Comparison of laparoscopic pyelolithotomy and retrograde intrarenal surgery in the management of large renal pelvic stone

Mehmet Cagatay Cicek (cgtycicek@gmail.com)
Uludag Universitesi Tip Fakultesi https://orcid.org/0000-0002-0471-5404
Tariq Asi
Hacettepe Universitesi Tip Fakultesi
Kadir Omur Gunseren
Uludag Universitesi Tip Fakultesi
Hakan Kilicarslan
Uludag Universitesi Tip Fakultesi

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Abstract

Background To compare the clinical outcomes of laparoscopic pyelolithotomy (LP) and retrograde intrarenal surgery (RIRS) in the management of large renal pelvic stones.

Methods This study included patients who presented with a single renal pelvic stone sized ≥20 mm and who were treated primarily by laparoscopic pyelolithotomy or retrograde intrarenal surgery. The patients were grouped based on the surgical procedure they underwent. We retrospectively examined and compared the age, the longest axis and the surface area of the stone, operation time, hospitalization time, complications and stone-free rates of the two groups.

Results Of the 156 patients included in the study, 44 had laparoscopic pyelolithotomy, and 112 had retrograde intrarenal surgery. Patients who received laparoscopic pyelolithotomy (13 males, 31 females) had a median age of 54 (18-79) years, while those who underwent retrograde intrarenal surgery (46 males, 66 females) had a median age of 54.5 (18-79).

Patients who received laparoscopic pyelolithotomy were found to have larger median stone size (30 mm vs 24 mm, p=0.003), longer operation time (100 minutes vs 70 minutes, p=0.007), lower complication rate (2% vs 8.9%, p=0.063), longer median hospital stay (3 days vs 1 day, p<0.001) and better stone-free rate at the third month (90.9% vs 67.9%, p<0.001).

Conclusion LP is a safe and efficient procedure that could be used as an alternative to retrograde intrarenal surgery in managing large renal pelvic stones.

Background

The technological advances in surgical techniques and the miniaturization of equipment have changed the management of large kidney stones in the last decades. Today, the management of these kidney stones depends largely on percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS) and shock wave lithotripsy (SWL), with PCNL being considered the first line treatment due to its high stone clearance rate [1]. Although, PCNL also accompanies higher complication rates [2].

Recent studies have shown RIRS to be a possible alternative to PCNL for kidney stones sized ≥ 20 mm. While RIRS offers lower morbidity at the cost of lower stone clearance, the latter can be increased with a second session [3].

Another possible alternative for the management of large kidney stones is laparoscopic pyelolithotomy (LP), which has not gained much popularity despite its early introduction. The reason was that it had a steep learning curve compared to the well-described PCNL [4]. Therefore, European clinical guidelines suggest the use of LP when other options have failed [1]. However, many studies have revealed LP to be as efficient as PCNL and to have lower complications in the treatment of single or multiple large kidney stones [5].

In the present study, we compared the outcomes of LP and RIRS in the treatment of single renal pelvic stones sized ≥ 2 cm. Our hypothesis was that LP could achieve higher stone-free rates and lower complications compared to RIRS.

Methods

After receiving approval from the ethics committee (2011-KAEK-26/64), patients who underwent RIRS or LP between August 2008 and July 2019 due to a single renal pelvic stone ≥ 2 cm and who were followed-up for at least 3 months were included in the study. The patients were divided into two groups based on whether they received RIRS (the RIRS group) or LP (the LP group).

We retrospectively collected and examined patients' demographic and clinical data, including age, the size and surface area of the stone, operation time, hospitalization time, complications and stone-free rates. Non-contrast computerized tomography was used to measure the stone size, and the formula of "Length x Width x 0.25 x pi" was used to calculate the stone surface area. Urinary tract radiography and ultrasonography were used to evaluate residual fragments three months after operation. Patients with residual fragments < 4 mm were considered stone-free.

Surgical Technique

Both surgical methods were performed under general anesthesia and by two surgeons with expertise in their respective procedures.

