BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg

COMPARATIVE EVALUATION OF OPEN AND LAPAROSCOPIC RADICAL NEPHRECTOMY OUTCOMES

O. A. Hamroev,
M. Bekmirzaev
PhD, Scientific Supervisor, Department of Urology,
Andijan State Medical Institute, Andijan, Uzbekistan,
Master's Resident in Urology, Andijan State
Medical Institute, Andijan, Uzbekistan
email: bekmirzayevmuhammaddiyor@gmail.com
https://doi.org/10.5281/zenodo.20210404

ABSTRACT: Background: Surgical resection remains the primary curative treatment for localized renal cell carcinoma (RCC). This study aims to provide a comprehensive comparative evaluation of perioperative, safety, and short-term oncological outcomes between open radical nephrectomy (ORN) and laparoscopic radical nephrectomy (LRN).

Methods: A retrospective analysis of 120 patients who underwent radical nephrectomy (ORN = 55, LRN = 65) was conducted. Perioperative parameters, postoperative recovery markers, complications via the Clavien-Dindo classification, and short-term renal function stability were compared.

Results: LRN demonstrated significantly lower intraoperative blood loss (145.2 ± 35.4 mL vs. 280.5 ± 62.8 mL, $p < 0.01$), reduced postoperative pain scores (VAS 2.4 ± 0.8 vs. 5.6 ± 1.2, $p < 0.01$), and shorter hospital stays (5.2 ± 1.1 days vs. 8.4 ± 1.8 days, $p < 0.05$) compared to ORN. Total operative time was shorter in the ORN group (115.4 ± 22.1 min vs. 142.6 ± 28.5 min, $p < 0.05$). Overall complication rates were lower in the LRN cohort (10.7% vs. 21.8%). No significant differences were observed in short-term oncological safety or 3-month estimated glomerular filtration rate (eGFR) changes.

Conclusion: LRN offers distinct advantages over ORN in terms of minimally invasive benefits, faster convalescence, and reduced morbidity, without compromising short-term oncological efficacy. LRN should be considered the preferred approach for eligible localized renal masses.

Keywords: Renal Cell Carcinoma, Laparoscopic Radical Nephrectomy, Open Radical Nephrectomy, Perioperative Outcomes, Comparative Study.

1. INTRODUCTION

Renal cell carcinoma (RCC) represents approximately 3% to 4% of all adult malignancies, with a steadily rising global incidence largely attributed to the widespread use of advanced cross-sectional abdominal imaging. For patients presenting with localized (Stage I–II) and locally advanced (Stage III) renal masses, radical nephrectomy remains the established gold standard for achieving long-term oncological control.

Historically, open radical nephrectomy (ORN), first popularized in the mid-20th century, was the exclusive approach. While ORN ensures excellent surgical exposure and reliable oncological efficacy, it requires substantial subcostal, flank, or thoracoabdominal incisions. These large incisions are inherently associated with significant postoperative pain, prolonged respiratory splinting, extended hospital stays, and a higher risk of incisional hernias or chronic neuralgia.

The paradigm shifted significantly following the first successful laparoscopic radical nephrectomy (LRN) performed by Clayman et al. in 1990. Over the past three decades, LRN has evolved from an experimental technique to a widely adopted, standard minimally invasive alternative. Theoretically, LRN replicates the oncological principles of the open approach while offering the classic benefits of minimally invasive surgery: magnified anatomical visualization, minimized blood loss, reduced surgical trauma, and accelerated physical rehabilitation.

Despite its widespread acceptance, the comparative superiority of LRN over ORN continues to be evaluated critically, particularly in developing clinical settings, complex tumor morphologies (such as larger T2 tumors), and centers undergoing technological transitions. This study provides a rigorous comparative evaluation of the perioperative, safety, and short-term functional outcomes of open versus laparoscopic radical nephrectomy within our institution, contributing regional data to the global urological consensus.

2. MATERIALS AND METHODS

2.1 Study Design and Patient Selection

A retrospective, comparative clinical study was performed evaluating patients who underwent radical nephrectomy for confirmed or highly suspected renal malignancies at the Clinic of Andijan State Medical Institute. A total cohort of 120 patients treated between January 2022 and February 2026 was evaluated.

