

Open partial nephrectomy in the robotic era^a

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ABSTRACT

Objective: To evaluate the contemporary role of open partial nephrectomy at a referral high-volume kidney cancer Center, presenting our step-by-step technique of open tumor enucleation.

Patient and Surgical Procedure: We queried our prospectively database to select patients undergoing open PN for non-metastatic renal masses at our Center between January 2017 and December 2020. Preoperative patients' and tumors' characteristics were recorded. Overall, open PN was performed by a single highly experienced surgeon (S.S.) (> 500 RAPN; > 500 open PN) following established principles. In this video we present a case of a 69-year-old patient with a highly complex (PADUA 10), cT2N0M0, predominantly endophytic 8 cm renal mass in a congenital right solitary kidney (preoperative eGFR 73 ml/min/1.73 m²), with no previous abdominal surgery, undergoing open PN.

Results: Overall, of 428 patients treated with PN at our Center in the study period, 422 (98.6%) underwent RAPN while 6 (1.4%) open PN. There were no intraoperative adverse events. Perioperative major (Clavien-Dindo grade > 3) complications were recorded in two patients. In the case shown in the video, the overall operative time was 240 min, while warm ischemia time 35 min. The postoperative course was uneventful, and the patient was discharged on postoperative day (POD) 6 in good clinical conditions and with an eGFR of 53.7 ml/min/1.73 m². The patient was then readmitted on POD 13 for an active bleeding from a small renal pseudoaneurysm detected by an angio-computed tomography scan. Therefore, the patient underwent super-selective embolization, and discharged four days later in good clinical conditions and with an eGFR of 49 ml/min/1.73 m². Histopathological examination revealed a pT3a Nx ISUP grade 3 clear cell renal cell carcinoma, with negative surgical margins.

Conclusions: While robotic approach has almost replaced open PN at referral high-volume Centers worldwide for localized renal masses, carefully selected patients may still benefit from an open approach.

Introduction

The European Associations of Urology (EAU) guidelines recommend partial nephrectomy (PN) for the management of T1 renal masses and selected patients with T2 renal masses, if technically feasible [1].

With the spread of minimally invasive surgery, robot-assisted partial nephrectomy (RAPN) has emerged as the "new" gold standard approach at referral high-volume Centers [2].

Although robotic surgery has gained an undeniable success in this field during the last two decades, selected highly complex clinical cases (such as patients with solitary kidney and/or chronic kidney disease with anatomically challenging renal masses, or patients with multiple

previous surgery for renal cell carcinoma, or those with absolute contraindications for minimally-invasive surgery) might still benefit from a traditional open approach [3].

As such, safeguarding the expertise in open PN even at high-volume robotic Centers is key to tailor the surgical approach according to the specific tumor- and patient-related characteristics, aiming to reach a personalized treatment plan ensuring oncologic safety, nephron preservation, and minimal perioperative morbidity.

In this video we present our step-by-step technique of open tumor enucleation for carefully selected patients with highly complex renal masses, focusing on the contemporary role of open surgery at a referral high-volume kidney cancer Center.

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Patient and surgical procedure

Patients and dataset

After Ethical Committee approval, we queried our prospectively maintained database to select patients undergoing open PN for non-metastatic renal masses at our Center between January 2017 and December 2020.

Preoperative patients' and tumors' characteristics were recorded. Particularly, comorbidities were assessed according to Charlson Comorbidity Index (CCI) and American Society of Anesthesiologists Classification (ASA score®), while pre- and postoperative renal function was evaluated using the estimated glomerular filtration rate (eGFR) according to Chronic Kidney Disease Epidemiology Collaboration formula.

Tumor complexity was classified according to both the Preoperative Aspects and Dimensions Used for an Anatomical Classification (PADUA score) [3].

Intra- and postoperative data were collected, including operative time, ischemia time, intraoperative complications (according to the Intraoperative Adverse Incident Classification (EAUiaIC) by the EAU [4]), postoperative complications (according to the modified Clavien-Dindo classification system [5]) and histopathological findings.

Resection technique and Trifecta were reported according to the definitions provided by the SIB International Consortium [6].

