Introduction

Urinary system stone disease is observed in 12% of the general population. After the first diagnosis, it recurs at a mean rate of 75% in 20 years. Of all types of urinary system stones, 20% are ureteral stones, and almost 70% of these are distal ureteral stones. As a result of ureteroscopic treatment methods and developments in intracorporeal lithotripters, significant progress has occurred in the treatment of this group of stones ***(Erturhan et al., 2007)***.

The optimal choice of ureteral calculus management depends on various factors, including stone size, composition, location, degree of obstruction, treatment cost, available equipment and surgeon skills ***(Cooper et al., 2000).***

Open surgical procedures for the treatment of ureteric stones became limited to very special circumstances in the last 30 years due to the emergence of increasingly efficacious minimally invasive techniques such as Extra Corporeal Shock wave lithotripsy (ESWL) and ureteroscopy. The choice of ESWL or ureteroscopy for ureteric stone management is one of the most commonly debated controversies in endourology. This is partially due to a parallel advancement in technologies in both the fields. The success rate following ureteroscopic management using different ureteroscopes and intracorporeal devices has been reported in the range of 86% to 100% depending on stone location ***(Pearle et al., 2001).***

Traditionally, ureteral stenting are frequently placed after ureteroscopy. It has been reported that the placement of a ureteral stent reduces the risk of post-operative ureteral obstruction, and possibly aids in the passage of small fragments. However, numerous recent studies have shown that routine stenting after an uncomplicated ureteroscopic lithotripsy may be unnecessary ***(Nabi, 2007).***

There is no consensus on placing a ureteral stent after ureteroscopy, some believe that it is routinely justified in belief that this practice decrease ureteral stricture formation, protect the kidney and minimizes postoperative pain if stone disintegration is not performed ***(Chen et al., 2002).***

It is well documented that ureteral stenting is associated with irritative voiding symptoms and pain that can affect quality of life temporarily. Furthermore, there are complications associated with ureteral stenting, including migration, urinary tract infection, breakage, encrustation, and stone formation ***(Bouzidi, 2008).***

Chen et al., 2002 reported that ureteral stenting neither hastened stone passage, nor facilitated restoration of renal function. Moreover, the potential benefits to non stented patients after ureteroscopy include cost savings, reduced operative time, and avoidance of follow up cystoscopy for removal ***(Chen et al., 2002)***.

Cheung et al. (2003**)** found that ureteral stenting is not necessary after uncomplicated ureteroscopic laser lithotripsy for ureteral stones after considering the cost, complication and side effects ***(Cheung et al., 2003).***

However, ***Damiano et al. (2004)*** found that routine stent placement is advisable after uncomplicated ureteroscopy using Swiss lithoclast; the same result of ***Djaladat, 2007*** that concluded that stenting after ureteroscopic lithotripsy has a role in reducing early postoperative morbidities and decrease pain and colic after discharge.

Aim of the Work

To study the consequences of non stented ureteroscopic retrieval of uncomplicated distal ureteric calculi, also to know the values and advantages of the non stented procedure.

Chapter one

ANATOMY OF THE URETER

Anatomy of the ureter (divisions, course & relations):

The ureters are paired muscular ducts with narrow lumina that carry urine from the kidneys to the bladder. In adults the ureter is 25-30cm (in neonates 6.5-7.0cm) long, with a diameter of 1.5-6mm. In the retroperitoneum, the ureter is situated just lateral to the tips of the transverse processes of the lumbar vertebrae. Urologists divide the ureter beyond the ureteropelvic junction (PUJ) arbitrarily into the proximal, middle and distal part. According to the international anatomical terminology the ureter consists of the abdominal, the pelvic and the intramural segment **(figure 1)** ***(Yabuki et al., 2005).***

