Journal of Robotic Surgery (2019) 13:245–251
https://doi.org/10.1007/s11701-018-0845-y

ORIGINAL ARTICLE

Simplified robot-assisted partial nephrectomy: step-by-step technique and perioperative outcomes

Benjamin Pradere[1] · Benoit Peyronnet[1] · Zine-eddine Khene[1] · Romain Mathieu[1] · Gregory Verhoest[1] · Karim Bensalah[1]

Received: 17 April 2018 / Accepted: 4 July 2018 / Published online: 7 July 2018

Abstract

Controversies have been raised and still exist regarding several technical aspects of robot-assisted partial nephrectomy (RAPN). While the "perfect RAPN" has still to be determined, we aimed to report a simplified technique of RAPN in a step-by-step fashion and the perioperative outcomes of a single-center series. A simplified technique of RAPN was developed, refined and standardized over the past 7 years in an academic department of urology to make it as safe and as reproducible as possible, the main goal being to make it an "easy to learn" technique for fellows. This technique is presented in 12 key steps. The patients' characteristics and perioperative outcomes were prospectively collected and are reported herein. Since the first case performed in our department in 2010, 406 patients have undergone RAPN with a standardized and stable simplified technique after the first 30 cases, involving several key steps including systematic use of the transperitoneal approach, minimal visceral mobilization of the colon, systematic psoas exposure and ureter identification, minimal dissection of the perinephric fat, arterial clamping with early unclamping, no use of hemostatic agents or drain. The majority of RAPN were performed by surgeons with either low experience (i.e., < 20 procedures; 46.3%) or intermediate experience (i.e., 20–50 procedures; 17.2%). The mean warm ischemia time was 15.3 min. Conversions to an open approach and to radical nephrectomy were required in 14 (3.5%) and 21 (5.2%) cases, respectively. From 132 patients who experienced post-operative complications (32.5%), 47 experienced a major complication (11.6%). The positive surgical margin rate was 5.6%. The simplified technique of RAPN was feasible and reproducible with satisfactory perioperative outcomes. Most of the key steps have been assessed through single-center and multicenter clinical studies.

Keywords Kidney neoplasm · Partial nephrectomy · Surgery · Robotic surgery

Introduction

In the early 2000s, some experts promoted laparoscopic partial nephrectomy (LPN) to decrease the morbidity of nephron-sparing surgery [1]. However, LPN was found to be associated with a higher rate of postoperative complications and a longer warm ischemia time (WIT) compared to OPN [2] which lead to a limited widespread among the urological community [3, 4]. Conversely, during the past decade, robot-assisted partial nephrectomy (RAPN) has spread significantly because it is technically easier than LPN [5]. Recent retrospective series suggested that RAPN may be associated with a lower rate of postoperative complications compared to open PN with equivalent oncological outcomes [6, 7]. However, most RAPN data available to date come from high-volume surgeons from tertiary referral centers and the issues of reproducibility among lower volume providers and learning curve of RAPN are still a matter of debate. Moreover, the race for surgical innovation and kidney function preservation has prompted key opinion leaders to refine RAPN towards more and more complex surgical techniques (e.g., off-clamp/zero ischemia, selective arterial clamping, near-infrared fluorescence, and tumor enucleation) making reproducibility and teaching of robotic PN even more questionable. In contrast with others, as none of the aforementioned technical innovations was proven to translate into clear patients oncological or functional benefits, our objective during the past 7 years in our tertiary referral academic institution has been to develop a standardized and simplified

✉ Benjamin Pradere
benjamin.pradere@gmail.com

1 Department of Urology, CHU Rennes, 2 rue Henri Le Guilloux, 35000 Rennes, France

RAPN technique to improve its reproducibility and facilitate its teaching/learning. The aim of this manuscript is to describe this simplified technique of RAPN and to report the perioperative outcomes of a single-center series.

Methods

Study design

A simplified technique of RAPN was developed, refined and standardized over the past 7 years in an academic department to make it as safe and as reproducible as possible, the main goal being to make it an "easy to learn" technique for fellows. While several refinements were implemented over the first 30 cases (e.g., early unclamping, no hemostatic agents used, no drain used, etc.) the technique has remained unchanged afterwards. This technique is presented in 12 key steps. The patients' characteristics and perioperative outcomes were prospectively collected and are reported herein.

