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Research Article

Next-Gen Nephron Sparing: The Retroperitoneoscopic Advantage for management of Renal Tumors

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ABSTRACT

Introduction: Retroperitoneoscopic partial nephrectomy (RPN) is a minimally invasive surgical technique for treating localized renal tumors while preserving kidney function. Unlike the traditional transperitoneal approach, RPN accesses the kidney directly via the retroperitoneum, potentially reducing recovery time and perioperative complications. Despite a steeper learning curve, RPN is gaining acceptance as a nephron-sparing surgery option. ***Materials and Methods:*** This retrospective study analyzed 21 patients who underwent RPN between January 2020 and September 2024 for localized renal tumors ≤7 cm. Inclusion criteria included age >18, ECOG performance status 0-1, and no significant comorbidities. Patients with multiple tumors or metastatic disease were excluded. Preoperative imaging (CT or MRI) assessed tumor size, location, and complexity using the RENAL nephrometry score. Surgery involved a small incision below the 12th rib, creation of retroperitoneal space with a balloon dissector, tumor excision under renal artery clamping, and renal reconstruction with absorbable sutures. Data collected included demographics, operative time, blood loss, warm ischemia time, complications, hospital stay, surgical margins, and recurrence rates. ***Results:*** The mean patient age was 58.3 years; tumor size averaged 3.8 cm. The average operative time was 132 minutes, blood loss approximately 100 mL, warm ischemia time about 25 minutes, and hospital stay ranged around 3 days. Complications were minimal, with 14.2% incidence mostly minor. No positive surgical margins or tumor recurrence were observed during follow-up. These findings demonstrate comparable oncologic safety to traditional methods with improved perioperative outcomes. ***Conclusion:*** RPN is a safe and effective approach for managing localized renal tumors, offering nephron preservation with fewer complications, shorter operative times, and faster recovery compared to conventional approaches. Patient selection and surgical expertise are essential for optimizing outcomes. Long-term studies are needed to validate durability. With further research and improved techniques, RPN has the potential to become the preferred minimally invasive nephron-sparing surgery.

Keywords*: renal tumor, nephrectomy, retroperitoneoscopy, nephron saving surgery, laparoscopy*

INTRODUCTION

There has been a steady global rise in the detection of renal tumors over recent decades [1]. Laparoscopic partial nephrectomy (LPN) compares favorably to traditional open nephron-sparing surgery (NSS) in terms of oncologic and surgical principles for kidney tumors [2-4]. For localized renal tumors, partial nephrectomy is often favored due to its ability to remove the malignancy while maintaining renal function. Traditionally performed via a transperitoneal approach, the retroperitoneoscopic partial nephrectomy (RPN) offers a direct route to the kidney, potentially reducing recovery times and perioperative complications. Despite a steeper learning curve, in the hands of experienced surgeons, RPN serves as an effective technique for nephron-sparing surgery [5].

Objective
To evaluate the efficacy and safety of RPN as a minimally invasive surgical technique for treating localized renal tumors, and to identify areas for further research in patient selection and long-term outcomes.

Methods
A retrospective analysis was conducted on patients who underwent RPN between January 2020 and July 2024. Data collected included patient demographics, tumor characteristics, operative details, and postoperative outcomes. Key parameters included operative time, blood loss, complications, hospital stay, surgical margins and recurrence rates.

Study Design and Patient Selection
A total of 21 patients who underwent retroperitoneoscopic partial nephrectomy for localized renal tumors between January 2020 and September 2024. Inclusion criteria were patients aged more than 18 with a single, localized renal tumor ≤7 cm in diameter, and a preoperative Eastern Cooperative Oncology Group (ECOG) performance status of 0 or 1. Exclusion criteria included patients with multiple renal tumors, metastatic disease, significant comorbidities that contraindicated surgery, and previous extensive abdominal surgeries that could complicate the retroperitoneal approach. Tumor complexity was assessed using the RENAL nephrometry score [6,7].

Preoperative imaging
CT or MRI abdomen-pelvis, with or without 3D reconstruction and contrast, were used to evaluate tumor characteristics and renal vasculature. Imaging confirmed tumor location, relationship to the collecting system, and the presence of any tumor thrombus.

Patient positioning
Flank Position and the patient supported with sandbags under the flank. The operating table was flexed to maximize the space between the costal margin and iliac crest. Careful placement of cotton padding at pressure points was ensured. A cushion was placed between the legs at the knees with the contralateral leg partially flexed at the knee joint. The upper arm was placed on a padded armrest. The patient was completely secured to the operating table using adhesive tape at chest and hips, cotton cushioning at contact points was ensured.

Preoperative antibiotics, third generation cephalosporins, were administered at the time of induction and foley catheterization was routine.

