



Laparoscopic ureterolithotomy; which is better: Transperitoneal or retroperitoneal approach?

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ABSTRACT

Objective: This was a prospective study to compare the outcome of laparoscopic transperitoneal ureterolithotomy (LTU) with laparoscopic retroperitoneal ureterolithotomy (LRU) as a primary treatment for a large stone in the proximal ureter.

Material and methods: A total of 24 patients with a solitary, large (>1.5 cm), and impacted stone in the proximal ureter was selected and randomly divided into two groups. The first group included 13 patients who were treated by LTU, and the second group included 11 patients who were treated by LRU. Patient demographics and stone characteristics as well as the operative and postoperative data of both groups were compared and statistically analyzed.

Results: There was no significant difference between the two groups regarding patient demographics and stone characteristics. The mean operative time was significantly shorter in the LTU group than in the LRU group [116.2±21.8 min vs 137.3±17.9 min, respectively (p=0.02)]. The mean time to oral intake was significantly longer in the LTU group than in the LRU group [21.2±4.9 h vs 15.5±2.8 h, respectively (p=0.002)]. There was significant higher rate (27.3%) of changing to open surgery in LRU (p=0.04). The stone-free rate was significantly higher in the LTU group than in the LRU group [100% vs. 72.8%, respectively (p=0.03)]. There was no statistically significant difference between the two groups regarding the mean blood loss, mean hospital stay, mean analgesia dose, blood transfusion rate, postoperative fever, and stone migration during surgery.

Conclusion: Both approaches of laparoscopic ureterolithotomy are effective in treating large impacted stones in the proximal ureter. LTU has significantly shorter operative time and lower rate of open conversion but has a significantly longer time to oral intake.

Keywords: Laparoscopy; retroperitoneal; transperitoneal; ureterolithotomy.

Introduction

Technical development in endourological procedures and extracorporeal shockwave lithotripsy (SWL) makes them the primary treatment option in the management of most ureteral stones, resulting in decreased indications for open surgery. However, in some situations such as large, hard, impacted stone or in case of multiple stones, ureterolithotomy either by open surgery or laparoscopy is indicated to completely clear the stone in a single surgical session.^[1,2] Laparoscopy is more preferable than open surgery because it enables lower postoperative morbidity and pain, less blood loss, and shorter hospital stay, with better cosmeses.^[3] Recently, with the adoption of

laparoscopy by most urologists, nearly all urological operations have been reported to be performed laparoscopically, including ureterolithotomy.^[4]

Focus on laparoscopic ureterolithotomy has increased since the initial report of laparoscopic retroperitoneal ureterolithotomy (LRU) by Wickham^[5] in 1979, but the approach did not gain popularity until Gaur et al.^[6] described hydraulic balloon dilation that provides quick access to the retroperitoneum. Laparoscopic transperitoneal ureterolithotomy (LTU) was described for the first time by Raboy et al.^[7] in 1992. Many studies have discussed these two approaches of laparoscopic ureterolithotomy separately; however, few compared both techniques. The objective of this study is to

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compare the safety and efficacy of the transperitoneal and retroperitoneal approaches.

Material and methods

From January 2012 to September 2013, a total of 24 patients were enrolled. They were selected from among those with ureteral stones and who attended the outpatient urology clinic at Benha University Hospital in Egypt. The inclusion criteria were a solitary, radio-opaque, large (more than 15 mm), hard (more than 1200 Hounsfield units), and impacted proximal ureteral stone. Patients with multiple ureteral stones, previous ureteric or renal surgery at the same side, previous SWL for a stone in the same ureter, associated congenital anomalies, and morbid obesity were excluded from the study.

The details of each procedure and possible retreatment, shift to another treatment, or possible complications were explained to all patients, and written informed consents were taken from all patients. Study protocols and consent forms were revised and approved by our research and ethics committee.

The selected 24 patients were assessed by obtaining a full clinical history and by serum creatinine, bleeding profile, urine culture, and spiral (non-contrast enhanced) computed tomography. The patients were randomly allocated into the following two groups: the first group included 13 patients who were treated by LTU, and the second group included 11 patients who were treated by LRU.

Surgical techniques

Patient preparation: The patient was placed in the supine position for general anesthesia and endotracheal intubation. The patient was then placed in the lithotomy position for cystoscopy and for the insertion of an open tip ureteric catheter till immediately distal to the stone by approximately 1 inch under fluoroscopy and was fixed to a urethral catheter to be secured. The umbilicus was positioned on the table bridge, and the patient was turned to the modified lateral decubitus position with padding of the axilla and buttocks.

