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Laparoscopic ureterolithotomy: Technique, morphological and functional outcome in large ureteric calculi

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Abstract
Introduction: Laparoscopic ureterolithotomy is an established alternative to open ureterolithotomy for the primary treatment of large, impacted, proximal or mid-ureteral stones or as salvage procedure for failed cases of extracorporeal shock wave lithotripsy and attempted ureterorenoscopy of stones in these locations. This study aimed to evaluate the efficacy and safety of laparoscopic transperitoneal ureterolithotomy for management of large proximal and mid-ureteric stones.
Aims and Objectives: To measure the efficacy of transperitoneal laparoscopic ureterolithotomy for management of large proximal and mid ureteric stones and impact of this treatment on renal function post-operatively.
Materials and Methods: We retrospectively reviewed the clinical charts of all patients subjected to laparoscopic transperitoneal ureterolithotomy (cases) in the Department of General Surgery at SMIMER Hospital, Surat between the period of March 2014 to October 2018. Clinical charts of all patients were assessed for demographic profile, co-morbidities, routine blood investigations, including RFT, urine cytology and culture sensitivity and X ray KUB, USG KUB, IVP/CT-IVU, DTPA.
Results: The mean operative time was 148±20 minutes with a mean blood loss of 50-60ml. The mean duration of hospital stay after surgery was 5±1 days, and the mean duration of stenting was 6-8 weeks. The stone clearance rate was 100% and no patient developed ureteric stricture.
Conclusion: Transperitoneal laparoscopic ureterolithotomy is an effective and safer treatment option for reducing ureteral obstruction in patients with large proximal and mid-ureteric stones. Our results show that laparoscopic ureterolithotomy is better than open surgery in selected cases.

Keywords: laparoscopic ureterolithotomy, large ureteric calculi, morphological, functional outcome

Introduction

The treatment of urinary lithiasis has been revolutionized during the last three decades. Minimally invasive therapies in the form of endoscopic surgery in conjunction with the advent of shock wave lithotripsy have diminished the role of open stone surgery [1]. Laparoscopic surgery provides a higher degree of patient satisfaction than open surgery from a cosmetic perspective [2]. It is also effective in reducing postoperative pain, operative wound complications, blood loss, and the length of hospital stay. Laparoscopy as a minimally invasive treatment is continuously gaining place in the treatment of urinary stones, mainly replacing open surgery [3]. Laparoscopic ureterolithotomy is now an established alternative to open ureterolithotomy for the primary treatment of large, impacted, proximal or mid-ureteral stones or as a salvage procedure for failed cases of extracorporeal shock wave lithotripsy and attempted ureterorenoscopy of stones in these locations [4].

Skolarikos *et al*. have tried to identify the level of evidence and grade of recommendation supporting the laparoscopic approach of stone extraction. The highest level of evidence (IIa) was found for laparoscopic ureterolithotomy. It is technically feasible and having lower postoperative morbidity compared to open ureterolithotomy. It is mostly recommended for large impacted stones or when endoscopic ureterolithotripsy or shock wave lithotripsy have failed [4].

The present retrospective study aimed to evaluate the efficacy and safety of laparoscopic transperitoneal ureterolithotomy for management of large proximal ureteric stones.

Aims and Objectives

In the present study, we evaluated the morphological and functional outcomes of laparoscopic Transperitoneal ureterolithotomy for the management of unilateral ureteric calculi.

Materials and Methods

We retrospectively reviewed the clinical charts of all patients subjected to laparoscopic ureterolithotomy (16 cases) in the Department of General Surgery at SMIMER Hospital (Tertiary care Centre), Surat between the period of March 2014 to December 2018. Record of all patients were assessed for demographic profile, co morbidities, routine blood investigations, including RFT, urine cytology and culture sensitivity, specialised investigation as X ray KUB,USG KUB,IVP/CT-IVU, DTPA.

