MÆDICA - a Journal of Clinical Medicine

ORIGINAL PAPER

MAEDICA – a Journal of Clinical Medicine
2025; 20(2): 228-234
https://doi.org/10.26574/maedica.2025.20.2.228

Factors Leading to Conversion from Laparoscopy to Open Surgery in Partial Nephrectomy: a Case Series and Literature Review

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ABSTRACT

Minimally invasive surgery offers significant benefits for partial nephrectomy. Intraoperative incidents and postoperative complications lead to conversion to open surgery and increase perioperative morbidity and mortality. Understanding the factors that contribute to the occurrence of complications is important for reducing the perioperative risk. Between 2022 and 2024, we prospectively observed intraoperative complications in cases of partial nephrectomy performed laparoscopically in the Urology Department of 'Professor Dr. Theodor Burghele' Clinical Hospital, Bucharest, Romania. We report seven cases in which laparoscopic partial nephrectomy was converted to an open approach, requiring prompt management. The most common complication leading to conversion was the presence of adhesions, which made dissection of the planes difficult, followed by intraoperative bleeding, which hindered optimal visualization. Laparoscopic partial nephrectomy is challenging and its management must be individualized. Conversion during laparoscopic renal procedures is usually rare; however, a significant event is influenced by the complexity of the procedure and patient characteristics.

Keywords: laparoscopic, partial nephrectomy, conversion to open approach, complications, hemorrhage.

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Article received on the 13th of May 2025 and accepted for publication on the 3rd of June 2025

INTRODUCTION

Partial nephrectomy (PN) is the preferred technique for treating stage cT1 renal cell carcinoma (RCC) (1, 2). The laparoscopic approach is becoming increasingly popular owing to its advantages such as reduced blood loss, shorter operative time, shorter hospitalization duration and lower morbidity associated with abdominal wall incisions.

Despite the favorable characteristics of laparoscopic procedures, they have drawbacks and specific complications that require appropriate management (3).

The factors contributing to the conversion of the laparoscopic approach to open surgery are significant bleeding that makes visualization of the surgical field difficult, anatomical considerations, adhesions that hinder the progress of dissection, accidental injury to adjacent tissues or organs without the possibility of repair due to the absence of haptic sense and patient-related factors such as increased body mass index (BMI) or other comorbidities. Finally, the experience of the surgical team plays a crucial role. Understanding predictive factors and recognizing risks helps surgeons choose the most suitable technique for each case, thus minimizing the risk of postoperative complications. Engaging patients in the decision-making process can positively influence their recovery and significantly improve their outcomes and quality of life.

This study aimed to assess the management of intraoperative complications of laparoscopic partial nephrectomy that lead to conversion.

PATIENTS AND METHODS

Over three years, from 2022 to 2024, we prospectively observed intraoperative complications in cases of laparoscopic partial nephrectomy (LPN) performed in the Urology Department of 'Professor Dr. Theodor Burghele' Clinical Hospital, Bucharest, Romania. We report seven cases in which laparoscopic surgery required conversion to an open approach and prompt management.

To evaluate these cases, we considered clinical and pathological parameters, such as age, sex, BMI, renal tumor status, RENAL nephrometry score, estimated blood loss (EBL), warm ischemia time, operative time and average hospitalization duration. Informed consent was obtained from all patients and the possible intraoperative and postoperative risks were thoroughly discussed before surgery.

The average age of patients was 63 years, with a female-to-male ratio of 5:2 and an average BMI of 28.92. Regarding tumor characterization, the average tumor diameter was 3.5 cm (1.8-7.4 cm), with lateralization on the left side in two cases and on the right side in five cases, without a preference for anterior or posterior location and without invasion of the hilum. The average operative time was 250 minutes (150–360 minutes), the mean warm ischemia time was 22.4 minutes and the estimated blood loss averaged 385 mL. The average hospitalization duration was 9.2 days (5-13 days).

