Editorial Commentary

Robot-assisted partial nephrectomy is safe and effective for complex renal masses when performed by experienced surgeons

Tristan S. Juvet, R. Houston Thompson, Aaron M. Potretzke

Department of Urology, Mayo Clinic, Rochester, Minnesota, USA

Correspondence to: Aaron M. Potretzke. 200 First Street SW, Rochester, Minnesota 55905, USA. Email: Potretzke.Aaron@Mayo.edu.

Comment on: Buffi NM, Saita A, Lughezzani G, *et al.* Robot-assisted Partial Nephrectomy for Complex (PADUA Score >/=10) Tumors: Techniques and Results from a Multicenter Experience at Four High-volume Centers. Eur Urol 2020;77:95-100.

Submitted Apr 16, 2020. Accepted for publication Jun 01, 2020.

doi: 10.21037/tau-20-865

View this article at: http://dx.doi.org/10.21037/tau-20-865

The treatment of renal masses continues to evolve. While in previous surgical generations large and small tumors were routinely managed by nephrectomy, the modern paradigm is arguably more refined. The contemporary approach considers the individual patient's overall clinical scenario, preferences, and the characteristics of the tumor itself. Active surveillance and percutaneous thermal ablation have been utilized more in recent years, and there is good evidence to support their employment in certain clinical scenarios (i.e., smaller, localized tumors) (1). However, partial or radical nephrectomy remains the stalwart intervention for larger renal masses or masses with concerning growth kinetics. The method by which surgery is undertaken is often surgeon specific, but the role of minimally invasive surgery has been expanded by both technology and innovative surgeons.

In the January 2020 edition of *European Urology*, Buffi and colleagues reported their multicenter (Humanitas Clinical and Research Center, Milan, Italy; Swedish Medical Center, Seattle, USA; Onze-Lieve-Vrouw Hospital, Aalst, Belgium; OLV Robotic Surgery Institute Academy, Melle, Belgium; San Luigi Gonzaga Hospital, Turin, Italy) experience of robot-assisted partial nephrectomy (RAPN) for complex renal tumors (2). We applaud the authors for this excellent undertaking and for the effort to advance the management of renal cell carcinoma. This retrospective study included 255 patients with highly complex renal tumors, defined as a PADUA (Preoperative Aspects and Dimensions Used for an Anatomical) score of ≥10.

The PADUA scoring system was first described in 2009 and is based on the anatomical relationships between the tumor and the kidney. In the original study, this score was used to predict the risk of surgical and medical perioperative complications following open partial nephrectomy (3). The score takes into account several factors regarding the tumor's anatomic relationships. These include the categorical tumor size, longitudinal location, endo/exophyticity, involvement of the renal sinus, lateral/medial location, anterior/posterior location, and involvement of the urinary collecting system.

In the present study, the optimal surgical outcome for partial nephrectomy was assessed by the Margin, Ischemia, and Complications (MIC) binary system (4). In this system, an optimal outcome encompasses the absence of any Clavien-Dindo >2 complications, a warm ischemia time (WIT) under 20 minutes, and an absence of positive surgical margins. This outcome was achieved in 68.5% of patients with PADUA scores of 10 and in 68.2% of patients with a PADUA score of 11. However, the rate of an ideal outcome decreased to 40.7% in patients with a PADUA score of 12-13. The risk of not achieving an ideal outcome was associated with PADUA scores of 12–13 and male gender ($P<0.05$ in multivariable analysis). High grade perioperative complications were noted in 5.1% of patients. The percentage of patients with a positive margin, requiring conversion to open surgery, or requiring radical nephrectomy was <2% for each. The authors concluded RAPN can be an effective and safe option in complex renal masses.

The authors acknowledge their unique experience—"*we still believe that RAPN is a complex surgery with a long* *learning curve and should be performed only in high-volume centers by highly trained urologists.*" We agree with the authors' commentary. While not all urologists are able to perform RAPN for complex renal masses, there are several important takeaways discussed in the manuscript that can be helpful to the general surgical management of renal masses. The authors discuss the pre-surgical assessment of renal mass complexity and intraoperative techniques designed to increase the chance of successful tumor extirpation. Moreover, the authors provide guidance and video instruction for those robotic renal surgeons endeavoring to expand the indications for RAPN.

