Comparative study on ureteroscopic lithotripsy and laparoscopic ureterolithotomy for treatment of unilateral upper ureteral stones[1]

Estudo comparativo entre litotripsia e ureterolitotomia laparoscópica no tratamento de cálculos unilaterais altos

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ABSTRACT

PURPOSE: To compare the curative effects of ureteroscopic lithotripsy and laparoscopic ureterolithotomy for unilateral upper ureteral stones, and to explore optimal surgical indications and skills.

METHODS: Fifty cases of unilateral upper ureteral stones were randomly divided into two groups: one group underwent ureteroscopic holmium laser lithotripsy under epidural or lumbar anesthesia (n=25), and another group underwent laparoscopic ureterolithotomy under general anesthesia (n=25). Double-J stent was routinely indwelled in both groups. Operating time, postoperative hospitalization time, stone clearance rate and perioperative complications were compared.

RESULTS: Operation was successfully performed in all 50 cases, and no open surgery was converted in any case. In the ureteroscopy and laparoscopy groups, the mean operating time was 49.0±10.7 min and 41.8±8.0 min (t=2.68, P=0.00999), respectively, their hospitalization time was 2.8±1.3 days vs. 2.9±0.8 days (t =-0.40, P=0.69413), and stone clearance rate was 88.0% (22/25) vs. 100% (25/25). Stone moved to the renal pelvis in three cases in the ureteroscopy group, and residual stones were removed by extracorporeal shock-wave lithotripsy (ESWL). All patients were followed up for more than three months, and no serious complications such as ureterostenosis occurred.

CONCLUSIONS: Laparoscopic ureterolithotomy has a higher stone clearance rate and shorter operation time compared with ureteroscopic lithotripsy. Laparoscopic ureterolithotomy is one safe and effective treatment on unilateral upper ureteral stones.

Key words: Ureteral Calculi. Ureteroscopy. Lithotripsy. Laparoscopy.

RESUMO

OBJETIVO: Comparar os efeitos curativos da litotripsia ureteroscópica e a ureterolitotomia laparoscópica para cálculos unilaterais altos e pesquisar as indicações e resultados.

MÉTODOS: Cinquenta casos de cálculos unilaterais altos foram distribuídos aleatoriamente em dois grupos: um grupo submetido a litotripsia ureteroscópica com laser holmium sob anestesia epidural ou lombar (n=25) e outro grupo submetido a ureterolitotomia laparoscópica sob anestesia geral (n=25). Duplo-J stent foi rotineiramente instalado em ambos os grupos. Comparou-se o tempo operatório, tempo de hospitalização pós-operatória, nível de desaparecimento dos cálculos e complicações pós-operatórias.

RESULTADOS: Atos operatórios nos 50 casos sem ocorrências e nenhum ato convertido. Nos grupos por ureteroscopia e laparoscopia, o tempo operatório médio foi 49,0±10,7 minutos e 41,8±8,0 minutos (t=2,68, P=0,00999) respectivamente, tempo de hospitalização foi 2,8±1,3 dias vs. 2,9±0,8 dias (t=0,40, P=0,69413) e o nível de desaparecimento dos cálculos foi 88.0% (22/25) vs. 100% (25/25). Cálculo deslocado para pelve renal em três casos no grupo ureteroscópico e cálculos residuais foram removidos por litotripsia por onda de choque extracorpóreo (ESWL). Todos pacientes foram seguidos por mais de três meses e não ocorreram complicações sérias como estenoses ureterais.

CONCLUSÕES: A ureterolitotomia laparoscópica teve maior nível desaparecimento dos cálculos e tempo operatório menor comparado à litotripsia ureteroscópica A ureterolitotomia laparoscópica é um tratamento seguro e efetivo para cálculos ureterais unilaterais altos.

Descritores: Cálculos Ureterais. Ureteroscopia. Litotripsia. Laparoscopia.

Introduction

With the development of endoscopic lithotripsy equipment and accumulation of experience, ureteroscopic lithotripsy has been widely used in the world. Due to its minimal invasion, safety and high curative effect, open surgery has been gradually replaced by ureteroscopic holmium laser lithotripsy[1]. Some reports show that extracorporeal shock wave lithotripsy (ESWL) has a higher stone clearance rate[2,3]. Nevertheless, stones shift to the renal pelvis in ureteroscopic holmium laser lithotripsy and lead to residual stones in some cases[4]. Laparoscopic ureterolithotomy can effectively prevent from the superior shift of stones to the renal pelvis and stone residual. From Jan 2008 to Dec 2010, 50 patients with unilateral upper ureteral stones randomly received ureteroscopic holmium laser lithotripsy and laparoscopic ureterolithotomy, and their curative effects as well as complications were compared to explore optimal surgical indications and skills.

