Laparoscopic Nephrectomy: A Prospective, Nonrandomized Comparison With Open Surgical Nephrectomy.

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Citation

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Abstract

Objective:
To comparatively study the effectiveness of Laparoscopic nephrectomy vis-à-vis Open nephrectomy in patients of benign non functioning kidney and early stage renal cell carcinoma. It was a prospective, non-randomized study.
Patients and Methods:
160 patients underwent open (n=80) or laparoscopic nephrectomy (n=80).The comparison was made in relation to the operative time, intra-operative and postoperative complications, blood loss and transfusions, pain and analgesia requirements, hospital stay and convalescence.
Results:
The mean operative time (96 minutes Vs 74 minutes) was more in the laparoscopic group. The mean blood loss (127 ml Vs 104 ml) was more in the open group. The resumption of oral intake (30.3 hours Vs 33.6 hours) and removal of drain (2.35 days Vs 2.6 days) was earlier in the laparoscopic group. Intra-operative complications were more in laparoscopic group (5% Vs 2.5%). A total of 4 patients (5%) had to be converted to open because of failure to progress, and bleeding due to major vessel injury. Post operative complications were significantly more in open group. Mean hospital stay in open group was 6.3 ± 1.34 days, significantly more than laparoscopic group of 4.2 ± 1.22 days. Tumor recurrence was seen in both the groups.
Conclusion:
Laparoscopic nephrectomy for benign and early stage malignant disease is superior to open surgery in terms of reduced blood loss, postoperative complications, hospital stay and cosmetic outcome. The accumulated follow-up oncological data has shown equal oncological efficacy of laparoscopic radical nephrectomy and the results are comparable to open radical nephrectomy.

INTRODUCTION

Advances in video technology and instrumentation design have resulted in rapid evolution of laparoscopic urology. Since Clayman et al.[1], performed the first laparoscopic nephrectomy in 1991, laparoscopic nephrectomy has been embraced by urologists worldwide and is being increasingly performed as a viable alternative to traditional open techniques. Although the laparoscopic operation takes longer than open surgery, there are considerable reductions in the length of postoperative hospital stay and the time taken to return to normal activities and to full recovery[4-9]. Major complications were relatively common in early operations, but with more experience morbidity has been reduced. Whereas laparoscopic nephrectomy has traditionally been indicated in most benign renal diseases in which permanent loss of renal function has occurred, its use in management of malignant renal disease is still controversial, largely because of the fear of spillage of malignant tissue into the abdominal cavity during morcellation and retrieval of the kidney. With the increasingly mainstream use of abdominal CT scans and ultrasound imaging in recent years, incidental detection of malignant kidney diseases has increased in asymptomatic patients. These tumors tends to be smaller and of lower stage, which results in better survival, lower recurrence rates, and lower metastasis rates than those in symptomatic patients. With new developments for improving various technical aspects of the operation, laparoscopic radical nephrectomy is becoming the preferred choice for these early stage cancers. There are two basic laparoscopic approaches for nephrectomy: retroperitoneal [3] and

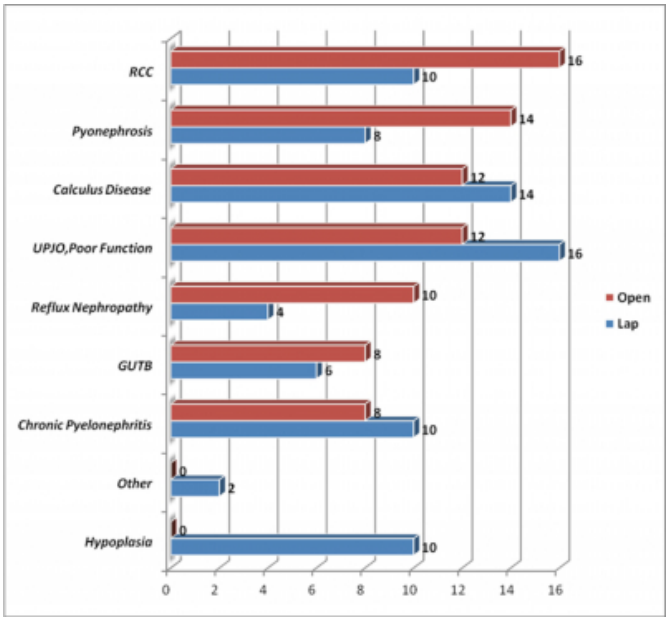
transperitoneal. A third approach, the hand assisted technique attempts to bridge the gap between laparoscopic and open surgery and may help surgeons without advanced laparoscopic training. At many medical centers, including ours, laparoscopic nephrectomy is being increasingly used in place of open nephrectomy as a treatment of choice for many benign and malignant diseases with excellent results.

