



Effects of Laparoscopic Ureterolithotomy and Simultaneous Trans-Trocar Semi-Rigid Ureteroscopy on Stone-Free Rate in the Treatment of Proximal Ureteral Stones

Proksimal Üreter Taşlarının Tedavisinde Laparoskopik Üreterolitotomi ve Eş Zamanlı Trans-Trokar Semirijid Üreteroskopinin Taşsızlık Üzerine Etkisi

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What's known on the subject? and What does the study add?

Effects of laparoscopic ureterolithotomy and simultaneous trans-trocar semi-rigid ureteroscopy on stone-free rate in treatment of proximal ureteral stones.

ABSTRACT

Objective

This study presents the effects of the use of semi-rigid ureteroscopy simultaneously during laparoscopic ureterolithotomy on the stone-free rate and, the techniques used to perform laparoscopic ureterolithotomy less invasively.

Materials and Methods

Between November 2011 and July 2013, laparoscopic ureterolithotomy was performed in 19 patients with proximal ureteral stones. A history of failed shock wave lithotripsy (SWL) or semi-rigid ureteroscopy (sr-URS), presence of ureter stones ≥ 15 mm and/or impacted stones, or a socio-economic status not allowing the patient to reach an advanced center for flexible ureteroscopy (f-URS) were identified as the surgical indications.

Results

Fourteen male (74%) and five female (26%) patients were enrolled in the study and the mean age was 36.4 ± 15.11 (15-70) years. The stones were located on right side in five patients (26%) and left side in 14 patients (74%). The mean stone size was 16.2 ± 3.55 mm (8-22). The mean operation time was 138.9 ± 29.56 minutes (90-200). The mean urethral catheter and drain removal time was 31.2 ± 24.28 (16-120) and 50.8 ± 33.61 hours (18-168), respectively. There was no postoperative complication in long-term period and stone-free rate was 100%.

Conclusion

Laparoscopic ureterolithotomy is a feasible alternative in a patient

ÖZET

Amaç

Laparoskopik üreterolitotomi sonuçlarımız ile operasyon sırasında eş zamanlı kullandığımız semi-rijid üreteroskopun taşsızlık üzerine etkisinden ve operasyonu daha az invaziv hale getirmek için uygulanan tekniklerden bahsedilmektedir.

Gereç ve Yöntem

Kasım 2011-Temmuz 2013 tarihleri arasında proksimal üreter taşı olan 19 hastaya laparoskopik üreterolitotomi uygulandı. Başarısız şok dalgası litotripsi veya üreteroskopi öyküsü, taşın 15 mm'den büyük ve/veya impakte olması ve hastanın fleksibil üreteroskopi gibi operasyonların yapılabileceği başka bir merkeze gitmesine engel olan sosyo-ekonomik durumu, operasyon endikasyonu olarak belirlendi.

Bulgular

Ortalama yaşı $36,4 \pm 15,11$ yıl (15-70) olan 14'ü erkek (%74), beşi kadın (%26) olan toplam 19 hasta çalışmaya alındı. Taşların beşi sağ (%26), 14'ü sol (%74) taraftaydı ve ortalama taş boyutu $16,2 \pm 3,55$ mm (8-22) hesaplandı. Ortalama operasyon süresi $138,9 \pm 29,56$ dakika (90-200) ölçüldü. Ortalama üretral kateter ve drenaj kateteri çekilme süreleri sırasıyla $31,2 \pm 24,28$ (16-120) ve $50,8 \pm 33,61$ saattir (18-168). Uzun dönemde hiçbir hastamızda komplikasyon görülmedi ve taşsızlık oranı %100 olarak tespit edildi.

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ABSTRACT

who had previously failed minimally invasive methods and/or with large impacted proximal ureteral stone. Furthermore, to use semi-rigid ureteroscopy during the laparoscopic procedure increases the stone-free rate and prevents the need for an additional procedure in case of concurrent presence of small kidney stones.