Renal mass complexity assessment

It is now generally accepted that the critical assessment of the complexity of a renal mass should be a standard practice (5). There are several published "nephrometry" scores including, but not limited to, PADUA, R.E.N.A.L nephrometry score (RNS), DAP (diameter-axial-polar), and C-index (concordance index). No specific scoring system is perfect in its ability to predict operative or oncologic events. In the present study, PADUA was used to standardize the preoperative assessment of tumors. Several previous comparisons have been made between the RNS and the PADUA scoring system and have found them to be comparable in their associations with surgical outcomes (6-8). However, Borgman *et al*. found RNS correlated best with MIC outcomes when compared to PADUA, C-index, and DAP. Of note, the Borgman *et al*. study included mostly open partial nephrectomies (91%) (9). We do not advocate for a specific metric to be used in clinical and research discussions, but we would support the use of a measurement which is understandable to an individual surgeon and the surgeon's colleagues.

Tumor size is often used as a simple metric to convey potential technical complexity and outcomes. As such, the authors attempted to control for tumor size in their assessment of the relationship between surgical outcomes and the PADUA score. While this statistical effort is important, it is likely that significant collinearity exists between tumor size and PADUA score; categorical size is a component of PADUA, after all. Tumor size as a continuous variable has previously been shown to be an important independent predictor of surgical outcomes, outperforming other specific components of RNS (10). A breakdown of the PADUA scoring components may have illustrated certain variables which were particularly important to the surgical outcomes of RAPN for complex tumors.

The preoperative evaluation of a tumor can likewise be used to predict histopathologic findings. Buffi *et al*. reported an overall rate of benign tumor histology of 17.3%, consistent with other reports (11). They reported a higher rate (21.8%) of benign findings in those patients with a PADUA score of 10. In that subset of patients, the average tumor size was 4.3 cm. In a large, recent series reported by Bhindi *et al*., a tumor >4 and ≤5 cm conferred a benign rate of approximately 10% (12). Further, Bauman *et al*. reported in a series of partial nephrectomies that tumor size, RNS, BMI, and gender were associated with benign pathology. While significant debate surrounds the use of preoperative renal biopsy, the findings in the present study suggest that some patients harboring a tumor with a PADUA score of 10 may be counseled regarding potential benefits of biopsy.

Intraoperative techniques

The authors made excellent use of ancillary software and equipment to improve surgical outcomes in this study. Minimization of WIT was likely aided by the use of advanced adjunctive technologies including TilePro, hyper-accuracy 3D reconstruction (HA3D), and near infrared fluorescence imaging with indocyanine green (ICG) for selective clamping. While there are efforts to increase access to HA3D at many sites, very few institutions and surgeons have access to this technology at present. Instead, surgeons may take advantage of virtual reality or printed 3D models to improve several operative outcomes, including operative time, blood loss, and WIT (13).

Furthermore, partial nephrectomists can use real-time ultrasound with TilePro (Intuitive Surgical, Sunnyvale, CA, USA) to identify the tumor and delineate margins. The Iris system (Intuitive Surgical, Sunnyvale, CA, USA) is being introduced and can also allow the surgeon to view a 3D segmented model based on CT imaging using TilePro. Thankfully, TilePro for use with ultrasound and the use of ICG are more commonly available. These adjuncts can assist in identification of tumor vasculature for selective clamping and can guide tumor excision (14,15). We commonly use both of these tools in our practice.

There are several techniques which have been previously described in the literature to minimize WIT. Certainly every safe effort should be made to achieve the lowest WIT possible, as there is evidence that prolonged WIT can impact short- and long-term renal function (16). The authors reported a commendably low median WIT of 18 minutes. Given the complexity of these tumors a rate of just 33.7% of patients with a WIT longer than 20 minutes is likewise impressive. A WIT >20 minutes represents the most common reason for failure to achieve the MIC outcome. It is noteworthy, however, that several authors have demonstrated protected short- and long-term renal function even with WIT as long as 30 minutes (17). It may be argued that the "optimal" outcome would have been achieved more frequently with a less stringent goal for WIT.

