Comparison of the outcomes of Laparoscopic and Open Nephrectomy in Rajavithi Hospital

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Background: *Since the first report of its use by Clayman et al in 1991, laparoscopic nephrectomy (LN) has been employed worldwide as a new alternative therapy for both benign and malignant diseases. The current study focuses on a comparison of the peri-operative and postoperative outcomes of LN and open nephrectomy (ON) and describes surgical techniques used in LN in Rajavithi Hospital.*
Objective: *To compare the peri-operative and postoperative outcomes of laparoscopic (LN) and open nephrectomy (ON) and to report surgical techniques used in laparoscopic nephrectomy in Rajavithi Hospital.*
Material and Method: *This was a retrospective study of the data of 97 patients who underwent open and laparoscopic nephrectomy by a single surgeon in Rajavithi Hospital between 1 May 2007 and 31 December 2016. Fifty-three patients who underwent LN were compared with 44 patients who had ON in terms of demographic, clinical and pathological data. The data collected were operative time, intra-operative blood loss, blood transfusion rate, post-operative analgesic drug use, time to return to normal activity, length of hospital stay, post-operative complications and size of surgical wound.*
Results: *No statistical significance was observed between ON and LN with respect to age, sex, underlying disease, ASA grade, tumor location, tumor stage or number of cancer cases in each group. There was a significant difference in estimated blood loss between ON and LN (871.59±1,125.62 ml vs. 290.00±262.00 ml, respectively; p = 0.002). There was also a significant difference in number of doses of post-operative analgesic drugs (2.64±2.31 doses vs. 0.91±0.98 doses, respectively; p<0.001) and length of hospital stay (8.91±3.89 days vs. 6.58±1.87 days, respectively; p = 0.001). Size of surgical wound was also significantly different (15.66±3.62 cm vs. 3.68±0.58 cm, respectively), and there were significant differences in complication rates, with 31.0% in ON and 13.2% in LN (p = 0.039). There was no mortality in either group of patients.*
Conclusion: *LN is a feasible, safe and effective procedure. Surgical outcomes with LN offer the advantages of decreased blood loss, fewer blood transfusions, reduced postoperative pain, shorter length of hospital stay, and early convalescence with improved cosmetic appearance of surgical wound.*

Keywords: *Kidney, Kidney neoplasms, Nephrectomy, Laparoscopy*

J Med Assoc Thai 2018; 101 (Suppl. 2): S103-S108
Full text. e-Journal: *http://www.jmatonline.com*

Nephrectomy provides effective therapy in patients with benign or malignant kidney disease, but open nephrectomy requires a large subcostal or flank incision and can cause significant postoperative pain and complications[1]. Since the report of its first use by Clayman et al in 1991[2], laparoscopic nephrectomy (LN) has been widely utilized as a novel alternative therapy for these types of patients[3-7]. In this era, minimally-invasive surgery-urology (MIS-U) techniques and instruments have been substantially developed and now allow MIS-U to be applied with many urologic modalities of treatment for both benign and cancerous diseases. In Rajavithi Hospital, LN was first used in 2003, and the technique has since been developed to improve surgical outcomes. The current study focuses on a comparison of the peri-operative and postoperative outcomes of LN and open nephrectomy (ON) and details surgical techniques used in LN in Rajavithi Hospital.

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Material and Method

After receiving the approval of the Ethics Committee of Rajavithi Hospital, we retrospectively reviewed the medical records of 97 patients who underwent nephrectomy by a single surgeon at Rajavithi Hospital between 1 May 2007 and 31 December 2016. Fifty-three patients underwent LN and 44 patients had ON during the same period. Patient

