Extracorporeal Shockwave Lithotripsy Versus Ureteroscopy In Management Of Distal Ureteric Stones

Thesis

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List of Abbreviations

(ESWL)	Extracorporeal shock wave lithotripsy
(URS)	Ureteroscopy
(SFR)	Stone free rate
(BMI)	Body mass index
(UTI)	Urinary tract infection
(DUC)	Distal ureteric calculi
(YAG)	Yttrium aluminum garent
(LUTS)	Lower urinary tract symptoms
(MET)	Medical expulsive therapy
(NSAID)	Nonsteroidal anti-inflammatory drugs
(RCTs)	Recent clinical trials
(PVC)	Premature ventricular contraction
(VUR)	Vesicoureteral reflux

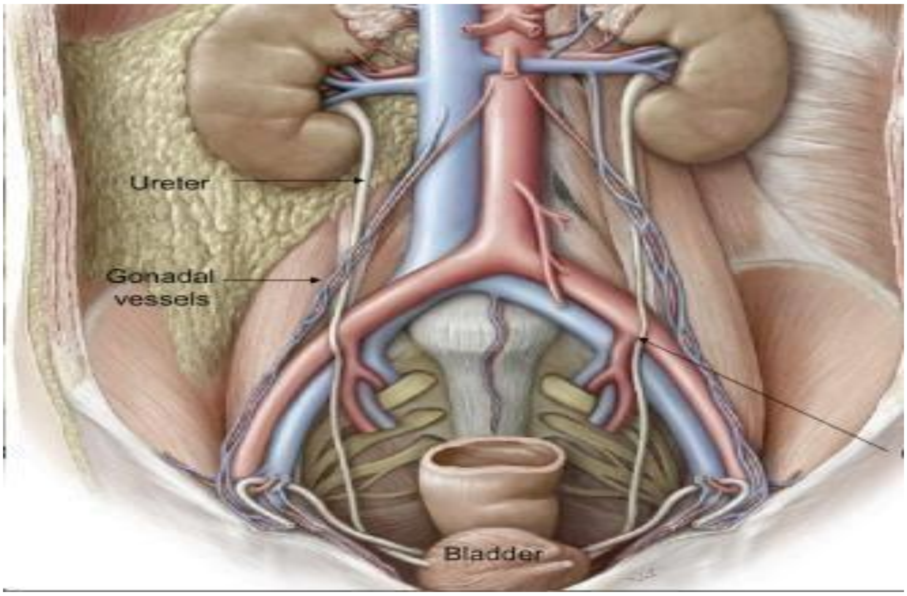
Anatomy of The Lower Ureter

For the safe instrumentation and surgery of the ureter, a comprehensive Knowledge needed to perform endoscopic ureteral procedures safely and efficiently will be reviewed

Gross anatomy and surface relations:

For anatomic purposes.the ureter can be conveniently divided into an abdominal portion above the iliac artery and a pelvic portion below: The abdominal part of the ureter starts from the renal pelvis at the ureteropelvic region. It runs downward on the medial part of the psoas muscle embedded in the subserous fascia and covered by the parietal peritoneum. It then reaches the bifurcation of the common iliac vessels to cross over their terminal part, or over the first part of the external iliac vessels. and begin its course in the pelvis. This part of the ureter can be further subdivided into a lumbar segment and an iliac segment of equal length. both being about 8 cm long.

As the ureters cross the iliac vessels. they are only 5cm apart. In case of hypertrophy of the psoas muscle, the ureters may be even closer ***(Bree et al., 1976).*** The ureters then diverge as they run downwards and laterally on the lateral pelvic wall along the anterior border of the greater sciatic notch intimately related to the posterior parietal peritoneum. At the lower end of the greater sciatic notch, it curves again to be directed medially towards the lateral angle of the bladder. It then runs obliquely for about 2 cm through the bladder wall to open at the angles of the trigone ***(Fröber ,et al 2007)***



figure(1) anatomy of ureter ***(Quoted from Fröber , 2007)***

The upper part of the pelvic ureter is related to the sacral vertebrae. the lower part is related to the ischial spine and finally, its termination into the bladder lies below the tip of the coccyx. On the right side, the appendix may overlies the ureter. while on the left the attachment of the sigmoid mesocolon usually lies anteriorly.

