the basis of severity and frequency. Grade 1 was mild and transient; grade 2 was moderate or persistent; grade 3 was severe; and grade 4 was life-threatening. Exchange of the Resonance® metallic stents was performed by initially removing the stents, followed by retrograde ureteroscopy. The

stent delivery procedures are described above. The exchange period was indicated at 12 months after the previous stents had been placed. Fisher's exact test is used to measure the impact of patients' sex, anesthesia type, operation methods, radiation and malignancy. The χ^2 test was used for comparison of the stent sites and obstruction sites. Wilcoxon signed ranks test was used to compare the changes before and after stent placement.

3. Results

Among the 23 successfully inserted Resonance® metallic stents, two were removed due to persistent ureteral obstruction and two due to acute pyelonephritis. The overall patency maintenance rate was 82.6% (19/23). The patient and disease characteristics are listed in Table 1. The mean follow-up time was 5.1 months (range, 0.5–18.2 months). The stent patency rate did not correlate with sex, stent site, anesthesia method, obstruction site, disease condition, or operation method. In the patients receiving radiotherapy, 50% (4/8) had ureteral obstruction after insertion of the Resonance® metallic stent, and the patency rate was significantly lower than in the non-radiotherapy group (100%, 15/15, $p = 0.008$, Table 2). Stents for malignant obstructions in those other than radiotherapy patients had a 100% patency rate (5/5).

Stents for benign obstructions in those other than radiotherapy patients also had a 100% patency rate (10/10). The four radiotherapy patients with obstructive stents had gynecological diseases (3 cervical and 1 endometrial cancer). There was no developed stent encrustation found after removal or change of the stents. Overall, 65.2% (15/23) of the patients had stent-related symptoms. Abdominal pain accounted for the majority (5/23, 21.7%), followed by flank pain (3/23, 13%), bladder pain (3/23, 13%), dysuria (2/23, 8.7%), and acute pyelonephritis (2/23, 8.7%). Only two patients reported grade 2 symptoms of dysuria, and the others were all grade 1. Both of the patients with acute pyelonephritis still had ureteral obstruction after stent placement and underwent stent removal after infection. The patients' variable changes during the stent procedure between the patent and the obstructive group are listed in Table 3. Patients in the patent group were younger and had a longer follow-up period than those in the obstructive group. Although the pre- and postoperative creatinine changes did not show statistical significance between the two groups, patients in the patent group had lower pre- and postoperative creatinine level and smaller deviation of the creatinine value.

In the patients who received radiotherapy, six had cervical cancer and two had endometrial cancer. Six (5 cervical and 1 endometrial cancer) patients were in a cancer-free condition. One patient who had external compression cervical cancer when the Resonance® stent was inserted had stent obstruction and removal within 1 month. The other patient, who had an enlarging mass from endometrial cancer, maintained patency after stent placement. The mode of radiotherapy among these eight patients varied. In the four obstructive stent patients, two received three-dimensional conformal radiotherapy and the other two received intensity-modulated radiation therapy plus remote afterloading brachytherapy (Table 4).

Table 2
Patency comparison in different variables

		Patent ($n = 16$)		Obstructive ($n = 4$)		p
		n	(%)	n	(%)	
Sex	Female	11	(68.8)	4	(100.0)	0.530[a]
	Male	5	(31.2)	0	(0.0)	
Side	Left	5	(31.2)	2	(50.0)	0.585[b]
	Right	8	(50.0)	2	(50.0)	
	Bilateral	3	(18.8)	0	(0.0)	
Anesthesia	LA	9	(56.2)	2	(50.0)	1.000[a]
	LMA	7	(43.8)	2	(50.0)	
Obstruction site	UPJ	2	(10.5)	0	(0.0)	0.466[b]
	Upper	3	(15.8)	0	(0.0)	
	Middle	1	(5.3)	1	(25.0)	
	Lower	13	(68.4)	3	(75.0)	
Disease condition	Benign	13	(68.4)	3	(75.0)	1.000[a]
	Malignant	6	(31.6)	1	(25.0)	
Operation method	Retrograde	18	(94.7)	3	(75.0)	0.380[a]
	Antegrade	1	(5.3)	1	(25.0)	
Radiotherapy	No	15	(78.9)	0	(0.0)	0.008[a]
	Yes	4	(21.1)	4	(100.0)	

Sex, side and anesthesia were counted by patient number, overall $n = 20$; the rest of the variables were counted by stent number, overall $n = 23$. [a]Fisher's exact test; [b]χ^2 test. LA = local anesthesia; LMA = laryngeal mask anesthesia; UPJ = ureteropelvic junction.

