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Original Article

# Open Nephron–Sparing Surgery for Renal Tumors is an Effective Surgical Option for Low Health–Resource Settings in the Era of Laparoscopic Surgery

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## Abstract

**Introduction:** Open nephron–sparing surgery (NSS) is known to have good outcomes in terms of renal function and oncology. Its role in the laparoscopic and robotic surgery era requires further evaluation in low–income countries. This study evaluated the renal function and oncological outcomes of open NSS surgery for renal tumors to provide insight into the future role of open NSS alongside laparoscopic and robotic surgery.

**Patients and Methods:** A cohort of 52 patients who underwent NSS for RCC were included in this study. Clinical data were recorded using a predesigned questionnaire covering epidemiology, patient presentation, comorbidities, laboratory investigation, imaging studies, TNM classification, CTU findings, selection criteria, intra– and postoperative complications, hospital stay, and follow–up outcome data. Data are expressed as mean ± SD, and dependent and independent variables were considered statistically significant at a P–value level <0.05.

**Results:** Of the 52 patients, 44.2% were male, and 55.8% were female, with an average age of 57.5 ± 14.8. Incidental renal masses were observed in 36.5% of patients, while flank pain was observed in 55.8% of patients. The average size was 5.9 ± 1.7 cm. A transcostal extraperitoneal approach was used, with a mean operative time of 87.6 ± 16.2 minutes. The main artery was clamped in 92.3% of the patients, and selective apical artery ligation was performed in one patient under specific conditions.

There were no instances of bleeding during or after the surgery, and the typical period of ischemia during tumor removal lasted approximately 12.5 ± 4.8 minutes. Histological results showed malignant tumors in 86.5% of the cases and benign lesions in 13.5%. Positive surgical margins were observed in one patient with a small entophytic upper pole mass of 3.7 cm. The average hospital stay was five days ± 1.6; however, 49 (94.2%) patients had their drain removed in less than three days. Only three (5.8%) patients developed a urinary fistula and responded well to conservative treatment.

Of the 52 patients, 21 (40.4%) were monitored for > 5 years, while 31 (59.6%) were observed for less than 5 years. Follow–up CTU analysis showed no evidence of recurrence or metastases, and serum creatinine levels at three months and one year were 1.4 (SD 0.6) and 1.2 (SD 0.7), respectively.

The correlation between ischemia time and tumor size was statistically significant (P = 0.034). Moreover, histological type was also significantly correlated with tumor size, with a P–value of 0.000.

**Discussion and Conclusion:** The study concluded that open NSS is a secure procedure that maintains renal function without compromising oncological outcomes. A warm ischemia time of 20 min did not compromise oncological outcomes or renal function. Tumor sizes of 7 cm or more can be safely managed. A double–layer suturing technique and follow–up scheme using serum creatinine and CTU at three months and then annually seems practical and applicable even in low–currency income countries.

**Keywords:** Open nephron–sparing, renal tumors, low health–resource settings, laparoscopic Surgery, renal cell carcinoma

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## Introduction

Renal cell carcinoma (RCC) accounts for approximately 3.8% of all newly diagnosed cancers. It is the most frequently diagnosed renal malignancy worldwide, with the highest incidence in Western countries and a median age of 64 years at diagnosis [1,2]. Approximately 85% of kidney tumors are RCC, and approximately 70% of these tumors have clear cell histology [3]. Other less common cell types include papillary, chromophobe, translocation, and Bellini duct tumors [4]. Obesity, smoking, high blood pressure, long–term use of hormones, and antipyretic and analgesic drugs have all been implicated as etiological factors of RCC [5].

Renal masses can be diagnosed using CT and/or MRI scans. However, MRI is more sensitive to contrast enhancement in renal masses with indeterminate enhancement on CT. These tools provide additional information on tumor extent, kidney function, and the potential involvement of other organs. Bone and brain scans are performed only if there are symptoms of metastasis [6].

