Wire-reinforced ureteral stents to rescue from nephrostomy tube in extrinsic ureteral obstruction

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Introduction: *Ureteral obstruction due to extrinsic compression is associated with significant morbidity and mortality. Management options for this condition include renal drainage with percutaneous nephrostomy (PCN) or internal ureteral stent placement. A significant portion of patients will have disease progression leading to internal stent obstruction which is almost uniformly managed with PCN. We evaluated a novel, wire-reinforced internal ureteral stent as an alternative to PCN in those patients who fail initial internal ureteral stent placement.*

Materials and methods: *A retrospective chart review was performed to identify patients with extrinsic ureteral obstruction that failed conventional plastic internal ureteral stent placement and ultimately underwent placement of wire-reinforced internal ureteral stents (Scaffold) at the University of Michigan Health System between 2006-2011. Outcomes assessed included time to Scaffold stent failure and failure free time with Scaffold stent in place.*

Results: *A total of 8 patients were identified with extrinsic ureteral obstruction that failed initial conventional ureteral stenting and had a Scaffold stent placed. Scaffold stents ultimately failed in 3 out of 8 patients. Mean time to Scaffold stent failure was 197 days (range 20-536). In the remaining 5 patients, mean failure-free time with Scaffold stents in place was 277 days (range 18-774).*

Conclusion: *Scaffold stent placement is a viable alternative to PCN in those patients with extrinsic ureteral obstruction who fail conventional internal ureteral stent placement.*

Key Words: ureteral obstruction, ureteral stents, stent failure

Introduction

Ureteral obstruction caused by extrinsic ureteral compression is associated with significant morbidity and mortality. Central to the management of this condition is preservation of renal function which can be achieved through percutaneous nephrostomy (PCN) or internal ureteral stents. Reports from large series demonstrate that 68%-89% of cases of extrinsic ureteral obstruction (EUO) are caused by malignant disease which carries a particularly poor prognosis with mean survival between 6-16 months.[1-3]

Given the predominance of malignancy as a cause of EUO and its progressive nature, it is not surprising that reported failure rates of internal ureteral stents in the management of this condition range from 16%-44%.[1-4] Traditional management of patients with EUO in whom internal stents have failed is PCN placement. Despite effective drainage by PCN in greater than 98% of patients, risks of dislodgement, the need for an externalized collection device, danger of placement in anti-coagulated patients and potential damage to adjacent viscera may limit the utility of this approach.[5]

To this end, we sought to evaluate a novel, wire-reinforced, internal ureteral stent as an alternative to

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PCN in those patients with EUO and prior failure of conventional ureteral stents.

Materials and methods

A retrospective chart review was performed to identify patients with EUO that persisted despite placement of conventional plastic internal ureteral stents (6 or 7 Fr. Percuflex ureteral stents, Boston Scientific, Natick, MA, USA) and ultimately underwent placement of 8 Fr. wire-reinforced internal ureteral stents (Scaffold Silhouette ureteral stent, Applied Medical, Rancho Santa Margarita, CA, USA) at our institution between 2006-2011.

Failure of either the initial conventional ureteral stent or wire-reinforced stent was defined as flank pain with radiographic evidence of worsening hydronephrosis when compared to prior imaging studies, or acute renal failure indicated by a rise in serum creatinine greater than 50% of nadir level.

At the time of failure of the initial conventional stent, patients either had immediate placement of a wire-reinforced stent or had a percutaneous nephrostomy tube (PCN) placed with later conversion to a wire-reinforced stent. All patients who failed wire-reinforced stents had a PCN placed.

Nadir serum creatinine values (mg/dL) were established during a period immediately before obstruction, or when drainage after obstruction was optimized. Serum creatinine values were also recorded at the time of initial conventional stent failure, following wire-reinforced stent placement, and at the time of wire-reinforced stent failure if this occurred.

Renal imaging in the form of ultrasonography was performed at the time of initial conventional stent failure to serve as a baseline level of hydronephrosis prior to wire-reinforced stent placement. Those patients who underwent immediate decompression for conventional stent failure with PCN had no residual hydronephrosis based on ultrasound or antegrade nephrostogram. Renal imaging was again obtained following wire-reinforced placement and at the time of suspected wire-reinforced stent failure, if this occurred, with computed tomography, ultrasonography, or diuretic renal scan. All radiology studies were interpreted by an attending radiologist.