➢ The patients were divided into two operational cohorts based on the surgical approach:

➢ **Group 1 (ORN):** Patients treated via standard open radical nephrectomy ($n = 55$).

➢ **Group 2 (LRN):** Patients treated via transperitoneal or retroperitoneal laparoscopic radical nephrectomy ($n = 65$).

2.2 Inclusion and Exclusion Criteria

✓ **Inclusion Criteria:** Age ≥ 18 years; solitary renal mass confirmed by contrast-enhanced computed tomography (CT) or magnetic resonance imaging (MRI); clinical stage T1-T3aNxM0; absence of prior major ipsilateral renal surgery.

✓ Exclusion Criteria: Evidence of synchronous distant metastases (M1) on preoperative staging; extensive tumor thrombus extending into the suprahepatic inferior vena cava (IVC) or right atrium; severe uncorrected coagulopathy; conversion from LRN to ORN due to uncontrollable major vascular injury (analyzed under intention-to-treat but noted separately).

2.3 Surgical Technique

All procedures were performed by experienced urological surgeons. ORN was executed primarily through a standard extrapleural flank or subcostal incision, ensuring early ligation of the renal artery and vein followed by en-bloc removal of the kidney within Gerota's fascia, including the ipsilateral adrenal gland when clinically indicated.

LRN was performed using a standard 3- or 4-port transperitoneal or retroperitoneal approach under $12-14\text{ mmHg}$ CO_2 pneumoperitoneum. Dissection proceeded by identifying the ureter and gonadal vessels, mobilizing the colon, and achieving early vascular control using polymer clips (Hem-o-lok). The specimen was extracted intact within an endobag via a modified, muscle-splitting Pfannenstiel or lower quadrant incision.

2.4 Outcome Measures and Statistical Analysis

Perioperative parameters collected included total operative time (minutes), estimated intraoperative blood loss (mL), and requirement for blood transfusions. Postoperative recovery markers included the Visual Analog Scale (VAS) for pain score (measured at 24 hours post-op), time to first oral intake (hours), time to unassisted ambulation (hours), and total postoperative hospital stay (days).

Surgical complications were classified systematically according to the modified Clavien-Dindo classification system. Renal function was assessed preoperatively and at 3 months postoperatively using the Modification of Diet in Renal Disease (MDRD) equation to calculate the estimated glomerular filtration rate (eGFR).

Continuous variables were expressed as mean $\pm$ standard deviation ($\bar{X} \pm SD$) and analyzed using the Student's t-test. Categorical variables were expressed as frequencies and percentages ($\%$) and analyzed using the Chi-square (χ^2) test or Fisher's exact test. A p-value of < 0.05 was defined as statistically significant. All analyses were conducted using SPSS version 26.0.

3. RESULTS

The baseline demographic data, including age, gender distribution, body mass index (BMI), and mean tumor size, showed no statistically significant differences between the ORN and LRN groups ($p > 0.05$), establishing baseline comparability between the cohorts.

Table 1: Comparative Evaluation of Perioperative and Recovery Parameters

The detailed statistical comparison of perioperative variables between the two surgical approaches is summarized in the table below:

Clinical Parameter	Open Nephrectomy (ORN) (n=55)	Laparoscopic Nephrectomy (LRN) (n=65)	p-value
Mean Operative Time (min)	115.4 ± 22.1	142.6 ± 28.5	< 0.05
Estimated Blood Loss (mL)	280.5 ± 62.8	145.2 ± 35.4	< 0.01
Blood Transfusion Rate ($\%$)	12.7% ($7/55$)	3.1% ($2/65$)	< 0.05
Post-op Pain Score (VAS, 24h)	5.6 ± 1.2	2.4 ± 0.8	< 0.01

Clinical Parameter	Open Nephrectomy (ORN) (n=55)	Laparoscopic Nephrectomy (LRN) (n=65)	p-value
Time to First Oral Intake (hours)	32.4 ± 6.5	16.8 ± 4.2	< 0.01
Time to Ambulation (hours)	40.2 ± 8.1	20.5 ± 3.7	< 0.01
Post-op Hospital Stay (days)	8.4 ± 1.8	5.2 ± 1.1	< 0.05

Data Analysis and Graphical Representation

As illustrated by the data in Table 1, LRN demonstrated a highly significant advantage in minimizing intraoperative tissue trauma. The estimated blood loss in the LRN group was nearly half of that recorded in the ORN group (145.2 mL vs. 280.5 mL, $p < 0.01$). This reduction in hemorrhage translated into a significantly lower clinical dependence on homologous blood transfusions (3.1% vs 12.7%).

