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Laparoscopic Ureterolithotomy: A Comparison Between the Transperitoneal and the Retroperitoneal Approach During the Learning Curve

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Abstract

Purpose: To compare the transperitoneal approach and the retroperitoneal approach in the laparoscopic management of ureteral stones, at two different urologic centers during the learning curve period.
Materials and Methods: We prospectively evaluated 35 consecutive laparoscopic ureterolithotomies performed by two different urologists during their learning curve period in laparoscopy. Each surgeon used a different approach: Transperitoneal (group A) and retroperitoneal (group B). Timing for patients' positioning, trocar placement, ureter isolation, stone extraction, and suturing were recorded to compare the transperitoneal with the retroperitoneal method. Intraoperative complications and perioperative morbidity were also reported.
Results: Eighteen procedures were performed using the transperitoneal method (group A) and 17 using the retroperitoneal method (group B). Significant differences between group A and B were observed in terms of time for access to the operating field (mean times 14 and 24 min, respectively, $P = < 0.001$); time for suturing the ureter (mean times 16 and 28 min, respectively, $P = < 0.001$); and total operative time (mean times 75 and 102 min, respectively, $P = 0.002$). No statistical differences were observed for any other parameters. Blood loss was minimal in all cases (mean losses 50 and 45 mL, respectively, $P = 0.852$); and hemotransfusion was not needed by either group. At the 12-month follow-up, no cases of ureteral stricture were recorded.
Conclusions: We suggest that urologists in training for laparoscopy perform laparoscopic ureterolithotomy using a transperitoneal route. In expert hands, both transperitoneal and retroperitoneal approaches are feasible, and the choice depends on personal preference.

Introduction

Despite the development of shockwave lithotripsy (SWL) and improved endourologic techniques, there are still some indications for open surgery for the management of ureteral calculi.[1] Laparoscopic ureterolithotomy has been proposed as an alternative to open surgery for the management of large and impacted proximal ureteral stones or when first-line treatments have failed.[2] The laparoscopic approach has advantages over open surgery with respect to aspects such as analgesia, hospitalization, recovery, and cosmesis.[3] Although similar results are reported in the literature, details of laparoscopic technique differ, depending on the author. Both transperitoneal and retroperitoneal access to the ureter have been reported, with neither approach having a clear advantage over the other.[2–5]

Acquisition of dexterity in laparoscopic surgery requires specific training. European Association of Urology (EAU) guidelines affirm that 50 laparoscopic procedures are necessary before a plateau in the incidence of complications occurs.[6] Laparoscopic ureterolithotomy is classified as a slightly/fairly difficult procedure, according to the EAU scoring system on laparoscopic operation.[6] The combination of dissection and suturing techniques make laparoscopic ureterolithotomy an ideal procedure in the learning curve period.

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The objective of this study is to compare the results of the transperitoneal approach to that of the retroperitoneal approach for the laparoscopic management of ureteral stones at two different urologic centers during the learning curve period.

Materials and Methods

A special training program was developed to allow the surgeons operating in two different hospitals to acquire comparable laparoscopic surgical skills. This program consisted of a parallel schedule made of laparoscopic procedures (from easy to fairly difficult), such as renal cyst ablation, renal biopsy, simple nephrectomy, varicocele ligation, and ureterolithotomy, which had to be performed within a period of 2 years. Moreover, both surgeons performed a timed list of exercises at the pelvic trainer before and after the training program to assess their basic laparoscopic skills and the improvement achieved.

Between 2004 and 2006, we prospectively evaluated 35 consecutive laparoscopic ureterolithotomies performed in two different centers by two urologists (PB and SM) during their learning curve in laparoscopy. In this study, each surgeon used a different approach according to personal preference: Transperitoneal (PB, group A) and retroperitoneal (SM. group B). Indications for the procedure were: Large (>10 mm) and impacted proximal ureteral calculi that did not respond to SWL or were not manageable by ureteroscopy.

The procedure was divided into various steps: Patient positioning, trocar placement and access to the operating field, ureter isolation, ureterotomy and stone extraction, and ureteral suturing. The times for single step and total time of the procedure have been recorded to assess differences between the transperitoneal and retroperitoneal approaches. Intraoperative complications and perioperative morbidity were also recorded. Ultrasonography, CT, and/or intravenous urography were performed preoperatively to evaluate the urinary tract.

