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Success of Ureteral Stents for Intrinsic Ureteral Obstruction

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ABSTRACT

***Purpose*: Previous reports suggest a high success rate for retrograde ureteral stenting for intrinsic ureteral obstruction, but few preoperative predictors of success have been offered. We reviewed our experience to look for factors that suggest failure of stents for intrinsic ureteral obstruction.**

***Materials and Methods*: We retrospectively reviewed the outcome of retrograde ureteral stent placement for intrinsic ureteral obstruction without concurrent or intended definitive management of the obstruction.**

***Results*: Thirty-eight patients treated for intrinsic ureteral obstruction, representing 41 ureteral units (UUs), were monitored for an average of 25.5 months. The overall success rate was 88%. Of the successes, 13 UUs had definitive therapy to permanently remove the cause of obstruction, obstruction resolved in 12 UUs after stent placement, and 11 UUs were managed with indwelling stents. Therapy failed in five UUs, with a median time to failure of 1.9 months. Of the UUs in which failure occurred, three failures were caused by misdiagnosis; in the remaining two, the stent did not correct the obstruction. On univariate analysis, male sex ($P = 0.006$), increased creatinine level as a presenting symptom ($P = 0.002$), and more severe preoperative hydronephrosis ($P = 0.042$) were predictive of failure. Adverse events were low, with complications from stenting occurring on only four of 41 UUs.**

***Conclusion*: If initial stent placement was possible, intrinsic ureteral obstruction was managed successfully in 88% of patients. Given high success and minimal complications, retrograde placement of ureteral stents can be performed to treat patients with intrinsic ureteral obstruction. Treatment failure is more likely to occur in men and patients with severe hydronephrosis or an elevated creatinine level.**

INTRODUCTION

INTRINSIC URETERAL OBSTRUCTION can cause significant morbidity and mortality. Retrograde placement of ureteral stents has been used as primary therapy for many causes of intrinsic ureteral obstruction, with success rates varying between 70% and 100%.[1–5] The alternative to retrograde stent placement is percutaneous nephrostomy tube placement. While reported health-related quality of life for patients with percutaneous nephrostomy tubes and patients with ureteral stents is similar, there is often patient preference for ureteral stents when given the option.[6]

Several investigators have reported significant complications with ureteral stent placement, especially infectious complications.[7–10] Ureteral stents also can significantly impact quality of life.[11,12] Given the morbidity and impact associated with ureteral stents, clinicians would benefit from knowing the likelihood of success of stent placement.

Few studies have examined predictors of stent success at relieving intrinsic ureteral obstruction.[4] Experience suggests that the majority of patients with intrinsic ureteral obstruction that is managed with a ureteral stent for a short period (i.e., a few weeks) do well. There is less experience and less published data on longer term stenting for intrinsic ureteral obstruction.

Given this minimal data, we reviewed our institution's experience with the management of intrinsic ureteral obstruction using retrograde stent placement. To focus our study on patients with a longer duration of stenting, we limited our review to patients who underwent retrograde stent placement for the management of intrinsic ureteral obstruction without definitive treatment performed at the time of stent placement or planned for shortly thereafter. We attempted to identify de-

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mographic, clinical, or radiographic markers for successful management.

MATERIALS AND METHODS

We retrospectively reviewed records of all patients treated at the University of Michigan Health System for intrinsic ureteral obstruction with initial retrograde ureteral stent placement (4.8F, 6F, 7F, or 16F Percuflex® stents [Boston Scientific, Natick, MA]) from November 1995 to October 2003. The diameter of the stent was selected by the attending physician, without a systematic protocol. Patients in whom initial stenting was unsuccessful were not considered for the study, nor did we include patients with initial stenting at the time of definitive therapy for the obstruction (calculus, ureteral tumors, etc.) or in whom definitive therapy was planned at a short interval.

Meeting these inclusion criteria were 54 consecutive patients, for a total of 59 ureteral units (UUs), treated by one of fifteen urologists. Eight patients, representing 10 UUs, were excluded because of lack of follow-up, and 8 patients, representing 8 UUs, were excluded because the stent was in a transplanted ureter. After the exclusions, there were 38 patients and 41 UUs for analysis.

