

## Complications and Outcomes of Nephrectomy in Renal Disease Management: A Comprehensive Review

José Salvador Rojas Maldonado<sup>1</sup>, Antonio Humberto Sánchez Maffiolo<sup>2</sup>

<sup>1,2</sup>Instituto Mexicano del Seguro Social

### ABSTRACT

Nephrectomy, encompassing both partial and radical approaches, is a cornerstone intervention for treating renal cell carcinoma, benign renal conditions, and other complex renal diseases. Surgical indications are tailored based on tumor size, location, stage, and underlying renal function, with partial nephrectomy preferred for small, localized tumors to preserve renal function. Despite its therapeutic benefits, nephrectomy carries potential complications, including vascular injuries, urinary leaks, infections, and renal function decline, notably acute kidney injury and progression to chronic kidney disease. Additional systemic risks such as thromboembolism and cardiovascular events further impact patient outcomes. Early detection and management of these complications are critical for optimizing survival and quality of life. This review summarizes current indications, surgical approaches, and the spectrum of postoperative complications, emphasizing the importance of individualized patient care to improve clinical outcomes in nephrectomy procedures.

**KEYWORDS:** Nephrectomy, renal cell carcinoma, partial nephrectomy, radical nephrectomy, surgical complications, acute kidney injury, chronic kidney disease, postoperative management, renal surgery outcomes

### ARTICLE DETAILS

**Published On:**  
**31 July 2025**

**Available on:**  
**<https://ijmscrs.com>**

### INTRODUCTION

Nephrectomy, which includes both partial and radical approaches, is indicated in a range of clinical scenarios, most commonly for the management of renal cell carcinoma (RCC), but also in select benign and symptomatic conditions. For renal cell carcinoma, nephrectomy is the preferred treatment for localized disease confined to the kidney. Partial nephrectomy is favored for T1 tumors ( $\leq 7$  cm) when technically feasible, as it preserves renal function with equivalent oncologic outcomes compared to radical nephrectomy. Radical nephrectomy is indicated for larger tumors, those with extension into the inferior vena cava, or when partial nephrectomy is not technically possible due to tumor location or complexity. In metastatic RCC, cytoreductive nephrectomy may be considered in select patients, but recent randomized trials have shown no survival benefit in intermediate- and poor-risk patients receiving targeted therapy, so patient selection is critical.[1-3]

In the context of autosomal dominant polycystic kidney disease (ADPKD), nephrectomy is indicated for severe symptoms from massively enlarged kidneys (such as pain,

early satiety, or poor oral intake), recurrent or severe kidney infection or bleeding, complicated nephrolithiasis, suspicion of malignancy, or to create sufficient space for a kidney transplant. The timing (pre-, peri-, or post-transplant) and laterality (unilateral or bilateral) depend on symptom burden, technical considerations, and local expertise. Nephrectomy is not routinely performed in all ADPKD patients but reserved for those with clear indications, as the procedure carries significant morbidity.[4-7]

Other indications for nephrectomy include:

- Non-functioning or poorly functioning kidneys causing hypertension, recurrent infection, or pain.
- Contiguous tumor involvement of the kidney during retroperitoneal lymph node dissection for non-renal malignancies (e.g., post-chemotherapy retroperitoneal lymph node dissection for testicular cancer when there is direct extension or involvement of perirenal structures).[8]
- Severe trauma with irreparable renal injury (not explicitly covered in the cited literature, but universally accepted in surgical practice).

## Complications and Outcomes of Nephrectomy in Renal Disease Management: A Comprehensive Review

Absolute indications for nephron-sparing surgery (partial nephrectomy) include situations where radical nephrectomy would render the patient anephric or at high risk for renal replacement therapy, such as bilateral tumors, solitary kidney, familial RCC, or pre-existing chronic kidney disease.[2]

### COMPLICATIONS

After nephrectomy, both partial and radical, a range of potential complications should be monitored, encompassing surgical, renal, and systemic domains.

Surgical site complications include bleeding, hematoma formation, vascular injuries (such as pseudoaneurysm or arteriovenous fistula), and injury to adjacent organs. Vascular complications, while uncommon, can be life-threatening and may present as delayed hemorrhage or hemodynamic instability, necessitating prompt imaging and possible intervention.[1-2] Urinary leaks and urinoma formation are notable risks, particularly after partial nephrectomy, and may manifest as persistent drainage, flank pain, or signs of infection.[1-2] The risk of these complications is influenced by tumor complexity and proximity to the collecting system.[1][3]

Infectious complications, including wound infection, abscess, and urosepsis, are also recognized and require vigilance, especially in the early postoperative period.[1][3]