Methods

Patients with unilateral upper ureteral stones admitted to our hospital from January 2008 to December 2010 were enrolled in this study. Incision criteria included: adult patients, duration ≥ 3 months, stone diameter ≥ 1.0 cm, single positive urinary tract stone above the upper edge of sacroiliac joint (upper ureteral stone). Exclusion criteria included acute urinary tract infection (preoperative fever and elevated white blood cell), congenital stricture of ureter, operation history of ipsilateral ureter or the ipsilateral lumbar and abdominal regions. A total of 50 patients were enrolled in this study, including 29 males and 21 females; with a mean age 35.7 ± 10.8 years (20~59 years). All patients had a history of ipsilateral low back pain or renal colic, with a duration for 3 months ~ 3 years. 23 cases once underwent ESWL. Patients in both groups received B-type ultrasonography, intravenous urogram (IVU) and CT urogram to identify the size and location of stones. There were different degrees of hydronephrosis in 50 patients. There was left stone in 27 cases and right stone in 23 cases. The mean max diameter of stones were 1.5 ± 0.4 cm (1.0~2.6 cm). Urinary tract infections in 13 cases were completely treated before operation. 5 patients with hypertension and (or) diabetes patients were well controlled. Preoperative localization X-ray film was performed in all cases.

These 50 cases were randomly divided by random number table into two groups. 25 cases received ureteroscopic holmium laser lithotripsy (ureteroscopy group) under epidural or lumbar anesthesia and another 25 cases received laparoscopic ureterolithotomy (laparoscopy group) under general anesthesia. All operations were performed by the same group of doctors. The detailed clinical data of patients in two groups are listed in Table 1.

TABLE 1 - Clinical data of patients between two groups.

Group (cm)*	Cases	Age (year)*	Male (case)	Left (case)	Maximum diameter
Ureteroscopy	25	36.9±11.8	15	13	1.5±0.4
Laparoscopy	25	34.4± 9.8	14	14	1.6±0.3

Note: * there was no significant difference between two groups P>0.05

Operation procedures

Ureteroscopic holmium laser lithotripsy

After epidural or lumbar anesthesia, the patient was placed in lithotomy position. A F 8/9.8 Olympus rigid ureteroscope was inserted into the bladder through the urethra. With the guide of zebra guide wire, a F 4 ureteral catheter was inserted into ureteral orifice. After through iliac vessels, the flow rate of perfusate was decreased. When stones were found, a F 4 ureteral catheter was inserted through stones. Normal saline was continuously perfused to artificially establish top-down stream, which was conducive to the expulsion of stones. A 60/100 W holmium laser generator (LUMENIS company) connected a 400 μm fiber was prepared, and the fiber was inserted through manipulating passageway of ureteroscope to broken stones from stone edge into <2 mm pieces (Figure 1), and a F 4.5 double-J was retrogradely indwelled.

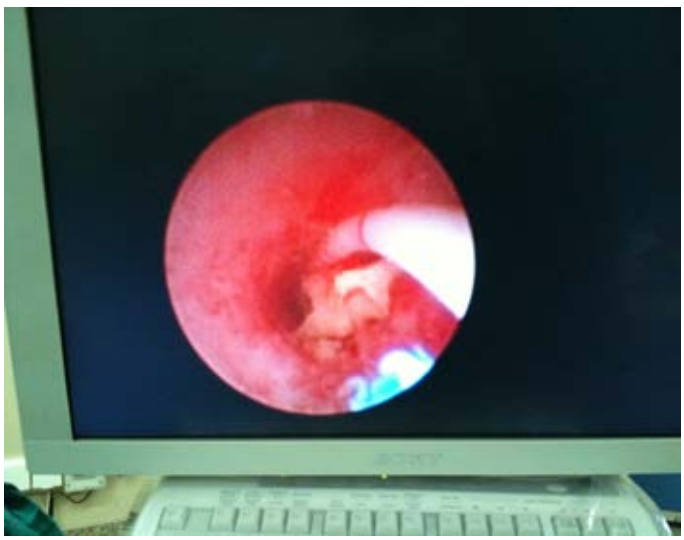

FIGURE 1 - A F 4 ureteral catheter was inserted through stones to continuously perfuse with normal saline.

