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Mohammed Taha Awd

بسم الله الرحمن الرحيم

﴿ وَأَنزَلَ اللَّهُ عَلَيْكَ الْكِتَابَ وَالْحِكْمَةَ وَعَلَّمَكَ مَا لَمْ تَكُنْ تَعْلَمُ وَكَانَ فَضْلُ اللَّهِ عَلَيْكَ عَظِيمًا ﴾

صدق الله العظيم

سورة النساء آية ([illegible])

INTRODUCTION

Since 1978, when the double-J stent and the single-pigtail stent were introduced by Finney and Hepperlen and colleagues to the urological society, ureteral stent usage has become a routine practice for every urologist ***(Aown et al., 2010).***

By definition, the double-j or pigtail stent is a catheter or tube placed within the ureteral lumen in a retrograde or antegrade fashion in order to maintain its patency ***(Monga, 2008).***

Ureteral stents passively dilate the ureter; urine flows through the center of the hollow stent as well as around the stent, facilitating the passage of debris ***(Siggers et al.,* 2009*).***

The main advantage of stenting is the prevention of ureteral obstruction and renal colic, and stenting may also promote ureteral healing and prevent ureteral stricture ***(Shao et al., 2009).***

It has been reported that the placement of a ureteral stent reduces the risk of postoperative ureteral obstruction and may promote ureteral healing ***(Danil et al. 2008).***

Endoscopic retrograde insertion of DJ is also a well-known prophylactic procedure in maintaining ureteral patency after endourological surgery ***(Al-Busaidy et al., 2003).***

The routine insertion of a double-J before shock wave lithotripsy (SWL) is controversial, however; due to the marked heterogeneity and poor quality of reporting, the place of stenting in the management of patients after uncomplicated ureteroscopy remains unclear ***(Nabi et al., 2007).***

Ureteral stents are frequently placed after ureteroscopy ***(Gerber et al., 2006).***

In addition to technical improvements and better devices, patients' quality of life during and after stone treatment is greatly affected by the practice of leaving a double J (DJ) stent in after Ureteroscopic lithotripsy. Patients often have pain or discomfort relating to the indwelling DJ stent ***(Ecke et al., 2010).***

The decision to use a DJ stent after Ureteroscopic lithotripsy depends on the surgical procedure or the extent of ureteral injury ***(Grossi et al., 2006).***

Despite the growing evidence of well-conducted randomized prospective trials demonstrating the safety of not leaving a post-ureteroscopy ureteral stent, many urologists' still place stents after the majority of uncomplicated stone-removal procedure ***(Haleblian et al., 2008).***

Metallic mesh stents were developed for long-term ureteral stents in either malignant extrinsic compression or intrinsic stenosis, and the patency rate reached 100% in some studies ***(Liatsikos et al., 2008).***

The use of double-J stents in malignant ureteral obstructions is a highly debated issue. The main reason is that relieving ureteral obstructions secondary to extrinsic causes, such as malignancies, with regular double-J stents had high rates of failure ***(Ganatra et al., 2006).***

Although double-J stents are generally safe and well-tolerated, patients have complications, such as pain, discomfort, urinary infection, recurrent obstruction, stent encrustation, stent fragmentation and stent migration. Their negative effects on quality of life and sexual functions have also been emphasized by some researchers ***(Kuyumcuoglu et al., 2011).***

Stent-related symptoms and morbidity were often reported. Many patients with stent suffered stent-related pain in the loin/ flank region, and severe pain in kidney area during voiding; some patients experienced urinary tract infections with high fever after stenting ***(Shao et al., 2009).***

Like any catheter that dwells in the urinary tract, the ureteral stent also provides surface for biofilm formation, bacterial colonization and encrustation. The issue of how to reduce or prevent them is still unresolved ***(Hamill et al., 2007).***

The longer the stent is in place, the more persistent the biofilm that forms on the surface ***(Laube et al., 2007).***

Unfortunately, discomfort associated with ureteral stents is a complaint of a high proportion of patients (up to 80%); stents have a negative impact on health-related Quality of Life ***(Joshi et al. 2003).***

The etiology of the discomfort associated with symptoms is not completely understood. Some have suggested that high pressure transmitted to the renal pelvis with urine in the bladder and trigonal irritation by the intravesical part of the stent could be irritating factors. In addition, stent-related pain and urinary frequency could be related to lower ureteral spasm or local trigone sensitivity ***(Deliveliotis et al., 2006).***

Some investigators have attempted to explain stent-related morbidity, considering the lengths of the stents. They reported that the length of stent and crossing the midline of the distal end were significantly associated with stent-related symptoms ***(Ho CH et al., 2008).***