characteristics and intra-operative parameters were obtained including age, sex, BMI, underlying disease, symptoms, American Society of Anesthesiologists (ASA) class, specimen dimensions, tumor size, tissue pathology, surgery duration (time of first incision to surgery end time), estimated blood loss (EBL), postoperative analgesia, day of postoperative ambulation, day of postoperative catheter removed, day of redivac drain removal, day of postoperative full diet intake, length of hospital stay, wound size and complications. Statistical analyses were performed using the non-parametric Mann-Whitney Test and Chi-square test, and the parametric Student t-test. Statistical significance was set at $p<0.050$. Open nephrectomy operations were performed by subcostal or flank incision. All laparoscopic and open procedures were performed by a single surgeon (Tanet Thaidumrong, MD) with urology residents as the assisting surgeons. Regardless of presumed pathology (benign vs. malignant), all patients underwent a radical nephrectomy dissection. Trans peritoneal LN was used exclusively. Patients with a solid renal lesion and benign renal disease underwent intact specimen removal. The technique of trans peritoneal LN was performed using a 3- or 4- trocar approach (left LN: 3-trocars, right LN: 4 trocars) as shown in Fig. 1. Laparoscopic nephrectomy was performed with the first trocar at the umbilicus using the open technique, and the other trocars under laparoscopic vision as shown in Fig. 1.

The colon was identified and the peritoneum was incised at the white line of Toldt. The colon was dissected reflex medially, and the gonadal vein and ureter were elevated to the abdominal wall by a striated needle hanging suture. Dissection was performed along the ureter above the Psoas muscle to identify the renal pedicle. The renal artery and vein underwent double ligation using a vascular clip, and the upper pole and lateral attachment of the kidney were dissected. Ligation of ureter and gonadal vein was performed by a vascular clip. The renal specimen was retrieved into the specimen bag which was removed through the umbilical trocar by a mini-extended umbilical incision as shown in Fig. 2.

Results

The LN and ON groups were comparable with regard to patient characteristics (Table 1). No statistical significance was observed in terms of age, sex, smoking, alcoholic consumption, underlying disease, ASA grade, tumor location, tumor stage or number of cancer cases in each group.

Table 2 lists the surgical outcomes of the two treatment modalities. There was a significant difference in estimated blood loss between ON and LN (871.59±1,125.62 ml vs. 290.38±262.37 ml, respectively; $p = 0.002$). The number of blood transfusion units was 1.14±2.01 for ON and 0.26±0.56 for LN ($p = 0.002$). There was a significant difference in number of doses of post-operative analgesic used (morphine 4 mg intravenous injection) between ON and LN (2.64±2.31 doses vs. 0.91±0.98 doses, respectively; $p<0.001$) and last day of postoperative analgesic drug used (0.75±0.78 days vs. 1.80±1.02 days $p<0.001$). The postoperative day to return to normal diet intake was 4.66±2.73 days for ON and 3.11±0.72 days for LN ($p = 0.001$). There was a significant difference in length of hospital stay (8.91±3.89 days for ON and 6.58±1.87 days for LN; $p = 0.001$), and the size of surgical wound was significantly longer in ON than in LN (15.66±3.62 cm and to 3.68±0.58 cm, respectively). No statistical significance was observed

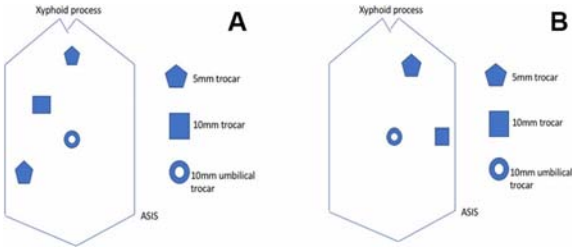

Fig. 1 Trocar position left and right laparoscopic nephrectomy. A) Trocar position of laparoscopic (4 trocars), B) Trocar position of laparoscopic left nephrectomy (3 trocars).

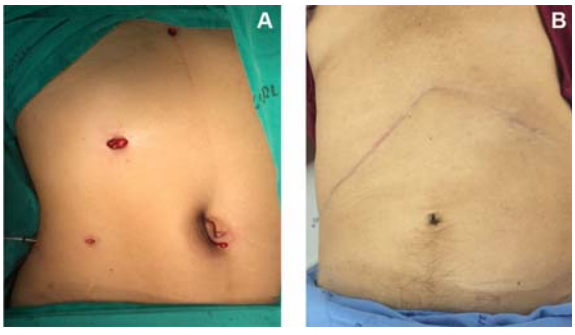

Fig. 2 Surgical wound laparoscopic nephrectomy and open radical nephrectomy. A) Laparoscopic right radical nephrectomy, B) Open right radical nephrectomy.

between ON and LN in terms of operative time, or time to removal of catheter and tube drain. Pathologic findings showed no significant difference between LN and ON with regard to pathologic diagnosis, cell type of renal cell carcinoma (RCC) or pathologic tumor stage. There was no positive surgical margin in either group of patients, as shown in Table 3.

