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ORIGINAL ARTICLE

A Study to Evaluate the Complications of Laparoscopic Renal and Adrenal Surgeries Using Modified Clavien-Dindo Classification

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Abstract

Background: Laparoscopic surgery has become a widely accepted approach for the treatment of renal and adrenal diseases. However, there is a need to assess the post-operative complications associated with these procedures using standardized classification systems. The modified Clavien-Dindo classification system offers a comprehensive framework for evaluating surgical outcomes and determining the severity of complications. **Methods:** This prospective study involved 106 patients who underwent laparoscopic renal and adrenal resective surgeries. Post-operative complications were recorded and graded according to the modified Clavien-Dindo classification system. The data collected were analysed to assess the incidence and severity of complications in relation to patient demographics, comorbidities, and surgical procedures. **Results:** Among the 106 patients, 16.03% experienced post-operative complications, with 13.20% classified as minor complications and 2.83% as major complications. The most common minor complications included delayed bowel movements and wound infection, while major complications included conversion to open surgery and the need for ventilator support or haemodialysis. No deaths were reported in the study. The association between complication rates and age, gender, ASA grade, side of pathology, comorbidities, and pathology/diagnosis was not statistically significant. However, higher grade complications tended to occur more frequently in elderly patients, males, and those with comorbidities. **Conclusions:** This study supports the effectiveness of laparoscopic surgery for renal and adrenal diseases, as evidenced by low complication rates. The modified Clavien-Dindo classification system proved valuable in assessing and categorizing post-operative complications, enabling a comprehensive evaluation of surgical outcomes. Implementation of this standardized classification system can contribute to improving patient safety and the overall quality of surgical care. Further research with larger sample sizes and longer follow-up periods is recommended to obtain more precise and comprehensive data on long-term morbidity and mortality associated with laparoscopic renal and adrenal resective surgeries.

Keywords: Clavien-Dindo classification, Risk factor, complication, Postoperative complications, Adrenal, Kidney, Laparoscopy, Nephrectomy, Adrenalectomy, Transperitoneal laparoscopic surgery

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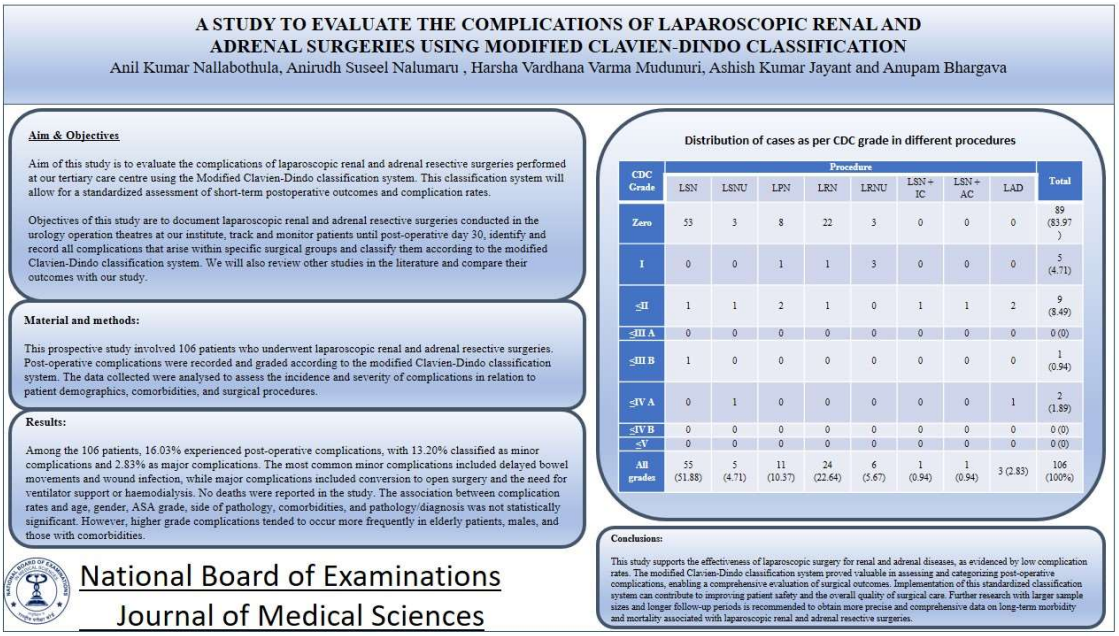
Graphical Abstract