A way to reduce symptoms related with stents might be to alter the design and material of the stents. Researchers continue to study the effect of several medical therapies on reducing the negative symptoms which affect quality of life ***(Duvdevani et al., 2006).***

The perfect ureteral stent should demonstrate optimal flow characteristics and should be well tolerated by the patient. Biocompatibility, radiopacity, visibility on ultrasound, ease of insertion and removal are also important features. Moreover, resistance to infection, corrosion and encrustation are characteristics that are crucial for long-term ureteral patency. A stent providing long-term ureteral patency and combining the above features represents the ultimate goal of urological stent research ***(Liatsikos et al., 2009).***

Failure to remove a double J stent cystoscopically is very uncommon and generally occurs in children with abnormal bladder anatomy or in cases of stent migration into the proximal ureter ***(Barnacle et al., 2011).***

Currently, there is no ideal DJ that relieves obstruction, is resistant to infection and encrustation, and is comfortable for the patient. The advances in biomaterials and design will result in a more biocompatible ureteral stent, which will reduce the stent-related morbidity and patients' discomfort ***(Lingeman et al., 2009).***

AIM OF THE WORK

To discuss the indications of ureteral stents ***(DJ)*** in different endoscopic and surgical operations and to determine is it essential or not.

To list ureteral stent related complication, morbidity which varies from minor side effects to major complications which affect the patients' global health and quality of life.

To highlight on ureteral stent types, biomaterials and coatings.

ANATOMY OF THE URETER

The ureter is a muscular tube that follows a gentle S-shaped course in the retro peritoneum. The muscle fibers are arranged in three separate layers: (1) inner and (2) outer longitudinal and (3) middle circular ***(Giuliani et al., 1990).***

The length of the ureter in adults ranges from 25cm to 30cm, varying in direct relationship with the height of the individual. The average diameter of the ureter is 10mm in the abdomen and 5mm in the pelvis ***(El-Galley and Keane, 2000).***

Surgically the ureter can also be divided into upper, middle, and lower segments. The upper ureter extends from the renal pelvis to the upper border of the sacrum, the mid ureter then extends to the lower border of the sacroiliac joint which roughly corresponds with the iliac vessels, and the lower ureter extends from the sacro iliac joint to the bladder ***(Anderson et al., 2007),*** but endoscopically, a normal ureter is relatively uniform in caliber and easily distensible; however there are three naturally occurring relatively narrow sites within the lumen that are recognizable endoscopically: The ureteropelvic junction, the pelvic brim region, and the ureterovesical junction ***(Anderson et al., 2007),*** but according to the international anatomical terminology the ureter consists of the abdominal, the pelvic and the intramural segment (Fig. 1) **(*Frober, 2007).***

