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Laparoscopic Nephrectomy by Transperitoneal Route for Benign Non-Functioning Kidney: Our Experience With 40 Cases

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Abstract
Background: The study evaluates the safety, outcome & complications of the transperitoneal laparoscopic nephrectomy procedure for benign non-functioning kidney with special focus on time taken for surgery, loss of blood, requirement of painkillers & postoperative stay in hospital.

Materials and Methods: Retrospective study was conducted over a period of 6 years from April 2015 to May 2021 at Maxxlyfe Hospital, Sunjwan Morh, near Bathindi, Jammu (J & K), India on 40 patients with benign non-functioning kidney who were subjected to transperitoneal laparoscopic nephrectomy.

Results: Authors analysed 40 patients (M=26; F=14) in the study period. Patient's mean age was 36 years (range: 24-71). 36 (90%) patients had symptoms of flank pain on the same side, 14 (35%) patients had lower urinary tract symptoms & 4 (10%) patients had haematuria. Causes of benign non-functioning kidney were stone related obstructive uropathy in 30 (75%) patients, neglected cases of obstruction at pelvic ureteric junction in 5 (12.5%), tuberculosis of kidneys in 3 (7.5%) & renovascular hypertension in 2 (5%) patients. In 5 (12.5%) patients, laparoscopic procedure was converted to open surgery due to adhesions & bleeding in two patients each & colon injury in one case. The mean hospital stay was 2 days. Complications during operation occurred in three patients & 12 patients postoperatively. There was no mortality.

Conclusion: Laparoscopic nephrectomy by the trans-peritoneal technique is a safe, effective & technically feasible procedure for the patients suffering from benign non-functional kidney with minimal complications & morbidity, reduced hospital stay, rapid recovery and better cosmesis & is a better alternative to open nephrectomy.

Keywords: Calculi; Nephrectomy; Non-functioning kidney; Renal scan

Introduction
Various non-malignant causes of permanent loss of renal function leading to non-functioning kidney include neglected urolithiasis/stone disease, chronic pyelonephritis, neglected pelvic-ureteric junction (PUJ) obstruction, renovascular hypertension, genitourinary tuberculosis, vesico-ureteric reflux, ureterocele, polycystic kidney, xantho-granulomatous pyelonephritis & emphysematous pyelonephritis.[1] Treatment of a benign non-functioning kidney is nephrectomy. Till the recent years, the option for treatment of benign non-functioning kidney was only open surgery, but with the advancement in minimally invasive surgery, laparoscopic nephrectomy has come into vogue and it has been shown in the literature that laparoscopic nephrectomy is more beneficial than open surgery as there is less postoperative pain, reduced hospital stay & early return to routine activity.[2,3]
The first laparoscopic nephrectomy was performed by Clayman *et al.*[4] in 1990. Since then, there has been an evolution in surgical practice from traditional open surgery towards minimally invasive means of treating operative lesions of kidneys. Basically, there are 2 methods for laparoscopic nephrectomy: retroperitoneal & transperitoneal. Retroperitoneal laparoscopic nephrectomy was introduced by Gaur *et al.* in 1993.[5] The most common

approach for laparoscopic nephrectomy has been the transperitoneal route because it provides an optimal working space & the surgeon is already familiar with the anatomic landmarks in this approach. In retroperitoneal approach, there is no need for manipulation of intraperitoneal organs, which lowers the risk of damage to these structures, but requires lot of experience & expertise & is usually done by the urologists experienced in the field of minimal invasive surgery. In the beginning, laparoscopic nephrectomy used to take quite a long time as compared to conventional open nephrectomy, with growing expertise & experience, there has been significant reduction in operative time in the laparoscopic nephrectomy technique.

Material and Methods

This retrospective study was conducted on 40 patients having non-functional kidney due to benign pathology at Maxxlyfe Hospital, Sunjwan Morh, near Bathindi, Jammu (J & K), India over a period of six years from April 2015 to May, 2021 by the corresponding author, who is an eminent General and laparoscopic surgeon with a vast experience in the field of laparoscopy. The opposite kidney was normally functioning in these patients. Laparoscopic nephrectomy was performed by the transperitoneal route in these patients. Following were the inclusion & exclusion criteria.