Background

Laparoscopic technology has revolutionized urological surgeries by providing several advantages over traditional open surgery, including reduced postoperative pain, shorter hospital stays, and faster recovery [1-3]. However, despite these benefits, laparoscopic procedures come with unique challenges and potential complications. Introduced over three decades ago, laparoscopy initially gained significant enthusiasm in urology, with the technique being widely adopted for various procedures such as pelvic lymphadenectomy, nephrectomy, and varicocelectomy [4]. Its popularity grew rapidly in both academic and private centres, leading to its widespread use in routine urology practice.

However, this initial enthusiasm was eventually followed by disappointment due to several factors [5]. First, laparoscopy proved to be more difficult than many had anticipated. During the early years of urological laparoscopy, researchers were still trying to identify appropriate indications, and many were not fully aware of the limitations of the technique. Additionally, most reports at the time reflected the challenges encountered during the learning phase, rather than focusing on the outcomes and complications of advanced laparoscopy. Some of the indications initially identified did not meet expectations.

Of the initial indications of urologic laparoscopy, only nephrectomy has stood the test of time. Although pelvic lymphadenectomy was associated with less morbidity than its open surgical counterpart, it has become less common as a result of intense screening for prostate cancer and the fact that a retro-pubic prostatectomy typically includes lymphadenectomy anyway. Some groups have even abandoned laparoscopy for this indication altogether.

Laparoscopic varicocelectomy has been considered an ideal operation for those inexperienced with laparoscopy. However,

surgical efficiency cannot compete with antegrade or retrograde sclerotherapy, and the recurrence rate of microsurgery is lower. The long-term efficacy of varicocelectomy is difficult to assess, so cost effectiveness remains the primary argument in favour of this procedure [4].

In contrast to general surgery, where laparoscopy has become the norm for procedures like cholecystectomy, urology has been slower to identify good and frequent indications for the technique. However, as more experience was gained, the accumulating results demonstrated that, for certain indications like Adrenalectomy [6], laparoscopy proved superior to open surgery in every aspect. Several other good indications soon followed including laparoscopy for the impalpable testis, nephrectomy for benign and malignant disease, adrenalectomy, pyeloplasty, and radical prostatectomy [7,8].

As the number and complexity of laparoscopic procedures increase, so do the potential complications, which can result in longer hospital stays and increased costs [9-11]. The recognition and classification of complications associated with urological laparoscopic procedures are becoming increasingly important. Although various studies have published the rates of complications encountered in urological laparoscopic procedures [9,10], there is currently no widely accepted classification system for reporting these complications. To enable the comparison of complication rates across different surgical centres and techniques, it is necessary to use a standardized complication classification system [12].

Centuries ago, Celsius introduced the assessment of postoperative complications, which he referred to as "professional mishap," and was followed indirectly by Hammurabi's code. The code specified that if a surgeon used a bronze lancet on a high-status patient leading to their death, the surgeon's hands would be amputated as punishment [9].

In 1992, Pierre-Alain Clavien and colleagues introduced a new system of classification that transformed the assessment of postoperative complications for general surgical practice, it was updated by Dindo in 2004 and was subsequently validated for urology [9,11,13]. It differentiates complications, sequelae, and failures and provides a standardized approach for grading and reporting postoperative complications in urology.

Now, the Clavien-Dindo classification system provides a standardized metric for evaluating surgical complications, offering an objective and convenient way to quantify and grade complications. It has been widely adopted in various surgical specialties [14].

