Original Article

This challenging procedure has successful outcomes: Laparoscopic nephrectomy in inflammatory renal diseases

Siddharth Jain, Sudhir K. Jain[1], Ram C. M. Kaza[2], Yashasvi Singh[3]

Department of Surgical Gastroenterology and Liver Transplantation, Sir Ganga Ram Hospital, [1]Department of Surgery, Maulana Azad Medical College, [2]Department of Surgery, Dr.BR Ambedkar Hospital, New Delhi, [3]Department of Urology, GMCH, Gauwhati, Assam, India

Abstract

In prospective study from November 2011- November 2013, we performed 44 laparoscopic nephrectomies for benign non-functioning kidney diseases. Twenty eight patients underwent laparoscopic transperitoneal nephrectomies (63.6%), ten were laparoscopic assisted (22.7%) and six (13.6%) were converted to open. Patient's age, gender, laterality and etiology of renal failure were noted. Outcomes were measured as operative time, intraoperative and post operative complications, blood loss, pain score and hospital stay. Patients were followed up at one, three and 12 weeks and 6 monthly thereafter. Of the 44, ten (22.7%) were 15-24 years old, 32 (72%) between 25-50 years and two were more than 50 years old. Females were 54.6%. 22 patients had either right or left nephrectomy. Pelviureteric-junction (PUJ) obstruction was the commonest cause, 26 cases (59.0%). Operative time: less than two hours in 30 (68.2%) patients, more than two hours in 14 cases. Blood loss: less than 100 ml in 12 (27.3%), 100-200 ml in 20 (45.4%) and more than 200 ml in 12 (27.3%) patients. All four major complications were converted to open, two had injury to mesocolic veins and two had vascular stapler malfunction. Post-operative complications: surgical site infection (SSI), paralytic ileus and mild grade fever in six cases each and non infected benign intra abdominal collection in two cases. Maximum pain score on POD-1: four in 20 cases (45.7%), two in 24 (54%). Two had pain score between 3-4 three weeks after surgery. Oral intake started by POD-2 in 30 (68.2%) and by POD-4 in 100% cases. 22 (50%) patients were ambulating by POD-2, 16 (36.7%) by POD-4. Our study and randomized and non-randomized published literature report acceptables complication and conversion rates. In conclusion, laparoscopic nephrectomy for benign non functional kidney is a better alternative to open nephrectomy

Keywords: Benign nonfunctioning kidney disease, inflammatory renal diseases, laparoscopic nephrectomy

INTRODUCTION

Urology has contributed immensely in the development of laparoscopy with pioneering contributions such as Clayman et al.,[1] laparoscopic exploration for undescended testis,[2] lymphadenoctomy,[3] and extraperitoneoscopy.[4] Laparoscopic radical nephrectomy is the gold standard for early tumors. Laparoscopic donor nephrectomy is firmly established procedure for kidney procurement.[5] However, same cannot be said for diseases with benign etiology. These are usually of inflammatory or infective origin with resulting distortion of surgical planes where maintaining the safety of nearby structures becomes

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challenging. Benign indications include nephrolithiasis, renal dysplasia, pelvi-ureteric junction (PUJ) obstruction, chronic pyelonephritis, tuberculosis, vesicoureteric reflux, ureterocele, polycystic kidney, and xanthogranulomatous pyelonephritis (XGN).[6-12] Although literature supports improved learning curves and outcomes[13,14] compared to early 1990s,[15] laparoscopic nephrectomy is still not well established for benign cases. With the reporting of improved results,[16-18] we hereby present our experience.

MATERIALS AND METHODS

This prospective study was carried out in the Department of Surgery at our institute from November 2011 to November 2013. Informed consent was obtained from the participants in the language that they were conversant with, which was either Hindi or English. Patients were explained the risks and benefits of both laparoscopic and hand assisted techniques. Most patients (28 patients, 63.6%) chose the laparoscopic technique that we more commonly perform. Ten patients (22.7%) patients chose hand assisted as they felt it was safer. Patients had the option of opting out of the study at any point of time without compromising their right for further treatment. A separate informed consent was taken at the time of surgical procedure. Clearance from Research and Ethical Committee of the College was obtained before initiating the study. Forty-four patients who were suffering from nonfunctioning kidney disease due to benign pathology with normal functioning opposite kidney were enrolled for the study. All these patients underwent laparoscopic transperitoneal nephrectomy based on the following inclusion and exclusion criteria.

