

# Comparison of the Clinical Results and Complications of Retroperitoneal Laparoscopic Surgery with Open Surgery in the Renal Pelvis and Ureter Stones

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## ABSTRACT

**Purpose:** The proper management of ureteral stones is essential due to the severity of symptoms and resulting kidney damage. Less invasive techniques such as ureteroscopy, shock wave lithotripsy, and percutaneous renal surgery have been proposed for the treatment of ureteral stones; however, they cannot entirely replace open surgery in patients with hard, large, prolonged, and impacted ureteral calculi. Recently, the use of laparoscopy in the treatment of ureteral stones has been considered. This study aimed to compare the clinical results and complications of retroperitoneal laparoscopic ureterolithotomy with open surgery in the renal pelvis and ureter stones.

**Materials and Methods:** In this clinical trial, 70 patients with ureter and pelvic stones referred to Imam Reza Hospital of Tabriz University of Medical Sciences were enrolled and divided into two groups (n=35 each) based on their desire. Patients in the first group underwent laparoscopic retroperitoneal surgery, and in the second group underwent open stone surgery. Age, sex, size and location of the stone, recovery, need for re-intervention, duration of surgery, and complications in both surgical methods were compared.

**Results:** Stones were successfully removed in all patients (100%) of the study groups. However, the incidence of postoperative complications in the retroperitoneal laparoscopic group was significantly lower than that of the open surgical group ( $p=0.023$ ), wherein the retroperitoneal laparoscopic group, 29 (82.9%) patients, and in the open surgical group, 17 (48.6%) patients had no complications due to surgery.

**Conclusion:** Retroperitoneal laparoscopic ureterolithotomy of the renal pelvis and ureter stones is an effective method without complications and can be used as an alternative to open surgery.

**Key words:** Ureteral stone, Pelvis stone, Retroperitoneal laparoscopy, Open surgery

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## INTRODUCTION

Urinary stones are the third most-commonly-reported problem in the urinary and genital tract after urinary tract infections and prostate diseases. Ureteral stones are more important than the stones of any other locations in the urinary system due to the severity of the symptoms and also the probability of the destruction of the kidney parenchyma [1]. Although the distal ureter stones can pass through the ureter to the bladder, it takes 2 to 3 weeks for large proximal ureteric stones (more than 10 mm) to reach the bladder and, in a worst case scenario, these stones compact and require surgical intervention [2,3].

In general, there are five therapeutic options for ureteral stones removal: extracorporeal shock-wave lithotripsy (ESWL), uteroscopic interventions, Laparoscopic nephrolithotomy (PNL), Laparoscopic ureterolithotomy (LUL) and Open Surgery (OSS) [4]. Although many ureteric stones can be easily managed by ESWL or ureteroscopy, some stones are resistant to these methods, and in developing countries, open surgical procedures are used due to their low cost and effectiveness [5].

Indications of surgical intervention for the removal of kidney stone include: Stones growth, Occlusion, Infection, Stones with severe symptoms, Stones larger than 15 mm, Preference of the patient, and Comorbidity [6]. The success rate of open surgery is as high as 97%, however, it has a more extended hospital stay and more postoperative

disability. Therefore, it is no considered as a first-line treatment option [7].

The complications and disadvantages of this method also include a large size of the incision and post-surgical pain [5].

Since the early report of Clayman *et al.*, laparoscopic surgery has been used in many urological surgeries such as interventions for ureteral stones [1]. The use of retroperitoneal laparoscopic surgery has been developed since Gaur explained the balloon dissection technique [7]. In this regard, the retroperitoneal laparoscopic technique is easy and safe and could also be used to remove ureteric stones [8]. Since the development of laparoscopic techniques in the urology field, it is carried out using transperitoneal and retroperitoneal methods [9,10].

The proper management of ureteral stones is essential due to the severity of symptoms and resulting kidney damage. Several less invasive techniques such as ureteroscopy, shock wave lithotripsy, and percutaneous renal surgery have been proposed for the treatment of ureteral stones; however, they have not been able to entirely replace open surgery in patients with hard, large, prolonged, and impacted ureteral calculi.