Inclusion criteria

- Non-functioning kidney due to non-malignant pathology with glomerular filtration rate (GFR) <15 ml/min & differential function <10%
- Opposite kidney having normal function
- Normal blood urea and serum creatinine

Exclusion criteria

- Uncorrected coagulopathy
- Active infection of urinary tract
- Pregnant women
- Severe cardiopulmonary disease
- Raised serum creatinine and BUN
- Any pathology noted in the opposite kidney
- Previous history of open surgery on the same side
- Suspicion of renal malignancy
- Morbid obesity.

Patient Evaluation and Preparation

The patients of non-functioning kidney taken up for laparoscopic nephrectomy by the transperitoneal route had glomerular filtration rate (GFR) <15 ml/min & split renal function <10%. The possible complications of the procedure including adjacent organ injury & unrecognized bowel injury were discussed with the patients & consent was taken for conversion to open surgery in case need arises and for the safety of the patient.

Preoperative evaluation included detailed history and thorough clinical examination of the patient. Age, gender, aetiology & side involved were noted. Special attention was paid to the presenting symptoms & any past history of abdominal surgery. CBC, blood urea and creatinine, serum electrolytes & urine routine microscopy were performed in all the patients. An ECG & a chest X-Ray were obtained before surgery. All patients had their blood typed & cross-matched. The preoperative imaging included digital X-ray Plain KUB, ultrasonography, intravenous urography & diethylene triamine penta acetic acid renal scan.

Mechanical bowel preparation with polyethylene glycol (Peglac) was done on the preoperative day & the patients were put on clear fluids. Patients were asked to stop any oral anticoagulants & anti-platelet drugs a week prior to surgery. All the patients were subjected to laparoscopic transperitoneal nephrectomy under strict aseptic measures. Prophylactic antibiotic 1.5 g cefuroxime intravenous injection was administered during induction to all patients.

Operative technique

The patient is initially kept in supine position for intravenous access, induction of general anaesthesia & endotracheal intubation. A bladder catheter & nasogastric tube is placed for decompression of the urinary bladder & stomach prior to insufflation. Then the position of the patient is changed to lateral decubitus position, with the pathologic kidney away from the table & kidney bridge of the OT table elevated to open the flank. Mostly, a three-trocar technique is used to complete the dissection. The initial 10 mm periumbilical trocar is inserted after insufflating the abdomen by a veress needle or by the open (Hasson's) technique, the preferred site being at the level of the umbilicus, lateral to the rectus muscle on the same side. Another 10/12 mm port is made at the midpoint from xiphisternum to umbilicus for the insertion of second trocar. Third 5 mm port is made over the iliac fossa in the anterior axillary line. Sometimes, fourth port is also required for traction of liver (Figure 1).

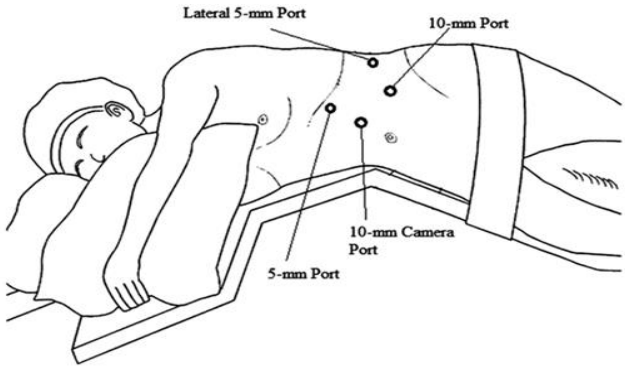

Fig 1: Sites of trocar placement in transperitoneal laparoscopic nephrectomy.