Inclusion criteria
* Nonfunctioning symptomatic kidneys due to benign pathology with glomerular filtration rate (GFR) <15 ml/min and differential function <10%
* Normal functioning opposite kidney
* Normal serum creatinine and blood urea nitrogen (BUN).

Exclusion criteria
* Raised serum creatinine and BUN
* Any pathology noted in the contralateral kidney
* Previous history of intervention on the ipsilateral side
* Space occupying lesion in the kidney with a suspicion of malignancy
* Morbid obesity.

After induction in the study, a detailed history was taken. Age, gender, etiology, and laterality were noted. History of presenting complaints and of any previous surgeries,

especially abdominal surgeries was noted. History for penicillin allergy was negative in all patients, which was the antibiotic used for surgical prophylaxis. The estimation of renal function was done with BUN and serum creatinine. Anatomical details of the urinary tract were obtained with ultrasound and computed tomography urography. Diethylenetriamine pentaacetic acid (DTPA) scan was performed in all patients. Kidneys with differential function <10% and GFR <15 ml/min were taken as nonfunctioning kidneys. All those patients who had the differential function of more than 5% and GFR >5 ml/min were given a trial with a double J (DJ) stent for 6 weeks. Patients were taken up for surgery if no significant improvement was demonstrated in the subsequent DTPA scan. All laparoscopic transperitoneal nephrectomies were performed by the same surgeon, with an experience of performing at least forty successful laparoscopic urological procedures.

Operative technique
Prophylactic Injection Augmentin® 1.2 g intravenous was administered at the time of induction to all patients. The patient was secured in 45° lateral decubitus position. Infraumbilical port was inserted with Hasson technique. Pneumoperitoneum was established by carbon dioxide insufflation maintaining an intra-abdominal pressure of 12–15 mmHg during the surgery. This was followed by insertion of 12 mm port at the midpoint from xiphisternum to umbilicus. One 5 mm port in the anterior axillary line was placed, over the iliac fossa. If assistant's traction was required another 5 mm port was placed occasionally during the procedure. The operation began with incision of the white line of Toldt using Harmonic ACE® + shears (Ethicon™) and reflecting the colon and mesocolon medially. Median traction was applied on the colon to define the correct plane avoiding injury to mesocolon. This maneuver is important for dissection close to the hilum as the planes of dissection are distorted from the underlying inflammatory and infective pathology. On the left side, the splenic flexure of the colon was freed by dividing the lienocolic ligament and mobilized medially enough to expose the kidney. On the right side, the procedure was started with the mobilization of duodenum and the ascending colon. The first target on either side was to identify the lower pole of the kidney and explore the ureter. Once the ureter was identified we then incised open the Gerota fascia over the lower pole and dissected it all around and the kidney. Once the kidney was mobilized and lifted up from the underlying psoas muscle, the ureter was clipped and divided. The divided ureter was then used to elevate the kidney. Medial downward traction of the colon and the lateral upward traction of the kidney placed

the hilar vessels under tension and helped in the dissection of the renal hilum. For polycystic kidneys, the cysts had to be punctured and suction aspirated if they were large and interfered with the view of the hilum or with instrument handling. Layer by layer anterior dissection was performed until the renal vein was exposed and skeletonized. Renal vein was divided by universal Multifire Endo GIA™ 30 Staplers, Minneapolis, MN, USA. After this, right angled pedicle dissector was used to identify the renal artery. The artery was clipped with LT clips 300 and divided. Once all the hilar vessels were divided, the dissection was continued posteriorly and superiorly to free the kidney of all the attachments. The specimen was retrieved by extending the epigastric port incision. Renal fossa was observed for any bleeding after reduction of intra-abdominal pressure to 5–6 mmHg. Once the hemostasis was satisfactory, a 30F drain was placed in the renal bed, and the trocar sites were closed in layers.

Operative time was calculated from the time of incision to closure of the skin. Estimated blood loss and transfusion requirements were taken into account. Intraoperative complications were recorded as major and minor, and number of conversions to open were noted.

