https://doi.org/10.48047/AFJBS.6.7.2024.4222-4239

AFJBS

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

A Large Ureteral Calculi Treatment Using Laparoscopic Ureterolithotomy or Extra Corporeal Shock Wave Lithotripsy

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Article History

Volume 6, **Issue** 7, 2024

Received: 05 July 2024

Accepted: 01 August 2024

Published: 05 August 2024

doi: *10.48047/AFJBS.6.7.2024.4222-4239*

Abstract:

The management of urolithiasis has evolved significantly in recent decades, now using numerous techniques that exhibit differing rates of full stone removal and varying incidences of morbidity. Ureteral calculi larger than one centimeter are likely to be impacted, and endoscopic failure rates are high. Therefore, these stones may represent a favorable indication for primary ureterolithotomy. Laparoscopic ureter lithotomy was conducted via the transperitoneal approach. or the retroperitoneal approach. But the transperitoneal approach has a shorter learning curve and less total operative time. Laparoscopic lumbar ureterolithotomy is a one-session efficient, safe procedure that ends in a stone-free patient with low postoperative pain, good cosmetic incisions, and a reduced hospital stay, with exposure to possible morbidities and high experience. Extracorporeal shock wave lithotripsy (ESWL) has become the preferred management for renal calculi smaller than two centimeters and proximal ureteral calculi that do not pass naturally. This method of treatment is the least invasive and has demonstrated great success rates for calculi throughout the whole urinary tract.

Keywords: Urolithiasis, ESWL, ureterolithotomy.

1. Introduction

The advancement of laparoscopic surgery has reignited interest in ureterolithotomy as an efficient treatment for ureteral stones. Wickham initially introduced laparoscopic ureterolithotomy in 1979, which has since demonstrated efficacy as a minimally invasive alternative to open operation **(1)**.

Laparoscopic procedure provides the benefit of achieving significantly greater rates of stone-free in a single session compared to ureteroscopic stone extraction or extracorporeal shock wave lithotripsy (2).

Laparoscopic ureterolithotomy is technically viable, providing the benefits of minimum invasiveness and reduced complications following the procedure relative to open ureterolithotomy. This procedure is primarily appropriate for significant impacted ureteral stones, or when endoscopic ureterolithotripsy or lithotripsy using extracorporeal shock waves has proven ineffective, or when a simultaneous laparoscopic procedure is required for a distinct indication (3).

Recently, laparoscopic technique has been continuously evolving, with efforts aimed at further reducing surgical morbidity & enhancing cosmetic results as experience in the laparoscopic field increases. This has resulted in the creation of methods, like multichannel single-port access, which are innovative articulating devices enabling laparoscopic procedures to be conducted with a single skin incision at the umbilicus (4).

Extracorporeal shock wave lithotripsy is advised as the main therapy for proximal ureteral stones measuring under one centimeter, but the ideal management for bigger proximal ureteral stones has yet to be established. A significant success rate has been documented for extracorporeal shock wave lithotripsy in the management of ureteral calculi; nevertheless, in certain cases, it is much lower than that of ureteroscopy (5)**.**

The objective of the investigation was to assess the results of laparoscopic ureterolithotomy and extracorporeal shock wave lithotripsy in the therapy of large ureteral calculi as regards stone-free rate & morbidity.

Surgical Anatomy of the Ureter

The ureters are bilateral, slender (three to four millimeters) tubular structures that link the kidneys to the urinary bladder, facilitating the movement of urine from the renal pelvis to the bladder. The muscular layers facilitate the peristaltic movement that the ureter employs to transport urine from the kidneys to the bladder. (6).

Gross anatomy

The ureters originate in the ureteropelvic junction (UPJ) of the kidneys, situated posteriorly to the renal vein & artery within the hilum. The ureters subsequently descend within the abdominal cavity. They traverse anterior to the psoas muscle & penetrate the bladder at the posterior edge of the trigone (7).

Urologists categorize the ureter beyond the ureteropelvic junction (PUJ) into three segments: middle, proximal, & distal. The ureter comprises the pelvic, abdominal, and intramural segments, as per international anatomical terminology (8)**.**

Microscopic anatomy

The ureteric wall consists of three primary tissue layers: the inside mucosa, the middle muscular layer, and the outside serosa. The inner layer is lined with transitional epithelium. The lamina propria, situated deeper, combines with epithelium to produce the mucosal lining. The subsequent deeper layer of tissue is the smooth muscle layer, often known as the lamina propria. The smooth muscle layer of the ureter consists of an inner longitudinal layer & an outer circular layer. (6).