Approaches

a. Transperitoneal: The first trocar (10 mm) was inserted at the umbilicus for thin patients (10 patients) but for obese patients, it was inserted at the lateral border of the ipsilateral rectus abdominis muscle at the level of the umbilicus (3 patients). The second and third trocars were at the anterior axillary line 5 cm above and below the first trocar, respectively (right-handed trocar was 12 mm and left-handed trocar was 5 mm). The incision of the parietal peritoneum at the paracolic gutter (Toldt's line) and the medial reflection of the colon to expose Gerota's fascia, which was opened at

the line of its merge with the psoas sheath. The ureter was identified from its blood vessels and the bulge caused by the stone and was bluntly dissected, preserving the periureteric vasculature. The ureter was opened by a laparoscopic scalpel taking the incision proximal to the stone and ensuring that the incision is large enough to extract the stone by a grasper. After the removal of the stone, the ureteric catheter was advanced under direct vision till it reached the renal pelvis. Suturing the ureterotomy by 4/0 polyglactin suture in 9 patients was then done, leaving 4 patients without suturing. A tube drain was then put. The trocars were removed after the evacuation of CO₂, and closure of the incisions in layers.

b. Retroperitoneal: A 1.5 cm muscle splitting incision was made just below the tip of the 11th rib. The transversalis fascia was incised, and the posterior parietal peritoneum was anteriorly peeled by the surgeon's finger to create sufficient space for balloon dilatation. We used a glove number 7 connected to a nelaton catheter 16 Fr with an injection of approximately 500–1000 cc of saline for 5 min to create a retroperitoneal space and tamponading. Then, a 10-mm trocar was inserted at the same site and was sutured to the surrounding for pneumoretroperitoneum. Under laparoscopic control, the second and third trocars were inserted at the midclavicular and posterior axillary lines, respectively (right-handed trocar was 12 mm and left-handed trocar was 5 mm), making three ports on a transverse line for possible open conversion. Gerota's fascia was opened for the identification of the ureter, and ureterolithotomy was completed as described in the transperitoneal approach.

Parameters of patient evaluations

- Preoperative:** Age, sex, body mass index (BMI), stone size, and stone side.
- Intraoperative:** Operative time calculated from the incision of the skin for the first trocar till the time of putting the tube drain, amount of blood loss, need for blood transfusion, vascular injury, stone migration, and open conversion.
- Postoperative:** Fever, mean time to oral intake, mean analgesia dose, and mean hospital stay (time of drain removal).

Statistical analysis

Data of the study were collected, tabulated, and statistically analyzed and compared using Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) software ver 17. The data were expressed as mean±standard deviation and number and percent according to the type of data. Independent samples T test and chi-square test were used in the statistical comparison of the two groups, and p-values were estimated and considered statistically significant if <0.05.

Results

Patient demographics and stone characteristics are shown in Table 1. There was no statistically significant difference between the LTU and LRU groups regarding the age and sex of the patients, stone size and side, and BMI. The mean age of the patients was 37.6±13.2 years in the LTU group and 44.6±7.9 years in the LRU group. In the LTU group, 69.2% were males and 30.8% were females, while in the LRU group, 72.7% were males and 27.3% were females. The mean stone size was 15.5±3.7 mm in the LTU group and 15.8±3.02 mm in the LRU group. In the LTU group, 38.5% of the stones were in the right side and 61.5% were in the left side, while in the LRU group, 45.5% were in the right side and 54.5% in the left side; all of them were radio-opaque. The mean BMI was 25.9±2.8 in the LTU group and 28.09±4.4 in the LRU group.

The operative and postoperative data are shown in Table 2. The mean operative time of the LTU group was significantly shorter than that of the LRU group (116.2±21.8 min vs. 137.3±17.9 min, respectively p=0.02). There were no significant differences between the LTU and LRU groups regarding mean blood loss (71.5±44.5 mL vs. 60±19.5 mL, respectively, p=0.43), need for blood transfusion (15.4% vs. 9.1%, respectively, p=0.82), postoperative fever (15.4% vs. 18.2%, respectively, p=0.34), mean time of hospital stay (5.4±1.2 days vs. 5±0.8 days, respectively, p=0.37), and mean dose of postoperative analgesia (126.9±47.3 mg vs. 136.4±45.2 mg, respectively, p=0.62). The mean time to oral intake was significantly shorter in the LRU group than in the LTU group (15.5±2.8 h vs. 21.2±4.9 h, respectively, p=0.002). There was vascular injury to the gonadal vein in one patient in the LTU group, and it was successfully controlled by ligature without complications. In the LRU group, there was one patient with stone migration to the renal pelvis, which was extracted by laparoscopic pyelolithotomy. Also, there were three patients with open conversion to open ureterolithotomy in the LRU group due to severe adhesion caused by periureteritis and the failure of identification of the ureter. The stone-free rate of the LTU group was 100% and was significantly higher than that of the LRU group, which was (72.8%).