For immediate relief postoperatively, standard pain medication of injection tramadol 100 mg intramuscular was administered to all patients. Later, oral tramadol 100 mg was prescribed. Patients were made ambulatory on the same day of operation. Orally, clear liquids were started on postoperative day 1. Postoperative pain was assessed by visual analog scale each day while the patient was in the hospital and the mean was calculated. Infection was assessed by clinical examination of the wound and treated as appropriate. After discharge from the hospital, patients were followed up at 1, 3, and 12 weeks and 6 monthly thereafter.

Postoperative length of stay (LOS) was noted (the day of surgery being day 0). Patients were asked to give an overall score for their satisfaction with the operation on a 0–10 scale at 1 month follow-up. Patients found to have tuberculosis on biopsy were started on Category 1 anti-tubercular treatment. Mean follow-up of the patients was 6 months, and it was more intense in those patients undergoing antitubercular treatment or were on medication for hypertension.

RESULTS

Demographics
Demographics have been shown in Table 1. Forty-two out of 44 patients (95.44%) were <50 years of age, out of which 10 (22.72%) were between 15 and 24 years, 32 (72.72%) were

between 25 and 50 years, and two were more than 50 years of age. Males and females had almost equal representation, 20 and 22 in number, respectively. First GFR estimation showed that 10 (22.72%) patients had a GFR of <5 ml/min, 24 (54.56%) patients had GFR between 5 and 10 ml/min and ten had a GFR of 11–14 ml/min. None of the patients had their kidney function recovered with DJ stenting. Maximum number of patients were of PUJ obstruction. These patients had gross hydronephrosis (HDN) without much perirenal inflammation which proved to be useful in dissection as mentioned later in the discussion. There were eight patients of end stage nephrolithiasis, four of ureteric stricture, four with renovascular hypertension (RVHT) and two patient with multicystic kidney disease.

Our operative data is depicted in Table 2. Our operative time was well within the acceptable range. The learning

Table 1: Demographics

	Number of patients	Percentage of distribution
Age (years)		
15-24	10	27.72
25-50	32	72.72
>50	2	4.56
Gender distribution		
Male	20	45.45
Female	22	54.55
GFR (ml/min)		
<5	10	22.72
5-10	24	54.56
11-14	10	22.72
Differential function (%)		
<5	10	22.73
5-10	34	77.27
Etiology		
ESNL	8	18.18
PUJ obstruction	26	59.01
Cystic disease	2	4.54
Ureteric stricture	4	9.09
Renovascular HT	4	9.09

ESNL: End stage nephrolithiasis, PUJ: Pelviureteric junction, HT: Hypertension, GFR: Glomerular filtration rate

Table 2: Operative data

	Number of patients	Percentage of distribution
Operative time (h)		
<1	2	4.55
1-2	28	63.63
>2	14	31.82
Blood loss (ml)		
<50	2	4.55
50-100	10	22.72
100-200	20	45.44
>200	12	27.27
Postoperative complications		
Suture line infection	6	13.63
Abdominal collection	2	4.54
Paralytic ileus	6	13.63
Mild fever	6	13.63

curve was steep. Twelve of the initial and in total 14 cases required more than 2 hours(h). Most of the cases thereafter had a shorter operative time. Overall, 30 out of the 44 patients required <120 min, in fact, two of our cases that required <1 h were both of RVHT.

About a fourth of all patients had a blood loss of more than 200 ml. Another one-fourth had a blood loss of <100 ml and about 45% lost between 100 and 200 ml of blood. Major intraoperative complications were seen in four patients. All these six cases had to be converted to open surgery. Two of them had a major bleeding when the mesocolon got injured while using harmonic scalpel. The other two patients in the complication group had instrument malfunction while applying the Endo GIA on the pedicle. Another two patients had to be converted to open due to a small atrophic kidney that could not be properly located. All the patients converted to open developed postoperative ileus. Two patients develop postoperative collections, but they were a simple collection, not requiring any drainage and subsided spontaneously on subsequent imaging. Six had a mild fever which resolved with oral antipyretics.

