

The Effect Of Laser Frequency And Energy Setting On The Outcome Of Upper Ureteric Stone Treated With Laser Ureteroscopy

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Abstract:

Objectives:

To assess the effect of laser frequency and energy setting on outcome in the management of upper ureteric stones by semi-rigid ureteroscopy. Study was conducted from June 2015 to June 2017 at our center (in al Hilla teaching hospital). Data of 46 patients were included in our study, these patients complaining from upper ureteric stone (>10mm), our patients were categorized into 2 groups:

Group I:(26 patients -26 ureteric stones -) using URS with laser setting (10-15 Hz ,0.5-0.8 J); high frequency low pulse energy with fixed irrigation system. [dusting method] .Group II: (20 patients -24 ureteric stones -included 4 patients with bilateral ureteric stones) using URS with laser setting (4-8 Hz ,1.7-2 J); low frequency high pulse energy with fixed irrigation system. [fragmentation method] Stone size was determined based on the preoperative abdominal ultrasound or CT examinations. (by measuring the longest diameter of the stone) Procedures were done under general or spinal anesthesia after a single dose of pre-operative antibiotic (IV Ceftriaxone) & postoperatively patients done KUB, ultrasonography or unenhanced helical -CT as required at 4th week of follow up to assess stone clearance rate.

The total number of our patients was 46 ,They were 28 males and 18 females and their age ranged from 17 to 80 years with a mean age of 46.08 ± 16.61 years ; their stone size ranging from 12 mm to 25 mm (mean of 15.8 mm), they were treated by ureteroscopy and intracorporeal holmium YAG laser lithotripsy.

in group I we achieve better result than group II , as stone freedom from single session was 80.7 % in comparison to 70.8 % in group II, also a lower incidence of intra-operative and early post-operative complication, especially stone migration

(7.6% Vs 20.8%), and mucosal injury (23.1% Vs 45.8%)) in group I and group II respectively.

The operative time in group I ranged from 40 to 69 minutes (mean: 50.4±3) while in group II it was ranged from 35 to 55 minutes (mean: 40.8 ± 5.3), DJ insertion was (46.2% VS 75%)) in group I and group II respectively.

Key words:

Ureteric stones, Ureteroscopy, holmium YAG laser Lithotripsy.

Introduction:

Urolithiasis is a health problem of worldwide importance and the urological treatment of urinary calculi has changed considerably in the past 20 years. Various endourological treatments are available for urinary calculi[1]. Despite the liberal use of ESWL, ureteroscopic lithotripsy is still the preferred treatment for managing ureteric stones at many hospitals, and achieves an immediate stone-free state in a high percentage of patients. [1,2]

Although flexible ureteroscopy (URS) is associated with improved access to the proximal ureter and superior stone-free rates, there are many reports advocating that semi-rigid URS (sURS) is a safe and successful treatment even for proximal ureteric stones.[1,2,3]

The location at which the passage of a ureteral stone is arrested is an important factor in assessing the likelihood of spontaneous passage as well as in determining the optimal treatment options and their relative successes. Ureteral stones usually become impacted at three distinct sites where the caliber of the ureter narrows: the UPJ, the iliac vessels, and the ureterovesical junction[4,5].

Impacted ureteral stones are the most difficult to treat, because there is a severe ureteral inflammation. an impacted ureteral stone may be defined as a stone that cannot be bypassed by a wire or a catheter or a stone that remains at the same site in the ureter for more than two months.[6]

The main clinical presentation for patients with ureteric stone are:

1.Pain: Ureteral pain is usually acute and secondary to obstruction. The pain results from acute distention of the ureter and by hyper-peristalsis and spasm of the smooth muscle of the ureter.[7]

2.Microscopic or gross hematuria : occurs in 95% of patients. Hematuria may be absent if the stone is causing complete obstruction.[7]

3.Nausea and vomiting : are frequently associated with ureteric colic.[7]