Laparoscopic surgery, recognized for its capacity to reduce hospitalization duration and expedite postoperative recovery, is predominant in high–income nations. Nevertheless, its widespread integration in low– and middle–income countries is impeded by the substantial costs associated with acquiring the requisite equipment and providing specialized training for healthcare personnel [7]. Thus, open NSS remains the standard procedure for treating renal masses in low–health settings, especially for clinical T1 (cT1) cases. Even for T3 renal tumors, NSS has become the preferred method owing to its learning curve. This approach is as practical as radical nephrectomy (RN), yet superior in that it preserves the nephrons and is critical to maintaining the patient's quality of life after surgery [8]. However, when tumors are at clinical stage T3 based on preoperative imaging studies, deciding whether to perform PN becomes more challenging despite its technical feasibility. Additionally, whether open NSS is as effective for deeply seated midline renal RCC near the anatomically complex renal coronal plane and collecting systems needs to be clarified. Recent studies have suggested that open NSS and RN may provide oncological requirements in pT3a RCC, with open NSS yielding better functional outcomes [9]. However, more studies are yet to be conducted on the complications, renal function, and oncological outcomes of NSS in patients with kidney tumors in nations with low healthcare facilities. Such studies can provide more conclusive evidence regarding NSS's oncological safety and efficiency of NSS for patients with RCC and help decide the best surgical strategy.

This study aimed to evaluate the presenting symptoms, imaging findings, surgical approach, histopathological findings, margin clearance, postoperative renal function, and oncological outcomes of open NSS in a cohort of Sudanese patients.

## Patients and Methods

The study included a cohort of 52 patients (44.2% male and 55.8% female, aged between 26 and 86 years, with unilateral or bilateral renal masses who underwent nephron–sparing surgery for RCC at Soba University Hospital between April 2010 and September 2017.

Clinical data were recorded in a predesigned questionnaire that included epidemiology (age and sex), patient complaints (hematuria, loin pain, and incidental findings), comorbidities (renal function, hypertension, diabetes, and coronary heart disease), laboratory investigation (FBC, RFT, UG, ECG), an imaging study (chest X–ray, abdominal US), TNM classification, CTU findings (tumor size, location, site of renal mass, laterality, and tumor relation to the collecting system and laterality), patient selection for PN (absolute, relative, and elective indication), operative data (surgical approach, operation, ischemia duration, hemorrhage during surgery), postoperative complexation (hemorrhage, urinary fistula, and drain output), postoperative histopathological findings including clear margin, hospital stay, follow–up data (CTU follow–up data of local recurrence and distant metastases, and serum creatinine in mg/dl).

## Statistical analysis

Data were analyzed using the computer program Statistical Package for Social Sciences (SPSS) version 20 for Windows. Data were expressed as mean ± SD, and dependent and independent variables were considered statistically significant at a P–value level $<0.05$.

## Results

Between April 2010 and September 2017, 52 patients diagnosed with a renal mass underwent nephron–sparing surgery (NSS) at Soba University Hospital. Of the 52 patients, 44.2% (n=23) were males, and 55.8% (n=29) were females. The average age was 57.5 +14.8 SD years, and the range was between 26 and 86 years.

The presenting symptoms were incidental discovery of a renal mass in 36.5% of the patients, flank pain in 55.8%, and visible hematuria in 7.7%. The mean serum creatinine level at surgery was 1.1 ± 0.53 SD mg/dl. Preoperative CTU findings showed that 50% of patients had a left renal mass, 44.2% had a right renal mass, and 5.8% had bilateral renal masses. The location of the mass within the kidney indicated that 27 patients had an upper pole mass,

18 had a lower pole mass, and seven had a mid–pole mass. The relation of the mass to the collecting system showed an exophytic mass in 61.5% of the cases, whereas in 38.5% of the cases, the mass was endophytic (Table 1). The average tumor size was 5.9 +1.7 SD cm, categorized according to TNM 2012 classification into T1a in 13.5%, T1b in 65.4%, T2a in 17.3%, and T2b in 3.9% (Table 1).

