Laparoscopic transperitoneal pyelolithotomy as an alternative to percutaneous nephrolithotomy for stones in anomalous kidneys: a preliminary report

Anomalili böbreklerdeki taşların tedavisinde perkütan nefrolitotomiye alternatif olarak laparoskopik piyelolitotomi: Ön çalışma sonuçları

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Abstract

Objective: We report our experience with laparoscopic transperitoneal pyelolithotomy (LTPL) and percutaneous nephrolithotomy (PCNL) in the management of patients with calculi in anomalous kidneys.

Materials and methods: Data from 11 patients who underwent LTPL and 13 patients who underwent PCNL for kidney stones between May 2006 and August 2010 were retrospectively analyzed. A flexible nephroscope and holmium:YAG laser lithotripsy were used for stone clearance in 2 patients in LTPL group and 3 patients in PCNL group.

Results: The two groups were similar in age, body mass index, and sex; however, mean stone size was slightly greater in the PCNL group, although this difference was statistically insignificant. Mean operative time and hospitalization time were significantly higher in the LTPL group whereas estimated blood loss and mean postoperative analgesic requirement were significantly reduced in the LTPL group. There were no statistically significant differences in terms of stone size, complication rates, blood transfusion rates or stone-free status. There were no residual fragments in either group, and complete clearance was achieved in all the cases.

Conclusion: With an experienced surgical team, most cases of stone disease in congenitally abnormal kidneys can be treated laparoscopically with low postoperative morbidity and complication rates, a short convalescence time, and good functional results.

Key words: Anomalous kidney; laparoscopic pyelolithotomy; percutaneous nephrolithotomy; urolithiasis.

Özet

Amaç: Yazımızda anomalili böbreklerde görülen böbrek taşlarının tedavisi için uygulamış olduğumuz laparoskopik transperitoneal piyelolitotomi (LTPL) ve perkütan nefrolitotomi (PCNL) deneyimlerimizi sunduk.

Gereç ve yöntem: Mayıs 2006 ve Ağustos 2010 tarihleri arasında, böbrek taşı tanısıyla LTPL uygulanan 11 hastanın ve PCNL uygulanan 13 hastanın verilerini retrospektif olarak değerlendirdik. LTPL grubundaki 2 hastada ve PCNL grubundaki 3 hastada tam taşsızlık elde edilmesi amacıyla fleksibl nefroskop ve Holmium:YAG lazer litotripsi kullanıldı.

Bulgular: Her iki grup da yaş, vücut kitle indeksi ve cinsiyet bakımından benzerdi. Bununla birlikte, istatistiksel olarak anlamlı olmamakla birlikte taş boyutu, PCNL grubunda biraz daha büyüktü. LTPL grubunda ortalama ameliyat süresi ve hastanede yatış süresi daha uzun, tahmini kan kaybı ve postoperatif analjezik kullanımı daha az idi. Taş büyüklüğü, komplikasyon oranları, kan transfüzyonu oranları ve taşsızlık oranları bakımından her iki grup arasında istatistiksel anlamlı farklılık gözlenmedi. Her iki grupta da rezidüel taş fragmanı izlenmedi ve tüm olgularda tam taşsızlık elde edildi.

Sonuç: Deneyimli cerrahi ekip ile, konjenital anomalili böbreklerdeki taşlar laparoskopik yolla, iyi fonksiyonel sonuçlar ve hızlı iyileşmenin yanında düşük postoperatif morbidite ve komplikasyon oranları ile başarılı bir şekilde tedavi edilebilir.

Anahtar sözcükler: Anomalili böbrek; laparoskopik piyelolitotomi; perkütan nefrolitotomi; urolitiyazis.

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Congenital anomalies of the kidneys are common. Horseshoe kidneys are the most common type of fusion anomaly and are present in 1:400 of the general population.[1] A typical complication associated with this abnormality is stone formation due to urinary stasis and recurrent infections combined with metabolic abnormalities.[2,3] The ectopic position and altered anatomy of these kidneys require differences in approaches for stone management.[4] Various modalities, including shock wave lithotripsy (SWL), percutaneous nephrolithotripsy (PCNL), flexible ureteroscopy, laparoscopy and open surgery, have been used for renal calculi treatment. Although SWL and PCNL are the most commonly used techniques, there are some circumstances where these procedures result in suboptimal outcomes. SWL may be a reasonable choice for patients with a small stone burden and when urinary drainage is not hindered.[5,6] Although PCNL has been the treatment of choice for patients with large calculi,[7-9] it can result in major complications in anomalous kidneys.[10,11] With the improvement in laparoscopic techniques and instrumentation and the increasing experience of surgeons with laparoscopic surgery, this minimally invasive approach can become a realistic alternative for stone removal in congenitally abnormal kidneys.[12]

We report our experience with laparoscopic transperitoneal pyelolithotomy (LTPL) and PCNL in the management of patients with calculi in anomalous kidneys. This is the first study to compare the two techniques (LTPL and PCNL) in urolithiasis patients with anomalous kidneys.