Preoperative assessment

A thorough history and physical examination is carried out in outpatient clinics. A CT-scan is performed to characterize renal masses, to seek for metastases and primary tumor extension, to assess tumor complexity using the RENAL nephrometry score [8] and the perinephric fat using the MAP score [9, 10]. The contrast-enhanced CT is also useful to get detailed information on renal vascular supply. Renal function is evaluated at baseline with the estimated glomerular filtration rate calculated using the abbreviated modification of diet and renal disease. As we previously described their impact on RAPN postoperative complications [11], anticoagulant and antiplatelet are stopped whenever deemed possible by the anesthesiology team and oral anticoagulation is switched to low molecular weight heparin otherwise. We do not prescribe routine bowel preparation before surgery.

Instrumentation

In our department, we use the Da Vinci Si surgical system (Intuitive Surgical Inc., Sunnyvale, CA, USA). We systematically use a 0° lense, a Maryland bipolar forceps and Hot Shears monopolar curved scissors for the dissection and tumor excision and two needle drivers for renal reconstruction. The collecting system is repaired by two running sutures with a 2-0 Vicryl on SH needle, cut 18 cm. The renorraphy is made with a 0-Vicryl using sliding ABSOLOK clips (Ethicon Endo-Surgery, Somerville, NJ, USA).

Table 1 12 key steps to simplify RAPN

1	Do not bend the table
2	No need for preoperative ureteral stenting
3	A transperitoneal approach in all cases
4	Only three arms
5	Minimal mobilization of the colon
6	A prerogative: psoas exposure and ureter identification
7	Renal hilum dissection: no need for vessel loops
8	Minimal release of perinephric fat focused on the tumor area
9	Artery only clamping
10	Limited warm ischemia time using the early unclamping technique
11	No hemostatic agents
12	No post-operative drain

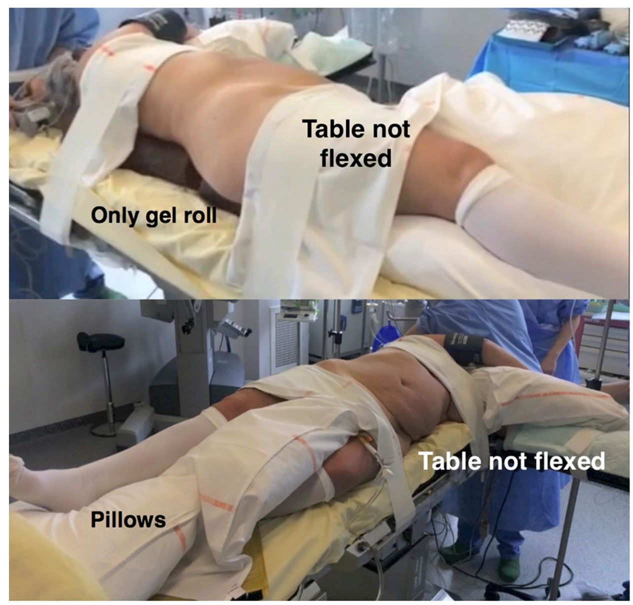

Fig. 1 Patient's positioning

The 12 key steps to simplify RAPN

The 12 key steps are summarized in Table 1.

Patient positioning and ports placement

Whatever the patient's body mass index (BMI) or the tumor location, the table is never flexed (Key step 1). Only two gel rolls are placed to support the back of the patient who is placed in a modified flank position with a 30° angle and secured to the table with two adhesive cloth tapes applied above the pelvis and chest. Legs' pressure points are carefully padded with pillows and foam pads (see Fig. 1). We never use any ureteral stent before or after RAPN (Key step 2). A transperitoneal approach is always favored to facilitate learning and reproducibility of the technique, which is a point of particular interest at an academic institution (Key step 3). Despite we acknowledge that the retroperitoneal approach might be of interest in selected cases (i.e., small posterior tumors of low complexity) we do believe it accounts for a relatively small proportion of patients [12, 13]. As we recently reported, teaching RAPN is a long process, with a steep learning curve [14] and we believe that standardizing the technique is fundamental.