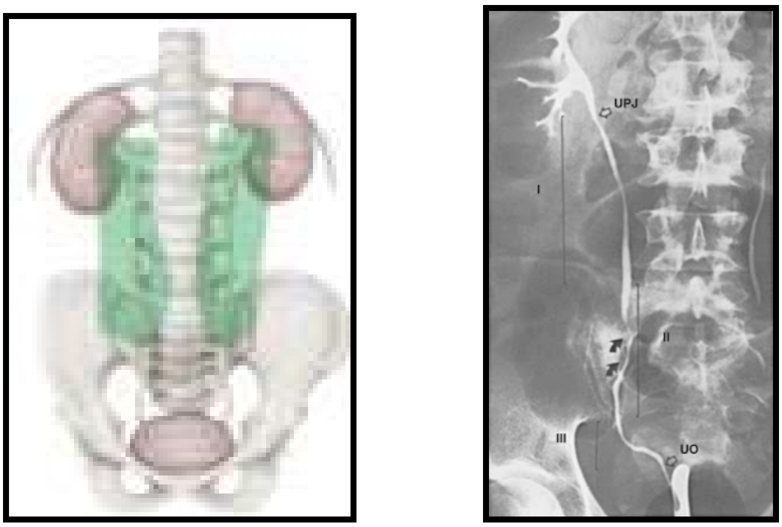

Figure (1): Parts of the ureter ***(Yabuki et al., 2005).***

In humans, the ureters arise from the renal pelvis on the medial aspect of each kidney before descending towards the bladder on the front of the psoas major muscle. The ureters cross the pelvic brim near the bifurcation of the iliac arteries (which they cross anteriorly). The ureters run posteroinferiorly on the lateral walls of the pelvis and then curve anteriormedially to enter the bladder through the back, at the vesicoureteric junction, running within the wall of the bladder for a few centimetres. The backflow of urine is prevented by valves known as ureterovesical valves.In females, the ureters pass through the mesometrium and under the uterine arteries on the way to the urinary bladder. An effective phrase for remembering this anatomical relationship is "water (ureters) under the bridge (uterine arteries or vas deferens) ***(Romer et al., 2000)***.

The abdominal part of the ureter:

Ureter arises from the renal pelvis (leaves kidney from hilum situated medially) formed by calyces encircling the renal papillae. It descends along the medial margin of the kidney, at the lower end of kidney, it becomes continuous with the abdominal ureter ***(Kogan, 2008)***.

The abdominal segment of the ureter extends from the renal pelvis to the pelvic brim. Passes downwards and medially to lie on the medial edge of psoas major .Then enters into the pelvis at the bifurcation of the common iliac artery in front of the sacroiliac joint. 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). Then passes above the pelvic brim, behind the mesosigmoid and sigmoid colon to cross the common iliac artery immediately above its bifurcation and enter the true (lesser) pelvis ***(Wunderlich et al., 2006).***

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. 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 **(fig. 2)** ***(Mescher, 2010).***

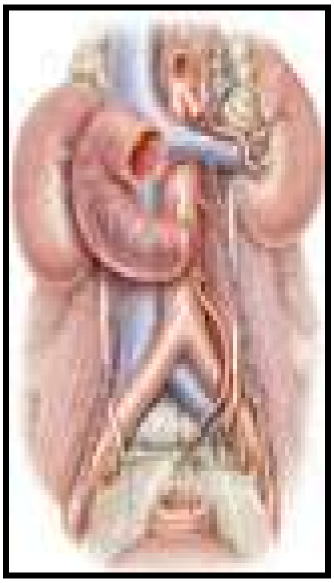

Figure (2): The retroperitoneal space with the anatomical structures surrounding the left and the right ureter (1- Duodenum**,** 2- Ureter, 3-Psoas**,** 4- Inferior mesenteric artery, 5- Testicular/ovarian artery and vein**,** 6- Genitofemoral nerve; femoral and genital branches**,** 7 -Sigmoid arteries, 8- Superior rectal artery ***(Mescher et al., 2010)***.

The pelvic part of the ureter:

The pelvic segment of the ureter is ≈15 cm long and accounts for roughly half of its total length. At the level of its beginning at the pelvic inlet, it crosses the common iliac vessels near their bifurcation (on the left side commonly anterior to the common iliac artery and on the right side commonly anterior to the external iliac artery). Within the pelvis the ureter can be divided into two portions. The descending part runs caudally still covered by peritoneum. It is dorsally accompanied by the internal iliac artery and its visceral branches as well as marked venous plexuses. Projected on to the lateral wall of the pelvis, the descending part of the ureter crosses the obturator artery, vein and nerve ***(Platzer, 2002).***