PATIENTS AND METHODS

This was a prospective, non-randomized study, conducted in our department. Of all the patients who underwent nephrectomy between April 2005 and March 2009, 160 patients were included in this study, 80 each in open (44 males & 36 females) and laparoscopic (26 males & 54 females) groups. The patients were initially evaluated in the outpatient department and then admitted for surgery. On admission a detailed history was asked including past history especially with reference to previous operation(s). Thorough abdominal examination was done in each patient. Each patient and his/her attendants were fully explained about the nature of both laparoscopic and open surgery, and written consent was taken. Patients planned for laparoscopic nephrectomy were informed regarding the possible complications and consent was taken for possible need for conversion to open surgery. Investigations performed included routine investigations and imaging studies for anatomic examination of the urinary tract. Differential renal function was assessed with computerized isotope renography (DTPA renal scan). All the patients had their blood typed and cross matched. Mechanical bowel preparation was done with polyethylene glycol (Peglac™) in case a transperitoneal approach was planned. In retroperitoneal approach formal bowel preparation was not done. Pre-anesthetic checkup was done in all patients. The decision to perform open or laparoscopic nephrectomy depended on the preference of the patient and surgeon in accordance with the underlying disease and possible contraindications to laparoscopic surgery. All the procedures were done as elective surgeries under general anaesthesia. Preoperative prophylactic antibiotic (inj. cefazolin 1 gm IV at the time of intubation) was given in all cases.

Figure 1

(Fig. 1. Indications. Many patients had more than one indication)

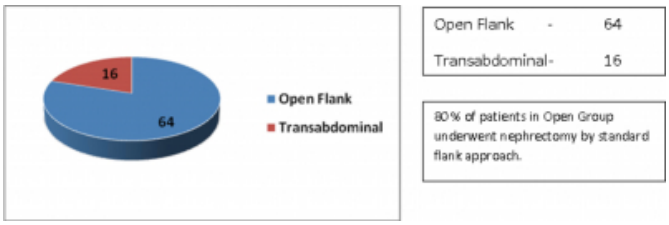


SURGICAL TECHNIQUES USED

Open Nephrectomy: In benign conditions and small renal tumors, standard flank approach was used. In patients with large tumors, radical nephrectomy was performed via an extended subcostal incision.

Figure 2

(Fig. 2. Open Group, approach)



LAPAROSCOPIC NEPHRECTOMY

Retroperitoneal Nephrectomy: The patient was placed in a modified flank position. A 15-mm incision was made 1 cm below the tip of 12th rib, which served as the middle trocar and was usually used for the camera port. A hole was created from the skin through the muscle into the retroperitoneal space using a blunt hemostat. The index finger was inserted through the incision and used for blunt dissection for creation of space and sweeping the peritoneum anteriorly. The potential working space was then created with a balloon dissector which was insufflated with 800-1000 ml of air and kept in place for a minimum of 5 minutes to achieve

haemostasis. After removal of the baloon, two working ports, 10 mm and 5mm, were made under finger guidance, one in the renal angle just below the 12 th rib at the lateral border of Sacrospinalis muscle, and the other 1.5 cm above and anterior to Anterior Superior Iliac Spine. Finally Hasson's cannula was secured at the primary port site and 30 degree telescope advanced. Additional trocar for retraction was used when necessary. The first step was to identify the psoas muscle and psoas tendon. From the psoas tendon, medial dissection revealed the ureter, which was then elevated and followed to the lower pole of the kidney and dissection carried upto the hilum to identify the vessels. By dissecting medially, the renal artery was identified. The artery was dissected with a right-angled renal pedicle dissector and doubly clipped with Hem-O- Lok clips and divided. Once the artery was divided, the vein was circumferentially dissected, clipped and divided. Next the kidney was freed of all attachments and the specimen was delivered through the primary port site, which was extended if necessary. Morcellation of the kidney was not done. Before the trocars were removed the retroperitoneal pressure was lowered to identify possible bleeding. A single tube drain was placed in the renal fossa and ports closed in layers.