In males, the ureter enters the pelvis anterior to the internal iliac artery. Behind the artery are the internal iliac vein. and the lumbosacral mink. It then crosses anterior and medial to the obturator vessels and nerves, umbilical artery, and superior vesical artery. Opposite the ischial spine.the ureter makes a medial turn. to descend in the endopelvic fascia with branches of the hypogastric nerves. Filially.before it enters the bladder, it is crossed anteriorly by the vas deferens. The ureter is then anterior and superior to the seminal vesicles as it reaches the posterolateral angle of the bladder within the lateral true ligament of the bladder. This ligament contains the nerves to the bladder, a plexus of veins and the inferior vesicalartery (***Bree et al, 1976***).

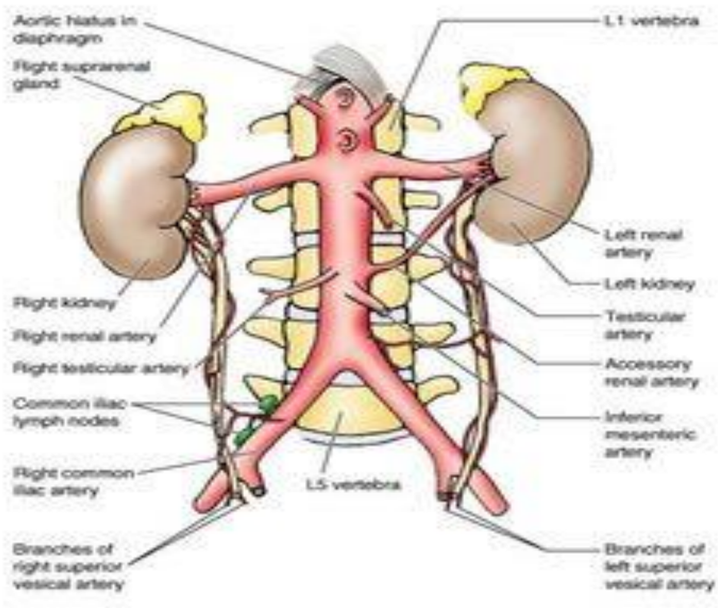
The ureter has a similar course in the female. although of necessity. the relations are somewhat different. Both ureters are medial to the ovarian vessels as they enter the suspensory ligaments. Furthermore, each ureter is immediately behind the ovary to form the posterior boundary of the ovarian fossa. The ureter crosses over the uterine artery at its origin from the internal iliac artery. it then passes through the base of the broad ligament to cross below the uterine artery. These two structures are thus in close proximity or even in contact far 1 to 2.5 cm of their course. The ureter then runs lateral to the supravaginal part of the cervix as it enters the lateral true ligament of the bladder and inclines medially and downward anterior to the vagina till it enters the bladder (***Bree et al., 1976***).

Blood supply:

No major artery directly supplies the ureter. Instead, its vascular supply consists of a vast network of anastomosing vessels located mainly in the adventitia. Contributing to this arcade are the renal. gonadal abdominal aorta. common iliac, uterine, middle rectal. superior and inferior vesical. deferential and vaginal arterial branches. The proximal and distal ureter benefit from rich vascular supply.

In fact. the blood supply to the right and left ureters is usually asymmetric. The upper part of the ureter is supplied by one or two branches of the renal artery, supplementary branches are supplied by the gonadal. aortic. renal polar. capsular or adrenal arteries. The pelvic ureter is supplied by branches from the common iliac artery, external iliac. gluteals. defferential artery in the male: uterine in the female and occasionally the obturator artery. Additional blood supply is also provided by the vaginal, superior vesical and middle rectal arteries. The iliac region of the ureter thus has the fewest direct arterial branches (***Olsson, 1986***).