Surgical Technique (Figures 1-12)
1. Incision: A small incision is made about 2 cm below the tip of 12th rib.
2. Skin and subcutaneous tissues are dissected.
3. Lumbar fascia is reached which is sharply divided with scissors
4. Retroperitoneal Space Creation: a balloon dissector (D.D. Gover Balloon) is used in creating a retroperitoneal space with around 450ml of normal saline.
5. A vertical hitch suture is taken to reduce leakage of pneumoretroperitoneum.
6. Trocar Placement: Three to four trocars are inserted under direct vision.
7. Tumor Localization: The kidney and tumor are identified.
8. Tumor Excision and Renal Reconstruction: The renal artery is clamped, and the tumor is excised with a margin of healthy tissue. Renal reconstruction is performed using absorbable sutures.

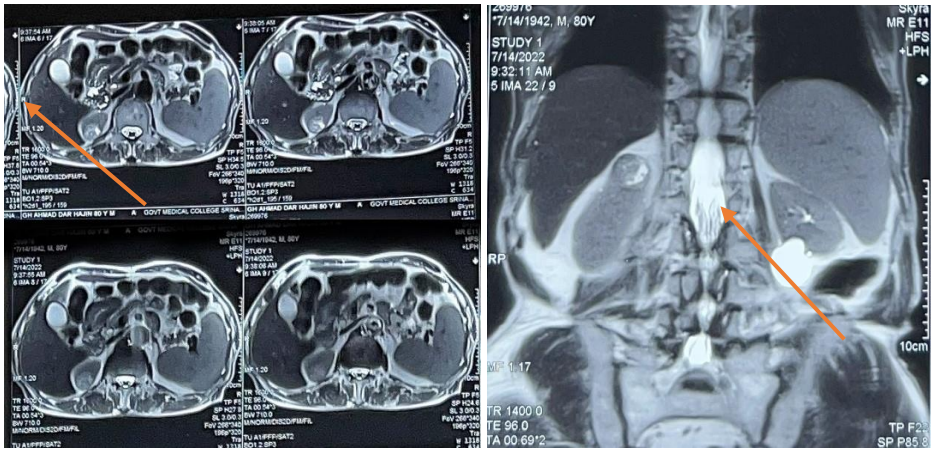

Fig 1. Axial and Coronal sections on MRI Abdomen showing Right Renal mass (orange arrow)

Fig 2. Flank Position with flexed table

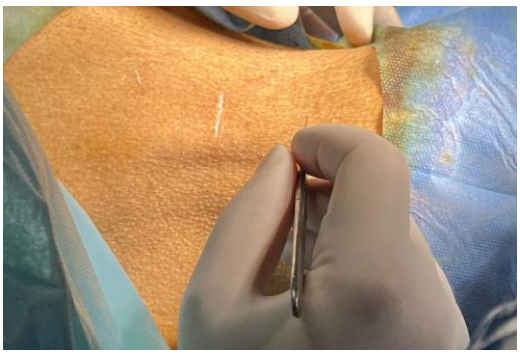

Fig 3. Incision 2cm below and in front of tip of 12th rib

Fig 4. DD Gover Balloon used for hydrodissection.

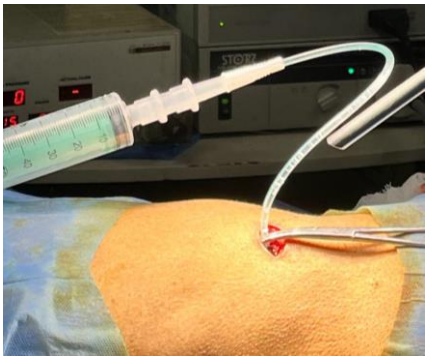

Fig 5. 450 mL of saline used for retroperitoneal space creation

Fig 6. Balloon removed

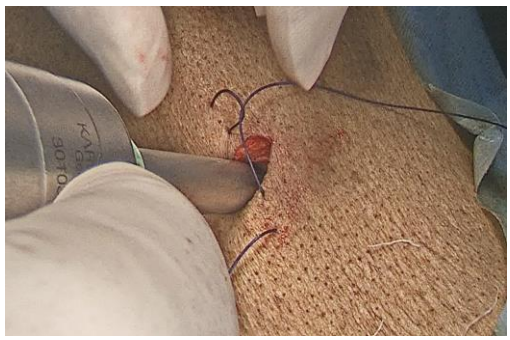

Fig 7. Vertical Hitch to secure primary port.