Transperitoneal Nephrectomy: The patient was positioned in a modified lateral decubitus position. Approximately 30 degrees of rotation of the chest and abdomen was used. Pneumoperitoneum was established by closed technique using veress needle periumblically and insufflating to an intra-abdominal pressure of 15 mmHg. The first trocar (10 mm) for the introduction of endocamera, was placed periumblically through a horizontal skin incision. After inspection of abdominal cavity additional trocars were placed under direct vision. A 12-mm and a 5-mm trocar were placed lateral to the rectus at the level of the umbilicus; and in the midline between the umbilicus and the xiphoid process, respectively. Additional trocars needed were used as necessary. The operation began with the incision of the peritoneum along the white line of Toldt using Harmonic scalpel (Ethicon™) for reflection of the colon medially. The psoas muscle and psoas tendon were identified and the psoas muscle followed medially, to reveal the gonadal vessels. These were swept laterally and the ureter identified. The ureter was elevated and followed proximally to the lower pole and hilum of the kidney. The ureter was not divided at this time and used to help elevate the kidney. Medial retraction of the colon and bowel by an additional retractor and/or lateral retraction of the kidney by lifting it out of the renal fossa placed the hilar vessels under tension and helped in the dissection of the renal hilum. Layer-by-layer anterior dissection was performed until the renal vein was uncovered. Careful dissection using right angled pedicle dissector was done to identify the renal artery. The artery was clipped with Hem-O-Lok™ clips and divided first, followed by the vein. Once all the hilar vessels had been divided, the dissection was continued posteriorly and superiorly to the free the kidney of all the attachments. Finally the ureter was clipped and transected. The specimen was retrieved through one of the port sites, after extension, or through a small 5 cm incision in the groin. Pneumoperitoneum was reduced and the renal fossa inspected for any bleeding. A tube drain was kept and the trocar sites were closed in layers.

Figure 3

(Fig. 3. Laparoscopic Group, approach)

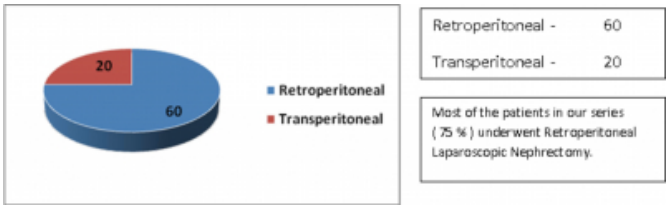
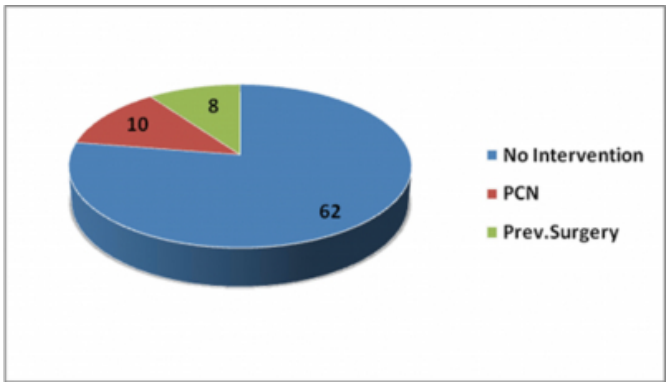


Figure 4

(Fig. 4. Previous surgeries/ interventions in patients undergoing laparoscopic nephrectomy)



Postoperative care: The orogastric tube was removed at the conclusion of the procedure. The Foley catheter was removed once the patient was comfortably ambulating. For the immediate post-op pain relief injectable diclofenac sodium 50 mg intramuscular was used. Later oral diclofenac 50 mg tab was used. Patients were made ambulatory on the next day in case of open nephrectomy and on the same day of operation, at evening, in case of laparoscopic nephrectomy. Orals were usually started on the 1 st post

operative day in laparoscopic group and on 1-3 day in open group. After discharge from hospital patients were called for follow-up at 1 week, 4 weeks, 12 weeks, and 6 monthly thereafter.

