LAPAROSCOPY
Original Article

Laparoscopic transperitoneal and retroperitoneal simple nephrectomy: The impact of etiological factors of the results of surgical treatment

Laparoskopik transperitoneal ve retroperitoneal basit nefrektomi: Etiyolojik faktörlerin cerrahi tedavi sonuçları üzerine etkisi

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ABSTRACT

Objective: This retrospective study compares the perioperative outcomes of laparoscopic simple nephrectomy (LSN) in patients with urinary stone disease (USD) in comparison with LSNs performed for other etiological factors.

Material and methods: 115 LSNs were identified from the two teaching hospitals' database. Depending on the etiological factors, patients were stratified in 2 groups. Group 1 consisted of 63 (mean age 44.8±1.7 [21-71] years) patients; where the cause of non-functioning kidney was USD. Meanwhile, Group 2 included 52 (mean age was 43.6±2.0 [19-78] years) patients; who underwent LSN because of other benign diseases. In both groups, a standardized transabdominal or retroperitoneal approach was used according to the discretion of the attending surgeon. Two groups were compared statistically in terms of perioperative parameters and standardized surgical complications.

Results: The use of transperitoneal approach was higher in Group 1 (69.8% vs. 30.2%) compared to Group 2 (51.9% vs. 48.1%). Elective open conversion was needed in 3 and 2 patients in Groups 1 and 2, respectively. The results for mean operative time (108.9±4.0 min vs. 106.7±5.0), estimated blood loss (92.5±8.2 vs. 86.8±10.1 mL) and length of hospital stay (4.1±0.33 vs. 3.85±0.42 days) were similar between the groups. Despite intraoperative complications were similar between the groups, overall post-operative complications were significantly higher (17.5% vs. 3.8%) in Group 1. However, the rate of significant complications (Clavien 3-5) was similar between the groups.

Conclusion: The present study revealed that perioperative outcomes of patients undergoing LSN for USD are similar to those seen in patients undergoing LSN for other etiological factors.

Keywords: Complication; laparoscopy, nephrectomy; transperitoneal.

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ÖZ

Amaç: Bu retrospektif çalışma üriner taş hastalığı (ÜTH) olanlarda laparoskopik basit nefrektominin (LBN) ve başka etiyolojik faktörler için uygulanmış LBN'lerin perioperatif sonuçlarını karşılaştırmaktadır.

Gereç ve yöntemler: İki eğitim hastanesinin veri tabanından 115 LBN tespit edilmiştir. Etiyolojik faktörlere bağlı olarak hastalar iki gruba ayrılmıştır. Grup 1, afonksiyonel böbrekte nedenin ÜTH olduğu 63 (yaş ortalaması: 44.8±1.7 [21-71] yıl) hastayı içermekteydi. Bu arada Grup 2, başka benign hastalıklar için LBN geçirmiş 52 (yaş ortalaması: 43.6±2.0 [19-78] yıl) hastayı içermekteydi. Her iki grupta ilgili cerrahın kararına göre standartlaşmış transabdominal veya retroperitoneal yaklaşım kullanılmıştı. İki grup istatistiksel olarak perioperatif parametreler ve standardize edilmiş komplikasyonlar açıdan karşılaştırılmıştı.

Bulgular: Transabdominal yaklaşımla karşılaştırıldığında Grup 2'ye (%48,1'e karşın %51,9) göre Grup 1'de (%30,2'e karşın % 69,8) transperitoneal yaklaşım daha fazla kullanılmıştı. Group 1'de 3 ve Grup 2 'de 2 hastada elektif olarak açık cerrahiye geçiş gerekmiştir. Her iki grupta ortalama ameliyat süresi (108,9±4.0 dk'ya karşın 106,7±5,0 dk), tahmini kan kaybı (92,5±8.2 mL'e karşın 86,8±10,1 mL) ve hastanede yatış süresi (4,1±0,33 güne karşın. 3,85±0.42 gün) benzemekteydi. Gruplar arasında intraoperatif komplikasyonlar benzer olmasına rağmen genellikle postoperatif komplikasyonlar Grup 1'de daha yüksek (%3,8'e karşın %17,5) orandaydı.Ancak önemli komplikasyonların oranı (Clavien 3-5) gruplar arasında benzerlik göstermekteydi.

