

Complications of Renal Surgery



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KEYWORDS

• Nephrectomy • Partial nephrectomy • Complications • Small renal masses • Risk stratification

KEY POINTS

- Partial nephrectomy is an inherently more complex operation than radical nephrectomy with an increased risk of complications.
- With management options that include those less invasive than surgery, urologists must be attuned to the potential complications of surgery and develop strategies to minimize their risks.
- Providers have access to several risk stratification schema to help in the quantification of individualized risk, perioperative decision making, and operative approaches to minimize risk.

INTRODUCTION

The incidence of the small renal mass continues to increase owing to the aging population¹ and the ubiquity of ultrasound imaging and computed tomography scanning.^{2,3} The majority of these tumors are stage I tumors.³ Contemporary management strategies include surveillance, ablation, and extirpation, often using minimally invasive techniques. There is a wide body of literature favoring nephron-sparing approaches, with more recent series documenting the increased risks of chronic kidney disease and cardiovascular events in patients who undergo radical nephrectomy.^{4,5} Although the trend toward nephron-sparing surgery may yield overall decreased long-term morbidity, it is not without its drawbacks. There is a higher reported rate of complications related to partial nephrectomy compared with radical nephrectomy, particularly with increasing anatomic complexity.⁶ Partial nephrectomy, by its nature, is a more technically challenging procedure.

With management options that include those less invasive than surgery, urologists must be attuned to the potential complications of surgery

and develop strategies to minimize their risks. To this end, we provide a review of general complications of nephron-sparing surgery for the small renal mass, with a particular focus on the risk of complications for partial nephrectomy for the more anatomically complex renal tumors. We discuss several risk stratification schema and scoring systems that provide insight into the risks of complications for increasingly complex renal tumors.

REPORTING OF COMPLICATIONS

To standardize reporting of complications, the Clavien–Dindo Classification system has been adopted widely in the current literature⁷ (Table 1). The wide adoption of this system has allowed adequate comparison of procedures and techniques.

More recent attempts at standardizing outcome reporting for partial nephrectomy have included the margin, ischemia, and complications (MIC) system, the trifecta, and the pentafecta. These are systems that attempt to simplify the quality outcomes for partial nephrectomy. All 3 systems

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Table 1
Clavien-Dindo classification system

Grade	Definition
I	Any deviation from the normal postoperative course without the need for pharmacologic treatment or surgical, endoscopic, and radiologic interventions. Allowed therapeutic regimens are drugs as antiemetics, antipyretics, analgesics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside.
II	Requiring pharmacologic treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.
III	Requiring surgical, endoscopic, or radiologic intervention.
IIIa	Intervention not under general anesthesia.
IIIb	Intervention under general anesthesia.
IV	Life-threatening complication requiring IC/ICU management.
IVa	Single organ dysfunction (including dialysis).
IVb	Multiorgan dysfunction.
V	Death of a patient.

Grade I and II complications encompass complications that can be treated with medications or blood transfusions and are grouped together as "minor complications." Grade III and IV complications require surgical interventions or organ dysfunction and are grouped together as "major complications."

Abbreviation: IC/ICU, intensive care/intensive care unit.

From Dindo D, Demartines N, Clavien P. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg* 2004;240(2):206; with permission.

include major complications (Clavien-Dindo III-V) in their reporting system.

Borrowing on the trifecta of prostate outcome reporting, Hung and colleagues⁸ used the combination of negative cancer margin, minimal renal functional decrease, and no urologic complications to look at outcomes of laparoscopic partial nephrectomy. Unacceptable renal functional decrease was defined as a 10% or greater decline in the postoperative glomerular filtration rate overpredicted the glomerular filtration rate, and complications were classified as intraoperative or postoperative and urologic or nonurologic. Over a 12-year period, the investigators found that they more routinely operated on more complex tumors with 29% of operated tumors T1b or greater, with an overall trifecta rate of 68%.

Similarly, the MIC system uses 3 objectively measured parameters. Warm ischemia was measured with a cutoff of 20 minutes and complications were determined by a Clavien-Dindo grade greater than II. Mirroring the trifecta, the overall MIC rate was 67%. In this series, the only independent predictor of achieving the MIC in a multivariate regression was tumor complexity.⁹ Thus, it is evident that tumor complexity influences patient outcomes significantly.

In an attempt to characterize more accurately the outcomes for larger, complex, renal masses compared with the traditional small renal mass

cutoff of less than 4 cm, Kim and colleagues¹⁰ investigated the "pentafecta" outcomes of partial nephrectomy. The pentafecta included negative surgical margin, no postoperative complications, warm ischemia time 25 minutes or less, perseveration of at least 90% of the glomerular filtration rate, and no chronic kidney disease, upgrading after 1 year of follow-up. When comparing T1a and T1b renal masses, complications were 13.3% versus 15.0%. Overall, the pentafecta rates were significantly lower in the T1b renal masses, namely, 26.7% versus 38.3% for T1a and predicted by tumor complexity on multivariate regression.

It is imperative to mention that publication bias likely exists in the reporting of complications,¹¹ because there is hesitancy to publish series with poor outcomes. Furthermore, there is a known significant learning curve associated with laparoscopic surgery. Many series are published from large academic centers with high-volume surgeons and true complication rates experienced in the wider urologic community may not be reflected.

UNDERSTANDING COMPLICATIONS

Among a large list of possible complications, the most common surgical complications of partial nephrectomy are hemorrhage and urinary leak.

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