Key Words

Laparoscopy, ureterolithotomy, ureteroscopy

ÖZET

Sonuç

Başarısız minimal invaziv tedavi öyküsü olan ve/veya büyük impakte proksimal üreter taşı olan hastalarda laparoskopik üreterolitotomi iyi bir tedavi seçeneğidir. Ayrıca laparoskopik cerrahi sırasında semi-rigid üreteroskopun kullanımı hem taşsızlık oranını arttırmakta hem de eş zamanlı küçük böbrek taşı olan olgularda ek bir girişim gerekliliğini ortadan kaldırmaktadır.

Anahtar Kelimeler

Laparoskopi, üreterolitotomi, üreteroskopi

Introduction

Currently, except in uncommon situations, shock wave lithotripsy (SWL), ureteroscopy (URS), percutaneous ureterolithotomy and laparoscopic surgery have replaced open surgery for the management of ureteral stones. SWL and URS are the first-line treatment options in the management of proximal ureteral stones with a low probability of spontaneous passage. Flexible ureteroscopy (f-URS) and laser lithotripsy have provided more successful results than semi-rigid URS (sr-URS) (1). Due to the high cost of the equipment involved, this method is not accessible in most medical centers. Thus, laparoscopic ureterolithotomy (LU) has become a viable alternative in most underdeveloped nations for the management of ureteral stones larger than 1 cm and impacted proximal ureteral stones, or after failed SWL and sr-URS (2).

Laparoscopy also enables the use of an additional approach or instrument such as laparoscopic-assisted percutaneous nephrolithotomy (PNL) or flexible nephroscope in complicated cases. In this study, we present the results of LU in patients with proximal ureteral stones. In addition, we try to demonstrate how sr-URS can be used simultaneously during LU, its effect on the stone-free rate, and how it can also be performed less invasively.

Materials and Methods

Between November 2011 and July 2013, LU was performed in 19 patients with proximal ureteral stones. A history of failed SWL or sr-URS, presence of ureter stones ≥ 15 mm and/or impacted stones, or a socio-economic status not allowing the patient to reach another center for f-URS were identified as the surgical indications.

Informed consent for surgery was obtained through a written signed document from all patients. Preoperatively, in all patients, complete blood counts; renal and liver function tests; coagulation parameters; urinalysis; kidney-ureter-bladder (KUB) radiograph; and abdominopelvic unenhanced computed tomography (CT) were performed. The stone size was considered to be the longest measurement determined by KUB or CT. The part of the ureter up to the upper edge of the sacrum from the renal pelvis was considered as the proximal segment.

Surgical Technique

Oral laxative was given to all patients the day before the surgery and a rectal enema was carried out on the morning of the operation. Under general anesthesia, the patients were catheterized and placed in the

lateral decubitus position with the side of the ureteral stone facing up. Pneumoperitoneum was created by a Veress needle, which was introduced through a pararectal incision 2 cm cranial to the umbilicus. A 10 mm trocar was introduced transperitoneally and visualization was performed with a 30° lens. Two 5 mm ports were placed at angles convenient for working; one in the pararectal region, 4-5 cm cranial to the umbilicus, and one in the mid-clavicular region, 4-5 cm caudal to the umbilicus. The ureter was found following the medial dissection of the colon and incised using laparoscopic scissors through the protrusion that was created by the stone or on the location where the stone was felt by an atraumatic grasper. The stone was removed using a dissector and placed in a tissue and organ retrieval bag and kept inside the body until the end of the procedure. A JJ stent was placed in the ureter through the 5 mm port directly or with the help of a 14 F Amplatz renal dilator which was inserted through the 5 mm port. The ureteral incision was closed using a continuous suturing technique by a laparoscopic needle holder with a 3/0 polyglactin suture. The 10 mm 30° lens was removed and replaced with a 2.9 mm lens (generally used during cystoscopy) inserted from the 5 mm port located 4-5 cm cranial to the umbilicus. The retrieval bag was removed from the 10 mm port or port incision. The operation was terminated after inserting a drain through the 5 mm caudal port. In cases when a stone, totally or partially, migrated into the kidney during the operation, or when a renal stone was present simultaneously, those stones were retrieved using a basket through the more convenient 5 mm caudal port using a 9.5 F semi-rigid ureteroscope introduced into the ureter through an incision made on the ureter (Figure 1A, 1B, and 1C).