The RENAL nephrometry score consists of (R)adius (tumor size as maximal diameter), (E)xophytic/endophytic properties of the tumor, (N)earness of the deepest portion of the tumor to the collecting system or sinus, (A) anterior (a)/posterior (p) descriptor and (L)ocation relative to the polar line (4). The RENAL score is a tool used to classify the complexity of renal masses into three categories based on imaging characteristics: low (two cases), intermediate (three cases) and high (two cases) (Table 1). Its primary utility includes supporting surgical decision-making, procedure planning, patient counseling and postoperative monitoring as well as helping to estimate the risk of late postoperative bleeding (5, 6).

A preoperative anatomical classification system is useful for comparing treatment options and evaluating postoperative outcomes in patients with small renal tumors. This scoring system serves as a valuable tool for assessing the complexity of the renal tumor anatomy and can help surgeons determine the most appropriate treatment options (7). Multicenter studies with larger sample sizes are necessary to evaluate their ability to predict perioperative outcomes.

Conversion to an open approach is not a failure of laparoscopic intervention but rather an

TABLE 1. The number of cases based on the nephrometric score

RENAL score		Number of cases
4-6	Low complexity	2
7-9	Moderate complexity	3
10-12	High complexity	2

act of surgical experience that can prevent the occurrence of irreversible errors leading to increased postoperative morbidity and mortality. The decision to convert may be made at the beginning of surgery, during surgical exploration, in cases where anatomy is uncertain owing to pathological changes or an adhesion process that prevents the identification of anatomical landmarks. Additionally, conversion may be required during a difficult dissection that fails to progress from the start of surgery or at any point during the intervention if a major hemorrhagic incident occurs that cannot be controlled laparoscopically. The presence of blood in the surgical field absorbs light and obstructs the visualization of anatomical landmarks or, worse, may lead to hemorrhagic shock, requiring a rapid response from the surgical team.

The risk of conversion to open surgery is difficult to predict using the laparoscopic approach and remains incompletely defined. The most common complication leading to the conversion of laparoscopic surgery to an open approach in our cases was adhesion syndrome, which led to difficult dissection, followed by intraoperative bleeding that impaired optimal visualization, despite suction.

Surgical techniques for LPN nephrectomy are performed under general anesthesia and involve well-defined steps (8). After dissecting the perirenal fat and Gerota's fascia, the renal vessels were dissected and the renal artery was clamped using bulldog clamps to suppress the blood supply (warm ischemia time). The tumor was excised using blunt-tipped scissors, and hemostasis was achieved in the renal resection bed. Renorrhaphy was performed using V-loc sutures to reapproximate the renal parenchyma (to close any collecting systems that were opened). After renorrhaphy, the bulldog clamps were removed. The surgery ended with the inspection of the kidney to rule out bleeding, followed by specimen extraction and drainage.

In the event of conversion to open surgery, the resection base was coagulated and renal parenchyma hemostasis was achieved using a combination of absorbable sutures and hemostatic agents. Bleeding sources were visualized and optimally controlled. In cases of extensive adhesions, rigorous dissection provides a clear view of the renal masses, allowing excision within the oncological safety margins.

We present three of the most relevant cases from the seven series, as the remaining cases were clinically and management-wise similar.

CASE 1

An overweight (BMI 25.95) 56-year-old female patient, smoker, hypertensive and diabetic, with a history of hematuria for which she underwent urological consultation, ultrasound examination and computed tomography, and was diagnosed with a right renal tumor measuring 4/3 cm, located medially on the anterior valve. The patient was admitted to the clinic for specialized surgical treatment. Preoperatively, her hemoglobin level was 10.9 g/dL, creatinine was 1.04, and eGFR (estimated glomerular filtration rate) were 60.44 (stage 2, mild kidney damage). She was hemodynamically and respiratory-stable, with a blood pressure of 140/80 mm Hg and a heart rate of 80 bpm. The RENAL nephrometry score was 10A, indicating a high probability of complications. A partial nephrectomy was performed using a laparoscopic retroperitoneal approach.

During surgery, extensive adhesion syndrome and excessive perivisceral fat were observed, which complicated visualization of the relevant structures. Conversion to an open surgical approach was performed to follow oncological principles and to ensure safe resection margins.

An incision was made in the 12th rib plane with the patient in the left lateral decubitus position and the procedure continued with tumor excision and renal parenchymal reconstruction.