Sonuç: Bu çalışma ÜTH için LBN geçirmiş hastaların perioperatif sonuçlarının diğer etiyolojik faktörler için LBN geçiren hastalarda görülenlere benzer olduğunu ortaya koymuştur.

Anahtar Kelimeler: Komplikasyon; laparoskopi, nefrektomi; transperitoneal.

Introduction

Urinary stone disease (USD) is an important health problem worldwide that affects both adults and children. Its prevalence increased in time from 6.3% to 10.6% in the last 15 years.[1] It is estimated that 1 of 11 Americans currently have USD or had before. This increase is thought to be associated with increasing prevalence of obesity and type 2 diabetes.[1,2] Longstanding urinary stones may lead to hydronephrosis and non-functioning kidneys with a pathological process including renal parenchymal atrophy, chronic pyelonephritis and lastly xantogranulamatous pyelonephritis. Meanwhile, inflammatory infiltrate involving diffusely or focally renal parenchyma and perirenal soft tissues caused by long-term obstruction and infection generally leads to loss of surgical planes during nephrectomy.[3] Thus, many authors have noted the technical difficulties of performing this surgery to these non-functioning kidneys.[4,5]

In the modern era, minimally invasive surgery has become the standard treatment for most of the urological pathologies.[6-8] After introduction of laparoscopic nephrectomy, this method has gradually gained widespread recognition.[2,3] Laparoscopic nephrectomy has many advantages as compared with the open method such as less intraoperative blood loss, decrease in postoperative pain, shorter hospital stay, faster recovery and good cosmetic outcomes even in the worst patients' conditions.[9-11]

Accordingly, the objective of the present study is to compare intraoperative and early postoperative results of laparoscopic simple nephrectomy (LSN) in patients with USD versus other etiological factors resulting in non-functional kidney. Despite some evidence available in the literature about the surgical outcomes of LSN performed for other etiological factors such as inflammatory conditions; a few studies specifically focused on LSNs associated with USD.[12-14]

Material and methods

The present study includes the retrospective analysis of patients who underwent simple LN between January 2010-January 2015 for non-functioning kidney in Urology departments of Istanbul University, Istanbul Faculty of Medicine and Azerbaijan Medical University. The database used in this study was adopted from the University of Michigan Laparoscopy Database Chart Abstraction Form and includes demographic operative and follow-up information from more than 1200 patients.[15] This chart also includes complications categorized according to the modified Clavien classification of surgical complications.[16]

Indications for LSN were severe renal hypofunction (<10% at DMSA renal scan), persistent renal pain, recurrent infection or complications depending on the underlying pathology such as pyonephrosis, abscess formation or fistulisation. All patients were also evaluated with ultrasonography and the diagnosis and

underlying etiological factors were confirmed with intravenous urography and/or computerized tomography (CT). Depending on the etiological factors resulted in the non-functional kidney; the patients were divided into 2 groups. The first group included 63 patients (mean age 44.8±1.7 [21-71] years) in whom the cause of non-functioning kidney was USD. Meanwhile, the second group included 52 patients (mean age was 43.6±2.0 [19-78] years) with various other etiological factors leading to loss of kidney function.

Surgical technique: In transperitoneal procedures, the patient was placed in a modified flank position with an angle of 45°-60°. For creating pneumoperitoneum, a Veress needle was inserted lateral to the umbilicus and 10 mm camera port was placed. In the right sided cases, a 12 mm second port was placed between the anterior superior iliac spine and umbilicus. Meanwhile, the third port with a size of 5 mm was placed at the midclavicular line 2 cm below the costal margin. A similar triangular configuration was also used for the left sided cases, except the size of the second and third trocars were changed. Dissection was started by incision of the white line of Toldt and ascending or descending colons were reflected medially depending on the side of nephrectomy to expose retroperitoneum. Afterwards, the ureter was identified and dissected up to the renal hilum to identify renal artery and vein which were ligated with 3 Hem-o-lock clips before transaction. Accordingly, the specimen was removed after release of the remaining tissues.

