RESEARCH ARTICLE

Evaluation of surgical outcomes of nephron-sparing surgery in a leading hospital of an advanced nation

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Abstract

Objectives: To assess the efficacy of renal score grading in guiding therapy decisions, predicting perioperative outcomes, and characterising tumours following partial nephrectomy.

Methods: The retrospective, single-centre study was conducted at the University College Hospital Galway, Ireland, and comprised data from January 11, 2012, to June 17, 2016, of all patients aged >18 years who underwent partial nephrectomy as part of treatment for kidney cancer. Data was analysed using SPSS 20.

Results: Of the 76 patients, 52(68.4%) were males and 24(31.6%) were females. The median age of patients was 58 years (IQR: 16). Tumours were predominantly on the right side 44(57.9%) and lower pole 36(47.4%), with a median tumour size of 2.35 cm (IQR: 1.0 cm), and renal score had a median of 5.00 (IQR: 2). Of the total, 70(92.1%) patients underwent open surgery, with complications in 6(7.9%), which were associated significantly with higher body mass index, American Society of Anaesthesiologists classification score, warm ischaemia time and tumour size ($p<0.05$). Recurrence correlated with tumour size and positive margins ($p<0.05$). Survival analysis showed a median disease-free survival (DFS) of 30 months (IQR: 6 months). However, due to the absence of events, the median overall survival (OS) and survival estimates could not be fully calculated. The longest follow-up time was 36 months, with no recorded mortality in the cohort.

Conclusion: For individuals with comparatively small localised renal tumours, the selection of partial nephrectomy was found to be a suitable alternative, showcasing exceptional results regarding the complication profile, recurrence-free survival and overall survival.

Keywords: Nephron Sparing surgery, Partial nephrectomy, Small renal masses, Renal score, Perioperative outcomes. (JPMA 75: 56; 2025) **DOI: https://doi.org/10.47391/JPMA.11367**

Introduction

Renal cell carcinoma (RCC), which accounts for 3% of all cancers, is becoming more prevalent in Western nations. Over 20% of new cases are found after the age of 75 years, while the typical age upon diagnosis is 64. The projected incidence rises especially among older people. The age-standardised rates per 10,000 are 35.0 over the age of 75, and 0.5 below the age of 40. The preferred method for treating clinical stage T1 renal tumours is partial nephrectomy. It delivers comparable oncological results to radical nephrectomy (RN) and improves kidney function. It lowers the chance of developing chronic kidney disease (CKD). Therefore, it is advised whenever it is theoretically possible.[1] The traditional triad of loin pain, mass and haematuria is rarely seen in patients nowadays due to the accessibility and extensive use of contemporary imaging. When conducting routine imaging examinations, such as computed tomography (CT), magnetic resonance imaging (MRI), or ultrasonography (USG), for unrelated purposes, the majority of RCC cases are incidentally discovered.[2] Contemporary kidney cancer seldom presents with the classical triad of abdominal mass, haematuria and flank discomfort, along with the various associated paraneoplastic symptoms, often termed the "internist's tumour". Due to the prevalent use of advanced abdominal imaging, nearly half of all kidney tumours are fortuitously identified at an early stage during screenings for other conditions. This stage migration has contributed to the improved responsiveness of renal tumours to treatment.[3] Consequently, in the present era, it might be more apt to characterise RCC as the "radiologist's tumour" rather than an internist's. According to the International Union Against Cancer's staging standards for RCC, an organ-confined tumour with a diameter up to 4.0cm (T1a) or between 4.1cm and 7.0cm (T1b) falls under stage 1 renal mass. The nephron-sparing surgery (NSS) method is employed for resectable small renal masses (SRMs) as it is generally effective in managing stage 1 renal masses and has been demonstrated to be feasible for individuals with specific needs, such as those with a single kidney, bilateral renal tumours, or moderate-to-severe CKD.[3] This has led to the widespread adoption of NSS for stage 1 renal masses. Pathological research indicates that seemingly "normal"

