Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: www.saspublishers.com

OPEN ACCESS

General Surgery

A Comparison Analysis between Laparoscopic Retroperitoneal Ureterolithotomy with Ureteroscopic Laser Lithotripsy for the Management of Upper and Middle Ureteric Stone

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| **Received:** 25.03.2019 | **Accepted:** 06.04.2019 | **Published:** 30.04.2019
DOI: 10.36347/sjams.2019.v07i04.013

Abstract — **Original Research Article**

Objectives: To compare and analyze the result of laparoscopic retroperitoneal ureterolithotomy with ureteroscopic laser lithotripsy for the management of upper and middle ureteric stone. ***Material and Methods*:** This study comprised of 60 patients who has isolated unilateral upper and middle ureteric calculus & were subjected to removal of stone. Thirty (30) patients were undergoing Laparoscopic Retroperitoneal Ureterolithotomy (Group A) and thirty (30) patients were undergoing ureteroscopic laser lithotripsy (Group B). ***Results:*** Sixty patients (Group A 30, Group B 30) met inclusion criteria. Among the patient who underwent Laparoscopic Retroperitoneal Ureterolithotomy (LRU), 100% patients had complete clearance of calculus. Among the patient who Underwent Ureteroscopic Laser Lithotripsy (URSL), 86.6% had complete clearance of calculus and 13.3% of patients had incomplete clearance of calculus. Among the patients who underwent Laparoscopic Retroperitoneal Ureterolithotomy, 6.7% patient s had urinary leak, 6.7% patient had inadvertent entry into peritoneum, 3.3 % patients had subacute emphysema and 83.3% of patient had no complication. Among the patient who underwent Ureteroscopic Laser Lithotripsy, 10% of patient had fever, 3.3% of patient had ureteric perforation intraoperatively and 86.7% patient had no complication. ***Conclusions:*** Comparing Laparoscopic Retroperitoneal Ureterolithotomy with Ureteroscopic Laser Lithotripsy for the management of upper and middle ureteric calculus we had results that, both the procedure are complimentary to each other. For bigger and impacted stone laparoscopic retroperitoneal ureterolithotomy is better procedure as there is no chance of residual stone. For smaller and non-impacted stone ureteroscopic laser lithotripsy is better procedure as it is intracorporeal procedure, with less morbidity, lesser operative time and lesser hospital stay.

Keywords: laparoscopic retroperitoneal ureterolithotomy, Ureteroscopic Laser Lithotripsy, kidney stones.

INTRODUCTION

Stone disease, although, one of the common affliction of modern society, has been described since ancient times. The oldest renal stone was described by Shattock in an Egyptian Mummy in a tomb dating approximately 4400BC [1]. The estimated lifetime prevalence of kidney stone disease is 1% to 15% with the probability of having a stone varying according to age, gender, race and geographic location [2-4]. The incidence of urinary tract stone disease is increasing. According to the national health and nutrition examination survey of 2012, 10.6% of men & 7.1% of women in the US are affected by renal stone disease, compared to just 6.3% of men & 4.1% of women that were affected in 1994[5].

With the development of endoscopic lithotripsy equipment and accumulation of experience, ureteroscopic lithotripsy has been widely used in the world. Due to its minimal invasion, safety and high curative effect, open surgery has been gradually replaced by ureteroscopic lithotripsy. Some reports show that extracorporeal shock wave lithotripsy (ESWL) has a higher stone clearance rate. Nevertheless, stones shift to the renal pelvis in ureteroscopic lithotripsy and lead to residual stones in some cases. Laparoscopic ureterolithotomy can effectively prevent retrograde shift of stones to the renal pelvis and stone residual.

History of laser lithotripsy: Laser Lithotripsy was invented at wellman center for photomedicine in

the 1980s to remove impacted stone from the urinary tract. Laser pulse delivered through a fiberoptic is used to pulverize the stone avoiding surgery. The technology was licensed to the cndela corporation which produced the first commercial laser lithotripsy system [6].