4. Irritative symptoms :Frequency, urgency, and dysuria can result from stone impaction at the ureterovesical junction and/or associated UTI.[7]

5. There may **be a low-grade fever**[8].

6. **upper urinary tract infection** associated with ureteral stones, or obstructed pyelonephritis, is a not uncommon and potentially lifethreatening urologic emergency. Such patients are typically febrile and may present with signs of septic shock, such as hypotension.[5]

For evaluation of the patients presenting with ureteric stone:

A. Laboratory tests:

1. Urinalysis :High specific gravity can indicate inadequate hydration. Low urine Ph (less than 5.5) is seen with uric acid stones, whereas high urine PH (at or about 7.2) is seen in patients with RTA(renal tubular acidosis) and struvite stones. Microscopic or gross hematuria is often seen.

Crystalluria can help in defining stone type .[8]

2. Urine culture: Early detection of UTIs is important.[8]

3. Blood tests: Complete blood count (CBC) may show mild peripheral leukocytosis. White blood count (WBC) higher than 15,000/mm³ may suggest an active infection.[8]

B. Radiologic Evaluation

1. Plain film of the kidneys, ureters, and bladder (KUB): This is 90% sensitive in detecting urinary calculi. Determining the size, number, and location of the stones allows for a rational planning of stone removal.

KUB has the advantage of being quick, inexpensive, and easily obtainable and provides an accurate measure of stone size[8] .

2. Intravenous urogram (IVU): This is the diagnostic procedure of choice to best define intrarenal and ureteral anatomy. It has a high sensitivity and specificity for determining stone location and the degree of obstruction. IVU can detect radiolucent stones and define anatomic abnormality contributing to stone formation. [8]

3. Ultrasonography (US): Procedure of choice in patients known to have allergy to contrast, pregnant females, and children. Sensitivity of US to renal calculi is less than radiography. US will detect radiolucent calculi and urinary tract obstruction if present. It is also used to follow the size of existing stones and formation of new ones. US is also used to rule out other etiology in patients presenting with acute flank pain.[8]

4. CT scan: A non-contrast-enhanced CT scan is the most rapid and cost-effective method for rapidly diagnosing nephrolithiasis and obstruction in patients with acute flank

pain. It is more sensitive than radiography, sonography, or both combined in detecting all types of stones. Helical or spiral CT scanning is superior to non-helical CT, as it requires less cooperation from the patient.[8]

There are many options for management of ureteral calculi include:

A. Conservative management

The conservative treatment strategy with ultrasound follow up is an attractive and efficacious approach for ureteral stone with a diameter of a 6 mm and less. Therefore conservative management for 4 to 6 weeks may be sensible for smaller stones if the patient remains asymptomatic.

Conservative treatments include analgesia (diclofenac sodium, indomethacin, ibuprofen, tramadol, and morphine), anti-inflammatory drugs (methyl prednisolone), calcium antagonists (nifedipine), and alpha blockers such as tamsulosin. However the presence of an acute infection, decreased renal function or the persistence of the symptoms despite the analgesic therapy are the main contraindications for such approach.[9]

B. Intervention

Indications for stone removal are :

- **Pain** that fails to respond to analgesics or recurs and cannot be controlled with additional pain relief.

- **Impaired renal function**(solitary kidney obstructed by a stone, bilateral ureteric stones, or pre-existing renal impairment that gets worse as a consequence of a ureteric stone).

- **Prolonged unrelieved obstruction** (generally speaking, ~ 4–6 weeks) that lead to irreversible renal units loss.