This case was notable for a shorter operative time than the other cases presented at 180 minutes and a warm ischemia time of 25 minutes, which would not significantly impact the remaining nephron function. Postoperatively, recovery was slow and the patient required transfusion of one unit of red blood cell concentrate despite an EBL of approximately 300 mL. Consequently, the hospitalization duration was 13 days, but with a favorable outcome at discharge, with a hemoglobin level of 9.3 g/dL and creatinine level of 1.14. With appropriate outpatient treatment, the patient returned for 30-day follow-up without any complaints.

CASE 2

A 66-year-old female patient, known to have hypertension and diabetes mellitus, with

morbid obesity (BMI 44.92), was diagnosed during an outpatient urological consultation and imaging investigations such as ultrasound and computed tomography, with a left renal tumor measuring 7.4/6.3/7.4 cm, located medially on the anterior valve. The patient was admitted for specialized surgical treatment. Preoperatively, her hemoglobin level was 11.6 g/dL, creatinine was 1.29 and eGFR was 43.7 (G3b). The RENAL nephrometry score was assessed at 11A, estimating a high risk of bleeding and complications. The associated pathologies were well controlled, and transperitoneal laparoscopic partial nephrectomy was planned to avoid potential wound healing complications in an obese patient.

During surgery, manipulation of the large tumor led to significant bleeding and excessive perivisceral fat made dissection and bleeding control challenging, resulting in the decision to convert to an open approach (Figure 1). Despite prompt management, hemorrhage required total nephrectomy, a complication that we discussed in every patient.

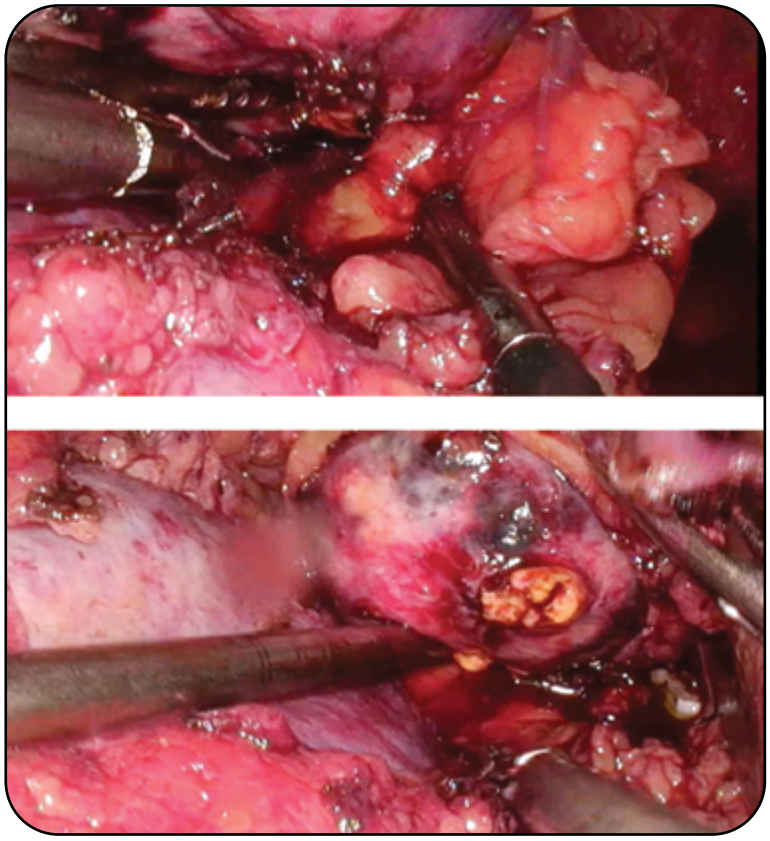

FIGURE 1. Large tumor that led to significant intraoperative bleeding

This case stands out for its short warm ischemia time of only 20 minutes, as renal artery clamping was performed after conversion, and the total duration of surgery was 255 minutes. Postoperatively, the patient required intensive care monitoring and received a transfusion of one unit of red blood cell concentrate (EBL 500 mL). The hospitalization duration was 12 days, with a favorable outcome at discharge, a hemoglobin level of 9.1 g/dL and a creatinine level of 1.2. With appropriate outpatient treatment, the patient returned for 30-day follow-up without any complaints.