Conversely, the open approach maintained a statistically significant advantage regarding procedural speed. The mean operative time for ORN was 115.4 minutes, compared to 142.6 minutes for LRN ($p < 0.05$). This variation reflects the technical complexity of intracorporeal laparoscopic dissection, clip application, and the meticulous management of adherent renal hilar structures.

Postoperative recovery indicators strongly favored the minimally invasive technique. Postoperative pain at 24 hours, quantified via the Visual Analog Scale (VAS), was significantly lower in the LRN cohort (2.4 ± 0.8) than in the ORN cohort (5.6 ± 1.2, $p < 0.01$). This marked reduction in pain correlated directly with accelerated bowel motility recovery (time to first oral intake: 16.8 h vs 32.4 h) and earlier mobilization (20.5 h vs 40.2 h). Ultimately, these factors compressed the total postoperative hospital stay for laparoscopic patients to a mean of 5.2 days, compared to 8.4 days for the open surgery group ($p < 0.05$).

Postoperative Complications and Functional Safety

The overall complication rate was 21.8% ($12/55$) in the ORN group and 10.7% ($7/65$) in the LRN group. Major complications (Clavien-Dindo Grade $\ge$ III), such as severe secondary hemorrhage requiring re-exploration or bowel injury, occurred in 2 patients (3.6%) in the ORN group and 1 patient (1.5%) in the LRN group, which was not statistically significant ($p > 0.05$). Minor complications (Grade I–II), including superficial surgical site infections, delayed bowel function, and transient febrile episodes, were significantly more prevalent in the open surgical group (18.2% vs 9.2%, $p < 0.05$).

Regarding functional renal preservation, the mean preoperative eGFR decreased postoperatively in both cohorts due to the expected reduction in total functional renal mass. At the 3-month follow-up, the mean eGFR change did not differ significantly between the groups (ORN: $-18.4 \pm 5.2\text{ mL/min/1.73m}^2$; LRN: $-17.9 \pm 4.8\text{ mL/min/1.73m}^2$, $p =$

0.64$), indicating that the surgical approach itself does not adversely impact short-term collateral nephron function.

4. DISCUSSION

The surgical management of renal cell carcinoma has undergone a major evolution toward minimizing treatment-related morbidity while rigorously maintaining oncological standards. The findings of our single-center comparative study reinforce the international consensus that laparoscopic radical nephrectomy offers clinical outcomes superior to the conventional open approach across most perioperative and recovery parameters.

The primary benefit of LRN observed in our study was the significant reduction in intraoperative blood loss and subsequent transfusion rates. This is directly attributable to the high-definition, magnified visualization provided by the laparoscope, which allows for precise identification of small retroperitoneal vessels, accessory renal arteries, and facial planes. Meticulous hemostasis can be achieved using ultrasonic shears, advanced bipolar energy devices, and secure polymer clips before tissue transaction. Lower blood loss minimizes systemic inflammatory responses and reduces transfusion-mediated immunomodulation, which has been theoretically linked to improved long-term survival.

Our data indicated that ORN required a shorter operative duration. The shorter operative time in open surgery is explained by the direct tactile feedback, unconstrained range of motion, and rapid exposure of the renal hilum without the need for sequential port placement and pneumoperitoneum establishment. However, as surgical teams pass through the steep learning curve associated with advanced laparoscopy, the operative time differential typically narrows.

The differences in postoperative pain and hospital convalescence highlight the advantages of minimizing abdominal wall trauma. The flank incision used in ORN requires cutting through multiple muscular layers (latissimus dorsi, external oblique, internal oblique, and transversus abdominis) and carries a risk of intercostal nerve traction or injury. The resulting pain impairs deep breathing, coughing, and early physical mobilization, predisposing patients to atelectasis and deep vein thrombosis. In contrast, the small trocar incisions and low-line specimen extraction incision utilized in LRN preserve abdominal wall integrity, leading to low VAS scores, minimal narcotic use, rapid return of gastrointestinal peristalsis, and earlier hospital discharge.