- **Social reasons**. Young, active patients may opt for surgical treatment because they need to get back to work or their childcare duties.[10]

For stones > 10 mm , URS had superior stone free rates. This can be attributed to the fact that proximal ureteral stones treated with URS did not vary significantly with size, whereas the stone free rate following ESWL negatively correlated with stone size.[9,11]

Since the advent of Extracorporeal and Intracorporeal lithotripsy , open surgery for stone disease has been very limited to selective cases only. With Intracorporeal lithotripsy through ureterorenoscopy has emerged as treatment of choice for ureteric stones.[11]

Percutaneous nephrolithotomy is a less commonly used treatment option and is usually reserved for a limited group of patients with large , proximal ureteral stones. Open ureterolithotomy is rarely indicated, although it may be an option as a salvage procedure. Laparoscopic ureterolithotomy has been described both as a salvage procedure in lieu of an open ureterolithotomy and as a first-line therapy.[12]

Ureteroscopy:

Modern ureteroscopes are produced as semirigid or flexible instruments. Semirigid ureteroscopes typically have a tapered distal tip (e.g., 6.75 to 9.0 Fr) that dilates to a larger diameter shaft closer to the eyepiece (e.g., 8.4 to 10.1 Fr). The advantages of the semirigid ureteroscope include a large working channel, faster irrigation flow, and a larger field of view because of the larger number of fiberoptic bundles compared with the corresponding flexible instruments.[13,14,15]

With the development of smaller caliber semirigid and flexible ureteroscopes and the introduction of improved instrumentation, URS has evolved into a safer and more efficacious modality for treatment of stones in **allocations in the ureter**. [16]

Types of Lithotripters available are:

Four types are available for intracorporeal lithotripsy: laser, electrohydraulic (EHL), ultrasonic and ballistic lithotripsy. These can be divided into flexible (laser lithotripsy and EHL) and rigid (ultrasonic and ballistic lithotripsy). [13].

Laser lithotripsy:

Laser is an acronym for light amplification by stimulated emission of radiation, The Holmium: Yttrium, Aluminum, Garnet laser was developed in early 1990s. The holmium: YAG is a pulsed source that can work with frequencies of up to 50 Hz and can be used with very fine fibers of up to 200µm. Its growing success is a result of its excellent performance as both a lithotripter and a surgical laser. It can vaporize as well as coagulate the tissues. It has a wide range of endoscopic applications, and has demonstrated effectiveness in clearing stones of all compositions. [17]

The holmium: YAG laser is transmittable via flexible fibers. The zone of thermal injury associated with laser ablation ranges from 0.5 to 1.0 mm. holmium laser lithotripsy occurs primarily through a photo-thermal mechanism that causes stone vaporization, The holmium laser is one of the safest, most effective, and most versatile intracorporeal lithotripters. [17]

Successful fragmentation of ureteral stones of all compositions has been reported in 91% to 100% of cases, with low risk of perforation and retropulsion. [13,18].

Modern day holmium laser systems for ureteroscopy (URS) provide users with a range of settings, namely pulse energy (PE), pulse frequency (Fr), and pulse width (PW). These variables allow the surgeon to choose different combinations that have specific effects on stone fragmentation during URS lithotripsy. Contact laser lithotripsy can be performed using fragmentation or dusting settings. [19,20,21]

Fragmentation employs settings of low Fr and high PE to break stones that are then extracted with retrieval devices.

Dusting is the utilization of high Fr and low PE settings to break stones into sub-millimeter fragments for spontaneous passage without the need for basket retrieval.

Recent systems have allowed the user to choose either short or long PW modes, the use of the long PW mode during lithotripsy can reduce stone retropulsion and is increasingly available in new generation lasers. [22]

fragmentation restricted to low Fr and high PE (LoFr-HiPE). This resulted in classic fragmentation settings for lithotripsy .

While **Dusting** technique; commonly defined as laser lithotripsy utilizing high Fr and low PE (HiFr-LoPE) settings to break stones into fine (i.e., submillimeter) fragments.

Pulse Energy:

Holmium PE settings can range from 0.2 to 6.0 J depending on the power of the system. Traditionally, PE settings have been used at ranges between 0.5 and 1.2 J to fragment stones.[23,24,25]

The outcomes of altering PE on fragmentation have been reported in several studies; the higher the PE the greater the loss in stone mass [25,27]

But Larger fragments are produced when high PE settings are used compared to when using lower PE settings[26].

