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Original Research Article

Safety and Outcomes of Retrograde Semi-Rigid Ureteroscopy in the Treatment of Renal Pelvic Stones by Using Holmium: YAG Laser.

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Abstract

The aim of this study was to evaluate the clinical utility, safety and outcomes of semi-rigid ureteroscopy in the treatment of single renal pelvic stones by using Holmium: YAG laser lithotripsy.

Hundred patients (56 females, 44 males), aged between (11) and (67) years (mean 41.5 years), with single renal pelvic stone range from 13-27 millimeter (mean size 21.8 millimeter). Inclusion criteria (any patient with single renal pelvic stone less than 30 millimeter in size regardless its composition and previous history of any urological intervention and the stone is visualized by uretroscope), treated with semi-rigid ureteroscopy by using Holmium: YAG laser for stones pulverization. DJ-stent had been inserted to all patients following stone fragmentation. Preoperative data, as well as stone free rate, operative time and associated perioperative complications were evaluated.The primary stone free rate (which was assessed by Ultrasonography and plain abdominal X-ray) was sixty-eight percent (68 patients) at the first postoperative day, which increased to eighty-six percent (86 patients) after one month by using ancillary procedures such as Extra Corporeal Shock Wave Lithotripsy and medical treatment. the operative time was ranges from 44.3 to 97.8 minute (mean of 72.4 minute), there was no major perioperative complications.

The study can conclude that Reterograde semi-rigid ureteroscopy using holmium: YAG Laser is effective and safe option for managing single renal pelvic stone less than 27 mm.

Key Words: Semi-rigid ureteroscopy; retrograde renal surgery; renal pelvic stone; Ho; YAG laser.

سلامة ونتائج استخدام ناظور الحالب والكلية شبه الصلب في علاج حصاة حوض الكلية بواسطة الليزر

الخلاصة

الهدف من الدراسة: لتقييم سلامه ونتائج استخدام ناظور الحالب والكلية شبه الصلب في علاج حصاة حوض الكلية بواسطة الليزر.

شملت هذه الدراسة (١٠٠مريضاً) مصابا بحصاة واحده في حوض الكلية، تمت معالجتهم بواسطة ناظور الحالب والكلية شبه الصلب باستخدام الليزر لتفتيت الحصى للفترة من تشرين الأول ٢٠١٣ إلى تشرين الأول ٢٠١٥. تراوحت أعمار المرضى من ١١ الى ٦٧ سنه (معدل الأعمار ٤١،٥ سنه)، وكان ٦٥ منهم نساء و ٤٤ رجال، ويتراوح حجم الحصى من ١٣ الى ٢٧ ملم (معدل حجم الحصى ٢١،٨ ملم). تم استبعاد حالات الفشل في الوصول الى حصاة حوض الكلية ولأي سببا كان من هذه الدراسة. المعايير التي تم دراستها في هذا البحث تشمل : نسبه النجاح والفشل (الأولي والثانوي)، وقت العملية، فترة الاستشفاء والمضاعفات إثناء وبعد العملية وطرق علاجها. وكذلك تم تقييم الإجراءات التبعية المكملة التي استخدمت لبقايا الحصى الكبيرة (اكبر من ٤ ملم) بعد العملية.

نتائج الدراسه: تم التخلص من الحصى بصوره كليةً في ٣٤ حالة (بمعدل ٦٨%) في اليوم الأول بعد العملية، وقد ازداد الى ٤٣ حالة (بمعدل ٨٦%) بعد شهر من العملية، وذلك باستخدام الإجراءات التبعية المكملة مثل تفتيت الحصى عن طريق الموجات الصادمة من خارج الجسم، او محاوله ثانيه لناظور الحالب والكلية شبه الصلب أو استخدام العلاج الطبي مع المتابعة. كان معدل وقت العملية ٧٢،٤ دقيقه ومعدل فترة الاستشفاء (١،٦ يوم). لم تسجل أي مضاعفات خطيرة أثناء وبعد العملية، وتمت معالجه بعض الحالات التي ظهرت فيها مضاعفات بسيطة تحفظيا. تم متابعه المرضى سريريا خلال فترات منتظمة بعد أسبوع ، شهر وثلاثة أشهر من العملية.