Preprocedural and postprocedural demographic, clinical, and radiographic data were collected via examination of electronic medical records. Yossepowitch and associates[3] defined intrinsic obstruction as obstruction caused by stone disease, ureteropelvic junction obstruction, and ureteral stricture. In addition to these diagnoses, we also included intrinsic obstruction caused by malignancies of the upper tract and other (not at the ureteropelvic junction) congenital defects of the urinary tract (eg, mega-ureter). Ureteropelvic junction obstruction was classified as either a congenital defect or a stricture, depending on whether the patient had or had not received previous treatment, respectively. An additional diagnostic category of "other" was created for patients who had ureteral obstruction within the ureteral lumen that did not fit one of the other diagnostic categories.

Obstruction level was defined as proximal, mid, or distal ureter based on the location of the obstruction above, at, or below the sacroiliac joints. Hydronephrosis was graded using the most recent ultrasonography, CT, or magnetic resonance imaging before stent placement. The grade of hydronephrosis was retrospectively assigned according to the guidelines of the Society for Fetal Urology.[3]

Treatment failure was defined as any UU that required an additional procedure to manage ureteral obstruction or any UU that continued to cause symptoms for the patient after stent placement. Patients who elected to undergo definitive therapy after successful treatment with a stent were not designated as having a treatment failure. The date on which obstruction resolved with stenting therapy in those UUs was the date the stent was removed.

Statistical analysis was conducted using an analysis of variance test for continuous data approximating the normal distribution. Chi-square tests were used to compare categorical data. P values < 0.05 were considered statistically significant. All analyses were conducted on commercially available software.

RESULTS

The study population consisted of 38 patients (14 men and 24 women) who represented 41 UUs (16 male and 25 female) managed for intrinsic ureteral obstruction with retrograde ureteral stent placement. The mean age of all patients was 52 years (range 12 to 84 years). Thirty-five patients had unilateral obstruction, and three patients had bilateral obstruction. Each UU was analyzed separately. Success was achieved in 36 of 41 (87.8%) patients.

The mean and median durations of follow-up in the 36 UUs with successful management were 26.5 and 9.9 months, respectively. The mean and median indwelling times of each stent among those with successful stenting were 5.4 and 4.0 months, respectively. Among the 36 UUs, 13 (36%) received definitive therapy in the form of corrective surgery at some point after stent placement. Of the 13 UUs that were managed definitively, eight UUs had ureteropelvic junction obstruction. Of these, five UUs were managed with endopyelotomy, one with pyeloplasty, and two with nephrectomy.

Two cases of ureteral stricture were managed with balloon dilation. Renal cyst resection, percutaneous treatment, and lithotripsy with stone basketing were used for ureteral obstruction caused by a renal sinus cyst, infundibular stenosis, and ureterolithiasis, respectively. Of the UUs that received definitive management, the mean and median times between placement of the stent and therapy were 3.5 and 1.2 months, respectively. Both the mean and median number of stents used in each treated UU was 2.0.

In the remaining 23 cases of successful management with ureteral stents, there was either resolution of the problem (n = 12) or stent exchanges were continuing (n = 11) at the time of last follow-up or at the time of the patient's death. Of the 12 with resolution, four were associated with stone passage (mean stenting duration of 1.5 months) and in eight the inflammatory process that caused obstruction resolved (prolonged ureteral inflammation after surgery in four, transient obstruction from infection in four).

Of the obstructed ureters in which resolution occurred, eight UUs had resolution after placement of the first stent and four required additional stents. The mean and median number of stents needed for resolution was 2.3 and 1, respectively. The mean and median time from stenting to resolution was 11.3 and 3.4 months, respectively.

Of the 11 UUs managed with chronic indwelling stents and periodic stent exchanges, three had ureteropelvic junction obstruction (all secondary), five were caused by strictures, one was caused by an endoscopically unresectable malignancy of the renal pelvis, one was caused by a large calculus for which definitive treatment was declined, and one was caused by an obstructing renal mass in a patient with metastatic renal cell carcinoma. In the patients treated longer term with stents, the mean and median number of stents placed was 9.0 and 6.5, respectively. The mean and median times between stent exchanges for this group were 5.6 and 4.2 months, respectively. The mean and median times of stenting in this group were 43.6 and 39.4 months, respectively.