Frequency:

Frequency is defined as the number of pulses emitted from the laser fiber per second .

Similar to PE, the range of pulse Fr's available to the user depends on the power of the holmium system. Initial 15- to 20-W systems were limited to maximum frequencies of 15–20 Hz. Currently, holmium systems are able to achieve frequencies as high as 80 Hz.

Pulse Width:

Pulse width (PW) represents the time during which a single pulse is emitted from the laser, measured in microseconds.[31]

The main difference when utilizing PW is that LP results in less stone retropulsion[32-34].

AIM OF THE STUDY:

To assess the effect of laser frequency and energy power setting on outcome in the management of upper ureteric stones by semi-rigid ureteroscopy.

In addition, the influence of stone size (> 10 mm) on the results and complications of ureteroscopy.

PATIENT AND METHOD:

This research is prospective cross sectional study carried out in the urology department in AL-HILLA Teaching Hospital. from June 2015 to June 2017.

The total number of patients was 46 ,They were 28 males and 18 females and their age ranged from 17 to 80 years with a mean age of 46.08 ± 16.61 years ;

These patients complaining from upper ureteric stone ranging in size from 12 mm to 25 mm (mean of 15.8 mm)

Inclusion criteria :

patients complaining from upper ureteric stone (>10mm), not responded to conservative management or complaining from associated infection or sustained pain due to colic some of them had renal impairment (azotemia).

Exclusion criteria:

- Uremic patients
- Patient cannot underwent major surgery (unfit for anesthesia)
- Pregnant patients
- Pediatric patients
- pyonephrosis

Those patients were categorized into 2 groups:

group I:(26 patients -26 ureteric stones -) using URS with laser setting ; high frequency low pulse energy with fixed irrigation system.[**dusting method**]

group II: (20 patients -24 ureteric stones -included 4 patients with bilateral ureteric stones) using URS with laser setting ; low frequency high pulse energy with fixed irrigation system. [**fragmentation method**]

Ethical approval was obtained from the department of urology and all patient were informed about the operation and its suspected complications and right concepts taken.

Assessment of the patients was done prior to operation depending on presenting symptoms that bring the patient to the hospital.

All the patients underwent thorough process : of history, physical examination, and laboratory investigations (which include blood urea, serum creatinine , hemoglobin , urinalysis and urine culture). Radiological evaluation with KUB, ultrasonography, IVU and unenhanced CT scan were preoperatively performed to confirm the diagnosis and determine the size and location of the stone.

Stone size was determined based on the preoperative abdominal ultrasound or CT examinations. (by measuring the longest diameter of the stone)

The patients were selected on the bases of standard indications for interventions for ureteric stone (in inclusion criteria). The operations were done under general anesthesia or spinal anesthesia.

All patients received a single dose of broad spectrum parenteral antibiotic (ceftriaxone) at the time of induction of anesthesia.

Postoperative Foley catheter stay for 24 hours, Parenteral antibiotics were continued for 2 days, and replaced by oral antibiotics for 5-7 days.

The patient was placed in dorsal lithotomy position with the ipsilateral leg somewhat straighter and lower than the contralateral leg.

The standard technique for ureteroscopy was employed using the following equipment:

1. The Holmium YAG laser lithotripsy system (calculase II - KARL STORZ-) which operates at a wavelength of 2100 nm and its power was (20) watt. **(figure 1)**
2. All the patients were treated with a 600 μ m quartz end fiber. **(figure 2)**
3. 8 Fr & 9.5 Fr. KARL STORZ semi rigid ureteroscope with 4 & 5 Fr. Working channel respectively. **(figure 3)**
4. A 0.035- inch (Polytetrafluoroethylene –PTFE-) coated guide wire.
5. Camera and video system.
6. continuous flow irrigation system (uromate E.A.S.I -KARL STORZ) using standard URS setting, (pressure 90 mmHg & flow 150 ml/min). **(figure 4)**

The technique of holmium laser lithotripsy involves placement of the fiber on the stone surface before the laser is activated . Furthermore, the laser fiber should extend at least 2 mm beyond the tip of the endoscope to avoid destroying the lens system or the working channel of the endoscope.