In the male, the following bent part of the pelvic segment of the ureter swings caudally in a convex curve and runs ventrally; the vas deferens loops over this part. Just before it enters the bladder, the ureter passes the ampulla of the vas deferens and the seminal vesicles. Depending on its size, the seminal vesicles or the ampulla of the vas deferens might overlap the ureter. At this level, the ureter runs to the bladder accompanied by inferior vesical vessels and the inferior hypogastric (pelvic) plexus ***(Leißner et al., 2001).***

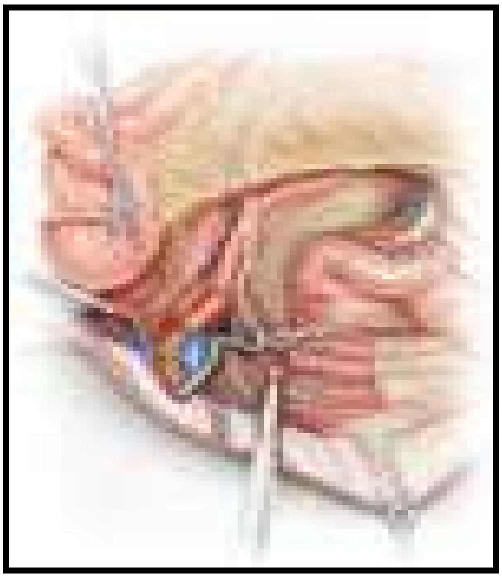

Figure (3): The pelvic space in the male, with neurovascular structures surrounding the pelvic segment of the right ureter (cranialview) (1 Ureter, 2 Common iliac artery,3 Superior hypogastric plexus,4 External iliac artery, 5 Internal iliac artery, 6 Testicular artery and vein, 7 Sigmoid arteries and veins, 8 Superior rectal artery and vein, 9 Hypogastric nerve, 10 Middle rectal artery, 11 Genitofemoral nerve, 12 Artery to vas deferens, 13 Inferior hypogastric (pelvic) plexus, 14 Inferior vesical artery, vein and vesical plexus, 15 Superior vesical artery and vein ***(Leißner et al., 2001).***

In the female, the descending part of the pelvic segment of the ureter courses posterior to the ovary. Following that, the bent part passes the middle rectal artery in the lateral ligament of the rectum (paraproctium), swings in a convex curve and crosses the uterine vessels in a sagittal direction near, i.e. 1.5–2 cm (occasionally even 1-4cm) away from the margin of the cervix of uterus. At this level, the ureter reaches the base of broad ligament of uterus (paracolpium) described by Kocks as the cardinal ligament and by Mackenrodt as the ligamentum transversale colli ***(Yabuki et al., 2005).***

The inferior hypogastric (pelvic) nerve plexus is positioned a little lower than the ureter, with the middle rectal vessels piercing almost at its centre. Finally, the terminal ureter runs forward, accompanied by the neurovascular bundle of the bladder. Just before entering the bladder, it passes the anterior vaginal fornix. As a rule, the left ureter has a more close relation to the anterior wall of the vagina than the right. The close proximity of the ureter to the uterine vessels so that, this is the site where ureteral injuries most commonly occur during gynaecological procedures. In case of vaginal surgery, there is a high risk of injury especially for the left ureter **(Figure 4)** ***(Bartsch et al., 1994).***

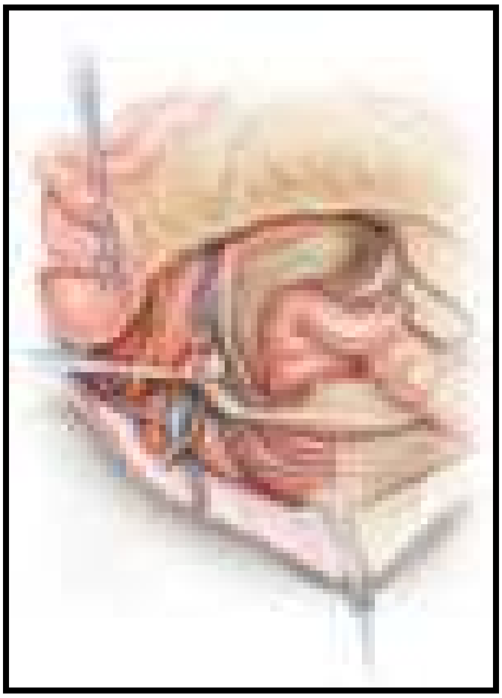

Figure (4): The pelvic space in the female with neurovascular structures surrounding the pelvic segment of the right ureter (cranial view) .Key as in Fig. 3, except 6, Ovarian artery and vein; 12 Uterine artery and veins ***(Bartsch et al., 1994).***