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kidneys often harbour underlying renal disease, and outcome data strongly suggests that nephrectomy can induce new CKD.[4] In recent years, the RENAL nephrometric scoring system, where R stands for radius, E for exophytic/endophytic properties, N for the nearness of the tumour to the collecting system or sinus in millimeters, A for anterior/posterior, and L for location relative to polar lines, has emerged as a valuable tool, utilising cross-sectional radiographic characteristics of the tumour. The method systematically assesses anatomical aspects to gauge the ease or difficulty of tumour removal.[5] Its utility has been highlighted in numerous studies,[6] enabling objective decision-making between RN and partial nephrectomy (PN) methods. This scoring system yields a score ranging 4-12. Higher scores signify a lower likelihood of PN, indicative of a more complex tumour. This scoring categorises tumours into three groups: low,[4-6] moderate (7-9) and high (10-12). Additionally, complex renal lesions are associated with an elevated risk of surgical complications.[7]

The current study was planned to assess the efficacy of renal score grading in guiding therapy decisions, predicting perioperative outcomes, and characterising tumours following PN.

Materials and Methods

The retrospective, single-centre study was conducted at the University College Hospital Galway, Ireland, and comprised data from January 11, 2012, to June 17, 2016, of all patients aged >18 years having solitary tumour who underwent PN as part of treatment for kidney cancer. The data was retrieved from the Hospital Inpatient Inquiry (HIPE) after approval from the institutional ethics review board. To offset the bias towards de novo tumour rebuilding against local recurrence, patients with a family history of kidney cancer development were excluded. A total of 76 patients underwent partial nephrectomy (PN). The sample size was calculated using the WHO calculator[8], based on the formula for estimating a population proportion with specified absolute precision. Parameters included a 95% confidence interval, an anticipated population proportion of 0.85%,[9] and an absolute precision of 0.10. Both preoperative and postoperative tumour characteristics, along with patient demographics, health status and presenting symptoms were noted.

Data were analysed using SPSS version 27. Categorical variables were summarized using frequencies and percentages. Normality testing was performed for numeric variables, and non-normally distributed data were expressed as median with interquartile range (IQR). For univariate analysis, the Pearson chi-square test was applied to explore associations between categorical variables, while the Mann-Whitney U test was used to assess differences between continuous variables. Multivariate analysis was performed using binary logistic regression to identify independent predictors of recurrence. Kaplan-Meier survival analysis was utilized to estimate disease-free survival (DFS) and overall survival (OS)**.** A p-value of <0.05 was considered statistically significant for all analyses.

Results

Of the 76 patients, 52(68.4%) were males and 24(31.6%) were females. The median age of patients was 58 years (IQR: 16). There were 40(52.6%) smokers, 51(67.1%) patients had diabetes mellitus (DM) and 50(65.8%) had hypertension (HTN) (Table 1).

Table-1: Patient demographics and comorbidities.

Information on the demographics	
Variable	**n(%)**
Age group	
1 yrs-27 years	2(2.6)
28 yrs-54 years	27(35.5)
55 yrs-81 years	47(61.8)
Body Mass Index	
Healthy weight range [10]	18(23.7)
Overweight range [10]	18(23.7)
Obesity range [10]	40(52.6)
Additional comorbidities	
None	59(77.6)
Renal Failure	2(2.6)
Coronary stunting	1(1.3)
Right-sided stoma	1(1.3)
Benign lung disease	1(1.3)
Reduced Left Kidney Functioning	2(2.6)
Reduced Right Kidney Functioning	1(1.3)
Asthma	1(1.3)
Horseshoe Kidney	1(1.3)
Prostate Cancer	4(5.3)
Bowel Cancer	2(2.6)
MRSA	1(1.3)

MRSA: Methicillin-resistant staphylococcus aureus.

There were 43(56.6%) patients who presented with American Society of Anaesthesiologists (ASA) grade 2 (Table 2). Pre-op biopsy was done in 12(15.8%) patients. Radiologically, tumours were located on the right side in 44(57.9%) patients and on the left side in 32(42.1%). Tumour size had a median value of 2.35 cm (IQR: 1.0 cm). Tumour distribution was at the lower pole in 36(47.4%) patients. The median renal score was 5.00 (IQR: 2). There were 57(75%) patients with low risk (≤6) and 19(25%) with intermediate risk (7-9).

A total of 72(92.1%) patients underwent open surgery, while 6(7.9%) had minimally invasive procedures. Blood-loss during surgery was 1-200mL in 20(26.3%) patients, 201-400mL in 24 (31.6%), 401-600mL in 17(22.4%), 601-

Table-2: Presenting symptoms.