We only use three arms of the robot (i.e., the fourth arm is never used) (Key step 4). The port placement is always the same regardless of patient's anatomy or tumor location (see Fig. 2). The patient cart is placed in a side-docking position. A 20-mm para-umbilicus incision is made to insert the 12-mm assistant port. A 12-mmHg pneumoperitoneum is created and a 12-mm camera port is placed at the mid-clavicular-line at the level of the umbilicus. Two 8-mm robotic ports are placed with at least a 7 cm space between each port along the lateral edge of the rectus on each side of the camera port. If necessary, in right-sided tumors, an additional 5-mm port is placed at the level of xyphoid process to allow liver retraction.

Minimal visceral mobilization of the colon (Key step 5)

It is not necessary and might be risky to perform a wide mobilization of the colon. With scissors in the surgeons' right arm and a Maryland bipolar forceps in the left arm, the peritoneum is opened along Toldt's fascia in an avascular plane. The colon is slightly moved medially to expose Gerota's fascia. This step might even be avoided on the right side.

A prerogative: psoas exposure and ureter identification

We strongly believe that operative landmarks are of utmost importance to ensure safety and reproducibility of the procedure. Hence, after mobilization of the colon, the Gerota's fascia is opened below the lower pole of the kidney to identify the psoas muscle and the ureter that is usually running just above the muscle (Key step 6) (Fig. 3). The ureter must not be skeletonized and just needs to be spotted and gently sweeped anteriorly following the psoas muscle up to the renal hilum.

A simple hilum dissection

Once the hilum has been identified, the lower pole is elevated by the assistant using a fenestrated forceps. In left-sided tumors, the renal vein is easily found following the proximal gonadal vein. The renal artery is, most of the time, identified behind the vein. We perform a minimal dissection of each vessel and do not use vessel loops to prevent unnecessary manipulation of the renal pedicle (Key step 7). The only goal is to have enough space around the renal artery to allow safe placement of a bulldog clamp.

A minimal dissection of the perinephric fat and tumor exposure

The dissection of perinephric fat is as minimalist as possible. The objective is to provide proper exposure of the tumor (Key step 8). In case of expected adherent perinephric fat (i.e., pre-operative MAP score of 4 or 5 or suspicious clinical parameters—male gender, obesity, hypertension—[10]), we rely on per-operative ultrasound to delineate tumor margins and we usually leave some fat around the tumor to avoid decapsulation, bleeding and accidental tumor incision. Similarly, in case of an endophytic tumor, the margins of the