CASE 3

A 64-year-old female patient with obesity class I (BMI 30.5), known to have hypertension and diabetes mellitus type II, was incidentally diagnosed during an ultrasound examination with a right renal tumor, later confirmed by computed tomography as an exophytic tumor measuring 2.7/2 cm, located cortically at the lower renal pole. The patient was admitted to our hospital for specialized surgical treatment. Preoperatively, her hemoglobin level was 15.4 g/dL, creatinine was 1.25 and eGFR was 56.8 (G3a). The RENAL nephrometry score in this case was low (6X), which did not raise concerns about intraoperative or postoperative complications.

Considering the favorable paraclinical investigation results, transperitoneal laparoscopic partial nephrectomy was proposed. However, the patient's constitutional profile, excessive perivisceral fat, and multiple intraoperatively discovered adhesions led the surgeon to convert to an open approach to minimize the risk of further complications (Figure 2). The peculiarity of this case lies in the fact that, despite the tumor having all the characteristics suitable for laparoscopic surgery and a RENAL score indicating low complexity, patient-related factors influenced surgical management. Renal function was preserved with an ischemia time of 20 minutes and EBL of approximately 300 mL. The operative time was 240 minutes and the duration of hospitalization nine days. Postoperatively, the patient showed a favorable evolution, with normal laboratory values at discharge, a hemoglobin being 12.8 g/dL and a creatinine level of 1.

Among the seven patients who underwent conversion to open surgery, two subjects re-

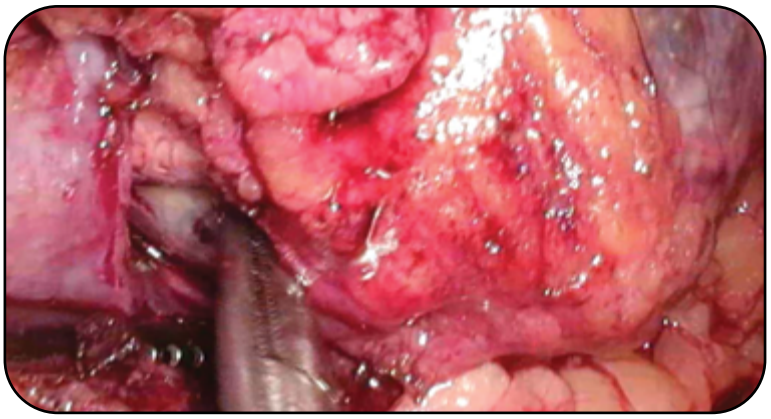

FIGURE 2. Excessive perivisceral fat

quired blood transfusions. The remaining five patients were monitored in the Intensive Care Unit but did not require additional procedures. All patients were discharged in good general condition, with normal urinary function, stable hemodynamic parameters, healing surgical wounds and a favorable 30-day follow-up evolution in all cases.

DISCUSSION

Laparoscopic partial nephrectomy is a viable alternative to open surgery, offering advantages, such as minimal blood loss, shorter hospitalization and favorable perioperative characteristics. However, some studies have reported higher complication rates for laparoscopic nephrectomy (9, 10), while other recent studies have indicated similar rates for both open and laparoscopic, depending on the tumor stage (11, 12).

This report used standardized systems (RENAL nephrometry score) to evaluate complications and tumor complexity, highlighting that the risk of complications increases directly in proportion to the score value. Five of the seven cases had a RENAL score greater than 8, with two cases exceeding 10, proving that these interventions carried a moderate to high risk of complications. No significant differences were observed in postoperative renal function or development of renal insufficiency during the early follow-up period ($p<0.05$). Laparoscopic partial nephrectomy for larger tumors is effective in maintaining functional outcomes, even though it has a higher complication rate than open surgery (13).

In a study conducted in 2012, Reifsnyder *et al* compared complication rates for partial nephrectomy through laparoscopic and open approaches using standardized systems and found that although the laparoscopic group had favorable characteristics such as lower nephrometry scores, reduced estimated blood loss and shorter hospitalization periods, these advantages did not lead to a lower complication rate compared to the open group (14).