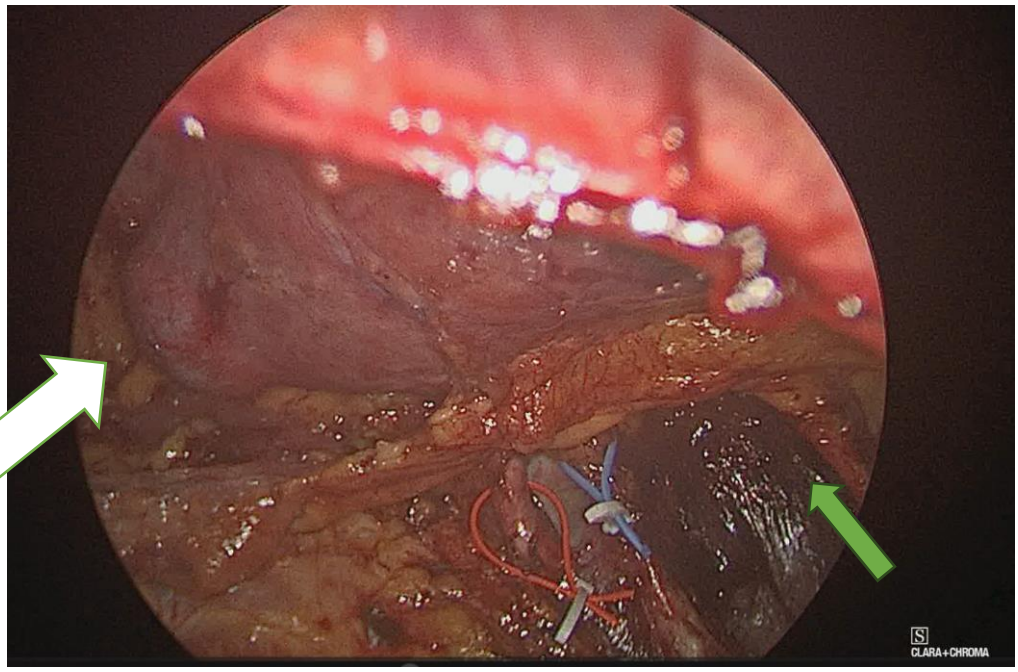

Fig 8. Renal tumour (white arrow) with renal artery (red sling), renal vein (blue sling) and ureter (green arrow).

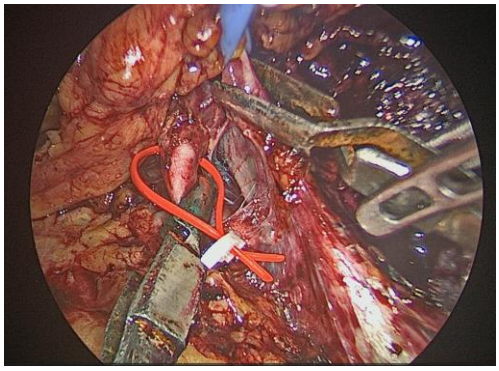
Fig 9. Renal artery and vein clamped.

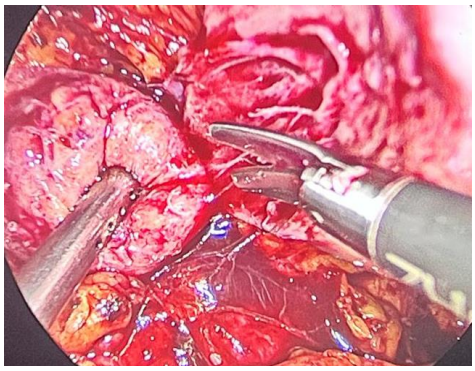
Fig 10. Tumour dissection

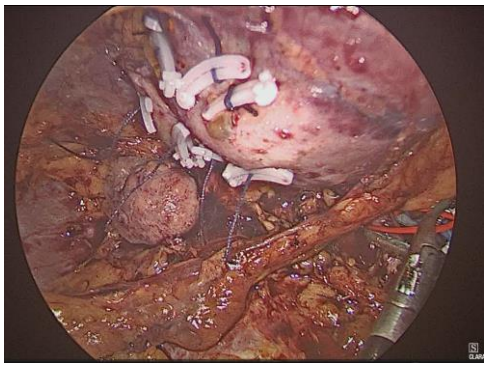
Fig. 11. Renoraphy and release of clamps.

Fig 12. Excised Tumour

Data Collection and Analysis

Data were collected : including patient demographics (age, gender, body mass index), tumor characteristics (size, location, histology), operative details (operative time, blood loss, warm ischemia time), and postoperative outcomes (hospital stay, complications, renal function). Oncological outcomes, such as positive surgical margins and recurrence rates, were also recorded.