During surgery, intra-abdominal pressure of 14–15 mm Hg is maintained by carbon dioxide insufflation. The operation begins with identification of the white line of Toldt which is incised carefully using a hook or laparoscopic scissors & reflecting the colon & mesocolon medially (Figure 2). To avoid injury to mesocolon, medial traction is applied on the colon which defines the correct plane & reveals colorenal attachments that must be divided to complete the colon dissection. For left sided nephrectomy, the lienocolic ligament is divided to free the splenic flexure of the colon & the kidney is exposed by mobilizing the colon medially. For right sided nephrectomy, initially the duodenum & the ascending colon are mobilized. On either side, the first target is to identify the lower pole of the kidney & explore the ureter over the psoas muscle. Once the ureter is identified, the Gerota's fascia over the lower pole is incised and dissected all around the kidney. Once the kidney is mobilized & lifted up, the ureter is clipped & divided. The divided ureter is then used to elevate the kidney. Medial downward pull of the colon & the lateral upward pull of the kidney place the hilar vessels under tension & help in the

dissection of the renal hilum. For polycystic kidneys, the cysts may be aspirated if they are large & interfere with the view of the hilum or with instrument handling. The renal artery & renal vein are identified individually by meticulous dissection at the hilum & clipped separately with double Titanium Ligating clips (LT Clips 300 or 400) & divided. As a rule, renal artery should be clipped & cut first followed by the renal vein. Now, the dissection is continued posteriorly & superiorly to free the kidney of all the attachments, preserving the adrenal gland. The main hemostatic devices used are the harmonic Scalpel, titanium ligating clips & bipolar diathermy. The specimen is retrieved by extending the epigastric port incision or by morcellating the organ with index finger inside the endo bag, facilitating piece meal removal of the kidney. Renal fossa is observed for any bleeding after reduction of intra-abdominal pressure to 5–6 mm Hg. Once the hemostasis is satisfactory, a 28 No. tube rubber drain is placed in the renal bed & the 10/12 mm trocar sites are sutured with 00 vicryl and dressing done.

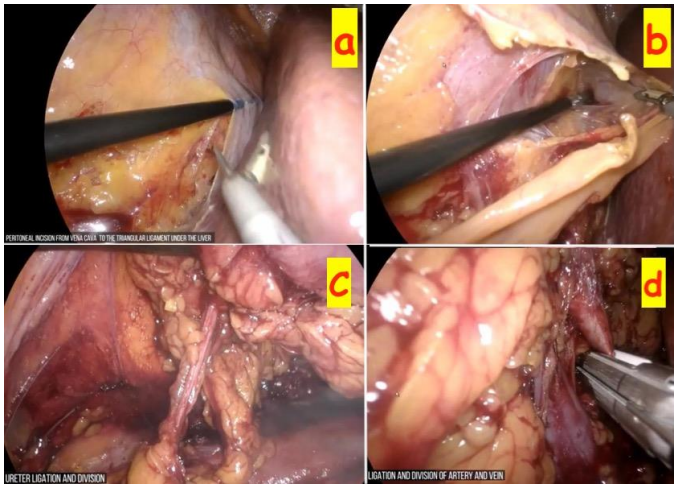

Fig 2: (a-d) Steps of transperitoneal laparoscopic nephrectomy.

Operative time was calculated from the time of incision to closure of the skin. Estimated blood loss & transfusion requirements were taken into account. Intraoperative & postoperative complications were recorded & number of conversions to open surgery were noted.

Postoperative care

The Ryle's tube was removed at the conclusion of the procedure. For immediate relief of pain postoperatively, injection tramadol 100 mg intravenous was administered to all patients & repeated after eight hours. Patients were made ambulatory on the same day of operation. Clear oral liquids were given to the patients on first postoperative day as soon as the bowel sounds appeared. Postoperative pain was assessed by visual analog scale & the mean was calculated. The Foley catheter was removed once the patient is ambulating & drain was removed when the output was less than 50 ml in 24 hrs. The patients were discharged in 2-3 days at an average and called for the follow up at 1, 2 and 4 weeks thereafter. At the time of 4 weeks follow up, overall score for patient's satisfaction with the operation was inquired & recorded on a 0–10 scale. Patients found to have tuberculosis on biopsy were started anti-tubercular treatment.

Results

Authors analysed 40 patients shown in Table 1. The patient's mean age was 36 years (range: 24-71). In our study, there was male predominance. Males & females were 26:14 (1.85:1). The incidence of non functioning kidney on the right side was 30 (75%), whereas on the left side, it was 10 (25%). In our study, the laparoscopic nephrectomy was performed by the transperitoneal route in all the cases.