Materials and methods

Patients

Data from eleven patients who underwent laparoscopic transperitoneal pyelolithotomy (LTPL) for kidney stones between May 2006 and August 2010 were retrospectively analyzed. Eight of the cases were horseshoe kidneys, and the rest were malrotated kidneys. These cases were compared with thirteen patients who underwent PCNL for renal calculi. In the PCNL group, ten patients had horseshoe kidneys, and three showed malrotation. Patients with stones smaller than 2 cm were excluded from the study. The data from the included patients were analyzed retrospectively. Preoperative stone characteristics and associated anomalies are detailed in Table 1. A complete blood count, urinalysis, urine culture, renal biochemistry, ultrasonography, intravenous urography (IVU), and a contrast-enhanced abdominal computed tomography (CT) scan were performed for all patients. All the patients had normal renal parameters, and all the laparoscopic and PCNL procedures were conducted by one surgeon (VT), with no conversions to open surgery.

On the first or second postoperative day, all patients underwent routine plain abdominal radiography and PCNL patients underwent nephrostography to check for residual stone fragments, leakage, and infrarenal obstruction. If the radiologic study revealed no obstructing stones, the nephrostomy tube was removed.

In the follow-up visits, patients were evaluated by urinalysis and urine culture, plain abdominal radiography, and ultrasonography along with IVU at the 6-month follow-up visit. Statistical analyses were performed using Fisher's exact test, student t test, chi square test, and the Mann-Whitney U test. A p value <0.05 was considered statistically significant.

Technique

The laparoscopic procedure was performed using a three- or four-port (5 mm and 10 mm, respectively) transperitoneal approach. The colon was insized

Table 1. Stone characteristics of patients

Groups	Number of patients	Preopertaive diagnosis
PCNL group	10	Horse-shoe kidney with pelvic stones+concomitant lower calyceal stones in 3 patients
	3	Malrotated kidney with pelvic stones
LTPL group	8	Horse-shoe kidney with pelvic stones+concomitant lower calyceal stones in 2 patients
	3	Malrotated kidney with pelvic stones

PCNL: Percutaneous nephrolithotomy, LTPL: Laparoscopic transperitoneal pyelolithotomy.

from the Toldt line and then mobilized. The ureter was identified and followed cranially. The renal pelvis was dissected. Stones in the renal pelvis were removed with an atraumatic grasper and placed in a laparoscopic bag (Fig. 1). For 2 patients in the LTPL group, a flexible nephroscope was passed through one of the 10-mm ports and guided laparoscopically. The kidney was systematically inspected, and lower calyceal stones were removed with a basket or fragmented using Holmium:YAG laser lithotripsy. The pelvis was closed with interrupted intracorporeal sutures using 4-0 vicryl. A percutaneous drain was placed, and the bag with the stones was removed.

PCNL was performed in the standard fashion; after retrograde pyelography (RGP), an end-hole ureteric catheter was left in the pelvis or upper ureter. All PCNL procedures were performed under general anesthesia. A single dose of second-generation cephalosporin (Cefuroxime axetil) was given intravenously. After ureteral catheterization, percutaneous access was achieved under fluoroscopy, using an 18-gauge access needle and with the patient in the prone position. A guidewire was inserted through the needle, and with the guidance of fluoroscopy, the catheter was advanced into the ureter or pelvicaliceal system. The tract was dilatated to 14F with fascial dilators, and a dual lumen catheter was inserted. A second guidewire was inserted as a safety guidewire through this catheter. Next, the tract was dilated with a high-pressure nephrostomy balloon catheter (NephroMax, Boston Scientific, Natick, MA, USA) inflated to a pressure of 16 atm using an inflator (LeVeen, Boston Scientific, Natick, MA, USA). Then, a 30F Amplatz working sheath was placed in the collecting system. Stone disintegration was performed with pneumolithotripsy as required. The stone fragments were removed through the rigid nephroscopes with grasping forceps. A flexible nephroscope was utilized extensively to reduce the need for additional accesses. For 3 patients in the PCNL group, a flexible nephroscope was passed through the access sheath and guided endoscopically. Lower calyceal stones removed with a basket or fragmented with Holmium:YAG laser lithotripsy. At the conclusion of the procedure, a 14F nephrostomy tube was inserted, and the operation was concluded.