Inclusion Criteria

1. Single large or impacted proximal or mid-ureteric stone.

Exclusion Criteria

1. Diabetes Mellitus
2. Extracorporeal shock wave lithotripsy indicated patients (SWL)
3. Patients with separate stone burden in different calyces or intra-renal pelvis
4. Solitary kidney with UPJO.
5. Recurrent cases
6. Non-functional kidney
7. Bleeding and Coagulation disorders
8. Previous laparotomy
9. Previous retroperitoneal surgery

All patients underwent routine laboratory tests including complete blood count, blood chemistry and urine analysis and urine culture preoperatively. To evaluate the impact of surgery on renal function, glomerular filtration rate (GFR) was measured preoperatively, at day 3 and three months after surgery. Estimated GFR was calculated using Cockcroft-Gault formula. To assess selective renal function, kidney scintigraphy with single–shot diethylen-etriaminepentaacetic acid (DTPA) was done before operation and at three months postoperatively in selected cases. Di-ethylene triaminepentaacetic acid (DTPA) scans were performed preoperatively and 1 year after ureterolithotomy to evaluate renal drainage and function. Drainage was classified as good if T1/2 was <20 minutes; fair if T1/2 was >20 min and the drainage curve was descending, or poor if T1/2 could not be counted and there was an increasing drainage curve. The patients were followed up clinically and radiologically at regular intervals. All perioperative and post-operative complications up to 3 months were recorded and classified according to the Clavien grading system. Stone-free result (as the primary end point of the study) was defined as no residual fragments or a residual fragment smaller than 4 mm on the postoperative imaging profiles (ultrasonography and kidney-ureter-bladder X-ray). Preoperative Radiological assessment included Renal USG, CT-urography for all patients, and DTPA scan for patients with poor renal function on CT-IVU.

We have followed standard technique of Laparoscopic Trans peritoneal ureterolithotomy. Retroperitoneal approach was not followed due to ergonomic problem and anatomical delinent issues.

Technical Details

1. Patient position: 45-60 degree lateral
2. Anesthesia: General anesthesia
3. Pneumoperitoneum created with veress followed by first a 12 mm port was inserted at the umbilicus using open access approach. (10) Then three 5 (sub xiphoid), 10 (para rectal region parallel to umbilicus) and 5 mm (2 cm medial to anterior superioiliac spine) ports were inserted under direct vision.
4. After medial mobilization of colon and once ureter were exposed, a longitudinal incision was made on the mid or proximal part, depending on the location and shape of the stone. Stones were removed from ureteric incision site using grasper forceps and delivered via an Endobag.
5. After suction- irrigation of ureter (to wash out further tiny stone particles), a double J ureter-al stent was passed through ureter to the bladder through the anterior axillary port.
6. Finally, ureter was closed using vicryl 3-0 round body (absorbable polyglactin) suture in an interrupted fashion.
7. Drain insertion is done through anterior axillary port followed by placement of mobilised colon and reverting the patient to supine position.
8. Foley catheter was removed 48 h after operation. Drain was removed when its daily output reached lower than 25 mL. Double J ureteral stent was removed under local anesthesia 4 weeks later.

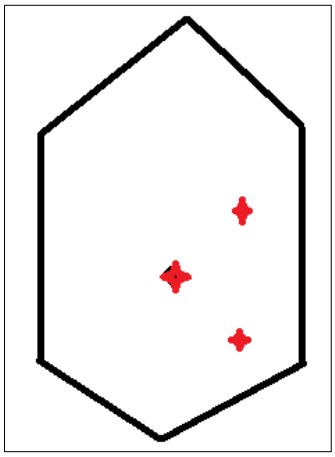

Fig 1

1. 11 mm trocar at umbilicus,used as camera port.
2. 5 mm (subcostal anterior axillary line) were inserted under direct vision.
3. 11mm (para rectal region at the level of umbilicus)