In group I : the used dusting settings for lithotripsy (HiFr-LoPE) was **{10–15 Hz \times 0.5–0.8 J}**.

While in group II : the fragmentation settings for lithotripsy (LoFr-HiPE) was **{4–8 Hz \times 1.7–2 J}**.

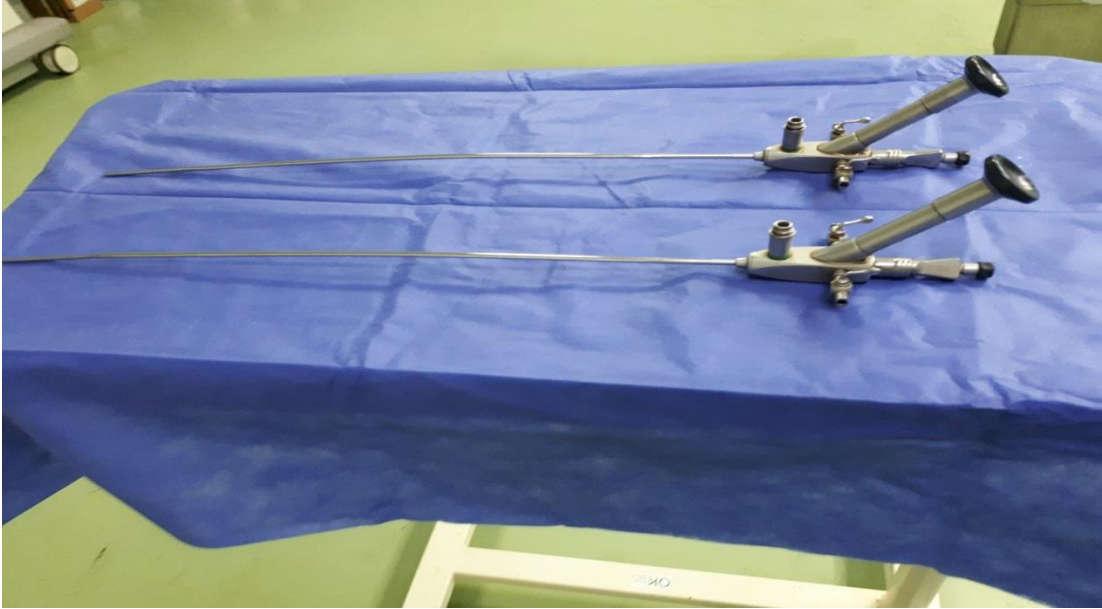
fixed pulse width (PW) was used in 2 groups **(100-500 μ s)**.



Figure(1): Holmium YAG laser lithotripsy system



Figure(2): laser fiber sized 600 μ m quartz end



Figure(3) : 8 Fr & 9.5 Fr. KARL STORZ semi rigid ureteroscopes



(figure4) :continuous flow irrigation system (uromate E.A.S.I -KARL STORZ) using standard URS setting.

Ureteric stent was placed based on following criteria:

- prolonged procedures (>60 minutes), a stent should be placed, because ureteric edema and temporary post-operative obstruction may be more likely to occur than with shorter procedures.
- large residual stone burden.
- evident ureteral edema/trauma.
- Ureteric stricture that required dilatation.
- Ureteric perforation ; diagnosed by extravasation of the contrast.(by using ureteric catheter)
- Solitary kidney or bilateral ureteroscopies have been performed.

In most cases urethral catheter was removed on 1st postoperative day. except in cases with perforation or hematuria where it kept longer.

