



Original Article

## Study on Complications of Laparoscopic Renal Surgeries Using Modified Clavien-Dindo Classification

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### ABSTRACT

**Background:** Laparoscopic renal surgery has become a standard approach in urology due to its minimally invasive nature, offering reduced postoperative morbidity and faster recovery compared to open surgery. However, complication rates vary depending on patient factors, disease pathology, and procedural complexity. Standardized evaluation using the Modified Clavien–Dindo classification enables objective assessment of surgical outcomes.

**Objectives:** To evaluate the demographic and clinical profile of patients undergoing laparoscopic renal surgeries and to analyze postoperative complications according to the Modified Clavien–Dindo classification system.

**Methods:** This retrospective analytical study **included 75 patients** who underwent elective laparoscopic renal surgeries, including laparoscopic radical nephrectomy, simple nephrectomy, and pyeloplasty, at a tertiary care centre between **December 2020 and November 2022**. Patients with palliative or cytoreductive surgeries were excluded. Demographic, clinical, and operative data were collected from medical records. Postoperative complications were recorded and graded using the Modified Clavien–Dindo classification. In cases with multiple complications, the most severe complication was considered for analysis.

**Results:** Among 75 patients, 16 (21.3%) had malignant pathology and 59 (78.7%) had benign conditions. LSN was the most commonly performed procedure (66.7%), followed by LRN (21.3%) and LP (12.0%). The overall complication rate was 18.7%, with higher rates observed in malignant cases (31.3%) compared to benign cases (15.3%). Procedure-wise, complications were highest in LP (44.4%), followed by LRN (31.3%) and LSN (10.0%). Most complications were low grade, with Grade I (10.7%) and Grade II (6.7%), while only one patient (1.3%) had a Grade IIIA complication. No mortality was reported.

**Conclusion:** Laparoscopic renal surgery is a safe and effective modality with predominantly low-grade complications. Higher complication rates in malignant and reconstructive procedures highlight the importance of patient selection and surgical expertise.

**Keywords:** Laparoscopic nephrectomy; Renal surgery; Clavien–Dindo classification; Postoperative complications; Minimally invasive surgery; Urology.

### INTRODUCTION

Laparoscopic surgery has transformed the practice of urology by providing a minimally invasive alternative to conventional open procedures. A major milestone in this evolution was the first reported laparoscopic nephrectomy by Clayman et al. in 1991, which demonstrated the technical feasibility of renal surgery through a laparoscopic approach and opened the way for broader application of minimally invasive techniques in urology.<sup>1</sup> In the same period, Schuessler

et al. further expanded the role of laparoscopy in urological oncology by describing transperitoneal endosurgical lymphadenectomy in patients with localized prostate cancer.<sup>2</sup> These pioneering efforts laid the foundation for the development of advanced laparoscopic urological procedures.

With growing experience and improvements in instrumentation, laparoscopy became increasingly applicable to a wide spectrum of renal conditions, including benign, inflammatory, reconstructive, and malignant diseases. McNeill and Tolley emphasized that laparoscopic urology had rapidly evolved from an experimental technique to an important surgical modality, while also highlighting the importance of appropriate case selection and structured training.<sup>3</sup> Similarly, Cadeddu et al. showed that complication rates could be reduced with concentrated training and increasing surgical experience, underscoring the significance of the learning curve in laparoscopic practice.<sup>4</sup> Parsons et al., in a longitudinal five-year analysis, reported that although laparoscopy offers substantial patient benefits, complications remain an important concern, particularly in complex abdominal urological procedures.<sup>5</sup>

Standardized reporting of complications is essential for meaningful comparison of outcomes across studies. Clavien et al. first proposed a classification of surgical complications based on severity and therapeutic consequences, providing a framework for objective assessment.<sup>6</sup> This system was later modified and refined by Dindo et al. into the widely accepted Clavien–Dindo classification, which has since become the standard method for reporting surgical morbidity.<sup>7</sup> In urology, Mitropoulos et al. further emphasized the need for uniform reporting and grading of complications after urological procedures to improve transparency and comparability.<sup>8</sup> Subsequent studies applying the Clavien–Dindo system to laparoscopic renal and urological surgeries have confirmed its value in evaluating perioperative outcomes and identifying procedure-specific risks.<sup>9–12</sup>

In this context, the present study was undertaken to evaluate the demographic and clinical profile of patients undergoing laparoscopic renal procedures and to analyse postoperative complications using the modified Clavien–Dindo classification.

## MATERIAL AND METHODS

This retrospective analytical study was conducted in the Department of Urology at People tree Hospital, Bangalore, India, and included patients who underwent laparoscopic renal surgeries between December 2020 and November 2022. A total of 75 patients who underwent elective laparoscopic transperitoneal renal procedures were included in the study.