Results

Fourteen male (74%) and five female (26%) patients were enrolled in the study and the mean age was 36.4 ± 15.11 years (15-70). Eleven (58%) patients had a stone ≥ 15 mm or an impacted stone, four (21%) patients had failed SWL, and two (10.5%) had failed sr-URS. Two (10.5%) patients were operated due to their socio-economic status. The indications are summarized in Table 1. The mean stone size was calculated as 16.2 ± 3.55 mm (8-22); five (26%) stones were located on the right side and 14 (74%) on the left side.

All operations were performed via the transperitoneal approach and none of the patients were converted to open surgery. Three ports were used in 16 (84%) patients and a fourth port was inserted for retraction in three (16%) patients due to difficulty in dissection. The JJ stent was inserted in 17 (90%) patients, and was not placed in 2 (10.5%) patients. The mean operation time for LU was calculated

as 138.9±29.56 minutes (90-200). There were no intraoperative complications observed except that the stone migrated into the kidney in four (21%) patients. The mean operation time was 155±32.01 minutes (120-200) while sr-URS was performed during laparoscopic surgery. None of the patients required any blood transfusion. The mean urethral catheter and drain removal time was 31.2±24.28 hours (16-120) and 50.8±33.61 hours (18-168), respectively. The findings are summarized in Table 2.

The JJ stent was placed on the second postoperative day in one patient (5%) in whom JJ stent was not inserted during the laparoscopic surgery because of urinary leakage from the drain. The urethral and drainage catheters were removed on the 5th and 7th days, respectively, in this patient (Clavien 3B complication). Pulmonary embolism occurred in one patient (5%) on the second postoperative day. The patient was shifted immediately to a tertiary care medical center with an intensive care unit (ICU) (Clavien 4A complication). Upon recovery in the ICU, the patient returned to our center where percutaneous nephrolithotomy was performed in the contralateral kidney. There were no other postoperative complications among the other patients.

The stone located in the proximal ureter migrated into the kidney in four patients (21%) during the operation. One of the stones was

retrieved by irrigation and aspiration of serum physiologic solution. The other three stones (16%) were retrieved by sr-URS as described.

It is notable that four of the five patients (26%) also had kidney stone with ureteral stone at the same time. The kidney stones were located in the upper or mid pole calyx. These stones were removed by basket catheter without using pneumatic lithotripter as the stone size was ≤1 cm. The kidney stone that was located in the lower pole of the calyx could not be reached in one (5%) patient. The mean size of the stones that were removed from the kidney was calculated as 9 mm (8-10). There was no postoperative complication in long-term period and all ureteral stones were removed in all patients (100%). The stone-free rate was 95% in patients with kidney stone and ureteral stones. The JJ stent was placed during the operation in all patients except for the first two patients. The JJ stent was removed 2-3 weeks postoperatively under local anesthesia or sedo-analgesia. All patients were examined with KUB and/or ultrasonography at 2 months postoperatively. The mean follow-up period was 13.31±6.11 months (3-23).

Discussion

The most appropriate method in stone management should ideally be one that is least invasive and painless, having an advantage of a short convalescence period, and provide a high stone-free rate. Furthermore, it should carry the least risk to the patient. SWL and sr-URS are minimally invasive methods and, therefore, the preferred options in the management of ureteral stones. Although SWL has a high stone-free rate in the management of proximal ureteral stones smaller than 1 cm, its success rate is low for proximal ureteral stones larger than 1 cm (1). Hence, stone size is one of the main factors that can affect the success rate of SWL in this location (3). Therefore, SWL may not be a good option in the management of large impacted proximal ureteral stones because of its low stone-free and high re-intervention rate.