The authors describe some very valuable, if challenging techniques to minimize the long-term impact of RAPN on renal function. Approximately 5% of these patients underwent the procedure using a "zero ischemia" technique, while another 16.5% underwent selective clamping only. As described by Gill *et al.*, zero ischemia refers to the control of higher order, tumor specific vessels using microsurgical clamps, and does not equate to "off-clamp" surgery (18). Selective clamping involves the isolation of accessory arteries and the use of ICG to determine areas of perfusion. No true off-clamp surgeries were performed in the experience of Buffi *et al.*, which is intuitive given the tumor complexity. It bears mentioning that recent prospective, randomized evidence would suggest that intermediate-term renal function does not differ between patients with a relatively short WIT and those with a WIT of 0 min (i.e., in a true off clamp procedure) (19). Selective clamping, hilar clamping, and zero ischemia techniques should be employed without hesitation in these cases. Briefly, other potential strategies to reduce WIT in RAPN include: pre-placement of renorrhaphy sutures, use of a barbed suture for renorrhaphy of the deep tumor bed, early unclamping, and starting the superficial tumor excision without the hilum clamped (20).

In summary, the authors have shown us that a robotic approach is feasible in patients with highly complex renal tumors, extending the technical advances in the field of robotic surgery. These patients experienced a low rate of major complications, good oncologic outcomes, and a low rate of conversion to radical nephrectomy. Intuitively, higher PADUA scores (12,13) were related to a lower rate of achieving an optimal outcome. We believe that the multi-institutional nature of their study (and the inherent heterogeneity) is a strength of the study and may provide optimism for further diffusion of this surgical approach in complex renal tumors. While this remains a nascent topic in the literature, a recent study by Garisto and colleagues retrospectively compared a series of open and robotic partial nephrectomies for complex renal masses as measured by RNS. The authors reported favorable outcomes with RAPN (21). Moving forward, a prospective study would be enlightening in terms of outcomes, as selection bias remains an important factor in retrospective series. Furthermore, a cost effectiveness analysis could provide great insight into the potential economic value/cost of the robotic approach.