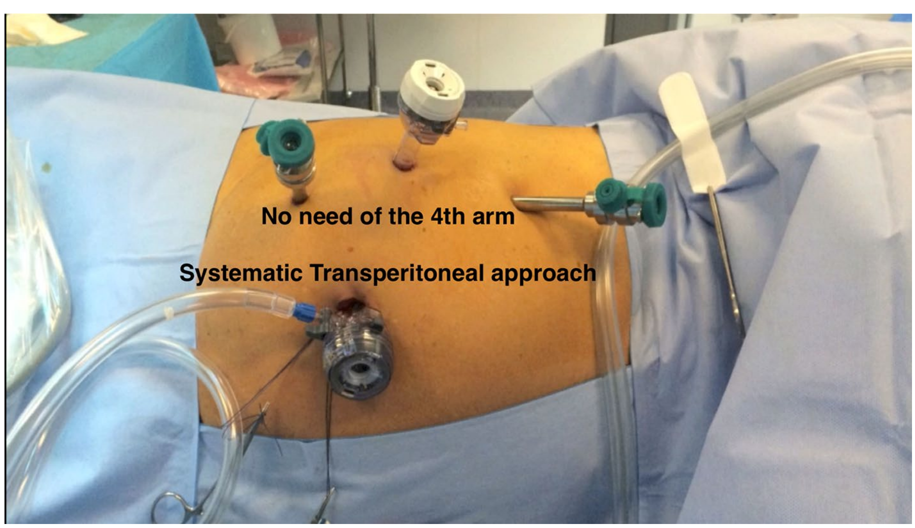

Fig. 2 Ports placement

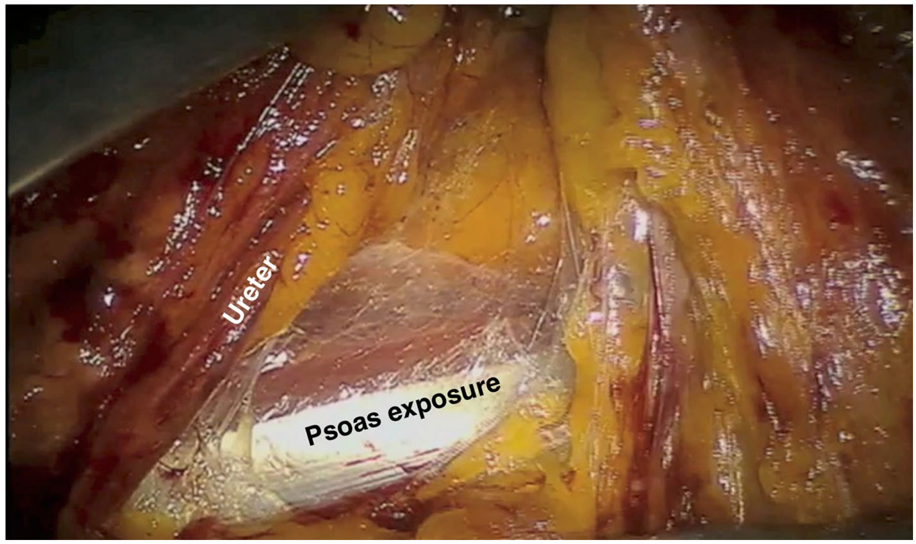

Fig. 3 Psoas exposure and ureter identification

tumor are identified with the flexible ultrasound probe and marked with cautery.

Arterial clamping

An on-clamp approach is always used because there is currently no evidence that limited ischemia time (i.e., ≤ 25 min) performs worse than 'zero ischemia' techniques [15, 16]. The hilar clamping is limited to the artery (Key step 9) as some suggested that it might lessen renal ischemic damage and because we feel, despite this is highly subjective, it might decrease blood loss by allowing venous blood drainage during the tumor resection. The arterial clamping is performed a bulldog clamp placed by the assistant. Efficacy of the clamping is evaluated by the discoloration of the parenchyma.

Tumor resection

The tumor is resected with a 5-mm parenchymal safety margin, using cold scissors while the assistant clears the resection bed and performs a countertraction with the suction device to improve visualization of the safety margin. As soon as the excision is achieved, the tumor is placed into a laparoscopic entrapment bag inserted by the assistant through the 12 mm port to prevent tumor spillage.

Repair of the collecting system and early unclamping

We close the collecting system and ensure hemostasis of the resection bed with one or two running 2-0 Vicryl sutures secured with two absorbable clips at each end (Fig. 4). Then, an early unclamping is performed (i.e., early removal of the arterial clamp after one or two running sutures on the tumor bed but before parenchymal repair) (Key step 10). The early unclamping is beneficial in several ways. First, it allows to minimize warm ischemia time without increasing perioperative morbidity as outlined in our multicenter series [17], but it could also reduce the risk of renal artery pseudo-aneurysm by showing remnant arterial bleeding requiring further sutures prior to perform parenchymal repair [18].