| Data | | Number | Percentage (%) |
|---|---|---|---|
| **Age** | Mean ± SD | 57.5 ± 14.8 years | |
| | Range | 26 – 86 years | |
| **Sex** | Male | 23 | 44.2 |
| | Female | 29 | 55.8 |
| **Main complain** | Loin pain | 29 | 55.8 |
| | Incidental findings | 19 | 36.5 |
| | Hematuria | 4 | 7.7 |
| **Mean tumor size** | 5.9 ± 1.7 cm. | | |
| **Tumor size according to TNM classification** | T1a [< 4 cm] | 7 | 13.5 |
| | T1b [4.01 – 7 cm] | 34 | 65.4 |
| | T2a [7.01 – 10 cm] | 9 | 17.3 |
| | T2b [> 10 cm] | 2 | 3.9 |
| **Indication of NSS** | Absolute | 7 | 13.5 |
| | Relative | 3 | 5.8 |
| | Elective | 42 | 80.8 |
| **CTU findings** | | | |
| **A. Site of The Renal Mass** | Right | 24 | 46.2 |
| | Left | 28 | 53.8 |
| **B. Location of The Renal Mass** | Upper Pole | 27 | 51.9 |
| | Lower Pole | 18 | 34.6 |
| | Mid–Pole | 7 | 13.5 |
| **C. Relation To the Collecting System** | Exophytic | 32 | 61.5 |
| | Endophytic | 20 | 38.5 |

**Table 1:** Clinical data of 52 patients who underwent open NSS for renal tumors.

All patients underwent a transcostal extraperitoneal approach with a duration ranging between 75 and 140 min and a mean operative time of 87.6+16.2 min. Warm ischemia was used in all patients, with the main artery clamped in 48 (92.3%) patients. The clamp technique was used in three patients, of which two had a solitary functioning kidney, and one had an exophytic renal mass of less than 4 cm. Selective apical artery ligation was applied in one patient with a solitary functioning kidney and an upper pole mass 7.4 cm in size.

No intraoperative or postoperative bleeding was observed in any of the 52 patients included in the study. However, five patients presented with Hb ≥ 10 g/dl and thus received preoperative blood transfusions.

The typical ischemia period during tumor removal procedures lasted approximately 12.5 ± 4.8 SD minutes, ranging from 0 to 20 minutes. The pelvicalyceal system was accessed in 25 patients (48.1%). Among these, 14.3% were classified as T1a, 47.1% as T1b, and 66.7% as T2a (Table 2).

| | | Number | Percentage (%) |
|---|---|---|---|
| Operative time | Mean ± SD | 87.6+16.2 min | |
| | Range | 75 to 140 min | |
| Intraoperative findings | | | |
| A. Methods of pedicle control | Artery only clamping | 48 | 92.3 % |
| | Off clamping | 3 | 5.8% |
| | Selective artery clamping | 1 | 1.9% |
| B. The pelvicalyceal system entry | Entered | 25 | 48% |
| | Not Entered | 27 | 52% |
| Histological findings | Clear Cell Carcinoma | 43 | 82.7 |
| | Papillary cell carcinoma | 2 | 3.8 |
| | Oncocytoma | 2 | 3.8 |
| | Angiomyplipoma | 4 | 7.7 |
| | Hydatid Cyst | 1 | 1.9 |
| Follow up Duration | < 5 years | 31 | 59.6 |
| | > 5 years | 21 | 40.4 |
| Postoperative complication | Bleeding | 0 | 0.0 |
| Drain removal time | < 3 days | 49 | 94.2 |
| | Within ten days | 3 | 5.8 |
| Mean hospital stay | 5 ± 1.6 days | | |
| mean serum creatinine (mg/dl) | At the time of surgery | 1.1 ± 0.53 SD | |
| | 3 months postoperative | 1.4 ± 0.6 SD | |
| | One year postoperative | 1.2 ± 0.7 SD | |

**Table 2:** Operative and postoperative clinical findings in 52 patients who underwent NSS

Histological results revealed that 86.5% of the patients had malignant renal masses, while 13.5% had benign lesions. Positive surgical margins were observed in 1.9% of the patients with a small entophytic upper pole mass of 3.7 cm (Table 2). The average hospital stay was 5 days ± SD 1.6; however, 49 (94.2%) patients had their drain removed in less than 3 days. Unfortunately, three (5.8%) patients developed a urinary fistula and responded well to conservative treatment, with the maximum time of drain removal after 10 days (Table 2).

