Comparison of Laparoscopic and Open Ureterolithotomy in Impacted and Very Large Ureteral Stones

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Purpose: To compare the efficacy of laparoscopic and open ureterolithotomy in patients with ureteral stones.

Materials and Methods: Patients who had undergone open or laparoscopic ureterolithotomy between 2001 and 2013 in our clinic were enrolled in the study.Ureterolithotomy was performed due to the following reasons: failure to position the patient for ureteroscopy,unreachable stone with ureteroscopy also use of balloon dilatation, high stone volume, and the need for removal of kidney stones at the same session.. The patients' demographic data, the volume of the stones, the duration of the operation and the hospital stay, the amount of analgesics administered after the operation, and the need for another procedure were compared.

Results: Of study subjects 32 patients had undergone open and 20 patients had undergone laparoscopic ureterolithotomy. When the two groups were compared, there was no statistically significant difference with regard to the mean age (44.5-44 years), the body mass index (26-24.7 kg/m^2), the stone volume (420-580 mm^3), the duration of operation (122-123 min), the need for another procedure and complications. The mean amount of analgesics administered after the operation (3.6 and 1.81 doses, $P = .02$) and the mean hospital stay (6.1 and 2.9 days, $P = .01$) were significantly lower in the laparoscopic ureterolithotomy group.

Conclusion: Laparoscopic ureterolithotomy is a good alternative with less need for analgesia and a shorter hospital stay when compared with open ureterolithotomy.

Keywords: laparoscopy; methods; ureteral calculi; surgery; treatment outcome.

INTRODUCTION

In recent years, with development of extracorporeal shock wave lithotripsy (SWL), percutaneous nephrolithotomy (PNL) and with the advances in the technology of ureteroscopy (URS), the rates of invasive surgery for stones in the urinary tract has dropped to levels of 1-5.4%. The rate of open surgery procedures is about 1.5% in all procedures, with the remaining surgical procedures comprising laparoscopic procedures.[1-5]

For patients who are unsuitable for SWL and URS and irresponsive to these treatment modalities, invasive treatment modalities are put forth. For the upper part of the ureter, antegrade percutaneous ureteroscopy is a good alternative. If the patient is not suitable for antegrade percutaneous ureteroscopy and for stones of the other parts of the ureter, the only alternative treatment is ureterolithotomy. Radiofrequency incision of intramural ureter and the extraction of the stone is a new alternative technique for distal impacted ureteral stone.[6] But this is not gold standard technique and described issue on urology guidelines.

In the European Urology Guideline on urolithiasis, it is accepted that if laparoscopic ureterolithotomy is performed with the right indications, it is superior to SWL and ureteroscopy with an evidence level of "1a". And for patients with impacted large ureteral stones who cannot be treated with SWL and endoscopic procedures, the evidence level for laparoscopic ureterolithotomy has been reported to be "2" with a recommendation level of "B".[7]

Impacted stones are defined as stones remaining at the same localization for at least for 2 months. The minimal time period for the diagnosis of an impacted stone may be unclear for each patient. Definitions for impacted stones include the following: if the contrast media is radiological observed not to have passed to the distal of the stone; and preoperatively, if the guide wire does not pass to the proximal of the stone, and when the stone remains at the same anatomical position for 2 months.[8-10] Being of state of impacted is very important for postoperative long-term complications. Because after ureteroscopy, for impacted stones, strictures may develop with rates as high as 24%.[11] We can referee to the European Urology Guideline on urolithiasis for the definition of "very large stone", a large ureter stone is >10 mm, whereas very large stones are described to be larger than 15 mm in diameter.[7]

So, for these reasons, we have aimed to comparison of open and laparoscopic approach for ureterolithotomy in terms of postoperative ureteral stricture, amount of the analgesic drug needing and hospitalization interval in patients who had we can take out this part of sentence impacted very large ureteral stones.

