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Metallic Ureteral Stents: A Cost-Effective Method of Managing Benign Upper Tract Obstruction

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Abstract

Introduction: The management of patients with upper urinary tract obstruction who are not candidates for definitive reconstruction often presents a challenge. We report our initial experience with the Resonance (Cook Urological, Spencer, IN) metallic ureteral stent for the management of benign ureteral obstruction and present a comparative cost analysis of metallic to standard polymer stent use.

Methods: Data were retrospectively gathered on all patients undergoing metallic ureteral stent placement for benign causes from July 2007 to February 2009. Baseline demographics, previous method of drainage, pre- and postoperative creatinine levels, procedural complications, stent-related side effects, and metallic stent dwell time were recorded. The cost of stent maintenance for polymer and metallic stents for a 12-month interval was calculated for each patient.

Results: Fifteen stents were placed in 13 patients to manage obstruction due to a variety of benign etiologies. Metallic stents provided adequate drainage in 12/13 patients, but were discontinued prematurely in 3 patients (2 for voiding symptoms, 1 for hematuria). Eight patients had their metallic stents changed after a mean time of 11.6 months, with no encrustation. The yearly cost associated with polymer and metallic stent use was $23,999 and $11,183, respectively. This amounted to a $10,394 annual cost reduction (43%) for each patient.

Conclusions: Metallic ureteral stents provide effective upper tract drainage for the majority of patients with benign upper tract obstruction, with significant cost benefit, largely because of the shorter exchange interval.

Introduction

The management of patients with upper urinary tract obstruction often presents a therapeutic challenge. When the obstructive etiology is nonmalignant, management typically consists of initial drainage, followed by reconstructive surgery. However, such reconstruction may be quite extensive and may be precluded by patient preference or comorbidities. In this instance, patients can be managed with either antegrade external drainage or indwelling ureteral stents. Traditional polymer stents require periodic exchange every 3 to 6 months because of encrustation.[1] These exchanges require general anesthesia or heavy sedation, resulting in repeated trips to the hospital, exposure to procedural risks, time lost from work and daily activities, and significant monetary cost.

The Resonance (Cook Urological, Spencer, IN) metallic ureteral stent is a spirally coiled metal stent that was created to provide long-term drainage of malignant upper urinary tract obstruction. It is corrosion resistant and magnetic resonance imaging-compatible and has ultrahigh tensile strength. This stent also resists encrustation, which permits dwell times of up to 12 months.[2] In light of these favorable characteristics, its use has been extended to patients with benign disease who require long-term urinary tract drainage.

We report our experience with the use of Resonance metallic ureteral stent in the management of benign ureteral obstruction as well as a comparative cost analysis of patients with metallic stents who were previously managed with polymer stents.

Methods

With Institutional Review Board approval, a prospective database involving all patients undergoing metallic stent placement at our institution between July 2007 and November 2008 was maintained. This included baseline demographic features, previous method of urinary drainage, etiology of obstruction, pre- and postoperative creatinine levels, and complications. The number of stent changes required during the 12-month interval prior to metallic stent placement was recorded for each patient, and then mean interval between stent exchanges was calculated.

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The cost of both a single polymer and metallic stent change was calculated by adding overall operating room fees, which included anesthetic, pharmacy, laboratory, X-ray, supply and recovery room charges, cost of the stent, and surgeon fee.

We then calculated the yearly cost of stent maintenance for both the polymer and metallic stent for each patient. For the polymer stents, the number of stent changes required during the 12-month interval prior to metallic stent placement was multiplied by the mean cost of a single stent change. This cost was compared with the cost of a single metallic stent placement, assuming a 12-month dwell time. For patients whose metallic stents were discontinued prior to the planned 12-month period, the cost of metallic stent removal/polymer stent placement as well as the cost of all subsequent polymer stent changes required during the remaining time of the 12-month period was added.

Results

Our database included 13 patients who had benign disease as the cause of ureteral obstruction. The mean age of patients was 66.5 years (range, 38–87). The causes of obstruction were ureteropelvic junction obstruction ($n = 7$), benign stricture ($n = 3$), ureteral tortuosity ($n = 1$), idiopathic retroperitoneal fibrosis ($n = 1$), and endometriosis ($n = 1$). One of the patients with ureteropelvic junction obstruction and the single patient with endometriosis required bilateral stent drainage. All patients were previously managed with polymer stents that were uniformly the *Endo-Sof* double pigtail stents (Cook Urological).

Metallic stents provided adequate drainage in 12/13 patients, which represents 92% of our sample. The one patient (no. 6 in Table 1) in whom the metallic ureteral stent failed had an extremely tortuous ureter, which was previously managed with two ipsilateral polymer stents. Her creatinine level rose from 1.6 to 2.7 mg/dL at 5 months after metallic stent placement; also, renal ultrasound confirmed new, moderate hydronephrosis. Her creatinine level returned to baseline after replacing with two polymer stents.

In eight patients the metallic stent was maintained *in situ* for 12 months, with no significant encrustation or complications noted upon change. The metallic stent was discontinued prematurely in three patients, two secondary to irritative voiding symptoms (no. 2 and 13) and one for recurrent gross hematuria (no. 5). Of the two patients with voiding symptoms, one resolved with polymer stent placement and the other eventually required nephrostomy tube placement for refractory lower urinary tract symptoms (LUTS) following polymer stent exchange. One patient (no. 8) had the metallic stent changed after 10 months because of recurrent urinary-tract infection, which was a problem with polymer stents even prior to the metallic stent use. In this case a new metallic stent was replaced without complications after proper antibiotic therapy.