Surgical technique

The choice of surgical approach was made after shared decision-making with patients based on a case-by-case evaluation of the tumor-

and patient-specific characteristics, as well as surgeon's preference.

Overall, open PN was performed by a single highly experienced surgeon (S.S.) (> 500 RAPN; > 500 open PN) following established principles [7].

Regarding tumor excision, a pure enucleation technique was employed [6]. The surgical principles of tumor enucleation have been described in detail in previous publications [8]. In brief, after delineation of the tumor contours, the anatomic dissection plane between the tumor and the peritumoral pseudocapsule is developed by the surgeon predominantly by blunt dissection, with selective use of electrocautery, until complete tumor excision is achieved.

Renal reconstruction was achieved employing either a single- or double-layer suture, according to the specific case [9].

In this video we present a case of a 69-year-old patient with a highly complex (PADUA 10), cT2N0M0, predominantly endophytic 8 cm renal mass in a congenital right solitary kidney, with no previous abdominal surgery, undergoing open PN (Fig. 1). Preoperative eGFR was 73 ml/min/1.73 m². Preoperative patient counseling included a comprehensive discussion with the patient regarding the potential benefits and harms of PN versus radical nephrectomy, as well as all major factors impacting on the choice of surgical approach for PN (robotic vs open) [3]. After shared decision-making, the patient opted for retroperitoneal open PN.

Results

Overall, of 428 patients treated with PN at our Center in the study period, 422 (98.6%) underwent RAPN while 6 (1.4%) open PN. The characteristics of these patients are shown in Table 1.

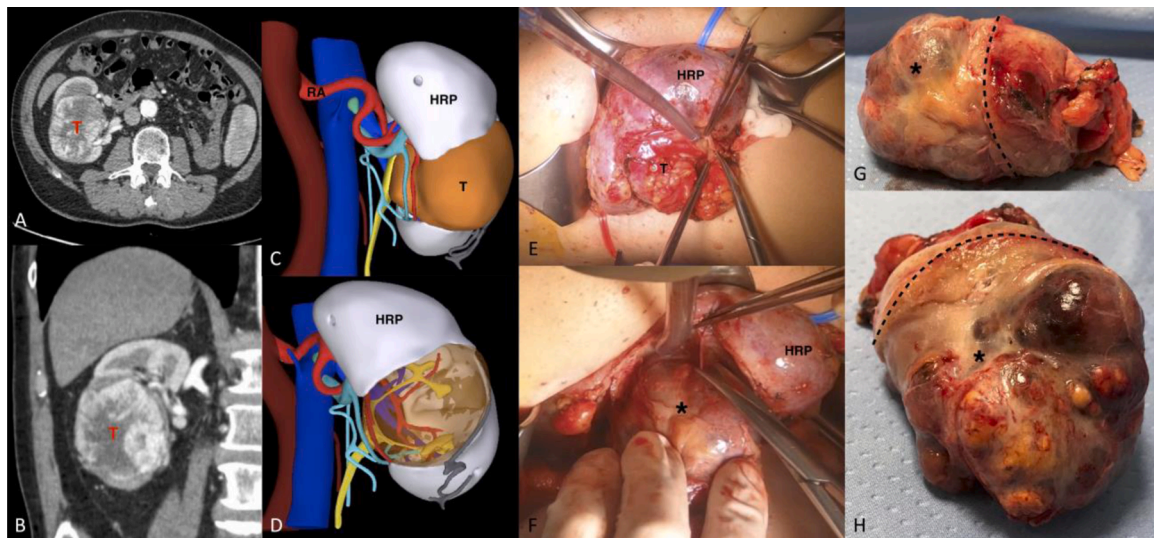


Fig. 1. Overview of the clinical case shown in the video accompanying the manuscript.