Wire-reinforced stents were placed under general or regional anesthesia with the assistance of fluoroscopy and were exchanged every 4 to 6 months, Figures 1-3. Time to initial conventional stent failure as well as time to wire-reinforced stent failure was calculated from the date of stent placement to the date of the imaging study or serum creatinine measurement that defined the failure. Failure-free time with wire-reinforced stent in place was calculated from date of initial wire-reinforced stent placement to the date of most recent follow up.

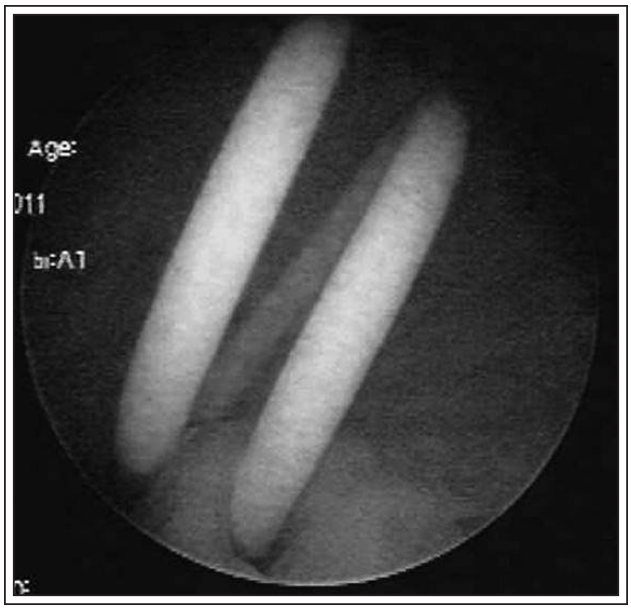

Figure 1. This cystoscopic photo shows the "double curl" design of the terminal end of the Scaffold stent as seen in the bladder.

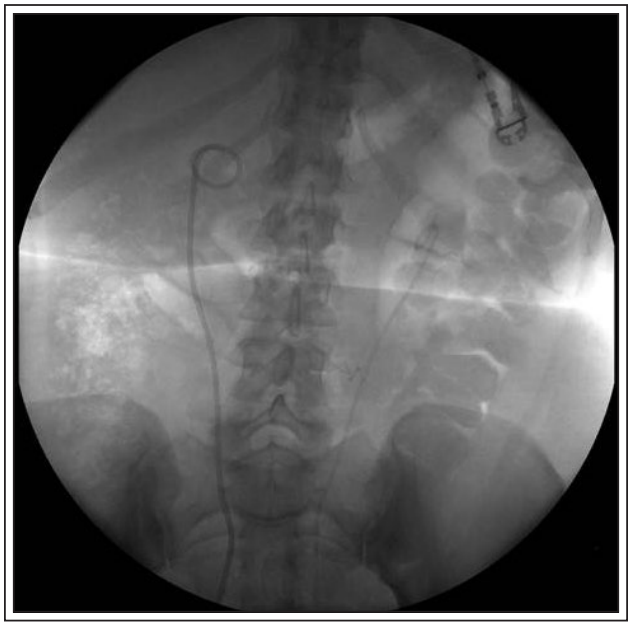

Figure 2. Static fluoroscopic image of proximal Scaffold stent on patient's right with traditional "double-pigtail" stent on patient's left.