Semi-rigid-URS is another option that has a high success rate especially when f-URS with laser is used allowing it as a first-line

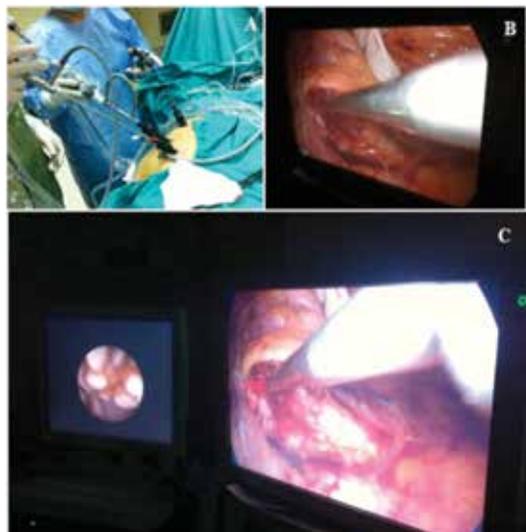


Figure 1. A: Semi-rigid ureteroscopy is placed as trans-trochar during laparoscopic surgery. B: Ureteroscope being inserted through an incision on the ureter. C: View of an intrarenal stone from the second imaging system that is connected to the ureteroscope and simultaneous intracorporeal image from the laparoscopy lens

Indications	Number of Patient (%)
>15 mm and/or impacted stone	11 (58%)
Failed SWL	4 (21%)
Failed URS	2 (10,5%)
Social Indication	2 (10,5%)

SWL: Shock wave lithotripsy, URS: Ureteroscopy

	Mean value ± Standard Deviation (minimum-maximum)
Mean Age (Year)	36.4±15.11 (15-70)
Sex (Woman/Man)	5 (26%)/14 (74%)
Side (Right/Left)	5 (26%)/14 (74%)
Number of Port	Three ports were used on 16 (84%) patients/Four ports were used on 3 (16%) patients
Mean Operation Time (minute)	138.9±29.56 (90-200)
Mean Duration of Drainage (hour)	50.8±33.61 (18-168)
Mean Duration of Urethral Catheter (hour)	31.2±24.28 (16-120)

option for ureteral stone management (4). However, the high cost remains a major disadvantage. The current literature describes the management of proximal ureteral stones using rigid or sr-URS with a pneumatic lithotripter (2,5,6) or Holmium laser (7). Very different stone-free rates have been reported (62.5-90%). To reach the stone located in the proximal ureter is sometimes not possible in a male patient with a large impacted stone due to inflammation, mucosal polyps, and ureteral kinks (8,9). In addition, additional interventions may be necessary for complete stone removal if the stone itself or larger fragments migrate to the kidney. Although sr-URS has some advantages as a minimally invasive method, its disadvantages should be considered in the management of large and impacted proximal ureteral stones.

Percutaneous nephrolithotomy may be preferred when retrograde access to the stone is not possible. Although it is an effective treatment method with a high stone-free rate, excessive bleeding may require transfusion and injury to adjacent organs and colon perforation can occur, albeit rarely (10). Karami et al. have reported that there was no difference between the antegrade approach using ultrasonography-guided PNL and LU with respect to stone-free rate and complication rate in the management of proximal ureteral stones larger than 1 cm (11). In another study, LU, PNL, and sr-URS were compared in the management of proximal ureteral stones, and PNL was found to be more favorable than the other techniques with respect to the mean operation time and blood loss. In addition, PNL was emphatically safer and more effective than the other methods (12).

According to the updated guidelines on urolithiasis, ureterolithotomy is recommended in the management of proximal ureteral stones after failed SWL and sr-URS. It is also a management option when f-URS is not available. It is performed via the open or laparoscopic approach. However, because of the known advantages of laparoscopy versus open surgery, LU is an option in a medical center where laparoscopy could be applied (13). Although LU is not the first option as it is more invasive when compared to other techniques, LU should be considered as a second option (salvage therapy) because of its high stone-free rate.

In our clinic, LU was selected as a first option in patients with a large and impacted stone or in those unable to reach advanced medical centers and as a salvage therapy option in patients in whom other techniques failed previously. We observed that the rate of patients who underwent LU as a first option was higher. We are of the opinion that this may be associated with the large mean stone size (16.2 ± 3.55 mm) and the large number of patients who were unable to reach advanced medical centers where f-URS is performed.

It is important to evaluate the patient thoroughly and consider the hospital background and own laparoscopic experience before choosing management options for urolithiasis. Because laparoscopic surgery requires an adequate skill that can be gained during training, experience with LU may be offered to surgeons as a management option for large, impacted proximal ureteral stones. In a study, SWL, sr-URS and LU were compared in the management of large proximal ureteral stones and, LU was found to associate with a longer operation and recovery time compared to the other methods. Moreover, the post-operative period was more painful with LU. However, a higher success rate was found in LU (9).