Table 1: Demographic data.

Characteristics	Number of Patients
Total number of cases	40
Age in years (Mean)	36
Sex ratio (M: F)	1.85: 1
Side of involvement	
Right Nephrectomy	30 (75%)
Left Nephrectomy	10 (25%)

Clinical presentation: 36 (90%) patients had symptoms of flank pain on the same side, 14 (35%) patients had symptoms of lower urinary tract & 4 (10%) patients had haematuria (Table 2).

Table 2: Clinical presentation.

Clinical presentation	Number of Patients	Percentage
Ipsilateral flank pain	36	90%
LUTS	14	35%
Haematuria	4	10%

Non-malignant causes of non-functioning kidney were stone related obstructive uropathy in 30 patients (75%), neglected obstruction at pelvic ureteric junction in 5 (12.5%), genitourinary tuberculosis in 3 (7.5%) & renovascular hypertension in 2 (5%) patients (Table 3).

Table 3: Aetiology of Benign Non-functioning Kidney.

Kidney disease	Number of Patients	Percentage
Renal/PUJ Stone	16	40%
Ureteric stone	8	20%
Renal stone + Pyonephrosis	6	15%
Neglected PUJ obstruction	5	12.5%
Genitourinary Tuberculosis	3	7.5%
Renovascular Hypertension	2	5%
Total	40	

Operative data

Our time for surgery was well within the acceptable range. Twelve of the initial & in total 14 cases were completed in more than 2 hours and thereafter, operation was completed in a shorter duration. Out of 40 operations, 26 cases were performed in less than 120 min. The mean operative time in the study was 103 minutes for the laparoscopic nephrectomy and was more in cases where laparoscopic nephrectomy was combined with laparoscopic cholecystectomy.

As shown in Table 2, 17 (42.5%) cases had <100 ml of blood loss during laparoscopic nephrectomy & about 50% lost between 100 & 200 ml of blood. Major blood loss (>200 ml) during laparoscopic nephrectomy occurred only in 2 patients who were converted to open surgery.

In 5 patients suffering from cholelithiasis along with non-functioning right kidney, combined surgery (Laparoscopic right nephrectomy along with laparoscopic cholecystectomy) was performed in the same sitting, thus

giving double benefit to the patients with just 25-30 minutes extra operative time without any additional morbidity.

Five (12.5%) patients were converted to open surgery due to adhesions in two patients, intra-operative bleeding in two cases & colon injury in one case.

The mean hospital stay of our cases after surgery was 2 days. The hospital stay was more in patients who required conversion to open. Major operative complications occurred only in three (7.5%) patients.

Table 4: Operative data.

Operative data	Number of Patients	Percentage
Operative time (hrs)		
1-2	26	65%
>2	14	35%
Blood loss (ml)		
<50	5	12.5%
50-100	12	30%
100-200	21	52.5%
>200	2	5.0%
Combined operations (Lap Chole + Right Lap Nephrectomy)	5	12.5%
Operative complications	3	7.5%
Conversion to open	5	12.5%

Overall complication rate was 37.5%, though major complications occurred in 3 (7.5%) patients only during surgery. Profuse bleeding occurred in 2 patients while dissecting the renal vessels & 1 patient had colon injury during lysis of adhesions. All these 3 cases were converted to open surgery with an uneventful postoperative course, whereas 12 (30%) cases had minor complications such as paralytic ileus in 4 patients, port site wound infection in 4 patients, abdominal collection in 3 patients and 1 case had incisional hernia (Table 5).

Table 5: Operative complications.

Complication	Number of Patients	Percentage
Port site infection	4	10%
Paralytic ileus	4	10%
Abdominal collection	3	7.5%
Bleeding	2	5%
Colon injury	1	2.5%
Incisional hernia	1	2.5%
Total	15	37.5%

All operations were successful by the laparoscopic technique, though 5 cases (12.5%) were converted to open nephrectomy. The reasons for conversion from laparoscopic to open nephrectomy were dense adhesions & difficult hilar dissection (two cases), bleeding (two cases) & colon injury in one patient. In our study, conversion rate was higher on right side (3 cases) as compared to left side (2 Cases). High conversion rate in right nephrectomy is generally because of difficulty in progressing the procedure due to dense perirenal adhesions & fibrosis around short renal vein & inferior vena cava. Postoperative recovery was affected in all the patients who were converted to open.