Postoperative outcomes have been mentioned in Table 3. All four patients of refractory RVHT benefited from the surgery. Two of the patients had their dose reduced significantly. The other two whose blood pressure was about 150/110 mmHg on two medications preoperatively became normotensive. One of the remarkable observations

of the study was the detection of tuberculosis in ten of our patients. Twenty-six patients had biopsy showing chronic pyelonephritis without any specific underlying pathology. Six patients had nephrosclerosis. Two patients had XGN on preopertive biopsy, but we did not have any difficulty in the laparoscopic removal of those kidneys. Postoperative recovery was affected in all the patients who were converted to open. All six of them were included among the 14 who had delayed return of bowel function. Again, all the converted patients had delayed ambulation, taking more than 4 days to mobilize adequately. Rest all our patients were out of bed and participating in physiotherapy in <4 days of their surgery.

About half of the patients (45.5%) reported pain with a maximum score of 4, which was also the highest score reported by any patient. The rest of the patients reported it to be in the range of 1–2. The pain score improved at 1 week and 3 weeks postoperatively when 86.4% and 95.5% patients respectively reported pain with a maximum score of 2.

DISCUSSION

As with any technology driven field, laparoscopic surgery has made tremendous progress in recent years. Since Clayman *et al*.[1] performed the first laparoscopic nephrectomy in 1990, it is being increasingly performed as a viable alternative to open approaches. Laparoscopic nephrectomy is associated with a learning curve for surgeons and at the same time with reduced postoperative pain, morbidity, hospital stay, and faster convalescence for patients.

Looking at the operative time mentioned in published literature, it is clear that it takes longer to perform laparoscopic nephrectomy when compared with open. Manohar *et al*.[19] found more favorable outcome with laparoscopic nephrectomy for benign conditions. Although the mean operative time was 22 min more in the laparoscopic group (170 ± 59.8 vs. 148 ± 42.5 min), the overall hospital stay was reduced by more than 3 days, 4.34 ± 0.8 versus 8.07 ± 1.8 days. Reduced blood loss 156.2 ± 6.8 versus 154 ± 68.8 ml and lesser analgesic requirement 165 ± 71.2 versus 284 ± 81 g of diclofenac sodium were reported with laparoscopic surgery. Complications rate was 31% (26 patients) in the laparoscopic group and 49% (46 patients) in the open group. Open technique was also more frequently associated with pleural entry and prolonged ileus. In this study, the conversion rate from laparoscopic to open was <10%, that is, eight out of 84 patients.

Shekarriz *et al*.[20] compared the outcome of laparoscopic nephrectomy in inflammatory and other benign conditions.

Table 3: Postoperative outcomes

	Number of patients	Percentage distribution
Renovascular HT after surgery		
No medication	2	50
Decreased dosage	2	50
Postoperative biopsy		
Tuberculosis	10	22.72
Chronic pyelonephritis	26	59.09
Nephrosclerosis	6	13.64
XGN	2	4.55
Oral intake start (POD)		
1-2	30	68.18
3-4	14	31.82
Ambulation start (POD)		
1-2	22	50
3-4	16	36.36
>4	6	13.64
Procedure		
Laparoscopic	28	63.64
Lap assisted	10	22.72
Lap converted to open	6	13.64
Pain score at POD 1		
1–2	24	54.54
3–4	20	45.46

HT: Hypertension, XGN: Xanthogranulomatous pyelonephritis, POD: Postoperative day

No conversion was required in benign cases other than inflammatory diseases which had 7% cases converted to open. Postoperative blood loss (155 ± 163 ml), mean operative time (284 ± 126 min), and LOS (4.1 ± 2) were more than in benign cases but much improved as compared to with open surgery.

Experience in laparoscopic nephrectomy for nonfunctioning tubercular kidney provides encouraging outcomes by Kim *et al*.[21] in 2000, who reported experience with 12 patients. Nephrectomy was performed after completing chemotherapy. Mean operative time (268 min, range: 190–500 min) was on a higher side. The author reported that despite the dense adhesiolysis that was performed, no major complications were encountered. One out of the 12 patients required conversion to open. LOS was 4 days. Return to normal activity took 10 days. When compared, nephrectomy for tuberculosis versus other benign diseases was found comparable for safety and efficacy, Chibber *et al*.[22]. Mean operative time was similar in both groups, 208.5 min in tuberculosis and 209.6 in control group. One parameter that was better in controls was the mean blood loss, 213 ml versus 326.5 in tubercular group. However, this was not statistically significant, $P = 0.17$. Other parameters in the two groups were also comparable. Conversion to open occurred with one patient among control but none in the tuberculosis group. Time to resumption to oral intake in test versus control groups was 16.75 h (12–28) versus 19.2 h (12–30), $P = 0.375$. The mean analgesic requirement was the same at 225 mg of diclofenac in both groups. Mean hospital stay was 2.62 versus 2.5 days in tubercular versus controls, $P = 0.70$.

