continued support. We also thank Jessica L. Parker for providing guidance on conducting appropriate statistical analysis.

## SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.urology.2018.03.055.

### References


1. Campbell S, Uzzo RG, Allaf ME, et al. Renal mass and localized renal cancer: AUA guideline. *J Urol*. 2017;198:520–529.
2. Ljungberg B, Bensalah K, Canfield S, et al. EAU guidelines on renal cell carcinoma: 2014 update. *Eur Urol*. 2015;67:913–924.
3. Zini L, Perrotte P, Capitanio U, et al. Radical versus partial nephrectomy: effect on overall and noncancer mortality. *Cancer*. 2009;115:1465–1471.
4. Mir MC, Derweesh I, Porpiglia F, et al. Partial nephrectomy versus radical nephrectomy for clinical T1b and T2 renal tumors: a systematic review and meta-analysis of comparative studies. *Eur Urol*. 2017;71:606–617.
5. Tan HJ, Norton EC, Ye Z, et al. Long-term survival following partial vs radical nephrectomy among older patients with early-stage kidney cancer. *JAMA*. 2012;307:1629–1635.
6. Kaushik D, Kim SP, Childs MA, et al. Overall survival and development of stage IV chronic kidney disease in patients undergoing partial and radical nephrectomy for benign renal tumors. *Eur Urol*. 2013;64:600–606.
7. Weight CJ, Lieser G, Larson BT, et al. Partial nephrectomy is associated with improved overall survival compared to radical nephrectomy in patients with unanticipated benign renal tumours. *Eur Urol*. 2010;58:293–298.
8. Kutikov A, Uzzo RG. The R.E.N.A.L. nephrometry score: a comprehensive standardized system for quantitating renal tumor size, location and depth. *J Urol*. 2009;182:844–853.
9. 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;56:786–793.
10. Leslie S, Gill IS, de Castro Abreu AL, et al. Renal tumor contact surface area: a novel parameter for predicting complexity and outcomes of partial nephrectomy. *Eur Urol*. 2014;66:884–893.
11. Klatte T, Ficarra V, Gratzke C, et al. A literature review of renal surgical anatomy and surgical strategies for partial nephrectomy. *Eur Urol*. 2015;68:980–992.
12. Okhunov Z, Rais-Bahrami S, George AK, et al. The comparison of three renal tumor scoring systems: C-Index, P.A.D.U.A., and R.E.N.A.L. nephrometry scores. *J Endourol*. 2011;25:1921–1924.
13. 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;196:664–671.
14. Kutikov A, Smaldone MC, Egleston BL, et al. Anatomic features of enhancing renal masses predict malignant and high-grade pathology: a preoperative nomogram using the RENAL nephrometry score. *Eur Urol*. 2011;60:241–248.
15. Haifler M, Ristau BT, Higgins AM, et al. External validation of contact surface area as a predictor of post-operative renal function in patients undergoing partial nephrectomy. *J Urol*. 2018;199(3):649–654.
16. Song C, Bang JK, Park HK, et al. Factors influencing renal function reduction after partial nephrectomy. *J Urol*. 2009;181:48–53. discussion 53-44.
17. Lane BR, Russo P, Uzzo RG, et al. Comparison of cold and warm ischemia during partial nephrectomy in 660 solitary kidneys reveals predominant role of nonmodifiable factors in determining ultimate renal function. *J Urol*. 2011;185:421–427.
18. Dagenais J, Maurice MJ, Mouracade P, et al. Excisional precision matters: understanding the influence of excisional volume loss on renal function after partial nephrectomy. *Eur Urol*. 2017;72:168–170.
19. Volpe A, Blute ML, Ficarra V, et al. Renal ischemia and function after partial nephrectomy: a collaborative review of the literature. *Eur Urol*. 2015;68:61–74.
20. Tobert CM, Takagi T, Liss MA, et al. Multicenter validation of surgeon assessment of renal preservation in comparison to measurement with 3D image analysis. *Urology*. 2015;86:534–538.
21. Zhao J, Zhang Z, Dong W, et al. preoperative prediction and postoperative surgeon assessment of volume preservation associated with partial nephrectomy: comparison with measured volume preservation. *Urology*. 2016;93:124–129.
22. Levey AS, Stevens LA, Schmid CH, et al. A new equation to estimate glomerular filtration rate. *Ann Intern Med*. 2009;150:604–612.
23. Finelli A, Ismaila N, Bro B, et al. Management of small renal masses: American society of clinical oncology clinical practice guideline. *J Clin Oncol*. 2017;35:668–680.
24. Simmons MN, Fergany AF, Campbell SC. Effect of parenchymal volume preservation on kidney function after partial nephrectomy. *J Urol*. 2011;186:405–410.
25. Thompson RH, Boorjian SA, Lohse CM, et al. Radical nephrectomy for pT1a renal masses may be associated with decreased overall survival compared with partial nephrectomy. *J Urol*. 2008;179:468–471. discussion 472-463.
26. Yossepowitch O, Eggener SE, Serio A, et al. Temporary renal ischemia during nephron sparing surgery is associated with short-term but not long-term impairment in renal function. *J Urol*. 2006;176:1339–1343. discussion 1343.
27. Ting-Po Lin Y-MK, Chen Marcelo, Sun Fang-Ju. Wun-Rong Lin: functional outcome prediction after partial nephrectomy using R.E.N.A.L. nephrometry, PADUA classification, and centrality index score. *Urol Sci*. 2017;28:10–13.