The advent of laparoscopic stone removal procedures has provided another way to circumvent open surgery. Every type of lithotomy procedure has been reported by use of a laparoscopic approach. The foundation of modern laparoscopy was laid in (1805) when Bozzini developed the first self-contained endoscope [7]. Nitze was the first to introduce glass optics for magnification [8]. The shift toword laparoscopy was initiated by kelling, a surgeon who was the first to apply Nitze's cystoscope, and introduced through a closed cavity endoscopic examination of living dog. Major advances in endoscope resolution and contrast were subsequently achieved by Hopkins, who introduced large, rod shaped quartz lenses to transmit light in the early 1960s [9]. Parallel to development of the light sources and improved optical instruments, invention and changes in the areas of insufflation techniques and trocars occurred.

In Kashmir valley (Jammu & Kashmir state), minimally invasive surgeries for the treatment of patients with kidney stones has been going on for more than a decade now, resulting in significant reduction in morbidity, fewer postoperative complications, fewer postoperative blood transfusions compared to procedures carried out using the open procedures. There has been no study in our state on the comparison between the two minimally.

Invasive procedures, i.e., Laparoscopic retroperitoneal ureterolithotomy and ureteroscopic Laser Lithotripsy, for the management of upper and middle ureteric stone. The present study has been undertaken in an attempt to compare the two minimally invasive procedures, with respect to safety and efficacy of each technique.

MATERIALS & METHODS

This prospective study was conducted in the department of General Surgery, Kidney and Urological diseases of Reasearch Center, Kidney hospital, Sonwar Bagh, Srinagar, between june 2014 to june 2016. A detailed clinical examination was done in all patients enrolled in the study. Baseline investigations for every patient included complete hemogram, urine examination, kidney function test, x-ray chest, ECG. All patients were subjected to imaging modalities like USG, x-ray (KUB) and intravenous urography for anatomic examination of urinary tract & to look for stone location, size and degree of hydronephrosis. CT urography and DTPA scan was done occasionally in patients where there was a need of more detailed anatomy and functional information. Each patient and his attendants were fully explained about the nature of operation in the language which they understood best, and written consent was taken from the patient and attendants before surgery which included the complications both intra and post-operative and possible need for conversion to open surgery.

Patient population

This study comprised of 60 patients who has isolated unilateral upper and middle ureteric calculus & were subjected to removal of stone. Thirty (30) patients were undergoing Laparoscopic Retroperitoneal Ureterolithotomy (Group LRU) and (Group URSL) thirty (30) patients were undergoing ureteroscopic laser lithotripsy.

Sample size calculation- one sample size for proposed study is calculated according to following formula-

$$n = \frac{[DEFF \times N \times p(1-p)]}{\left[\left(\frac{d^2}{z^2_{1-\alpha/2}}\right)(N-1) + p(1-p)\right]}$$

Where $z_{1-\alpha/2}$ = 1.96
Population size (N)=100
Hypothesized % frequency (P) =10%
Confidence limit as % of 100(d) =5%
Design effect (DEFF) = 1

Sample size

$$n = \frac{[1 \times 100 \times 0 \cdot 10(1-0.10)]}{\left[\left(\frac{0.05^2}{1.96^2}\right) \times (100-1) + 0.10(1-0.10)\right]}$$

$$= \frac{100 \times 0.09}{\left(\frac{0.0025}{3.8416}\right) \times 99 + 0.09}$$

$$= \frac{9}{0.064 + 0.09} = \frac{9}{0.154}$$

$$= 58.4$$

$$n \cong 58$$

By the above formula we got 58 is sample size for our study. However to enable the deduction of potential variation & to avoid potential errors, sample size of 60 was taken. 30 patients were included in each group.

Systematic random sampling technique has been used to draw a sample of 60. First patient chosen at random from sample and placed in group 1, and then another in group 2. 3rd patient in group 1 and 4th in group 2 and so on. The surgery was performed by the same surgical team. Preanaesthetic checkup is done in all patients.