While previous studies have compared complications in laparoscopic renal and adrenal surgeries, there is a limited number of prospective studies that have utilized the Modified Clavien-Dindo classification system to assess these procedures [15].

A study, by Çetin et al. (2018), analysed complications of laparoscopic urological surgeries using the Clavien classification system[16]. The overall postoperative complication rate was 18.9%, with laparoscopic radical nephrectomy and laparoscopic simple nephrectomy having the lowest complication rates. Laparoscopic partial nephrectomy had the highest complication rate.

A prospective cohort study, by Agrawal et al. (2017), evaluated complications in patients undergoing laparoscopic nephrectomy using the

Clavien-Dindo scale [17]. The study found a complication rate of 46%, with 34 low-grade and 11 high-grade complications. There were no mortalities, and the complication rates were similar for inflammatory and non-inflammatory causes.

A study, by Balcı (2018), examined complications of laparoscopic procedures, including radical nephrectomy, pyeloplasty, and adrenalectomy, using the Clavien-Dindo classification [18]. Laparoscopic surgery was found to be safe and effective, with low complication rates in selected patients with renal and adrenal diseases.

By employing the Modified Clavien-Dindo classification system in a prospective manner, this study will provide valuable insights into the quality and safety of laparoscopic urological procedures. The findings will contribute to the existing literature on complications in laparoscopic surgery and help improve patient outcomes.

Therefore, the aim of this study is to evaluate the complications of laparoscopic renal and adrenal resective surgeries performed at our tertiary care centre using the Modified Clavien-Dindo classification system. This classification system will allow for a standardized assessment of short-term postoperative outcomes and complication rates.

Objectives of this study are to document laparoscopic renal and adrenal resective surgeries conducted in the urology operation theatres at our institute, track and monitor patients until post-operative day 30, identify and record all complications that arise within specific surgical groups and classify them according to the modified Clavien-Dindo classification system. We will also review other studies in the literature and compare their outcomes with our study.

Material and Methods

This prospective observational study was conducted in the department of Urology at Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, Andhra Pradesh. The study included all consecutive patients who underwent laparoscopic renal and adrenal resective surgeries from August 2021 to January 2023. Ethical approvals were obtained, and written informed consent was obtained from all participants. Data collection involved recording patients' demographics, clinical information, and postoperative complications based on the modified Clavien-Dindo classification scale. Follow-up data were collected through outpatient visits or telephonic interviews until discharge and up to 30 days postoperatively.

Inclusion criteria encompassed both male and female patients who underwent laparoscopic trans-peritoneal renal and adrenal resective procedures, including simple nephrectomy, partial nephrectomy, radical nephrectomy, radical nephro-ureterectomy, and adrenalectomy, in the Urology OT at SVIMS. For cases of malignancy, organ-confined malignancy evaluated preoperatively with imaging was included. Elective procedures were performed after thorough preoperative evaluation, optimization of comorbidities, and stabilization in functional tumour cases. Exclusion criteria consisted of patients refusing to participate in the study and those undergoing palliative or cyto-reductive surgeries.

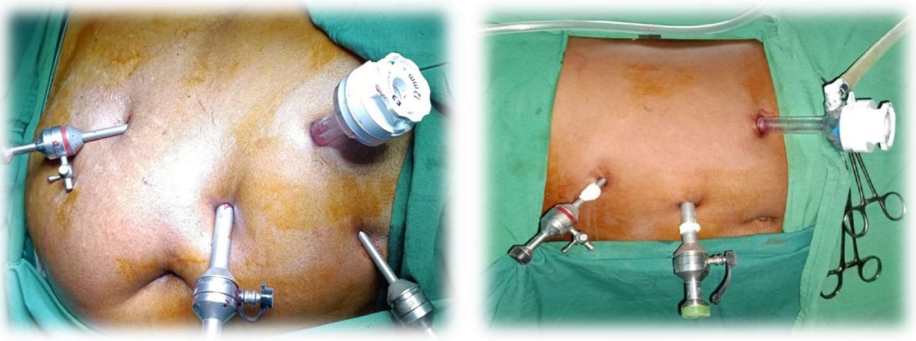
Patient evaluation involved a comprehensive assessment of eligible patients. A detailed patient history was

obtained, including renal and adrenal complaints, comorbidities, substance abuse, and prior abdominal surgical history. Physical examinations, including BMI, vital data, general physical examination, and abdominal examination, were performed.