Laparoscopic surgery has been able to tackle these issues, and thus is used for the treatment of such ureteral stones. Based on the facts mentioned above, here, authors aimed to compare the clinical results and complications of retroperitoneal laparoscopic ureterolithotomy with open surgery in the renal pelvis and ureter stones.

## MATERIALS AND METHODS

### Study design and patients

In a randomised clinical trial (RCT), 70 patients with ureteral or renal pelvis stones who were candidates for surgery and referred to Imam Reza Educational Hospital of Tabriz University of Medical Sciences (TUOMS) were randomly selected using convenient sampling and enrolled into the study.

This study was performed between June 2016 and 2017 for one year to compare the clinical results and complications of retroperitoneal laparoscopic surgery with open surgery in the renal pelvis and ureter stones.

### Inclusion and exclusion criteria

The patients were included if they had 18 years of age or more, had a stone in the first and second upper thirds of the ureter or renal pelvis, had stone larger than 15 mm or smaller than 15 mm unresponsive to ESWL, and had written informed consent to participate in the study.

The patients were excluded if they had any prior surgery for kidney stones.

### Study method

Seventy patients with ureteral or renal pelvis stones candidate for surgery were randomly selected using convenient sampling and entered the study. Patients were then randomly divided into two equal groups based on their desire to do either of the two methods. Patients in the first group (n=35) underwent laparoscopic retroperitoneal surgery, and patients in the second group (n=35) underwent open stone surgery. Both types of surgery were performed by one urologist who was skilled in both surgical procedures. The patients were followed up after retroperitoneal laparoscopy and open surgery, during the hospitalisation and two weeks after the surgery, and the required information was recorded in the study checklist.

The study checklist included the type of surgery, age, sex, size of the stone (at its largest diameter in millimeters), the location of the stone, the rate of recovery, the need for re-intervention, postoperative complications such as bleeding, hospitalization time after surgery, the need for pain relievers, as well as the duration of the surgery. The patients were followed-up for two weeks after surgery; ultrasonography and CT scan were used to assess the outcome of stone treatment.

### Ethics

In the present study, the purpose and manner of conduction of the study were thoroughly explained to the patients. It was also stated that all of their information would be kept confidential, and their personal information would not be mentioned anywhere. This study was also approved by the Ethics Committee of TUOMS under ethics code of TBZMED.REC.1396.56.

A complete explanation about the potential benefits and complications of retroperitoneal laparoscopy (according to previous studies, the incidence of serious side effects is unlikely) was also given to the patients. Written informed consent was obtained from all of the patients.

During the study, no additional intervention was performed (except for the surgical procedure based on patient's desire). The costs of the present study were provided by the project implementer and supported by the vice chancellor of research of TUOMS, and no additional cost was received from the patients.

Finally, the study was registered at the Iranian Clinical Trials website under IRCT2013031312728N2 code.

### Statistical analysis

All statistical analyses were performed using SPSS software version 15.0. Data were expressed as mean  $\pm$  standard deviation (SD), frequency and percentage. The normal distribution of data was evaluated using Kolmogorov-Smirnov test. Chi-square test was used to compare the qualitative variables. Independent t-test or Mann Whitney U test was applied to compare the quantitative variables between the two groups. The p value less than 0.05 was considered as statistically significant.

## RESULTS

### General study characteristics

In the retroperitoneal laparoscopy group, 17 (48.6%) patients were male, and 18 patients (51.4%) were female. Also, in the open surgery group, 21 (60.0%) patients were male, and 14 (40.0%) were female. There was no significant difference in gender between the two groups ( $p=0.472$ ). Also, the mean age of patients in the retroperitoneal laparoscopic group was  $45.11 \pm 12.38$  years and in the open surgical group was  $47.22 \pm 12.10$  years. The two groups did not differ significantly in age ( $p=0.473$ ).

### Stone characteristics

The mean stone size in the retroperitoneal laparoscopic group was  $27.74 \pm 9.8$  mm. Also, the mean stone size in the open surgical group was  $31.85 \pm 10.06$  mm. There was no significant difference between the two groups in mean stone size ( $p=0.087$ ).