Blood supply

The circulatory supply to the ureter is segmental and originates from multiple sources. The upper part of the ureter receives its blood supply from the renal artery and aorta. The mid ureter receives its circulatory supply via branches of the colic artery, gonadal artery, & internal iliac artery. The distal ureter receives blood supply from the branches of the upper and lower vesical arteries. (9).

Ureterolithiasis

Ureterolithiasis is a painful illness that impacts millions of people annually. To reduce the significant mortality & morbidity related to this illness, timely diagnosis and treatment are essential. (10).

Epidemiology

Urolithiasis is a prevalent condition that poses a significant burden on cases and the healthcare system. Thirty years ago, the incidence of urolithiasis in the USA was roughly 3.8 percent. Since that time, the occurrence has nearly doubled, reaching a stated 8.8 percent in a national survey conducted in 2010. (11).

Moreover, the prevalence is anticipated to increase. There exists a distinction in occurrence among various racial groupings. The prevalence of racial groups, in descending order, is as follows: White/non-Hispanic, Hispanic, and Black. Furthermore, nephrolithiasis is typically found in cases in their 40s. (10).

Pathophysiology

The composition of urine predicts the composition of stones. Renal calculi may develop when urine contains elevated levels of oxalate, calcium, and/or uric acid. Hypercalciuria leads to calcium stones, hyperuricosuria causes uric acid stones, and hyperoxaluria produces oxalate stones. (12).

Presentation

The clinical manifestation of urinary stones is mostly influenced by the location of the stone, the presence of infection, & particular patient variables, including the renal function of the contralateral kidney. (13).

Physical examination

The physical investigation of cases with renal colic is non-specific and limited, even in the presence of intense pain. The presence of tenderness or other clinical symptoms may result from sequelae like urine extravasation (urinoma) or subsequent calyceal rupture. (14).

Laboratory workup

The diagnosis may be facilitated by one or more of the following examinations: basic metabolic panel (BMP), complete blood count (CBC), and urine. Urinalysis frequently reveals the presence of red blood cells. Nevertheless, the presence of leukocyte esterase, white blood cells, and/or bacteria may signify a more severe disease, specifically an infected renal calculus. An assessment of the stone composition can be conducted in either an outpatient or inpatient environment. (10).

Radiological investigations

Plain abdominal radiographs

The primary benefit of plain radiography of the kidney ureters and bladder (KUB) is the evaluation of the stone's radioopacity. Although most calcium-containing stones calcium (phosphates, calcium oxalate monohydrate, & calcium oxalate dihydrate) are readily struvite, visible, apatite & cystine stones exhibit semi-opacity and are just faintly visible on kidney ureters and bladder imaging. Radiolucent calculi (ammonium urate, xanthine, and uric acid) aren't visible on kidney ureters and bladder unless they exhibit mixed composition (15).

Plain X-ray (KUB) is an appropriate imaging modality for monitoring stones of opaque ureteral, with advantages of reduced cost & lower radiation exposure (0.5–1 millisievert (mSv)) in comparison to CT (16).

Ultrasonography

Ultrasonography is a prevalent imaging technique utilized by urologists due to its cost-effectiveness, absence of radiation, non-invasive nature, and repeatability. The sensitivity of ultrasound to identify urolithiasis ranges from nineteen percent to ninety-six percent (17).

Although both specificity and sensitivity are elevated for calculi situated in the renal calices, renal pelvis, ureterovesical junction, and ureteropelvic junction, the identification of ureteral stones is more challenging and necessitates specialized knowledge. The deep positioning of the midureter & the presence of intestinal gas may obstruct the vision of the calculi and ureter (18).

