EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY VS URETEROSCOPY IN THE TREATMENT OF LOWER URETERIC STONES, EFFICACY AND COMPLICATIONS

Thesis
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قَالُوا سُبْحَانَكَ
لاَ عِلْمَ لَنَا
إِلاَّ مَا عَلَّمْتَنَا
إِنَّكَ أَنتَ
الْعَلِيمُ الْحَكِيمُ

Abstract

We performed randomized study to determine the appropriate first line treatment modality for distal ureteral stones. Between May 2009 and November 2009, a total of 40 patients with distal ureteral calculi were entered into the study (mean age 37 years, 23 male and 17 female). Twenty patients were treated with shock wave lithotripsy (SWL) and 20 patients with ureteroscopy (URS). The average stone size was 10 mm (7-15) for SWL and 8.3 mm (5–13 mm) for URS. URS was performed under general anaesthesia, using semirigid 10.5 Fr. SWL was performed under sedoanalgesia using a HM3 lithotripter. Of patients treated with SWL, 85% had a success rate, 95% after URS. These results show a significant success (P=0.05) in favor of URS. The average hospital stay after SWL was 17.2 hours and for URS 52.8 hours (significant). The results show a high efficacy and a low complication rate for both modalities.

Keywords: Distal ureteral calculi- Shock wave lithotripsy and Ureteroscopy.

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TO:

MY BELOVED FAMILY
AND
MY BEST FRIENDS

WHOSE ENCOURAGMENT WAS THE CAUSE OF ESTABLISHING THIS WORK

Abbreviations

ANN	**:** Artificial Neural Network.
ARF	**:** Acute Respiratory Failure.
AUA	**:** American Urological Association.
BMI	**:** Body Mass Index.
BPH	**:** Benign Prostatic Hyperplasia.
COM	**:** Calcium Oxalate Monohydrate.
CT	**:** Computed Tomography.
dB	**:** Decibels.
DUC	**:** Distal Ureteral Calculai.
DXA	**:** Dual X-ray Absorptiometry.
EAU	**:** European Association of Urology.
eESWL	**:** Emergency Extra corporeal Shock wave Lithotripsy.
EHL	**:** Electro Hydraulic Lithotripsy.
EQ	**:** Effectiveness Quotient.
FDA	**:** Food and Drug Administration.
Fig	**:** Figure.
F	**:** French.
GIT	**:** Gastro Intestinal Tract.
HM3	**:** Human Machine 3.
Ho: YAG	**:** Holmium: yttrium aluminum garnet.
HU	**:** Hounsfield Unit.
IVP	**:** Intravenous Pylography.
IVU	**:** Intravenous Urography.
KUB	**:** Kidney Ureter and Bladder.
KV	**:** Kilo Volt.
LUTS	**:** Lower Urinary Tract Symptoms.
MET	**:** Medical Expulsive Therapy.
MRI	**:** Magnetic Resonance Imaging.
MRU	**:** Magnetic Resonance Urography.
NCSCT	**:** Non Contrast Spiral Computerized Tomography.
OSHA	**:** Occupational Safety Health Administration.
PEAA	**:** Piezoelectric Annular Array.
PCN	**:** Percutaneous Nephrolithotomy.

PSA	**:** Prostate Specific Antigen.
PTH	**:** Parathyroid Hormone.
PVCs	**:** Premature Ventricular Contractions.
RBCs	**:** Red Blood Corpuscles.
RCTs	**:** Random Clinical Trials.
RTA	**:** Renal Tubular Acidosis.
SFR	**:** Stone Free Rate.
SMC	**:** Stone Mineral Content.
SWL	**:** Shock Wave Lithotripsy.
SWs	**:** Shock Waves.
TENS	**:** Transcutaneous Electrical Nerve Stimulation.
TUL	**:** Trans Ureteral Lithotripsy.
UHCT	**:** Unenhanced Computerized Tomography.
UPJ	**:** Uretero Pelvic Junction.
URS	**:** Ureteroscopy.
US	**:** Ultra Sound.
UTI	**:** Urinary Tract Infection.
UVJ	**:** Uretero Vesical Junction.
WBCs	**:** White Blood Cells.
WHO	**:** World Health Organization.

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Introduction

Ureteral stones were managed by open ureterolithotomy for a long time ***(Rofeim et al 2001)***.

