

Simple Retrograde Balloon Dilation for Treatment of Ureteral Strictures: Etiology-based Analysis

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This study consists of an analysis of the results of simple retrograde balloon dilation in the treatment of ureteral strictures for the evaluation of the long-term efficacy of this procedure, and the factors affecting its success rate.

A prospective study was performed on 43 ureteral strictures (22 malignant, 21 benign) from 37 patients treated with retrograde balloon dilation from October 1997 to May 1999. After the stricture segments were dilated, ureteral stents were indwelled uniformly for 3 weeks. Strictures were postoperatively followed up radiographically at 1, 3, 6 and 12 months, and annually thereafter. Success was defined by symptomatic and radiographic improvement. The follow-up periods ranged from 8 to 57 months (mean 41 months).

The success rates of the benign strictures at 12 and 36 months were much higher than those of the malignant strictures (67 and 57% vs., 18 and 14%, $p=0.0009$). While 56% and 47% of the patients with strictures shorter than 2cm were successful at 12 and 36 months, respectively, none with strictures longer than 2cm were successful at the same follow-up periods ($p=0.0002$). Of the successful benign cases with a shorter segment at 12 months, 12 out of 14 (86%) showed persistent long-term successes at the 36 months follow-up. Other prognostic factors, such as sex, age, location, disappearance of a waist, dilation time and grade of hydronephrosis, were not found to influence the success rate. A multivariate analysis revealed the etiology and stricture length were the only significant prognostic factors affecting the final outcome ($p=0.030$ and $p=0.0262$, respectively, by Cox's proportional hazards model).

In consideration of its minimal invasiveness and acceptable long-term outcome, simple retrograde balloon dilation is an effective treatment modality for benign ureteral stricture with

a short segment (≤ 2 cm), and a shorter duration of stenting (3-weeks) is viable.

Key Words: Ureteral obstruction, balloon dilatation, survival analysis

INTRODUCTION

Ureteral strictures may result from various etiologies including ureteral injury after endoscopic urological procedures, stone passage, radiation therapy, and open or laparoscopic surgery.¹ While a variety of open surgical techniques, including renal mobilization, psoas hitch, Boari flap, ureteroneocystostomy, urinary diversion, transureteroureterostomy, intestinal interposition, renal autotransplantation and nephrectomy, can be used to treat patients with ureteral strictures, they all require major abdominal surgery, with its attendant morbidity, need for hospitalization and prolonged recovery.^{2,3} However, improved instrumentation and advances in endourological techniques, have provided a less invasive means of treating ureteral stricture disease with lower morbidity and cost.⁴

Recent endourological procedures for the treatment of ureteral strictures include balloon dilation, endoureterotomy, Acucise endoureterotomy, metallic stents and Holmium laser endoureterotomy. Balloon dilation is one of the least invasive methods for the treatment of ureteral strictures and can be performed in either the antegrade or retrograde approach. Previous studies on balloon dilation have reported a variety of success rates (20-85%) for the treatment of ureteral strictures with various etiologies.⁵⁻¹¹ However, there have

Received October 30, 2002

Accepted December 27, 2002

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been few studies investigating prospectively the management of ureteral strictures using only the retrograde approach as this approach is less invasive than the antegrade approach because a percutaneous nephrostomy is avoided. The objective of this study is to analyze the long-term results of simple retrograde balloon dilation for ureteral strictures with various etiologies and to investigate the prognostic factors affecting the final outcome of this procedure.

MATERIALS AND METHODS

A prospective study was performed on 43 ureteral strictures from 37 patients who had undergone retrograde balloon dilation from Oct 1997 to May 1999 at Seoul National University Hospital. The mean age of the 10 male and 27 female patients was 46.8 years, ranging from 4 to 82 years old. The etiologies of the ureteral strictures were classified as benign and malignant, in 21 and 22 cases, respectively, and are detailed in Table 1.