Herein, we would like to elaborate the techniques we applied in LU so as to make it less invasive and to maximize the stone-free rate. As mentioned earlier, the 10 mm lens was removed from the 10 mm port and replaced with a 2.9 mm lens from the 5 mm port towards the end of the operation. This maneuver allowed us to remove the stone from the 10 mm port or the incision of the 10 mm port. Otherwise, we would have had to extend the incision of the 5 mm port or use a second 10 mm port at the beginning of the operation. A small port incision not only reduces the incidence of complications such as port site herniation and/or bleeding, but also provides a better cosmetic result. This has been confirmed in a study that examined the relationship between the length of the port site and port site complications (14). In the literature, preferred port sizes are seen as one or two 10 mm ports and one 5 mm port in addition to the 10 mm camera port (15,16,17,18). In our technique, the operation can be completed with one 10 mm and two 5 mm ports. A 5 mm additional fourth port was needed for retraction in the first three of our cases (16%). Three ports were sufficient for the rest of the patients.

Ureteral stones, especially those located proximally, can migrate into the kidney with minimal invasive techniques (15,16,17,19,20). This has been managed by open surgery, f-URS, or PNL (15,16,17,20). We have reported an alternative approach in the present study. We considered the cost, complication rates, and the need for an additional intervention and we simultaneously used sr-URS during LU. As mentioned, a 9.5 F sr-URS was introduced from the 5 mm port that was located more caudally and the stones were removed by using basket catheter in patients with migrated stones into the kidney and/or in those with a concomitant kidney stone. We stress the fact that it is important to be careful about the location of the 5 mm port that is placed more caudally. This port should be placed according to the ureter at the beginning of the operation. We could easily access the collecting system of the kidney from the ureteral incision by sr-URS when the 5 mm port was placed 4-5 cm below the umbilicus in the mid-clavicular line. In this aspect, the upper and mid pole calyces or pelvis could easily be reached, however, it was difficult to return to the lower calyx. The pelvis of the kidney is more inferior than the lower pole calyx in the lateral decubitus position. Therefore, stone migration towards the lower pole calyx is unlikely due to gravity. Stones migrate towards the renal pelvis or upper pole calyx rather than the lower pole calyx. All migrated stones were removed from the renal pelvis in our patients.

We performed sr-URS during LU not only in patients with migrated stones but also in patients with proximal ureteral and kidney stones. The kidney stone size in four patients was 8-10 mm and these stones were removed without a need for a lithotripter. Large stone sizes require crushing and may be complicated to perform by this procedure. In that case, PNL may be a more appropriate alternative method in patients with kidney stones larger than 2 cm and a proximal ureteral stone.

We found that the mean operation time was prolonged by 17 min when the additional sr-URS procedure was performed during the operation. This is an acceptable prolonged time interval when considering the high stone-free rate.

Prolonged urinary leakage was observed in one patient in whom a JJ stent was not inserted during the operation. After this case, we

placed JJ stent in all patients. Although this is a controversial issue, in a study, the authors have suggested that JJ stent placement is not necessary except when excessive inflammation is seen or suturing is not appropriate (20). Karami et al. have reported that JJ stent placement during LU does not prolong operation time and prevents urinary leakage (21). In the present study, we did not observe urinary leakage in any patient when JJ stent placed into the ureter and suturing performed.

Conclusion

LU is a feasible alternative in a patient with failed SWL or sr-URS, or with a large and/or impacted proximal ureteral stone, and in a situation when the patient cannot reach an advanced center offering f-URS and laser surgery. In addition, LU offers a high stone-free rate with acceptable and manageable complications, and has some advantages over open surgery. Furthermore, in case of having to use sr-URS during the laparoscopic procedure, the operation time is not obviously increased. On the other hand, the stone-free rate is increased and, by allowing kidney stones to be removed simultaneously, it prevents the need for an additional procedure.

Ethics Committee Approval: Ethics committee approval was not obtained due to the study was disigned as retrospectively.

Informed Consent: All the patients gave written informed consent.

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