الاستنتاج أثبتت الدراسة أن استخدام ناظور الحالب شبه الصلب لعلاج حصاه حوض الكلية بحجم اقل من ٢٧ ملم بواسطة التفتيت بالليزر هو وسيلة امينه وفعاله في الحالات التي تم اختيارها. كانت فترة الاستشفاء سريعة، والمضاعفات قليله مع نسبه التخلص من الحصى جيده وعدم الحاجة لاستخدام التصوير الشعاعي خلال العملية.

الكلمات المفتاحية: ناظور الحالب والكلية شبه الصلب، حصاة حوض الكلية، الليزر.

Introduction

Huffman *et al* reported the usage of semi-rigid ureteroscopy for the treatment of pyelic calculi the first time in 1983 [1].

Renal pelvic stone less than 2cm in diameter them first line of management is ESWL but RIRS is regarded as alternative for ESWL [2].

Retrograde endoscopic intracorporeal lithotripsy has several advantages including higher immediate stone free rate, calculi can be located, fragmented and removed under direct vision [3], Also concomitant ureteric obstruction by stone or stricture can be treated at the same time, with in situ fragmentation and basket removal of the fragments. ESWL

therapy is limited to certain stone compositions but the holmium laser can fragment all types of stones [3].

Today, the vast majority of renal pelvis calculi are accessible and treatable using a retrograde ureterorenoscopic approach. Evolution of technique and miniaturization of instruments have changed the management of renal pelvic stone disease. Reduction in the size of ureteroscopes, improvements in the electronic imaging systems, proliferation of auxiliary equipment, and improvement in endourological skills among urologists make ureteroscopic management of upper urinary tract stones a treatment of choice [4].

Larger stones those more than 2cm in diameter, particularly those composed of cystine or struvite, can be approached via establishing percutaneous access to the collecting system through a small flank puncture. This would allow direct visualization and intracorporeal lithotripsy for stone fragmentation, and removal of fragments known collectively as Percutaneous nephrolithotomy (PCNL). PCNL has high success rates of around 90% however intraoperative or postoperative major complications rates are often reported as 0.03% to 10% [5]. For larger renal stones more than 2cm RIRS is not first line of management and it indicted when PCNL is contra indicated. Until recently, percutaneous nephrolithotomy (PCNL) was recommended as the treatment of choice for renal pelvic calculi >2 cm in diameter; however the European Association of Urology (EAU) guidelines suggest that in such stones ureteroscopy (URS) is another option. This is because PCNL bears several drawbacks as substantial morbidity, analgesic requirements and high anesthetic risk in patients with compromised cardiopulmonary status [6].

Semi-rigid ureteroscope are very durable instruments compared with flexible ureteroscopes [7]. Both Karl Storz and Richard wolf instruments manufactured a 40cm ureteroscope with a sheath caliber of 7.5 to 9.8fr. The development of this ureteroscope marked the beginning of modern ureteropyeloscopy [8].

The introduction of the holmium: YAG laser represented a major advance in the armamentariums of laser lithotripsy devices, the holmium laser dramatically changed intracorporeal lithotripsy, and has become the energy of choice for most urologists performing retrograde ureteroscope lithotripsy [9]. A new technology used in orthodontic to polymerization the adhesive by light emitting diode (LED). The LED characterized by low generation of heat, and for that reason it is having lifetime over 10000 hrs., with the same constant level of light output, in addition to that the LEDs are cordless so it does not need fan and function noiselessly [4-9].

Materials and Methods:

Hundred patients with single renal pelvic stone ranging between 13-27 mm (mean of 21.8 mm) With main stone volume of 0.98 cm3 were chosen selectively in this prospective study, the stone were evaluated mainly by ultrasound and KUB and volume was checked by low radiation dose native CT, those stones which were fully seen by URS were included and those who were non visualized by ureteroscope were excluded from the study (only DJ was inserted for them as preparations for ESWL), Patient age was range from 11-67 years (mean of 41.5 years). 56 were female and 44 were male .

Adult patients were managed by spinal anesthesia and pediatric age group by general anesthesia, prophylactic antibiotic with anesthesia, in lithotomy position using semi rigid Ureterosope 8-9.5 fr. With 5 fr. working channel after safety guide wire 0.038 inch insertion .

As the stone visualized directly, the stone pulverized completely using 550 µm laser fiber with an energy output of 0.8-1.5 joule, at 8-15 Hz was used, the laser source was from Qunta (Italy).