Variable	n(%)
Diagnosis	
Incidental	65(85.5)
UTI	5(6.6)
Haematuria	6(7.9)
Symptoms	
Asymptomatic	70(92.1)
Symptomatic	6(7.9)
Creatinine	
Normal	73(96.1)
Not normal	3(3.9)
American Society of Anaesthesiologists (ASA) classification	
ASA 1	28(36.8)
ASA 2	43(56.6)
ASA 3	5(6.6)

Table-3: Perioperative outcomes

Variable	n(%)
Warm Ischaemia time in minutes	
0 mins	41(53.9)
1 min-8 min	4(5.3)
9 min-16 min	26(34.2)
17 min-24 min	5(6.6)
Drain Removal Day	
Day 2	54(71.1)
Day 3	16(21.1)
Day 4	6(7.9)
Catheter Out Day	
Day 2	31(40.8)
Day 3	40(52.6)
Day 4	2(2.6)
Day 5	3(3.9)

Table-4: Tumour characteristics.

Variable	n(%)
Pathological TNM	
pT1a	4(5.3)
pT1aNx	1(1.3)
pT1aNxMx	36(47.4)
pT1aNxR0	1(1.3)
pT1NxMx	22(28.9)
pT3aNxR1	5(6.6)
pT3aNxMx	3(3.9)
pT3aN0M0	4(5.3)
Fuhrman Grade (FG)	
FG 1	10(13.2)
FG 2	54(71.1)
FG 3	8(10.5)
FG 4	4(5.3)

TNM: Tumour-node-metastasis.

800mL in 5(6.6%), and 801-1000mL in 10(13.2%). A stent was used in 1(1.3%) patient during surgery. Operation duration was 80-100 min in 16(21.1%) patients, 101-120 min in 45(59.2%), 121-140 min in 6(7.9%), and 141-160 min in 9(11.8%). There were 65(85.5%) patients who were discharged within 5-8 days. Perioperative outcomes, including warm ischaemia time (WIT), drain out day, and catheter out day, were noted (Table 3). The median length of stay (LOS) in days was 6 (IQR: 1). Complications occurred in 6(7.9%) patients. Of them, 1(16.7%) displayed a steady decline in renal function, and 6 months later, it was discovered that the patient still had the disease, 2(33.3%) patients experienced lung metastases, 1(16.7%) had infection of a wound, and 2(33.3%) had urine leakage.

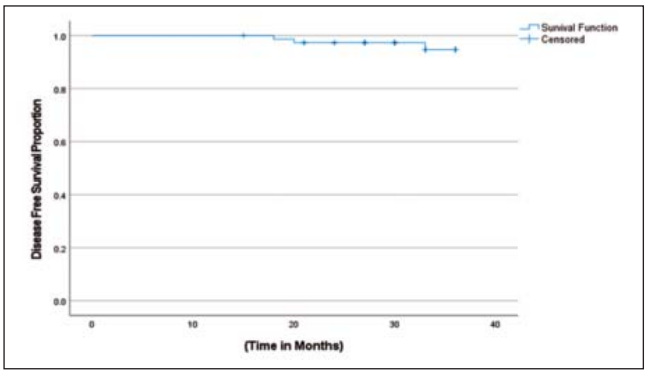

Figure: Post-procedure disease-free survival (DFS)

Among the patients 40 (52.6%) had obesity, and 6 (15%) of them experienced early postoperative complications (p=0.053). The Likelihood Ratio (p=0.017) and linear-by-linear association (p=0.029) indicated significant values. Higher ASA grade (p<0.001), WIT (p=0.047) and tumour size (p=0.049) had significant association with complications.

Tumour characteristics, including pathological type and Fuhrman grade (FG), were noted (Table 4). Negative margins were achieved in 73(96.1%) cases, while positive margins were found in 3 (3.9%). Three-year follow-up showed 73 (96.1%) patients were well, while 3 (3.9%) were unwell due to the recurrence.

There were significant association between tumour size and recurrence rates, with larger tumours (2.1-5.0cm) showing increased recurrence risk (p=0.034). Specifically, recurrence rates were highest in tumours sized 4.1-5.0 cm (33.3%) and 2.1-3.0 cm (5.7%). No recurrence was observed in smaller tumours (1.0-2.0cm and 3.1-4.0cm). Positive margins were also strongly associated with recurrence (p<0.001). Logistic regression suggested that the tumour size and margins as predictors achieved a perfect fit (p<0.001) and accurately classified 73 (96.1%) cases without recurrence. While the model showed strong predictive capability (Nagelkerke R Square = 1.000), individual tumour size variables did not independently predict recurrence (p>0.05).