Operative complications and their treatments are listed in Table 4. There were significant differences in complication rates, with 31.0% in ON and 13.2% in LN (p = 0.039), as shown in Table 4, but there was no mortality in either group of patients.

Discussion

Since the report of the first use of LN by Clayman et al in 1991[2], it has been applied widely as a novel alternative therapy in this category of patients. ON and LN are relatively recent techniques and have been significantly developed for treating patients with renal cell carcinoma and non-cancerous kidney disease. They represent accepted standards of care in those diseases and normal contralateral kidney[1]. Moreover, owing to dramatic improvements in laparoscopic techniques and instruments, the indications for LN have expanded to include larger, more complex masses, as

Table 1. Demographic data between LN and ON (n = 97)

	LN (n = 53)	ON (n = 44)	*p*-value
Demographics (mean±SD)			
Age (years)	56.15±14.06	54.00±15.23	0.472
Weight (kg)	60.32±14.21	60.80±11.17	0.855
Height (cm)	157.49±9.02	158.91±9.10	0.445
BMI(kg/m^2)	24.35±4.38	23.83±4.65	0.575
ASA class (%)			
1	37.7	29.5	0.320
2	34.0	47.7	
3	28.0	22.7	
Sex men/women (%)	50.9/49.1	45.5/54.5	0.587
Underling disease (%)	32.0	21.0	0.213
Tumor in each group (%)	45.3	38.9	0.870

Values are represented as Mean ± SD, %, LN = laparoscopic nephrectomy, ON = open nephrectomy

Table 2. Intraoperative and post-operative dataof LN and ON (n = 97)

	LN (n = 53)	ON (n = 44)	*p*-value
Intra-operative outcomes			
Operative time (min)	249.53±57.01	271.82±88.55	0.154
EBL(ml)	290.38±262.37	871.59±1125.62	0.002*
Blood transfusion (unit)	0.26±0.56	1.14±2.01	0.008*
Analgesic drug use (dose)	0.91±0.98	2.64±2.31	<0.001*
Last date of post operative analgesic drug use	0.75±0.78	1.80±1.02	<0.001*
Post operativeoutcomes			
time of tube drain remove (day)	4.77±2.10	5.70±2.91	0.080
time of catheter remove (day)	2.26±1.21	3.00±2.25	0.560
time of full diet intake (day)	3.11±0.72	4.66±2.73	0.006*
LOS (day)	6.58±1.87	8.91±3.89	0.001*
Size of surgical wound(cm)	3.68±0.58	15.66±3.62	<0.001*

Values are represented as Mean±SD, %, LN = Laparoscopic Nephrectomy, ON = Open Nephrectomy, LOS = length of hospital stay
* = significant at p<0.05

Table 3. Pathologic findings of LN and ON (n = 97)

	LN (n = 53)	ON (n = 44)	*p*-value
Pathologic findings(%)			
RCC	37.7	31.8	0.179
Other malignancy	7.5	6.9	
Benign	54.8	61.3	
RCC tumor subtype in cancer group(%)			
Clear cell	90.0	93.5	0.925
Papillary	5.0	0.0	
Other	6.0	6.5	
Positive surgical margin	no	no	
Site of lesion(%)			
left side	49.1	63.6	0.152
right side	50.9	36.4	
Pathologic tumor stage(%)			
PT1A	37.5	0.0	0.870
PT1B	16.7	19.6	
PT2A	4.2	39.1	
PT2B	4.2	11.8	
PT3a	8.3	11.8	
PT3b	0.0	11.8	

