RESEARCH ARTICLE

Comparative Study of Outcome and Complications of Laparoscopic and Open Simple Nephrectomy in Patients with Non-functioning Kidneys

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Abstract

Background: Nephrectomy is the cardinal treatment option for patients with non-functioning kidneys due to malignant and benign causes. Both laparoscopic and open nephrectomy is preferred but the laparoscopy has less complication and improved surgical outcome when compared over open procedure. In this backdrop, the present study was conducted to compare the surgical outcomes and complications of open and laparoscopic nephrectomy procedures.

Materials and methods: This was a retrospective study conducted on 50 patients admitted with non-functioning kidneys. They were divided into two groups—laparoscopic nephrectomy ($n = 25$) and open simple nephrectomy ($n = 25$). The duration of hospital stay, surgery, postoperative catheter drain removal and surgical complications were analyzed and compared between laparoscopic and open methods.

Results: Laparoscopic nephrectomy showed less operative time (90.60 ± 15.99 vs 133.64 ± 10.57 minutes; $p = 0.001$), shorter hospital stay (3.40 ± 0.12 vs 5.48 ± 0.16 days; $p = 0.001$) and early postoperative catheter removal (3.20 ± 1.08 vs 2.56 ± 1.04; $p = 0.03$) when compared with open nephrectomy and it was significant. The complication rate was lower in laparoscopic nephrectomy when compared with simple open nephrectomy (12 vs 36%).

Conclusion: Laparoscopic nephrectomy for non-functioning is an effective alternative to open nephrectomy, leading to reduced operative time, quicker recovery and fewer complications as indicated by our findings.

Keywords: Complications, Hospital stay, Laparoscopic nephrectomy, Non-functioning kidneys, Open nephrectomy.

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Introduction

Nephrectomy is the surgical excision of kidneys and it is indicated for both benign and malignant disorders. Common indications for these conditions include kidney stones, persistent pyelonephritis, untreated ureteropelvic junction obstruction, renal tuberculosis, and renal cell carcinoma.[1] The first nephrectomy procedure is conducted by Gustav Simon in 1869, and since then, this treatment has been widely performed globally, with subsequent advancements in methodology.[2] Open or laparoscopic methods is accepted for the nephrectomy procedures and in earlier days for both benign and malignant conditions open nephrectomy method are preferred. Urologic laparoscopy has gained significant attention with the first procedure of total laparoscopic nephrectomy conducted by Clayman in 1990.[3] The laparoscopic nephrectomy is used in benign conditions, such as renal tuberculosis, chronic pyelonephritis, obstruction of pelviureteric junction during renal stones, reflux nephropathy, multicystic dysplastic kidney, renal cystitis, renovascular hypertension xanthogranulomatous pyelonephritis, post-kidney transplantation hypertension.[4]

The advantage of laparoscopic nephrectomy is reduced hospital stay, quick recovery time, less bleeding, postoperative pain, and cosmetic benefits. Due to these benefits, laparoscopic surgery is now considered the preferred procedure for nephrectomy in cases of both benign and malignant illnesses.[5]

However, previous studies have shown that laparoscopic nephrectomy procedures elicit more risk for complications and also require longer duration for surgery when compared with open nephrectomy, but recent reports showed no differences.[6,7]

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Furthermore, wide range of studies have demonstrated that laparoscopic nephrectomy is associated with reduced morbidity, shorter times of ischemia, and shorter hospital stay as that of the open procedure.[8,9] So the present study was aimed to compare outcomes and complications in patients underwent laparoscopic and open simple nephrectomy due to non-functioning kidney.

Materials and Methods

This was a retrospective study conducted on 50 patients admitted with non-functioning kidneys at the Department of Urology and Renal Transplantation, SRIHER. The study was conducted for a period of 6 months from November 2022 to May 2023.

Inclusion Criteria

Patients >18 years of age with non-functioning kidney confirmed through dimercaptosuccinic acid (DMSA) and diethylenetriamine pentaacetate (DTPA) scan were included in the study.

Exclusion Criteria

Patients with coagulopathy or use of platelet aggregation inhibitors, renal abnormalities physical abnormality, severe untreated hypertension and aortic aneurysms were excluded from the study. Patients who were prone to anesthetic risk and having pregnancy were excluded from the study.

Study Procedure

The data of patients who underwent laparoscopic nephrectomy and open simple nephrectomy with non-functional kidney were collected retrospectively for the study. Patients with non-functioning kidney were enrolled into the study-based DMSA and DTPA scans. The sociological data of the patients such as sides of kidney, percentage of non-functioning kidney, duration of the hospital stay, duration of the surgery were analyzed. Surgical complications, catheter removal day and drain removal day were documented. Preoperative assessment was done with routine investigations, such as complete blood count (CBC), renal blood test (RFT), coagulation profile, urine routine, urine culture, blood grouping, and typing and viral markers. If urine culture is positive, the required antibiotic is given for appropriate time period and the urine culture is repeated and preceded for the surgery if the urine culture is negative.

