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REVIEW

Stents for malignant ureteral obstruction

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Abstract Malignant ureteral obstruction can result in renal dysfunction or urosepsis and can limit the physician's ability to treat the underlying cancer. There are multiple methods to deal with ureteral obstruction including regular polymeric double J stents (DJS), tandem DJS, nephrostomy tubes, and then more specialized products such as solid metal stents (e.g., Resonance Stent, Cook Medical) and polyurethane stents reinforced with nickel-titanium (e.g., UVENTA stents, TaeWoong Medical). In patients who require long-term stenting, a nephrostomy tube could be transformed subcutaneously into an extra-anatomic stent that is then inserted into the bladder subcutaneously. We outline the most recent developments published since 2012 and report on identifiable risk factors that predict for failure of urinary drainage. These failures are typically a sign of cancer progression and the natural history of the disease rather than the individual type of drainage device. Factors that were identified to predict drainage failure included low serum albumin, bilateral hydronephrosis, elevated C-reactive protein, and the presence of pleural effusion. Head-to-head studies show that metal stents are superior to polymeric DJS in terms of maintaining patency. Discussions with the patient should take into consideration the frequency that exchanges will be needed, the need for externalized hardware (with nephrostomy tubes), or severe urinary symptoms in the case of internal DJS. This review will highlight the current state of diversions in the setting of malignant ureteral obstruction.

1. Introduction

Obstruction of the ureter can be commonly caused by advanced urological or non-urological malignant lymphadenopathy or by direct extension of the process. Ureteral stenting can bypass the obstruction in order to provide relief and prolong survival. Determining the cause and level of obstruction is important to determine the

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appropriate technique for urinary diversion. Those with malignant ureteral obstruction (MUO) have a median survival rate of 3.7—15.3 months [1]. If untreated, ureteral obstruction can lead to renal failure and even death. Current management options include various types of stents, both metal and silicone, as well as nephrostomy tubes and extra-anatomic stents. However, it is often difficult to know which option would be most beneficial for the patient and their potential short life expectancy. As we continue to search for new ways to improve our techniques, we look at minimizing stent related symptoms, ease of the procedure, effect on quality of life (QoL), decreasing cost, and achieving high success rates. Recent research has addressed these issues and are the main highlights of this review article.

2. Methods

A PubMed review of publications in the English language was performed using the terms "metallic stents", "tandem stents", "extra-anatomic stents", "nephrostomy tubes", and "double J stents" published from 2012 to 2016. The majority of studies reviewed looked at MUO however studies investigating other etiologies were also included if they were deemed relevant to the topic.

3. Double J stents (DJS)

The most commonly used stent type is the standard DJS, named for its J-shaped curled ends. Manufactured from polyurethane, silicone, or various polymers, DJS are changed frequently at approximately 3—6 month intervals, as they are prone to encrustation, obstruction, migration, and fracture [2]. Furthermore, one of the main problems associated with DJS is encrustation of stone formation on the surface of the stent [2]. Polymeric stents have shown to be inferior in long-term drainage when compared to metal stents in the setting of MUO [2,3].

4. Metallic stents

Metallic stents have become a feasible choice in the long-term management of MUO. Different types of metallic stents exist including the non-expandable coiled metallic Resonance stent (Cook Medical, Bloomington, IN, USA), the thermo-expandable metal alloy Memokath 051 stent (PNN Medical, Glostrup, Denmark), and the self-expandable covered metallic UVENTA stent (Taewoong Medical, Gojeong-ro, Wolgot-myeon, Gimpo-si, Gyeonggi-do, South Korea).

The Resonance stent is a nickel—cobalt—chromium—molybdenum alloy DJS [2] (Fig. 1). This stent does not have a lumen like the Memokath 051 and UVENTA stents; therefore, insertion of the stent is done through the lumen of a 10 Fr ureteric catheter under fluoroscopic guidance [4]. Outcomes from studies utilizing metal stents are shown in Table 1.

The Memokath 051 stent is composed from a nickel-titanium alloy that forms a tight spiral structure [5] (Fig. 2).

Figure 1 Resonance metallic ureteral stent (permission for use granted by Cook Medical, Bloomington, IN, USA).

Regulating the temperature of the stent during insertion and removal is important for proper use of this stent [4]. Expertise is required to place the Memokath 051 stent, as insertion can be complicated and technically challenging [2]. Its coiled structure prevents urothelial ingrowth, preserves peristalsis, and reduces the risk of secondary ischemic damage to the ureteric wall [5].

Two layers of a self-expandable nickel-titanium alloy mesh covering a polytetrafluoroethylene (PTFE) layer combine to make the UVENTA stent (Fig. 3). The outer mesh containing a nickel-titanium skeleton holds the stent against the ureteral urothelium preventing stent migration [5]. The inner PTFE and mesh layers prevent tissue ingrowth and maintain patency by strengthening the overall radial force of the stent.

Kim et al. [5] were the first to publish a study comparing the UVENTA and Memokath 051 stents in 27 patients. Both types of stents demonstrated similar minor complications when used for both benign and MUO. However, the clinical success rate (defined as improved renal function and no obstruction on intravenous urography, computed tomography, or diuretic renography) of the UVENTA stent was significantly higher than the Memokath 051 stent (82.4% *vs.* 42.9%, respectively; $p = 0.031$). The difference with success rate further increased when comparing just malignant obstruction (92% UVENTA *vs.* 33% Memokath 051; $p = 0.022$). Failures in the Memokath 051 group included tumor progression, and stent migration. Failures in the UVENTA group included stent migration and mucosal hyperplasia causing luminal obstruction. Migration of the Memokath 051 was the biggest reason for differences between the two stents—all other failure reasons were equal between the two groups. Shortcomings of this study include the fact that these patients were retrospectively analyzed, the short-term follow-up, and the small sample size. The Memokath 051 and UVENTA had mean indwelling times of 13.6 months (range, 7—21 months) and 12 months (range, 9—16 months), respectively. The small sample size precludes the authors from definitively identifying which factors predicted long-term success.

Kadlec et al. [6] performed a retrospective study on 47 patients with chronic ureteral obstruction and examined their results over a 5-year follow-up period. They found the