Laboratory investigations included routine surgical profile tests such as complete blood count, serum creatinine, serum electrolytes, coagulation profile, random blood sugar, serological tests (HBV, HCV, and HIV), and urine culture. Trans-abdominal ultrasound with a 5 Hz probe was conducted to evaluate the genitourinary system. Relevant imaging and nuclear scans, such as contrast CT KUB or MRI for diagnosis confirmation and tumour staging, were performed. DTPA renogram was used to assess renal function in cases of suspected PUJO or planned nephrectomy to document kidney function. For suspected functional adrenal tumours, blood and urine meta/nor-metanephrine assessments were conducted, and consultations with an endocrinologist were sought for pre-operative stabilization. Pre-anaesthetic evaluation, ASA grading, and additional investigations as recommended by the anaesthetist were carried out. Routine ECG was performed, and patients with abnormal ECG or prior cardiac issues underwent 2D ECHO for cardiac evaluation.

Preoperative preparation included bowel cleansing with proctoclysis enema administered twice the night before and early morning on the day of surgery. For deep vein thrombosis prophylaxis, knee varicose stockings were provided, and low molecular weight heparin was subcutaneously administered 12 hours before the operation and continued every 24 hours postoperatively until the patient was fully mobilized. Antibiotic prophylaxis consisted of using a third-generation cephalosporin.

All the surgical procedures were performed by a single chief surgeon with assistants. Trans-peritoneal simple/radical nephrectomy/radical nephro-ureterectomy involved 3-4 trocar accesses with the patient in the lateral decubitus position (Figure 1). Hasson's technique was used to generate pneumoperitoneum. The colon was mobilized medially, and the ureter was dissected cranially to define the hilar structures of the kidney. Renal artery and vein were released, doubly clipped, and divided. Posterior and superior dissection was performed, and the adrenal gland was preserved or removed based on intra-operative assessment. The ureter was divided, and the kidney was removed intact through a separate incision.



A **B**

Figure 1. Port placement for procedures - **A**: Right side, **B**: Left side

For laparoscopic partial nephrectomy, after releasing the renal artery and vein, Gerota's fascia was opened, and the renal mass was identified. The boundary between the mass and normal renal parenchyma was determined, and the renal artery was clamped to achieve warm ischemia. The mass was removed using cold scissors, and the collecting system and bleeding areas were sutured. Surgicell cushions were placed, and the renal parenchyma was closed. The specimen was removed through a separate incision.

Laparoscopic adrenalectomy involved mobilizing the colon medially and dissecting between Gerota's fascia and the mesocolon. The vasculature was identified and confirmed before isolating and clipping the adrenal vein. Dissection was carried out, and care was taken to avoid injury to surrounding structures. The adrenal gland was freed within the abdomen and extracted intact. Trocar sites were closed, and a nasogastric tube and urethral catheter were inserted in all patients.

The modified Clavien-Dindo classification is used to categorize complications that occur after surgery [14]. The grades are as follows:

Grade I: Any deviation from the normal postoperative course that does not require pharmacological or invasive interventions. Examples include prolonged drainage, delayed bowel movements, hernia treated conservatively, and urinary retention requiring catheterization.

Grade II: Complications requiring pharmacological treatment with drugs other than those allowed for Grade I. Blood transfusions and total parenteral nutrition are also included. Examples include high fever requiring antibiotic therapy, wound site infection, blood loss requiring transfusion, and respiratory infections.

Grade IIIa: Complications requiring surgical, endoscopic, or radiologic interventions under local anaesthesia. Examples include abscess requiring drainage and angio-embolization of a bleeding vessel.