The following parameters were recorded in a pre-structured Proforma.

Information on gender, age, body mass index, co-morbidities and past surgical history.

Procedure used, indication of surgery, side of disease, kidney size, differential function, estimated blood loss, transfusions.

Operative time: was recorded from the time of incision to closure of skin and port sites.

Intra operative complications, major and minor; conversion to open/ reason for conversion.

Pain: was evaluated by visual analogue scale and the number of analgesic doses required.

Infection was assessed by clinical examination and treated as appropriate.Postoperative hospital stay was noted (the day of surgery being day zero).

RESULTS

OPERATIVE PARAMETERS

The mean operative time was significantly less in the open group but the operative times in the laparoscopic group became lesser with increased experience and the overall operative times are comparable with open surgery group. The mean blood loss and mean time for starting oral intake was less in laparoscopic group. Most patients in laparoscopic nephrectomy group started oral intake within 24 hours and were usually discharged the day after the drain was removed. There were a total of 4 (5%) major intra-op complications in the laparoscopic nephrectomy group. In one of the patients, a case of pyonephrosis with a previous history of PCN, a transperitoneal approach was used. After reflection of colon, dense perinephric adhesions were encountered and while breaking the adhesions there was profuse bleeding. The procedure was converted to open because of bleeding and failure to progress. In another patient, also a case of pyonephrosis, retroperitoneal approach was used. There were dense perinephric adhesions and while dissecting the upper medial part of kidney, a small rent occured in the IVC. The bleeding was controlled by maintaining pressure with a gauze pack till open access was achieved and repair of the IVC rent was done. Two more patients required conversion because of failure to proceed. These complications occured early in the series and depict the difficulty in dealing with long standing pyonephrosis laparoscopically. There was inadvertant opening of peritoneum in 4 patients of retroperitoneal nephrectomy. A Veress needle was put in just before completion and the gas aspirated, both the procedures were completed laparoscopically without much difficulty. A total of 4 patients (5%) had to be converted to open because of bleeding, failure to progress, and IVC injury, as already described. Of the 80 patients taken up for laparoscopy, 10 patients had a previous history of PCN. The procedure was successfully completed in 8 of them and 2 required conversion. 8 patients had undergone previous abdominal surgeries (splenectomy in two, hysterectomy in five and open flank pyelolithotomy in one). Transperitoneal approach was used in the patient with open flank surgery. All the other patients were planned for retroperitoneal laparoscopic nephrectomy and the procedure was successfully completed in all of them.

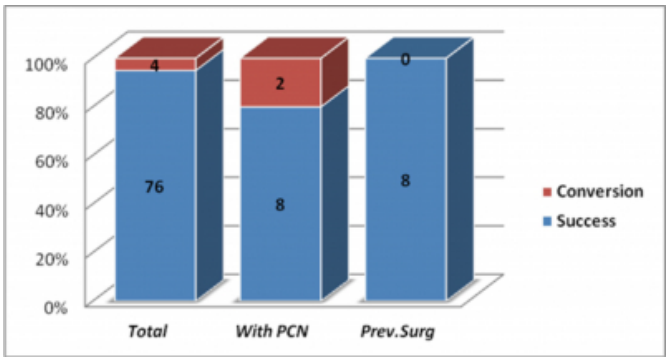
Figure 5

(Table:1. Comparison of operative parameters between open and laparoscopic groups)

		Open (n=80)	Laparo (n=80)	p – value
Operative Time (min)	mean	74.0 ± 29.40	96.25 ± 36.94	0.0038
	range	30 – 140	40 – 190	
Blood Loss (ml)	mean	127 ± 78.78	104.25 ± 66.62	0.1652
	range	50 – 600	40 – 350	
Oral Intake (hours)	mean	33.6 ± 14.87	30.3 ± 13.3	0.2987
	range	24 – 72	12 – 72	
Drain Removal (days)	mean	2.6 ± 0.68	2.35 ± 0.57	0.0786
	range	2 – 4	1 – 4	
Intra-Op Complications	major	2 (2.5%)	4 (5%)	
	minor	2 (2.5%)	4 (5%)	
Transfusions		14 (17.5%)	8 (10%)	

Figure 6

(Fig. 5. Overall success rate of 95%. Success rate of 80% with previous PCN)



While analyzing the peri-operative details of patients within the laparoscopic nephrectomy group, it was evident that the patients undergoing retroperitoneal nephrectomy had an overall better outcome. The operative times were shorter, blood loss was less, they started orals significantly earlier and had a shorter hospital stay than their counterparts undergoing transperitoneal nephrectomy.