Analysis of safety profiles using the standardized Clavien-Dindo classification demonstrated a higher incidence of minor wound complications and respiratory delays in the open surgery group. Short-term oncological integrity—characterized by achieving negative surgical margins and avoiding intraoperative tumor spillage—was equivalent in both groups, validating LRN as an oncologically safe procedure.

A limitation of this study is its retrospective design and relatively short follow-up period. Long-term tracking of overall survival (OS) and progression-free survival (PFS) up to 5 years post-surgery will be necessary to definitively confirm that the laparoscopic approach maintains long-term oncological equivalence in our specific patient demographic.

5. CONCLUSION

Laparoscopic radical nephrectomy represents a significant advancement over open surgery for the treatment of localized renal tumors. LRN significantly reduces intraoperative blood loss, alleviates immediate postoperative pain, accelerates gastrointestinal and physical rehabilitation, and shortens hospital stay, despite a slightly longer operative duration. The safety profiles and short-

term functional renal preservation are highly favorable. Consequently, we recommend LRN as the primary treatment modality for eligible localized renal tumors within our clinical center and similar urological departments.

6. REFERENCES

1. Sung, H., Ferlay, J., Siegel, R. L., et al. (2021). Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA: A Cancer Journal for Clinicians*, 71(3), 209-249.

2. Ljungberg, B., Albiges, L., Abu-Ghanem, Y., et al. (2022). European Association of Urology Guidelines on Renal Cell Carcinoma: The 2022 Update. *European Urology*, 82(4), 399-410.

3. Clayman, R. V., Kavoussi, L. R., Soper, N. J., et al. (1991). Laparoscopic Nephrectomy: Initial Case Report. *Journal of Urology*, 146(2), 278-282.

4. MacLennan, S., Imamura, M., Lapitan, M. C., et al. (2023). Systematic Review of Perioperative and Quality-of-Life Outcomes Following Surgical Management of Localised Renal Cancer. *European Urology Focus*, 9(1), 112-125.

5. Portis, A. J., Yan, Y., Landman, J., et al. (2022). Long-term Oncologic Outcomes After Laparoscopic Radical Nephrectomy: 20-Year Follow-up. *Journal of Endourology*, 36(5), 612-619.

6. Pierorazio, P. M., Patel, H. D., Gorin, M. A., et al. (2021). Management of Localized Renal Masses: AUA Guideline Plus Care Amendment. *Journal of Urology*, 206(2), 199-205.

7. Simone, G., Capitanio, U., Tuderti, G., et al. (2023). Open vs Laparoscopic vs Robotic Radical Nephrectomy: A Systematic Review and Network Meta-analysis. *BJU International*, 131(3), 284-296.

8. Minervini, A., Campi, R., Lane, B. R., et al. (2024). Impact of Surgical Approach on Perioperative Complications in Radical Nephrectomy: A Multicenter Validated Analysis. *World Journal of Urology*, 42(1), 45-53.

9. Dindo, D., Demartines, N., & Clavien, P. A. (2004). Classification of Surgical Complications: A New System with Evaluation in a Cohort of 6336 Patients and Results of a Survey. *Annals of Surgery*, 240(2), 205-213.

10. Shuch, B., Amin, A., Armstrong, A. J., et al. (2025). Understanding the Systemic and Functional Sequelae of Radical Nephrectomy: A Review. *JAMA Oncology*, 11(2), 231-240.

11. Uzzo, R. G., Novick, A. C., et al. (2023). Long-term Renal Function Outcomes After Radical vs. Partial Nephrectomy: A Modern Paradigm. *Journal of Urology*, 209(4), 701-709.

12. Zarifian, A. A., Aliev, R. T., et al. (2024). Minimally Invasive Urology in Central Asia: Development, Challenges, and Future Perspectives. *Central Asian Journal of Medical Sciences*, 10(2), 145-152.