The intramural part of the ureter:

The intramural segment of the ureter runs obliquely through the bladder wall. Near the bladder the terminal ureter is enveloped by the muscular layer of Waldeyer. It coalesces with bundles of the detrusor muscle in the bladder wall and consists of coarser longitudinally arranged muscle bundles.Reflux of urine is prevented because the ureter passes diagonally through the bladder wall musculature for a short distance before entering the bladder lumen. The length of this intramural part of the ureter in adults is 1.2–2.5 cm **(fig. 5)** ***(Fröber, 2007).***

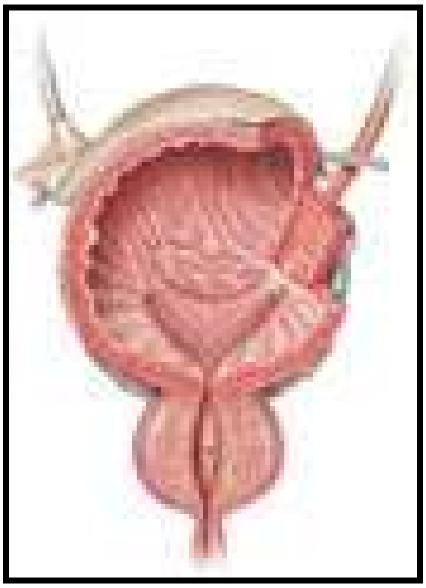

Figure (5): The intramural segment of the ureter with the bladder wall and the muscular layer of Waldeyer in the male **(Fröber, 2007).**

The ureter has 3 physiologic narrowings: (1) the ureteropelvic junction, (2) the crossing over the iliac vessels, and (3) the ureterovesical junction. Also, it has 5 surgical constrictions: (1) Pelviureteric junction (2) Pelvic brim (Crossing of iliac vessels) (3) Crossing of Vas deferens in male/ Broad ligament in female (4) Ureterovesical junction (5) Ureteric orifice (Intravesical). This is crucial in the manifestations of calculus disease. These narrowings may result in ureteral stones becoming trapped and obstructing at these specific levels. These narrowings may also limit retrograde instrumentation performed for diagnostic or therapeutic purposes (fig. 6) ***(Schlussel et al., 2007).***

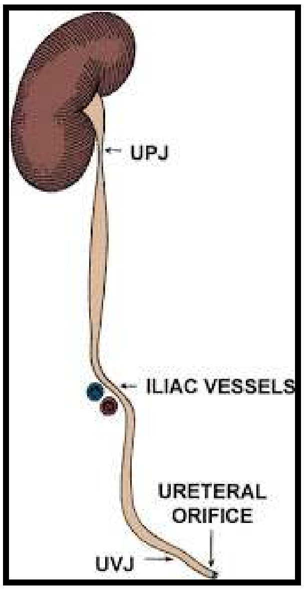

Figure (6): Reas of relative narrowing ***(Schlussel et al. 2007).***

Blood supply &venous drainage of the ureter:

The vascular supply and venous drainage of the ureter is derived from varied and numerous vessels. One critical feature is that the arterial vessels travel longitudinally in the periureteral adventitia. In the abdominal ureter, the arterial supply is located on the medial aspect of the ureter, whereas in the pelvis, the lateral aspect harbors the blood supply. The upper ureter is supplied by the renal artery and by branches from the gonadal artery and aorta. The arterial supply of the middle ureter is derived from the gonadal arteries. In addition, there are also branches coming from the aorta and the common iliac arteries which supply the adventitial vascular plexus. Finally, the distal ureter is supplied by branches of the common iliac and internal iliac branches, particularly uterine and superior vesical arteries. The nutrient arteries generally approach the ureteric wall from one direction. Above the pelvic brim, the surgeon must be aware on the medial side, and below the pelvic brim on the lateral side of the ureter. Ligation of the renal artery does not cause necrosis of the ureter or the renal pelvis because of the multiple nutrient branches at the level of the PUJ **(fig.7)** ***(Schlussel & Retik, 2007).***