A-B. Selected snapshots from the transversal (A) and coronal (B) views of preoperative contrast-enhanced computed tomography (CT) scan showing the nephrometric characteristics of the right renal tumor (T). C, D. Three-dimensional virtual model of the clinical case (provided by MEDICS™; www.medics3d.com) showing the anatomic relationships between the tumor and the healthy renal parenchyma (HRP), as well as the details of the renal vasculature (RA = renal artery). E, F. Intraoperative snapshot showing key steps of tumor enucleation. The patient was placed in a flank position; a 12° rib supracostal incision was performed; the latissimus dorsi, the serratus posterior inferior, and the external and internal oblique muscles over the top border of the rib were divided to gain access to the retroperitoneum. Once completely dissected, the tip of the 12° rib was resected to increase exposure. Once the retroperitoneal space was developed, and the Gerota's fascia opened, the right ureter was identified and encircled with a vessel loop. The kidney was then entirely dissected and mobilized, and the renal pedicle identified, carefully dissected, and encircled with vessel loops. The tumor contours were demarcated using electrocautery before clamping the renal hilum (delayed clamping strategy). The renal artery was clamped using a Satinsky clamp. Following the principles of tumor enucleation, the surgeon carefully developed, predominantly by blunt dissection, the natural anatomical cleavage plane between the tumor and the healthy renal parenchyma, trying to spare as much vascularized healthy renal parenchyma as possible. Renal reconstruction was performed with a two-layer technique. First, selected renal calyces opened during tumor enucleation were selectively sutured with 3.0 monocril sutures. Then, the reconstruction was completed with three running sutures of the renal medulla and one running suture for the cortical renorrhaphy, following the principles of the sliding-clip technique. Methylene Blue was administered through the ureteral catheter to test for the watertightness of the pelvicalyceal system closure. Finally, hemostatic agents (FloSeal and tabotamp) were applied after the medullary suture to the tumor resection bed before closing the cortical suture. G, H. Postoperative views of the specimen after tumor enucleation. The enucleation bed appeared macroscopically safe. Final histopathological analysis revealed a pT3a ISUP grade 3 clear cell renal cell carcinoma, with negative surgical margins.

Table 1
Overview of the patient-, tumor- and surgery-related characteristics of the clinical cases treated with open partial nephrectomy at our Center between 2017 and 2020.

| Patient | Sex; Age (years) | eGFR (ml/min/1.73 m ²) | Asa Score | Side | Tumor Diameter (Cm) | Padua Score | cTNM stage | Reason To Perform Partial Nephrectomy | Operative Time (min) | Warm Ischemia Time (min) | eGFR at Discharge (ml/min/1.73 m ²) | Highest Clavien Dindo grade | Hystotype; pT stage |
|---------|------------------|------------------------------------|-----------|-------|---------------------|-------------|------------|---|----------------------|--------------------------|---|---|----------------------------|
| #1 | M, 77 | 51.7 | 1 | Right | 2.8 | 9 | T1aN0M0 | Previous major abdominal surgery | 160 | 20 | 48.5 | 0 | ccRCC, pT3a |
| #2 | F, 76 | 54.3 | 2 | Right | 5.0 | 8 | T1bN0M0 | Previous left radical nephrectomy for ccRCC and previous right RAPN (ccRCC, pT3a pN0) | 135 | 22 | 46.8 | 3b (jj stent placement for urinary fistula) | ccRCC, pT1 |
| #3 | F, 59 | . | 2 | Right | 12.8 | 10 | T2bN0M0 | Surgeon's preference | 220 | 14 | 31.0 | 2 (Antibiotic therapy) | Oncocytoma |
| #4 | F, 61 | 72.0 | 2 | Left | 11.0 | 9 | T3aN0M0 | Previous major abdominal surgery | 125 | 14 | 95.0 | 2 (Antibiotic therapy) | Epithelioid Angiomyolipoma |
| #5 | M, 76 | 18.0 | 3 | Left | 14.5 | 9 | T4N0M0 | Previous right nephrectomy (ccRCC, pT1b pN1) | 270 | 0 (Clampless) | 13.0 | 2 (transfusion) | Liposarcoma |
| #6 | M, 69 | 73.0 | 1 | Right | 8.0 | 10 | T2aN0M0 | Surgeon's preference | 240 | 35 | 53.7 | 3a (Super-selective renal embolization) | ccRCC, pT3a |

ccRCC = clear cell renal cell carcinoma.