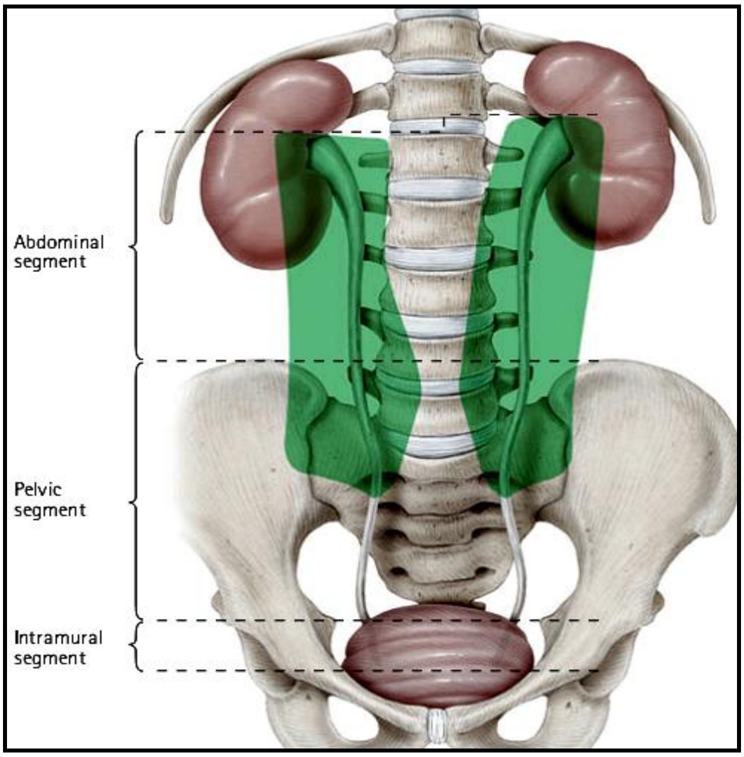

Fig. (1): Parts of the ureter ***(Frober, 2007).***

Normal Variations in Ureteral Caliber

The normal ureter is not of uniform caliber, with three distinct narrowings classically described: the ureteropelvic junction, crossing of the iliac vessels, and the ureterovesical junction. At the ureteropelvic junction, the renal pelvis tapers into the proximal ureter. In many cases, this perceived narrowing may be more apparent than real, with no evidence of obstruction evident on radiographic or endoscopic investigation. The second region of narrowing occurs as the ureter crosses the iliac vessels. This is due to a combination of extrinsic compression of the ureter by the iliac vessels and the necessary anterior angulation of the ureter as it crosses the iliac vessels to enter into the pelvis. There is also no intrinsic change in the ureteral caliber at this location. The third site of narrowing observed in the normal ureter is the ureterovesical junction. There is a true physical restriction of the ureter as it makes the intramural passage through the bladder wall to the ureteral orifice. These three sites of ureteral narrowing are clinically significant because they are common locations for urinary calculi to lodge during passage. In addition, the angulation of the ureter, first anteriorly as it passes over the iliac vessels, then posteromedially as it enters the pelvis and courses behind the bladder, may restrict successful passage of rigid endoscopes. Appreciation of this normal angulation and the three-dimensional course of the ureter are critical for safe and successful ureteral endoscopy (Fig. 2) **(*Frober, 2007*).**

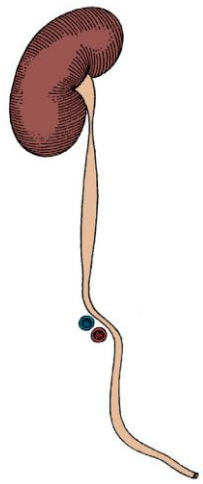

Fig (2): Sites of normal functional or anatomic narrowing ***(Frober, 2007).***

Relations of abdominal Ureter:

The abdominal segment of the ureter extends from the renal pelvis to the pelvic brim. The right ureter begins behind the descending part of the duodenum. Just below their origin the ureters are crossed by gonadal (testicular or ovarian) vessels (the so-called 'bridge over water'). Behind the ureter the genitofemoral nerve (or its genital and femoral branches) runs on top of the psoas. On the left side, the sigmoid arteries and veins embedded in the sigmoid mesocolon run in front of the ureter towards the sigmoid colon. The inferior mesenteric artery and its terminal branch, the superior rectal artery, follow a curved course close to the left ureter. Proceeding from medial to lateral, the following sequence of structures is found: superior rectal vessels; left ureter; left testicular or ovarian vessels. Just above the entry to the pelvis, the ureter is still covered by peritoneum by virtue of the ureteric fold. Next to the ureteric fold, the gonadal vessels form an adjacent fold (in female, infundibulopelvic or suspensory ligament of ovary) ***(Frober, 2007).***

Relations of pelvic Ureter:

The ureters come within 5cm of each other as they cross the iliac vessels on entering the pelvis; they diverge widely along the pelvic side walls toward the ischial spines. The ovarian vessels (infundibulo-pelvic ligament) cross the iliac vessels anterior and lateral to the ureter, and dissection of the ovarian vessels at the pelvic brim is a common cause of ureteral injury ***(Brooks, 2007).***

The ureter travels on the anterior surface of the internal iliac vessels and is related laterally to the branches of the anterior trunk. Near the ischial spine, the ureter turns anteriorly and medially to reach the bladder ***(Drake et al., 2005)***.

In males, the anteromedial surface of the ureter is covered by peritoneum, and the ureter is embedded in retroperitoneal connective tissue, which varies in thickness. As the ureter courses medially, it is crossed anteriorly by the vas deferens and runs with the superior vesical arteries, veins, and nerves in the lateral vesical ligaments. Viewed from the peritoneal side, the ureter is just lateral and deep to the recto genital fold ***(Brooks, 2007).***

In females, the ureter first runs posterior to the ovary and then turns medially to run deep to the base of the broad ligament before entering a loose connective tissue tunnel through the substance of the cardinal ligament. As in the male, the ureter can be found slightly lateral and deep to the recto uterine folds of peritoneum. It is crossed anteriorly by the uterine artery and is therefore subject to injury during hysterectomy. As it passes in front of the vagina, it crosses 1.5cm anterior and lateral to the uterine cervix. The ureter may be injured at this level during hysterectomy, resulting in an ureterovaginal fistula. The ureter courses 1 to 4cm on the anterior vaginal wall to reach the bladder. Occasionally, a stone lodged in the distal ureter can be palpated through the anterior vaginal wall ***(Brooks, 2007).***