Assessment of the procedure outcomes included **stone freedom** and **complication rates**.

Stone freedom was defined as pulverization of all calculi to fine dust or fragments not larger than 2 mm in diameter on x-ray imaging and US at the end of procedure. This was considered to be too small to extract and was liable to pass spontaneously .

Complication were analyzed in relation to its location (upper ureter) and size of stone .

Results:

The total number of our patients was 46 complaining from upper ureteric stone; from them 4 cases have bilateral sides stone.

They were treated by ureteroscopy and intracorporeal Holmium YAG laser lithotripsy for their calculi (> 10 mm).

They were 28 males and 18 females and their age ranged from 17 to 80 years with a mean age of 46.08 ± 16.61 years ; as illustrated in **table (1)**.

Table (1): patients characteristics :

Variable	No. of patients	%
Age group (years)	Total No. =46	
<20	2	4.3

20-39	16	34.7
40-59	22	47.8
>60	6	13.04
Gender		
Male	28	60.9
Female	18	39.1

These patients complaining from upper ureteric stone ranging in size from 12 mm to 25 mm (mean of 15.8 mm) . as illustrated in table (2)

Table (2): Parameters of treated stones :-

Stone Size (mm)	No.=50**	%
11-15	30	60
16-20	16	32
>20	4	8
** 4 cases had bilateral upper ureteric stones		

Regarding lateralization and site of stones, 18 patients (39.1%) have right ureteric stone while 24 patients (52.2%) have left ureteric stone and 4 patients (8.6%) have bilateral ureteric stones and these results showed in table (3)

Table (3) stone site percentage:

Stone site	No.=50	%
Right	18	39.1
Left	24	52.1

Bilateral	4	8.6
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Our patients were categorized into 2 groups:

group I : (26 patients :**26 ureteric stones**) (56.5 %) using URS & laser lithotripsy setting ; high frequency and low pulse energy with fixed irrigation system. [**dusting method**]

group II : (20 patients :**24 ureteric stones**) (43.5 %)included 4 patients with bilateral upper ureteric stones) using URS and laser lithotripsy setting ; low frequency and high pulse energy with fixed irrigation system. [**fragmentation method**]

we deal with the stones in 2 groups and we assess the result depending on intra-operative and early post-operative complication which is statistically significant; as illustrated in table (4) & table (5) respectively:

Table (4) show intra-operative complication in 2 groups:

variable	Group I NO=26	%	group II NO=24 Included bilateral cases	%
Simple mucosal injury	6	23.1	11	45.8
Migration	2	7.6	5	20.8
Perforation	1	3.8	1	4.1
Access failure (stricture)	1	3.8	1	4.1
Pearson chi-square = 6.533 P value =0.038 (significant)				

table (5) show early postoperative complication in 2 groups:

variable	Group I NO=26	%	group II NO=20 included bilateral cases	%
Transient hematuria	4	15.3	8	40
Flank pain	4	15.3	6	30
fever	1	3.8	2	10

Pearson chi-square = 9.493				
P value =0.023 (significant)				

And by those 2 laser setting we get a clear difference in stone freedom rate and operative time as stone free rate is higher in group 1(dusting method) 80.7% while in fragmentation method it is about 70.8% although it is statically insignificant; as illustrated in table (6)

Table (6) show stone freedom from single session and mean operative time in 2 groups:

variable	Group I NO=26	%	group II NO=24 Included bilateral cases	%
**Stone freedom from single session	21	80.7	17	70.8
Mean operative time	50.4±3 min	-----	40.8 ± 5.3 min	-----
** Fisher exact test = 0.51				
P value =0.31 (not significant)				

Regarding ureteric stenting post operatively we take in the account the true indication for DJ stenting and avoid insertion when it was not needed; i.e. not to do it routinely .this showed in table (7)

Table (7). Comparison of need for DJ stent in both groups:

DJ stent	Group I NO=26		group II NO=24 Included bilateral cases	
	NO.	%	NO.	%
Need(used)	12	46.2	18	75
Not need	14	53.8	6	25
Pearson chi-square = 4.327				
Fisher exact test = 0.048				
P value =0.036 (significant)				

From all cases that we operate ; only 6 cases had pre-operative biochemical elevation of renal indices (azotemia) .