General anesthesia was used during open simple nephrectomy and laparoscopic nephrectomy. A urethral catheter and nasogastric tube were inserted for patients undergoing surgery. The laparoscopic nephrectomy was done in lateral position. Instruments used were Karl Storz, Richard Wolf and Olympus (Germany) based on surgeon's expertise. The open simple nephrectomy was done in lateral position with flexed operation table and flank approach. Instruments used were open and vascular equipment's (VL enterprises, India). The umbilicus served as the main entry point, and trocars were inserted directly there. The abdominal cavity was examined using a laparoscopic lens after creating a pneumoperitoneum with CO_2. Access to the retroperitoneum was made possible following colon medialization. The surgeon's tool (Valley lab) for laparoscopic dissection and bleeding control which was especially helpful in challenging cases.

Statistical Analysis

The data were represented as mean ± SD. The comparison of variables between the laparoscopic and simple open nephrectomy was done using independent sample student *t*-test. The *p*-value < 0.01 was considered statistically significant.

Results

We evaluated 50 patients who underwent laparoscopic and open simple nephrectomy due to non-functioning kidney during the period and fulfilling the inclusion criteria. The patients were divided into two groups as laparoscopic nephrectomy ($n = 25$) and open simple nephrectomy ($n = 25$), respectively.

The demographics and clinical characteristic of the study participants are given in Table 1. In both the groups, male preponderance was observed, 17 (68%) in laparoscopic group and 16 (64%) in open nephrectomy group. The most affected side of the kidney was left in laparoscopy 18 (72%) and right in open nephrectomy 14 (56%).

Table 1: Demographics and clinical characteristic of the study participants

Variables	*Laparoscopic nephrectomy (n = 25)*	*Simple open nephrectomy (n = 25)*
Gender (*n*, %)		
Male	17 (68%)	16 (64%)
Female	8 (32%)	9 (36%)
Kidney side (*n*, %)		
Right	7 (28%)	18 (72%)
Left	11 (44%)	14 (56%)

The surgical outcome between the laparoscopic group and open nephrectomy group is given in Table 2. The surgical operative time (90.60 ± 15.99 vs 133.64 ± 10.57 mins; $p = 0.001$ mins), hospital stay (3.40 ± 0.12 vs 5.48 ± 0.16 days; $p = 0.001$) was significantly lower in laparoscopic groups as compared with simple open nephrectomy. The postoperative catheter removal was earlier in laparoscopic nephrectomy group as compared with open nephrectomy and it was significant (2.56 ± 1.04 vs 3.20 ± 1.08; $p = 0.03$). Meanwhile drain removal was earlier in laparoscopic nephrectomy group as compared with open nephrectomy but it was not significant (1.24 ± 0.52 vs 1.48 ± 0.65; $p = 0.15$).

The complication among the laparoscopic nephrectomy and simple open nephrectomy is given in Table 3. The complication rate was lower in laparoscopic nephrectomy when compared with simple open nephrectomy (12 vs 36%). The most common complication in laparoscopic nephrectomy was bleeding, wound infection, and organ damage and in simple open nephrectomy, peritonitis was the major complication in 4 (16%) of the patients.

Radiological investigation among the groups is presented in Table 4. In this study, DMSA renal scan predicted renal function in 84% and DTPA predicted renal function in 16% of the patients in laparoscopic nephrectomy. Meanwhile, in simple nephrectomy, DMSA predicted renal function in 56% and DTPA in 44% of the patients respectively.

Discussion

In recent years, technological advancements have led to the increasing use of minimally invasive procedures over traditional open surgery. Laparoscopic nephrectomy offer significant benefits in terms of early return to perform daily activities, shorter hospital stays, low requirement of analgesics, enhanced cosmetic appeal, and faster healing compared to open nephrectomy.[10] Currently, laparoscopic nephrectomy is the primary treatments for patients with non-functional kidney disease who experience frequent infection, significant lumbar discomfort and severe renovascular hypertension due to advancements in clinical practice. Laparoscopic nephrectomy is performed by two approaches, namely, transperitoneal or a retroperitoneal, respectively. Retroperitoneal access allows for prompt management of the renal pedicle, although it can be challenging due to fibrotic tissue dissection in a confined surgical area. Retroperitoneal laparoscopic simple nephrectomy can be effectively performed by skilled surgeons with less complications rates.[11] Meanwhile, the transperitoneal method is commonly chosen for surgery for inflamed kidneys. The extensive surgical area and the surgeon's

Table 2: Comparison of surgical outcome between laparoscopic nephrectomy and simple open nephrectomy

Variables	*Laparoscopic nephrectomy (n = 25)*	*Simple open nephrectomy (n = 25)*	*p-value*
Surgical operative time (in mins)	90.60 ± 15.99	133.64 ± 10.57	0.001*
Hospital stay (in days)	3.40 ± 0.12	5.48 ± 0.16	0.001*
Catheter removal (POD)	2.56 ± 1.04	3.20 ± 1.08	0.03*
Drain removal POD	1.24 ± 0.52	1.48 ± 0.65	0.15^{NS}

The data were shown as mean ± SD. *$p < 0.05$ statistically significant (Independent student *t*-test). NS, non-significant