Of the five failures, the mean and median times to failure were 2.0 and 1.9 months, respectively. Both UUs failed in a

42-year-old man with what appeared to bilateral ureteral strictures; a subsequent diagnosis was e ureteral obstruction secondary to neurogenic bladder. Bilateral percutaneous nephrostomy tubes were placed (1.9 months after stenting) to drain the kidneys while the neurogenic bladder was addressed.

A 13-year old boy with distal ureteral obstruction secondary to posterior urethral valves (resected in the past) who presented with an increasing serum creatinine level had stent placement in an effort to preserve renal function. A subsequent renal scan showed poor function of the kidney, and the stent was removed 4 months later.

A 69-year-old man with urothelial cancer had bilateral ureteral obstruction, at the distal ureter on one side and the proximal ureter on the other, superimposed on a degree of bilateral distal ureteral obstruction from previous radiotherapy. Bilateral percutaneous nephrostomy tubes were placed 1 month later for adequate renal drainage, and the patient died of metastatic cancer 5 months after stent placement.

Thus, of the five failures, three were caused by misdiagnosis (neurogenic bladder in two UU, poor renal function in one UU), and only two were caused by absolute failure of the stents.

Of the patients, five (with 6 UUs) died with ureteral stents in place. Mean and median survival times after stent placement were 19.9 and 5.8 months, respectively (range 2.1 to 93.0 months). One patient (two UUs) was the above-noted patient with urothelial cancer who received percutaneous nephrostomy tubes; the stents had not been removed. The patient with obstruction from a renal mass died of metastatic renal cancer. Another patient had planned to undergo definitive therapy, but was ill on the planned surgical date and died shortly thereafter. The two remaining patients had indwelling stents with routine changes for several years before their deaths.

Multiple stents were placed in 24 (65%) of the successfully managed UU, for a total of 129 stents. The mean and median total number of stents were 5.3 and 3.0, respectively (range 2 to 23). The mean and median intervals between stent exchanges were 5.8 and 3.1 months, respectively.

Table 1 summarizes variables compared with outcome. Presenting symptom ($P = 0.002$), degree of preoperative hydronephrosis ($P = 0.042$), and patient sex ($P = 0.006$) were statistically significantly associated with stent success. Stents for pain and other symptoms had high success rates (92% and 100%, respectively), compared with stents for increased creatinine level (40%).

UUs associated with no or mild hydronephrosis had 100% successful management with stenting. Moderate and severe hydronephrosis had less success; stenting relieved obstruction 82% and 63% of the time, respectively. Women also appeared to be treated more effectively than men. Of the women, 100% had successful treatment, compared with only 69% of the men. Patient age at the time of stent placement (data not shown) was not a significant predictor of success ($P = 0.58$).

Complications were minimal. Thirty-seven UUs (90 %) of the 41 UUs managed did not have complications from stenting procedures. Two patients (3 UUs) experienced pyelonephritis after stent exchange. One patient (1 UU) had an episode of postoperative hypotension and myocardial infarction.

Table 1. Variables and Outcome

	Success	*All*	*% Success*	P *value*[a]
Sex				
Men	11	16	69	0.006
Women	25	25	100	
Race				
White	32	37	86	0.99
Other	4	4	100	
Location				
Proximal	24	26	92	0.37
Middle	2	3	67	
Distal	10	12	83	
Side				
Right	18	20	90	0.68
Left	18	21	86	
Symptoms				
Pain	24	26	92[b]	0.002
Increased creatinine	2	5	40[b,c]	
Other	10	10	100[c]	
Stent diameter				
4.8F	1	1	100	0.871
6F	26	31	84	
7F	5	5	100	
8F	3	3	100	
16F[d]	1	1	100	
Causes				
Congenital	5	6	83	0.26
Stricture	17	19	89	
Calculus	6	6	100	
Malignancy	3	5	60	
Other	5	5	100	
Hydronephroses				
None	14	14	100	0.042
Mild	8	8	100	
Moderate	9	11	82	
Severe	5	8	63	

[a]For comparison between successful and failed patients.