Figure 7

(Table:2. Operative parameters of retroperitoneal and transperitoneal groups)

		Retroperitoneal(n=60)	Transperitoneal(n=20)	p - value
Operative Time (min)	mean	94.5 ± 36.20	101.5 ± 40.62	0.6102
	range	40 - 185	50 - 190	
Blood Loss (ml)	mean	96.83 ± 62.23	126.5 ± 77.60	0.2272
	range	40 - 350	60 - 300	
Oral Intake (hours)	mean	26.0 ± 10.49	43.2 ± 12.89	0.0001
	range	12 – 72	24 – 72	
Drain Removal (days)	mean	2.26 ± 0.52	2.60 ± 0.69	0.1075
	range	1 – 3	2 – 4	
Intra-Op Complications	major	2/60	2/20	
	minor	4/60	0/20	
Transfusions		8.33 %	15 %	

POST-OPERATIVE PARAMETERS

Post operative complications were significantly more in open group. Out of a total of 16 post-operative complications, 12 occured in open group and 4 in laparo group. 8 patients in open group and 2 in laparo group developed superficial wound infection which was managed by a short course of empirical antibiotic against Staph.aureus. Two patients in open group had severe wound infection which was managed by skin stitch removal and daily dressing and broad spectrum antibiotics. They were subsequently planned for secondary suturing after discharge. Post-op prolonged ileus was seen in 2 patients of open group and this was managed conservatively and orals were started on day 3. Two patients in laparoscopic group, including the one with intra-op major vessel injury developed post operative collection/hematoma which was managed by USG guided aspiration and broad spectrum antibiotics. No patient in either group required re-exploration.

Figure 8

(Table:3 Post-operative complications)

	Open (n = 80)	Lap (n = 80)
Sup. Wound infection	8	2
Hematoma / Collection	2	2
Prolonged Ileus	2	0
Total	12 (15 %)	4 (5%)

Patients were discharged as soon as they became ambulant, tolerated orals and after removal of the drain. The longest hospital stay in open group was in the patient who developed severe wound infection, he stayed in the hospital for 9 days. In laparoscopic group longest stay was in the patient who had intraoperative IVC injury, who had to be converted to open and subsequently developed postoperative wound infection and collection/hematoma formation. This patient was discharged on 9 th postoperative day. Mean hospital stay in open group was 6.3 ± 1.34 days and in case of laparoscopic group was 4.2 ± 1.22 days.

Figure 9

(Table:4 Hospital Stay- days)

Hospital Stay	Open	Laparo	P - value
Mean	6.3 ± 1.34	4.2 ± 1.22	0.0001
Range	3-9	5-9	

Post operative pain relief: Postoperative pain was quantified using Visual Analogue Scale (VAS Score) and the total quantity of analgesic, diclofenac sodium, (i/m Inj., plus per oral) used in the postoperative period. There was not a statistically significant difference in the VAS score and the quantity of diclofenac used in the two groups. Laparoscopic nephrectomy group had generally low VAS Score and the use of analgesics was also less.

Figure 10

(Table:5 Post operative pain – VAS Score and Analgesia requirement)

Mean	Open group (n=80)	Lap. Group (n=80)	'p' value
VAS Score Day 01	5.92	5.34	0.682
VAS Score Day 02	4.21	3.78	0.543
VAS Score Day 03	2.01	1.86	0.437
Diclofenac used, mg	175	105	0.283

Follow up and patient satisfaction: All patients in both groups were followed strictly after the surgery. Mean follow up of the patients in the open group was 8.3 months and in laparoscopic group 7.5 months. One patient in the laparoscopic nephrectomy group, who had undergone retroperitoneal nephrectomy for T_1 renal mass of left kidney developed port site recurrence after 15 months of surgery. HPE report had shown it to be a papillary RCC. The recurrence occurred at the renal angle port site which had been used as the main 10 mm working port. The specimen had been retrieved after extending the 15 mm camera port site. There was one tumor recurrence in the open group also. There were no incisional hernias or any other delayed complications in either group. Patients undergoing

laparoscopic surgery were overall better satisfied. They were usually surprised by the results of the laparoscopic surgery in the post operative period, with no incision and only three small dressings (band-aids) at the port sites.