Table 6: Indications of conversion.

Complication	Number of Patients	Percentage
Bleeding	2	5%
Adhesions	2	5%
Colon injury	1	2.5%
Total	5	12.5%

Discussion

Since Clayman *et al.*[4] performed the first laparoscopic nephrectomy in 1990, it became a viable alternative to open surgery with less pain, less morbidity, reduced hospital stay and early resumption to work.

In our study, 90% patients presented with flank pain on the same side, 35% with LUTS and 10% with haematuria. Andualem *et al.*[6] mentioned that loin pain was the most common presenting symptom in 100% of their patients, haematuria in 43.5% and abdominal/flank mass in 35.6%.

In our study, majority of patients 30 (75%) were having benign non-functioning kidney due to stone induced obstructive uropathy (chronic pyelonephritis and pyonephrosis). Similar results were reported with the series from developing countries like Jordan, Pakistan, Saudi Arabia, and Sudan. Tepeler *et al.*[7] reported that the only difference was operation time in the results of laparoscopic surgery in kidneys with and without stones.

Literature shows that it takes longer to perform laparoscopic nephrectomy when compared with open. With growing expertise and experience current operative times have decreased dramatically & are comparable to those in the open group. Manohar *et al.*[8] reported more favorable outcome in patients who underwent laparoscopic nephrectomy for benign conditions. In this study, the operative time was associated with surgeon's experience. First 12 cases had a mean operative time of 2 hours and 5 min. The next 32 cases had a mean operative time of 1 h and 39.5 min. The study by Phillips *et al.*[9] had a mean operative time of 150 min (130–180). Similarly, the mean operative time in our study for transperitoneal laparoscopic nephrectomy was 103 min.

In our study, laparoscopic nephrectomy group, mean blood loss was 104 ml. The patients in whom conversion to open nephrectomy was done suffered more blood loss. Seventeen (42.5%) cases had <100 ml blood loss during the laparoscopic nephrectomy. During the laparoscopic nephrectomy, the maximum blood loss was 350 ml whereas the minimum blood loss was 15 ml with insignificant hemoglobin drop in the postoperative period and none of our cases required blood transfusion during or after the procedure. Kurt *et al.*[10] reported 72.2 ± 104.4 ml loss of blood during the procedure due to noninflammatory diseases, whereas in inflammatory causes of non-functioning kidney, the blood loss was 105.0 ± 133.1 ml. Forde *et al.*[11] showed that 65 ml (range 50–200 ml) was the mean operative blood loss in the laparoscopic group and in the open nephrectomy group, it was 351 ml (range 50–1740 ml). These studies show that the blood loss is negligible in laparoscopic nephrectomy.

In most of the published series, the conversion rate to open surgery in laparoscopic trans-peritoneal nephrectomy ranges from (5-11.1 %) (Table 7).

Table 7: Incidence of conversion to open surgery.

S. No	Authors	Number of conversions	Percentage (%)
1	Eraky *et al.*[12]	9	8
2	Keeley *et al.*[13]	4	5
3	Ono *et al.*[14]	3	11.1
4	Kerbl *et al.*[15]	1	5
5	Rassweiler *et*	2	11.1