Balloon dilations, all utilizing the retrograde approach, were performed under local (20), spinal (11) or general (12) anesthesia by the same surgeon (HH Kim). Twelve Fr. (for 3 pediatric patients) to 24 Fr. Uromax II® (Boston Scientific, Natick, MA, USA) balloons were used to dilate the ureteral strictures for either 5 or 10 minutes, under 2 to 18 Atm. of pressure. Seven Fr. ureteral stents were postoperatively indwelled for 3 weeks postoperatively. The follow-up periods ranged from 8

to 57 months, with a mean of 41 months. Clinical evaluation and follow-up studies, including excretory urography, were performed at 1, 3, 6, and 12 months postoperatively, and annually thereafter. Ultrasonography was performed if a patient was not appropriate for excretory urography.

Success was judged by both symptomatic and radiographic improvement, the former defined as the improvement of pre-dilation symptoms (flank or abdominal pain) attributable to the obstruction, and the latter as the improvement in the grade of hydronephrosis. The hydronephrosis was classified according to the system suggested by Williams and Kenawi.¹² In brief, grade I was characterized by slight blunting of the calyceal fornices, and grade II as obvious blunting of the fornices. Rounding of the calyces with obliteration of the papillae characterized grade III, whereas extreme calyceal ballooning defined grade IV. Severe nonfunctioning hydronephrosis described grade V. Prognostic factors, such as sex, age, etiology, length, location, disappearance of a waist, dilation time and hydronephrotic grade, were evaluated for their effect on the final outcome of the ureteral stricture management. A log rank test and Cox's proportional hazards model were used for a statistical analysis, with $p < 0.05$ considered statistically significant.

RESULTS

The overall success rates at 12, 24 and 36

Table 1. Etiologies of Ureteral Strictures

Etiology		No. of Strictures
Benign (21 ureters)	UPJ obstruction	6
	UVJ obstruction	1
	Stone-related	6
	Idiopathic	6
	Surgery	2
Malignant (22 ureters)*	Cervical cancer	17
	Ovarian cancer	1
	Rectal cancer	3
	Bladder cancer	1
Total		43

*Managed by surgery (6), radiotherapy (2), and combined (14).

months after dilation were 42, 37 and 35%, respectively. The success rates differed significantly between the benign and malignant strictures; being 67, 57 and 57% for the benign strictures, but only 18, 18 and 14% for the malignant strictures, at 12, 24 and 36 months, respectively ($p=0.0009$ by log rank test) (Table 2). The length of the stricture influenced the success rate; as 56, 50 and 47% of the patients with strictures shorter than 2 cm were successful, while none with strictures longer than 2 cm were successful at 12, 24, and 36 months after the procedure, respectively ($p=0.0002$ by log rank test). Whereas, the success rates of the benign strictures shorter than 2 cm were 74, 63 and 63%, while none of benign strictures longer than 2 cm were successful at 12, 24 and 36 months postoperatively, respectively ($p=0.0375$ by log rank test) (Table 3). Of the successful benign cases with a short segment at 12 months, 12 out of 14 (86%) showed a persistent long-term success at the 36

month follow-up.

Other prognostic factors, such as sex, age, location, disappearance of a waist, dilation time and hydronephrotic grade, were not found to influence the success rate (Table 2). A multivariate analysis revealed that etiology and stricture length were the only significant prognostic factors affecting the final outcome ($p=0.030$ and $p=0.0262$, respectively, by Cox's proportional hazards model).

Two patients experienced gross hematuria, for a few days postoperatively, which resolved spontaneously with conservative management. In one other patient, an ureteroenteral fistula was identified on retrograde pyelography at 1 month postoperatively, which was resolved without further complication following a further 3 weeks of double-J ureteral stenting.