In retroperitoneoscopic technique, the patient was placed in a full-flank position and 2 cm incision was made to Petit triangle to introduce balloon dilator through toracolumbar fascia. After creation of the retroperitoneal space with balloon dilator, 3 trocars were placed with the aid of fingertip that was inserted to the retroperitoneal space through the incision at Petit triangle. For the left sided cases, a 12 mm trocar was inserted at the tip of the 12th rib and a 5 mm trocar was inserted 3 cm above the anterior superior iliac spine. In the right sided cases, the 12 mm and 5 mm ports were reversed and for both sides the incision at the Petit triangle was used for insertion of 12 mm camera port. After placement of the ports, Gerota's fascia was opened by sharp dissection and ureter was identified at the retroperitoneum

Table 1. Demographic parameters of the patients			
Parameters		**Group I (n=63)**	**Group II (n=52)**	**p**
Mean age (years)		44.8±1.7 (21-71)	43.6±2.0 (19-78)	0.525
Gender	Male	33 (52.4%)	13 (25.0%)	0.003
	Female	30 (47.6%)	39 (75.0%)	0.003
Side	Right	37 (58.7%)	19 (36.5%)	0.18
	Left	26 (41.3%)	33 (63.5%)	0.18
BMI (kg/m²)		26.8±0.4 (19-38)	26.5±0.5 (20-37)	0.592
BMI: body mass index				

for being used to as s guide to reach renal artery and vein at the renal hilum. After ligation of the both vessels with 3 Hem-o-lock clips and consequent transaction, the remaining attachments of the kidney were released and removed.

Statistical analysis
Statistical studies of materials processing has been done by rank by using the IBM Statistical Package for the Social Sciences 20 (IBM SPSS Statistics; Armonk, NY, USA) program. The Student's t test, the Mann-Whitney U test, Pearson Chi-square test and Kruskal-Wallis teste were used where appropriate. P values <0.05 were considered as significant.

Results

General: Demographic parameters of the study cohort were given in Table 1. Overall, 21 of 115 (18.2%) patients had history of surgical interventions involving urinary tract. Times of the previous surgeries were ranging from 1 month to 25 years. For Group 1, these were pyelolithotomy in 4, open nephrolithotomy in 2, open ureterolithotomy in 1 (for mid-upper ureter), percutaneous nephrolithotomy (PCNL) in 2, ureteroscopic lithotripsy in 3 patients. Subsequently, these were failed open pyeloplasty in 1, failed single port pyeloplasty in 1, ureteroneocystostomy in 1 and injection therapy for vesicoureteral reflux in 2, vesicovaginal repair in 1, urethrotomy intern in 1 patient, for Group 2. Meanwhile, 3 patients in this group had history of nephrostomy tube placement. In addition, 3 and 1 patients had hysterectomy and hemicolectomy (leading to hydroureteronephrosis), respectively. Consequently, 9 (14.2%) patients in Group 1 (pyelolithotomy, open nephrolithotomy, PCNL) and 5 (9.6%) patients group 2 had previous surgeries (failed open and single port laparoscopic pyeloplasties and nephrostomy tube placement) that may affect LSN.

Evaluation of Group 1: In this group, the concomitant diseases were hypertension (n=19), diabetes mellitus (n=6), ischemic heart disease (n=4), hypothyroidism (n=2), heart failure (n=1) and chronic renal failure (n=1). The etiological reason for nonfunctioning kidney in 52 (82.5%) patients was existing kidney stones. Of these, 16 have been observed staghorn calculi or multiple stones with large stone load. Meanwhile, 11 (17.5%) patients, the cause of non-functioning kidneys were the ureteral stones leading to significant hydroureteronephrosis.