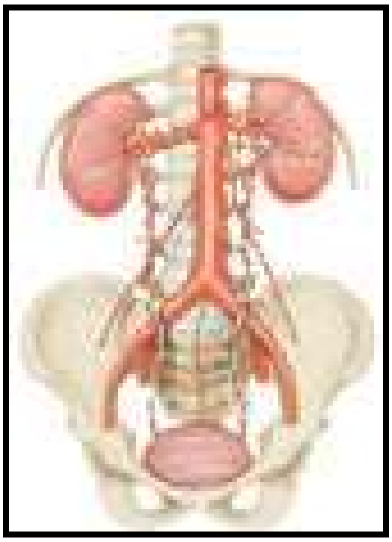

Figure (7): The arterial supply to the abdominal segment and the descending portion of the pelvicsegment of the ureter.1 Renal arteries**,** 2 Ovarian/testicular arteries**,** 3 Aorta**,** 4 Common iliac arteries**,** 5 Internal iliac arteries ***(Schlussel & Retik, 2007).***

The bent portion of the pelvic segment of the ureter is supplied from branches of the internal iliac artery. Belonging to it are the superior vesical arteries (1-4) arising from the umbilical artery (12.8% according). The terminal part of the umbilical artery is obliterated to form the median umbilical ligament. Moreover, the inferior vesical artery, arising from the internal pudendal artery or from the inferior gluteal artery (sometimes directly from the internal iliac artery), is chiefly engaged in supplying the lower wall of the retrovesical ureter (12.9% according). Occasionally, the terminal segment of the ureter is also supplied via the middle rectal artery **(fig.8)** ***(Brooks et al., 2008)*****.**

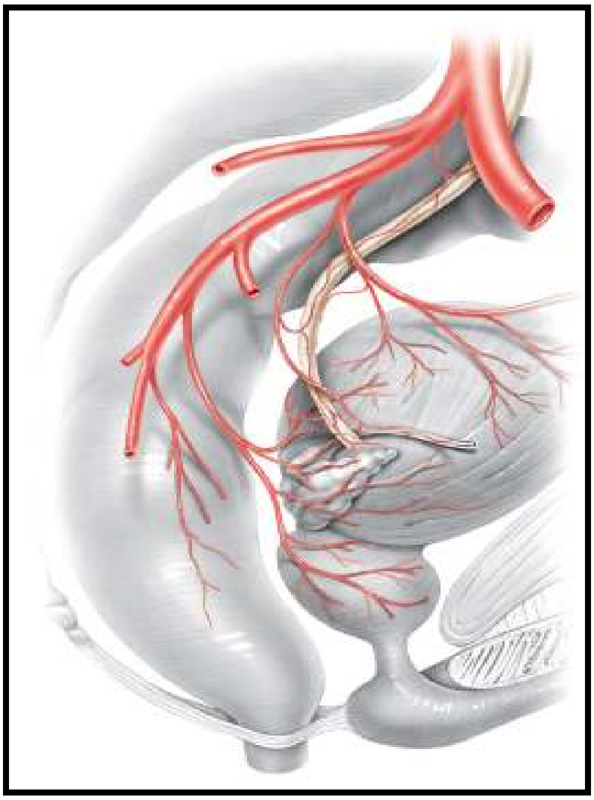

Figure (8): Arterial supply of the bent portion of the pelvic segment of the ureter in the male (lateral view). 1Ureter, 2 Internal iliac artery, 3 External iliac artery, 4 Superior gluteal artery, 5 Artery to vas deferens, 6 Obturator artery, 7 Umbilical artery, 8 Superior vesical arteries, 9 Inferior gluteal artery, 10 Middle rectal artery, 11 Inferior vesical artery, 12 Pudendal artery ***(Brooks, 2008)*****.**

In the male, another nutritive branch is the artery to vas deferens, which can arise directly from the internal iliac artery or from the umbilical artery. When running together with the vas deferens to the seminal vesicles, it extends branches to the