Sometime the stone was entrapped by using dormia basket for easy disintegration and preventing its retropulsion and active extraction of stone fragments, with the basket engaged the ureteroscop and stone are moved together keeping the stone in view at all times.

Dj stent was routinely inserted for all patients and to be removed one week after successful procedure and to be kept for longer period of time if there residual hidden stone, on first post-operative day abdominal U/S and KUB

were performed to all patients to assess stone free status and DJ position and any complication, success (in term of clearance) was defined as <4mm non obstructing asymptomatic residual fragments or no any residual fragments. Ancillary procedure as medical managements, ESWL or ureteroscope may be added accordingly.

Most of patients discharged on the first post-operative day, operative time any period post-operative complications, stone free rate and hospitalization period were recorded.

Results;

Hundred patients with single renal stone were managed by semi rigid ureteroscopy with intracorporeal Holmium-YAG laser lithotripsy. Parameters of treated stones in table 1.

Primary Success (Stone free or insignificant fragment) was achieved in (68) patient (46 female, 22 male) 68% after single ureteroscopic procedure at first post-operative day and increased to 86% after one month.

Primary success in term of stone clearance was not achieved in (39%) of patients, Ancillary procedure were done for them which was Medical treatment in 8 patients, ESWL for 6 patients and second session of semi rigid ureteroscopy for 4 patients.

The mean operative time was 72.4 minutes (ranging from 44.3-97.8 minute which greatly related to stone size. Table 2.

Mean hospitalization period was 1.6 days (from 1-4 days). No major perioperative complication were encountered in our patients but minor intra and post-operative complications has encountered as illustrated in table 3.

Table (1): Parameters of treated stones.

Stone size cm	1-2cm	68	2-3cm	32
Stone volume cm	$<1(cm)^3$	76	$>1(cm)^3$	24
Laterality	Right	56	left	44
Stone opacity	Opaque	72	Leucent	28
Hydronephrosis	Mild	15		
	Moderat	56		
	Sever	26		

Table (2): Preoperative and postoperative complications.

Perioperative complications A-intra operative complications	
Mucosa laceration	22
Pelvic and ureteral wall perforation	11
Bleeding	12
Stone migration	5
B-post operative complications	
Fever	6
Hematurea	18
Hematoma	5
Urenoma	3
Dysurea and post-operative pain	18

Table (3): Operative time in relation to stone size.

Stone size mm	Mean operative time
10-15	44.3min
15-20	61.7
20-25	76.2
25-30	97.8
Total	72.4

Discussion:

Recent advances in the endourology in the last 2 decade, with innovation in endoscopes and endoscopic lithotrities such as availability of small caliber semi-rigid ureteroscope which is long enough to reach the pelvis, and reliable laser technology which is used to disintegrate all stones of any composition increase the indications of retrograde ureteroscopic treatment of renal pelvic stone with the aim of providing effective treatment and minimizing the unpleasant effect of the therapy at the same time and it is suspected that the results of this method will improved dramatically after introduction of high power laser system up to 60 watt and high caliber laser fiber up to 1000µm.

Patients age was range from 11-67 years mean of 41.5 years. 14 patients (28%), were below (20) yrs. old, they were with high success rate and less complications and this is agree with a similar study done by Alex *et al* (2006) at Cleveland, Ohio which conclude that semi-rigid pyeloscopy can be safely applied toward treatment of renal pelvic calculi as well as diagnostic ureteropyelo-scopy in prepubertal children with several advantages compared to flexible ureteroscopy [10].

Although flexible ureteroscopes have the advantage of allowing easy access into both the renal pelvis and the calices and superior stone free rates with the limitations of less durability and higher cost [11, 12]. It was noticed that S-URS may be sufficient for renal pelvic stones, in particular those located at a position not necessitating instrument flexibility to be disintegrated, with large irrigation channel, improved irrigation flow and visualization and generally a large field of view [13]. There are many reports advocating that semi-rigid URS (S-URS) is a safe and successful treatment even for proximal ureteric and renal pelvic stones [14, 15]. In order to minimize total flexible URS time, Ebertand Schafhauser used the semi rigid ureteroscope for laser lithotripsy in 12 patients with resistant renal calculi, after repositioning of the stones in the renal pelvis with the flexible instrument [16].