Discussion

These days, open ureterolithotomy has a limited role in the management of ureteric stones, especially with development in SWL and endourological procedures.^[7,8] The European Association of Urology/American Association of Urology Nephrolithiasis Guideline Panel, 2007, for the management of ureteral calculi recommended either ureteroscopy or SWL as an acceptable first line treatment modality for the management of ureteral stones larger than 1 cm.^[9]

Table 1. Patient demographics and stone characteristics

| | LTU n=13 | LRU n=11 | p |
|--|-----------|-----------|------|
| Mean age (years) | 37.6±13.2 | 44.6±7.9 | 0.14 |
| Sex | | | |
| Male: No (%) | 9 (69.2) | 8 (72.7) | 0.72 |
| Female: No (%) | 4 (30.8) | 3 (27.3) | |
| Mean stone size (mm) | 15.5±3.7 | 15.8±3.02 | 0.85 |
| Stone side | | | |
| Right: No (%) | 5 (38.5) | 5 (45.5) | 0.93 |
| Left: No (%) | 8 (61.5) | 6 (54.5) | |
| BMI | 25.9±2.8 | 28.09±4.4 | 0.15 |
| LTU: laparoscopic transperitoneal ureterolithotomy; LRU: laparoscopic retroperitoneal ureterolithotomy; BMI: body mass index | | | |

Table 2. Operative and postoperative data

| | LTU n=13 | LRU n=11 | p |
|--|------------|------------|--------|
| Mean operative time (min) | 116.2±21.8 | 137.3±17.9 | 0.02* |
| Mean blood loss (mL) | 71.5±44.5 | 60±19.5 | 0.43 |
| Vascular injury: No (%) | 1 (7.7) | 0 (0) | 0.6 |
| Blood transfusion: No (%) | 2 (15.4) | 1 (9.1) | 0.82 |
| Postoperative fever: No (%) | 2 (15.4) | 2 (18.2) | 0.34 |
| Mean time to oral intake (h) | 21.2±4.9 | 15.5±2.8 | 0.002* |
| Mean hospital stay (days) | 5.4±1.2 | 5±0.8 | 0.37 |
| Mean dose of analgesia (mg) | 126.9±47.3 | 136.4±45.2 | 0.62 |
| Stone migration: No (%) | 0 (0) | 1 (9.1) | 0.75 |
| Open conversion: No (%) | 0 (0) | 3 (27.3) | 0.04* |
| Stone-free rate | 13 (100) | 8 (72.8) | 0.03* |
| *Significant p-value | | | |
| LTU: laparoscopic transperitoneal ureterolithotomy; LRU: laparoscopic retroperitoneal ureterolithotomy | | | |

Distal ureteric stones are easily accessible and managed using semi-rigid ureteroscopes with a high stone-free rate of up to 90%, while stones in the proximal ureter are more difficult to manage with semi-rigid ureteroscopy; a high stone-free rate necessitates the use of laser lithotripsy and flexible ureteroscopy, which are not available in all centers.^[10] Moreover, there are still ureteral stones that are poorly treated by SWL, such as impacted, large, hard stones (cystine stones) and stones with soft increments of struvite-apatite composition. These stones at the upper or middle ureter, in particular, can be better treated by open ureterolithotomy;^[10,11] however, in these situations, laparoscopic

ureterolithotomy is a better alternative and can replace open ureterolithotomy as the first option treatment modality.^[12,13]

As evident from many clinical series, the distinct advantage of laparoscopic ureterolithotomy is the high success rate of removing a large, impacted stone in one operation without needing an additional procedure. Laparoscopic ureterolithotomy can be conducted via a transperitoneal or retroperitoneal approach, both of which are equally challenging.^[7,14]

In the current study, the patient demographics and stone characteristics in the two groups were homogenous. There was no statistically significant difference between the two groups with regard to the age and sex of patients, mean stone size, stone side, and BMI; this minimized the effect of any of them on the outcomes of the procedures. The operative time was significantly shorter in the LTU group than in the LRU group (116.2±21.8 min and 137.3±17.9 min, respectively); this is due to the relative easiness of LTU because of the larger working space, presence of more anatomical landmarks, and easy identification of the ureter, while the retroperitoneal approach has a limited working space with a relative difficult identification of the ureter.