Results

The preoperative, intraoperative and postoperative details are shown in Tables 2 and 3. The two groups were similar in age (39.00±10.84 years and 40.00±13.09 years in the PCNL and LTPL groups, respectively), body mass index (23.00±4.49 kg/m^2 and 24.00±4.67 kg/m^2 in the PCNL and LTPL groups, respectively) and sex; however, stone size was slightly greater in the PCNL group, although this difference was statistically insignificant. A flexible nephroscope with a basket or Holmium:YAG laser lithotripsy was used for 3 patients in the PCNL/horseshoe group and for 2 patients in the LTPL/horseshoe group because of the presence of lower calyceal stones. The complications encountered in the LTPL group were as follows: ileus in 1 patient, though this managed conservatively, mild wound infection in 1 subject and prolonged drainage (72 hours) in 1 patient. In the PCNL group, fever was noted in 2 patients, pleural injury in 1, bleeding in 1, which required a single unit of blood transfusion, and sepsis in 1 patient who recovered after medical treatment. Mean operative time was significantly higher in the LTPL group (130.00±36.19 min vs. 77.00±30.37 min), whereas estimated blood loss (50.00±33.69 mL vs. 346.15±71.82 mL) and mean postoperative analgesic requirement were significantly lower (1.23±0.60 days vs. 1.96±0.66 days) in the LTPL group compared with the PCNL group. Hospitalization time was also significantly longer (3.86±0.95 days vs. 2.88±0.61 days) in the LTPL group. There were no statistically significant differences between the groups in stone size, complication rates, blood transfusion rates and stone-free status.

There were no residual fragments in either group, and complete clearance was achieved in all the cases.

Discussion

Treating renal calculi in congenitally abnormal kidneys is challenging. SWL has been used to fragment stones in horseshoe kidneys, but this technique is associated with a low clearance rate and the need for auxiliary treatments.[13-15] However, SWL is safe and reliable and is the preferred therapy for stones <2 cm.[5,6]

PCNL is associated with several concerns regarding the management of stone disease in malformed kidneys, including abnormal position with abnormal renal and caliceal orientation, abnormal relations of calices to the renal pelvis and upper ureter, aberrant vasculature, relative kidney immobility impeding the maneuverability of rigid instruments, and abnormal relations with other organs, particularly the bowel.[7]

Table 2. Pre-operative characteristics of patients [mean±SD or n (%)]

		PCNL (n=13)	LTPL (n=11)	p value
Age (years)		39.00±10.84	40.00±13.09	0.840
Weight (kg)		62.00±7.55	67.00±15.48	0.345
BMI (kg/m^2)		23.00±4.49	24.00±4.67	0.599
Sex	Male	8 (61.5%)	6 (54.5%)	0.729
	Female	5 (38.5%)	5 (45.5%)	
Stone size (cm)		3.64±0.36	3.32±0.48	0.399
Type of anomaly	Horse-shoe	11 (84.6%)	8 (72.7%)	0.630
	Malrotated	2 (15.4%)	3 (27.3%)	
Side of anomaly	Right	4 (30.8%)	4 (36.4%)	1.000
	Left	9 (69.2%)	7 (63.6%)	

BMI: Body mass index, PCNL: Percutaneous nephrolithotomy, LTPL: Laparoscopic pyelolithotomy.

Table 3. Operative time, blood loss, drain extracting time, hospitalization time, analgesic requirement, and complication rates between two groups [mean±SD (median) or n (%)]

		PCNL (n=13)	LTPL (n=11)	p value
Operative time (min)		77.00±30.37	130.00±36.19	0.001
Drain extracting time (day)		2.19±0.75	3.50±1.07	0.001
Blood loss (mL)		346.15±71.82 (370)	50.00±33.69 (40)	0.001
Hospitalization time (day)		2.88±0.61 (3)	3.86±0.95 (4)	0.005
Analgesic requirement (day)		1.96±0.66 (2)	1.23±0.60 (1)	0.004
Complication	Yes	4 (30.8%)	3 (27.3%)	1.000
	No	9 (69.2%)	8 (72.7%)	

PCNL: Percutaneous nephrolithotomy, LTPL: Laparoscopic pyelolithotomy.