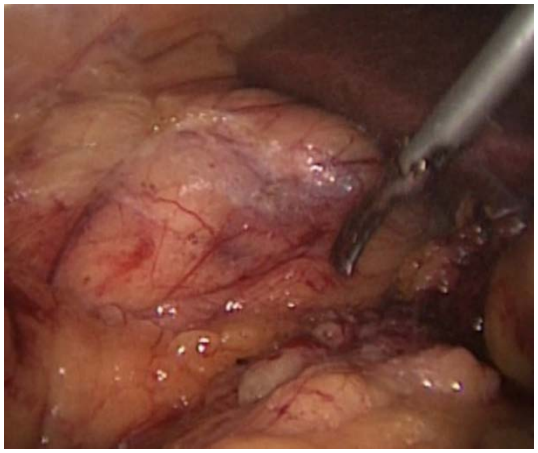

Fig 2: Mobilisation of colon

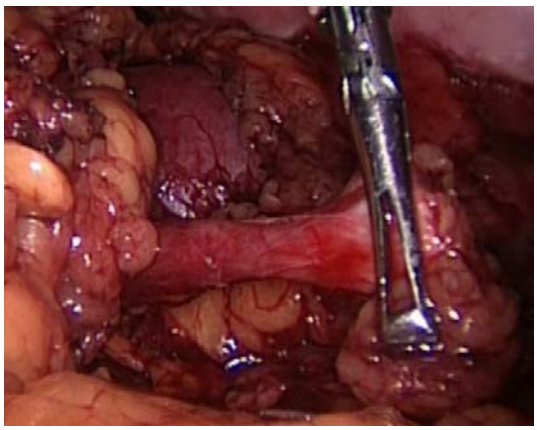

Fig 3: Identification of ureter

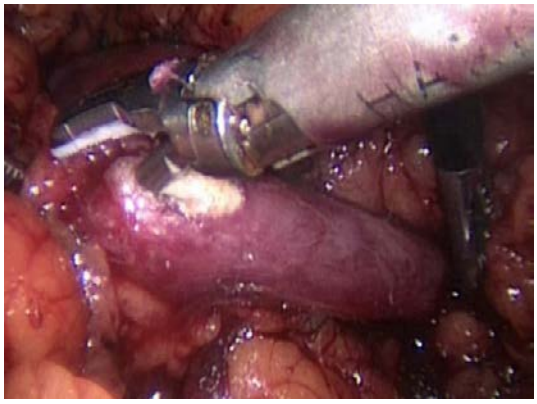

Fig 4: Ureterotomy Done

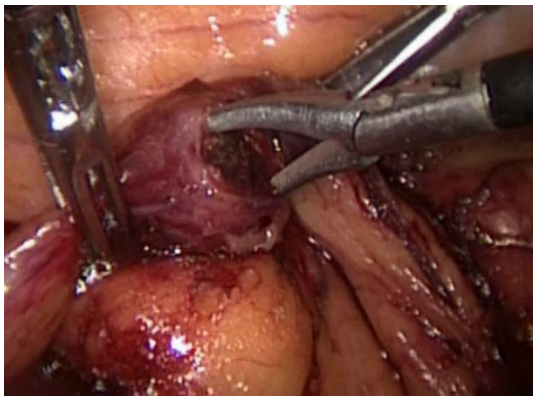

Fig 5: Ureteral stone extraction done

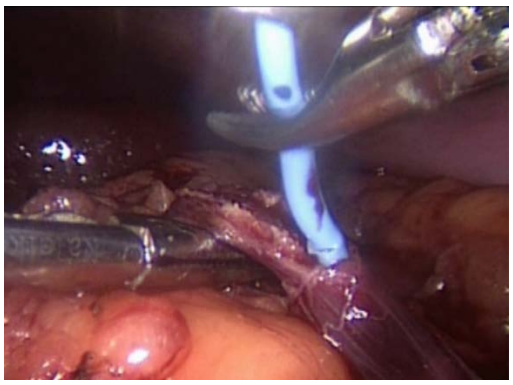

Fig 6: DJ stent insertion

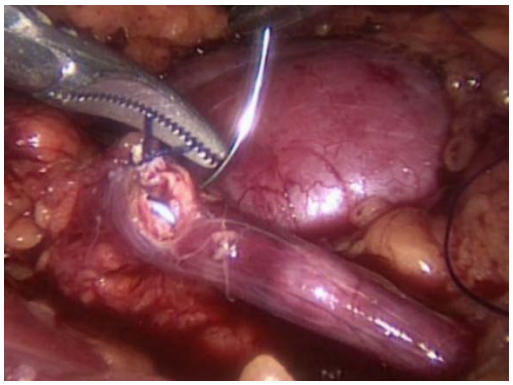

Fig 7: Ureterotomy Suture Line Closed With Vicryl 3-0

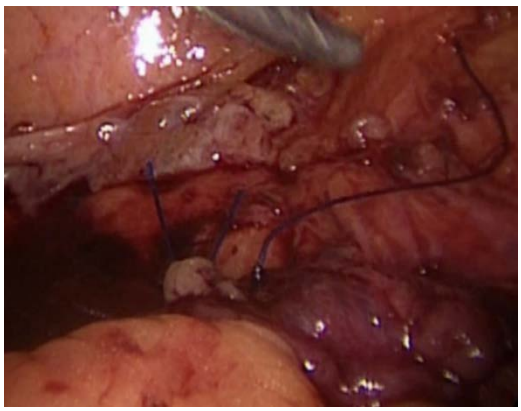

Fig 8: Final suturing (3-4 interrupted suturing) done.