All patients who experienced severe hydronephrosis or pyonephrosis, fever, septic status, acute renal impairment, or pain that did not respond to drugs received preoperative drainage of the urinary tract with a Double-J stent or nephrostomy tube.

Technique

The patient is placed in the supine position, and general anesthesia is induced. Tracheal intubation is performed, and a nasogastric or orogastric tube is inserted to decompress the stomach. A Foley catheter is inserted to drain the bladder. Patient placement and trocar position are related to the access chosen.

Retroperitoneal access

The patient is secured in a standard flank position with the table flexed; a rolled towel is placed between the operating table and the patient to maximize the space between the 12th rib and the iliac crest (lumbar triangle). A 12-mm incision is made within this area on the midaxillary line, and a laparoscopic visual trocar (Visiport; Autosuture, US Surgical Corporation, Norwalk, CT) is advanced directly into the retroperitoneum. Insufflation with CO_2 at 15 mm Hg is then instituted. The laparoscope is then used to bluntly dissect the retroperitoneal space and separate the lateral peritoneum from the anterior abdominal wall. Once the space has been created, 12-mm and 5-mm ports are placed at the posterior and anterior axillary line, respectively. A 0-degree lens is used.

Transperitoneal access

With the exception of the first patient in whom we used a Veress needle and an optical trocar to access the abdominal cavity, the first laparoscopic 10-mm port is placed by open umbilical access. Through this trocars, the abdomen is insufflated with CO_2 to 15 mm Hg, with the patient fully relaxed. A 30-degree laparoscope is then inserted, and two operating 10-mm trocars are placed on the midline, 10 cm above and below the umbilicus, respectively. The colon is reflected medially, and the ureter is exposed.

In both approaches, the ureter is located, dissected, and traced to the stone, which is identifiable by a bulge. Before the ureterotomy, a delicate grasper or a vessel-loop is positioned surrounding the ureter cranially to the stone to avoid the stone slipping into the kidney. The ureter is opened over the stone using an electrical cutting-mode hook, starting from the largest bulge of the stone to further upward to 5 to 10 mm beyond the upper part of the stone. The stone is extracted by leverage or by angling the ureter with the assistance of a laparoscopic shear and grasper. The stone is then placed in a glove finger for later extraction.

The ureteral incision is closed by 3 or 4 interrupted intracorporeal laparoscopic sutures. No urinary drainage (ureteral stent or nephrostomy tube) is inserted, except in those patients with preoperative indication. Drainage is left in place retroperitoneally only in the case of a difficult suture of the ureter or slight bleeding of the periureteral tissue. Trocars are removed under vision after closure of the fascia in the case of transperitoneal access. The operating field is deflated, and wounds are sutured.

Statistical analysis

The chi-square test or the Fisher exact test has been used to compare percentages between the two groups. Medians were compared using the nonparametric two-sample median test. All analyses were performed with the SAS software (SAS Institute, Cary, NC). All tests were two sided.

Results

During the laparoscopic training program, a comparable amount of total procedures (82 cases PB; 71 cases SM) were performed in both centers, and no statistical differences were measured between the two surgeons at the pelvic training exercises before and after the learning curve.

Preoperative data

No statistically significant differences were observed between groups A and B for preoperatively considered characteristics: Age, body mass index (BMI), related pathologies, and preoperative urinary drainage.

Only one patient in group A had undergone previous abdominal surgery (laparoscopic cholecystectomy compli-

Table 1. Preoperative Patient Characteristics

Variable	*Comparison*	*Trans (total 18)*	*Retro (total 17)*	P *value*
Age	Median (range)	42 (25–60)	40 (28–61)	0.603
Related pathologies	% None	83	71	0.443
BMI	Median (range)	22.3 (20.6–35.7)	21.6 (20.2–31.8)	0.617
Stone (mm)	Median (range)	23 (15–45)	20 (13–35)	0.228
Preoperative urinary drainage	Number (%)	5 (28)	6 (35)	–

Trans = transperitoneal; retro = retroperitoneal; BMI = body mass index.

cated by an abdominal hematoma). No patients in group B had undergone previous abdominal surgery. Two patients in group A and 1 patient in group B had a BMI higher than 30.