Arterial Blood Supply:

The upper ureter derives its blood supply from a ureteric branch of the renal artery. During their course in the abdomen, the ureters receive blood from the gonadal vessels, aorta, and retroperitoneal vessels. In the pelvis, they receive additional branches from the hypo gastric artery, vasal artery, and vesical arteries. The abdominal portion of the ureter has a medial vascular supply, whereas the pelvic part receives its blood vessels from the lateral side. This should be taken into consideration during partial mobilization of the ureter to preserve as much of the blood supply as possible (Fig. 3) ***(Drake et al., 2005).***

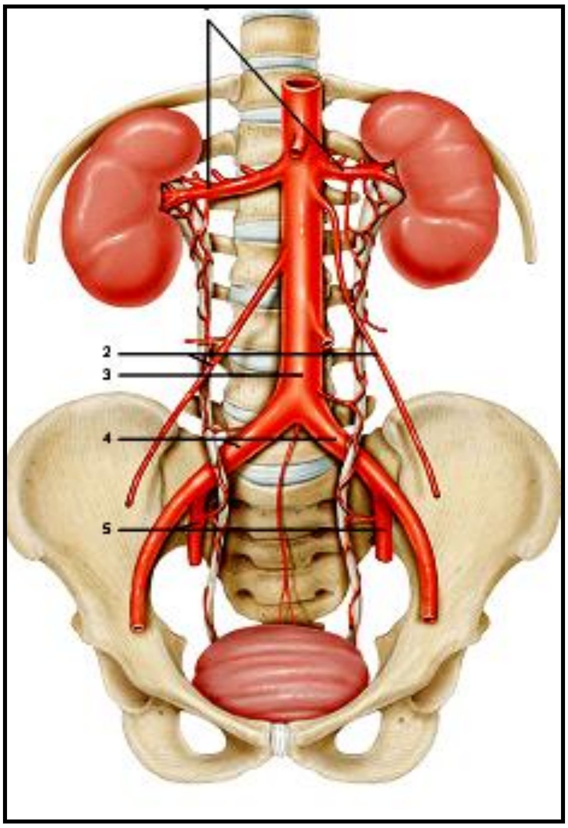

Fig. (3): Arterial supply of the ureter; 1, Renal arteries; 2, Ovarian/testicular arteries; 3, Aorta; 4, Common iliac arteries; 5, Internal iliac arteries.

Venous Drainage:

Venous drainage of the ureters follows the arterial blood supply.

Lymphatic Drainage:

A freely intercommunicating plexus of lymphatic vessels drains the submucosa, muscularis and adventitia.

The lymphatic drainage of the upper third ureter empty into lateral aortic lymph nodes either directly or after intercommunicating with the lymphatic draining the kidney. The lymphatic drainage of the middle third ureter empty into the common iliac node chain.

The lymphatic drainage the lower third ureters merge with that of the urinary bladder into the internal iliac lymph node group including the presacral and the obturator lymph nodes ***(Anderson et al., 2007).***

Nerve Supply of the ureter:

The pelvic ureter has rich adrenergic and cholinergic autonomic innervations derived from the pelvic plexus. The functional significance of this innervation is unclear, as much as the ureter continues to contract peristaltically after denervation. Afferent neural fibers travel through the pelvic plexus and account for the visceral quality of referred pain from ureteral irritation or acute obstruction ***(Brooks, 2007).***

The ureteric muscle fibers contain alpha-adrenergic (excitatory) and beta-adrenergic (inhibitory) receptors, but peristaltic contractions occur in denervated ureters and can be altered by sympathomimetic or sympatholytic medications, which indicates that the role of nerve supply to the ureter is to modulate peristaltic activity rather than to initiate it ***(El-Galley et al., 2000).***

The autonomic nervous system may exert some modulating effect on this process, but the exact role is unclear. The ureter receives preganglionic sympathetic input from the 10th thoracic through 2^{nd} lumbar spinal segments. Postganglionic fibers arise from several ganglia in the aortico renal, superior, and inferior hypo gastric autonomic plexuses. Parasympathetic input is received from the 2^{nd} to 4th sacral spinal segments ***(Anderson et al., 2007).***

Anatomy of the Uretero Vesical Junction:

As the ureter approaches the bladder, its spirally oriented mural smooth muscle fibers become longitudinal. Two to three cm from the