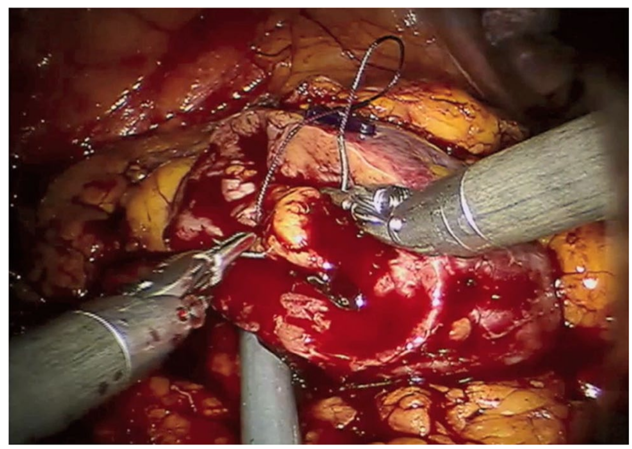

Fig. 4 Collecting system repair with 2-0 Vicryl running sutures

Parenchymal repair after unclamping

No hemostatic agents are used during the renorraphy (Key step 11) as several series, including ours, have shown no benefits in terms of hemorrhagic complications while increasing the cost of the surgical procedure [19]. If possible we close the Gerota's fascia. We do not leave any drain post-operatively as we showed that it does not decrease the incidence of complications [20] (Key step 12). The parenchymal defect is repaired using 0-Vicryl running sutures. We use sliding absorbable clips placed after each passage through

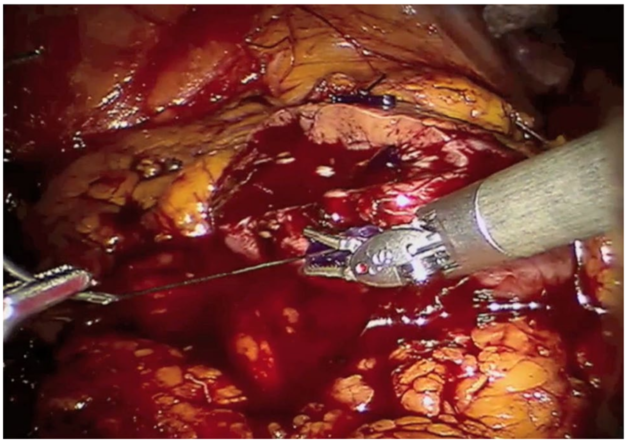

Fig. 5 Sliding-clip renorraphy with 0-Vicryl and ABSOLOK clip

the capsule to apply adequate pressure on renal parenchyma edges (Fig. 5). The renal hilum and the resection bed are then carefully inspected for any residual bleeding.

Postoperative care pathway

Regular diet is offered in the evening of the surgery and patients are encouraged to walk out of bed within hours of surgery. Serum creatinine and hemoglobin are assessed on postoperative day 1. If a urinary catheter was placed before surgery, it is removed in post-operative recovery room. The majority of patients are discharged on day one if they are doing well. Otherwise, they go home on day two (except in case of complications).

Perioperative variables

For each patient, demographics, age, gender, American Society of Anesthesiologists (ASA) classification, body mass index (BMI), Charlson's score, preoperative glomerular filtration rate (eGFR), tumors' characteristics (size, RENAL score, MAP score), surgeon's experience (categorized as < 20 procedures; 20–50 procedures; > 50 procedures) and intraoperative data (blood loss; warm ischemia time; operative time) were collected. Postoperative complications were graded using the Clavien–Dindo classification [21]. Major complications were defined as a Clavien score of 3 or higher.

Statistical analysis

Means and standard deviations were reported for continuous variables and proportions were used for nominal variables. Analysis of variance (ANOVA) and chi-square tests were used for continuous and nominal variables, respectively, to compare perioperative outcomes between RPN performed by surgeons with low, intermediate and high experience. Statistical analyses were performed using JMP v.12.0 software (SAS institute Inc, Cary, NC, USA).

Results

Patients' characteristics

Since the first case performed in our department in 2010, 406 patients have undergone RAPN and were included in the present descriptive analysis. The patients' characteristics are summarized in Table 2. The mean age was 60 years with a mean body mass index (BMI) of 31.8 kg/m^2. There were a majority of male patients (66%). The mean RENAL score and MAP score were 7.6 and 2.1, respectively, and the mean tumor size was 38.1 mm. The majority of RAPN were performed by surgeons with either low experience (i.e., < 20 procedures; 46.3%) or intermediate experience (i.e., 20–50 procedures; 17.2%).