Table 3
Variable comparison between two groups

	No. of patients	Mean	SEM	p
Age				
Patent	16	50.38	3.74	0.016
Obstructive	4	70.20	4.87	
Follow-up (mo)				
Patent	16	6.09	1.14	0.017
Obstructive	4	1.29	0.37	
Patent				
Preoperative Cr	16	1.66	0.20	0.101
Postoperative Cr	16	1.57	0.19	
Obstructive				
Preoperative Cr	4	2.20	0.47	0.465
Postoperative Cr	4	2.20	0.91	

SEM = standard error of mean; Cr = serum creatinine.

Table 4
Characteristics of gynecological malignancy patients receiving radiotherapy

Patient no./Age (yr)	Side	Cancer	Condition	Radiotherapy	Patent/obstructive
1/52	Left	Endometrial	NED	IMRT+RAB	Obstructive
2/71	Right	Cervical	NED	3DCRT	Obstructive
3/78	Right	Endometrial	With	IMRT+RAB	Patent
4/47	Right	Cervical	NED	IMRT + RAB	Patent
5/55	Right	Cervical	NED	3DCRT	Patent
6/71	Left	Cervical	With	IMRT + RAB	Obstructive
7/56	Left	Cervical	NED	IMRT + RAB	Patent
8/77	Right	Cervical	NED	3DCRT	Obstructive

NED = no evidence of disease; IMRT = intensity modulated radiation therapy; RAB = remote afterloading brachytherapy; 3DCRT = three-dimensional conformal radiotherapy.

4. Discussion

Ureteral obstruction is a common issue among urological patients. Therapeutic options for releasing the obstruction include surgical reconstruction, PCN urinary diversion, and ureteral stents. Treatment selection is based on the disease etiology, prognosis, quality of life and complications.[3] Patients should be well-informed about the advantages and disadvantages of the therapeutic options and the therapeutic algorithm. The Resonance® metallic stent was designed to afford compression and intraluminal forces, and has been reported to have a high patency rate in malignant extrinsic compression.[11] In our series, six out of seven ureteral obstructions caused by malignancy remained patent with the Resonance® metallic stent. The only patient with a failed stent had received previous radiotherapy. This implied different outcomes using the Resonance® metallic stent between the malignant extrinsic compression- and radiation-induced ureteral stenosis. Our result is similar to that of Liatsikos et al, which showed a good stent response in malignant extrinsic compression.[9] However, we found a situation in which metallic stent might fail in the treatment of post-radiation ureteral stenosis. In the patients with radiation-induced ureteral stenosis, other treatments such as different kinds of stents, urinary diversion or surgical reconstruction should also be considered.[8]

Radiotherapy is important in gynecological malignancies, and consequent ureteral stenosis complications are not uncommon.[13,14] In our study, all of the patients with previous radiotherapy had gynecological malignancies, and these patients had a lower patency rate using the Resonance® metallic stent than the non-radiotherapy group. In addition, three out of the four patients with failed stents were clinically cancer-free. These results correspond with those of Liatsikos et al, although they only mentioned a 44% patency rate in patients with benign disease and could not identify the specific failure risk.[11]

Fujikawa et al have reported a 4.1% ureteral stenosis rate in the treatment of cervical cancer using external beam radiotherapy combined with remote afterloading brachytherapy.[14] However, our patient group was too small to distinguish the relationship between radiation mode and ureteral stenosis. In our analysis, we could not clearly identify why the Resonance® stent failed in some patients who had gynecological malignancies and had received radiotherapy. The total dose delivered and individual volume of the ureter exposed to the radiation dosage may play important roles, and they are difficult for us to control.[15] Stent-related complications were common in our series. Although proper stent size has been reported to decrease patient discomfort, we found a 65.2% rate of complicating symptoms after stent placement.[16] Three patients changed stents after 12 months. Only a small amount of fibrin coating was found on the stents.

In conclusion, the Resonance® metallic stent was feasible and safe for our patients with ureteral obstruction with either malignant extrinsic compression or benign intrinsic stenosis. Gynecological malignancy patients who had previously received radiotherapy had a significantly lower patency rate than other non-radiation disease entities.

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