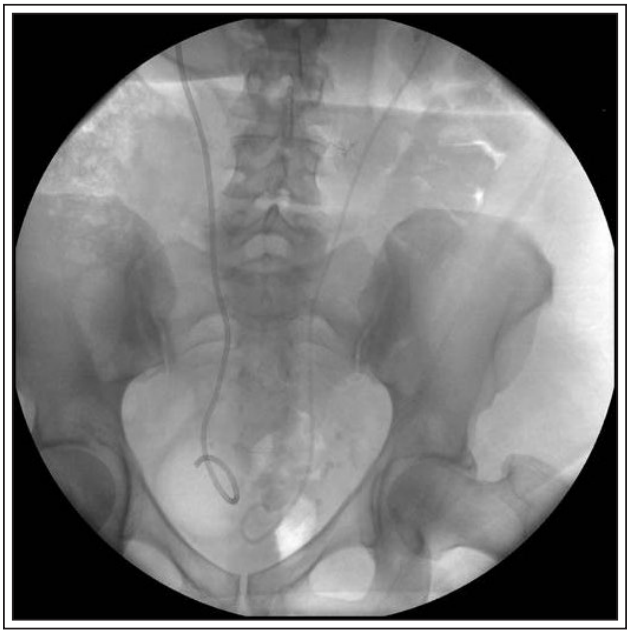

Figure 3. Static fluoroscopic image of distal Scaffold stent on patient's right with traditional "double-pigtail" stent on patient's left.

Results

A total of 8 patients were identified with EUO and failure of initial conventional ureteral stenting ultimately managed with placement of a wire-reinforced stent. Of these patients, 7 were female. The mean age of the study population was 60 years old (range 43 to 83). Mean nadir creatinine in the cohort was 0.9 mg/dL. The etiology of EUO was cancer in 7 of the 8 patients. The site of primary malignancy was ovarian cancer in 3 patients, breast cancer in 2 patients, colorectal cancer in 1 patient, and lymphoma in 1 patient. The remaining patient had idiopathic retroperitoneal fibrosis. Six of the 7 patients with malignancy and the sole patient with retroperitoneal fibrosis underwent chemotherapy. Two patients received abdominal/pelvic radiation for colorectal cancer and lymphoma respectively. Four patients underwent an abdominal/pelvic debulking procedure; 3 for ovarian cancer and 1 for colorectal cancer.

Mean time to initial conventional stent failure was 270 days (range 2 to 654 days). The sign of conventional stent failure was acute renal failure in 5 patients and progressive hydronephrosis in 3 patients. Five patients underwent immediate wire-reinforced stent placement at the time of conventional stent failure with the remaining 3 patients undergoing initial PCN placement with subsequent conversion to a wire-reinforced stent after a mean of 388 days (range 4 to 1013 days).

Mean serum creatinine at the time of conventional stent failure was 2.6 mg/dL (range 0.6-4.3) with 1 patient missing this information because stent failure occurred at an outside institution. Mean serum creatinine decreased to 1.1 mg/dL (range 0.4-1.6) in the 5 patients who had immediate wire-reinforced stent placement. Mean serum creatinine decreased to 1.0 mg/dL (range 0.8-1.2) in the 3 patients with initial PCN placement; mean serum creatinine following wire-reinforced stent placement was 1.0 in the 2 of these 3 patients with post-stent creatinine.

All 5 patients treated with immediate wire-reinforced stent placement had stable-to-improved hydronephrosis postoperatively on either ultrasonography or computed tomography when compared to imaging studies performed at the time of conventional stent failure. The remaining 3 patients who underwent initial PCN placement with later conversion to wire-reinforced stents demonstrated no radiographic evidence of obstruction immediately post-operatively with ultrasonography demonstrating none-to-mild hydronephrosis in 2 patients and the remaining patient having a patent ureter on antegrade nephrostogram.

Wire-reinforced stents ultimately failed in 3 out of 8 patients at a mean of 197 days after the first wire-reinforced stent placement. Time to wire-reinforced stent failure was 20, 37, and 536 days in the 3 patients, with signs of stent failure being acute pain with hydronephrosis on US, pain with obstruction on diuretic renal scan, and acute renal failure respectively, Table 1.

TABLE 1. **Scaffold stent failures**

Patient	Cause of obstruction	Cr, baseline	Cr, initial stent failure	Cr, post-scaffold placement	Time to failure	Chemo	XRT	Vital status
1	Ovarian cancer	0.8	2.0	0.8	536	yes	no	alive
2	Colorectal cancer	1.0	n/a	1.0	20	yes	yes	alive
3	Lymphoma	0.7	0.7	0.4	37	yes	yes	alive

Cr = creatinine; chemo = chemotherapy; XRT = radiation therapy; n/a= not available

TABLE 2. **Scaffold stent success**

Patient	Cause of obstruction	Cr, baseline	Cr, initial stent failure	Cr, post-scaffold placement	Time to failure	Chemo	XRT	Vital status
4	RP fibrosis	0.8	4.2	1.0	774	yes	no	alive
5	Ovarian cancer	0.8	2.3	1.6	79	yes	no	dead
6.	Breast cancer	0.6	4.3	1.1	124	yes	no	alive
7	Breast cancer	1.0	3.6	1.5	18	no	no	dead
8	Ovarian	1.3	1.5	1.1	392	yes	no	dead

Cr = creatinine; chemo = chemotherapy; XRT = radiation therapy; RP = retroperitoneal

In the remaining 5 patients, mean failure-free time with wire-reinforced stents in place is 277 days (range 18-774), Table 2.