In the RIRS group, two hydrophilic guidewires were inserted into the ureter under fluoroscopy using 7.5f semi rigid ureterorenoscope in lithotomy position. Flexible ureterorenoscope (FURS) was pushed forward up to the stone over one of the guidewires, while the other guidewire was used for safety. Laser lithotripsy was done with dusting technique using a 273 μ holmium YAG laser fiber. At the end of surgery, a double j stent was placed into the ureter, and small stone fragments were left for spontaneous passage.

In the LP group, a transperitoneal approach was used in full lateral decubitus position. After establishing pneumoperitoneum with a Veres needle, three 10 mm and one 5 mm trocar were used in both approaches. After exposing the renal pelvis, a longitudinal pyelolithotomy was made using a laparoscopic scalpel or scissors. The stone was extracted with a laparoscopic grasper. After inserting a double j stent, the pyelolithotomy incision was closed with a 4/0 polyglactin suture. In both groups, ureteral double j stents were removed 4–6 weeks after surgery.

All statistical analyses were done using SPSS version 22 (Statistical Package for Social Sciences for Windows 22; SPSS Inc., Chicago, IL, USA). Median values were compared using the Median test. Categorical variables were compared using Chi-squared test and Fisher's exact test. Minimal statistical significance was defined as p values ≤ 0.05.

Results

Of the 156 patients included in the study, 112 were treated with RIRS, and 44 were treated with LP. Table 1 shows the clinical and demographic characteristics of both groups. In all patients, the median stone longest axis and surface area were 27 mm (20–50) and 2.68 cm^2 (0.52–19.7), respectively. Failed cases were given either SWL or RIRS depending on the size and location of residual fragments.

Table 1
Clinical and demographical data of both groups.

Parameter*	RIRS Group (n:112)	LP Group (n:44)	p
Age, year	54 (18–79)	54.5 (18–79)	0,580 m
Gender, Male/Female	66/46	31/13	0.182
Stone size, longest axis mm	24 (20–45)	30 (20–50)	**0,003** m
Stone surface area, cm^2	2.25 (0.52-17,4)	3.16 (0.54–19.7)	**0,021** m
Operation time, minute	70 (30–120)	100 (35–175)	**0,007** m
Hospitalization time, day	1 (1–2)	3 (2–17)	**0,000** m
Stone free rate (3rd month) (n) (%)	76 (67,9%)	40 (90.9%)	**0,000** f
Complications (n) (%)	10 (8,9%)	1 (2%)	0,063 f
RIRS: Retrograde Intra-renal Surgery, LP: Laparoscopic Pyelolithotomy.			
*: continuous variables are given in median (min-max).			
m: Median test			
f: Fisher's exact test			

10.7% (12/112) of the RIRS group and 9.1% (4/44) of the LP group had a history of ipsilateral renal stone surgery (2 RIRS, 2 open pyelolithotomy, 5 PCNL and 3 shock wave lithotripsy in the RIRS group; 2 open pyelolithotomy and 2 RIRS in the LP group). One patient had urinary leakage after LP and was managed conservatively. Ten patients in the RIRS group had complications: three had postoperative fever without documented infection source and were managed conservatively, five had pyelonephritis and were managed with empiric broad spectrum antibiotics, and two had obstruction due to Steinstrasse and were managed with ureterorenoscopy and double j stent replacement.

Discussion

PCNL has very high stone-free rates that reach up to 95% and is thus considered the first line of treatment for large kidney stones [1]. Although, PCNL still has considerable complication rates due to its invasive nature [6]. In addition, the effect of using a percutaneous approach on renal function has not been fully studied and defined [7, 8]. While miniaturized PCNL techniques can decrease complication rates, this comes with a decrease in stone-free rate [9, 10].