Results

Table 1: Profile of Patients with Laproscopic Ureterolithotomy

		MALES	FEMALES
1.	Number of patients	06	10
2.	BMI	25.27	24.22
3.	Abdominal operative history	None	None
4.	Affected Kidney Side	Right-4 Left-2	Right-6 Left-4
5.	Mean stone size	15+/-5 mm	15+/-5 mm
6.	Operative time (min)(+/- 20 minutes)	140	156
8.	Calculated blood loss (ml)	50-60ml	50-60ml
9.	Total drained amount	50-100ml	50-100ml
10.	Hospital Stay(+/- 1 day)	5 days	4 days
11.	Drain Removal	4 days	4 days
12.	Split function in DTPA scan *in %		

13.	Preoperative split function	32.2	31.4
14.	Postoperative split function	45.4	44.4

Follow Up Table

Table 2

	1st Post-operative day	2nd Post-operative day	2 weeks	6 weeks	8 weeks	3months
1. X ray KUB	Radiological stone clearance, DJ stent in situ					
2. USG KUB		No calculi visualised and DJ stent in situ				WNL in All Cases
3. DJ stent removal				Stent removed in 14 cases	2 cases	
4. Clinical			Asymptomatic with Normal physical examination.	2/16 cases symptomatic and rest Asymptomatic with Normal physical examination	Asymptomatic with Normal physical examination	Asymptomatic with Normal physical examination
5. RFT	WNL	WNL	WNL	WNL	WNL	WNL

Discussion

Laparoscopy is associated with lower postoperative morbidity, shorter hospital stays and time to convalescence, and better cosmetic results with comparably good functional results [1].

There is no uniform consensus about port placements for advanced laparoscopic procedures. The placement of ports is currently dictated by the surgeons' preference based on individual experience. To facilitate smooth instrument manipulation along with adequate visualisation during laparoscopy, usually trocars are placed in triangular fashion. This is termed as triangulation. The target organ should be 15–20 cm from the centre port used for placing the optical trocar. Generally, the two remaining trocars are placed in the same 15–20 cm arc at 5–7 cm on either side of the optical trocars. This allows the instruments to work at a 60°–90° angle with the target tissue and avoids problems of long handle due to too far or too near placement of ports and the problem of abdominal wall interference. If necessary, two more retracting ports can be placed in the same arc but more laterally so that instruments do not clash [2].