Of the patients, 21 (40.4%) were monitored for over 5 years, whereas 31 patients (59.6%) were monitored for less than 5 years. One patient was excluded because of a non–cancer–related death, and the other patient missed his scheduled follow–up. CTU analysis revealed no evidence of local recurrence or distant metastasis in either group. Furthermore, the postoperative serum creatinine levels were recorded at 3 months and one year, with values of 1.4 (SD 0.6) and 1.2 (SD 0.7), respectively (Table 2).

The correlation between ischemia time and tumor size was statistically significant (P = 0.034) (Table 3). Moreover, the histological type was also significantly correlated with tumor size, with a P–value of 0.000 (Table 3).

## Discussion

Nephron–sparing surgery (NSS) is a surgical technique designed to preserve renal function while achieving comparable oncological outcomes in renal tumors > 7 cm [8]. In Sudan, open surgical treatment, including radical nephrectomy or partial nephrectomy, is the primary surgical modality because of the limited availability of laparoscopic surgery, which is not commonly performed. This may be due to the advanced stage and size of the tumors or a need for more familiarity with the techniques. There is no published research evaluating renal function and oncological outcomes following open NSS in Sudanese patients. The study participants had an average age of 57.5, falling within the global age distribution range of 50–70. Interestingly, there was a slightly higher prevalence of females (1.3:1), contrary to the findings of previous studies [3,10]. This may be attributed to women being more frequently exposed to ultrasound as a primary diagnostic tool for obstetric and gynecological conditions, leading to an earlier incidental diagnosis of renal mass, as women accounted for 74% of incidental in our sample.

Based on the clinical presentation, it was observed that 55.8% of the patients presented with flank pain,

| | | Tumor Size Group (Cm) | | | | Total |
|---|---|---|---|---|---|---|
| | | < 4 | 4.01 – 7 | 7.01 –10 | > 10 | |
| Histology result | Clear cell carcinoma | 5 (71.4%) | 32 (94.1%) | 6 (66.7%) | 0 (0.0%) | 43 (82.7%) |
| | Angiomyolipoma | 1 (14.3%) | 1 (2.9%) | 2 (22.2%) | 0 (0.0%) | 4 (7.7%) |
| | Oncocytoma | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 2 (100%) | 2 (3.8%) |
| | Papillary cell carcinoma | 1 (14.3%) | 0 (0.0%) | 1 (11.1%) | 0 (0.0%) | 2 (3.8%) |
| | Hydatid cyst | 0 (0.0%) | 1 (2.9%) | 0 (0.0%) | 0 (0.0%) | 1 (1.9%) |
| Ischemia time (Minutes) | 0 –5 | 0 (0.0%) | 5 (14.7%) | 0 (0.0%) | 0 (0.0%) | 5 (9.6%) |
| | 6–10 | 2 (28.6%) | 11 (32.4%) | 0 (0.0%) | 0 (0.0%) | 13 (25%) |
| | 11–15 | 4 (57.1%) | 14 (41.2%) | 5 (55.6%) | 0 (0.0%) | 23 (44.2%) |
| | 16 –20 | 1 (14.3%) | 4 (11.8%) | 4 (44.4%) | 2 (100%) | 11 (21.2%) |
| Total | | 7 (100%) | 34 (100%) | 9 (100%) | 2 (100%) | 52 (100%) |

**Table 3:** Cross–tabulation of tumor size, histology types, and ischemia time in the 52 patients. Statistical significant correlation between the histology type and tumor size and between the ischemia time and the tumor size with P–values of 0.000 and 0.034, respectively.