4 cases had bilateral ureteric stones and other 2 cases had solitary kidney with obstruction.

Five cases were normalized biochemically on follow up and only one case was referred to dialysis which had single obstructed left kidney and right atrophied kidney and on follow up post-operatively this patient biochemically get high renal indices.

DISCUSSION:

URS and ESWL are the most common procedures used for treating upper ureteric stones, with better results for URS in cases of impacted stones.[38]

Ho:YAG laser lithotripsy represents the gold standard for endoscopic lithotripsy of stones in the upper tract.[43]

The Ho:YAG-laser is capable to fragment stones of any composition and hardness; consequently a high stone free rate is achievable. with a successful fragmentation rate of 90-100%. [44]

patients in our study ages range from 17-80 years with a mean age of 46.08 ± 16.61 years. Male to Female ratio in our study was (1.55:1) which was comparable to other studies in which male to female ratio was 2: 1 and reflect that men are affected two times more frequently than women.[45]

in our study we focus on these parameters in laser setting, trying to achieve a better result with minimal complication.

These studies was comparable with our research study as we achieve a better result in group I than group II , with a lower intra-operative and early post-operative complication. In our study, successful stone fragmentation were (80.7% Vs. 70.8%) in group I and group II respectively, these percentages from single session only.

This mean by using dusting method, high percentage of stone freedom can be achieved. the difference was not significant between 2 groups.

While the American Urological Association and the European Association of Urology guideline reports that the stone-free rate for ureteroscopy when treating proximal ureteral stones is 81%. The stone-free rate for stones >10 mm decreased to 79%.[56] so the results are of no wide differences.

larger sample may be needed to achieve a better and more clear results

In comparison to ESWL, the success rate of ESWL for upper ureteral stones reported by Iraqi study were 70%.[57]

in our study we focus on the parameters of laser setting(PE,PFr.) trying to achieve a better result with minimal complication.

These studies was comparable with our research study as we achieve a better result in group I than group II , with a lower intra-operative and early post-operative complication.

As Kronenberg P, Traxer O give his Experts' summary :the authors review literature on the use of Ho:YAG lasers for endoscopic lithotripsy of calculi in the upper urinary tract, focusing on the ablation efficiency of lithotriptors and a wide range of relevant parameters such as pulse energy(PE), frequency(Fr), pulse duration-width-(PW), total power, and the diameter and tip of the laser fiber.[24]

Experimentally, they found low-frequency high-pulse energy settings are more ablative than high-frequency low-pulse energy settings despite similar total power levels.[24]

But High power(pulse energy) levels and short pulses width (PW) increase the risk of retropulsion and mucosal damage.[43,46,47]

That finding was also confirmed by Chawla et al.[48]who showed that Low repetition rate and high energy per pulse settings produce always higher fragmentation rates compared to high repetition rate and low power setting but increase the incidence of stone retropulsion and ureteric wall injury

The findings of Kronenberg and Traxer : High-frequency, low power settings are more favorable for fine fragmentation of stones -especially in impacted ureteric stone- which produces smaller stone fragments (dusting effect) than high power.[24]

another advantage of low power is minimal trauma to mucosa , but its increase operative time & may be not efficient for hard stones.[48]

Regarding intra operative complication we get less stone migration (7.6% Vs 20.8%),and less mucosal injury (23.1% Vs 45.8%)) in group I and group II respectively, and P value =0.038 which is significant.

Also we get less post operative complication in group I than group II like (Transient hematuria, Flank pain, fever) and P value =0.023 which is significant.