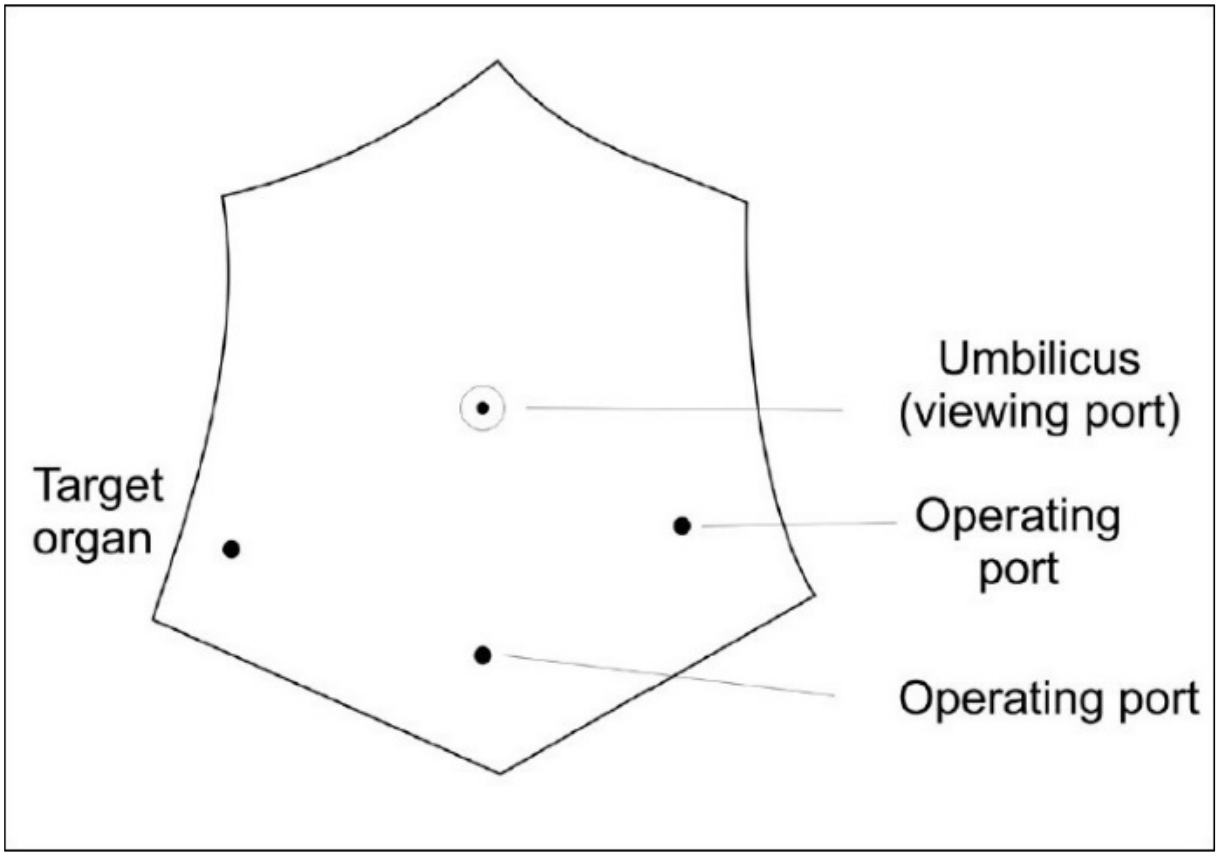

Fig 9

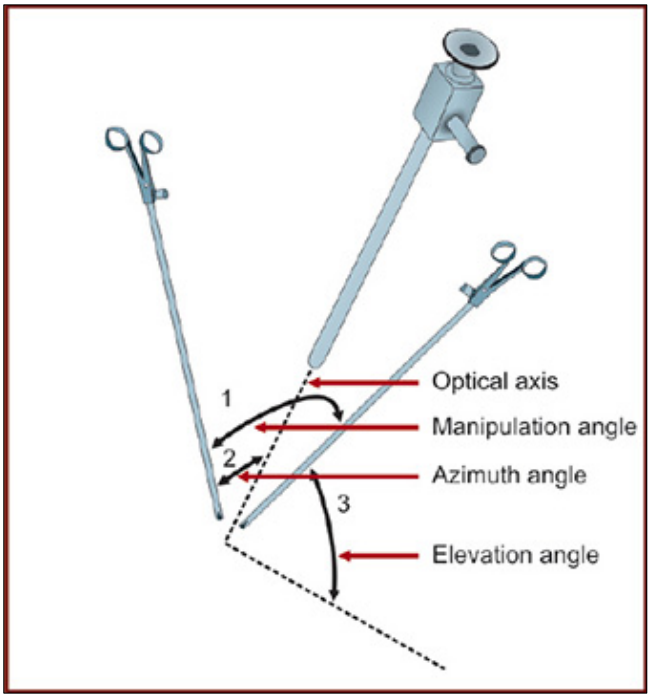

Fig 10

In the present era of minimally invasive surgery, laparoscopic ureterolithotomy remains a valuable alternative to open lithotomy for the primary treatment of impacted upper and mid ureteric stones larger than 1.5cm [3]. Laparoscopic ureterolithotomy is relatively easy with good results. The distinct advantage of laparoscopic ureterolithotomy is the high probability of removing the entire stone in one procedure, which is economical and ensures short operation time with indwelling ureteral stents compared to open procedures [4] However, Laparoscopic ureterolithotomy is not suitable when stone has been crushed by extracorporeal SWL, because complete removal of shattered stones is difficult [5].

Laparoscopic ureterolithotomy can be performed via transperitoneal or retroperitoneal route. Simforoosh *et al*. compared the use of retroperitoneal versus intraperitoneal approach for laparoscopic proximal ureterolithotomy and reported that operative time was significantly different in favour of the intraperitoneal approach [6]. In our study, we have employed the transperitoneal approach keeping in account the ergonomics associated with the procedure in accordance to the experience and clinical skills of the operating surgeon.