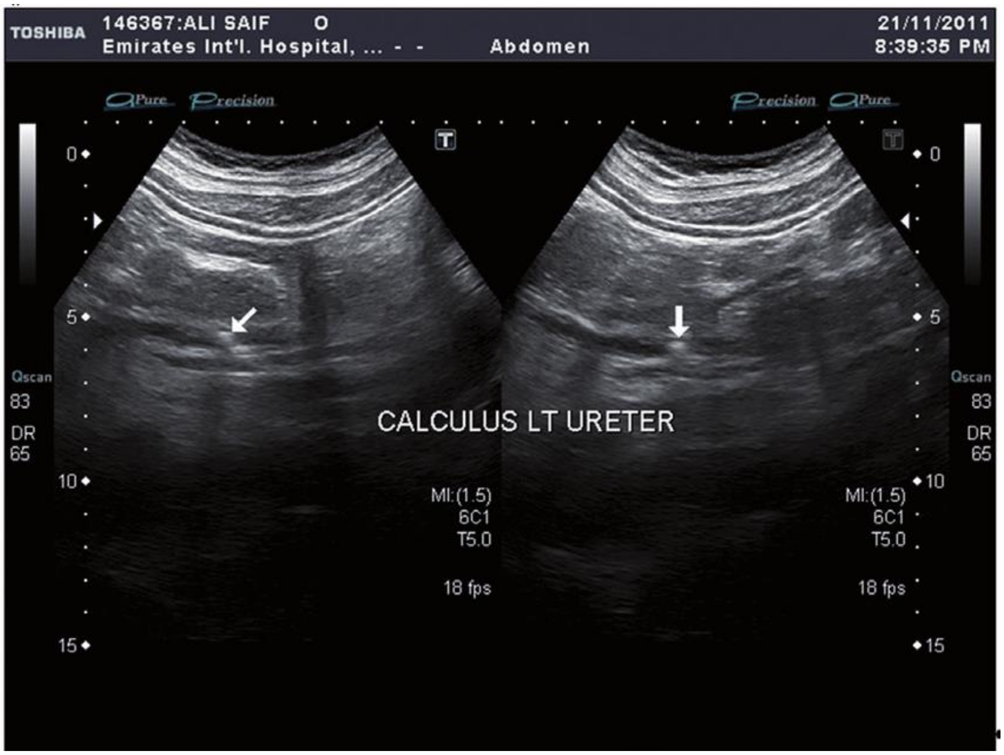

Figure (1): Ultrasound reveals a calculi in the left mid-ureter accompanied by posterior acoustic shadowing. (19).

Intravenous urography

An intravenous urography, which is the standard way to diagnose sudden flank pain, shows how well the kidneys are working, how bad hydroureteronephrosis is, where stones are located, and if there are any problems with the pelvicalyceal system or the ureter. It can also show if there are tumors in the collecting system or the ureter. **(20)** **.**

Computed tomography

In recent times, CT has become the gold standard imaging technique for the initial identification of acute ureteric colic due to its superior specificity (92–100%) and sensitivity (94–100%) compared to other imaging modalities **(21, 22)**.

Its ability to identify non-urologic conditions that resemble renal colic, including diverticulitis, appendicitis, cholelithiasis, pancreatitis, or lumbar discitis, combined with its short investigation duration and elevated specificity and sensitivity rates, renders it the most effective & prevalent imaging modality using in emergency departments **(15)**.

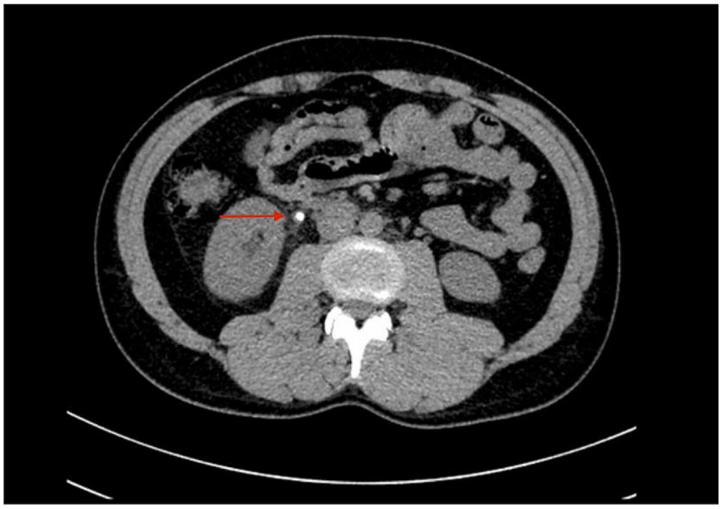

Figure (2): Axial non-contrast CT scan depicting a calculus in the right proximal ureter accompanied by perinephric & periureteric fat stranding **(23).**

A CT scan identifies various stone-related factors, including the number of calculi, stone position, stone volume, and stone attenuation determined by Hounsfield units (HU) and skin-to-stone distance (SSD), which influence the selection of the appropriate treatment regimen to optimize outcomes. Hounsfield unit attenuation & skin-to-stone distance are critical determinants influencing the efficacy of ESWL. Pareek et al. have shown that skin-to-stone distance assessed via CT is a robust predictor of the efficacy of shock wave lithotripsy for renal calculi **(24).**

Magnetic resonance imaging

Magnetic resonance imaging is a radiation-free imaging method that offers a detailed representation for evaluating all soft tissues. Despite its reduced sensitivity in detecting urinary calculi compared to magnetic resonance imaging, computed tomography can identify secondary symptoms of urolithiasis **(25).**