Twenty patients (57.1%) had a stone in the ureter (12 in the middle ureter and 8 in the upper ureter), and 15 (42.9%) patients in the renal pelvis in retroperitoneal laparoscopy group. On the other hand, in the open surgical group, 16 (45.7%) patients had a stone in the ureter, and 19 (54.3%) patients had stones in the pelvic region. There was no significant difference in the location of stone between the two groups ( $p=0.473$ ).

### Success rate

The stones were successfully removed in all patients (100%) in the retroperitoneal laparoscopic group, and none of the patients needed re-intervention. Also, in the open surgical group, the success rate was 100%, but one patient (2.8%) required re-intervention (ureteroscopy and DJ insertion) due to stenosis. There was no significant difference in the success rate in the extraction of stones ( $p=1.000$ ) and need of re-intervention ( $p=1.000$ ).

### Post-surgical complications

Twenty-nine (82.9%) patients had no post-surgical complications, 4 (11.4%) patients had postoperative cellulitis, and 2 (5.8%) patients had hematuria in the retroperitoneal laparoscopic group. In the open surgery group, 17 (48.6%) patients had no surgical complications, 7 (20.0%) patients had ileus, 5 (14.3%) patients had cellulitis, 5 (14.3%) patients had hematuria, and one (2.9%) patient experienced urine leak.

The incidence of postoperative complications in the retroperitoneal laparoscopic group was significantly lower than that of the open surgical group ( $p=0.023$ ) (Table 1 and Table 2).

No significant side effects were observed in any of the two groups, and all complications observed after surgery

were improved by supportive measures during admission.

**Table 1: Comparison of complications after ureteral stones surgery in the two study groups, (The incidence of postoperative complications in the retroperitoneal laparoscopic group was significantly lower than that of the open surgical group,  $p=0.023$ )**

Complication   Group	Retroperitoneal laparoscopic (n=20)	Open surgery (n=16)
None	18 (90.0%)	11 (68.8%)
Hematuria	1 (5.0%)	0 (0.0%)
Cellulitis	1 (5.0%)	3 (18.8%)
Ileus	0 (0.0%)	2 (12.5%)

**Table 2: Comparison of complications after renal pelvis stones surgery in the two study groups, (The incidence of postoperative complications in the retroperitoneal laparoscopic group was significantly lower than that of the open surgical group,  $p=0.023$ )**

Complication   Group	Retroperitoneal laparoscopic (n=15)	Open surgery (n=19)
None	11 (73.3%)	6 (31.6%)
Cellulitis	3 (20.0%)	2 (10.5%)
Ileus	0 (0.0%)	5 (26.3%)
Hematuria	1 (6.7%)	5 (26.3%)
Urine leak	0 (0.0%)	1 (2.9%)

### Duration of surgery and admission and need for analgesics

The duration of surgery as well as admission, and also the need for analgesics after surgery were significantly lower in the retroperitoneal laparoscopic group compared to the open surgery group ( $p=0.001$ ) (Table 3).

**Table 3: Comparison duration of surgery and admission, and the need for analgesics after surgery in the two groups**

Variables   Group	Retroperitoneal laparoscopic	Open surgery	p-value
Duration of surgery (min)	$119.4 \pm 34.4$	$160.5 \pm 40.2$	$p=0.001$
Duration of admission (day)	$3.0 \pm 0.7$	$5.2 \pm 1.5$	$p=0.001$
Need for analgesics	14 (40.0%)	35 (100%)	$p=0.001$

## DISCUSSION

Stone formation is influenced by various factors such as age, sex, and geography of the residence place. Men are more prone to stone formation than women (3:1). The prevalence of urinary stones increases with age and its highest incidence is in the 4<sup>th</sup> and 5<sup>th</sup> decades of life [11]. Several treatments have been proposed for ureteral stones over the last few years, which include: (1) intracorporeal and extracorporeal lithotripsy (2) Percutaneous lithotripsy [8], (3) Laparoscopy which is performed in two ways: transperitoneal and retroperitoneal, and (4) Open surgery [4]. It has been shown that both of the laparoscopic methods are effective in the management of large impacted stones.