Twenty-four of the 28 treatment failures (86%) occurred within the first 4 months following the

Table 2. Success Rates and Significance of Prognostic Factors

Prognostic Factor		Number	Success Rate (%)			p-value
			12 mo	24 mo	36 mo	
Etiology	Benign	21	67	57	57	0.0009*
	Malignant	22	18	18	14	
Length	≤ 2 cm	32	56	50	47	0.0002*
	> 2 cm	11	0	0	0	
Sex	Male	10	50	30	30	0.9741*
	Female	33	39	39	37	
Age	< 40	10	70	60	50	0.3495 [†]
	40 - 60	24	33	29	29	
	> 60	9	33	33	33	
Location	Upper	15	60	53	47	0.5299*
	Lower	28	32	32	32	
Disappearance of a Waist	Yes	12	42	33	25	0.5335*
	No	31	42	39	39	
Dilation Time	5 minutes	25	44	36	32	0.7874*
	10 minutes	18	39	39	39	
Hydronephrotic Grade	II	14	36	36	36	0.9182 [†]
	III	17	47	41	35	
	IV	12	42	33	33	

mo, months.

*evaluated by log rank test.

[†]evaluated by Cox's proportional hazards model.

Table 3. Success Rates Stratified by Etiology and Length

Prognostic Factor		Number	Success Rate (%)			p-value
			12 mo	24 mo	36 mo	
Benign	≤ 2 cm	19	74	63	63	0.0375*
	> 2 cm	2	0	0	0	
Malignant	≤ 2 cm	13	31	31	23	0.0264*
	> 2 cm	9	0	0	0	

mo, months.

*evaluated by log rank test.

Table 4. Management for 28 Failed Balloon Dilations

Management	Number		Success	Failure
	Benign	Malignant		
Observation*	1	4		
Double-J Insertion	4	8		
Nephrectomy	1	0		
Repeat Balloon Dilation	1	2	1	2
Endoureterotomy	1	6	5	2

*Observation was done due to mild symptoms.

procedure and the management of these 28 failures is listed in Table 4. Three and 7 patients received repeat balloon dilation and endoureterotomy with a cold knife, respectively. Six patients showed successful outcome but 4 failed again. A double-J stent was indwelled in 2 cases and a percutaneous nephrostomy was performed for recurred strictures in a further 2.

DISCUSSION

With the rapid advance of endourologic instrumentation and techniques, most ureteral strictures can now be managed effectively by various endourologic procedures. Among the various available techniques, simple balloon dilation is one of the least invasive and cost-effective modalities for the treatment of an ureteral stricture. Although endourologic procedures for ureteral strictures have been known to be relatively safe, some reports on various endoureterotomic procedures, including Acucise balloon cautery, have shown that serious

problems (like iliac artery laceration), although infrequent, could arise.¹³⁻¹⁶ However, complications induced by balloon dilation have been very rare.

Goldfischer and Gerber⁴ suggested in their review article that simple dilation and stent placement should be initially recommended for most patients with ureteral strictures due to its minimal morbidity and short hospitalization. However, rapid progress in the development of endourological instruments has enabled many urologists to switch to other advanced modalities, although simple balloon dilation remains a good treatment option for ureteral strictures. Consequently, there are insufficient data on the long-term results of balloon dilation, especially with retrograde approaches, which can avoid a percutaneous nephrostomy. Therefore, this study was prospectively conducted to investigate the long-term success rate of retrograde balloon dilation and the prognostic factors affecting the final outcome of the procedure in the treatment of ureteral strictures.

The reported success rates for balloon dilation vary from 20 to 85%.⁵⁻¹¹ Our study revealed a 35% success rate at 36 months postoperatively, this being at the lower end of the previously reported rates. However, this increased to 57% for strictures with benign etiologies. Richter et al.¹¹ reported only 21% (3 of 14 patients) success rate following balloon dilation for ureteral strictures that were secondary to malignancies. Our data also demonstrate a poor outcome for malignant strictures. Strictures secondary to operations and/or radiotherapy for malignancy could not be successfully treated by simple retrograde balloon dilation. We believe that the poor outcome of strictures with malignant etiologies was caused by the relatively wider ischemic damage to the ureter and/or from extrinsic ureteral obstructions. Simple balloon dilation should not be considered as a good option for strictures with malignant etiologies, as reported in the previous studies.