Preoperative preparation

- Patients were kept fasting for 6 hours before surgery

- Informed and written consent was taken before Performance of each procedure.
- Plain X – ray abdomen (KUB) were taken early in the morning on the day of surgery to confirm the exact site of the Stone.
- Antibiotic prophylaxis (i.v.) was administered before the Procedure in every patient.

All procedures were done as elective surgeries. Each patient was positioned supine for intravenous access and in each patient calculus removal was followed by double J stenting of the ureter.

Postoperative care

For immediate postoperative pain relief, injectable Diclofenac sodium 75 mg intramuscular was used. Later, oral pain medication, diclofenac sodium 50 mg is used. i.v. fluids were given to the patients as required. Intravenous antibiotics, a combination of cefperazone/sulbactum was given for two days, which was then replaced with oral antibiotics. Orals are usually started 12 to 14 hours after surgery, and by about 14 to 16 hours after surgery, patients were made ambulatory and X-ray (KUB) taken.

Each patient was monitored for following

- Vitals-Pulse ,blood pressure, temperature and respiratory rate
- Bleeding/ Haematuria requiring transfusion,
- Septicemia
- Postoperative pain
- Urinary leakage
- Wound infection

Foley's catheter was removed on first postoperative day in both cases. Drain was removed in laparoscopic retroperitoneal ureterolithotomy 2nd postoperative day if drainage is minimal. After discharge from the hospital, patients were called for follow up at 1 week, 6 week, 12 week and 6 months thereafter. Double J stent was removal after 6 weeks on OPD basis. All the parameters were recorded in the pre-structured proforma. The follow up information was collected through follow up clinic. The patient under study was evaluated for clearance of fragments of calculus (if left over at the time of surgery) at the time of follow up. A complete physical examination, X-ray (KUB), Ultrasonography (if needed) was performed around 4 weeks of surgery which was followed by removal of Double J stent (on outpatient department basis).

All the data was subjected to statistical analysis. The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were summarized in the form of means and standard deviations and categorical variables were summarized as percentages. Student's independent t-test was employed for continuous variables. Chi-square test or Fisher's exact test, whichever appropriate, was used for comparison of categorical variables. Graphically the data was presented by bar and line diagrams. A P-value of less than 0.05 was considered statistically significant. All P-values were two tailed.

RESULTS

The mean age, gender, position of stone and the duration of surgery were comparable in both the and there was no statistically significant difference among the groups Table 1.

Table-1

variable	Group LRU	Group URSL	P value
Age	41.4±13.92	39.9±16.65	0.692
Male/Female	23/7	24/6	0.754
Left/ Right	18/12	17/13	0.793
Duration of surgery	53.3±12.57	24.4±6.01	0.738

Mean calculus size of patients who underwent Laparoscopic Retroperitoneal Ureterolithotomy (LRU), was 16.6±2.09 Mean calculus size of patients who underwent Ureteroscopic Laser Lithotripsy (URSL), 15.9±2.16. Calculus size parameter was comparable in two groups. There was no statistical difference in two groups (p-value=0.251, Insignificant using t-test for Equality of Means Table 2.

Among the patient who underwent Laparoscopic Retroperitoneal Ureterolithotomy (LRU), 100% patients had complete clearance of calculus.Among the patient who Underwent Ureteroscopic Laser Lithotripsy (URSL), 86.6% had complete clearance of calculus and 13.3% of patients had incomplete clearance of calculus Table 2.

Table-2: Calculus clearance rate, hospital stay and VAS score.

Variable	Group LRU	Group URSL	P value
Complete/Incomplete	30/0	26/4	0.112
Hospital Stay (Days	3.2±0.98	2.2±0.89	0.002
VAS score	2.5±0.68	0.4±0.67	0.005

VAS score parameter was not comparable in two groups there was statistical difference in two groups (p-value=<0.001, significant using t-test for Equality of Means Table 3.