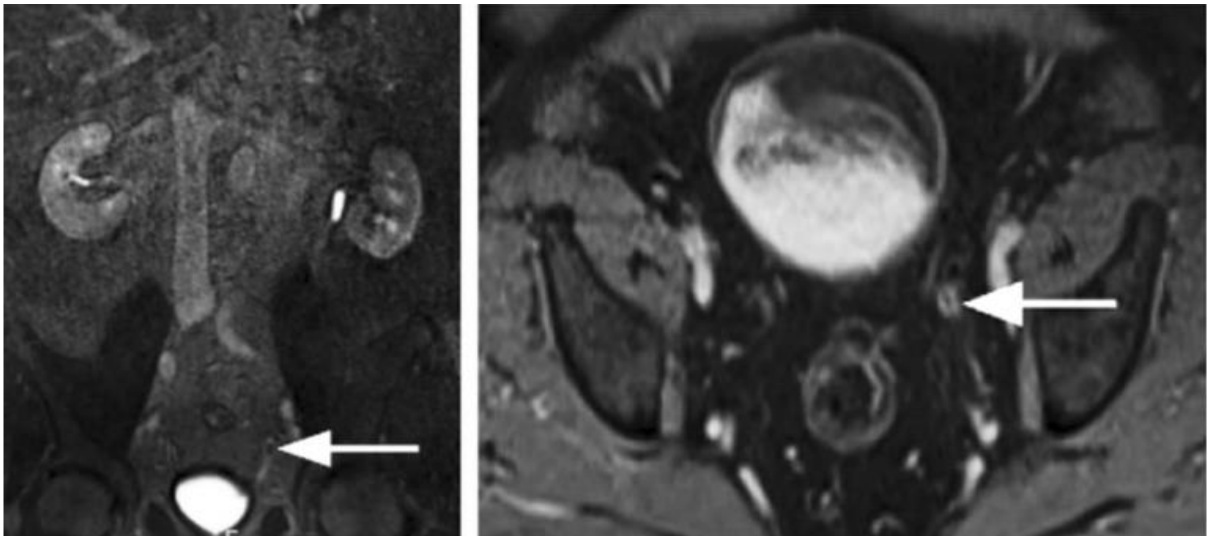

Figure (3): Intraluminal filling deficiency (calculi) in the distal left ureter identified with magnetic resonance imaging [26].

The MRI provides full information regarding edema, hydronephrosis, & ureteral wall thickness. Fegan et al. have shown that a combination of magnetic resonance imaging and kidney ureters and bladder can detect calculus obstruction with an accuracy rate comparable to that of computed tomography [27].

Complications

Nephrolithiasis and ureterolithiasis don't always follow a benign course. Complications include infected kidney stones, infection, perforation, ureteral scarring, renal abscess formation, hemorrhage, reduced renal function, & obstruction. Chronic kidney disease may arise from a urologic procedure, blockage, or the intrinsic factors contributing to stone production. [10].

Management of urinary stones

Medical management

Ureterolithiasis management involves acute pain management and medications like tamsulosin for stone passage. The AUA/EAU guidelines recommend Me for selected patients. Alpha antagonists can improve stone expulsion rates, and evidence suggests medical expulsive therapy can reduce use of narcotic, colic events, & hospital visits. It may also reduce medical costs and prevent unnecessary surgeries and associated risks. Numerous alpha antagonists have supporting data for MET use. [28].

Surgical management

Emergency surgery:

Immediate decompression of the collecting system is required in the subsequent clinical situations [29]: Cases with obstructive calculi & suspected or proven urinary tract infection (UTI). Cases exhibiting bilateral blockage and acute kidney damage (AKI). Cases exhibiting unilateral blockage with acute renal injury in one functional kidney.

Elective surgery:

INDICATIONS FOR INTERVENTION

For adult cases without an emergency indication for operation, the 2016 American Urological Association/Endourological Society recommendations define specific indications for surgical stone therapy, recommending surgical intervention in the following clinical scenarios **(30)**: Ureteral stones exceeding ten millimeters and uncomplicated distal ureteral stones measuring ten millimeters or less that have not passed following four to six weeks of observation, regardless of medical expulsive therapy (MET). Pregnant women with ureteral or renal calculi in whom conservative management has proven ineffective, chronic renal obstruction due to calculi, and recurrent urinary tract infections associated with stones.

CHOOSING THE TYPE OF SURGICAL INTERVENTION

Ureteroscopy (URS) & lithotripsy using shock wave lithotripsy (ESWL) are the predominant surgical techniques utilized in the extraction of ureteral calculi. In cases not requiring emergency operation & indicated for elective stone removal, the selection of operation is primarily determined by the size and location of the stones but may also be affected by additional case characteristics (like urinary tract anatomy, pregnancy, or stone composition) & comorbidities (for example, obesity, bleeding diathesis). **(75).**

Extra Corporeal Shock Wave Lithotripsy for Ureterolithiasis

The existing literature on ESWL indicates that the most effective strategy needs careful case selection and the refinement of surgical procedures **(31)**. Extracorporeal Shock Wave Lithotripsy utilizes high-intensity acoustic pulses to fragment urinary tract calculi. This method provides a completely non-invasive solution with few complications. **(32)**.