Table 3: Comparison of complication among the laparoscopic nephrectomy and simple open nephrectomy

Complication	*Laparoscopic nephrectomy (n = 25)*	*Simple open nephrectomy (n = 25)*
Bleeding	1 (4%)	2 (8%)
Wound infection	1 (4%)	2 (8%)
Organ damage	1 (4%)	1 (4%)
Peritonitis	0 (0%)	4 (16%)
Total	3 (12%)	9 (36%)

Table 4: Radiological investigation among the laparoscopic nephrectomy and simple open nephrectomy

Radiological investigation	*Laparoscopic nephrectomy (n = 25)*	*Simple open nephrectomy (n = 25)*
DMSA	21 (84%)	14 (56%)
DTPA	4 (16%)	11 (44%)

familiarity with anatomical landmarks provide comfort for the transperitoneal approach.[11] The current study compared surgical outcome and complication between laparoscopic nephrectomy and simple open nephrectomy.

In the current observation, the incidence of patients undergoing nephrectomy was higher in males. Likewise in a study done by Ölçücüoğlu,[12] among the patients undergoing donor nephrectomy, majority are males constituting 69.4%.

The surgical operative time showed significant decrease in laparoscopic nephrectomy as compared with simple open nephrectomy (90.60 ± 15.99 vs 133.64 ± 10.57 minutes; $p = 0.001$). In a recent meta-analysis study done by Wang et al.,[9] the operating time was less in laparoscopic as compared with open nephrectomy, and it was significant ($p = 0.01$). In contrast, mounting studies reported no significant variations in the operative time between laparoscopic nephrectomy and simple open nephrectomy as reported by Singh and Urry[13] (113 vs 111 minutes; $p > 0.05$), meta-analysis study You et al.[14] ($p = 0.13$) and Falahatkar et al.[4] (188 vs 176.25 minutes; $p = 0.57$), respectively.

In the present study, laparoscopic nephrectomy has shorter hospital stay as compared with simple open nephrectomy and it was significant (3.40 ± 0.12 vs 5.48 ± 0.16 days; $p = 0.001$). Likewise, in a study done by Falahatkar et al.[4] (3.45 vs 4.9 1 days; $p = 0.004$), Murtaza et al.[10] (3.30 vs 5.5 days; $p < 0.0001$), and Ganpule et al.,[15] (5.72 vs 9.18 days; $p < 0.001$), the hospital stay was shorter in laparoscopic procedure as compared with open for various indications, The shorter hospital stay in laparoscopic nephrectomy is attributed for various factors, such as strict bowel preparation, accurate analgesic protocols and improved quality of life.

In our study, the postoperative catheter and drainage removal was shorter in laparoscopic nephrectomy as compared with open nephrectomy. Prophylactic placement of drains postoperatively is important for both open and laparoscopic nephrectomies. Studies indicate that there was a significant association between the use of surgical drains and abdominal and surgical wound infections and abdominal infections. Lebowski and Saclarides.[16] reported that the use of drains showed the development of postoperative ileus and more time for bowel recovery. In addition, some studies also reveals that drain use might allow infections by the formation of ascites as a result of peritoneal irritation and provokes abdominal pain.[17] The shorter hospital stay in our study in patients underwent laparoscopic nephrectomy might be due to early drain removal and low incidence of infections.

In the present study, the incidence of complications in laparoscopic nephrectomy is 12% and in simple, open nephrectomy is 36%, respectively. Likewise in a study done by Murtaza et al.,[10] the incidence of complication was lower in laparoscopic nephrectomy as compared with simple open nephrectomy and it was significant (16.7 vs 26.7%; $p < 0.05$). In a meta-analysis done by Chen et al.[18] Laparoscopic nephrectomy displayed less complications as compared with open procedures (OR 0.59, 95% CI, 0.40–0.86; $p = 0.007$). In another study done by Liu et al.,[19] the incidence of postoperative complications in laparoscopic surgery was significantly lower when compared with open technique (19.5 vs 47.8%; $p = 0.004$). In a recent study done by Lyu et al.[20] complications due to surgical cause measured by the Clavien-Dindo scoring was lower in laparoscopic procedure as compared with open (5 vs 23; $p < 0.001$).

In this study, DMSA predicted renal function effectively in both laparoscopic and open nephrectomy group encompassing 84% and 56%, respectively as compared with DTPA in 16% and 44% of the cases. Momin et al.[21] reported that both 99mTc- DMSA and 99m Tc- DTPA scans produces similar results on renal function and DMSA scan is the primary choice for evaluating renal function.

Conclusion

Overall, laparoscopic nephrectomy demonstrated several advantages over open nephrectomy in terms of outcomes and complications. Laparoscopic nephrectomy resulted in shorter hospital stays and lower complication rate compared with those who underwent open nephrectomy. Based on the available literature, laparoscopic nephrectomy appears to be a safe and effective alternative to open simple nephrectomy for treating non-functioning kidney. However, the choice between laparoscopic and open simple nephrectomy should be individualized based on patient's characteristics, surgeon expertise and institutional resources.

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