## Editorial Comment


In this issue of *Urology*, Lane et al. evaluated the ability of tumor complexity scoring systems to predict postoperative renal function (PRF) following partial nephrectomy (PN). The authors found that the assessed scoring systems (RENAL, PADUA, CSA, and PAVP) had similar predictive characteristics for nadir GFR, while RENAL and PAVP scores demonstrated an association with new baseline GFR on univariable analyses. These findings add to our growing knowledge regarding the utility of nephrometry systems, but only paint a partial picture of the landscape of variables that determine PRF.

Evidence has long shown that performing a PN on most localized renal tumors is oncologically safe. This is reflected in recent AUA guidelines promoting the consideration of PN over radical nephrectomy (RN) for certain clinically localized tumors.[1,2] PN, however, carries unique risks, as is reflected by data from the AHRQ[2]; NSQIP estimates that the baseline risk for any complication for PN is 10.8% vs. 7% for a laparoscopic RN.[3] To therefore justify its use, the renal functional benefits of PN must outweigh the perioperative risk; and clinicians must be able to better articulate the functional tradeoffs inherent to these decisions.[4,5]

From a patient's perspective, discussing expected post-PN renal function is an important aspect of preoperative counseling. Whereas we currently have limited tools to make such predictions,

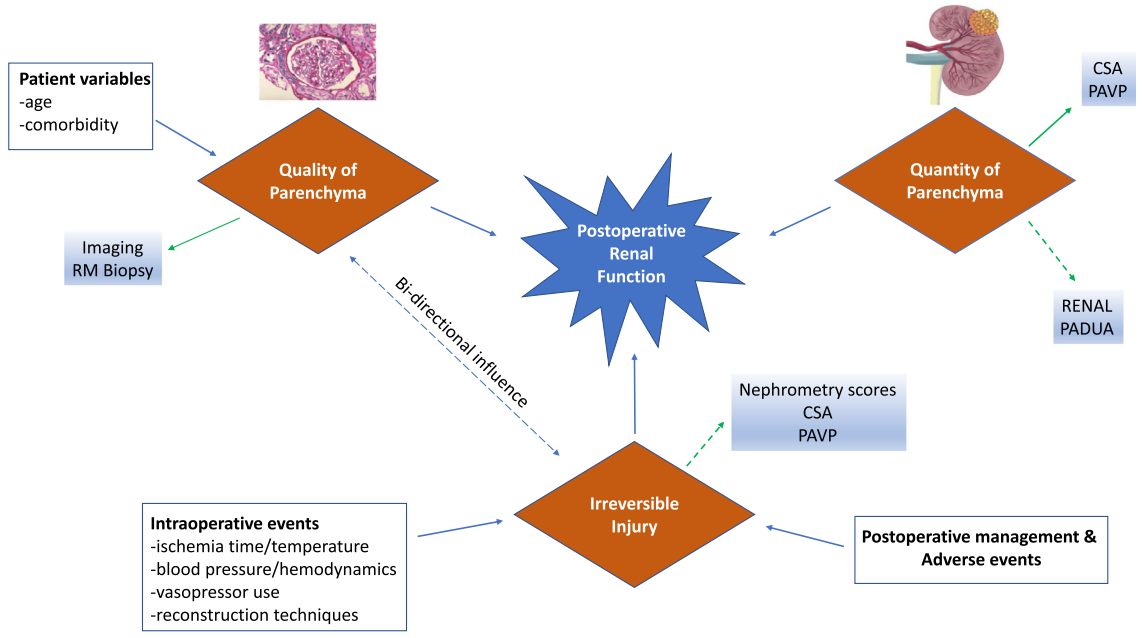


**Figure.** Postoperative renal function is determined by the quantity of parenchyma, quality of parenchyma, and amount of irreversible parenchymal injury sustained during surgery. Many factors influence each of these variables, examples of which are shown in the figure.