Seshardri PA *et al*.[23] demonstrated technical feasibility and safety in patients with autosomal dominant polycystic kidney disease undergoing laparoscopic transabdominal surgery. Ten patients were present in the laparoscopic and ten in open group. The mean operative time was 32 min more in the laparoscopic arm (247 vs. 205 min, $P = 0.04$). However, the mean LOS was 2.6 days instead of 6.6 with the open technique, $P = 0.00002$. One case with kidney size of 40 cm had to be converted to open. No intraoperative complications were reported in either group. One patient required two units of blood transfusion in the open group. The one postoperative complication reported with laparoscopic technique was of thrombosed arm fistula. Five complications were reported in open cases which included one episode each of atrial fibrillation, wound hematoma, pneumonia, and respiratory depression with narcotics.

Lima *et al*.[8] in 2012, in the largest series for reported for XGN of 66 patients have reported a conversion rate of 12.1%. Conversions were found to be due to technical difficulty. There was no difference observed in the distribution of patients in the two groups (conversion vs. no conversion). Mean operative time (215 ± 38.3 min), blood loss (300 ± 142.4 ml), and LOS (4.3 ± 2.3 days) were more in pure laparoscopic group than in those converted to open. Complications in converted cases were one colonic perforation and two wound infections. Still for the nature of the disease, the approach was concluded to be feasible and safe.

In this study, the operative time was associated with surgeon's experience. First 12 cases had a mean operative time of 2 h and 5 min. The next 32 cases had a mean operative time of 1 h and 39.5 min. The maximum operative time among all cases was 2 h and 15 min in case of chronic pyelonephritis requiring conversion to open. All cases with tuberculosis and XGN had the operative time of <2 h, none requiring conversion. Hence, increased operative time was observed only in early cases.

Blood loss was in the range of 50–200 ml. Laparoscopic nephrectomy group had a mean blood loss of 104 ml. The cases which needed conversion from laparoscopic to open resulted in higher blood loss. All but two cases having more than 200 ml of blood loss were of chronic pyelonephritis. These cases of pyelonephritis were the last ten cases that were performed, and four of these were converted to open. The other two with more than 200 ml blood loss had tuberculosis. We did not observe any increase in mean operative time, pain score, blood loss, conversions to open or increased LOS associated with any particular etiology. Conversion rate from laparoscopic to open procedure was 13.63% (six cases out of 44). These were the same patients who had intraoperative complications of profuse bleeding due to dense perinephric adhesions, instrument malfunction (stapling malfunction in two cases) and injury to mesocolic veins (two cases). Small atrophic kidney was reasons for conversion in two separate patients as there was the inability to identify the kidney laparoscopically. Cost factor needs to be addressed with respect to laparoscopic surgery. The main contributor to the cost was disposable trocars, Endo GIA stapler and linear cutter needed for pedicle control. However, due to the shorter hospital stay, lesser morbidity and convalescence, overall costs were lesser.

Limitations
We do acknowledge that our sample size is small to evaluate any causal relationship of etiology with these parameters. Maximum number of patients were of PUJ obstruction. These patients had gross HDN without much perirenal

inflammation with preserved tissue planes. This made the dissection easier and lessened our operative time especially as the number of cases increased. This may have skewed our operative time in comparison to cases with inflammation and more dense adhesions.

CONCLUSION

Laparoscopic nephrectomy for a benign nonfunctional kidney is a better alternative to open nephrectomy. There is learning curve, but this is achievable. The cost of the surgery exceeds that of open but the effective cost is less as the LOS is shorter.

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Conflicts of interest
There are no conflicts of interest.

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