The study population comprised patients undergoing laparoscopic radical nephrectomy, laparoscopic simple nephrectomy, and laparoscopic pyeloplasty for appropriate clinical indications. In cases of malignancy, only patients with organ-confined disease, as assessed preoperatively using imaging modalities, were included. All procedures were performed by the same chief operating surgeon to maintain procedural consistency.

Patients undergoing palliative or cytoreductive surgeries were excluded from the study. Demographic details, clinical characteristics, operative data, and postoperative outcomes were obtained from medical records and retrospectively analyzed.

Postoperative complications were recorded and classified according to the Modified Clavien–Dindo classification system. In patients who developed more than one complication, all complications were documented; however, only the most severe complication was considered for grading purposes. The occurrence, type, and severity of complications were analyzed in relation to surgical indication and type of procedure performed.

The collected data were compiled and analyzed descriptively, and results were presented in terms of frequencies, percentages, and mean values where appropriate.

## RESULTS

The present study included a total of 75 patients undergoing laparoscopic renal procedures. Of these, 16 (21.3%) had malignant pathology and 59 (78.7%) had benign disease. Patients with malignant conditions were older, with a mean age of 54.1 years compared to 40.3 years in the benign group. A male predominance was observed overall, particularly in the malignant group (75.0%). Comorbidities were more frequent among malignant cases (50.0%) than benign cases (33.9%). Most benign patients were classified as ASA I (71.2%), whereas malignant cases had a higher proportion of ASA II and III, indicating relatively poorer baseline status. Conversion to open surgery was more common in malignant cases (37.5%) compared to benign cases (16.9%) (Table 1).

Laparoscopic simple nephrectomy (LSN) was the most commonly performed procedure, accounting for 50 cases (66.7%), followed by laparoscopic radical nephrectomy (LRN) in 16 cases (21.3%) and laparoscopic pyeloplasty (LP) in 9 cases (12.0%) (Table 2). Malignant indications were exclusively managed by LRN (21.3%). Among benign conditions, inflammatory etiologies predominated, with stone disease associated with non-functioning kidney accounting for 37.3%

and genitourinary tuberculosis for 29.3% of cases. Non-inflammatory indications such as pelviureteric junction obstruction (PUJO) constituted a smaller proportion (Table 3).

Postoperative complications were observed in 14 patients (18.7%), while 61 patients (81.3%) had an uneventful recovery. Complication rates were higher in malignant cases (31.3%) compared to benign cases (15.3%). Among procedure types, LP demonstrated the highest complication rate (44.4%), followed by LRN (31.3%) and LSN (10.0%) (Table 4).

According to the modified Clavien–Dindo classification, the majority of complications were low grade, with Grade I complications seen in 8 patients (10.7%) and Grade II in 5 patients (6.7%). Only one patient (1.3%) experienced a Grade IIIA complication requiring percutaneous drainage, while no Grade IIIB or higher complications were recorded. Overall, minor complications such as delayed bowel movements, abundant drain output, and postoperative fever were the most frequent, whereas major complications were rare (Table 5).

**Table 1. Baseline Demographic and Clinical Characteristics**

Variable	Malignant (n=16)	Benign (n=59)	LRN (n=16)	LSN (n=50)	LP (n=9)	
Age, mean (range), years	54.1 (44–70)	40.3 (15–62)	54.1 (44–70)	47.8 (28–62)	28.1 (15–38)	
Gender	Male	12 (75.0)	33 (55.9)	12 (75.0)	29 (58.0)	4 (44.4)
	Female	4 (25.0)	26 (44.1)	4 (25.0)	21 (42.0)	5 (55.6)
Comorbidities present	8 (50.0)	20 (33.9)	8 (50.0)	17 (34.0)	3 (33.3)	
ASA	Grade I	7 (43.8)	42 (71.2)	7 (43.8)	34 (68.0)	8 (88.9)
	Grade II	6 (37.5)	10 (16.9)	6 (37.5)	10 (20.0)	1 (11.1)
	Grade III	3 (18.7)	7 (11.9)	3 (18.7)	6 (12.0)	0 (0.0)
Conversion to open surgery	6 (37.5)	10 (16.9)	6 (37.5)	6 (12.0)	4 (44.4)	

**Table 2. Distribution of Laparoscopic Renal Procedures (n = 75)**

Procedure	n (%)
Laparoscopic Simple Nephrectomy (LSN)	50 (66.7)
Laparoscopic Radical Nephrectomy (LRN)	16 (21.3)
Laparoscopic Pyeloplasty (LP)	9 (12.0)
<b>Total</b>	<b>75 (100)</b>