The technological advances in flexible ureterorenoscopy have led to the miniaturization of equipment, superior vision and improved deflective capability [11], which enhanced the effectiveness of retrograde intrarenal surgery in managing a wider range of renal stones. A metanalysis on nine retrospective non-comparative studies including over 400 patients reported a stone-free rate between 77%-96% with a mean number of procedures of 1.6, a mean operation time of 82 (range 28–215) minutes and a complication rate of up to 10%. In the study, Steinstrasse, pyelonephritis and subcapsular hematoma were the major complications reported. The metanalysis also showed decreased stone-free rates and increased complication rates in larger stone sizes [12]. These results encouraged various centers to carry out randomized studies where they compared RIRS and PCNL in the management of large renal stones. They reported a lower stone-free rate of 73% after the first session of RIRS and lower complication rates, operation time and hospital stay, similar to our study [3, 13].

Although it was introduced quite early, the LP method did not gain much popularity due to its steep learning curve compared to the well-described PCNL [4]. Hence, the use of LP has only been reported in cases with renal anomaly or cases accompanying ureteropelvic obstruction without clear criteria or consensus [14]. However, recent studies have reported LP to have higher stone-free rates, lower bleeding and longer operation times and hospital stay compared to PCNL in the management of large and complex kidney stones [5, 15, 16]. In the current study, our stone-free rates and complication rates in LP were similar to the literature, with no conversions to open surgery. We associated this result with the good selection of patients and the high experience of our center in laparoscopic surgery. Moreover, LP achieved higher stone-free rates than RIRS despite the larger stone burden in the LP group.

Other than better clinical outcomes, LP may also have additional advantages over RIRS and PCNL. Firstly, in LP, the entire stone is extracted, unlike RIRS, where the stone is broken down into very small fragments and left for spontaneous passage, which may lead to Steinstrasse and urinary tract infections after surgery [17]. Another advantage of LP is not using fluoroscopy, as it constitutes a potential risk for genetic mutation and malignancy for both the patients and the physician's [18]. While some studies have reported the use of fluoroscopy-free RIRS, this may not be available in all centers or applicable for all patients [19]. Finally, with the reported negative effect of economic downturn on various surgical procedures, the high cost and short lifespan of the basic equipment used in RIRS (laser lithotripter and FURS) constitute major obstacles for its widespread use and availability [20, 21]. On the other hand, the main limitation of LP is its steep learning curve and requirement of great experience [22]. Another limitation is its possible side effects and complications after surgery. One of these complications is urinary leakage, with a reported incidence of 0–12%, similar to the prolonged urine leakage reported for PCNL [23]. Another possible complication in LP is bleeding, although at lower rates than PCNL. In our

study, urinary leakage was observed only in one patient (2%), while bleeding was not reported in any patient. We associated this with the fact that the procedures were carried out by a surgeon with great expertise.

Our study had some limitations, the main one being its retrospective and comparative nature. In addition, we could not provide any information on the differences between the two groups in terms of postoperative pain management. Still, this study represents the first series that compares LP and RIRS in English literature. Our study revealed that LP had higher stone-free rates and lower complication rates after a single session compared to RIRS in the management of kidney stones sized ≥ 2 cm. The study also showed LP to achieve a combination of the high stone-free rates of PCNL and the low complication rates of RIRS within experienced hands. Further large-scale, prospective, randomized and controlled trials are needed to confirm these results.

Conclusion

LP is a safe and efficient procedure that can be used as an alternative to RIRS in managing large renal pelvic stones.

List Of Abbreviations

LP: Laparoscopic pyelolithotomy

RIRS: Retrograde intrarenal surgery

PCNL: Percutaneous nephrolithotomy

SWL: Shock wave lithotripsy

FURS: Flexible ureterorenoscope

Declarations

Ethics approval: Uludag University local ethics committee 2011-KAEK-26/64

Consent for publication: Not applicable

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Authors' contributions:

MCC has contribution on study design, data collection and writing the manuscript

TA has contribution on statistics and writing the manuscript

KOG has contribution on study design, data collection and statistics

HK has contribution on study design and writing the manuscript

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