MATERIALS AND METHODS

Thirty-two patients who had undergone open ureterolithotomy and 20 patients who had undergone laparoscopic ureterolithotomy between 2001 and 2013 were retrospectively analyzed. Ureterolithotomy was performed due to the following reasons: failure to position the patient for ureteroscopy (1 patient); unreachable stone with ureteroscopy also use of balloon dilatation (17 patients); high stone load (31 patients), and the need for removal of kidney stones at the same session (3 patients). All of patient's stones are very large and impacted. Open ureterolithotomy was preferred between the years of 2001-2008, and with the advances in laparoscopic surgery in our clinic, laparoscopic ureterolithotomy was preferred between 2008-2013. One patient underwent open ureterolithotomy in 2011 and another patient underwent open ureterolithotomy in 2012, both due to the fact that they were unsuitable for laparoscopic surgery. Two patients underwent open ureterolithotomy at 2013 due to patients' request.

In open procedures, lombotomy for superior and mid-part ureteral stones and the Gibson incision for distal part ureteral stones were used. After palpation of the ureter for stones, the ureter was opened through a vertical incision and the stone was extracted. Then a double J ureteral stent was placed in ureter and ureter was closed with absorbable sutures. An abdominal drain was then placed at the operation site. Fifteen patients had been operated for upper, 3 mid and 14 distal ureteral segment stones.

Laparoscopic procedures were performed trans and retroperitoneally. Having palpated the stone with the laparoscopic instrument, with the technique that we have developed in our clinic to increase safety, the ureter was vertically incised using a No.11 or a No.15 scalpel and the stone was extracted.

Table 1. Demographic and clinical characteristics of study subjects.

Variables	Open	Laparoscopic	*p*
Female/Male ratio	7/25	4/16	.72
Mean age (years)	44.5 ± 17	44 ± 12	.9
Mean BMI (kg/m^2)	26 ± 3	24.7 ± 3	.41
Mean stones volume (mm^3)	420 ± 280	580 ± 325	.085
Operation time (minutes)	122 ± 38	123 ± 40	.9
Hospitalization time (days)	6 ± 2.6	2.9 ± 1.4	.01*
Analgesic drug needing (doses)	3.6 ± 2.7	1.81 ± 1.2	.02*
Additional treatment	3	1	.12
Complication	1	2	.4

Key: BMI, body mass index.
* Statistically significant.

A double J ureteral stent was then placed and the ureter was closed using absorbable sutures. An abdominal drain was then placed at the operation site. Fifteen patients had been operated for upper, 4 mid and 1 distal ureteral segment stones. All of operations, open and laparoscopic, were performed by same surgeon.

The demographic data of the patients, the age, sex and the body mass index were recorded. The analgesic medications that had been administered postoperatively were analyzed. Amount of analgesic drug needed was taken into account for first 24 hours. One analgesic dose is accepted to be 50 mg pethidine, 50 mg diclofenac, and 500 mg paracetamol. The stone volume was calculated with the formula: (stone width × stone length × π × 0.25)^1.27 × 0.6.

The patients were divided into two groups according to the surgery being open or laparoscopic, and their demographic data, stone volumes, durations of operation and hospitalization, amount of analgesics administered after the operation and the need for another procedure were compared. Finishing of operation laparoscopically and reaching stone- free were considered success criteria. Complications were classified by Clavien- Dindo system.

Mann Whitney *U* and Fisher's exact test were used for the statistical analyses and *P* value of < .05 was considered as significant.

RESULTS

All of the open procedures were retroperitoneal, while 5 of the laparoscopic procedures were transperitoneal and 15 of the laparoscopic procedures were retroperitoneal. In the open procedure group, 7 patients were women and 25 were men, with a mean age of 44.5 years. In the laparoscopy group, 4 patients were women and 16 were men, with a mean age of 44 years. When the body mass indexes of the two groups were compared, there was no statistically significant difference (Table 1).

For the stone volumes, although the volumes in the laparoscopy group were higher, the difference between two groups was not statistically significant. We think that it was because of the small number of patients. When we compared the operation times, interestingly, the mean operation times were very close to each other for the two groups. Operation times are similar between trans and retroperitoneal laparoscopy groups (114 vs. 126 min, $P = .45$). The need for analgesia was significantly lower in the laparoscopy group in the postoperative period. Furthermore, the postoperative hospitalization time was significantly shorter in the laparoscopy group (Table 1).

In the open ureterolithotomy group, 3 patients had pain and hydronephrosis after the double J stent was removed at the fourth postoperative week. They underwent diagnostic uret-

Table 2. Our and other studies' databases about laparoscopic ureterolithotomy in current literature.