A Kaplan-Meier survival analysis was conducted over a three-year follow-up period including 76 patients to assess DFS time, revealing a median of 30 months with an interquartile range of 6 months (Figure 1), as well as OS, all

of whom were alive at the study's conclusion (censored), indicating a 100% survival rate. Since no deaths were observed during the three years, survival curves could not be plotted, and median overall survival time and survival estimates could not be calculated. These findings suggest that the cohort experienced excellent survival outcomes, with the longest follow-up time being 36 months (the upper limit of follow-up duration) and no recorded mortality across the cohort. This indicates a highly favourable outcome for the patient group during the entire three-year follow-up. These findings suggest that PN is associated with positive outcomes in terms of disease control and overall survival in patients with small localized renal cell tumours.

Discussion

Partial nephrectomy is the standard for organ-confined renal cell carcinomas, preserving kidney function but with higher surgical risk. Open partial nephrectomy (OPN) remains crucial for difficult cases, such as single kidney, multiple tumours, or extensive surgical history, despite the rise of minimally invasive techniques, maintaining its value in modern urological practice. More than 60% of kidney tumours are now found incidentally due to advancements in diagnostic imaging techniques.[11] Consequently, tumours are smaller and less advanced at diagnosis. In a Memorial Sloan-Kettering Cancer Centre study, 80% of patients undergoing kidney cancer surgery had incidental tumours.[12] Another multicentre prospective study found that 60% of tumours were unrelated to the patient's presenting problems.[13,14] In our investigation, 65 (85.5%) cases were detected by chance, with lower urinary tract symptoms in 5 (6.6%) patients and haematuria in 6 (7.9%) patients (Table 2). This indicates many patients treated for non-specific haematuria and UTIs had incidental kidney tumours. However, many still present later.

A significant number of surgeons opt for the extra-peritoneal flank incision (open) above the 11th or 12th rib when performing nephrectomies for renal tumours.[15,16] In the current series, this incision was employed in 70(92.1%) cases, whereas only 6(7.9%) patients underwent minimally invasive surgery. Greco et al. in 2019 suggested that WIT ideally should be limited to 20-25 minutes to optimise surgical, oncological and functional outcomes in NSS.[17] The current results, with a substantial proportion experiencing no WIT and a majority within the recommended limits, supported the feasibility of PN as a preferred surgical approach for RCCs (Table 4). PN should be considered the preferred surgical treatment for RCCs ≤7cm in diameter to preserve kidney function postoperatively.[18] This recommendation aligns with the current findings, where the median tumour size was 2.35 cm (IQR: 1.0 cm).

On the other hand, recurrences were noted in 20-40% of the patients who underwent therapy for the isolated incidence.[19] In a multi-centre study, 5% of patients with clinically limited RCC who had PN experienced a recurrence of the disease.[20] Renal tumours that are considered highly complicated are those that fit the criteria for the RENAL nephrometry score, which was created as a helpful assessment tool for forecasting operational complexity brought on by WIT or postoperative complications.[21] In the current cohort of patients, 25% were of intermediate, while 75% were of low RENAL score risk category. Over extended follow-up periods, recurrence rates following NSS ranged 0-10.6%.[22] Research[23] noted a local recurrence rate of 2.8%, while in the current series, only 3(3.9%) participants experienced a recurrence.

A study on PPN reported a 10-year cancer-specific survival of 99% with no long-term renal function decline.[24] The current PN survival rates were similar. Patard et al.[25] found a 97.8% 5-year DFS rate in 314 OPN patients, consistent with other findings.[26] In the current study, 6(7.9%) patients had early postoperative complications; one had a steady decline in renal function and persistent disease after 6 months. Consistent with other findings,[7,27] the current study observed an association of complications with higher BMI, ASA and tumour size.

The current study has limitations as had a retrospective design with a non-comparative approach and a lack of long-term follow-up.

Conclusion

PN exhibited positive survival rates in intermediate follow-up, establishing itself as an effective therapeutic choice for those with small renal tumours, showcasing exceptional results regarding the complication profile, DFS and OS.

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Conflict of Interest: None.

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Author Contribution:
NBN, KW, FD, GD, AA: Concept, design, data collection, writing, revision and final approval.
SI: Data analysis, interpretation, revision and final approval.