while 36.5% had incidentally discovered masses. This contrasts with international studies, wherein 50% of renal tumors were found incidentally [11]. . The disparity may be attributed to the predominantly rural background of the patients, resulting in limited access to healthcare facilities, including ultrasound services. Consequently, delayed presentation occurs when the tumors have already caused symptoms. Previous studies in Sudan have indicated a pattern of late presentation among renal mass patients. Essential factors such as tumor size, location, and degree of collecting system invasion were considered when deciding about open NSS eligibility. These determinants align with earlier studies that showed most patients (80.8%) underwent NSS as an elective measure, corresponding with the existing literature [12,13]. However, most patients have smaller tumors ranging from 4.1–12 cm with an average tumor size of 5.9 cm. The highest percentage (86.5%) of patients were categorized as T1b and T2 N0M0. These findings align with prior studies by Becker et al. [14], which similarly advocate using NSS in carefully selected patients with localized renal masses smaller than 10 cm.

Based on our analysis, most renal masses were situated in the outer part of the kidney. Notably, only 14% of the tumors were located in the mid–polar region, which aligns with a study conducted in Egypt [15]. However, our findings differed from a study by Van Poppel et al. [16], which reported that mid–polar masses were present in 38.8% of patients who underwent NSS. The variation in results may be attributed to genetic and environmental factors. Nonetheless, all three studies indicated that most patients had a left renal tumor. In our study, 46% of patients had an endophytic renal mass, consistent with a study from Korea [17].

Renal ischemia is a crucial factor that can significantly impact the outcome of procedures that preserve kidney function. In response, we have implemented warm ischemia for a maximum of 20 minutes following the recommendation of Lane and Becker [18]. Our research revealed that the average warm ischemia time (WIT) was 12.5 minutes, significantly lower than the 20–31–minute range indicated in other studies. It is important to note that those studies utilized intraoperative ultrasonography and hemostatic synthetic material to manage bleeding at the tumor site, which could explain the longer ischemia time. In our case, we used a double–layer suturing technique for bleeding control and renography. Additionally, we found a statistically significant correlation between warm ischemia time and tumor size ($p<0.034$). When a vascular clamp was used during surgery, the artery–only clamping technique was employed, as described previously [18]. Enucleoresection was performed in 92.3% of the cases. However, this method has been criticized for its increased risk of bleeding. This study found no intraoperative or postoperative bleeding requiring blood transfusion, as observed in another study [19].

Our study revealed that only 5.8% of patients experienced postoperative urinary fistula that responded well to conservative treatment, compared with 13.3% in a previous study conducted by Northern Western investigators [20]. This was surprising, given our series's large tumor size (5.9 cm) and a high percentage of endophytic tumors (46%). In contrast to previous studies, our findings did not show a significant relationship between these factors and the risk of urinary fistula [21]. The higher percentage in other studies may be due to the increasing number of mid–polar tumors and the inclusion of laparoscopically resected masses.

The analysis of our tumor histology showed that 66.7% of them had clear cell carcinoma, with a size of 7 cm or larger. We also discovered a strong link between tumor size and histological subtype (P–value = 0.00) (Table 3), consistent with the findings of the MSKCC study [22]. Furthermore, four of our patients had angiomyolipoma, and one had a hydatid cyst, which aligns with an Egyptian previous study [15]. Only one patient with a small, entophytic renal mass had a positive surgical margin (PSM), which supports the findings of a combined study by the Mayo Clinic and MSKCC, indicating an elevated risk of PSM in such tumors due to difficulties in finding the correct resection plane because of the pseudocapsule. The study recommends using intraoperative ultrasound for such tumors [23].

According to the European guidelines for renal cell carcinoma, all patients in this study underwent CTU at three months and one year. A similar oncological follow–up schedule was adopted in the study by Becker et al., which included patients with tumor sizes greater than 4 cm. In our study, 40.4% (n=21) of the patients with annual CTU were followed up for over five years. In both groups, the remaining 31 patients had a follow–up period of less than five years.