Preoperative drainage of the urinary tract was performed on 11 patients, for severe hydronephrosis or pyonephrosis, fever, septic status, acute renal impairment, or pain that did not respond to drugs: Five patients in group A (three Double-J stent and two nephrostomy) and six patients in group B (three Double-J stent and three nephrostomy). Table 1 summarizes the preoperative characteristics of the patients.

Perioperative data

Mean total operative time was 75 minutes (median 68 min; range 48–130 min) for group A and 102 minutes (mean 103 min; range 69–147 min) for group B, respectively ($P = 0.002$). Time for access to the operating field was significantly shorter ($P < 0.001$) in group A (median 12 min; range 7–40 min) compared with group B (median 22 min; range 15–35 min).

Time for suturing was also statistically different between the two procedures, with a mean of 16 minutes (median 14 min; range 10–30 min) for group A and 28 minutes (median 30 min; range 14–40 min) for group B ($P < 0.001$).

No statistically significant differences were noted in terms of time for patient positioning, ureter isolation, ureterotomy, and stone extraction. The stone was removed intact in all cases. One patient in group A (second case) was converted because of a lesion of the inferior cava vein during positioning of the first optical trocar (Visiport; Autosuture, US Surgical Corporation, Norwalk, CT); the lesion was sutured by an open access, and the intraoperative complication was resolved. Ten (59%) patients in group B had a peritoneal tear that caused difficulties in establishing an adequate working retroperitoneal space. No major intraoperative complications were observed in group B. Blood loss was minimal in all cases, and no hemotrasfusion was necessary in either group. Table 2 summarizes the operative data of the two groups.

Postoperative data

In group A, the following complications were observed: Fever (six cases); wound hematoma (two cases); ileus (one case); and persistent hydronephrosis (1 case necessitating nephrostomy tube positioning on postoperative day 3). In group B, the clinical complications included: Fever (seven cases); wound hematoma (two cases), and retroperitoneal hematoma (one case). In that case, 1 day after the ureteral stent was removed postoperative day 21, fever and flank pain developed; the CT scan showed a retroperitoneal hematoma that was causing severe hydronephrosis. A nephrostomy tube was positioned and removed at the time of resolution of the hematoma.

Ureteral stents were removed 30 days after the operation. Nephrostomy tubes were removed after a normal passage of contrast medium in the bladder was observed during descendant urography. No complications occurred after the removal of the ureteral stent or nephrostomy tube.

The mean time of hospitalization was comparable for both groups, with a mean of 4 (range 2–7) and 5 (range 2–10) days for groups A and B, respectively ($P = 0.173$). A shorter drainage time was observed for group A but with no real clinical relevance. Table 3 summarizes all the postoperative data.

At 12 months of follow-up, no cases of ureteral stricture were recorded.

Discussion

Feasibility and advantages of laparoscopic ureterolithotomy over open surgery with both transperitoneal and retroperitoneal approaches have been demonstrated.[7–9] This article is a prospective study that analyzes two groups of patients who underwent transperitoneal (group A) or retroperitoneal (group B) laparoscopic ureterolithotomy for large and impacted proximal ureteral stones by two different urologists during their learning curve in laparoscopy. The surgeons

Table 2. Operative Data

Variable	*Comparison*	*Trans (total 18)*	*Retro (total 17)*	P *value*
Patient positioning (min)	Median (range)	20 (10–30)	21 (10–30)	0.412
Access (min)	Median (range)	12 (7–40)	22 (15–35)	< 0.001
Ureter isolation (min)	Median (range)	33 (20–60)	35 (22–70)	0.865
Stone removal (min)	Median (range)	10 (5–25)	15 (8–25)	0.137
Suture (min)	Median (range)	14 (10–30)	30 (15–40)	< 0.001
Total time (min)	Median (range)	68 (48–130)	103 (69–147)	0.002
Blood loss (mL)	Median (range)	50 (35–80)	45 (35–85)	0.852
Major complications (N)	–	1	0	–

Trans = transperitoneal; retro = retroperitoneal; min = minutes; N = number.