Grade IIIb: Complications requiring surgical, endoscopic, or radiologic interventions under general anaesthesia. Examples include conversion to open surgery for reasons other than failure to progress and injury to major blood vessels.

Grade IVa: Life-threatening complications requiring ICU management and involving single organ dysfunction. Examples include splenectomy, respiratory failure requiring ventilator support, and renal failure needing dialysis.

Grade IVb: Life-threatening complications requiring ICU management and involving multi-organ dysfunction.
Grade V: Death of the patient.

If a patient experiences multiple complications, all are recorded, and the most severe complication is graded.

The data was recorded prospectively in an electronic database and analysed using Excel and IBM SPSS software. The sample size was calculated to be 40 based on a confidence level of 95% and a margin of error of 5%. Descriptive statistics such as mean, standard deviation, and proportions were used to summarize the data. Tests such as the Chi-square test and t-test were performed for comparisons between variables, with a significance level of $p<0.05$ considered statistically significant.

Observations and Results

A total of 106 patients underwent laparoscopic renal and adrenal resective surgeries at Sri Venkateswara Institute of Medical Sciences (SVIMS) between August 2021 and January 2023 (Table 1). Among them, 103 patients had renal and ureteric pathologies, while 3 patients had adrenal pathologies. The age ranged from 6 to 81 years with a mean age of 48.85 years. There were 47 men and 59 women in the study. Most patients (64) were classified as ASA grade I, followed by grade II (24) and grade III (18). The distribution of pathologies showed 62 left-sided and 44 right-sided cases. A total of 42 patients had comorbidities, with the most common being diabetes mellitus (21) and hypertension (17). The diagnoses included various benign conditions (66 cases) and malignancies (40 cases) (Table 2). The various laparoscopic surgical procedures performed included nephrectomy, partial nephrectomy, nephro-ureterectomy, adrenalectomy and other combined surgeries (Table 3).

In the study, out of 106 patients, complications were observed in 16.03% of patients, with 13.20% experiencing minor complications and 2.83% experiencing major complications. The most common minor complications were delayed bowel movements and wound infection, while major complications included conversion to open surgery and the need for ventilator support or haemodialysis. There were no deaths in the study.

The analysis of factors associated with complications showed that the rates did not significantly differ based on age ($p=0.446$), gender ($p=0.189$), ASA grade ($p=0.294$), side of pathology ($p=0.113$), comorbidities ($p=0.220$), or pathology/diagnosis ($p=0.749$). However, higher grade complications tended to occur more frequently in elderly patients, males, and those with comorbidities.

Though there were trends observed, the p-values for these associations were not statistically significant. Probably the observed differences may have occurred by chance rather than being truly indicative of an association.