In this group, LSN was performed in 44 patients (69.8%) by transperitoneal access (including 9 nephroureterectomies) and in 19 (30.2%) patients through retroperitoneoscopic route (including 1 nephroureterectomy). The right and left sided simple nephrectomies were performed in 37 (58.7%), and the 26 patients (41.3%) patients, respectively.

In group 1, the mean operative and insufflation times were recorded as 108.7±3.9 (50- 230) min and 97.4±3.8 (40-210) min., respectively. The mean intraoperative blood loss was found to be

92.5±8.2 (20-400) mL. Conversion to open surgery was necessitated in 3 patients (4.8±2.7%); where the cause was multiple adhesions in all cases. Intraoperative complication occurred in 1 case (1.6%); which was due to damage to the renal vein leading 300 ml of blood loss. This complication was eliminated laparoscopically without open conversion.

In 30 (47.6%) patients, the gross specimen has been removed through one of the port sites. Meanwhile, the same number of patients received Gibson's incision and in 3 cases (4.8%) an incision bridging the ports was used. During surgery all patients were installed a drainage tube, and the drainage time ranged 2 to 15 (mean 3.16±0.21) days.

In this group, 11 (17.5%) (p<0.05), cases experienced postoperative surgical complications. Nine of these patients had fever in the postoperative period (Clavien I). Meanwhile, 1 case needed blood transfusion (Clavien II), and 1 patient experienced paralytic ileus (Clavien IVa) after surgery. The mean length of hospital stay of the patients was found as 4.1±0.33 (2-17) days.

Pathological examination of this group of patients revealed various benign renal pathologies; whereas 4 patients were found to have concomitant pyonephrosis. Any kind of malignancies such as renal cell or urothelial carcinomas were not encountered in any of the patients.

Evaluation of Group 2: In Group 2, the concomitant diseases and conditions were hypertension (n=15), CRF (n=4 [3 under hemodialysis]), diabetes (n=3), ischemic heart disease (n=2), hypothyroidism (n=2), chronic heart failure (n=1), pulmonary tuberculosis (under medical therapy, n=1), rectal cancer (n=1), cervical cancer (n=1). Etiological causes that resulted in the functional kidney loss were as follows: ureteropelvic junction (UPJ) obstruction (n=20, 38.8%), nephrosclerosis (n=13, 25%), pyonephrosis (n=7, 13.5%), vesicoureteral reflux (n=5, 9.6%), arteriovenous fistula (n=1, 1.9%), kidney tuberculosis (n=1, 1.9%), hydronephrosis after vesicovaginal fistula repair (n=1, 1.9%), ureteroneoocystostomy (n=1, 1.9%) and ureteral strictures (n=2, 3.8%) after hemicolectomy and diagnostic ureteroscopy.

In this group, right-sided laparoscopic nephrectomies were performed in 19 cases (36.5%); while the left-sided nephrectomies were done in 33 (63.5%) patients. Nephrectomies were performed in 27 (51.9%) patients through transperitoneal access (3 of them were nephroureterectomies); whereas it was performed with retroperitoneoscopic access in 25 (48.1%) patients (5 received nephroureterectomy).

In group 2, the mean operation time was 106.7±6.3 (40-240) min. whereas; insufflation time was 95.9±6.3 (30-230) minutes. The mean intraoperative blood loss was calculated as 86.8±10.1 (20-250) mL. In this group, conversion to open surgery was re-