The upper part of the ureter receives its vascular supply from its medial aspect. while the lower pelvic ureter receives its blood supply from its lateral aspect (***Racker and Braithvvaite, 1951***). This takes the form of a variable number of long arteries that run close to the peritoneum and supply it with small twigs. This arteries divide into ascending and descending branches that travel in the adventatial cover of the ureter and anastomose with each other. The anastomosing arteries from a plexus on the surface of the ureter and send small branches into its substance to form a second more delicate plexus in the submucosa . the capillaries rejoin in a submucosal venous plexus that drains in an outer adventitial plexus. The veins then follow the arterial pathways (***Davis et al, 1981***).



figure(2) anatomy of ureter ***(Quoted from Fröber , 2007)***

Lymphatic drainage:

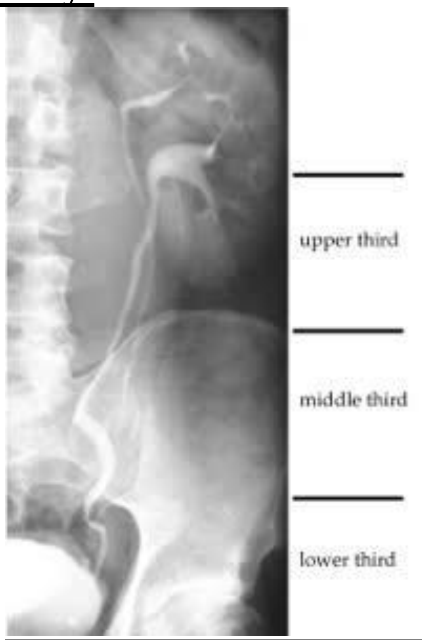
The lymphatic's of the ureter start as plexuses within its muscular and adventitial layers. The lymphatic's from the upper ureter end partly in the efferent vessels of the kidney. and in part directly in the lateral aortic set of lumber nodes. The middle portion above the pelvic brim drains into the common iliac nodes. While the intrapelvic part of the ureter drains into the external and internal iliac nodes and more distally may also join efferent vessels from the bladder (***Clemente, 1985***).

Nerve supply

The ureter receives a rich autonomic nerve supply. Nerves to the ureter arise from the celiac. aortic. renal, and mesenteric ganglia. As well as the aortic. Superior hypogastric and inferior hypogastric (pelvic) plexuses. The sympathetic supply arises from preganglionic fibers of the eleventh and twelfth thoracic. And first lumbar segments. The parasympathetic supply to the upper ureter apparently arise from vagal fibers via the coeliac plexuses. The lower ureter is supplied by the sacral segments S2. S3 and S4.
Similarly. afferent nerves from the upper ureter reach the spinal cord with the sympathetic fibers at T11. T12 and LI. Afferents from the lower ureter go via the pelvic plexus to S2. S3 and S4 (***Abdel-Razzak, 1996***).

The full significance of the various autonomic nerves to the ureters is not yet fully understood. Except, that they conduct afferent sensory stimuli. The ultra-structural features of the human ureter seem to indicate that the autonomic nervous system has a minor role in control of ureteral motility (Hanna et al, 1976). Furthermore, excised portions of the ureter continue to contract, and denervation of the lower ureter does not cause reflux to occur (***Olsson, 1986***).

Radiologic anatomy:



figure(3)anatomy of ureter***(Quoted from Fröber , 2007)***

The first step in any endourologic procedure is the examining excretory urogram. The right renal pelvis is usually opposite L2. With the left side 1 to 2 cm higher, because the kidneys may move up to 4 cm with respiration. The urogram is thus best obtained in the expiratory phase (***Friedenberg, 1990***).

The abdominal ureter usually descends vertically downwards over the transverse processes of the lumbar vertebrae and lateral to their pedicles until it reaches the level of L5. where it becomes more medial. This course is very variable and in fact the ureters may not be symmetrical bilaterally. However, as a general rule, a ureter over 1.5 cm lateral to the margin of the transverse process, is suspect. Similarly a ureter that crosses medial to a pedicle is usually abnormally displayed (***Friedenberg, 1990***). It should also be remembered that medial placement of one or both ureters may occur as a normal variant. This happens more frequently in young males, especially blacks, and is commoner on right side (***Adam et al, 1985***). However. medial displacement of the ureters should arouse suspicious of retroperitoneal fibrosis.

Hypertrophy of the psoas muscles can also cause lateral displacement of the ureters below the renal pelvis. The ureters then turn medially to descend along the anteromedial surface of the psoas. The ureters are often then displaced more medial than usual especially front the level of L5 downwards ***(Bree et al., 1976)***.