Among the patients who underwent Laparoscopic Retroperitoneal Ureterolithotomy, 6.7% patient s had urinary leak, 6.7% patient had inadvertent entry into peritoneum, 3.3 % patients had subacute emphysema and 83.3% of patient had no complication. Among the patient who underwent Ureteroscopic Laser Lithotripsy, 10% of patient had fever, 3.3% of patient had ureteric perforation intraoperatively and 86.7% patient had no complication.

DISCUSSION

The study was conducted in the department of General Surgery, Kidney Hospital, Sonwar Bagh, and Srinagar. The study consisted total of 60 patients who were randomized into two groups. Each group consisted of 30 patients. One group was subjected to laparoscopic Retroperitoneal Ureterolithotomy (LRU), whereas other group underwent Ureteroscopic Laser Lithotripsy (URSL). The two groups were compared with respect to age, sex, side affected, grade of hydronephrosis, calculus size, operative time, calculus clearance, blood transfusion required, conversion to open surgery, hospital stay, loss of active days of work, VAS score and complications.

In our study, patients in two groups were almost similar with respect to mean age. In our study, patients in two groups were almost similar with respect to mean age. Mean age of patients was 41.4 years in laparoscopic Retroperitoneal Ureterolithotomy (LRU) group and 39.9 years in Ureteroscopic Laser Lithotripsy (URSL) group. Overall age range was 20-85 years. Majority of our patient presented in 2nd to 4th decade of life. In our study age parameter was comparable in two groups. You quing Fang *et al*. [10] in their study had mean age of 34.4 years in laparoscopic Retroperitoneal Ureterolithotomy (LRU) group and 36.9 years in Ureteroscopic Laser Lithotripsy (URSL) group. There was no significant difference between two groups.

Among the patients who underwent laparoscopic Retroperitoneal Ureterolithotomy (LRU), 76.7% were male whereas 23.3%were female. Among the patients who underwent Ureteroscopic Laser Lithotripsy (URSL, 80% were male whereas 20%were female. You quing Fang *et al*. [11] in their study had 60%male and 40% female in laparoscopic Retroperitoneal Ureterolithotomy (LRU),and 56 % male and 44% female in Ureteroscopic Laser Lithotripsy (URSL).

Among the patient who underwent Laparoscopic Retroperitoneal Ureterolithotomy (LRU), 40% had Grade I hydronephrosis, 46.7% had Grade II hydronephrosis and 13.3% had Grade III hydronephrosis. Among the patient who underwent Ureteroscopic Laser Lithotripsy (URSL), 40% had Grade I hydronephrosis, 56.7% had Grade II hydronephrosis and 3.3% had Grade III hydronephrosis. Grade of Hydronephrosis parameter was comparable in two groups.

Mean calculus size of patients who underwent Laparoscopic Retroperitoneal Ureterolithotomy (LRU) was 16.6±2.09. Mean calculus size of patients who underwent Ureteroscopic Laser Lithotripsy (URSL), 15.9±2.16. Calculus size parameter was comparable in two groups. You quing Fang *et al*. [11] had mean calculus size 1.6$\pm$0.3 in Laparoscopic Retroperitoneal Ureterolithotomy (LRU) group and 1.5$\pm$0.3 in Ureteroscopic Laser Lithotripsy (URSL). Our results were consistent with the study.

Among the patients, who underwent Laparoscopic Retroperitoneal Ureterolithotomy (LRU), 20% patient had operative time ranging from30-44minutes and 80% patients had operative time more than 45 minutes. Mean Operative time of patient who underwent Laparoscopic Retroperitoneal Ureterolithotomy (LRU) was53.3±12.57 minutes. You quing Fang *et al.* [11] had mean operative time 41.8±8in Laparoscopic Retroperitoneal Ureterolithotomy (LRU).