[b,c]Indicates pair with Bonferroni-corrected $P < 0.95$ for between-group comparison.

[d]The 16F stent was an externalized single pigtail stent in a patient with an ileal loop urinary diversion.

DISCUSSION

Several investigators have noted high success rates with retrograde ureteral stenting to manage intrinsic ureteral compression. Barbalias and colleagues[4] used retrograde stent placement as primary therapy in patients with recurrent ureteropelvic junction obstruction, and three (75%) of four patients had no further therapy after a mean of 16 months. Reinberg and associates[1] treated five patients who had ureteral strictures from various causes that were refractory to other treatment. They used Wallstent placement, and after a follow-up period of 6 to 24 months, all stents remained patent.

Leventhal and coworkers[2] determined that stent placement can aid in the passage of stones as large as 10 mm from the distal ureter in 83% of patients and prevent the need for surgical intervention to remove the stones. Yossepowitch and associates[3] noted 100% stent patency after 3 months in patients with intrinsic ureteral obstruction caused by stones, ureteropelvic junction obstruction, and ureteral stricture.

Our study examined all causes of intrinsic ureteral obstruction and found an overall success rate of 88% after a mean follow-up interval of 25.5 months. Failure of the stent to provide adequate drainage was not related to the cause of obstruction.

Few investigators have addressed such a large cohort of patients with intrinsic causes of ureteral obstruction as we have presented. None have examined exclusively patients with intrinsic ureteral obstruction and attempted to predict stent success or failure based on preoperative data.

In 2001, Yossepowitch and associates[3] examined 61 cases of intrinsic and 39 cases of extrinsic ureteral obstruction, noting that, in addition to having significantly greater success rates when managing intrinsic disease, a greater degree of hydronephrosis was the only significant predictor of stent failure in the intrinsic group.

Our data also suggest that more severe hydronephrosis is a significant predictor of failure. Increasing severity of hydronephrosis may indicate a greater degree of ureteral obstruction. This affords little opportunity for urine to drain around the stent, which may explain the poorer success rates.

In addition, our study also shows that clinical presentation and sex were significant predictors of stent failure. Patients presenting with an increased creatinine level caused by ureteral obstruction had significantly poorer outcomes than patients presenting with flank pain or other symptoms. An increasing creatinine level does not necessarily imply postrenal obstruction within the ureter. Both intrinsic kidney disease and obstruction distal to the ureter can explain why stenting would improve neither hydronephrosis nor serum creatinine values. Men also failed stent therapy significantly more often than women.

A significant proportion of our patients sought definitive treatment. Although these patients were not permanently treated with stenting, all had obstruction corrected were safely before definitive treatment. Several other patients were treated successfully with stenting and either had resolution of their disease or continued with stent exchanges until death. These procedures were also performed safely in the majority of patients. In contrast to other investigators who have shown complications in as many as 36% of their patients, complications occurred in only four (10%) of 41 stented UUs in our study.[8]

Of the five failures, 3 were because of misdiagnosis, and only two were caused by failure of the stent. All failures occurred in men. The two stents that failed were in a patient with ureteral malignancy combined with ureteral damage from radiotherapy, and percutaneous nephrostomy was needed in both kidneys for adequate drainage. As other investigators have shown, malignancy as an extrinsic cause generally produces lower success rates than intrinsic causes.[3] The same could likely be applied to intrinsic malignancies of the urinary tract.

The median time to failure was 1.9 months. The median time of follow-up in the successful cases was 9.9 months, more than five times as long as the median time to failure. Therefore, we are quite confident that the follow-up interval is long enough to determine true failure.

While our study is one of the largest performed exclusively regarding intrinsic causes of ureteral obstruction, there are disadvantages to the study. First, all of these procedures were performed at a single institution. The type of patients treated at the University of Michigan may be different from those at other institutions. Second, the 41 UUs analyzed had stent placement by 12 urologists at our institution. Of these, only three were fellowship-trained endourologists at the time of the procedure. One study has shown that placement technique may influence symptoms with indwelling ureteral stents,[15] and it is possible that stent success or failure might also be related.