Evaluation of patients with distal ureteric Calculi

The increased prevalence of small urinary calculi has brought about a change in clinical symptoms, with frequent episodes of renal-ureteral colic, persistent pain and hydronephrosis. Similarly, the presence of residual fragments after extracorporeal shock wave lithotripsy has induced a radical change in the management of small calculi through the use of mini-invasive surgical techniques.***(Bartoletti R et al , 2007)***

Epidemiology:

The prevalence of stone disease is estimated at 1 to 15% with a recent evidence suggests that the incidence of stone disease may be increasing, along with a higher percentage of female stone formers (***Scales et al., 2005***).

1- Genetics:

About 25% of patients with urolithiasis have a positive family history (***Curhan et al., 1997***). Several disorders that cause urinary stones are hereditary. Familial renal tubular acidosis and cystinurea are well known examples.

2- Race:

The highest prevalence of stone disease is found in whites, followed by Hispanics, Asians, and Africans, who had prevalence of 70%, 63%, and 44% of whites, respectively (***Soucie et al., 1994***).

3- Age and sex:

Stone disease typically affects adult men more commonly than adult women (2-3 times) (***Pearle et al., 2005***). It is relatively uncommon before age of 20, but peaks in incidence in the fourth decade. Women show a bimodal distribution with a second peak in the sixth decade, corresponding to the onset of menopause (***Johnson et al., 1979***).

4- Geography:

In a review of several worldwide geographic surveys, it was found that the areas of high stone prevalence include the United States, the British Isles, Mediterranean countries, central Europe, China, northern India and Pakistan. Low-incidence areas include central and south America, and most of Africa (***Finlayson, 1974***).

5- Occupation:

Heat exposure and dehydration constitute occupational risk factors for stone disease. A significantly higher incidence of stones was found among steel workers exposed to high temperature (8%) compared with those working in normal temperature (0.9%) (***Atan et al., 2005***).

6- BMI and weight:

In two large prospective studies, the prevalence of stone disease was directly correlated with weight and BMI in both sexes, although the magnitude of association was greater in women **(*Curhan et al., 1998; Taylor et al., 2005*)**. Recent evidences linking obesity and insulin resistance with low urine pH **(*Maalouf et al., 2004*)**, and hyperinsulinemia with hypercalciurea **(*Nowicki et al., 1998*)** could account for an increased risk of uric and calcium stones respectively in obese patients.

Clinical presentation:

Symptoms & signs

The classic presentation of a renal stone is acute, colicky flank pain radiating to the groin. As the stone descends in the ureter, the pain may localize in the abdominal area overlying the stone and radiate to the gonad. Peritoneal signs are absent. As the stone approaches the ureterovesical junction, lower-quadrant pain radiating to the tip of the urethra, urinary urgency and frequency, and dysuria are characteristic, mimicking the symptoms of bacterial cystitis. Physical examination typically shows a patient who is often writhing in distress, trying to find a comfortable position. Tenderness of the costovertebral angle or lower quadrant may be present. Gross or microscopic hematuria occurs in approximately 90 percent of patients; however, the absence of hematuria does not preclude the presence of stones.

Owing to the shared splanchnic innervation of the renal capsule and intestines, hydronephrosis and distention of the renal capsule may produce nausea and vomiting. Thus, acute renal colic may mimic acute abdominal or pelvic conditions.(KoberA,et al***,2003)***

Investigations:

Laboratory investigations :

Urine analysis:

Microscopic hematuria and pyuria with or without infection commonly appear in the urine analysis of patients with urolithiasis. On occasion, a patient who is in an active phase of urinary lithiasis has urine crystals of the same type that are creating the calculus. The urine analysis should include pH determination. Urine culture should be ordered if there is suspicion of infection-related calculi (by urea-splitting organisms) or if there are signs or symptoms of UTI which will warrant treatment before the initiation of any procedural therapy .

Radiological investigations:

1) Plain x-ray of the kidneys, ureters and bladder (KUB):
The value of the KUB in the evaluation of urinary stones lies in the fact that 90% of urinary stones are radio-opaque (***Begunet al., 1997***). The degree of opacity varies according to the composition of the stones. Calcium phosphate stones are the most radio-opaque (density similar to that of bones), followed by calcium oxalate then struvite stones.

2) Excretory Urogram (IVU):
The value of IVU is not in the specific identification of the stones However, IVU is of value in detecting any underlying abnormalities, and diagnosing radiolucent stones**.** It also provides a gross estimate of renal function and help to choose between conservative and different active procedural therapies**(*Van Arsdalen et al.,1990*)**.