Table 1: Patient data

S. No.	Age	Sex	Comorbidities	ASA Grade	Diagnosis	Side	Surgery	Complications	CDC Grade
1	69	M	DM, CKD, HTN	III	STONE	R	LSN	Wound infection, Delayed bowel movements	II
2	35	M		I	GUTB	L	LSN + AC	Wound infection, blood transfusion, atelectasis	II
3	67	M	CVA	III	RCC	R	LRN		
4	73	F		I	RCC	R	LRN		
5	25	F		I	RCC	L	LRN		
6	64	M	HTN	II	TCC	L	LRNU	Delayed bowel movements	I
7	27	F		I	PUJO	L	LSN		
8	45	F	CKD, HTN	III	STONE	R	LSN		
9	52	M	DM, CVA	III	PUJO	R	LSN		
10	43	F	PTB	II	GUTB	R	LSN		
11	70	F	HTN, BA	II	RCC	L	LRN		
12	45	F		I	RCC	R	LRN		
13	50	F		I	STONE	R	LSNU	Wound infection	II
14	60	M	CAD	III	TCC	R	LRNU		
15	43	F		I	RCC	R	LRN		
16	36	M		I	RCC	L	LRN		
17	34	F		I	PUJO	L	LSN		
18	50	M		I	DONOR	L	LSN		
19	68	M	CKD, CVA	III	RCC	L	LRN	Delayed bowel movements	I
20	64	M	CKD, HTN	III	STONE	L	LSNU	Dialysis requirement	IV A
21	35	M	HTN, CVA	III	PUJO	L	LSN		
22	54	F	HYPOTHYROID	II	RCC	L	LRN		
23	38	F		I	PUJO	R	LSN		
24	51	M	DM, COPD	III	TCC	R	LRNU	Abundant drainage through drain	I
25	58	M		I	STONE	L	LSN		
26	43	M		I	RCC	R	LRN		
27	51	F		I	PUJO	L	LSN		
28	47	M		I	RCC	L	LRN		
29	55	M		I	STONE	L	LSN		
30	53	F	DM, HTN	II	STONE	L	LSN		
31	51	M		I	STONE	L	LSN		
32	64	M		I	RCC	L	LRN		
33	60	M		I	RCC	R	LRN		
34	67	M	HTN	II	RCC	R	LRN		
35	62	M	DM	II	PUJO	L	LSN		
36	55	F		I	STONE	R	LSN		
37	58	F		I	RCC	R	LRN		
38	60	F		I	STONE	L	LSN		
39	21	F		I	AML	R	LPN	Delayed bowel movements	I
40	53	M	DM	II	GUTB	L	LSN		
41	71	F	DM, CVA	III	RCC	L	LRN		
42	32	F	HYPOTHYROID	II	STONE	L	LSN		
43	48	F		I	RCC	R	LPN		
44	25	F		I	RCC	R	LRN		
45	58	M	COPD	III	STONE	L	LSN		
46	46	F		I	STONE	L	LSN		
47	53	F	PTB	II	GUTB	R	LSN		
48	65	M		I	STONE	R	LSN		
49	43	F		I	DONOR	L	LSN		
50	66	F		I	RCC	L	LRN		
51	59	F		I	STONE	L	LSN		
52	61	M	DM, CVA	III	TCC	L	LRNU		
53	42	M	HTN	II	PUJO	L	LSN		
54	44	F		I	RCC	L	LPN		
55	43	F		I	GUTB	R	LSN + IC	Wound infection, blood transfusion, Abundant drainage through drain	II
56	50	F		I	RCC	L	LRN	Blood transfusion	II
57	61	F		I	STONE	R	LSN		
58	48	M	DM	II	RCC	L	LPN		
59	56	M	DM	II	AML	R	LSN		
60	51	M		I	STONE	L	LSN		
61	27	F		I	XGPN	R	LSN	Delayed bowel movements, Conversion to open (for reason other than failure to progress)	III B
62	18	M		I	PUJO	L	LSN		
63	34	F	PTB	II	GUTB	L	LSN		
64	56	F	DM	II	RCC	L	LRN		
65	33	M		I	RCC	R	LRN		