A recent study analyzed possible postoperative complications and the frequency of bleeding after partial nephrectomy. Between January 2008 and December 2019, Styopushkin *et al* evaluated 175 partial nephrectomies in a high-volume center and monitored patients' physical condition, tumor volume, RENAL score, surgical method, warm ischemia time, severity of postoperative bleeding and treatment options. They concluded that the RENAL score could be a useful tool for predicting late postoperative bleeding after partial nephrectomy, while perioperative risk factors include the proximity of segmental arteries to the resection margin, presence of any coagulopathy, preoperative antithrombotic therapy and obesity (15).

Additionally, Luzzago *et al* stated that the conversion rate to open surgery was closely linked to patient obesity and the surgical volume of the hospital, factors that should be considered in preoperative counseling, as well as in clinical and administrative decisions. Regarding the administrative aspect and its impact on the healthcare system, conversion from a minimally invasive approach to open surgery for radical or partial nephrectomy is considered to be independently associated with an increased risk of hospital readmission within 30 days, most often due to ureterohydronephrosis (16).

A study published in 2020 identified the main reasons for conversion as follows: hilar structure invasion, residual renal insufficiency, large tumor size, central tumor location, low preoperative glomerular filtration rate and presence of symptoms at presentation (17).

Other sources cite tumor location as a predictive factor for complications, with the corticomedullary tumor pattern being more challenging to approach than cortical growth patterns (18, 19).

Although numerous studies have analyzed the postoperative complications of LPN, no scoring system has been established that considers both patient characteristics and intraoperative risk factors. In the most recent study published in

March 2025, Celen *et al* evaluated the Estimation of Physiological Ability and Surgical Stress (E-PASS) score as an assessment system that integrates both the patient's preoperative condition and intraoperative variables to predict the risk of postoperative complications (20). Patients who developed complications had higher average age, higher performance scores, larger tumor sizes, longer hospitalization stays and higher E-PASS values (21, 22).

The learning curve significantly affects the reduction of complication risks, and case selection must be performed carefully based on the surgeon's experience (23). While LPN offers the benefit of minimizing blood loss, intraoperative hemorrhage remains a significant challenge. Minimally invasive surgery is a viable alternative for selected cases of renal cancer; however, its success depends on surgeon experience. Standardization and improvement of surgical techniques remain essential to reduce the learning curve of future surgeons (23, 24). Ramani *et al* evaluated intraoperative and postoperative complications in 200 cases of LPN and highlighted complications similar to those presented in this report, such as conversion to open surgery due to technical difficulties and intraoperative or postoperative bleeding requiring reintervention, including one case of radical nephrectomy (25). Laparoscopic partial nephrectomy is an advanced procedure with significant potential complications that requires extensive expertise in reconstructive laparoscopy.

Since 2004, when Gettman *et al* published their first experience, robotic surgery has become widely used in the treatment of RCC (26). Many authors have stated that the robotic approach can be associated with lower rates of unplanned conversion to open surgery than laparoscopy (27). Moreover, in a large multicenter comparative analysis, Carbonara *et al* reported that a robotic approach can be performed with acceptable outcomes despite an increased risk of prolonged warm ischemia time and overall complications (28).

CONCLUSIONS

The present study concludes that LPN is a challenging procedure and its management must be individualized. The specific complications of laparoscopic surgery are not only technique-related incidents that can lead to vascular, nerve, bladder, ureteral, or intestinal injuries but also situations that require prompt management.

Postprocedural or postinfectious adhesion syndrome, obesity, or unpredictable hemorrhages can represent limitations to laparoscopic techniques, especially for inexperienced operators. Conversion during laparoscopic renal intervention is a rare but significant event that is influenced by procedural complexity and patient characteristics, emphasizing the importance of case selection and surgical expertise. A thorough understanding of tumor complexity, possible risks and effective management methods is essential to minimize complications, properly inform patients and select the appropriate surgical approach. ❑

Conflicts of interest: none declared.
Financial support: none declared.
Data availability: available upon request.
Informed consent: obtained from all subjects involved in the present study.

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