Rosso et al. [23] discovered that nephron–sparing surgery (NSS) is more effective than radical nephrectomy in reducing the risk of renal failure, thus making renal function preservation the primary goal of NSS. In this study, we monitored renal function using serum creatinine at three months and one year post–surgery, with an average serum creatinine of 1.4 mg/dl (SD 0.60) and 1.2 mg/dl (SD), respectively. The mean preoperative serum creatinine was 1.1 (SD 0.51), similar to a Mexican study [24] that showed an average postoperative serum creatinine of 1.12 mg/dl after three months of follow–

up. Although the use of serum creatinine to assess renal function in patients with normal contralateral kidneys has been criticized by some authors [18] for being imprecise, in our study, six monorenal patients had a mean preoperative serum creatinine of 1.3 mg/dl (SD 0.73). They had normal postoperative renal function at three months with a mean serum creatinine of 1.5mg/dl (SD 0.5). The effects of tumor size and anatomical complexity on postoperative renal function after NSS are inconsistent across studies. Some clinical studies have suggested that tumor size predicts postoperative renal function [25], while others have not [16]. Our study found no significant relationship between tumor size or location and postoperative renal function assessed at three months and one year.

This study has some limitations. It was conducted at only one institution with a limited sample size, and patient selection did not adhere to widely recognized anatomical classifications. Additionally, serum creatinine was considered imprecise for evaluating postoperative renal function in patients with a normal contralateral kidney. Finally, the short–term follow–up period may have impacted the overall outcome.

## Conclusion

Although conducted on a limited sample size and within a single center with relatively short–term follow–up, the research is the first of its kind in Sudan and aligns with previous studies. It indicates that open NSS is a secure procedure that maintains renal function without compromising oncological results. A warm ischemia time of 20 minutes does not affect oncological outcomes or renal function. Tumors measuring up to 7 cm or more can be safely treated. A double–layer suturing technique and a follow–up plan involving serum creatinine and CTU at three months, followed by annual check–ups, seem feasible and applicable even in low–income nations. Moreover, more extensive local multicenter studies with prolonged postoperative follow–up periods are essential to investigate the factors influencing renal function and oncological outcomes following open NSS for renal tumors.

## Ethical approval

Ethical approval was granted by the Scientific Committee at the Sudan Medical Specialization Board (SMSB) and the Education Development Center (EDC) Ethical Committee. To protect confidentiality, the data collected was anonymized and decoded.

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## References

1. D'Avella C, Abbosh P, Pal SK, Geynisman DM. Mutations in renal cell carcinoma. In: Urologic Oncology: Seminars and Original Investigations. Elsevier; 2020. p. 763–73. Available from: https://www.sciencedirect.com/science/article/pii/S1078143918304368
2. Padala SA, Barsouk A, Thandra KC, Saginala K, Mohammed A, Vakiti A, et al. Epidemiology of renal cell carcinoma. World journal of oncology. 2020;11(3):79.
3. Capitanio U, Bensalah K, Bex A, Boorjian SA, Bray F, Coleman J, et al. Epidemiology of renal cell carcinoma. European urology. 2019;75(1):74–84.
4. Algaba F, Akaza H, López–Beltrán A, Martignoni G, Moch H, Montironi R, et al. Current pathology keys of renal cell carcinoma. European urology. 2011;60(4):634–43.
5. Macleod LC, Hotaling JM, Wright JL, Davenport MT, Gore JL, Harper J, et al. Risk Factors for Renal Cell Carcinoma in the VITAL Study. Journal of Urology. 2013 Nov;190(5):1657–61.
6. Barr RG, Peterson C, Hindi A. Evaluation of Indeterminate Renal Masses with Contrast–enhanced US: A Diagnostic Performance Study. Radiology. 2014 Apr;271(1):133–42.
7. Weber DM. Laparoscopic surgery: an excellent approach in elderly patients. Archives of surgery. 2003;138(10):1083–8.
8. Lesage K, Joniau S, Fransis K, Van Poppel H. Comparison between open partial and radical nephrectomy for renal tumors: perioperative outcome and health–related quality of life. European urology. 2007;51(3):614–20.
9. Gill IS, Kavoussi LR, Lane BR, Blute ML, Babineau D, Colombo JR, et al. Comparison of 1,800 Laparoscopic and Open Partial Nephrectomies for Single Renal Tumors. Journal of Urology. 2007 Jul;178(1):41–6.
10. Bahadoram S, Davoodi M, Hassanzadeh S, Bahadoram M, Barahman M, Mafakher L. Renal cell carcinoma: an overview of the epidemiology, diagnosis, and treatment. G Ital Nefrol. 2022;39(3):1.
11. Konnak JW, Grossman HB. Renal cell carcinoma as an incidental finding. The Journal of Urology. 1985;134(6):1094–6.
12. Van Poppel H, Bamelis B, Oyen R, Baert L. PARTIAL NEPHRECTOMY FOR RENAL CELL CARCINOMA CAN ACHIEVE LONG–TERM TUMOR CONTROL. Journal of Urology. 1998 Sep;160(3 Part 1):674–8.