66	38	F		I	STONE	L	LSN		
67	46	M	DM	II	GUTB	L	LSN		
68	56	F	DM	II	STONE	R	LSN		
69	61	F		I	STONE	L	LSN		
70	76	M	HTN	II	Adrenal Mass	L	LAD	Conversion to open (for reason other than failure to progress), Ventilatory support	IV A
71	31	F		I	PUJO	R	LSN		
72	26	F		I	RCC	R	LPN		
73	66	F	CKD, HTN	III	STONE	L	LSN		
74	48	M		I	RCC	L	LRN		
75	25	F		I	GUTB	R	LSN		
76	37	F	DM, BA	II	PUJO	R	LSN		
77	29	F		I	PUJO	L	LSN		
78	46	M		I	RCC	R	LPN	Atelectasis	II
79	61	F		I	RCC	L	LPN		
80	53	F	CAD	III	STONE	R	LSN		
81	33	M		I	PUJO	L	LSN		
82	41	F		I	STONE	L	LSN		
83	56	F	DM, HTN, COPD	III	VUJO Ca Cx	L	LSN		
84	54	M	DM, HTN	II	Adrenal Mass	R	LAD	Intercostal pain	II
85	12	M	HTN	II	Renal Artery Stenosis	L	LSN		
86	51	M		I	STONE	L	LSN		
87	40	F		I	STONE	L	LSN		
88	46	M		I	STONE	R	LSN		
89	7	F		I	PUJO	L	LSN		
90	30	F		I	Adrenal Mass	R	LAD	Atelectasis	II
91	81	M	DM, HTN, CVA	III	TCC	R	LRNU	Delayed bowel movements	I
92	53	M		I	STONE	L	LSN		
93	51	F		I	STONE	L	LSN		
94	64	F	DM, CAD	III	RCC	R	LPN		
95	45	F		I	STONE	L	LSN		
96	42	F	DM, HTN	II	STONE	L	LSN		
97	6	M		I	VUR + Ureterostomy	L	LSN		
98	64	M		I	RCC	R	LPN		
99	56	F	DM	II	STONE	R	LSN		
100	70	F	DM, HTN	II	RCC	L	LPN	Wound infection	II
101	67	F		I	RCC	L	LRN		
102	76	F		I	RCC	R	LRN		
103	61	M		I	STONE	R	LSNU		
104	62	F	CAD	III	TCC	L	LRNU		
105	46	M		I	PUJO	R	LSN		
106	19	M		I	Duplex UP VUJO	L	LPN		

Table 2. Diagnosis (Pathology) wise distribution of patients

S. No	Diagnosis	Number of patients
1.	Pheochromocytoma	3
2.	AML	2
3.	Donor	2
4.	Duplex moiety with UP NFK	1
5.	GUTB	8
6.	PUJO	15
7.	RCC	33
8.	Renal artery stenosis with NFK	1
9.	Stone disease with PFK/NFK	32
10.	TCC	6
11.	Ca Cervix with VUJO with NFK	1
12.	VUR (S/P ureterostomy) with NFK	1
13.	XGPN	1
	Total	**106**

Table 3. Procedure wise distribution of patients

S. No	Procedure	Number of patients
1.	LSN	55
2.	LRN	24
3.	LPN	11
4.	LRNU	6
5.	LSNU	5
6.	LSN + IC	1
7.	LSN + AC	1
8.	LAD	3
	Total	**106**

Discussion

In this prospective study, 106 patients with renal and adrenal pathologies underwent laparoscopic resective procedures. The post-operative complications were classified according to the modified Clavien-Dindo classification system, which provided an objective and simple grading system. The overall rate of complications in this study was 16.03%, with 13.20% experiencing minor complications and 2.83% experiencing major complications.

The most common complications observed were delayed bowel movements, abundant drainage, wound infection, basal atelectasis of the lung, intercostal pain, blood product transfusion, conversion to open surgery, haemodialysis requirement, and the need for reintubation and mechanical ventilator support. No deaths occurred during the study.

When analysing the factors associated with complications, it was observed that elderly patients, males, and those with comorbidities tended to have a higher occurrence of higher grade complications. However, these associations were not statistically significant.

The correlation between age and complications showed an increasing trend with age, but it was not significant. Similarly, there was no statistically significant correlation between ASA grades, side of pathology, or comorbidities and the occurrence of complications.

Regarding the type of pathology, higher grade complications were seen more frequently in patients with benign pathologies, while patients with malignancies experienced mostly low grade complications. However, no statistically significant difference was found between the type of pathology and complication occurrence (Table 4).

In terms of the procedures performed, simple resective surgeries had a higher occurrence of complications, likely due to the complexity of the procedure in the presence of pre-existing inflammatory or infective pathology. Donor nephro-ureterectomy had no complications, possibly due to the healthy status of the kidney and careful patient selection (Table 5).

The majority of complications fell into grades I and II, requiring only pharmacological treatment, while a smaller portion required ICU management or interventional treatment. The Clavien-Dindo classification system was found to be a useful tool in assessing the severity of complications.