The mean cost for a single polymer stent change was \$7675 versus \$8446 for a metallic stent change, the only difference in cost being that of the stent itself. The cost of maintenance with each type of stent was individually calculated and listed in Table 1. The average annual cost associated with polymer stent maintenance was \$23,995 compared with \$13,633 for the metallic stent. This resulted in a mean overall savings of \$10,362 per patient, representing a 43% reduction in cost per patient per year.

Discussion

Upper urinary tract obstruction is a common problem encountered in urologic practice. The relief of obstruction is critical to the maintenance of renal function, amelioration of pain, and avoidance of septic complications. In patients with advanced abdominal or pelvic malignancy, where the median survival time is only 3 to 7 months, the goal of intervention is to maximize quality of life (QOL) during this period.[3] This can be accomplished with percutaneous nephrostomy drainage or indwelling stents, with little objective difference in terms of QOL issues between the two.[4,5] Unfortunately, in the setting of malignant obstruction, stents fail in up to 58% of cases.[6–8]

Unlike those with external compression from malignancy, patients with benign obstruction typically require a more durable solution. Although the mean age in our series was 66, these patients were quite functional and their individual preference, comorbidities, or the nature of their disease precluded definitive surgical reconstruction. Rather than to live with an external collecting device, they preferred indwelling stents.

Table 1. Cost of Stent Maintenance Per Patient

Patient no.	*Regular stent change interval (months)*	*No. of regular stents per 12 months*	*Cost ($)*	*Metallic stent change interval (months)*	*No. of stents per 12 months*	*Cost ($)*
1	5.0	2.4	18,420	12	1.0 met	8466
2	3.5	3.4	26,095	2	1.0 met, 2.9 reg	30,703
3	3.5	3.4	26,095	12	1.0 met	8446
4	3.5	3.4	26,095	12	1.0 met	8446
5	3.0	4.0	30,700	3	1.0 met, 3.0 reg	31,471
6	4.5	5.4	21,016	6	1.0 met, 2.7 reg	18,954
7	4.5	2.7	20,722	12	1.0 met	8446
8	3.0	4.0	30,700	10	1.08 met	9121
9	3.0	8.0	31,136	12	2.0 met	9326
10	3.5	6.8	26,476	12	2.0 met	9326
11	6.0	2.0	15,350	12	1.0 met	8446
12	4.5	2.7	20,722	12	1.0 met	8446
13	5.0	2.4	18,420	5	1.0 met, 1.2 reg	17,656

Average cost for polymer stent change was \$7675 and for metallic stent \$8446.
met = metallic, reg = regular.

The Resonance metallic ureteral stent was initially developed for the management of malignant ureteral obstruction. It has shown promise in the long-term management of obstruction in this setting because of its tensile strength and resistance to encrustation. In an *in vivo* pig model, Blaschko et al[9] demonstrated that the Resonance stent maintained adequate flow rates despite attempted suture ligature. In another study that evaluated nine different stents, a statistically greater force was required to compress the Resonance stent compared with other types of polymer stents.[10] Whether this translates into improved success in patients with malignant obstruction is unknown. To date our experience with the metallic stent in this setting is limited.

One of the most attractive features of the metallic stent is its resistance to encrustation. Although the manufacturer supports a 12-month dwell time, the current literature is limited in this regard. After a mean dwell time of over 11 months in eight patients we found no significant stent encrustation.

Our series show excellent results in terms of maintaining upper urinary tract patency in patients with benign obstruction. A theoretical concern is that the stiffer nature of these stents may lead to poor tolerability and irritable lower tract urinary symptoms. Joshi et al[11] compared stents made of a firm and a soft polymer and found no difference in the impact on QOL between the two, using a validated questionnaire. In our series the metallic stent appears to be well tolerated, with only 2/13 patients (13%) requiring removal for LUTS. One of these patients did well with a standard polymer stent and the other required nephrostomy tube placement for persistent symptoms with a standard stent.

In the era of cost reduction, the Resonance metallic stent appears to provide an economic alternative to standard polymer stents. Although the metallic stent itself is more expensive than the regular polymer stent ($880 vs. $109), this cost is more than that made up in fewer visits to the operation room for stent exchange. The overall cost reduction was 43%, without taking into account other savings such as fewer office visits for reevaluation, less time off from work, and less burden placed on family and friends for frequent changes.

We recognize several limitations of our study. It is a retrospective study and includes a small sample size, with only intermediate follow-up. Not all of the patients who had metallic stents placed were followed for a full year following surgery. In addition, the cost analysis takes into account only the charges at our institution, which may not be generalizable to all centers.

Conclusion

Metallic ureteral stents appear to provide a feasible, safe, and cost-effective alternative to standard polymer stents for the management of benign upper urinary tract obstruction in patients who are not candidates for definitive reconstruction. These stents appear to be well tolerated and resistant to encrustation, with dwell times up to 12 months.

Disclosure Statement

No competing financial interests exist.

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Abbreviation Used

QOL = quality of life

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