In a comparative study between transperitoneal and retroperitoneal laparoscopic ureterolithotomy, Bove et al.^[15] reported that the mean operative time of LTU was 75 min and that of LRU was 102 min. Gaur et al.^[16] reported a mean operative time of 79 min in 101 patients who underwent ureterolithotomy via the transperitoneal approach. Hamel et al.^[17], in their study on 31 patients who underwent LTU, reported a mean operative time of 67 min, while Noura et al.^[18] mentioned a longer mean operative time (160 min) in their study on 6 patients who underwent LRU, which was completed in 5. Although the mean operative time is usually longer in LRU, majority of reports advocating the retroperitoneal approach because it has advantages over the transperitoneal approach by obviating a compromise of the peritoneum, mobilizing the viscera, and preventing urine spillage into the peritoneal cavity.^[19]

In the present study, the mean time to oral intake was significantly shorter in the LRU group than in the LTU group (15.5±2.8 h vs 21.2±4.9 h, respectively). This is due to the mobilization of the colon, dissection and retraction of the viscera, and blood and urine leak in the peritoneal cavity, causing intestinal movements and sounds to be more delayed in the LTU group. In contrast, the lost blood during the retroperitoneal procedure does not come into contact with the bowel, and if urine leakage occurs, it would be contained within the retroperitoneal space.

In their randomized comparative study, Singh et al.^[20] found that LTU was associated with a significantly higher rate of ileus than LRU. Al-Hunayan et al.^[21] in their series, found that the

retroperitoneal approach is better in aspects related to the speed of postoperative recovery and oral intake because there is no bowel manipulation that minimized the incidence of bowel injury or postoperative ileus. Additionally, Fan et al.^[4] reported that the retroperitoneal approach decreases the incidence of ileus and intestinal adhesion and that even if urine leakage occurs, it can be confined to the retroperitoneal space and easily drained to avoid peritoneal contamination.^[17,22]

In contrast to the previously mentioned studies, Nambirajan et al.^[23] conducted a prospective randomized study in a more complicated procedure as they compared transperitoneal and retroperitoneal laparoscopic nephrectomy and concluded that there was no difference between the two approaches regarding the technical difficulty of the procedure or patient morbidity. The absence of urine leakage after laparoscopic nephrectomy in the study by Nambirajan et al.^[23] might be the cause of a similar postoperative period and morbidity of the two groups.

In the current study, 3 patients in the LRU group were made to undergo open surgery because of the failure to identify the ureter because of the inflammatory adhesion caused by the long impaction time in addition to the difficulty of anatomical narrowing of the retroperitoneal space with the absence of anatomical landmarks. In the LTU group, however, no patients were made to undergo open surgery.

We convert the first case of them into LTU, but we found that the operative time significantly increased due to patient's change in position and the insertion of new trocars. Secondly, after the incision of the paracolic gutter and entering Gerota's fascia, the ureter was not identified again due to severe inflammatory adhesions, so the patient was managed surgically. Lastly, because of the easiness of the change from LRU to ureterolithotomy by extending the incision between trocars ports and by the rapid entrance into the already dissected retroperitoneum, we preferred to make the other two patients undergo direct open retroperitoneal ureterolithotomy.

In their series, Harewood et al.^[24] reported that 2 of 3 retroperitoneal approaches were changed to transperitoneal laparoscopy because of a limited working space. Hamal et al.^[25] reported a success rate of 75% in their LRU series and explained that open conversion occurred early in their work and was related to the stepwise learning curve. Also, Jeong et al.^[26] reported a high rate of change to open surgery (50%) as they opened 6 of 12 patients due the failure of ureter identification because of adhesion and periureteritis in 5 patients and vascular injury in 1. Combining these results, LRU may be a significantly more difficult approach than LTU; however, with more experience, the learning curve is increased, and the operative time and complication rate will decline.^[27]

In the current study, vascular injury occurred in 1 patient in the LTU group as the gonadal vein was injured during the dissection of the ureter and bleeding was controlled by ligation without any need for changing to open surgery. Stone migration up to the renal pelvis occurred in 1 patient in the LRU group, and dissection was completed up to the renal pelvis, and the stone was extracted by pyelolithotomy.

The other operative and postoperative parameters between the two groups as mean blood loss, blood transfusion rate, postoperative fever, mean hospital stay, and mean analgesia dose are comparable with no significant difference. In the study by Singh et al.^[20], they found that a much larger dose of analgesia was required in the LTU group with longer time of hospital stay than in the LRU group. The limitation of the study was the relatively small number of patients because of the strict inclusion criteria of the study and the selection of suitable patients for the procedures.

In conclusion, laparoscopic ureterolithotomy is a better alternative to open surgery for large, impacted, and hard stones with a significantly less operative time and lower rate of change to open surgery in LTU and a better postoperative recovery in LRU. The higher rate of change to open surgery in LRU will decrease by improving the learning curve.

Ethics Committee Approval: Ethics committee approval was obtained.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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