Perioperative outcomes

The perioperative outcomes are shown in Table 3. The mean warm ischemia time and estimated blood loss were 15.3 min and 326 ml, respectively. Conversions to an open approach and to radical nephrectomy were required in 14 (3.5%) and 21 (5.2%) cases, respectively. Fifty-four patients received perioperative blood transfusion (13.3%). From 132 patients who experienced post-operative complications (32.5%), 47

Table 2 Patients' characteristics

	N = 406
Mean age (years) (± SD)	60 ± 11.5
Mean BMI (± SD)	31.8 ± 12.7
Gender	
Male	268 (66%)
Female	138 (34%)
Anticoagulant or antiplatelet intake (%)	90 (22.2%)
Mean Charlson (± SD)	3.2 ± 2.3
ASA score	
1	92 (22.7%)
2	237 (58.3%)
3	77 (19%)
Mean MAP score (± SD)	2.1 ± 1.9
Mean RENAL score (±SD)	7.6 ± 2.0
Mean tumor size (mm) (± SD)	38.1 ± 16.5
Preoperative MDRD (ml/min) (± SD)	85 ± 23.7
Surgeon's experience	
< 20 procedures	188 (46.3%)
20–50 procedures	70 (17.2%)
> 50 procedures	148 (36.5%)

Table 3 Perioperative outcomes

	$N = 406$
Warm ischemia time (min) (± SD)	15.3 ± 7.9
Operative time (min) (± SD)	145.9 ± 57.5
Conversion to an open approach	14 (3.5%)
Conversion to radical nephrectomy	21 (5.2%)
Estimated blood loss (ml) (± SD)	326.4 ± 328.3
Postoperative complications	132 (32.5%)
Major complications (Clavien grade ≥ 3)	47 (11.6%)
Blood transfusion	54 (13.3%)
Urinary fistula	3 (0.7%)
Positive surgical margins	24 (5.6%)

experienced a major complication (11.6%). The positive surgical margins rate was 5.6%. All perioperative outcomes were comparable between procedures performed by surgeons with low, intermediate and high experience.

Discussion

Over the past 10 years, RAPN has clearly been impacting the evolution of nephron-sparing surgery. We believe simplification and standardization are the cornerstones to allow the widespread of a new surgical technique. The simplified RAPN technique described in this manuscript has proven its internal applicability on two generations of fellows [21] and its external validity with satisfactory perioperative and oncological outcomes reproduced in multiple centers [7] and assessed through many retrospective and prospective series over the past 5 years [7, 10, 11, 14, 15, 17, 19, 20, 22–25]. The present study, one of the largest RAPN single-center series ever reported, confirms the satisfactory outcomes associated with this simplified RAPN technique. We think this technique can be used by most of the surgeons including those in their early learning curve as 12 surgeons were involved in our series and this study presents their initial experience in RAPN including their very first cases. Nevertheless, patient selection remains very important particularly at the beginning of the experience. We recommend to start with small T1a exophytic tumors, without expected adherent perinephric fat according to the CT-scan and no history of abdominal surgery. Being properly trained, with a proctor in the operative room during the first 10–20 cases sounds like a reasonable option to ensure patient's safety [14].

Some points of our techniques are debated. We always perform a transperitoneal approach, while an increasing body of evidences suggests better perioperative outcomes in selected posterior renal masses with the retroperitoneal approach [13, 26–28]. The table is not flexed because we think it does not lead to improved kidney exposure and could lead to unnecessary body distortion which could increase postoperative pains. The fourth arm is never used to avoid possible conflicts between arms and to minimize costs. We perform a minimal mobilization of the colon to improve bowel recovery. Some surgeons start by the hilar dissection, but we think it is easier and faster to standardize the technique with a routine dissection of the psoas muscle and identification of the ureter. However, all these steps of our simplified technique are not supported by any evidence. Finallly, two points of our technique are still a matter of controversy. We decided to stop using hemostatic agents because we felt it did not help decreasing blood loss and hemorrhagic complications, as supported by an increasing body of the literature [19, 29, 30]. However, one could argue that it might, at least partly, explain the relatively high-estimated blood loss and transfusion rates in our series. We also decided to stop leaving drain postoperatively because of the decreased likelihood of urinary fistula [31] with the robotic approach, the uncertain utility in the early diagnosis of post-operative bleeding [20, 32], and the possible barrier it could be to enhanced recovery by causing additional pain and preventing early mobilization, as suggested by the prolonged length of stay associated with pain in a recent series [20]. However, this "drainless" policy could clearly be debated considering the scant evidence supporting it.