In the last 20 years, the management of ureteric stones has radically changed ***(Segura et al 1997)***, currently most ureteric stones are successfully managed with extracorporeal shockwave lithotripsy (SWL) or ureteroscopy.

Technological advances and innovation by physicians have improved the endourological treatment of ureteric stones. Regardless of the location of the ureteric stones, access and definitive treatment is commonly achieved with a minimal risk of complication. Despite the definite success of endourological stone treatment, ongoing question about optimum management remain debated among urologists ***(Segura et al 1997)***.

There is an ongoing discussion about the optimal management of distal ureteral stones. Stenting, shockwave lithotripsy (SWL), and ureteroscopic (URS) extraction are the minimally invasive modalities now used in urology clinics. It is a fact that URS is invasive. However, in the hands of an experienced urologist, it may prove to be a highly effective procedure, with success rates of nearly 100% in the distal ureter. Proponents of ureteroscopy cite the high success rates achieved by this technique, negligible retreatment rates, low cost, and widespread availability ***(Tugcu et al 2006).***

Increased use of SWL showed that ureteral calculi did not fragment as reliably as kidney stones when exposed to shock waves. Several experimental and clinical studies showed that lack of an expansion chamber and stone fluid interfaces were responsible for this phenomenon ***(Turna et al 2008).***

Medical therapy to promote spontaneous expulsion of ureteral stones may potentially diminish health care expenditures associated with SWL and ureteroscopy. Alpha blockers are a particularly promising class of stone expulsive agents ***(Sigala et al 2005).***

The choice of TUL (Trans Ureteral Lithotripsy) or SWL (Shock Wave Lithotripsy) for the treatment of lower ureteral calculi is still open to debate. The indications for ureteroscopic lithotripsy for the stones of all parts of the ureter have been expanded with the advent of smaller semi rigid ureteroscopy, laser technology, and more flexible instruments. It is stated that SWL, even in its new generation formats, takes the second option after more invasive endoscopic therapy. Previous SWL failure, large calculi, hard calculi, and obstruction or impaction are indicated for TUL rather than SWL ***(Anagnostou et al 2004)***.

Anatomy of the ureter

The ureter begins at the pelviureteral junction as the renal pelvis tapers down gradually to become the ureter proper ***(Maizels et al 1986)***.

In 86% of adult individuals, it starts at the level of L1 ***(Tanagho et al 1986)***.The pelviureteric region is normally extrahilar. In some individuals, the entire renal pelvis lies inside the sinus of the kidney and, consequently, the pelvi-ureteric region is situated either in the vicinity of the renal hilum or completely within the sinus ***(Maizels et al 1986)***.

The ureter measures 24-30 cm depending on individual height and position of the kidney, the left ureter 1 cm longer than the right ***(Davis et al 1981)***. Anatomically it is divided into two almost equal abdominal and pelvic portions: the abdominal ureter consists of lumbar and iliac parts and pelvic part consists of a longer parietal and a shorter intravesical division ***(Drake et al 2005)***

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 sacrum, which roughly corresponds with the iliac vessels, and the lower ureter extends from the sacrum to the bladder ***(Williams et al 1989) (Anderson et al 2007).***

Endoscopic anatomy:

Just inside the bladder neck is the trigone. It is a raised smooth triangular area with its apex at the bladder neck, and its base formed by the interureteric ridge "**Mercier's bar**" extending between the two ureteral orifices which is prominent in male than in female. The ureteral orifices are usually symmetrically located along this ridge, 1 to 2 cm from the midline. The orifice of a normal ureter has the appearance of a volcanic cone. That of a slightly weaker valve looks like a football stadium; an even weaker one has the appearance of a horse-shoe with its open end pointing

toward the vesical neck. The completely incompetent junction has a golf-hole orifice ***(Tanagho, 2000)***.

The 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 ***(Huffman et al 1985)***.

The degree of narrowing that is encountered endoscopically varies among individuals. Beside these anatomic regions there are other landmarks to be observed. The portion of the ureter as it crosses the termination of the common iliac artery may often be seen pulsating thus signifying the close approximation of the ureteral and arterial lumen ***(Huffman et al 1985).***

Variations in the caliber of the ureter, according to its course, were reported by ***(Olsson et al 1986)*** as follows:

-At the P.U.J.	2 mm (6 F.)
-At the lumber region (widest)	10 mm (30 F.)
-At the crossing with the iliac vessels	4 mm (12 F.)
-At the parietal pelvic part	4-6 mm (12-18 F.)
-At the intramural part (narrowest)	1-5 mm (3 -15 F.)
-At the ureteric orifice	3-4 mm (9 -12 F.)