**Table 3. Indications for Surgery**

Indication Category	Specific Indication	Procedure	n (%)	
Malignant (n = 16)	Renal malignancy	LRN	16 (21.3)	
Benign (n = 59)	Non-inflammatory	PUJO	LP	5 (6.7)
		PUJO with non-functioning kidney	LP	4 (5.3)
	Inflammatory	Stone with non-functioning kidney	LSN	28 (37.3)
		Genitourinary tuberculosis with NFK	LSN	22 (29.3)

**Table 4. Postoperative Complications (Modified Clavien–Dindo Classification)**

Variable	Malignant (n=16)	Benign (n=59)	LRN (n=16)	LSN (n=50)	LP (n=9)	Total (n=75)
Patients with complications	5 (31.3)	9 (15.3)	5 (31.3)	5 (10.0)	4 (44.4)	14 (18.7)
No complications	11 (68.7)	50 (84.7)	11 (68.7)	45 (90.0)	5 (55.6)	61 (81.3)

**Table 5. Overall Distribution of Complication Grades**

Clavien–Dindo Grade	n (%)
No complications	61 (81.3)
Grade I	8 (10.7)
Grade II	5 (6.7)
Grade IIIA	1 (1.3)
<b>Total</b>	<b>75 (100)</b>

**Table 6: Type of Complications (n = 75)**

Complication Grade	Type	n (%)
Grade I (n=8; 10.7%)	Abundant drain	6 (8.0)

	Delayed bowel movements	7 (9.3)
	Fever	6 (8.0)
<b>Grade II (n=5; 6.7%)</b>	Surgical site infection	4 (5.3)
	Blood transfusion	3 (4.0)
<b>Grade IIIA (n=1; 1.3%)</b>	Abscess requiring PCD	1 (1.3)

## DISCUSSION

The present study demonstrates that laparoscopic renal surgery is a safe and effective modality with an overall complication rate of 18.7%, the majority being low-grade (Clavien–Dindo Grade I–II). These findings are consistent with earlier reports that highlight the advantages of minimally invasive urological procedures in terms of reduced morbidity and faster recovery.<sup>1,3</sup> The evolution of laparoscopic techniques since the initial description by Clayman et al. has significantly improved perioperative outcomes, although complications remain an inherent aspect of surgical practice.<sup>1,5</sup> In the current study, patients with malignant pathology were older and had a higher prevalence of comorbidities compared to those with benign conditions. This observation aligns with previous literature, where renal malignancies are more commonly associated with advanced age and increased baseline risk factors.<sup>10,11</sup> The higher ASA grades observed in malignant cases further support the presence of increased perioperative risk, which may explain the relatively higher complication rate in this group (31.3%) compared to benign cases (15.3%).

Procedure-wise analysis revealed that laparoscopic pyeloplasty had the highest complication rate (44.4%), followed by laparoscopic radical nephrectomy (31.3%) and laparoscopic simple nephrectomy (10.0%). These findings are in agreement with previous studies that have reported higher complication rates in reconstructive and oncological procedures due to their technical complexity and longer operative times.<sup>9,10</sup> Laparoscopic simple nephrectomy, being a relatively standardized procedure, demonstrated the lowest complication rate, reflecting its widespread acceptance and reproducibility.<sup>3</sup>

The conversion rate to open surgery was higher in malignant cases and reconstructive procedures, which is consistent with earlier reports emphasizing the challenges posed by tumor characteristics, adhesions, and distorted anatomy in inflammatory conditions.<sup>4,5</sup> Importantly, conversion should be regarded as a strategic intraoperative decision rather than a complication, aimed at ensuring patient safety in technically demanding situations.

The use of the Clavien–Dindo classification in this study allowed for objective and standardized reporting of postoperative complications.<sup>6,7</sup> The predominance of low-grade complications and the low incidence of major complications (Grade IIIA: 1.3%) are comparable to previously published series, reinforcing the reliability of this classification system in laparoscopic urological surgery.<sup>8,12</sup> Furthermore, studies applying this grading system have consistently demonstrated its utility in benchmarking surgical outcomes and facilitating inter-study comparisons.<sup>9</sup>

Overall, the findings of the present study corroborate existing evidence that laparoscopic renal surgery offers a favourable safety profile with acceptable complication rates. However, careful patient selection, surgeon experience, and adherence to standardized surgical protocols remain crucial factors in minimizing complications and optimizing outcomes.

## CONCLUSION

Laparoscopic renal surgery is a safe and effective approach for both benign and malignant renal conditions, demonstrating acceptable complication and conversion rates. The majority of complications were low grade, confirming the favourable safety profile of minimally invasive techniques. Higher complication rates observed in malignant and reconstructive procedures reflect increased technical complexity and patient-related risk factors. The use of the Clavien–Dindo classification enabled standardized and objective assessment of postoperative outcomes. With appropriate patient selection and surgical expertise, laparoscopic renal procedures can be performed with minimal morbidity, supporting their continued role as the preferred approach in contemporary urological practice.

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