Finally, because we only considered patients in whom stent placement was initially possible, our findings cannot be generalized to predict the long-term success of stenting in all patients who present with intrinsic ureteral obstruction.

CONCLUSION

Retrograde ureteral stenting for intrinsic ureteral compression was successful in 88% of patients when stent placement was possible initially. Male sex, a moderately or severely hydronephrotic kidney, and patients presenting with an increasing creatinine level were more likely to have treatment failure with a stent. Complications were rare. We advocate an attempt at retrograde placement of ureteral stents in all patients with intrinsic ureteral obstruction.

REFERENCES

1. Reinberg Y, Ferral H, Gonzales R, et al. Intraureteral metallic self-expanding endoprosthesis (Wallstent) in the treatment of difficult ureteral strictures. J Urol 1994;151:1619–1622.
2. Leventhal EK, Rozanski TA, Crain TW, Deshon GE Jr. Indwelling ureteral stents as definitive therapy for distal ureteral calculi. J Urol 1995;153:34–36.
3. Yossepowitch O, Lifshitz DA, Dekel Y, Gross M, Keidar DM, Neuman M, Livne PM, Baniel J. Predicting the success of retrograde stenting for managing ureteral obstruction. J Urol 2001;166: 1746–1749.
4. Barbalias GA, Liatsikos EN, Kagadis GC, Karnabatidis D, Kalogeropoulou C, Nikiforidis G, Siablis D. Ureteropelvic junction obstruction: An innovative approach combining metallic stenting and virtual endoscopy. J Urol 2002;168:2383–2386.
5. Joshi HB, Adams S, Obadeyi OO, Rao PN. Nephrostomy tube or 'JJ' ureteric stent in ureteric obstruction: Assessment of patient perspectives using quality-of-life survey and utility analysis. Eur Urol 2001;39:695–701.
6. Docimo SG, Dewolf WC. High failure rate of indwelling ureteral stents in patients with extrinsic obstruction: Experience at 2 institutions. J Urol 1989;142:277–279.
7. Ku JH, Lee SW, Jeon HG, Kim HH, Oh SJ. Percutaneous nephrostomy versus indwelling ureteral stents in the management of extrinsic ureteral obstruction in advanced malignancies: Are there differences? Urology 2004;64:895–899.
8. Andriole GL, Bettmann MA, Garnick MB, Richie JP. Indwelling double-J ureteral stents for temporary and permanent urinary drainage: Experience with 87 patients. J Urol 1984;131:239–241.
9. Kehinde EO, Rotimi VO, Al-Hunayan A, Abdul-Halim H, Boland F, Al-Awadi KA. Bacteriology of urinary tract infection associated with indwelling J ureteral stents. J Endourol 2004;18:891–896.
10. Eschwège P, Blanchet P, Alexandre L, et al. Infectious complications after the use of double J ureteral stents. Transplant Proc 1996; 28:2833.

11. Franco G, De Dominicis C, Dal Forno S, Iori F, Laurenti C. The incidence of post-operative urinary tract infection in patients with ureteric stents. Br J Urol 1990;65:10–12.
12. Joshi HB, Stainthorpe A, MacDonagh RP, Keeley FX Jr, Timoney AG, Barry MJ. Indwelling ureteral stents: Evaluation of symptoms, quality of life and utility. J Urol 2003;169:1065–1069.
13. Leibovici D, Cooper A, Lindner A, et al Ureteral stents: Morbidity and impact on quality of life. Isr Med Assoc J 2005;7:491–494.
14. Fernbach SK, Maizels M, Conway JJ. Ultrasound grading of hydronephrosis: Introduction to the system used by the Society for Fetal Urology. Pediatr Radiol,1993;23:478–480.
15. Rane A, Saleemi A, Cahill D, Sriprasad S, Shrotri N, Tiptaft R. Have stent-related symptoms anything to do with placement technique? J Endourol 2001;15:741–745.

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ABBREVIATIONS USED

CT = computed comography; UU = ureteral unit.