Henkel *et al*. concluded that the mean operative time was about 107 min within a range of 70–250 min. Only one case with 3 stones in the initial experience required prolongation of operative time up to 250 min, while the actual range was 70–115 min with a mean time around 90 min [7]. Proper patient selection allowed for completion of the procedure without the need for open conversion and indicates a favourable surgical outcome depends on the combination of proper patient selection and surgical experience. In line with this observation, the mean operative time was approximately 130+/-20 minutes. However, one initial case required a longer operative time upto 150 minutes, and 2 cases with severe adhesion around the ureter and one case with ureteric stricture required a longer time of 150-160 minutes. Thus, the actual range was 130+/-20 minutes.

A major complication of laparoscopic ureterolithotomy is ureteral stricture, which has been reported in 15-20% of cases in a separate series. Although the etiologies of post-operative ureteral stricture are not clear, explanations involve tight suturing of the ureterotomy leading to wall ischemia with subsequent stenosis. In addition, prolonged post-operative urinary drainage with retroperitoneal fibrosis is another possible cause of ureteral stenosis [7]. However, Nouria *et al*. estimated the incidence of ureteral stricture to be only 2.5% based on the review of previously published reports, and none of our cases experienced ureteral stricture after surgery [8]. In our study, no cases with post-operative ureteric stenosis or retroperitoneal fibrosis were noted. Post-operative period and follow up at different time intervals was uneventful.

Ahmed al Sayyad *et al*. reported that all patients were discharged stone-free without stone recurrence throughout follow-up period and were free of complications apart from one patient who developed later a ureteric stricture and responded to endoureterotomy without re-stricture formation. These data indicate the efficacy and safety of laparoscopic transperitoneal approach [9]. In our study, all patients were discharged stone free without stone recurrence throughout the follow up period and were free of complications, indicating the safety and efficacy of a laparoscopic transperitoneal approach. In fact, the stone free rate for laparoscopic lithotripsy is reportedly higher than that for uretero-renoscopic or percutaneous nephron lithotripsy.

Laparoscopic ureterolithotomy is relatively easy, with stone free rates upto 100%, provided that expertise is available. However, laparoscopic ureterolithotomy in the distal ureter is less successful than in the middle and proximal ureter, although the size of the stone does not appear to influence outcome. According to the European guidelines, laparoscopic ureterolithotomy is not first line therapy in most cases, the indication of laparoscopic ureterolithotomy is limited for large or impacted stones.

Our reported mean duration of hospital stay of 5 ± 1days was superior to that previously reported by El-Feel *et al*.[10],who reported a mean hospital stay of 4.1 and 3.8 days, respectively, despite the absence of intraoperative or postoperative complication, but was also superior with Matias *et al*., [11]. Who reported a mean hospital stay duration of 3.3 Days. Duration of Hospital stay is increased due to prolonged drain placement till 4 days and proper post-operative ambulation of patients after adequate analgesic and infection control.

Almedia *et al*. reported that all patients had low pain VAS scores despite being lower in patients received neuroaxial anesthesia with significantly lower frequency of requests of postoperative analgesia compared to those received general anesthesia. Irrespective of the type of anesthesia, mean pain score was low and this could be attributed to minimal dissection and minimization of wound-related pain. The lower pain scores and the decreased consumption of postoperative narcotics allowed early ambulation and resumption of oral intake and spared the narcotic-related side effects, especially nausea and vomiting. Also, it was concluded that comparison of laparoscopic and open ureterolithotomy proved laparoscopy offering significant advantages over traditional open ureterolithotomy, resulting in improved analgesia and shorter hospital stays, but with similar complication rates [12]. In our study, all patients were operated in

general anesthesia, and post-operative pain was assessed and managed with non-narcotic analgesics.

Recoverability of renal function after obstruction depends on the level, the duration of the obstruction. Importantly, removal of stones did not cause either deterioration or improvement of the affected kidney function, however, improvement of obstruction was confirmed by DTPA scintigraphy, indicating that removal of large stones is useful for maintaining renal function in future.

It can be concluded that transperitoneal laparoscopic ureterolithotomy is safe and effective approach for selected patients with large proximal ureteric stones and can be considered as a treatment option for its advantages concerning consumption of postoperative analgesia and other medications with short-hospital stay. However, considering the limitations of the retrospective and non-comparative design of our study, larger scale prospective randomized controlled trials are mandatory to confirm the therapeutic yield for this option.

Conclusion

Transperitoneal laparoscopic ureterolithotomy is a safe and effective treatment option for select patients with large and impacted proximal ureteric stones and can used as a salvage procedure for SWL or ureteroscopy. The procedure has all of the advantages of laparoscopy

Including good cosmetic appearance and a short convalescence period.

Conflicts of interest

None

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