Indications

The American Urological Association Stone Guidelines Panel has designated extracorporeal shock wave lithotripsy as a possible 1st-line management for ureteral & renal stones measuring under two centimeters. **(33)**.

Contraindications

ESWL should not be used in certain situations, such as a bacterial urinary tract infection, impaired drainage, hemostasis, anticoagulation, uncontrolled hypertension, renal failure, aneurysm damage, stones that cannot be found with conventional imaging, pregnancy, or patients with pacemakers or defibrillators. These risks increase the risk of urosepsis, hemorrhage, and complications such as renal failure, aneurysm damage, and complications from pregnancy. It is crucial to follow manufacturer instructions for lithotripter and implant patients. **(16, 34)**.

Mechanism of action

Typically, stone fragmentation arises from cracks induced by strains resulting from applied shock waves. Repetitive strains cause these fissures to expand, resulting in fragmentation. The primary fracturing of stones results from various hypothesized shockwave mechanisms involving spallation, quasi-static squeezing, tear/shear forces, cavitation, & dynamic squeezing. **(35)**.

Tear/shear forces

Shear stresses, resulting from a combination of compressive and shear waves, arise when shock waves propagate through kidney stones, generating significant shear stresses at crystal surfaces and facilitating kidney stone fracture. The variance of compressive waves in solid & liquid media induces shear stress. (36).

Spallation

This idea suggests that after the acoustic pulse has passed through the stone, it is inverted and reflected from the far surface of the stone. This generates a tensile (negative wave) force capable of fragmenting the stone. (37).

Quasi-static squeezing

Quasi-static squeezing transpires when the focal zone exceeds the diameter of the stone. Fragmentation arises from the variation in sound velocity among the stone & the adjacent fluid (38).

The acoustic pulse propagating through the stone is more rapid than the pulse traversing the fluid external to the stone. This pulse generates a circumferential force on the stone, leading to tensile tension in the stone. The force is greatest at the proximal & distal extremities of the stone **(37).**

Cavitation

Cavitation bubbles originate from negative pressure shock waves in the fluid around and within the micro-cracks of kidney stones. Upon the collapse of the bubble adjacent to the stone, a microjet of fluid pierces it, affecting the stone's surface. Secondary shock waves possessing amplitudes akin to those of focused shock waves also form. (39).

Dynamic squeezing

Dynamic squeezing posits that the damage inflicted by extracorporeal shock wave lithotripsy develops throughout the therapy session, ultimately resulting in the disintegration of the stone. All the mechanisms that have been previously discussed have the capacity to cause progressive harm to the stone. (35).

Generators

Three primary generators are utilized to produce shock waves. These incorporate electromagnetic (EML), electrohydraulic (EHL), & piezoelectric (PZL) systems.

ESWL imaging for stone localization

Stone fragmentation using ESWL requires localization of the stone. Fluoroscopy and ultrasound are two methods for localizing urinary stones for ESWL. Fluoroscopy is easier and more familiar to urologists, and most stones can be identified using it, including ureteral stones. Both techniques have their advantages and disadvantages (34).

Complications

Overall, extracorporeal shock wave lithotripsy exhibits a minimal complication rate. As many as five percent of cases can get ureteral obstruction from stone fragments, frequently short-term, while up to two percent may develop a urinary tract infection (40). Transient haematuria frequently occurs post-procedure but generally resolves within days. Significant problems, including sepsis & hemorrhage, are infrequent, occurring in fewer than one percent (29).

A systematic analysis showed no significant data relating extracorporeal shock wave lithotripsy to long-term problems like kidney injury, hypertension, and infertility, with previous concern. (41).

Outcomes

A meta-analysis of the European Association of Urology Guidelines on Urolithiasis Panel indicates that stone-free rates following initial therapy were eighty-six percent for distal ureteral stones less than ten millimeters and seventy-four percent for those more than ten millimeters, eighty-four percent on mid-ureteral stones less than ten millimeters and seventy-six percent for those more than ten millimeters, and eighty-nine percent for proximal ureteral stones less than ten millimeters and seventy percent for those more than ten millimeters (42). This information reveals insignificant variations when compared to the 2007 meta-analysis conducted by the American Urological Association / European Association of Urology Ureteral Stones Guidelines Panel (43).