The abnormal relationship of the pelvicaliceal system with the surrounding viscera is an important issue that should always be kept in mind by all urologists because of the risk of visceral injuries, especially to the colon, during PCNL in patients with horseshoe kidneys.[9] Although none of the patients in our series suffered from bowel injury, prior reports have demonstrated the an increased risk of this complication.[10,11]

We used upper pole access in 46% of the PCNL procedures, with one pneumothorax approach. Mosavi-Bahar et al.[7] reported 2 mild pleural injuries in 16 patients with anomalous kidneys (7 horseshoe, 5 malrotated, 3 ectopic and 1 small kidney). Gupta et al.[9] reported their experience with 46 patients with anomalous kidneys (31 horseshoe, 4 crossed fused ectopic, 7 malrotated and 4 ectopic pelvic kidneys) and achieved complete clearance in all patients, similar to our results. The hospital stay length in our study was similar to that in their study (2.88 days vs. 3.2 days). Symons et al.[8] reported a stone-free rate in their series of 88% compared with 100% in our study. This difference may be due to stone size. They used PCNL for larger stones (mean digitized surface area of 614.32 mm^2), whereas we used PCNL for stones with a mean size of 3.64 cm. We used a flexible nephroscope in 2 patients compared with 1 in their series. They used multiple tract procedures in 10 patients (17%) compared with none in our series. We believe that the extensive use of a flexible nephroscope reduces the need for additional accesses and increases stone-free rates.

The laparoscopic approach has been previously reported for stone treatment, with successful results. Micali et al.[16] reported 17 patients who underwent laparoscopic stone extraction, including 11 with renal calculi and 9 with associated anomalies (ureteropelvic junction obstruction), with stone sizes up to 6 cm. Fifteen patients were eventually rendered stone free, and 1 patient showed postoperative urinoma. They concluded that indications for laparoscopy

Figure 1 Stone extraction from the renal pelvis following pyelolithotomy.

included stones associated with anatomical abnormalities requiring reconstruction and calculi for which previous endourological procedures had failed. Ramakumar et al.[17] reported a 90% stone-free rate in 19 patients who underwent laparoscopic pyelolithotomy and pyeloplasty. Stein et al.[18] reported laparoscopic pyeloplasty with concomitant pyelolithotomy in 15 patients with an overall stone-free rate of 80% and concluded that laparoscopic pyelolithotomy, primarily using laparoscopic graspers, is an efficient procedure associated with high stone-free rates and without a significant increase in operative time or morbidity. Intraoperative flexible nephroscopy may be necessary only occasionally for stone retrieval. Nadu et al.[19] reported their experience with laparoscopy on 13 patients with renal stones and concomitant urinary anomalies. The stone-free rate in there study was 77% (10 of 13 patients), which became 100% after one ancillary treatment in the remaining patients, compared with 100% in our study. In their study, 1 patient had postoperative urine leakage, which was the same as in our study.

Our experience shows that PCNL and LTPL are both effective treatments for removing calculi from anomalous kidneys. Although mean operative time (130.00±36 min vs. 77.00±30.37 min) and mean hospital stay (3.86±0.95 days vs. 2.88±0.61 days) were significantly higher in the LTPL group compared with the PCNL group, estimated blood loss (50.00±33.69 cc vs. 346.15±71.82 cc) and mean postoperative analgesic requirement (1.23±0.60 vs. 1.96±0.66) were significantly lower. There was no significant difference in overall complication rates, but there was one pneumothorax case in the PCNL group.

In this study, we compared two small patients series in a retrospective fashion, which is the primary limitation of this paper. However, we believe that these experiences will contribute to the development of this new and scarcely studied approach.

As a conclusion, although PCNL is an effective treatment for stones in congenitally abnormal kidneys and has excellent stone-clearance rates, it is associated with serious complications. With an experienced surgical team, most cases of stone disease in congenitally abnormal kidneys can be treated laparoscopically with low postoperative morbidity and complication rates, a short convalescence time and comparably good functional results.

Conflict of interest

No conflict of interest was declared by the authors.

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