	al.[16]		
6	Parra *et al.*[17]	1	8
7	Our study	5	12.5

An overall conversion rate of 5% in a series of 185 laparoscopic nephrectomies with 15% minor and 7% major complications rate was reported by Katz r *et al.*[18], whereas an overall conversion rate of 28% of 50 laparoscopic nephrectomies cases with 12% minor and 9% major complications rate was reported by Ricardo j *et al.*[19]. In another study by Zaidi z *et al.*[20], an overall conversion rate was 11.6% in a series of 60 laparoscopic nephrectomies with 16% minor and 3% major complications rate, whereas Wayland hsiao *et al.*[21] mentioned an overall conversion rate of 6.6% in a series of 100 laparoscopic nephrectomies with 11% minor and 20% major complications. Also, an overall conversion rate of 9.8% in a series of 185 laparoscopic nephrectomies in a study by Hemal ak *et al.* [22]. with 3.8% minor and 9.8% major complications. Again, in a study by M. tobias-machado *et al.* [23], an overall conversion rate was 11.7% in a series of 17 laparoscopic nephrectomies with 13% minor and 6% major complications. In our study, data analysed shows an overall conversion rate of 12.5% in a series of 40 laparoscopic nephrectomies with 30% minor and 7.5% major complications. These were the patients who had profuse bleeding during surgery because of dense perinephric adhesions and injury to colon during lysis of adhesions. Rate of conversion to open surgery & complications encountered in our study are comparable with other series performing laparoscopic nephrectomies for benign non-functioning kidney.

In our study, the main reasons for conversion from laparoscopic to open surgery were dense adhesions (two cases), bleeding (two cases) & colon injury (one case). The study by Phillips *et al.*[9] had a conversion rate of 6%, reasons being a failure to progress due to dense adhesions (in three cases), uncontrollable haemorrhage (two cases) and IVC trauma (one case). A similar observation was also reported by other investigators. Gill *et al.*[24] has reported complications in 19 (12%) patients with most of the complications (n=12) occurring in the first 20 cases performed in a multi-centre analysis of 153 patients who underwent laparoscopic nephrectomy for benign non-functioning kidney. Five patients were converted to open surgery, out of which 4 cases were amongst the first 20 that were performed. In terms conversion rates & Complications, a learning curve for laparoscopic nephrectomy has been also documented by other authors. In our study, there was one major complication of colon injury while dissection. This case was converted to open nephrectomy by making a flank incision. There was a small perforation in the ascending colon that was managed by a two-layered closure, inner layer of 000 absorbable suture & an outer layer of interrupted seromuscular 000 silk sutures. The patient recovery was uneventful and after 8 days of surgery, the patient was discharged from the hospital. Patients with unrecognized bowel injury after laparoscopy usually have nausea, loss of appetite, loose motions, low grade fever & persistent bowel sounds. If the injury is not recognized quickly and treated promptly, the patient can rapidly develop hemodynamic instability & can die. In such cases, CT scan abdomen is the initial investigation followed by open surgical exploration to evacuate bowel spillage to prevent septicaemia and perform the necessary repair as we did in our study & saved the patient.

In our study, more cases had involvement of the right kidney with an incidence of 30 (75%) and the left kidney was affected in 10 (25%) cases. Rafique[25] has reported 65 (55%) of 118 patients with the right-sided non-functioning kidney & left-sided non-functioning kidney was seen in remaining 53 (45%) cases. On the contrary, in a prospective study performed by Shah *et al.*[26] in 2012–2013, left-sided renal disease was seen in 35 cases and right-sided renal disease was seen in 32 cases.

The mean hospital stay of patients in our study was 2.68 days, whereas the minimum was 2 days and the maximum was 8 days. It has been observed that the five cases converted to open had a longer recovery time, higher analgesic requirement, more blood loss and a longer stay in hospital (8 days). Our results were similar to various studies mentioned in the literature.

In the literature, the higher cost for laparoscopic nephrectomy has been contributed to the usage of disposable trocars, Endo GIA stapler & linear cutter needed for renal pedicle control. On the contrary, we used the routinely available laparoscopic instruments to perform nephrectomy without adding extra cost for the procedure. Moreover, short hospital stay, less morbidity and early resumption to routine work resulted in less overall cost of the procedure in our study.

Conclusion

Laparoscopic nephrectomy by the transperitoneal route for a benign non-functional kidney is a safe & effective procedure & is associated with minimal morbidity & has significant advantages in terms of less postoperative pain, reduced hospital stay, early resumption to work and better cosmesis and is a better alternative to open nephrectomy. This procedure can be performed with the routinely available laparoscopic instruments by experienced laparoscopic surgeon with no extra cost and should be offered to every patient with benign renal disease who is scheduled for elective nephrectomy.

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Conflict of Interest: None.

Ethical approval: Clearance from Research and Ethical Committee of the hospital was obtained before initiating the study.

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