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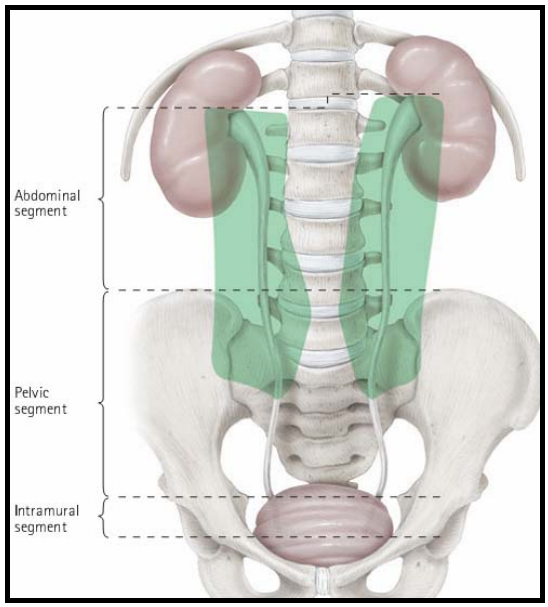
Coverings of the ureter

A fascial layer comprised of pre ureteral leaf and a retro ureteral leaf was delineated, and was found caudal to the fusion of leaves of the gerota's fascia. The resulting sheath, containing the ureter and more medially to the genital vessels, continues caudally towards the base of the bladder with its entire medial border attached to the psoas muscle ***(Davis et al 1981).***

The juxtavesical ureter (distal 3-4 cm) as well as the intramural segment of the intravesical ureter is surrounded by a fibro muscular sheath Waldeyer's sheath ***(El Badawy et al 1972).***

Course and relations of the ureter

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 (UPJ) 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 **(Fig. 1)** ***(Frober, 2007).***



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

The abdominal part of the ureter lies posterior to the peritoneum on the medial part of the psoas major muscle, which intervene between it and the tips of the transverse processes of the lumber vertebrae. It crosses in the front of the genitofemoral nerve and it crossed obliquely by the gonadal vessels before entering the pelvis ***(Drake el al 2005).***

The right ureter descends lateral to the inferior vena cava where it passes behind the 2nd portion of the dudenum and is crossed anteriorly by the right colic and iliocolic vessels in the root of the mesentery. The appendix may overlie the ureter. **The left ureter** is crossed anteriorly by the left colic vessels and near the pelvic prim it passes posteriorly to the sigmoid colon and its mesentery. At the level of the pelvic brim after crossing of the iliac

vessels, the ureter turn lateral, posterior and downward in relation to the lateral pelvic wall till it reaches the ischial spine where it changes its direction to become medial, anterior and downwards until it penetrates the urinary bladder ***(Drake el al 2005).***

In males, the ureter descends anterior to the internal iliac artery. It crosses anterior and medial to the obturator vessels and nerves and is crossed by the obliterated umbilical artery and superior vesical artery. Just before the ureter enters the bladder it is crossed again by the vas deferens anteriorly**. In females**, both ureters lie medial to the ovarian vessels as they cross the pelvic prim and enter the suspensory ligaments. Each ureter lies posterior to the ovary forming the posterior border of the ovarian fossa ***(Davis et al 1981) (Drake el al 2005).***

Each ureter crosses over the uterine artery where it arises from the internal iliac artery, the ureter then passes through the base of the broad ligament but here it crosses below the uterine artery. Thereafter the ureters enter the tissues of the lateral true ligaments of the bladder and incline medially and downwards in contact with the vagina to its entrance into the bladder ***(Davis et al 1981) (Drake el al 2005).***

Arterial blood supply of the ureter:

The ureter takes its arterial supply along its course from almost all the adjacent arteries as follows: the abdominal ureter may receive branches from the renal artery, gonadal artery, abdominal aorta and the common iliac artery. After entering the pelvis, additional arterial branches to the distal ureter may arise from the internal iliac artery or its branches, especially the vesical and uterine arteries and also from the middle rectal and vaginal arteries. The branches to upper ureter approach from a medial direction whereas arterial branches within the pelvis approach the ureter from a lateral direction ***(Olsson et al 1986)*****(Fig. 2)**