Migration of the stone up into the pelvi-caliceal system isingeneral secondary to :**Gravitational forces , Pressurized irrigation or stone retropulsion** during lithotripsy.

To prevent stone migration, surgeons have traditionally used a number of maneuvers, including reverse Trendelenburg position, to optimize the effects of **gravity** . This technique, however, compromise surgeon comfort and can also prolong procedures.[49,50]

several reports recommended many different materials and devices for preventing retrograde stone displacement during ureteric lithotripsy, including lidocaine jelly, ureteric baskets, the stone cone and recently, thermophilic polymers , but even with these materials stone migration may occur during insertion of these devices.[39,40,41,42]

in our research this position was not used practically and we satisfy with classical lithotomy position during ureteroscopiclithotripsy..

But we deal with **irrigation** by using standard URS setting in uromate system (pressure 90 mmHg & flow 150 ml/min)& by manipulation in laser power & frequency to minimize this complication,

The Use of long PW mode during lithotripsy can reduce stone **retropulsion** and is increasingly available in only new generation lasers.[22]

Retrograde stone migration during ureteroscopic lithotripsy occurs in 5% to 40% of proximal ureteral stone cases.[51]

In our study the percentage of stone migration, (7.6% Vs 20.8%) in group I and group II respectively, as mentioned previously and this low percentages mostly due to using standard URS setting in uromate system (pressure 90 mmHg & flow 150 ml/min)& by manipulation in laser power & frequency to minimize this complication.

Other factors that are affect migration in upper ureteric stone are distance of calculi from the ureteropelvicjunction and degree of proximal ureteral dilatation.[45]

We applied ESWL for migrated stones, and it proved to give a good complementary option.

Ureteric perforation can be caused by the ureteroscope, guide wire, or laser energy. The risk of perforation from laser energy is negligible, because the depth of thermal injury is only 0.5 to 1 mm.[52,53]

Ureteric perforations in our patients were due to ureteroscopicmanipulation and guide wire equally. Perforations rate in our study was (3.8% Vs 4.1%) in group I and group II respectively which was approximately the same rates that observed in other studies concerning laser lithotripsy which ranged from 2.6%-6 %.[45,54]

The reported operative duration of ureteroscopy is 18–93 min.[55]

In our study,the operative time in Group 1 ranged from 40 to 69 minutes(mean: 50.4±3min) while in Group 2 it ranged from 35 to 55 minutes (mean: 40.8 ± 5.3min), i.e. :dusting method is a time consuming operation.

Regarding DJ insertion was (46.2% VS 75%)) in group I and group II respectively and this difference between 2 groups was significant.

DJ stenting in group I mostly due to long operative time , so stent should be placed because ureteric edema and temporary post-operative obstruction may be more likely to occur than with shorter procedure.

While in group II DJ stenting mostly due to simple mucosal injury caused by high energy power of laser in addition to the cases with bilateral stones.

And in both groups other indication for DJ stenting was taken in account , like migration, perforationetc

Lastly in our study we use 600 µm laser fiber, not the smallest size 230µm because of the CALCULASE II (laser lithotripter) is equipped with fiber recognition system, a permissible frequency/energy combination is provided depending on the fiber used; from which the user can select the corresponding capacity.

In addition small size fiber has limited energy transport, and cannot achieve maximum power that we needed in our study.

Conclusion:

- 1.Ho: YAG laser has a linear increase in stone retropulsion with increased pulse energy.
- 2.High-frequency, low pulse energy settings are more favorable for fine fragmentation (dusting) of stones especially in impacted ureteric stones. with minimal trauma to the mucosa and less retropulsion . also this setting achieve less intra and post-operative complication.

but its increase operative time & may be not efficient for hard stones.

3. On other hand low-frequency , high- pulse energy settings are more effective for stone fragmentation , less operative time, but increase the risk of retropulsion and mucosal damage.

4. In dusting method DJ stenting was needed in less percentage of patients & as a result less post-operative pain and irritative symptoms.

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