Ureteral Stenting Options in Malignant Ureteral Obstruction - A Brief Narrative Review

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ABSTRACT

Introduction and Objectives. In urology, advanced pelvic cancers with gynecologic origins are the most common cause of ureteral blockage from extrinsic compression. Metallic ureteral stents have been proposed to give long-lasting urinary patency and overcome the intrinsic limitations of conventional double-J stents as noninvasive solutions for malignant ureteral blockage.

Materials and Methods. We presented three different kinds of regularly utilized metal stents in this review, including coiled stents, self-expanding stents, and thermo-expandable stents.

Results. The Wallstent predicted inconsistent patency rates, as well as a significant occlusion rate. The Memokath 051 catheter demonstrated acceptable patency rates, frequently > 90%, as well as a distinct increased migration rate. With documented efficacy rates ranging between 20% to 100%, which are nevertheless generally high, the Resonance stent delivered generally encouraging outcomes.

Conclusions. Metal stents are becoming acceptable solutions for addressing malignant ureteral stent obstruction due to their durability.

Key-words: expandable stents, malignant ureteral obstruction, metallic stent, ureteral drainage

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INTRODUCTION AND OBJECTIVES

Charles Thomas Stent, for whom the ureteral stent is called, is the first figure in the history of ureteral stents. In the 1850s, Dr. Stent, a dentist in London, created a substance that he used to take impressions of teeth. This substance was a mixture of talc, tallow, and gutta percha, a natural latex. His product, called "Stent's compound," was used to secure skin grafts in place during World War I and was later reported by surgeon J.F. Esser. This procedure became known as "stenting," and the phrase subsequently spread to other medical specialties, such as urology, to indicate inserting a tube in an organ [1,2].

Herdman published the first description of ureteric stents in 1949 [3]. They extended from the kidney to the urethra's outer wall and were constructed of polyethylene. Because they caused less encrustation, silicone and polyurethane eventually replaced other materials as the preferred option. R.P. Gibbons, a urologist, changed the way stents were designed from being a straight tube that emerged from the urethra to one with a distal bulb that may lodge in the bladder and prevent proximal dislodgment [2]. Finally, Thomas Hepperlen and Roy Finney created the well-known single J and double J stents in the 1970s [2].

To satisfy clinical needs, ureteric stent technology is evolving at this time. Indwelling ureteral stents are associated with infection, discomfort, encrustation, drainage failure, dislodgment, hematuria, and urinary symptoms, such as frequency and urgency. They are usually used to relieve obstruction or to facilitate ureteral healing. If ignored or patients are lost to follow-up, they may interfere with normal ureteric physiology and induce kidney damage or even renal failure. There isn't a perfect ureteric stent on the market right now. The goal of the most recent stent innovation has been to move closer to the ideal stent's characteristics. Longer stay times without sequelae, straightforward extraction, and minimal patient discomfort are a few of these. We have discussed improvements in the field of ureteric stents in earlier assessments [4,5].

An important clinical issue that needs to be treated by a urologist is ureteral blockage brought on by extrinsic compression as a result of benign or malignant diseases. The median life expectancy is typically less than one year in individuals with metastatic cancer-causing ureteral blockage, and malignant extrinsic obstruction has been observed to be a predictor of poor prognosis [6].

A severe urinary tract infection may occur from renal failure brought on by urinary tract obstruction, which will also have a negative impact on the therapy of cancer. The extrinsic ureteral blockage is thus an urgent cancer condition [7].

Double-J ureteral stents may temporarily ease the obstruction, but their adoption in complex instances was constrained by a lack of compressive strength. Metal stents were developed in this situation as a novel substitute to guarantee long-term ureteral patency and maintain renal function.

This brief narrative review describes various types of metal stents that are frequently used for the treatment of malignant ureteral blockage.

MATERIALS AND METHODS

The data used for this review were collected using PubMed and Scopus databases. The selected articles varied between 2010 and 2022. Keywords used were: “ureteral obstruction”, “ureteral stent”, “metallic stent”, “malignant ureteral obstruction”, “double-J stent”, “resonance metallic stent”, “memokath stents”,“wallstent”.