Light blue boxes with green arrows = measurement methods (Solid arrows = direct measurements; Dashed arrows = indirect measurements)

CSA= Contact Surface Area

PAVP= Preoperative Assessment of Volume Preservation

RENAL= Nephrometry score: Radius, Endophytic/exophytic, Nearness to collecting system, Anterior-posterior, location relative to Polar lines

PADUA= Preoperative Aspects and Dimensions Used for Anatomic classification

RM biopsy = Renal mass biopsy

attempts to generate predictive algorithms in this space should be encouraged for the benefit of both patients and physicians.

Nephrometry, at first glance, seems like a natural tool for predicting functional outcomes. But as the name suggests, complexity scores are only intended to communicate tumor complexity. They are powerful tools when used for tumor analysis and risk-communication[6]; but their power to predict functional risks is only a derivate of their primary goal and does not incorporate other important variables that determine postoperative function. Alternatively, calculating parenchymal mass preservation may be a more accurate way of predicting the expected quantity of remaining kidney. However, these calculations are bulky to use at the point of care and may require significant coordination with radiology, all for minimal improvements in predictive ability.[7] More importantly, the quantity of preserved parenchyma is not the only variable that determines postoperative function.

The goal, of course, is to give patients an upfront idea about renal functional risks. The accompanying figure illustrates a conceptual framework for discussing functional risks with patients. Postoperative renal function is determined by the combined effects of parenchymal quality, quantity, and irreversible parenchymal damage that results from surgery. Tumor complexity scores and parenchymal mass calculations can help describe some of these variables. However, none of these scores are able to incorporate *all* of the important variables that go into determining postoperative renal function.

We should continue to encourage efforts that improve our ability to counsel patients on oncological versus functional risks. Patients with renal tumors fear both cancer progression AND the risk of renal replacement therapy. Moreover, they ascribe different values and tradeoff preferences to each. Though complexity scores are an important tool in our armamentarium, their role in predicting composite outcomes like PRF should not be overestimated.

**Acknowledgments.** Shreyas S. Joshi – No conflicts of interests, financial interests, or disclosures relevant to this editorial.

Robert G. Uzzo - No conflicts of interests, financial interests, or disclosures relevant to this editorial.

**Shreyas S. Joshi, M.D., Robert G. Uzzo, M.D.,**
Department of Surgical Oncology, Division of Urologic Oncology, Fox Chase Cancer Center, Temple Health; Philadelphia, PA

## References

1. Campbell S, Uzzo RG, Allaf ME, et al. Renal Mass and Localized Renal Cancer: AUA Guideline. *J Urol.* 2017;198:520–529.
2. Pierorazio PM, Johnson MH, Patel HD, et al. *Management of Renal Masses and Localized Renal Cancer.* Rockville (MD); 2016.
3. Bilimoria KY, Liu Y, Paruch JL, et al. Development and evaluation of the universal ACS NSQIP surgical risk calculator: a decision aid and informed consent tool for patients and surgeons. *J Am Coll Surg.* 2013;217:833–842. e831-833.

4. Kim SP, Campbell SC, Gill I, et al. Collaborative Review of Risk Benefit Trade-offs Between Partial and Radical Nephrectomy in the Management of Anatomically Complex Renal Masses. *Eur Urol*. 2017;72:64–75.
5. Kutikov A, Smaldone MC, Uzzo RG. Partial versus radical nephrectomy: balancing nephrons and perioperative risk. *Eur Urol*. 2013;64:607–609.
6. Joshi SS, Uzzo RG. Renal Tumor Anatomic Complexity: Clinical Implications for Urologists. *Urol Clin North Am*. 2017;44:179–187.
7. Zhao J, Zhang Z, Dong W, et al. Preoperative Prediction and Postoperative Surgeon Assessment of Volume Preservation Associated With Partial Nephrectomy: Comparison With Measured Volume Preservation. *Urology*. 2016;93:124–129.

https://doi.org/10.1016/j.urology.2018.03.058
UROLOGY 124: 165–167, 2019. 