Table 3. Postoperative Data

Variable	*Comparison*	*Trans (total 18)*	*Retro (total 17)*	P *value*
Hospital stay (days)	Median (range)	4 (2–7)	5 (2–10)	0.173
Drainage (days)	Median (range)	1 (0–5)	3 (0–9)	0.026
Fever	Number (%)	6 (33)	7 (41)	–
Wound hematoma	Number (%)	2 (11)	2 (12)	–
Ileus	Number (%)	1 (5)	–	–
Persistent hydronephrosis	Number (%)	1 (5)	–	–
Retroperitoneal hematoma	Number (%)	–	1 (6)	–
Overall postoperative complications	% None	50	47	0.862

Trans = transperitoneal; retro = retroperitoneal.

were part of a training program in laparoscopy, starting from any experience as first operator for the transperitoneal or retroperitoneal approach. They previously completed a well-established pelvic training program and subsequently participated to a number of laparoscopic procedures as assistant surgeon. Moreover, in this training program, laparoscopic ureterolithotomy represented the first operation with a potential choice of a retroperitoneal access by the surgeon.

The two groups were comparable in terms of patient characteristics. In our study, total operative time, time for access to the operating field, and time for suturing the ureter were significantly shorter in the transperitoneal procedures ($P < 0.001$). This can be easily explained: The transperitoneal route needs only the trocar insertion to access the operating field, while in retroperitoneal access, once the first optical trocar has been inserted in the retroperitoneum, a blunt dissection with the laparoscope is needed to gain an adequate working space. This maneuver, especially during the learning curve, may lead to a tear of the peritoneum with a bulging of the bowel that causes a reduction of the retroperitoneal space. Only after the creation of an adequate retroperitoneal space may accessory trocars be safely positioned.

In a series of 55 retroperitoneoscopic ureterolithotomies, Goel and associates[10] reported two cases of conversion to open surgery caused by peritoneal tear. This complication may be managed by placing a retractor over the peritoneum and placing a Veress needle in the abdomen to reduce the peritoneal pressure, or by enlarging the peritoneal tear to equalize the pressure; in all those cases, the potential advantages of the retroperitoneal approaches will be lost. In the same retroperitoneoscopic series, Goel and colleagues[10] reported 10 cases of conversion to open surgery that occurred in an early phase of the learning curve. A similar experience was reported by Jeong and coworkers[11] in a series of 12 retroperitoneoscopic ureterolithotomies, with a 50% rate of conversion to open surgery.

Although no conversion to open surgery was required in group B (retroperitoneal access), we experienced 10 cases of peritoneal tearing, causing a statistically significant prolonged operative time. We believe that the high conversion rate reported in the literature reflects the need for training and surgical experience, and the inherent difficulties in the retroperitoneal approach are because of the limited working space and the absence of clear anatomic landmarks.

A balloon dissection technique may be used to facilitate the creation of the retroperitoneal space.[9] Although Gaur and associates[9] did not report complications related to the balloon technique, potential complications have been described.[12]

In reference to the time for ureteral suture, 90 degrees is the desirable angle for laparoscopic knotting. While this is easily established using the transperitoneal approach, with all operative trocars on the midline, the smaller retroperitoneal space does not always allow a good angle for the person holding the needle, leading to difficulties in ureteral suturing that are amplified during the learning curve. Although the suturing time is statistically significantly shorter in the transperitoneal procedures, it may be considered acceptable for both groups, given the difficulties of the retroperitoneal procedure.

One major intraoperative complication was observed in our series (group A). That patient, who underwent a transperitoneal procedure, had previous abdominal surgery (laparoscopic cholecystectomy complicated by subhepatic hematoma). An optical trocar was used to access the intraperitoneal space, and an inferior cava vein injury was recognized at the end of the procedure during desufflation, because of minor bleeding from the retroperitoneum. The procedure was promptly converted to open surgery, considering our initial experience with laparoscopic suture at that time. After that procedure, the optical trocar was no longer used, and we preferred open umbilical access during a transperitoneal procedure. Although not observed in group B, a major vascular injury is possible with retroperitoneal access.[8]

Should urinary drainage be insured after a laparoscopic ureterolithotomy? This is still an open question. In our series, a nephrostomy tube or a Double-J ureteral stent was put in place before the operation in complicated cases, such as patients with acute renal impairment, severe hydronephrosis or pyonephrosis, fever or septic status, and pain that did not respond to drugs. Those patients did not present any complications after the procedure.