RESULTS

Self-expandable metal stents

The Wallstent device is made of elastic, self-expanding stainless cobalt-based alloy filaments and is manufactured by Schneider in Zurich, Switzerland. Following guidewire negotiation and balloon catheter dilation of the stenotic section, both antegrade and retrograde insertion are possible [8].

Following insertion, the stent should be dilated once again. [9] However, Wallstent can cause edema and urothelial hyperplasia in the first four to six weeks after insertion, which can infiltrate the perforations. [10,11].

Therefore, to prevent occlusion, temporary double-J stents should be placed via the Wallstent lumen during the first several weeks [9,10].

Wallstent's application in the treatment of gynecologic cancers has received relatively little clinical attention to date. Early in the 1990s, papers on the application of Wallstents for the relief of malignant ureteral blockage were documented. In a research by Pauer and Lugmayr, 12 patients who had ureteral blockage from malignant tumors had 15 stents implanted. Within three weeks, one endometrial cancer patient who had a stent in place passed away. Two out of three ovarian cancer patients passed away with stents in place after 6 and 7 months, respectively. The other one had hematuria as the only side effect and maintained lasting patency for up to 12 months [12].

The effectiveness of utilizing Wallstents to treat ureteral blockage brought on by gynecologic cancers was also assessed in a different study by Barbalias et al. 24 stents in all were successfully placed without also inserting double-J stents through the Wallstents. A double-J stent was implanted for one month in only one incidence of urothelial hyperplastic response and subsequent stent blockage. Due to tumor ingrowth, an extra metallic stent was needed in two other patients [13].

In a 2013 retrospective analysis, Lung et al. assessed 24 patients treated with Wallstents for malignant ureteral blockage due to advanced cervical cancer, including 10 patients in stage T3b and 14 patients in stage T4. Technically, 100% of placements were successful. At the distal end of the stent, fourteen patients displayed tumor proliferation or ingrowth that was treated with holmium laser ablation.

From one to five chemotherapeutic rounds, nineteen patients received Wallstents (18–140 months). In five individuals, the levels of creatinine did not fall sufficiently to permit chemotherapy treatment. 13 of the stents were still patent at 18 months, for a primary patency rate of 54%. Subsequent treatments, such as installation of polymeric double-J stents (32), extension Wallstents (4), and replacement of new Wallstents (6), were utilized to sustain the ureter's patency. Primary and secondary patency durations were, respectively, 16.5 and 52 months on average. The mean durations of primary patency for T3b and T4 patients were 20,6 and 13,6 months, respectively, while secondary patency was 73,9 and 36,4 months, respectively. The deployment of the Wallstent was not related with any major difficulties [14].

Coiled metallic stents

In order to treat both benign and malignant ureteral blockage, the ResonanceVR metallic ureteral stent (Cook Urological, Bloomington, IN, USA) was recently created. It has identical pig-tail ends and is made to resemble a full-length double-J stent, but it lacks the end-holes. The nickel-cobalt-chromium-molybdenum alloy wire used to make the Resonance stent is tightly spiral coiled, and it also has a patent lumen [15].

Due to the lack of an end hole, the urine predominantly drains around the spiral outside, with the possibility of entering the internal lumen when it encounters the stricture and subsequently exiting the stricture [16]. It is adaptable to various ureter lengths thanks to its variable lengths of 20–30 cm and fixed diameter of 6 Fr. The manufacturer claims that the Resonance stent differs from conventional stents in that it has a very high tensile strength, great flexibility, greater resistance to corrosion and encrustation, and compatibility with MRI. These positive characteristics ensure the renal system's long-term patency and permit a stay of up to 12 months [16].

The Resonance stent's insertion technique differs from that of conventional double-J stents and can be accomplished using either a retrograde or an antegrade approach.

The patient should be positioned in lithotomic posture under local or general anesthesia for retrograde approach. Using a combination of cystoscopic and fluoroscopic guidance, a 0.035-inch guide wire is then introduced into the collecting system. Next, a coaxial system consisting of a 9-F outer introducer sheath and a 5-F inner ureteral catheter with a radiopaque tip is advanced to the renal pelvis through the guide wire. The inner catheter and guide wire are then withdrawn, while the outer sheath remains in place. Using the inner catheter as a pusher at its proximal end, the

Resonance stent is advanced through the introducer sheath. After the distal curl has been produced in the renal pelvis, the introducer sheath must be retracted while the pusher catheter remains in place until the distal pigtail curl has been deployed in the bladder [17].