Multiple sessions of ESWL therapy have demonstrated high stone-free rates of 96.1 percent for proximal, 97.8 percent for mid-ureteral, and 97.9 percent for distal ureteral calculi (44). A prior investigation indicated that the mean number of shock wave lithotripsy procedures was 1.37, 1.47, & 1.22 for proximal, mid-ureteral, and distal ureteral stones, respectively (45).

Predictors of ESWL outcomes

Due to the frequent availability of non-contrast computed tomography (NCCT) before extracorporeal shock wave lithotripsy, various indicators were shown for predicting treatment results. (46).

Technical outcomes

Lithotripter type

The initial generation lithotripter (HM3, Dornier) has been created in the 1980s (47). Currently, four versions of lithotripters are available on the market. The findings of research evaluating various generations of lithotripters in the management of ureteral calculi are inconclusive. Gerber et al. compared the outcomes of the first-generation lithotripter with those of 2nd- and 3rd-generation lithotripter, demonstrating superior stone-free rates with the 1st-generation device. (48).

Shock rate

A meta-analysis by Semis and coworkers demonstrated that the outcomes of shock wave lithotripsy at sixty shocks per minute are superior to those at 120 shocks per minute (49). A review by Weizer et al. and the controlled, randomized, double-blind trial conducted by Honey et al., which had 163 cases with proximal ureteral stones, yielded identical results. (50).

Energy of shock waves

The kilovoltage (kV) of the shock wave generator directly correlates with the energy of the shock waves generated by the lithotripter. In comparison to a constant kilovoltage for the entirety of the treatment, the voltage stepping approach, which begins with a lower kilovoltage and gradually builds to the maximum, has been shown to be superior. In vitro investigations & clinical trials indicated enhanced stone fragmentation and reduced shock wave-induced renal tissue injury. (51, 52).

CT-based parameters

Stone density

A surrogate marker for stone hardness was identified as stone density, determined by Hounsfield Units (HU). Softer stones, including calcium oxalate dihydrate & calcium phosphate, are more easily fractured by SWL than tougher stones, like calcium oxalate monohydrate or cystine. **(53, 54)**.

Stone size

Larger stones are more prone to retreat, necessitate more treatments, and result in problems with SWL compared to URS. The stone burden is generally assessed by maximum diameter; however, alternate measures such as area & volume may predict treatment efficacy. **(55)**.

Body mass index & skin-to-stone distance

The patient's body habit significantly influences the efficiency of shock wave lithotripsy. The energy of the shockwave decreases by ten to twenty percent for every six centimeters of tissue it traverses. Furthermore, numerous lithotripters possess a maximal focal point of roughly twelve to fourteen centimeters **(56)**.

Body mass index is an easily accessible statistic that is a recognized risk factor for SWL failure. Pareek et al. demonstrated a substantial disparity in body mass index among stone-free cases & those with residual stones (BMI 26.9 ± 0.5 versus body mass index 30.8 ± 0.9, $p < 0.05$) **(57)**.

Ureteric stenting

The American Urological Association / European Association of Urology Ureteral Stones Guidelines Ureteral Stones Guidelines Panel (2007) is against the routine placement of ureteral stents in cases receiving shock wave lithotripsy. Their investigation indicated no enhancement in fragmentation of stone or the flow of stone fragments following the insertion of a ureteral stent. Nevertheless, stent-associated morbidity has been observed to be elevated upon stent placement. **(43)**.

Medical Expulsive Therapy and Shockwave Lithotripsy

The following surgery, administration of tamsulosin was shown to enhance SWL results. Minimizing ureteral spasm can enhance the effective transit of remaining fragments **(58)**.

A meta-analysis of fifteen randomized investigations involving over 1,300 cases demonstrated a twenty-four percent enhancement in stone passage rates following shock wave lithotripsy for ureteral & renal stones. The advantage was more pronounced with proximal stones (RR = 1.83, ninety-five percent confidence interval 1.20–2.78) compared to distal stones (RR = 1.43, ninety-five percent confidence interval 1.13–1.81). Comparable to MET results for spontaneous passage, tamsulosin enhanced rates of passage & was correlated with a reduced time to stone passage and diminished discomfort. **(59)**.

Laparoscopy for Ureteric Stone Removal

In the era of endourology, most urinary calculi can be managed using modern endoscopic methods. The 2016 guidelines of the American Urological Association (AUA) on stone treatment recommend against the preferential use of laparoscopy for stone treatment **(60)**.

