UROONCOLOGY
Invited Review

Is robotic partial nephrectomy convenient for solitary kidney?

Soliter böbrekte robotik parsiyel nefrektomi uygun bir yaklaşım mı?

Jihad H. Kaouk, Ercan Malkoç

ABSTRACT

Nephron sparing surgery (NSS) is the gold standard treatment option for patients with a solitary kidney in order to preserve renal function. Open partial nephrectomy (OPN) has been long considered the standard care for NSS. Robotic partial nephrectomy (RPN) is being gradually used more commonly even for solitary kidney and complex tumors. There was no difference between RPN and OPN regarding the rate of intraoperative-postoperative complications and positive surgical margin (PSM) (RPN: 7.5%, OPN: 8%) for patients with solitary kidney who underwent partial nephrectomy for small renal masses. Warm ischemia time (WIT) in all of our studies was within the safe range of <25 minutes which is acceptable ischemia time for robotic approaches. More studies are needed in order to evaluate kidney function. In conclusion with increasing experience, solitary kidney tumors can be managed safely with robotic approach. For patients having complex tumors with a potential of WIT >25 minutes, administration of intracorporeal ice slush during surgery may be considered.

Keywords: Partial nephrectomy; robotic surgical procedures; solitary kidney.

ÖZ

Böbrek fonksiyonlarını koruma açısından, soliter böbreği olan hastalarda nefron koruyucu cerrahi (NKC) altın standart tedavi seçeneğidir. Açık parsiyel nefrektomi (APN)'nin uzun zamandan beri NKC için standart tedavi olduğu düşünülürdü. Robotik parsiyel nefrektomi (RPN) giderek soliter böbrek ve kompleks tümörlerde bile daha sık kullanılmaktadır. Tek böbrekli ve küçük renal kitleler için parsiyel nefrektomi uygulanan hastalarda intraoperatif ve postoperatif komplikasyonlar ve pozitif cerrahi sınır (PCS) açısından RPN ve APN arasında herhangi bir farklılık yoktur (RPN: %7,5, APN: %8). Çalışmalarımızın hepsinde sıcak iskemi süresi güvenli ve robotik yaklaşımların kabul edilebilir sınırlar (<25 dakika) içindeydi. Böbrek fonksiyonlarını değerlendirmek için daha fazla sayıda çalışmaya gerek vardır. Sonuçta, giderek artan deneyimle soliter böbrek tümörleri robotik yaklaşımla güvenle tedavi edilebilmektedir. Sıcak iskemi zamanının 25 dakikadan uzun olabildiği kompleks tümörlerde intrakorporal buz kırıntılarının kullanılması düşünülebilir.

Anahtar kelimeler: Parsiyel nefrektomi; robotik cerrahi işlemler; soliter böbrek.

Department of Urology, Glickman Urological and Kidney Institute, Cleveland Clinic, Cleveland, OH, USA

Submitted:
22.04.2016

Accepted:
25.04.2016

Correspondence:
Jihad H. Kaouk
E-mail:
kaoukj@ccf.org

Available online at
www.turkishjournalofurology.com

Introduction

Nephron sparing surgery (NSS) is the gold standard treatment option for patients with a solitary kidney to maximize preservation of renal function. While open partial nephrectomy (OPN) is considered the standard care for NSS, robotic partial nephrectomy (RPN) is now more commonly considered. In addition to RPN, laparoscopic partial nephrectomy (LPN) and ablative procedures such as cryotherapy and radiofrequency are additional treatment options. Ablative treatments may induce low morbidity and minimal impact on renal function[1,2], however oncologic outcomes are still inferior compared to partial nephrectomy (PN).[3]

With high definition 3-D vision system, magnification of surgical field, and EndoWrist® instruments, RPN is being performed with a wide range of indications, including larger and high complex tumors.[4] Combining these features with intraoperative ultrasonography enables resection of the tumor with minimal amount of parenchyma during PN. Although maximizing the amount of preserved parenchyma is as important as warm ischemia time (WIT) for functional preservation, surgical margin positivity (PSM) is crucial for oncological outcomes. In this article we summarized the role of RPN for localized small renal tumors in a solitary kidney.

Turk J Urol 2016; 42(3): 127-9
DOI:10.5152/tud.2016.69851

Perioperative Outcomes

There is a paucity of data in the literature regarding RPN used for the management of tumors in solitary kidneys.[5-7] The perioperative outcomes for different approaches for solitary kidney at the same center are detailed in Table 1. The overall complication rate and days of hospital stay seem to be more favourable in patients who underwent RPN.