Primary Outcomes:

Operative time (minutes)
Intraoperative blood loss (milliliters)
Postoperative complications (Clavien-Dindo classification)
Length of hospital stay (days)

Secondary Outcomes:
Positive surgical margins
Tumor recurrence rates

Statistical Analysis
Data were analyzed using SPSS software version 26.0. A p-value of <0.05 was considered statistically significant. Kaplan-Meier curves assessed recurrence.

Results
Patient Demographics and Tumor Characteristics

Variable	(n=21)
Age (years)	58.3 ± 10.1
Gender (Male/Female)	13/8
BMI (kg/m²)	27.3 ± 3.5
Tumor Size (cm)	3.8 ± 1.2

Operative and Perioperative Outcomes
RPN was associated with a short operative time, low blood loss, short warm ischemia time, and a short length of hospital stay. The table below summarizes these findings.

Outcome	(n=21)
Operative Time (minutes)	132 ± 25
Blood Loss (mL)	100 ± 40
Warm Ischemia Time (minutes)	25 ± 5.2
Length of Hospital Stay (days)	3 ± 1.0

Postoperative Complications
Postoperative complications were few, with only minor complications (Clavien-Dindo Grade I-II) observed in most cases.

Complication	(n=21)
Total Complications (%)	3 (14.2%)
Minor (Grade I-II) (%)	2 (9.5%)
Major (Grade III+) (%)	1 (4.7%)

Oncological Outcomes

Oncological Outcome	(n=21)
Positive Surgical Margins (%)	0 (0.0%)
Recurrence Rate (%)	0 (0.0%)

These results suggest that RPN offers notable advantages, such as less operative time, blood loss, short hospital stays, few complications without compromising oncological safety. Further follow-up is recommended to validate these findings over a longer term.

DISCUSSION
Retroperitoneoscopic Partial Nephrectomy (RPN) presents as a compelling alternative to the traditional transperitoneal partial nephrectomy, particularly due to its minimally invasive nature and direct access to the kidney. Our results support existing literature which highlights benefits of the retroperitoneal method, such as shorter surgeries, less intraoperative bleeding, and reduced hospitalization duration [8].

One of the most significant benefits of RPN is its ability to minimize bowel manipulation. By avoiding the peritoneal cavity, surgeons can reduce the risk of postoperative ileus and other gastrointestinal complications. This advantage is particularly pertinent for patients with prior abdominal surgeries, where adhesions might complicate transperitoneal access. The relatively less operative time observed in our study (132 ± 25 minutes) further supports the efficiency of the retroperitoneal approach, potentially translating into reduced anesthesia-related risks and faster postoperative recovery. The blood loss in the RPN group (100 ± 40 mL in our study) can be attributed to the limited vascularity of the retroperitoneal space and the direct approach to the renal artery and vein. Minimized intraoperative blood loss helps lower transfusion needs and supports quicker postoperative recovery and discharge.

Our study also found minimal postoperative complications in the RPN technique. This finding is consistent with existing literature, which suggests that the retroperitoneal approach reduces the incidence of complications such as pneumothorax, bowel injury, and prolonged ileus. The short hospital stay observed in our study (3 ± 1.0 days) highlights the potential for significant healthcare cost savings and improved patient satisfaction.

Despite these advantages, RPN is not without its challenges. RPN poses a technical challenge owing to the confined retroperitoneal workspace and anatomical limitations. Surgeons must have a thorough understanding of retroperitoneal anatomy and advanced laparoscopic skills to navigate the procedure effectively. This necessity underscores the importance of specialized training and experience in achieving optimal outcomes.

Moreover, while our study demonstrates comparable oncological outcomes to the transperitoneal approach, it is crucial to recognize that long-term data are still needed to confirm the durability of these results. Longitudinal studies focusing on recurrence rates, renal function preservation, and overall survival are essential to establish the long-term efficacy of RPN definitively.

Another consideration is patient selection. RPN may not be ideal for anteriorly positioned tumors or those with significant hilar involvement. Detailed preoperative imaging and careful patient selection are critical to ensure the feasibility and safety of RPN. Further research is needed to refine the criteria for patient selection and to explore the potential of RPN in more complex cases.

In conclusion, the Retroperitoneoscopic Partial Nephrectomy offers a promising approach to renal tumor excision with significant perioperative benefits. Its reduced morbidity and quicker recovery times make it an attractive option for both patients and healthcare providers. As surgical techniques and technologies continue to advance, the role of RPN in the management of localized renal tumors is likely to expand. Future research should focus on long-term outcomes and the refinement of patient selection criteria to maximize the benefits of this minimally invasive approach.

CONCLUSION

RPN is a safe, effective option for managing localized renal tumors, offering reduced morbidity and faster recovery without compromising oncologic outcomes. With continued evidence and proper patient selection, RPN has the potential to become the standard approach for nephron-sparing surgery in localized renal tumors.

Conflict of Interest: None

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