The present study has several limitations that should be acknowledged. First it has several shortcomings inherent to its single-center, non-comparative design. Moreover, despite most of the key steps described herein have been assessed through dedicated study, the present series was only descriptive, aiming to provide an overview of the perioperative outcomes obtained with the simplified technique depicted. Finally, the oncological outcomes have not been addressed in the present report, which could be considered as a limitation, but we found it irrelevant as we have just published our long-term outcomes in another, dedicated study [33].

Conclusion

Our simplified technique of RAPN is described, emphasizing 12 key steps. As outlined by multiple retrospective and prospective series that our team published during the past 5 years and by the data presented in the present report, this standardized technique might help teaching/learning of RAPN while providing satisfactory perioperative and oncological outcomes. Better understanding of key determinants of renal function preservation, as well as improved knowledge of optimal management of small renal masses will undoubtedly lead to refinement of this technique in future years.

Compliance with ethical standards

Conflict of interest Karim Bensalah and Gregory Verhoest are proctors for Intuitive Surgical®. Other authors have nothing to disclose.

References

1. Gill IS, Kavoussi LR, Lane BR et al (2007) Comparison of 1800 laparoscopic and open partial nephrectomies for single renal tumors. J Urol 178:41–46
2. Porpiglia F, Bertolo R, Amparore D et al (2013) Margins, ischaemia and complications rate after laparoscopic partial nephrectomy: impact of learning curve and tumour anatomical characteristics. BJU Int 112:1125–1132
3. Patel HD, Mullins JK, Pierorazio PM et al (2013) Trends in renal surgery: robotic technology is associated with increased use of partial nephrectomy. J Urol 189:1229–1235
4. Poon SA, Silberstein JL, Chen LY et al (2013) Trends in partial and radical nephrectomy: an analysis of case logs from certifying urologists. J Urol 190:464–469
5. Ficarra V, Rossanese M, Gnech M et al (2014) Outcomes and limitations of laparoscopic and robotic partial nephrectomy. Curr Opin Urol 24:441–447
6. Wu Z, Li M, Liu B et al (2014) Robotic versus open partial nephrectomy: a systematic review and meta-analysis. PloS One 9:e94878
7. Peyronnet B, Seisen T, Oger E et al (2016) Comparison of 1800 robotic and open partial nephrectomies for renal tumors. Ann Surg Oncol 23:4277–4283
8. Kutikov A, Smaldone MC, Egleston BL et al (2012) Should partial nephrectomy be offered to all patients whenever technically feasible? Eur Urol 61:732–734
9. Davidiuk AJ, Parker AS, Thomas CS et al (2014) Mayo adhesive probability score: an accurate image-based scoring system to predict adherent perinephric fat in partial nephrectomy. Eur Urol 66:1165–1171
10. Khene Z-E, Peyronnet B, Mathieu R et al (2015) Analysis of the impact of adherent perirenal fat on peri-operative outcomes of robotic partial nephrectomy. World J Urol 33:1801–1806
11. Pradere B, Peyronnet B, Seisen T et al (2017) Impact of anticoagulant and antiplatelet drugs on perioperative outcomes of robotic-assisted partial nephrectomy. Urology 99:118–122
12. Choo SH, Lee SY, Sung HH et al (2014) Transperitoneal versus retroperitoneal robotic partial nephrectomy: matched-pair comparisons by nephrometry scores. World J Urol 32:1523–1529
13. Xia L, Zhang X, Wang X et al (2016) Transperitoneal versus retroperitoneal robot-assisted partial nephrectomy: a systematic review and meta-analysis. Int J Surg Lond Engl 30:109–115
14. Khene Z-E, Peyronnet B, Bosquet E et al (2017) Does training of fellows affect peri-operative outcomes of robot-assisted partial nephrectomy? BJU Int 120:591–599