Table 2. Operative and postoperative data of patients

Intra and postoperative parameters	Group I	Group II	p
Number of ports	3.16±0.05 (3-5)	3.12±0.04 (3-4)	>0.05
Mean operation time (min.)	108.9±4.0	106.7±5.0	>0.05
Mean insufflations time (min.)	97.5±3.9	86.8±8.4	>0.05
Estimated blood loss (mL)	92.5±8.2	86.8±10.1	>0.05
Open conversion (%)	4.8±2.7	3.8±2.7	>0.05
Intraoperative complications (%)	1.6±1.6	1.9±1.9	>0.05
Drainage left (days)	3.16±0.21	2.87±0.13	>0.05
Maximum length of the specimen (cm)	11.21±0.45	9.71±0.48	<0.05
Postoperative complications (%)	17.5±4.8	3.8±2.7	<0.05
Mean hospital stay (days)	4.1±0.33	3.85±0.42	>0.05

quired in 2 (3.8%) patients due to perirenal adhesions. Intraoperative complications occurred in 1 (1.9%) case. In this patient, the renal vein was damaged and this situation was managed without conversion to open surgery. In this group, all patients were also provided with the drainage tube for 2 to 6 (mean 2.87±0.13) days.

In 18 (34.6%) patients, surgical specimen was removed through the Gibson's incision; whereas expanding the port incision was used in 32 (61.5%) patients and a small additional incision bridging 2 ports was needed in 2 (3.8%) cases.

Postoperative complications were observed in 2 (3.8%) patients. These were pneumonia (Clavien II) in 1 patient and pleural effusion (Clavien IIIa) in 1 patient. The mean hospital stay of patients in Group 2 was 3.85±0.42 (2-18) days.

The pathological examination of surgical specimen in Group 2 revealed various benign renal pathologies. Among these 1 had concomitant pyonephrosis. Meanwhile, 3 patients were reported to have segmental xantogranulamatous pyelonephritis, 1 had urinary tuberculosis and 1 had arterio-venous fistula. Malignancies such as renal cell or urothelial carcinomas were not detected in any of the patients.

Comparison of Groups 1 and 2: Table 2 represents the parameters that were compared for the comparison of the study groups. According to our analysis, the only statistically significant parameters were laparoscopic access (transperitoneal vs. retroperitoneal) maximum length of the specimen (11.2±0.45 vs. 9.79,71±0.48 cm) and postoperative complications (17.5% vs. 3.8%, p<0.05). However, the rate of significant complications (Clavien 3-5) was found to be similar between the groups (1.55 vs. 1.9%, 1 patient in each group).

Discussion

Laparoscopic simple nephrectomy in USD is not always simple because of the significant perirenal adhesions associated with infectious, inflammatory and fibrotic components of the underlying diseases. Meanwhile, previous renal surgeries (21 of 115 [18.2%] patients in the present cohort) or interventions (such as nephrostomy tube placement) also contribute to the complexity of the surgery. For this reason, it was proposed to change the term "simple nephrectomy" to "benign nephrectomy" for preventing underestimation of the surgery.[17] Recently, Zelhof et al.[17] retrospectively evaluated all nephrectomies performed for non-malignant conditions in the United Kingdom in 2012. They reported that stone disease patients had the highest intraoperative (9.9%) and postoperative complications (23.9%) in comparison with other benign pathologies; such as non-functioning kidney (3.7% vs. 9.1%), pyelonephritis (7.0% vs. 13.2%) and other benign diseases (4.9% vs. 10.5%). Recently, Angerri et al.[18] retrospectively evaluated 96 cases with LSN for USD and reported 7 (7.2%) conversions to open surgery because of the difficulties during hilar dissection. Meanwhile, the authors faced significant intraoperative complications such as limited tear of vena cava and incomplete resection of the juxtaaortic renal vessels. In addition 3 patients needed to have reoperation due to intestinal obstruction due to adhesions, pleural injury and spleen laceration, respectively. Similarly, Kaba et al.[19] reported significant complications in 2 of 15 patients with USD who underwent transabdominal LSN. One of these was colon perforation repaired with laparoscopic technique and uncontrollable venous bleeding from the renal hilum requiring conversion to open surgery.