The 74% success rate for benign strictures with shorter segments at postoperative 12 months is comparable with the Acucise endoureterotomic results of Cohen et al.¹³ and Preminger et al.,¹⁴ and with the endoureterotomic results of Meretyk et al.¹⁷ and Yamada et al.¹⁸ In addition, 86% (12 out of 14) of the successful benign cases with shorter segments at 12 months showed excellent long-term results at 36 months, which were comparable to the results of Nadler et al.¹⁹ Therefore, it is evident that for the appropriate patients, simple retrograde balloon dilation represents one of best modalities for ureteral strictures. We suggest that benign ureteral stricture with a shorter length (≤ 2 cm) would be an ideal candidate for simple retrograde balloon dilation.

The most appropriate duration for postoperative stenting remains to be defined. Since full regeneration of the ureteral muscular wall may require as long as 6 weeks, this interval has been most commonly chosen for postoperative stenting.^{17,20} However, success with much shorter periods of stenting (1 to 3 weeks) have been reported, even as few as 5 days.^{21,22} Kerbl et al.²³ demonstrated that a stent duration of only 1 week was sufficient in pigs. They thought that the inflammation associated with a chronic (6 week) indwelling stent was possibly the source of late fibrosis. We applied a shorter duration of stenting

to minimize stent-related morbidity. Considering the success of the results with the benign cases in our series, a stent duration of 3-weeks seems to be more appropriate than 6-weeks.

The optimal stent size remains controversial. Several reports have suggested that a 4- to 10-F stent may produce good results, although tapered 14/7-F double pigtail catheters are most commonly used.²⁴⁻²⁶ Moon et al.²⁵ suggested that after endoureterotomies in pigs, the primary function of the stent was to divert urine and act as a scaffold rather than a mold for the healing ureter. Therefore, a small, easily placed, 7-F stent may give the same degree of success as a larger, more cumbersome, 14-F stent. We adopted the former, which functioned well for benign cases. From our data, it appears that a 7-F ureteral catheter may produce good results in benign ureteral strictures.

Simple retrograde balloon dilation is a relatively less invasive method. With a retrograde approach, the need to perform a percutaneous nephrostomy is not required, so the potential problems associated with a percutaneous nephrostomy can be avoided. Three cases of complications related to retrograde balloon dilation occurred in our study. Two cases with gross hematuria were resolved with conservative management and the other, an ureteroenteric fistula, was identified on retrograde pyelography. The latter was a female patient who had undergone two operations, radiation therapy and chemotherapy for rectal cancer prior to the balloon dilation procedure. Her peri-stricture tissue must have been very fibrotic and adhered to the small bowel due to the variety of anticancer modalities. Therefore, we considered that the ureteroenteric fistula had developed despite the relatively less invasive balloon dilation. Fortunately, she experienced no symptoms related to the fistula, which was resolved after 3 weeks of Double-J ureteral stenting. As evident from the data on complications, a simple retrograde balloon dilation is a relatively safe modality for the treatment of ureteral strictures.

Many options remain available for the failed cases. Repeat dilation and endoureterotomy have been suggested by some authors as appropriate treatment methods for stricture recurrence.^{17,27-29} Our success rate (60%) for the management of failed cases was comparable to previously re-

ported results that ranged from 50% to 82%. We suggest that repeat balloon dilation or an endoureterotomy must be considered for the treatment of recurred cases before open surgical techniques are applied.

In conclusion, simple retrograde balloon dilation, with its minimal invasiveness and acceptable long-term results, is recommended as an effective 1st-line treatment modality for benign ureteral stricture with a short segment (≤ 2 cm), and a 3-week catheter indwelling is an acceptable duration of stenting.

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