Comparing the study with previous research, it was found that the complication rates in this study were comparable or lower than other studies (Table 6). This may be attributed to the expertise of the main surgeon, a well-trained team, and a streamlined peri-operative management protocol.

Table 4. Distribution of cases as per CDC grade in groups of different pathologies

CDC Grade	Pathology		Total
	Benign	Malignant	
Zero	56	33	89 (83.97)
I	1	4	5 (4.71)
≤II	6	3	9 (8.49)
≤III A	0	0	0 (0)
≤III B	1	0	1 (0.94)
≤IV A	2	0	2 (1.89)
≤IV B	0	0	0 (0)
≤V	0	0	0 (0)
All grades	66 (62.26)	40 (37.74)	106 (100%)

Table 5. Distribution of cases as per CDC grade in different procedures

CDC Grade	Procedure								Total
	LSN	LSNU	LPN	LRN	LRNU	LSN + IC	LSN + AC	LAD	
Zero	53	3	8	22	3	0	0	0	**89 (83.97)**
I	0	0	1	1	3	0	0	0	**5 (4.71)**
≤II	1	1	2	1	0	1	1	2	**9 (8.49)**
≤III A	0	0	0	0	0	0	0	0	**0 (0)**
≤III B	1	0	0	0	0	0	0	0	**1 (0.94)**
≤IV A	0	1	0	0	0	0	0	1	**2 (1.89)**
≤IV B	0	0	0	0	0	0	0	0	**0 (0)**
≤V	0	0	0	0	0	0	0	0	**0 (0)**
All grades	**55 (51.88)**	**5 (4.71)**	**11 (10.37)**	**24 (22.64)**	**6 (5.67)**	**1 (0.94)**	**1 (0.94)**	**3 (2.83)**	**106 (100%)**

Table 6. Comparison of present study with previous studies

Study	Type	Year	Number of patients	Complications	MCD Grade	
					Low	High
Hua Xu et. al[26]	Retrospective	2014	88	17(19.3%)	18.2%	1.1%
Balcı M. et. al[18]	Prospective	2016	208	13(6.3%)	5.8%	0.5%
Agrawal T. et.al[17]	Prospective	2017	97	45(46%)	35%	11%
Ali S.G. et.al[28]	Retrospective	2017	330	65(19.7%)	12.7%	7%
Çetin D et.al[16]	Retrospective	2018	396	75(18.9%)	17.7%	2.2%
Present Study	Prospective	2023	106	11 (16.03%)	13.2%	2.8%

In conclusion, this study provides valuable insights into the post-operative complications associated with laparoscopic renal and adrenal resective surgeries. The modified Clavien-Dindo classification system proved useful in grading the severity of complications. Although certain trends were observed in relation to age, gender, comorbidities, and pathology, they did not reach statistical significance. Further research with larger sample sizes is necessary to validate these findings and identify potential risk factors for complications.

Limitations of this study

This study has several limitations that should be taken into consideration. Firstly, the sample size was relatively small, and the study was conducted over a limited period of time, which may have resulted in limited precision and generalizability of the findings. The short follow-up period also limits the ability to assess long-term morbidity and mortality associated with the procedures. Additionally, as the study was conducted in a single tertiary-level hospital in a specific country, the results may not be representative of other populations or healthcare settings. Despite these limitations, the study provides valuable insights into the post-operative complications of elective laparoscopic renal and adrenal resective surgeries.

Conclusion

In conclusion, this study demonstrates the effectiveness of laparoscopic surgery in treating renal and adrenal diseases, with low complication rates observed. The modified Clavien-Dindo classification system proved to be a valuable tool for assessing and categorizing post-operative complications, enabling a clear distinction between different grades of severity. The findings highlight the significance of this standardized classification system in evaluating surgical outcomes and improving patient safety. It is recommended that the modified Clavien-Dindo classification system be widely implemented and incorporated into routine reporting of surgical results. By doing so, the quality of surgical care can be enhanced, leading to better patient outcomes.

Conflicts of interest

The authors declares that they do not have conflict of interest.

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