The study by Buffi and colleagues is commendable for its reflection of an advancing surgical practice. While these results may be reproducible by skilled surgeons in tertiary centers, we are in agreement that a careful discussion must be held with these patients regarding the surgical options. The goal is, of course, to deliver the best oncologic outcomes in keeping with the surgeon's skill set and available resources. RAPN may provide improvements in blood loss, ischemia time, transfusion rate, convalescence, and hospital stay (20,21). However, open partial nephrectomy and minimally invasive radical nephrectomy remain viable, and in many cases, favorable options, with similar oncologic outcomes for patients with complex masses (22,23). Ultimately each patient deserves an approach considerate of the available data, the patient's preferences, and the surgeon's expertise.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Translational Andrology and Urology*. The article did not undergo external peer review.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/tau-20-865). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Jewett MA, Mattar K, Basiuk J, et al. Active surveillance of small renal masses: progression patterns of early stage kidney cancer. Eur Urol 2011;60:39-44.
2. Buffi NM, Saita A, Lughezzani G, et al. Robot-assisted Partial Nephrectomy for Complex (PADUA Score >/=10) Tumors: Techniques and Results from a Multicenter Experience at Four High-volume Centers. Eur Urol 2020;77:95-100.
3. Ficarra V, Novara G, Secco S, et al. Preoperative aspects and dimensions used for an anatomical (PADUA) classification of renal tumours in patients who are candidates for nephron-sparing surgery. Eur Urol 2009;56:786-93.
4. Buffi N, Lista G, Larcher A, et al. Margin, ischemia, and complications (MIC) score in partial nephrectomy: a new system for evaluating achievement of optimal outcomes in nephron-sparing surgery. Eur Urol 2012;62:617-8.
5. Campbell S, Uzzo RG, Allaf ME, et al. Renal Mass and Localized Renal Cancer: AUA Guideline. J Urol 2017;198:520-9.
6. Kriegmair MC, Mandel P, Moses A, et al. Defining Renal Masses: Comprehensive Comparison of RENAL, PADUA, NePhRO, and C-Index Score. Clin Genitourin Cancer 2017;15:248-55.e1.
7. Veccia A, Antonelli A, Uzzo RG, et al. Predictive Value of Nephrometry Scores in Nephron-sparing Surgery: A Systematic Review and Meta-analysis. Eur Urol Focus 2020;6:490-504.
8. Schiavina R, Novara G, Borghesi M, et al. PADUA and R.E.N.A.L. nephrometry scores correlate with perioperative outcomes of robot-assisted partial nephrectomy: analysis of the Vattikuti Global Quality Initiative in Robotic Urologic Surgery (GQI-RUS) database. BJU Int 2017;119:456-63.
9. Borgmann H, Reiss AK, Kurosch M, et al. R.E.N.A.L. Score Outperforms PADUA Score, C-Index and DAP Score for Outcome Prediction of Nephron Sparing Surgery in a Selected Cohort. J Urol 2016;196:664-71.
10. Potretzke AM, Potretzke TA, Knight BA, et al. Tumor diameter accurately predicts perioperative outcomes in T1 renal cancer treated with robot-assisted partial nephrectomy. World J Urol 2016;34:1643-50.
11. Bauman TM, Potretzke AM, Wright AJ, et al. Partial Nephrectomy for Presumed Renal-Cell Carcinoma: Incidence, Predictors, and Perioperative Outcomes of Benign Lesions. J Endourol 2017;31:412-7.
12. Bhindi B, Thompson RH, Lohse CM, et al. The Probability of Aggressive Versus Indolent Histology Based on Renal Tumor Size: Implications for Surveillance and Treatment. Eur Urol 2018;74:489-97.
13. Shirk JD, Thiel DD, Wallen EM, et al. Effect of 3-Dimensional Virtual Reality Models for Surgical Planning of Robotic-Assisted Partial Nephrectomy on Surgical Outcomes: A Randomized Clinical Trial. JAMA Netw Open 2019;2:e1911598.
14. Furukawa J, Miyake H, Tanaka K, et al. Console-integrated real-time three-dimensional image overlay navigation for robot-assisted partial nephrectomy with selective arterial clamping: early single-centre experience with 17 cases. Int J Med Robot 2014;10:385-90.
15. Rogers CG, Laungani R, Bhandari A, et al. Maximizing console surgeon independence during robot-assisted renal surgery by using the Fourth Arm and TilePro. J Endourol 2009;23:115-21.
16. Thompson RH, Lane BR, Lohse CM, et al. Every minute counts when the renal hilum is clamped during partial nephrectomy. Eur Urol 2010;58:340-5.
17. Zargar H, Akca O, Ramirez D, et al. The impact of extended warm ischemia time on late renal function after robotic partial nephrectomy. J Endourol 2015;29:444-8.
18. Gill IS, Patil MB, Abreu AL, et al. Zero ischemia anatomical partial nephrectomy: a novel approach. J Urol 2012;187:807-14.
19. Anderson BG, Potretzke AM, Du K, et al. Comparing Off-clamp and On-clamp Robot-assisted Partial Nephrectomy: A Prospective Randomized Trial. Urology 2019;126:102-9.
20. Potretzke AM, Weaver J, Benway BM. Review of robot-assisted partial nephrectomy in modern practice. J Kidney Cancer VHL 2015;2:30-44.
21. Garisto J, Bertolo R, Dagenais J, et al. Robotic versus open partial nephrectomy for highly complex renal masses: Comparison of perioperative, functional, and oncological outcomes. Urol Oncol 2018;36:471.e1-9.
22. Bravi CA, Larcher A, Capitanio U, et al. Perioperative Outcomes of Open, Laparoscopic, and Robotic Partial

Nephrectomy: A Prospective Multicenter Observational Study (The RECORd 2 Project). Eur Urol Focus 2019. [Epub ahead of print].

23. Gershman B, Thompson RH, Boorjian SA, et al. Radical Versus Partial Nephrectomy for cT1 Renal Cell Carcinoma. Eur Urol 2018;74:825-32.

Cite this article as: Juvet TS, Thompson RH, Potretzke AM. Robot-assisted partial nephrectomy is safe and effective for complex renal masses when performed by experienced surgeons. Transl Androl Urol 2020;9(6):2474-2478. doi: 10.21037/tau-20-865