Since its first usage in 2004 on a lady with bilateral ureteral obstruction caused by retroperitoneal fibrosis owing to advanced breast cancer, the Resonance stent has become one of the most frequently utilized metal stents for the treatment of malignant ureteral obstruction [18].

In 2007, 15 patients with diverse cancers, including five cases of gynecologic malignancy, were treated antegradely with the Resonance stent prior to adjuvant chemotherapy. Three of the seventeen stents failed immediately, as indicated by nephrograms and deteriorating renal function. All of them were implanted in patients with large pelvic malignancies, which created considerable intravesical pressure, and percutaneous nephrostomy was employed to maintain urine drainage. Moreover, the remaining stents functioned effectively and maintained persistent patency during their follow-up. When stents were routinely replaced after six to twelve months, no encrustation was found in any of the instances [16].

Liatsikos et al. assessed the efficacy of the Resonance stent in 25 patients with MUO, including seven with gynecologic cancer. After 11 months of follow-up, the patency rate was 100 percent, which is considerably greater than in benign instances. There were no serious difficulties. At the time of stent replacement, 12 of 54 stents exhibited macroscopically visible encrustation, but none of the stents displayed corrosion [19].

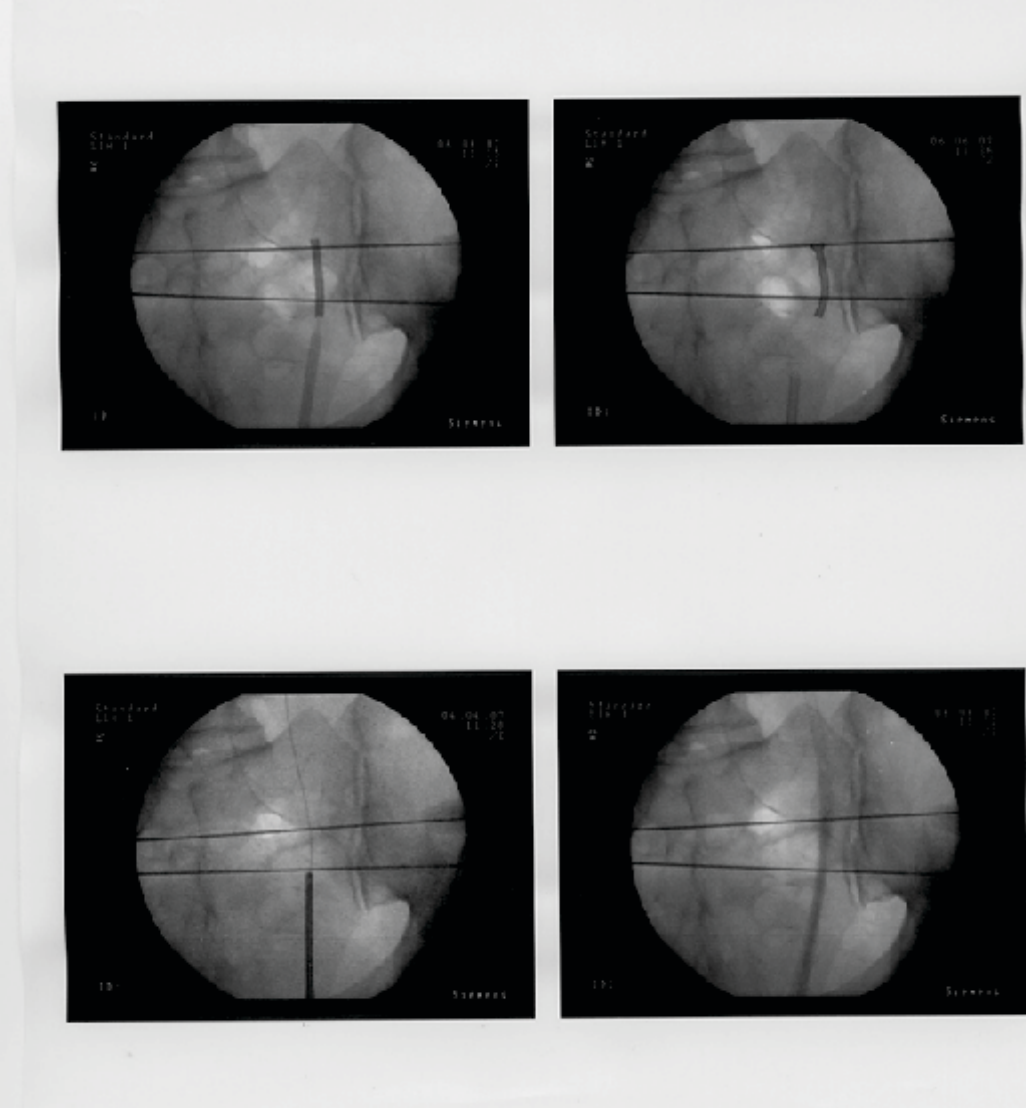
In a retrospective analysis, Chow et al. reviewed 117 Resonance stents successfully implanted in 79 patients, with gynecologic cancer being the most prevalent kind of malignancy (19 cervical cancer, one endometrial cancer and nine ovary cancers). In this study, the median duration of the Resonance stent was 5.77 months, and no severe problems were reported. Cancer type (p .0494), preoperative blood creatinine level (p .0174), and age (p .043) were significant factors associated with stent failure, as determined by multivariate analysis [20].