DISCUSSION

As with any technology-driven field, laparoscopic surgery has made tremendous progress in recent years. Laparoscopic nephrectomy is usually performed at specialized centers since this operative technique is associated with a certain learning curve. Relative to conventional surgery, laparoscopy reduces postoperative pain, morbidity, hospital stay and convalescence. However, it remains controversial because of the lengthy surgery and problems in respecting oncological principles. Early reports of laparoscopic nephrectomy showed the advantages of less postoperative pain, and quicker recovery and convalescence. As reported by Gill et al.[5] (1995), the average operating time was 353 min., which was significantly more than in open surgery, but the patients had a shorter hospital stay, less postoperative analgesia requirements, early resumption of orals and a briefer convalescence. McDougall et al [10] (1996) reported the first 17 patients from Washington University had an average operating time of 414 min., but the hospital stay (4.5 vs 8.5 d) and convalescence (5.8 vs 39 weeks) were dramatically better than patients undergoing open radical nephrectomy. With the gain in experience and modification of techniques, operative times have been significantly reduced and are comparable with open surgery. Keely and Tolly [13] (1998) – 152 min., Abbou et al [19] (1999) – 145 min., Fornara et al [24, 30] (2001 &2003) – 90 min., and many more recent series have demonstrated operative times which are comparable to open surgery. Initial critics of the laparoscopic approach questioned the possible deviation from the classic Robson radical nephrectomy. But the accumulated follow-up oncological data, to compare the efficacy of laparoscopic radical nephrectomy with open nephrectomy examining surrogate markers, showed equal oncological efficacy of laparoscopic radical nephrectomy. Studies conducted by Gill et al, [20] (2000), Dunn et al, [21] (2000), Chan et al, [25] (2001), all showed oncological results comparable to open radical nephrectomy. Although these results were encouraging, a longer follow up is still needed to substantiate the initial claims of oncological equivalency.

In the present study which consisted of 160 patients, there were more females in laparoscopic group and more males in the open group. Most common age group was 21-40 years in the laparoscopic group and 41-60 in open group. In our study mean operative time for laparoscopic group was significantly longer than that in the open group, but still the operative times were not as high as reported in literature. In laparoscopic nephrectomy blood loss was less as compared to open group which correlates with the reported literature. Patients in laparoscopic group had an earlier resumption of oral intake and an earlier removal of drains although the difference was not statistically significant. These factors in addition to less post operative pain and early ambulation resulted in shorter hospital stay. The post-op complications were mostly wound related and were expectedly more in the open group. No patient in either group required re-exploration. All patients were followed strictly after the surgery. The follow up was more in patients undergoing nephrectomy for malignancy. Laparoscopy was costlier than open surgery. However due to briefer hospital stay, lesser morbidity and shorter convalescence, overall costs associated are expected to be less.

Thus with lower postoperative pain and complications, early resumption of orals and early ambulation, reduced hospital stay and advantages in terms of lesser blood loss, better cosmesis, and ability to do the procedure in obese patients without increased morbidity, the laparoscopic nephrectomy has gained wide acceptance and should be considered the standard of care for the treatment of benign non-functioning kidneys and early renal cancers. Even though the retroperitoneal approach carries inherent disadvantages, like a steeper learning curve because of absence of traditional landmarks and a limited working space that can result in difficulty with orientation, visualization, trocar spacing and organ entrapment, the advantages like quicker access to the renal hilum resulting in early vascular control, easier dissection in individuals who are obese, and the avoidance of intraperitoneal irritation should make it the preferred approach for nephrectomy. However it should be considered as an advanced laparoscopic procedure and should be performed after adequate training in basic laparoscopic procedures.

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