The ultimate reasons to choose an open approach in these cases included presence of a solitary kidney, previous surgery for renal cell carcinoma (RCC), multiple previous major abdominal surgeries, or surgeon's preference. There were no intraoperative adverse events. Perioperative major (Clavien-Dindo grade ≥ 3) complications were recorded in two patients.

In the case shown in the video, the overall operative time (incision-to-closure) was 240 min, while warm ischemia time 35 min. The post-operative course was uneventful, and the patient was discharged on postoperative day (POD) 6 in good clinical conditions and with an eGFR of 53.7 ml/min/1.73 m². Resection technique was classified as pure enucleation (SIB score 0).

The patient was then readmitted on POD 13 for lumbar pain and worsening of his general conditions; an active bleeding from a small renal pseudoaneurysm was detected by an angio-computed tomography scan. Therefore, the patient underwent super-selective embolization, and discharged four days later in good clinical conditions and with an eGFR of 49 ml/min/1.73 m².

Histopathological examination revealed a pT3a Nx ISUP grade 3 clear cell renal cell carcinoma, with negative surgical margins.

Discussion

PN is currently recommended by EAU Guidelines on RCC for all T1 renal masses and for T2 renal masses in patients with solitary kidney and/or chronic kidney disease, if technically feasible [1]. Of note, the benefits and harms of PN for cT2 renal masses is still controversial [1, 10].

One of the most critical aspects of decision-making in real-life clinical practice for patients with cT2 renal masses remains selection of surgical approach [3]. This is important, as the main goal of surgery in these cases is tumor excision with negative margins, maximizing the preservation of renal function and minimizing intra- and perioperative morbidity. While robotic surgery is being increasingly performed by kidney cancer surgeons at referral high-volume Centers for the treatment of carefully selected patients with cT2 renal masses, open surgery may still have a role in such challenging clinical scenarios.

Despite being a more "invasive" approach as compared to RAPN, performing open PN might indeed provide distinct advantages for surgeons, such as: easier manipulation of the kidney, reduced warm ischemia time, better control of the tumor resection bed, possibility to apply cold ischemia techniques, potentially improved finesse in excising large cystic lesions, safer management of severe intraoperative adverse events, or simply more confidence regarding the opportunity to perform PN (instead of radical nephrectomy). Furthermore, open PN may be required in selected cases scheduled for RAPN due to intraoperative adverse events or technical issues preventing the safe completion of tumor excision using robotic surgery.

From a technical perspective, simple tumor enucleation, performed at our Center via an open approach since 1981 [7] for the treatment of sporadic RCC (an then transferred to the robotic era [8]), may provide a key opportunity to spare as much vascularized healthy renal parenchyma as possible during open PN for large and/or anatomically complex renal masses, ensuring favorable perioperative and oncological outcomes, as previously reported in the literature.

In our experience, almost 99% of patients with non-metastatic renal masses undergoing PN were treated with a robotic approach. Yet, a few highly selected cases benefitted from open surgery after shared decision-making, in light of particularly challenging features (Table 1) [3]. Taken together, our findings highlight that keeping a specific expertise in open PN should be a contemporary goal even at Centers performing most PN robotically, aiming to pursue a truly tailored and patient-centered surgical approach by offering all available options for the treatment of complex renal tumors. To do so, proper training in open kidney cancer surgery remains valuable for urological trainees working at teaching Hospitals. Notably, larger multicenter studies are needed to define the

most suitable indications for open partial nephrectomy in the robotic era.

Conclusions

While RAPN has almost replaced open PN at referral high-volume Centers worldwide for localized renal masses, carefully selected patients may still benefit from an open approach.

These challenging cases highlight the value of proper expertise and training for an open approach even in the era of minimally-invasive surgery.

Patient consent statement

We obtained a written consent from the patient agreeing on the procedure to be recorded and to participate in research and teaching.

The video related to this article can be found online at: [doi:10.1016/j.urolvj.2022.100149](https://doi.org/10.1016/j.urolvj.2022.100149).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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