However, in the transperitoneal method, the time needed for oral intake is longer [12].

To the best of our knowledge, this is the first clinical trial in our region that aimed to evaluate and compare the clinical results and complications of “retroperitoneal” laparoscopic surgery with open surgery in the renal pelvis and a ureter stone, as this method is less invasive and its use is gaining unprecedented attention. Based on the results of this study, the success rate in retroperitoneal laparoscopic surgery was 100% and was similar to that of open surgery. Also, the incidence of adverse events, duration of surgery and hospitalisation, and the need for postoperative painkillers was significantly lower in the retroperitoneal laparoscopic group compared with the open surgical group.

In line with that, Shah *et al.* carried out a study to investigate retroperitoneal laparoscopy. In this study, 56 laparoscopic ureterolithotomy operations were performed in 54 patients. Of these 56 stones, 34 were in the upper, 18 were in the middle, and four were in the lower one-third of the ureter. The results showed that the procedure failed only in two patients without leaving any major complications. The average hospital stay was 2 to 4 days. During the three-month period of follow up, intravenous urogram (IVU) showed normal ureter in all patients [13].

Similarly, Sharma *et al.* also evaluated the outcomes of retroperitoneal laparoscopic ureterolithotomy in 20 patients with single and large stone (greater than 8 mm or large impact). This study showed that retroperitoneal laparoscopic ureterolithotomy accompanies with lesser postoperative pain as well as morbidity and a quick return to work. It also has no major complication during or after surgery [14].

In another study, Zhong *et al.* performed retroperitoneal laparoscopic ureterolithotomy in 39 patients (23 males and 16 females) with stone sizes ranging between 10 mm and 25 mm. The study found that, compared to open surgery, laparoscopy has a lower traumatic injury rate as well as postoperative discomfort and thus, can replace open surgery [15].

Ge *et al.* performed ten retroperitoneal and two transperitoneal laparoscopic ureterolithotomy. The average size of the stone was 18.5 mm located in the upper ureter. No complications after surgery were reported, except that there was a urine leakage in a patient within 24 hours of surgery. Similarly, the authors concluded that this procedure is a minimally invasive and safe method for removal of impacted upper ureter stones [16].

In a study by Qadri *et al.*, the outcomes of retroperitoneal laparoscopic ureterolithotomy were assessed over a period of ten years. In this study, 820 patients with ureteral stones were studied, and 126 patients underwent retroperitoneal laparoscopy. The most common indications were the large and impacted stones of the upper and middle ureter and uteroscopic failure. The mean time of laparoscopic retroperitoneal surgery

was 88 minutes with a success rate of 97.6%. The most common complication was peritonotomy in 11.9% of patients. The average hospital stay was 2.8 days, and prolonged urine leakage was observed in 2.38% of patients [17]. In line with that, in the present study, the mean duration of retroperitoneal laparoscopic surgery was 119 minutes, and the median duration of hospitalisation was three days. However, no long-term urine leakage was observed in any of the patients.

In conclusion, according to the results of this study, and also based on the most studies conducted in this field, laparoscopic retroperitoneal ureterolithotomy is an effective and safe method for removal of renal pelvis and ureter stones, and this method can be used as an alternative to open surgical procedures, reducing the complications of surgery, duration of admission and surgery. Some differences observed in this regard are due to the differences in study as well as sample selection method, and the variables studied. Due to the clinical significance of this issue and the lack of definitive findings in medical reference books, further studies in this field are necessary for better decision making.

## CONCLUSION

In this study, the clinical results and complications of retroperitoneal laparoscopic ureterolithotomy with open surgery in the renal pelvis and ureter stones was compared. In this clinical trial, 70 patients with ureter and pelvic stones were enrolled and divided into two groups (n=35 each) based on their desire. Patients in the first group underwent laparoscopic retroperitoneal surgery, and in the second group underwent open stone surgery. Age, sex, size and location of the stone, recovery, need for re-intervention, duration of surgery, and complications in both surgical methods were compared. It was confirmed that retroperitoneal laparoscopic ureterolithotomy of the renal pelvis and ureter stones is an effective method without complications. Therefore, it can be used as an alternative to open surgery.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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