Values are represented as %, LN = Laparoscopic Nephrectomy, ON = Open Nephrectomy, RCC = renal cell carcinoma

Table 4. Complicationsin LN and ON (n = 97)

	LN (n = 53)	ON (n = 44)	*p*-value
%Post operative complications	13.2	31.0	0.039*
Surgical site infection	1.9	4.5	
Lymphatic leakage	9.4	13.6	
Bowel injury	1.9	2.3	
Partial gut obstruction	0.0	2.3	
Intra-abdominal collection	0.0	6.8	

Values are represented as %, LN = Laparoscopic Nephrectomy, ON = Open Nephrectomy
* = significant at $p<0.05$

well as cytoreduction[8,9]. Many series have shown LN to be superior to ON in terms of blood loss, postoperative pain and cosmetic parameters[4-7,10,11]. In our LN series we compared patients who underwent ON and LN and found no statistical difference in demographic data. The primary aim of the current study was to assess the safety and perioperative efficacy of LN compared with ON. Our data demonstrated that LN and ON had similar operative times ($p = 0.154$), time to removal of catheter ($p = 0.056$) and time to removal of tube drain ($p = 0.080$) but that LN was superior in terms of lower blood loss ($p = 0.002$) and fewer blood transfusions ($p = 0.008$). With regard to post-operative pain, we used indirect data to interpret dose numbers of post-operative and last day of post-operative analgesic drugs used and found that LN was superior in these areas ($p<0.001$ in both parameters). This could be because the number of trocars and size of extraction incision were lower in LN. We used only 3 trocars for left LN and 4 trocars for right LN. We used one trocar more in right left LN because of the need for elevation of the liver to dissect the right kidney. The surgical extraction incision was rather small with mean surgical wound size of 3.68 ± 0.72cm at the umbilicus because the skin fold there can be extended to remove the specimen. In other series, specimens were removed with a Gibson or Pfannenstiel incision at the lower abdomen by cutting the abdominal muscle, but this

can increase postoperative pain due to the larger size of extraction incision. The convalescence period was evaluated in terms of time to return normal diet intake and length of hospital stay, and LN was superior (p = 0.001 in both parameters). Complications in the LN group were significantly fewer than in the ON group (p = 0.039). The most common complication in both LN and ON was lymphatic leakage (9.4% and 13.6%), although the LN group had fewer occurrences because clips and energy-sealing machines were used to control it. Surgical site infection in LN and ON were 1.9% and 4.5%, respectively, and was associated with chronic pyelonephritis and thick abdominal wall (high BMI). With regard to bowel injury, LN and ON had 1.9% and 2.3%, respectively. Complications were corrected by intracorporeal suturing repair and NPO for 7 days with intravenous parenteral nutrition. Partial gut obstruction and abdominal fluid collection were found only in the ON group (2.3% and 6.8%, respectively). The treatment in case of partial gut obstruction was conservative with step diet intake, but in cases of abdominal collection and ultrasound guide, aspiration was performed. There was no mortality in either group in our series.

Conclusion

LN is a practical, safe and effective procedure. Surgical outcomes of LN offer advantages in the form of reduced blood loss, fewer blood transfusions, lower post-operative pain, shorter length of hospital stay, and early convalescence with cosmetically superior surgical wound.

What is already known on this topic?

Laparoscopic nephrectomy (LN) is a feasible, safe and efficacious surgical technique when compared with open nephrectomy. LN also offers the advantages of lower blood loss, fewer blood transfusions, less post-operative pain, early convalescence, short length of hospital stay and improved cosmetic appearance of surgical wound.

What this study adds?

This present study aimed to report surgical techniques used and outcomes achieved together with complications encountered using laparoscopic nephrectomy. Our findings showed that it can be used to further improve surgical techniques and long-term outcomes.

Acknowledgements

This study was supported by a grant from Rajavithi Hospital, Department of Medical Services, Ministry of Public Health. The authors wish to thank the MIS Urology Rajavithi team and coordinators for data review at Rajavithi Hospital and Miss Somjith Duangkae for assistance with statistical analysis.

Potential conflicts of interest

None.

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