Studies	Patients No.	Success Rate (%)	Complication Rate (%)	Additional Treatment Rate (%)	Operation Time (min)	Hospitalization Time (day)
Our Study, 2014	20	90	10	5	123	2.9
El Moula et al. 2008[12]	74	94.6	0	1.4	58.7	6.4
Ko HY et al. 2011[13]	71	93.8	12.5	4.2	118	5.9
Flasko et al. 2005[14]	75	98.7	0	0	45	3
Skrepetis et al. 2001[15]	18	100	0	0	130	3
Kijvikai et al. 2006 [16]	30	96	13.3	3.3	121.38	3.86
Gaur et al. 2002[17]	101	92	11	0	79	3.5
Fang et al. 2012[18]	25	100	0	0	41.8	2.9
Huri et al. 2010[19]	41	97.5	12.5	12.5	124	4.8
Wang et al. 2010[20]	36	94.5	17.6	0	131.5	5.8
Keeley et al. 1999[21]	14	100	0	14	105	5.6
Simforoosh et al. 2007[22]	123	96.7	11.4	10.5	143	5.86

eroscopy, and the remaining stones in the ureter were treated endoscopically. That patients stones may be broken during open ureterolithotomy. In the open ureterolithotomy group, 1 patient had developed ureterovesical obstruction. Then, with open surgery, the obstructed segment was excised and ureteroneocystostomy was performed. On the follow-up, it was seen that the obstruction had been alleviated. Furthermore, in the open ureterolithotomy group, 1 patient had permanent obstruction in a long segment of the mid-part of the ureter. As the other kidney was hypoplastic and the obstruction was in the long segment, he was on follow-up for 91 months without any further complications by changing the double J stent every 6 months. All of patients were followed mean 15, minimum 3 months in open group.

In the laparoscopy group, in the one and only patient in whom a double J stent had not been placed, the drain revealed over 1000 mL day drainage with urine content postoperatively. Hence, we performed endoscopy after 2 days, and the remaining stone was treated endoscopically. We have recovered to open procedure at one patient due to bleeding. Postoperative ileus occurred in none of the patients. All of patients were followed mean 30, minimum 6 months in laparoscopy group. There were no differences between the two groups with regard to the requirement for an extra procedure.

DISCUSSION

The success of the operation is defined as finishing the surgery laparoscopically and reaching a stone free state for laparoscopic ureterolithotomy. The success rate for this procedure is usually reported as 90%; however, there are reports of 100% success, too.[15,18,21] In our study, the success rate was 90%, all the procedures were completed laparoscopically and with a complete stone free state except one patient (Table 1). Simforoosh and colleagues reported 96.7% success rate and their series was 123 patients.[22] Nasseh and colleagues reported 94% success rate. Also this study was published at 2013 years and operations were done between 2008-2011 years.[23] That is to say, we think real success rate of laparoscopic ureterolithotomy is about 95%.

In the literature, the complication rates are low and the high-

est reported rate is 17.6%.[24] There are several studies reporting the complication rate of 0%.[12,14,15,18,21] In our study, the complication rate was 10% (Table 2). Ureteral stricture is the main complication concern after the operation. In a review of the literature, Nouira and colleagues reported this complication rate as 2.5%.[25] To prevent the strictures, it is important not to disturb the vasculature of the incised part of the ureter during the operation. Gaur and colleagues reported that it is safe to use the hook device in the cutting mode of the electrocautery device for the ureter incision. They reported that in the 10-year follow-up of 75 patients, only 3 had strictures in the part that the stone had been impacted, but they did not mention anything about the incision technique in the patients who had developed strictures. Two of those 3 patients were treated with balloon dilatation and 1 underwent double J stent placement for 3 months and no recurrence was observed.[17] We used the scalpel for incision with a safe technique that we had developed in our clinic, and in the mean follow-up time of 30 months (range, 7-42 months), none of the patients experienced ureteral stricture.