Overall, 4 of 8 patients died during the study period. Mean time to death from initial conventional ureteral stent placement (onset of obstruction) and conventional stent failure in the 4 patients was 296 days (range 20 to 516) and 136 days (range 18 to 392) respectively. Of these 4 patients, 3 died with a wire-reinforced stent in place with no evidence of failure at a mean follow up of 163 days (range 18 to 392). The remaining deceased patient experienced Scaffold stent failure 37 days following placement, had a subsequent PCN placed, and then died 18 days thereafter.

Discussion

Although early experience with ureteral stent management of EUO were unfavorable,[6,7] several more recent reports have established that primary ureteral stent placement is a viable alternative to PCN placement in EUO.[1-3] Certainly, though, PCN placement is the standard of care in those who develop recurrent obstruction with a ureteral stent in place. Although there is no difference in health-related quality of life between those patients managed with PCN versus internal ureteral stents, the freedom of patients to choose alternatives to external drainage is important.[8]

Our series demonstrates that wire-reinforced stents can be considered in patients with EUO who have failed conventional stent placement and wish to avoid PCN placement. With a mean follow up of 277 days, 5 out of 8 patients in whom a wire-reinforced ureteral stent was placed have remained free of recurrent obstruction. This success rate of 67% is comparable to larger contemporary series investigating primary stent placement for EUO. In a retrospective review of 157 patients, Ganatra et al report successful management of EUO in 65% of patients.[3] In a similar study of 101 patients with EUO, Chung et al report successful management in 60 with a mean follow up of 11 months.[1] However, in the latter study, approximately 40% of those patients who developed recurrent obstruction did so within 6 days of initial stent placement. This particular fact is similar to our series in which 2 of 3 patients experiencing wire-reinforced stent failure within approximately 1 month.

Investigators have explored other alternatives to PCN in those with EUO with mixed results. Siablis et al reported on 90 patients with EUO managed with antegrade placement of a self-expandable metal mesh stent. Technical success rates of initial placement were reported as 100% however problems with stent migration and encrustation as well as overall patency rates of 50% with relatively short follow-up limit the applicability of this approach.[9] Hrebinko et al evaluated placement of parallel or side-by-side conventional ureteral stents in those EUO in a case series of 4 patients. Three of 4 patients remained free of obstruction but tolerability of two stents in a single ureter and short mean follow up of 5 months limit this study.[10] Despite this fact, this approach has been utilized on occasion at our institution with variable success.

Recently, two different metallic ureteral stents have been introduced and are being implemented in clinical practice. The Resonance stent (Resonance, Cook Medical, Bloomington, IN, USA) is a metallic coil double-pigtail stent manufactured from a nickel-cobalt-chromium-molybdenum alloy. It is deployed in the usual retrograde fashion and has potential benefit in that it may dwell for up to 12 months between exchanges. It has been shown to have greater tensile strength than the Scaffold stent but decreased resistance to extrinsic compression in ex-vivo studies.[11] Clinical experience has indicated that the Resonance stent has failure rates

similar to those reported in contemporary series in which standard polyurethane stents were utilized for EUO. Abbasi et al report successful renal decompression in 70% of 20 patients with EUO at a mean follow up of 7 months[12] whereas Goldsmith et al report success rates of 65% in 37 ureteral units.[13] The latter series did note the incidence of 3 cases of symptomatic subcapsular hematoma following Resonance stent placement which was managed conservatively in all instances. The second variety of metallic ureteral stents is a gold-plated stainless steel double-pigtail coil stent marketed as the Passage or Snake stent (Passage/Snake, Prosurg Incorporated, San Jose, CA, USA). Ex-vivo studies have shown that both the Passage and Snake stents have higher resistance to extrinsic compression than either the Scaffold or Resonance stent but clinical experience is lacking.[14]