In a more recent trial, 66 metallic Resonance stents were implanted in 52 patients with extrinsic ureteral blockage of malignant etiology, including 10 patients with gynecologic cancer. The percentage of technical success was 98.1%, with one instance failing because of a severe ureteral stricture. Bilateral ureteral obstruction was associated with a considerably greater occlusion rate than unilateral obstruction. At six months and one year, the overall patency rates were 86.0% and 60.0%, respectively, with a median survival duration of 210 days for these patients. Nephrostomy was subsequently done on eight individuals whose stents failed. There was no calculi adhesion on the switched metal stents [21].

Thermo-expandable stents

Thermo-expandable stents were developed to overcome common stent flaws, such as urothelial hyperplasia, encrustation, and removal difficulties. The Memokath 051 (Engineers & Doctors A/S, Hombaek, Denmark) is made from a nickel-titanium alloy with a low tendency for encrustation. Insertion of the stent can be difficult and technically hard, necessitating endoscopy expertise [22].

Under general anesthesia, a retrograde ureterogram is performed to determine the length and location of the stricture. The renal pelvis is then inserted with a 0.9-mm guidewire, and the stricture is dilated to 12 F. The sheath is advanced beyond the stricture's proximal end, and the dilator and guidewire are then removed. The Memokath 051 stent assembly is put into the sheath, which is subsequently removed to expose the stent under fluoroscopy. To modify the exact location of the stent, the complete assembly is shifted. In the end, 50mL of warmed sterile water are delivered through the injection port to inflate the proximal end. To validate the stent's accurate placement, a retrograde pyelogram should be performed. The stent may be securely extracted with biopsy forceps because to its thermal shape-memory, which causes it to unroll below 10C [23].



Img. 1 Memokath stent placement

In 2001, Kulkarni and Bellamy described their four-year experience deploying Memokath 051 stents to 28 patients with malignant or benign ureteral blockage, including three patients with cervical cancer and each with vaginal and vulvar cancer that had spread to the pelvis. In every patient, the entire upper urinary tract was decompressed. After a mean of 19.3 months of follow-up, three patients with the 9.5Fr version device and one patient with the 10.5Fr larger version experienced stent migration following the treatment of underlying cancer. No patient required additional therapy for stent-related discomfort, infection, or hematuria, and there were no radiological signs of encrustation [24].

In 74 Memokath 051 stents implanted in 55 patients over a period of 11 years (28 for MUO, cervix in three, vagina in one, and vulva in one), 14 (19%) patients required reinsertion after a mean of 7.1 months. There were 13 migrations, two encrustations, and three fungal infections among the immediate and delayed consequences. However, no significant factor was identified as a cause of the increased migration rate [25].

Papatsoris and Buchholz examined their experience utilizing the Memokath 051 in 73 patients with 86 ureteral strictures. The mean duration of stent placement was 11.2 months, with a mean duration of 17.1 months for follow-up.

Episodes in 15 stents with migration and five with encrustations were associated with a failure rate of 23% (20/86) in the long run. Surprisingly, no reports of hyperplastic response were found [26].