In specific situations, maybe correlated with the stone or abnormal anatomy, an endourological technique mayn't be optimal for attaining stone-free status while minimizing consequences like hemorrhage, sepsis, & excessive absorption of irrigation fluids (2). Laparoscopic stone operation can be classified into two categories: ablative or reconstructive, utilizing either a transperitoneal or retroperitoneal method. **(61)**

Indications for ureteric stones

In the era of minimally invasive endoscopic techniques & shock wave lithotripsy, laparoscopy has a restricted function in the urologist's repertoire for management of surgical stone. In patients of significant stones, cases or combined endourologic treatments mayn't be more economically viable than a singular, one-session method for total stone extraction **(4)**.

Significant ureteral calculi can still pose difficulties for contemporary endourological methods. The SFR significantly diminishes from eighty-four percent to forty-two percent when the ureteral stone size exceeds one centimeter **(62)**.

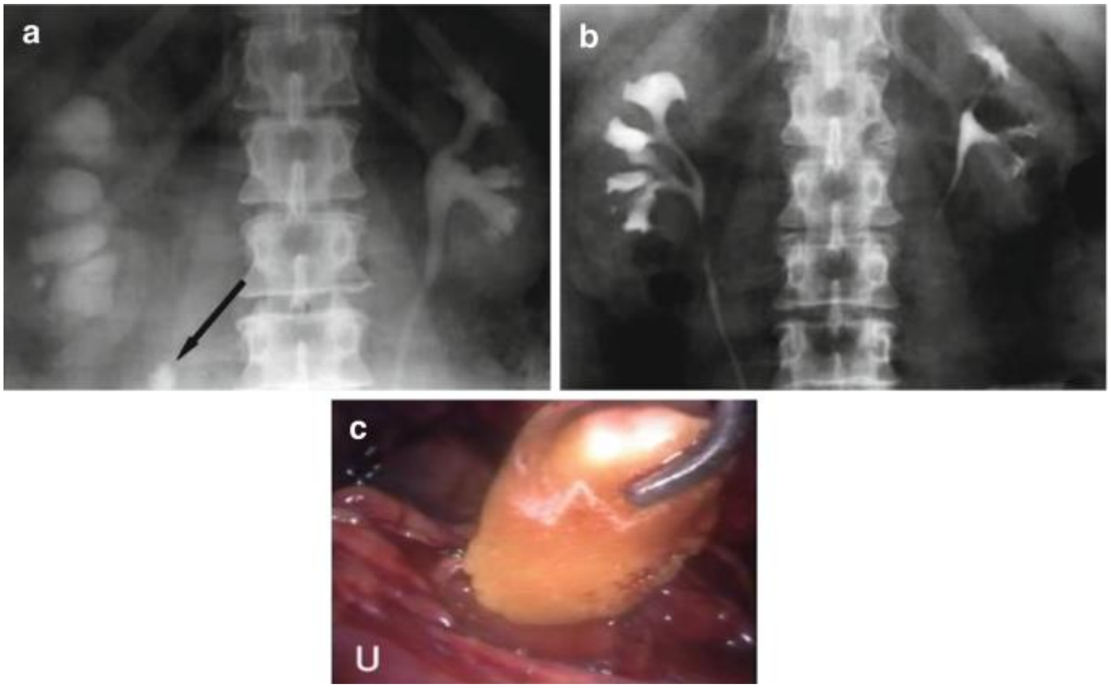

Figure (4): before surgery (a) and following surgery (b) intravenous urography (IVU) after laparoscopic ureterolithotomy (c). Significant relief from obstruction is noticed. (Arrow on a shows the proximal ureteral stone, U ureter) **(63)**

Laparoscopic ureter lithotomy (LU) serves as an alternate method for the extraction of impacted ureteric stones greater than fifteen millimeters **(3)** or may be utilized as a salvage technique following unsuccessful shock wave lithotripsy and/or ureteroscopic lithotripsy **(64)**.

Approaches

Laparoscopic urology can be conducted by a retroperitoneal (RP) or transperitoneal (TP) approach. While the optimal method is primarily determined by a surgeon's desire and expertise, most surgeons choose a transperitoneal technique, particularly for average or beginner laparoscopic surgeons **(65)**.

Compared to the retroperitoneal method, the transperitoneal technique provides an expanded working space with recognizable anatomical features. Furthermore, challenges and complexity may be more effectively managed with a transperitoneal strategy. Laparoscopic ureterolithotomy is quite simple, particularly for beginners, in the absence of thick retroperitoneal fibrosis. **(63)**.

The surgical technique

The patient's positioning and port placement are identical for upper tract operations. Nevertheless, if the calculus is in the distal ureter, the ports must be repositioned caudally. The ureter is shown following the retraction of the colon. The stone's position is occasionally obscured by periureteral adhesions. In such cases, intraoperative laparoscopic ultrasound or fluoroscopic guidance facilitates the precise localization of the stone's location. **(4)**.