13. Huang WC, Elkin EB, Levey AS, Jang TL, Russo P. Partial Nephrectomy Versus Radical Nephrectomy in Patients With Small Renal Tumors—Is There a Difference in Mortality and Cardiovascular Outcomes? Journal of Urology. 2009 Jan;181(1):55–62.

14. Becker F, Siemer S, Humke U, Hack M, Ziegler M, Stöckle M. Elective nephron sparing surgery should become standard treatment for small unilateral renal cell carcinoma: long–term survival data of 216 patients. European urology. 2006;49(2):308–13.

15. Abd El Hamid HE, Helmy A, Ibrahim AH. Nephron–sparing surgery for renal tumors. Journal of the Egyptian National Cancer Institute. 2011;23(2):61–6.

16. Van Poppel H, Da Pozzo L, Albrecht W, Matveev V, Bono A, Borkowski A, et al. A prospective randomized EORTC intergroup phase 3 study comparing the complications of elective nephron–sparing surgery and radical nephrectomy for low–stage renal cell carcinoma. European urology. 2007;51(6):1606–15.

17. Kwon O, Byun SS, Hong SK, Ku JH, Kwak C, Kim HH, et al. Efficacy of Partial Nephrectomy for Renal Tumors> 4 cm: Comparison With Renal Tumors 4 cm. International Surgery. 2016;101(1–2):7–13.

18. Becker F, Van Poppel H, Hakenberg OW, Stief C, Gill I, Guazzoni G, et al. Assessing the impact of ischaemia time during partial nephrectomy. European urology. 2009;56(4):625–35.

19. Funahashi Y, Kato M, Yoshino Y, Fujita T, Sassa N, Gotoh M. Comparison of Renal Ischemic Damage During Laparoscopic Partial Nephrectomy with Artery–Vein and Artery–Only Clamping. Journal of Endourology. 2014 Mar;28(3):306–11.

20. Meeks JJ, Zhao LC, Navai N, Perry KT, Nadler RB, Smith ND. Risk Factors and Management of Urine Leaks After Partial Nephrectomy. Journal of Urology. 2008 Dec;180(6):2375–8.

21. Rogers A, Thiel DD, Brisson TE, Igel TC. Use of the Habib 4 × Radiofrequency–Assisted Bipolar Hemostatic Device to Avoid Warm Ischemia in Select Large Partial Nephrectomies: Description and Video of Technique. Journal of Laparoendoscopic & Advanced Surgical Techniques. 2011 Mar;21(2):153–6.

22. Thompson RH, Kurta JM, Kaag M, Tickoo SK, Kundu S, Katz D, et al. Tumor Size is Associated With Malignant Potential in Renal Cell Carcinoma Cases. Journal of Urology. 2009 May;181(5):2033–6.

23. Russo P. Nefrectomía parcial abierta. Técnica personal y resultados actuales. Archivos Españoles de Urología. 2011;64(7):571–93.

24. Sánchez–Coral M, Báez–Reyes JR, García–Cano E, Quintero–León MÁ, Cárdenas–Rodríguez E, Priego–Nino A. Experience in nephron–sparing surgery in patients with small renal tumours. Cirugía y Cirujanos (English Edition). 2015;83(4):297–302.

25. Porpiglia F, Volpe A, Billia M, Scarpa RM. Laparoscopic versus open partial nephrectomy: analysis of the current literature. European urology. 2008;53(4):732–43.