In a recent study[6], which represents the largest series of RPN, we compared perioperative outcomes of RPN and OPN in patients with anatomically or functionally solitary kidney. We stratified the cases according to RENAL score as simple and complex renal tumors. There was no difference between the groups as for intraoperative-postoperative complications and PSM rates (RPN: 7.5%, OPN: 8%). The incidence of PSM was higher when compared with our previously reported rate of 2.2% in patients with a normal contralateral kidney.[8] These differences might be related to small cohort size or might reflect the attempt to protect the healthy parenchyma by the surgeon. WIT for simple renal tumors was 15 minutes and 22.7±5.8 minutes for complex tumors in the RPN group. In another study[7] in which we compared RPN with LPN in solitary kidneys, median WIT was shorter in the RPN group (19 vs. 15 min, p=0.04). In our multi-institutional study where a total of 26 solitary patients were included, the median WIT was 17 minutes.[5] WIT in all of our studies was within the safe range of <25 minutes which is described previously.[9]

Table 1. Perioperative outcomes of partial nephrectomy in solitary kidney at the same center

	Open	Laparoscopic	Robotic
Number of cases	85	52	40
Tumor size, median, (cm)	3.7	2.8	2.5
Ischemia Time, (min)	23*23.9±8.1†	19	15*22.7±5.8†
PSM, n (%)	7 (8)	2 (4)	3 (7.5)
EBL, median (ml)	300	250	200*-225†
Overall Complication, n (%)	36 (42.3)	22 (42)	13 (32.5)
Major Complication, n (%)	13 (15.2)	10 (19.2)	6 (15)
Temporary Dialysis, n (%)	5 (5.8)	4 (7.6)	2 (5)
Hospital stay, median (days)	5.5* - 6†	4	3*-4†

PSM: Positive Surgical Margin; EBL: Estimated Blood Loss
* For R.E.N.A.L score 4-8 tumor
† For R.E.N.A.L score 9-12 tumor

Functional Outcomes

Renal functional preservation is the cornerstone of PN and the outcomes after surgery depend on a variety of factors such as age, body mass index (BMI), baseline estimated glomerular filtration rate (eGFR), comorbidity, amount of preserved parenchyma, and WIT. To evaluate renal recovery, early and late functional outcomes, rate of postoperative hemodialysis, quantity of eGFR preservation and chronic kidney disease (CKD) upstaging should be considered. The studies evaluating these factors in this setting are limited. In the largest series of RPN[6], the early functional outcomes and the necessity of temporary dialysis were similar with OPN (Table 1). New onset CKD cases occurred in the RPN (16.2%), and OPN (26%) groups (p=0.5).

Is RPN feasible for large and complex tumors in a solitary kidney?

The growing experience in robotic approach has allowed performing RPN for larger and complex tumors.[10,11] But the cumulative robotic experience in these tumors is very limited and OPN remains the preferable technique. In our study that included solitary kidneys (13.8%) we indicated that RPN is feasible and a safe approach for highly selected cases whose tumors are bigger than 7 cm.[10] Combining renal hypothermia with robotic approach for large and complex tumors is important because renal hypothermia is used to decrease the oxidative injury and allows longer clamp times. Previous studies have shown that cooling the kidney to 5-20°C slows renal metabolism and provides ischaemia time up to 3 hours, without risking the renal functions.[12,13] Ice slush application during PN is usually used in open approaches. The use of intracorporeal ice slush during LPN with endocatch bag was initially described by Gill et al.[14] and it was firstly used by Rogers et al.[15] with a Gelpoint® access port for obtaining renal hypothermia during RPN. In our alternative technique[16] ice slush is applied via an accessory subcostal mid-axillary port without the need of a Gelport or endocatch bag and we use thermocouple (Mon-a-Therm; Covidien, Mansfield, MA, USA) to measure temperature of kidney intraoperatively so as to confirm that the kidney is at the desired temperature. For patients with an anticipated WIT >25 minutes intracorporeal ice slush should be considered.

In conclusion, with increasing experience, solitary kidney tumors can be managed safely with robotic approach. Intracorporeal cooling during RPN is feasible and can be used for larger and complex tumors to reduce the risk of functional loss of kidney.

Peer-review: This manuscript was prepared by the invitation of the Editorial Board and its scientific evaluation was carried out by the Editorial Board.

Author Contributions: Concept – J.H.K.; Design – E.M.; Supervision – J.H.K.; Analysis and/or Interpretation – J.H.K., E.M.; Literature Search – E.M.; Writing Manuscript – E.M., J.H.K.; Critical Review – J.H.K.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

Hakem Değerlendirmesi: Bu makale Editörler Kurulu'nun davetiyle hazırlandığından bilimsel değerlendirmesi Editörler Kurulu tarafından yapılmıştır.