Laparoscopic ureterolithotomy

After endotracheal intubation and general anesthesia, patients were in healthy lateral position. A 1.5 cm skin incision was made in midaxillary line above spina iliace. Muscular layer and lumbodorsae fascia was separated with a pair of long curved forceps. Peritoneum was push forward, and a self-made gas balloon was inserted and 500~600 ml gas were infused to expand retroperitoneal space. With the guide of index finger, a 10 mm and 5 mm Trocar was inserted in posterior axillary line and anterior axillary line under 12 ribs, respectively. Corresponding laparoscopic instruments was inserted to open fascia along major psoas muscle and perirenal fascia. Dilated ureter was found below inferior pole of kidney along medial side of major psoas muscle, and ureter segment containing stone was isolated. Ureter above stones was clamped with a pair of separating forceps to avoid the superior shift of stones. Then, ureter at stones was slivered to take out stones. A F 4.5 Double-J stent pre-inserted with plastic wire (guide wire of F 8 children chtreter) was inserted into the distal and proximal ends of ureter (Figure 2).

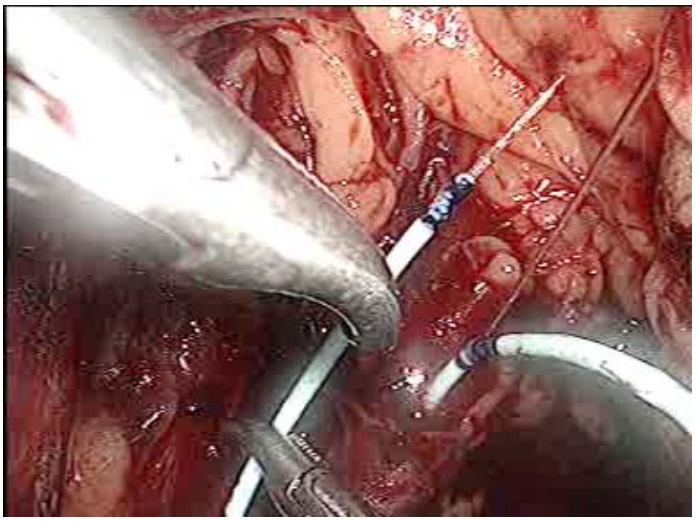

FIGURE 2 - A F 4.5 Double-J stent pre-inserted with plastic wire (guide wire of F 8 children chtreter) was inserted into the distal and proximal ends of ureter.

After the plastic wire was removed, the ureteral incision was interruptedly sutured with 3-0 absorbable suture. A retroperitoneal drainage tube was indwelled.

Postoperative treatments

Antibiotics were routinely used to prevent from infection. On postoperative day 1~2, KUB imaging was made to identify whether there was no residual stones or not and the position of double-J stent. In the ureteroscopy group, catheter was removed and patient was discharged on postoperative day 1~2. In the laparoscopy group, drainage tube was removed after drainage volume < 20 ml/d. On postoperative week 4~6, double-J stent was removed under cystoscopy under local anesthesia in two groups.

Statistical analysis

All statistical analyses were performed with SPSS version 11.0 statistical software. Mean was compared with t test and rate was compared with χ^2 test. $P<0.05$ was considered significantly different.

Results

All operations were successfully performed in both groups, and no intraoperative complications occurred, and no case was converted to open surgery. The detailed operation indexes of patients are listed in Table 2. Operating time in the laparoscopy group was significantly shorter than that in the ureteroscopy group ($P<0.05$). The stone clearance rate was 100% in the laparoscopy group. In the ureteroscopy group, ≥ 4 mm stones shifted to the renal pelvis in 3 cases (12%, 3/25), and residual stones were removed by ESWL. All patients were followed up for 3-12 months, and there were no obvious residual stones or ureterostenosis. Nephrohydrosis was significantly decreased, and clinical symptoms were alleviated and disappeared.

TABLE 2 - Operation indexes of patients between two groups (x±s).

Group	Operating time(min)	Stone clearance rate	hospitalization time(d)*	postoperative dosage of antalgesica(mg)*
Ureteroscopy	49.0±10.7	88.0% (22/25)	2.8±1.3	96.4±45.9
Laparoscopy	41.8± 8.0	100% (25/25)	2.9±0.8	97.2±36.5

Note: * there was no significant difference between two groups, P>0.05

Discussion

Due to no anesthesia need and surgical invasion, extracorporeal shock wave lithotripsy (ESWL) has many advantages on the treatment of upper ureteral stones. However, one time of ESWL is difficult to remove bigger stones, harder cystine stones and calcium oxalate stones, and repeated ESWL may result in renal atrophy and irreversible damage of renal function[5]. Therefore, minimally invasive endourological treatment has many incomparable advantages on the treatment of upper ureteral stones compared with ESWL and open surgery. Recently, with the development of endoscopic lithotripsy equipments and

accumulation of experience, ureteroscopy and laparoscopy is more and more widely used in the world. For physicians with experienced ureteroscopic lithotripsy and careful manipulation, ureteroscopic holmium laser lithotripsy is one safe and effective treatment on upper ureteral stones[2].