On the contrary, two cases of persistent postoperative hydronephrosis (one each in groups A and B) occurred in patients with no preoperative urinary drainage. One patient presented a severe ureteral kinking just below the calculus with mild hydronephrosis. An attempt to place a ureteral stent immediately before the operation failed. A postoperative retroperitoneal hematoma developed in a second patient that caused an extrinsic ureteral compression (group B). Our experience suggests that a ureteral Double-J stent or a nephrostomy tube is recommended in uncomplicated cases only when an abnormal anatomy on CT scan or urography is found, suggesting potentially difficult urinary drainage. Moreover, urinary drainage is advisable in case of a non-completely watertight suture or in case of inflamed ureteral mucosa.

The major drawback of our study is the lack of randomization. Considering the relatively small number of cases with an indication for laparoscopic ureterolithotomy, it was not possible to perform a randomized study. Another bias could be that two different surgeons performed the operations. Our intention was not to establish what approach, transperitoneal or retroperitoneal, is the gold standard for the management of ureteral calculi, but rather to suggest which is preferable during the learning curve. To evaluate this, two surgeons with basic laparoscopic experience were enrolled in a training program that was designed to obtain comparable results. In a period of 2 years, both surgeons performed more than 70 laparoscopic urologic procedures, and no differences between them were found at the pelvic trainer exercises before and after the training program.

Conclusion

Laparoscopic ureterolithotomy is a feasible and safe procedure to be considered by the urologist during training in laparoscopy. We firmly believe that, in expert hands, both transperitoneal and retroperitoneal approaches are feasible, and the choice depends on personal preference.

We would suggest that urologists in training for laparoscopy should perform laparoscopic ureterolithotomy using a transperitoneal route. Other approaches are recommended once the urologist achieves a good level of skill in laparoscopy.

Disclosure Statement

No competing financial interests exist.

References

1. Muslumanoglu AY, Karadag MA, Tefekli AH, Altunrende F, Tak A, Berberoglu Y. When is open ureterolithotomy indicated for the treatment of ureteral stones? Int J Urol 2006;13:1385–1388.
2. Gill IS, Clayman RV, McDougall EM. Advances in urological laparoscopy. J Urol 1995;154:1275–1294.
3. El-Feel A, Abouel-Fettouh H, Abdel-Hakim AM. Laparoscopic transperitoneal ureterolithotomy. J Endourol 2007; 21:50–54.
4. Feyaerts A, Rietbergen J, Navarra S, Vallancien G, Guillonneau B. Laparoscopic ureterolithotomy for ureteral calculi. Eur Urol 2001;40:609–613.
5. Keeley FX, Gialas I, Pillai M, Christofos M, Tolley DA. Laparoscopic ureterolithotomy: The Edinburgh experience. BJU Int 1999;84:765–769.
6. EAU guidelines on laparoscopy 2002; www.uroweb.org. Accessed April 21, 2009.
7. Skrepetis K, Doumas K, Siafakas I, Lykourinas M. Laparoscopic versus open ureterolithotomy: A comparative study. Eur Urol 2001;40:32–37.
8. Hemal AK, Goel A, Kumar M, Gupta NP. Evaluation of laparoscopic retroperitoneal surgery in urinary stone disease. J Endourol 2001;15:701–705.
9. Gaur DD, Trivedi S, Prabhudesai MR, Madhusudhana HR, Gopichand M. Laparoscopic ureterolithotomy: Technical considerations and long-term follow-up. BJU Int 2002;89: 339–343.
10. Goel A, Hemal AK. Upper and mid-ureteric stones: A prospective unrandomized comparison of retroperitoneoscopic and open ureterolithotomy. BJU Int 2001;88:679–682.
11. Jeong BC, Park HK, Byeon SS, Kim HH. Retroperitoneal laparoscopic ureterolithotomy for upper ureter stones. J Korean Med Sci 2006;21:441–444.
12. Adams JB II, Micali S, Moore RG, Babayan RK, Kavoussi LR. Complications of extraperitoneal balloon dilation. J Endourol 1996;10:375–378.

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Abbreviations Used

BMI = body mass index
CT = computed tomography
EAU = European Association of Urology
SWL = shockwave lithotripsy