Yazar Katkıları: Fikir – J.H.K.; Tasarım – E.M.; Denetleme – J.H.K.; Analiz ve/veya Yorum – J.H.K., E.M.; Literatür Taraması – E.M.; Yazıyı Yazan – E.M., J.H.K.; Eleştirel İnceleme – J.H.K.

Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.

Finansal Destek: Yazarlar bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

References

1. Altunrende F, Autorino R, Hillyer S, Yang B, Laydner H, White MA, et al. Image guided percutaneous probe ablation for renal tumors in 65 solitary kidneys: functional and oncological outcomes. J Urol 2011;186:35-41. [CrossRef]
2. Raman JD, Raj GV, Lucas SM, Williams SK, Lauer EM, Ahrar K, et al. Renal functional outcomes for tumours in a solitary kidney managed by ablative or extirpative techniques. BJU Int 2010;105:496-500. [CrossRef]
3. Turna B, Kaouk JH, Frota R, Stein RJ, Kamoi K, Gill IS, et al. Minimally invasive nephron sparing management for renal tumors in solitary kidneys. J Urol 2009;182:2150-7. [CrossRef]
4. Patel HD, Mullins JK, Pierorazio PM, Jayram G, Cohen JE, Matlaga BR, et al. Trends in renal surgery: robotic technology is associated with increased use of partial nephrectomy. J Urol 2013;189:1229-35. [CrossRef]
5. Hillyer SP, Bhayani SB, Allaf ME, Rogers CG, Stifelman MD, Tanagho Y, et al. Robotic partial nephrectomy for solitary kidney: a multi-institutional analysis. Urology 2013;81:93-7. [CrossRef]
6. Zargar H, Bhayani S, Allaf ME, Stifelman M, Rogers C, Larson J, et al. Comparison of perioperative outcomes of robot-assisted partial nephrectomy and open partial nephrectomy in patients with a solitary kidney. J Endourol 2014;28:1224-30. [CrossRef]
7. Panumatrassamee K, Autorino R, Laydner H, Hillyer S, Khalifeh A, Kassab A, et al. Robotic versus laparoscopic partial nephrectomy for tumor in a solitary kidney: a single institution comparative analysis. Int J Urol 2013;20:484-91. [CrossRef]
8. Khalifeh A, Kaouk JH, Bhayani S, Rogers C, Stifelman M, Tanagho YS, et al. Positive surgical margins in robot-assisted partial nephrectomy: a multi-institutional analysis of oncologic outcomes (leave no tumor behind). J Urol 2013;190:1674-9. [CrossRef]
9. Thompson RH, Lane BR, Lohse CM, Leibovich BC, Fergany A, Frank I, et al. Renal function after partial nephrectomy: effect of warm ischemia relative to quantity and quality of preserved kidney. Urology 2012;79:356-60. [CrossRef]
10. Brandao LF, Zargar H, Autorino R, Akca O, Laydner H, Samarasekera D, et al. Robot-assisted partial nephrectomy for >/= 7 cm renal masses: a comparative outcome analysis. Urology 2014;84:602-8. [CrossRef]
11. Miyake H, Hinata N, Imai S, Furukawa J, Tanaka K, Fujisawa M. Partial nephrectomy for hilar tumors: comparison of conventional open and robot-assisted approaches. Int J Clin Oncol 2015;20:808-13. [CrossRef]
12. Wickham JE, Hanley HG, Joekes AM. Regional renal hypothermia. Br J Urol 1967;39:727-43. [CrossRef]
13. Ward JP. Determination of the Optimum temperature for regional renal hypothermia during temporary renal ischaemia. Br J Urol 1975;47:17-24. [CrossRef]
14. Gill IS, Abreu SC, Desai MM, Steinberg AP, Ramani AP, Ng C, et al. Laparoscopic ice slush renal hypothermia for partial nephrectomy: the initial experience. J Urol 2003;170:52-6. [CrossRef]
15. Rogers CG, Ghani KR, Kumar RK, Jeong W, Menon M. Robotic partial nephrectomy with cold ischemia and on-clamp tumor extraction: recapitulating the open approach. Eur Urol 2013;63:573-8. [CrossRef]
16. Kaouk JH, Samarasekera D, Krishnan J, Autorino R, Acka O, Brando LF, et al. Robotic partial nephrectomy with intracorporeal renal hypothermia using ice slush. Urology 2014;84:712-8. [CrossRef]