15. Peyronnet B, Khene Z-E, Pradère B et al (2017) Off-clamp versus on-clamp robotic partial nephrectomy: a multicenter match-paired case-control study. Urol Int 99:272–276
16. Rod X, Peyronnet B, Seisen T et al (2016) Impact of ischaemia time on renal function after partial nephrectomy: a systematic review. BJU Int 118:692–705
17. Peyronnet B, Baumert H, Mathieu R et al (2014) Early unclamping technique during robot-assisted laparoscopic partial nephrectomy can minimise warm ischaemia without increasing morbidity. BJU Int 114:741–747
18. Kondo T, Takagi T, Morita S et al (2015) Early unclamping might reduce the risk of renal artery pseudoaneurysm after robot-assisted laparoscopic partial nephrectomy. Int J Urol Off J Jpn Urol Assoc 22:1096–1102
19. Peyronnet B, Oger E, Khene Z et al (2015) The use of hemostatic agents does not prevent hemorrhagic complications of robotic partial nephrectomy. World J Urol 33:1815–1820
20. Peyronnet B, Pradère B, De La Taille A et al (2016) Postoperative drainage does not prevent complications after robotic partial nephrectomy. World J Urol 34:933–938
21. Dindo D, Demartines N, Clavien P-A (2004) Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 240:205–213
22. Masson-Lecomte A, Yates DR, Bensalah K et al (2013) Robot-assisted laparoscopic nephron sparing surgery for tumors over 4 cm: operative results and preliminary oncologic outcomes from a multicentre French study. Eur J Surg Oncol J Eur Soc Surg Oncol Br Assoc Surg Oncol 39:799–803
23. Masson-Lecomte A, Bensalah K, Seringe E et al (2013) A prospective comparison of surgical and pathological outcomes obtained after robot-assisted or pure laparoscopic partial nephrectomy in moderate to complex renal tumours: results from a French multicentre collaborative study. BJU Int 111:256–263
24. Fardoun T, Peyronnet B, Oger E et al (2016) Impact of robotic assistance on the use and the outcomes of nephron-sparing surgery: a single center experience. Progres En Urol J Assoc Francaise Urol Soc Francaise Urol 26:1163–1170
25. Mathieu R, Verhoest G, Droupy S et al (2013) Predictive factors of complications after robot-assisted laparoscopic partial nephrectomy: a retrospective multicentre study. BJU Int 112:E283–E289
26. Weizer AZ, Palella GV, Montgomery JS et al (2011) Robot-assisted retroperitoneal partial nephrectomy: technique and perioperative results. J Endourol 25:553–557
27. Hughes-Hallett A, Patki P, Patel N et al (2013) Robot-assisted partial nephrectomy: a comparison of the transperitoneal and retroperitoneal approaches. J Endourol 27:869–874
28. Kim EH, Larson JA, Potretzke AM et al (2015) Retroperitoneal robot-assisted partial nephrectomy for posterior renal masses is associated with earlier hospital discharge: a single-institution retrospective comparison. J Endourol 29:1137–1142
29. Maurice MJ, Ramirez D, Kara Ö et al (2016) Omission of hemostatic agents during robotic partial nephrectomy does not increase postoperative bleeding risk. J Endourol 30(8):877–883
30. Antonelli A, Minervini A, Mari A et al (2015) TriMatch comparison of the efficacy of FloSeal versus TachoSil versus no hemostatic agents for partial nephrectomy: results from a large multicenter dataset. Int J Urol 22(1):47–52
31. Potretzke AM, Knight BA, Zargar H,et al (2016) Urinary fistula after robot-assisted partial nephrectomy: a multicentre analysis of 1791 patients. BJU Int 117(1):131–137
32. Abaza R, Prall D (2013) Drain placement can be safely omitted after the majority of robotic partial nephrectomies. J Urol 189(3):823–827
33. Beauval JB, Peyronnet B, Benoit T et al (2018) Long-term oncological outcomes after robotic partial nephrectomy for renal cell carcinoma: a prospective multicentre study. World J Urol. https://doi.org/10.1007/s00345-018-2208-8