Renal complications are of particular concern. Acute kidney injury (AKI) is a frequent early complication, with incidence rates varying by surgical approach and patient comorbidity profile. AKI is a strong predictor of adverse outcomes, including progression to chronic kidney disease (CKD), major adverse cardiovascular events, and mortality.[4-7] The risk of AKI and subsequent CKD is higher after radical nephrectomy compared to partial nephrectomy, and is further increased in patients with pre-existing CKD, older age, or larger tumor size.[4-7] CKD progression is a significant long-term risk, with the majority of renal function decline occurring within the first three months postoperatively; this period is critical for monitoring and intervention.[5][7] In rare cases, acute renal failure requiring dialysis may occur, though this is uncommon even in high-risk populations.[6]

Systemic complications, such as thromboembolic events, cardiovascular complications, and pulmonary issues, can also occur, particularly in patients with significant comorbidities. The occurrence of any postoperative complication, including renal and non-renal events, is associated with decreased long-term survival after nephrectomy for malignancy.[8]

In the context of living kidney donation, the risk of major perioperative complications is low (approximately 2.5–2.9%), but minor complications and readmissions do occur and should be monitored.[9]

In summary, the key complications to monitor after nephrectomy include bleeding and vascular injuries, urinary leaks, infection, AKI, CKD progression, and systemic events such as thromboembolism and cardiovascular complications.

Early identification and management of these complications are essential to optimize outcomes.[1][4][7][9][8]

### CONCLUSION

In conclusion, nephrectomy remains a vital intervention in the management of renal tumors, benign conditions, and various complex renal diseases. While partial nephrectomy is preferred for small, localized tumors to preserve renal function, radical nephrectomy remains necessary for larger or more invasive disease. The procedure carries a spectrum of potential complications, including vascular injuries, urinary leaks, infections, and renal function decline. Particularly, acute kidney injury and subsequent chronic kidney disease pose significant long-term risks, especially in patients with pre-existing renal impairment or comorbidities. Systemic complications such as thromboembolism and cardiovascular events further influence postoperative outcomes and survival. Careful patient selection, meticulous surgical technique, and vigilant postoperative monitoring are essential to minimize complications and optimize both short- and long-term outcomes. Continued research and individualized patient management strategies are key to advancing nephrectomy outcomes in diverse clinical scenarios.

### REFERENCES

- I. Chapman, Jeremy R., Geissler, Edward K., Pomfret, Elizabeth A., et al. 2017 Kidney Disease: Improving Global Outcomes (KDIGO) Clinical Practice Guideline on the Evaluation and Care of Living Kidney Donors. *Kidney Disease: Improving Global Outcomes*.
- II. Connor, J., Doppalapudi, S.K., Wajswol, E., et al. Postoperative Complications After Robotic Partial Nephrectomy. *Journal of Endourology*. 2020;34(1):42-47. doi:10.1089/end.2019.0434.
- III. Filipas, D.K., Yu, H., Spink, C., et al. Nephrometry and Cumulative Morbidity After Partial Nephrectomy: A Standardized Assessment of Complications in the Context of PADUA and R.E.N.A.L. Scores. *Urologic Oncology*. 2023;41(1):51.e1-51.e11. doi:10.1016/j.urolonc.2022.09.014.
- IV. Schleef, M., Roy, P., Lemoine, S., et al. Renal and Major Clinical Outcomes and Their Determinants After Nephrectomy in Patients With Pre-Existing Chronic Kidney Disease: A Retrospective Cohort Study. *PloS One*. 2024;19(5):e0300367. doi:10.1371/journal.pone.0300367.
- V. Stahl, C.C., Schwartz, P.B., Ethun, C.G., et al. Renal Function After Retroperitoneal Sarcoma Resection With Nephrectomy: A Matched Analysis of the United States Sarcoma Collaborative Database. *Annals of Surgical Oncology*. 2021;28(3):1690-1696. doi:10.1245/s10434-020-09290-z.

## Complications and Outcomes of Nephrectomy in Renal Disease Management: A Comprehensive Review

- VI. Tan, H.J., Hafez, K.S., Ye, Z., Wei, J.T., Miller, D.C. Postoperative Complications and Long-Term Survival Among Patients Treated Surgically for Renal Cell Carcinoma. *The Journal of Urology*. 2012;187(1):60-66. doi:10.1016/j.juro.2011.09.031.
- VII. Trevisani, F., Floris, M., Trepiccione, F., et al. Surgery or Comorbidities: What Is the Primum Movens of Kidney Dysfunction After Nephrectomy? A Multicenter Study in Living Donors and Cancer Patients. *Journal of Clinical Medicine*. 2024;13(21):6551. doi:10.1148/rg.220196.
- X. . doi:10.1148/rg.220196.
- doi:10.3390/jcm13216551.
- VIII. Yan, Y., Liu, Y., Li, B., et al. Trends and Predictors of Changes in Renal Function After Radical Nephrectomy for Renal Tumours. *BMC Nephrology*. 2024;25(1):174. doi:10.1186/s12882-024-03601-2.
- IX. Chaurasia, A., Singh, S., Homayounieh, F., et al. Complications After Nephron-Sparing Interventions for Renal Tumors: Imaging Findings and Management. *Radiographics*. 2023;43(7):e220196