The extra procedures were ureteroscopy, percutaneous nephrolithotomy and double J stent placement for patients with prolonged urinary leakage or patients who could not be rendered stone free. This rate has been reported to be as high as 14% in the literature,[20] but there are studies reporting the rate as 0% (Table 2).[14,15,17,18,21] In our study, the one and only patient in whom we did not place a double J ureteral stent, developed urine leakage of 1000 mL/day, and hence, we performed ureteroscopy on the second postoperative day and placed a double J ureteral stent (Table 1). Urinary leakage for a prolonged duration should be avoided, since it must be kept in mind that prolonged retroperitoneal urinary leakage can cause retroperitoneal fibrosis.[26]

The operation time in the available literature shows a wide range from 41.8 to 132 minutes (Table 2). Fan and colleagues demonstrated that after completion of a 20 case series comprising the teaching curve, the operation time decreased from 120 minutes to 65 minutes in the second 20 cases.[26] Gaur and colleagues reported that closing the ureter with primary sutures prolongs the operation by about 26 minutes.[17] In our study, we closed the ureter with primary sutures, and due to the fact that the teaching curve for laparoscopic ureterolithotomy was not completed, the operation time was longer (Table 1). It is expected that when we have a sufficient number of cases, the operation time will decrease.

The duration of hospital stay has been reported to be between 2.9-6.4 days (Table 2),[16,25] and in our study it is estimated to be 2.9 days (Table 1). Since the previous studies had been carried out with regard to laparoscopic ureterolithotomy experiences and its comparison with ureteroscopy, there is hardly any mention about the duration of hospital stay. Skrepetis and colleagues reported the duration of hospital stay for the laparoscopy group as 3 days and that for the open surgery group as 8 days.[15] Gaur and colleagues demonstrated that with ureter suturing and placement of a double J ureteral stent, the urinary leakage time in patients decreased from 5.5 days to 3.2 days.[17] In our study, when we compared the groups, the time duration was determined to be significantly lower in the laparoscopy group. We think that, except for one, we sutured the ureter and placed double J ureteral stent in all the other operations and this decreased the duration of hospital stay. In that one particular patient, the duration of hospital stay was 7 days. Many of open ureterolithotomy patients have stayed prolonged time due to pain. A patient, one of open ureterolithotomy has stayed 16 days in hospital only due to pain.

Unfortunately, the need for analgesia has not been defined with a common drug or a unit. Every clinic has reported the drugs for its own practical use and analgesia unit of their own. The number of studies about the need of analgesia for open and laparoscopic ureterolithotomy groups is very limited. Skrepetis and colleagues reported the daily requirement of analgesics in the laparoscopic group as 1, and that in the open surgery group as 4 we can takeout tihs part.[15] In our study, the need for analgesia was expressed as unit analgesia, and this was 1.8 units in the laparoscopy group and 3.5 units in the open group, which is significantly lower in the laparoscopy group (Table 1).

Small sample size and retrospective design are limitations of our study.

CONCLUSION

Laparoscopic ureterolithotomy has similar success and complication rates to open ureterolithotomy. In the treatment of large impacted ureteral stones, laparoscopic ureterolithotomy

may be preferred to open ureterolithotomy due to low amount of analgesic drug needed and hospitalization time.

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CONFLICT OF INTEREST

None declared.