Among the patients who underwent Ureteroscopic Laser Lithotripsy (URSL), 73.3% patients had operative time ranging from 15-29 minutes and 26.7% of patients had operative time ranging from 30-44 minutes. Mean operative time of patients who Underwent Ureteroscopic Laser Lithotripsy (URSL) was 24.4±6.01minutes. You quing Fang *et al.* [11] had mean operative time49±10.7in Ureteroscopic Laser Lithotripsy (URSL). Mean operative time parameter was not comparable in two groups. There was a statistical difference in the two groups in our study and study done by you quing Fang *et al.* [11].

Among the patient who underwent Laparoscopic Retroperitoneal Ureterolithotomy (LRU), 100% patients had complete clearance of calculus. Among the patient who Underwent Ureteroscopic Laser Lithotripsy (URSL), 86.6% had complete clearance of calculus and 13.3% of patients had incomplete clearance of calculus. You quing Fang *et al*. [11] had a stone clearance of 100% in Laparoscopic Retroperitoneal Ureterolithotomy (LRU) group and 88% in Ureteroscopic Laser Lithotripsy (URSL) group.

Among the patient who underwent Laparoscopic Retroperitoneal Ureterolithotomy (LRU), 10% of patient had hospital stay of <3days and 90% of patient had hospital stay of 3days. Among the patient who underwent Ureteroscopic Laser Lithotripsy (URSL), 93.3% of patient had hospital stay of <3days and 6.7% of patient had hospital stay of ≥3days. Mean hospital stay of patient who underwent Laparoscopic Retroperitoneal Ureterolithotomy was 3.2±0.98 days whereas Mean hospital stay of patient who underwent was2.2±0.89 days. You quing Fang *et al*. [11] had a

mean hospital stay of 2.8±1.3 in Laparoscopic Retroperitoneal Ureterolithotomy (LRU) group and 2.8±0.8 in Ureteroscopic Laser Lithotripsy (URSL) group. Mean hospital stay parameter was not comparable in two groups. There was a statistical difference in two groups.

Among the patient who underwent Laparoscopic Retroperitoneal Ureterolithotomy (LRU) had pain postoperatively measured on basis of Visual Analogue score (0-10), had VAS score in the range of 2-4. Among the patient who underwent Ureteroscopic Laser Lithotripsy (URSL) had pain postoperatively measured on basis of Visual Analogue score (0-10), had VAS score in the range of 0-2. Postoperative analgesia is an important parameter for patient convalescence. If patient is pain free, he feels cured of disease subjectively. Our strategy for postoperative pain relief was so effective that most of our patient were pain free in postoperative period.

Two patients had urinary leak from operative site among the patients who underwent Laparoscopic Retroperitoneal Ureterolithotomy which were managed by bladder catheterization for few days. Two patients had inadvertent entry into peritoneum during Laparoscopic Retroperitoneal Ureterolithotomy which was taken care of with veres needle and had no significant effect over the performance of the procedure while one patient had surgical emphysema which resolved spontaneously. Fever occurred in three patients among Ureteroscopic Laser Lithotripsy which were managed conservatively and responded well to antibiotics. One patient had ureteric perforation while performing Ureteroscopic Laser Lithotripsy in case of impacted calculus but afterward guide wire negotiated up in the kidney and DJ stenting was done.

From the study, following suggestion should be kept in mind for future

- Flow of perfusate should be adequate for proper visualization and should be decreased to avoidsuperior shift of stone while performing Ureteroscopic Laser Lithotripsy.
- Always try to negotiate guide wire above the calculus in ureteoscopic laser lithotripsy to avoid ureteric perforation and ureteric wall avulsion
- Retroperitoneal anatomic landmarks such as psoas major muscle, peritoneum and perirenal fascia should be accurately identified to decrease periopeative complications. Quick screen of stones is crucial to shorten the operating time.
- Ureteral incision must be closed water tight to avoid the complication of urinary leak.

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