Compared to PCNL, retrograde ureteroscopic lithotripsy, offer shorter post-operative recovery, decreased overall morbidity and lower complications risk [17]. In particular, PCNL has been reported to have a substantial complication rate (0.03-10%) counteracting its high efficacy [18, 19]. In a recent randomized study in patients with renal stones >2 cm, S-URS although less efficacious, was found to be advantageous over PCNL in terms of operating time, drop of hemoglobin and hematocrit, need for analgesia and duration of hospital stay [20]. RIRS utilize natural office and tract without need for even to artificial puncture-also RIRS usually without blood lose and even can be done with anti-coagulated patients.

Primary success rate in our study was 68% at the first postoperative day which is achieved in 68 patient . In those patients a DJ stent had been removed on the first follow up visit after one week post operatively, to be seen after 1 month from the operation. Finally, we achieved an 86% overall success rate after 1 month by using ancillary procedure such as (ESWL, ureteroscopy), for cases with significant stone fragments (i.e. more than 4 mm). We used ESWL for residual fragment

>10mm, which was successful in 3 patients, second session S-URS had been successfully done in (2) patients with large residual stone >15mm in size. While in other patients with fragments less than 10mm, radiolucent fragments, kept on medical treatment with observation which was successful in achieving stone free status in 4 patients.

Regarding the means operative time in our study was 72.4 minute which is greatly related to the size of stone as illustrated in table (3), which was agree with similar study done be Lee and colleagues found that when the size of the stone increase both operative time and need for ancillary treatment also will be increased [21]. In our study the average hospitalization was 1 to 4 days. In a similar study done by Atis *et al* [22]. 47 patients with an isolated renal pelvic stone underwent S-URS and holmium laser lithotripsy, over a period of two years. The renal pelvic stones were accessed only in (25) out of the (47) patients, F-URS were performed in remaining 22 patients. The complication rate was 4% and the mean hospitalization period was 1.5 days. The mean operative time was 65.4 min, while the stone free rate (with in mean of 1.6 days).

Most of our patients were discharged 24 hours post operatively except in few cases where complications prolonged their hospital stay to a maximum of 4 days (was 72% the 1st postoperative day and 76% after 1 month). The authors concluded that URS is a feasible alternative treatment modality for isolated renal pelvic stones, with no significant difference among two group in term of stone-free rate, complications rates and hospitalization period).

This operation method is regarded safe method that there is no radiation to surgical staff or to patient and patient managements is in supine position under spinal anesthesia which is much safer than prone position for PCNL, it is safer because no major complication. Only easily managed minor complications. Fever which was of low grade in most of patients, except in (6) patients where a high grade fever developed due to urinary tract infection and was managed conservatively. Hematuria occurred in (18) patients, and was transient, self-limiting, and treated conservatively. Dysuria and post-operative pain which was mild and ameliorated successfully with medical treatment. Urinary extravasation (urinoma) which is small in size, and occurred in 3 patients and treated conservatively. Hematoma (perinephric or subscapular) occurred in (5) patients, (2) of them were managed successfully by percutaneous drainage and the third one treated conservatively.

All of these complications were approximately with the same rates that observed in similar study done by Khaled *et al* at Kasr Al-Ainy Hospitals, Cairo University, Cairo, Egypt in 2 June 2013 [23]. In another similar published study done by Mitsogiannis *et al* (2012) at University of Athens, Sismanoglio Hospital, Athens, Semi-rigid Laser Ureterolithotripsy for Single Large Renal Pelvic Stones, this study was enrolled (20) patients with large renal pelvic stone more than 1.5 cm treated by semi-rigid ureteroscopy .mean stone size 2.1 cm, mean operative time was 69.4 minute, primary stone free rate 70.6% at first post-operative day increasing to 82.3% at 1 month post operatively, with a mean hospitalization 1.4 day, with no major complications. Adjuvant Extracorporeal Shockwave Lithotripsy (ESWL) was performed in (3) patients with residual stones [24].

Conclusion:

Retrograde S-URS with Holmium:YAG laser lithotripsy, is an efficient and safe reliable alternative treatment modality for single renal pelvic stone <3cm in size. Morbidity, hospital stay and complications are low with good stone free rate and no radiation fluoroscopy.

This technique is widely accepted modality of treatment among patients due to less invasiveness than PCNL and higher immediate stone-free rate than ESWL ,and associated with few complications which were minor and mostly amenable for conservative treatment.

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