REFERENCES

1. Assimos DG, Boyce WH, Harrison LH, McCullough DL, Kroovand RL, Sweat KR. The role of open stone surgery since extracorporeal shock wave lithotripsy. J Urol. 1989;142:263-7.
2. Segura JW. Current surgical approaches to nephrolithiasis. Endocrinol Metab Clin North Am. 1990;19:919-35.
3. Honeck P, Wendt-Nordahl G, Krombach P, et al. Does open stone surgery still play a role in the treatment of urolithiasis? Data of a primary urolithiasis center. J Endourol. 2009;23:1209-12.
4. Bichler KH, Lahme S, Strohmaier WL. Indications for open stone removal of urinary calculi. Urol Int. 1997;59:102-8.
5. Paik ML, Resnick MI. Is there a role for open stone surgery? Urol Clin North Am. 2000;27:323-31.
6. Guner B, Gurbuz C, Caskurlu T. A novel technique for treatment of distal ureteral calculi: early results. Urol J. 2013;10: 807-10.
7. Türk C, Knoll T, Petrik A, Sarica K, Seitz C, Straub M. EAU. Guidelines on Urolithiasis 2012 Available at http://www.uroweb.org/gls/pdf/20_Urolithiasis_LR%20March%2013%202012.pdf.
8. Goel R, Aron M, Kesarwani PK, Dogra PN, Hemal AK, Gupta NP. Percutaneous antegrade removal of impacted upper-ureteral calculi: still the treatment of choice in developing countries. J Endourol. 2005;19:54-7.
9. Erhard M, Salwen J, Bagley DH. Ureteroscopic removal of mid and proximal ureteral calculi. J Urol. 1996;155:38-42.
10. Morgentaler A, Bridge SS, Dretler SP. Management of the impacted ureteral calculus. J Urol. 1990;143:263-6.
11. Roberts WW, Cadeddu JA, Micali S, Kavoussi LR, Moore RG. Ureteral stricture formation after removal of impacted calculi. J Urol. 1998;159:723-6.
12. El-Moula MG, Abdallah A, El-Anany F, et al. Laparoscopic ureterolithotomy: our experience with 74 cases. Int J Urol. 2008;15:593-7.
13. Ko YH, Kang SG, Park JY, et al. Laparoscopic ureterolithotomy as a primary modality for large proximal ureteral calculi: comparison to rigid ureteroscopic pneumatic lithotripsy. J Laparoendosc Adv Surg Tech A. 2011;21:7-13.
14. Flasko T, Holman E, Kovacs G, Tallai B, Toth C, Salah MA. Laparoscopic ureterolithotomy: the method of choice in selected cases. J Laparoendosc Adv Surg Tech A. 2005;15:149-52.
15. Skrepetis K, Doumas K, Siafakas I, Lykourinas M. Laparoscopic versus open ureterolithotomy. A comparative study. Eur Urol. 2001;40:32-6.
16. Kijvikai K, Patcharatrakul S. Laparoscopic ureterolithotomy: Its role and some controversial technical considerations. Int J Urol. 2006;13:206-10.
17. Gaur DD, Trivedi S, Prabhudesai MR, Madhusudhana HR, Gopichand M. Laparoscopic ureterolithotomy: technical considerations long term follow-up. BJU Int. 2002;89:339-43.
18. Fang YQ, Qiu JG, Wang DJ, Zhan HI, Situ J. Comparative study on ureteroscopic lithotripsy and laparoscopic ureterolithotomy for treatment of unilateral upper ureteral stones. Acta Cir Bras. 2012;27:266-70.
19. Huri E, Basok EK, Uğurlu O, et al. Experiences in laparoscopic removal of upper ureteral stones: multicenter analysis of cases, based on the TurkUroLap Group. J Endourol. 2010;24:1279-82.
20. Wang Y, Hou J, Wen D, OuYang J, Meng J, Zhuang H. Comparative analysis of upper ureteral stones (> 15 mm) treated with retroperitoneoscopic ureterolithotomy and ureteroscopic pneumatic lithotripsy. Int Urol Nephrol. 2010;42:897-901.
21. Keeley FX, Gialas I, Pillai M, Chrisofos M, Tolley DA. Laparoscopic ureterolithotomy: the Edinburgh experience. BJU Int. 1999;84:765-9.
22. Simforoosh N, Basiri A, Danesh AK, et al. Laparoscopic management of ureteral calculi: a report of 123 cases. Urol J. 2007;4:138-41.
23. Nasseh H, Pourreza F, Kazemnejad Leyli E, Zohari Nobijari T, Baghani Aval H. Laparoscopic transperitoneal ureterolithotomy: a single-center experience. J Laparoendosc Adv Surg Tech A. 2013;23:495-9.
24. Mitchinson MJ, Bird DR. Urinary leakage and retroperitoneal fibrosis. J Urol. 1971;105:56-8.
25. Nouira Y, Kallel Y, Binous MY, Dahmoul H, Horchani A. Laparoscopic retroperitoneal ureterolithotomy initial experience and review of literature. J Endourol. 2004;18:557-61.
26. Fan T, Xian P, Yang L, Liu Y, Wei Q, Li H. Experience and learning curve of retroperitoneal laparoscopic ureterolithotomy for upper ureteral calculi. J Endourol. 2009;23:1867-70.