In this study, the one-stage stone clearance rate was 88% in the ureteroscopy group, and there were no serious complications such as mucous membrane avulsion and perforation, and no case was converted to open surgery. The mean operating time of 25 cases was less than 60 min, indicating that ureteroscopic lithotripsy was one safe and effective treatment on unilateral upper ureteral stones. Residual stones resulted from intraoperative shift was the main challenge of ureteroscopic lithotripsy. Chow *et al*.[6] reported that upper ureteral stones shifted upward in 25% cases. In this study, ≥ 4mm stones shifted upward only in 3 cases (12%), its proportion was lower than Chow's study, which might be result from relatively fixed stones, longer incarcerated history and higher lithotripsy efficiency of holmium laser. Besides, the experienced skills of surgeons were another important factor. In this study, following aspects were strictly performed to ensure the safety and high efficiency of lithotripsy: 1) the ureteroscopy must be gently and slowly performed, and visual angle and flow rate of perfusate should be appropriately adjusted to ensure clear visual field in case of abnormal ureteral curvature and vague visual fields. Repeated movement of ureteroscope should be avoided. Operating time should be shortened as soon as possible. If there was strong resistance, treteroscope could not directly insert to avoid serious complications such ureteral perforation and avulsion. If necessarily, ureteroscopy should be immediately terminated to select other treatments. 2) The fixation and immobility of stones was crucial for the lithotripsy[4]. Flow rate and pressure of perfusate should be decreased to avoid the superior shift of stones when stones were found. Besides, a ureteral catheter was inserted over stones and continuously perfused with normal saline. On one aspect, catheter push stones on the contralateral side of ureteral lumen. On another aspect, normal saline perfused through ureteral catheter could prevent from superior shift of stones and ensure clear visual fields of ureteroscope. 3) Stones could be pushed to the contralateral side of ureteral lumen with holmium laser fiber. Patients could be in low-foot body position to decrease the risk of stone's movement to renal pelvis.

Ureteroscopic lithotripsy has no satisfactory curative effects on bigger stones > 1.0 cm or stones with longer history, irregular morphology, rough surface, severe obstruction and concurrent infections, and there are many perioperative complications. Therefore, upper ureteral stones with strong hardness and longer incarceration history which were not suitable for the treatment of ESWL or ureteroscopic lithotripsy were the optimal indications of laparoscopic ureterolithotomy[3]. In this study, all 25 cases of laparoscopic ureterolithotomy were successfully performed, and its mean operation time was 41.8 min which was significantly shorter than that in the ureteroscopy group. No obvious complications such as bleeding and urine leakage occurred. Follow-up showed curative effects were satisfactory. Our experience was summarized as follows: 1) Quick screen of stones is crucial to shorten the operating time and decrease periopeative complications. Retroperitoneal anatomic landmarks such as major psoas muscle, peritoneum and perirenal fascia should be accurately identified. Ureter was found along internal side of major psoas muscle below the inferior pole of kidney. Ureteral stones were identified by repeated clamping with a pair of grasping forceps. 2) The upper segment of ureter above stones was isolated, and then the upper segment was clamped with Satinsky's clamp to prevent from the superior shift of stones. Then, a ureteral incision on stones was made[7]. 3) A F 4.5 Double-J stent was pre-inserted with two plastic wires (guide wire of F 8 children chtreter) to increase the hardness of double-J stent, which was conducive to laparoscopic intubation of double-J stent. The distal end of double-J stent was first inserted to bladder, and proximal end was then inserted into renal pelvis, and then plastic wires were removed. In this method, intubation of double-J stent could be performed in 3-5 minutes[8]. 4) Ureteral incision must be aligned, and enough ureteral lumen must be retained at saturation of muscular layer to avoid postoperative ureterostenosis[9].

Conclusions

Laparoscopic ureterolithotomy has a higher stone clearance rate and shorter operating time compared with ureteroscopic lithotripsy. Laparoscopic ureterolithotomy is one safe and effective treatment on unilateral upper ureteral stones.

Acknowledgments

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