Although effective and durable renal decompression is the primary goal of any intervention for ureteral obstruction, other factors such as patient tolerability and quality of life as well as cost certainly play a role. No patient in our series required wire-reinforced ureteral stent removal due to pain or discomfort but a limitation of the present study is that there was no formal assessment of patient quality of life. With regard to cost, review of our institutional purchasing records indicate that the average cost of a Percuflex stent is 161 dollars whereas Scaffold and Resonance stents cost an average of 300 dollars and 943 dollars respectively. It is our contention that although the cost of the Scaffold stent is nearly double that of a standard Percuflex stent, this associated cost is not prohibitive, and as indicated by our data, may obviate PCN placement whose cost and maintenance (i.e. tube check and change) are not insignificant.

Certainly, the present study does have several limitations. First, failure was defined by flank pain and imaging findings of worsening hydronephrosis or rise in serum creatinine. Patients with advanced malignancy may develop flank or abdominal pain merely due to mass effect, nerve irritation, or invasion of visceral structures and thus may not have truly developed stent failure by these criteria. In addition, radiographic evidence of obstruction was determined by ultrasonography, whereas the gold standard to diagnose functional obstruction is to utilize renal scintigraphy. Either of these two factors may have underestimated or overestimated the rate of failure. In addition, the study was limited by small sample size which precludes assessment of prognostic factors associated with wire-reinforced ureteral stent failure. Although the present study suggests the feasibility of wire-reinforced ureteral stent placement in this patient population, additional, larger studies are needed to validate these findings and identify those in whom early failure may result from wire-reinforced stent placement.

Conclusion

EUO is a progressive entity associated with considerable mortality owing largely to the fact that it is often caused by locally advanced or metastatic abdominal and pelvic malignancy. Renal decompression is paramount to reduce patient morbidity. Although decompression can be achieved with conventional ureteral stents, this approach is associated with predictable rates of failure. Retrograde placement of wire-reinforced ureteral stents is a viable alternative to PCN placement in those patients in whom conventional ureteral stents have failed. □

References

1. Chung SY, Stein RJ, Landsittel D et al. 15-year experience with the management of extrinsic ureteral obstruction with indwelling ureteral stents. *J Urol* 2004;172(2):592-595.
2. Rosevear HM, Kim SP, Wenzler DL, Faerber GJ, Roberts WW, Wolf JS Jr. Retrograde ureteral stents for extrinsic ureteral obstruction: nine years' experience at University of Michigan. *Urology* 2007;70(5):846-850.
3. Ganatra AM, Loughlin KR. The management of malignant ureteral obstruction treated with ureteral stents. *J Urol* 2005;174(6): 2125-2128.
4. Yossepowitch O, Lifshitz DA, Dekel Y et al. Predicting the success of retrograde stenting for managing ureteral obstruction. *J Urol* 2001;166(5):1746-1749.
5. 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(5):895-899.
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(2 Pt 1):277-279.
7. Feng MI, Bellman GC, Shapiro CE. Management of ureteral obstruction secondary to pelvic malignancies. *J Endourol* 1999; 13(7):521-524.
8. 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(6):695-701.
9. Liatsikos EN, Karnabatidis D, Katsanos K et al. Ureteral metal stents: 10-year experience with malignant ureteral obstruction treatment. *J Urol* 2009;182(6):2613-2617.
10. Liu JS, Hrebinko RL. The use of 2 ipsilateral ureteral stents for relief of ureteral obstruction from extrinsic compression. *J Urol* 1998;159(1):179-181.
11. Pedro RN, Hendlin K, Kriedberg C, Monga M. Wire-based ureteral stents: impact on tensile strength and compression. *Urology* 2007;70(6):1057-1059.
12. Abbasi A, Wyre H, Ogan K. Use of full-length metallic stents in malignant ureteral obstruction. *J Endourol* 2013;27(5):640-645.
13. Goldsmith ZG, Wang AJ, Banez LL et al. Outcomes of metallic stents for malignant ureteral obstruction. *J Urol* 2012;188(3):851-855.
14. Hendlin K, Korman E, Monga M. New metallic ureteral stents: improved tensile strength and resistance to extrinsic compression. *J Endourol* 2012;26(3):271-274.