Zaman et al. examined their experience with 42 Memokath 051 stents in 37 patients with MUO during a four-year period, with 45% of gynecologic etiology. After an average of 22 months of follow-up, the principal problems included five stent migrations, three UTIs, and two stent obstructions due to tumor growth. Additionally, no instances of hyperplastic response were detected [27].

DISCUSSIONS

Malignant ureteral obstruction is frequently caused by advanced gynecologic tumors. In recent decades, a number of ureteral stents have been introduced and widely utilized as effective and minimally invasive treatments to maintain a durable patency and improve patients' quality of life.

Traditional double-J stent placement has been used for resolving ureteral obstruction for a long time, but due to its inadequate resistance in the context of malignant compression and the need for frequent device replacement due to encrustation, which is technically challenging as pelvic malignancy progresses, its long-term outcomes are unfavourable [28].

Chow et al. compared the metallic Resonance stent to the polymeric double-J stent in 42 patients and found that the metallic stents had a mean increase in functional duration of four months (p .0001). In this retrospective analysis, cervical cancer was the most common gynecologic cancer (11 patients), followed by endometrial cancer (three patients) and ovarian cancer (one patient) (three patients). Before the implantation of polymeric and metallic stents, the degree of hydronephrosis was assessed; it decreased or stayed stable in 90% of these individuals, as did blood creatinine. No significant complications were observed, and no stents were replaced due to intolerance. A few patients experienced minor problems, including urinary frequency, hematuria, flank pain, fever, and dysuria, which were similar to the side effects associated with polymeric stents [29].

Heparin-coated ureteral stents were developed and showed success in some publications as a means of inhibiting the encrustation process. In their work, Tenke et al. showed that heparin-coated ureteral stents could offer protection from incrustation and biofilm formation for up to six to twelve months, both in vitro and in vivo [30].

According to Lange et al., the use of prophylactic antibiotics in earlier trials cleaned the urine of germs and subsequently prevented the start of encrustation. They hypothesized that the heparin coating would even make it easier for bacteria to adhere because it can combine with positively charged non-specific urine proteins and negatively charged heparin [31].

Later, metal stents were developed to get over the inherent drawbacks of conventional or coated polyurethane stents. The Wallstent's experiences with malignant ureteral blockage demonstrated a variable long-term patency percentage, ranging from 6% to 100%, based primarily on retrospective data. Hematuria, encrustation, and high occlusion rates as a result of endoluminal hyperplasia and tumor ingrowth - which may be brought on by its woven structure were common problems [8-10].

The Memokath 051 stent showed a relatively good patency rate, mostly > 90%. The tightly spiraled design lowered the incidence of tumor ingrowth and encrustation, but a specific higher migration rate and propensity for infection were commonly observed in the publications [29,30].

With a published success rate in situations involving more than 15 patients ranging from 37% to 100%, resonance stents offered an overall encouraging result. Hematuria, urinary infections, flank pain, and stent migrations—mostly mild to moderate—are among the reported consequences. Even though the Resonance stent's manufacturers claimed it was encrustation-resistant, encrustations were frequently seen in exchanged stents with the naked eye or under a microscope, yet none of them resulted in stent exchange [21].

For urologists, ureteral obstruction caused by benign gynecologic illnesses such ureteral endometriosis is not uncommon and frequently challenging to identify, with the exception of malignant etiologies. Memokath 051 has been used successfully by Arya et al. as a non-invasive treatment for patients with extraluminal endometriosis. After a six-month follow-up, it was found to be successful without any complications. Traditional double-J stents might work effectively as an adjunctive therapy for individuals undergoing medicinal or surgical treatments. Nevertheless, patients with intraluminal endometriosis may not be a good candidate for metal ureteral stents because the proliferative endometrium may obstruct the external drainage of metal stents and reduce their patency [35,36,37].

CONCLUSIONS

Treatment of malignant ureteral obstruction caused by late-stage gynecologic cancers, including obstructions caused by metallic ureteral stents, has proven to be possible. The Memokath 051 and Wallstent metal stents, two of the three types of regularly utilized metal stents, demonstrated respectable patency rates but also noticeable problems. The overall performance of the Resonance stent was encouraging, and its long-term viability made it an attractive alternative.

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