In our series, 2 cases (1 case in each group) had renal vein injury during hilar dissection which leaded to significant bleeding. In both cases, intraabdominal pressure was increased initially and an additional port was placed. The latter step was for better aspiration of the surgical field and elevation of the lower pole of the kidney. This additional port allowed the surgeon to use both hands for controlling the bleeding. We also found that the rate of post-operative complications were significantly higher in group 1. However, most of these complications were mild such as fever and blood transfusion and the rate of significant complications (Clavien 3-5) was similar in both groups despite the significant rates of previous surgeries involving urinary tract in both groups. Consequently, LSN performed for USD should be considered as one of the most challenging procedures in laparoscopic urology. Furthermore, we believe that it should be categorized as at least "difficult" instead of "fairly difficult" in European Scoring system (ESS) according to its technical difficulties.[20]

As mentioned before, the loss of anatomical dissection planes in patients with stone disease prone the patient to intra and postoperative complications. In this situation, a prudential decision

might be converting to "elective open surgery". In our experience, conversion to open to surgery after a significant complication such as bleeding is more challenging. First of all, in an urgent situation the surgeon should be as fast as he/she can for fixing the complication. However, the race over time may give rise to the other complications. For example, one may damage bowel while opening a flank incision or tear vena cava while trying to clamp a bleeding in renal vein. Secondly, approach to the area where surgical complication happened generally is not as exquisite as a standard open approach. Because, during laparoscopic nephrectomy in either transabdominal or retroperitoneal access, a limited dissection; such as elevation of the lower pole with the aid of ureter, is generally being done without the release of the entire kidney. This limited dissection mostly does not allow adequate field for surgical maneuvers for the correction of the complication. Moreover, additional dissections might be needed; consuming utmost valuable time for the patient. Thirdly, surgical team including anesthesiologist (and/or medical instruments) might not be prepared for an open conversion and this preparation may also take time. For these reasons, we prefer to use elective conversion to open surgery; if we have significant difficulties in finding correct surgical dissection planes. In the present cohort, elective conversion to open surgery was required in 5 (4.3%) of 115 patients and postoperative courses of these patients were uneventful.

Despite these problems, we found that perioperative parameters such as operation time, estimated blood loss and length of hospital stay was not different between groups 1 and 2. Similarly, Tepeler et al.[21] conducted a match pair analysis for age, BMI and previous renal surgery for the comparison of patients undergoing retroperitoneoscopic nephrectomies for USD compared to other benign pathologies. Although, the mean operation time was longer in patients with USD, they did not find any significant difference between the groups with respect to mean hemoglobin drop and mean hospitalization time. Similarly, Kaba et al.[19] detected no significant difference in terms of these parameters similar to our study. Thus, we think that LSNs associated with USD have similar outcomes with LSNs performed for other etiological factors in experienced hands.

The present study revealed that; we prefer transabdominal approach more than retroperitoneal approach for the nephrectomies performed for USD. We have several explanations for this outcome. Transperitoneal approach offers a large working space which is a major advantage especially for the large hydronephrotic kidneys. Meanwhile, anatomic landmarks such as liver, spleen and colon facilitate orientation during operation. Also additional ports do not cause "clashing of swords" that is frequently encountered in retroperitoneal route. On the contrary, retroperitoneoscopic surgery is; to our opinion, suitable for non-hydronephrotic or mildly hydronephrotic kidneys in which large working space is not that much required. Meanwhile, 90° flank offers additional advantages, such as the avoidance of transab-

dominal fatty tissue and pannus. Moreover, direct access to renal hilum with limited dissection of the kidney also eases the most critical part of the operation. Consequently, despite preference of approach either transperitoneal or retroperitoneal is mostly dependent on the education and experience of the laparoscopist; disease related issues such as volume of the kidney, previous operations, past infectious episodes or existence of pyonephrosis, radiographic appearances should be taken into consideration for the decision of the surgical approach.

The present study is not without limitations. LSNs in this report were performed by surgeons with different levels of experience including trainees. However, since both institutions are teaching hospitals, we think that; this heterogeneity in surgical experience is inevitable. Meanwhile, retrospective nature of the study is another downside of this report that is worth to be mentioned. In addition, we plan to compare the outcomes of transperitoneal and retroperitoneal approaches in patients who underwent LSN for USD in a future study including extended number of patients.

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