Advantages

The primary advantage of laparoscopic ureterolithotomy over ureteroscopic lithotripsy for big upper ureteral stones is its high success rate following a single surgery, alongside comparable complication rates. **(66, 67)**.

Disadvantages

The disadvantages involve an extended length of stay, the potential for harm to adjacent buildings, and the possibility of open conversion **(68).** The predominant surgical consequence is urine leakage (zero to twenty percent), followed by stricture formation (1.4–5.2 percent) **(69, 70).**

Controversies: to close or not to close the ureterotomy?

Although most surgeons concur on the insertion of a DJ stent during laparoscopic ureterolithotomy **(71, 72)** some prefer to seal the ureterostomy **(73, 74),** and others prefer to keep it open **(72, 75).**

Difficulties throughout laparoscopic ureterolithotomy

Stone migration

The optimal situation for LU involves a significant obstruction of the ureteral calculus. Nonetheless, like open ureter lithotomy, there exists an inherent risk of upward stone migration during the surgery. To minimize the risk of stone transmission to the kidney, ureteric dissection must be performed as delicately as possible from proximal to distal. **(76)**.

Difficult stone localization

Identifying the stone site after ureter dissection can be challenging, particularly in obese cases & those with dense, fibrotic adhesions because chronic inflammation or multiple SWL sessions **(77)**.

Intermittent compression of the dilated proximal ureter using laparoscopic Babcock can assist in identifying the location of the obstructing stone, while fluoroscopy or intraoperative laparoscopic ultrasonography may reduce difficulties presented by significant periureteric fibrosis **(78)**.

Adherent stone to the mucosa

Following the ureteral incision, the stone may occasionally be difficult to extract due to its adhesion to the ureteral mucosa. This is particularly applicable to chronic, significant calculi and those subjected to several sessions of shock wave lithotripsy **(79).**

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Direct stone grasping with the laparoscopic grasper is recommended, particularly when the stone is somewhat soft. Grasping the stone could break it, potentially leading to migration **(68).**

Lost stones

Occasionally, post-extraction stone may be removed prior to its removal from the abdomen. To reduce this risk, it is advisable for the surgeon to position an end bag or its equivalent within the abdomen prior to incising the ureter. The stone may subsequently be inserted into the bag immediately following its removal **(80).**

The stone may be broken because of prior SWL or grasper force throughout extraction. Positioning the bag close to the field facilitates the collection of fragments and mitigates loss. If the stone is lost, it typically remains medial to the ureter, adjacent to the reflected colon. Altering the camera port may assist in locating the missing stone **(65).**

Stenting and suturing

Traditionally, ureteral stenting & suturing were suggested. Laparoscopic antegrade ureteral stenting is achievable by inserting the feeding tube or double J into the laparoscopic suction & directing it to the ureteral incision. Evidence suggests that ureteral stenting throughout laparoscopic urologic procedures could be safely obviated **(81)**.

Demirci & colleagues have established the safety of avoiding stenting in sutured ureterotomy **(82)**. Comparable results have been evidenced by others as well (83, 84). Goel and Hemal advocate for stenting only in cases of renal failure and/or stone impaction **(85)**.

Ureteric stricture

The incidence of ureteral stricture after laparoscopic urology has been shown to range from 2.5 percent to twenty percent **(86, 87).** Multiple contributing variables may influence the progress of ureteral stenosis. Nouira & colleagues have advised that following the concepts of ureterotomy closure throughout open surgery, specifically utilizing loose sutures to only approximate the ureteral margins, may diminish the risk of ureteral stricture after laparoscopic urology **(86).**

They contend that utilizing a laparoscopic cold knife is preferable to utilizing an electrical hook. In the authors' view, the utilization of a cutting-mode electrical connection is much more convenient & prevalent **(84, 88).**

Outcomes

Typically, this method yields complete removal of stone in a single minimally invasive operation with minimal hospitalization or a reasonable procedure duration **(84).**

Research by Basiri et al. compared laparoscopic ureter lithotomy to percutaneous nephrolithotomy and URS, revealing that laparoscopic ureter lithotomy achieved the highest single-setting stone-free rate at eighty-eight percent, followed by percutaneous nephrolithotomy at sixty-four percent, and URS at fifty-six percent. The second stone clearing treatment was least necessary with laparoscopic ureter lithotomy (ten percent), followed by percutaneous nephrolithotomy (fourteen percent), and ureteroscopy (twenty-two percent). The research indicates that laparoscopic ureter lithotomy may provide superior single-session stone-free rates with few supplementary procedures **(89).**

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