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Research Article

Utilizing the R.E.N.A.L Nephrometry Score to predict the Surgical Technique and Peri-operative Outcomes of Renal Masses

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ABSTRACT

Background: despite the rise in the incidence of renal cell carcinoma attributed to availability of medical imaging, a considerable decline in mortality is an association. Morbidity-wise, the shift from radical nephrectomy to partial nephrectomy is the trend for now. Multiple scoring systems have been introduced over the past decades to help surgeons choose between radical and partial nephrectomy. One commonly used system is the RENAL nephrometry score that was first introduced by Kutikov and Uzzo in 2009.

Objective: to evaluate the role of RENAL nephrometry scoring system in predicting the surgical technique to use to resect renal masses and associated perioperative outcomes.

Subjects and Methods: between December 2018 and December 2020, we prospectively recruited 88 patients with renal masses. Nephrometry scores of all patients were calculated by an experienced radiologist and a decision then was made by blinded treating surgeons to proceed to radical or partial nephrectomy. Patients then sub-grouped into low, moderate, and high nephrometry scores, and into radical and partial nephrectomy. Pre-, intra-, and post-operative data were collected and analyzed.

Results: Eighty-three patients completed the study. Thirty-three had undergone radical nephrectomy and 50 had partial nephrectomy. Total nephrometry score differed significantly between the two groups. Mass radius and nearness to the renal hilum were the only influential components. The only complication that differed significantly among the three nephrometry groups was the estimated blood loss, being highest in the low complexity group. No significant difference was found in the total operation time, ischemia time, renal function and hospital stay. Major complications were seen only in the high complexity group.

Conclusion: Total nephrometry score, mass radius and nearness to renal hilum can be regarded as good and reproducible predictors of type of surgery required to treat renal masses. They also can predict the perioperative complication to a good extent.

Introduction

Renal cell carcinoma (RCC) is a rare but a very lethal cancer of humans. Despite a minor rise in its incidence, the fatality rates are slowly declining over the last decades (1). For years, radical nephrectomy (RN) was considered the gold-standard of care as RCC responds poorly to other treatment modalities. Whereas partial nephrectomy (PN) used to have certain limited indication in the past, it gradually started to replace RN as it resulted in good disease control with preservation of renal function specially in the increasingly diagnosed T1a incidentalomas (2,3). Kidney and mass anatomy are considered critical factors affecting the outcome of partial nephrectomy, not to mention the surgeon's skills and facilities available (4). In 2009 Kutikov and Uzzo described the RENAL nephrometry score (RNS) to aid choosing the best surgical treatment for renal masses, facilitate the inter-surgeon communication, and standardize case series comparison (5). They built their scoring system on 5 reproducible features of any mass that they considered to affect the mass resection difficulty. These parameters are the mass Radius, Edno- and exophyticity, Nearness to the collecting system, being Anterior or posterior, and Location relative to the polar lines (5). Nephrometry scores of 4-6, 7-9, and 10-12 are considered of low, intermediate and high complexity respectively.

In this study, we presented our results of open RN and PN for renal masses that were assessed according to the RNS to evaluate the association of the overall score and individual components with the operative technique and postoperative outcomes.

Subjects and Methods

This prospective study was conducted in surgical specialties hospital after obtaining approval from the hospital local ethical committee. From December 2018 to December 2020 a total of 88 patients diagnosed to have a renal mass were enrolled in this study after being consented.

All patients were firstly assessed by a thorough history and clinical examination with special emphasis on presence of previous abdominal surgery, medical comorbidities, smoking, and the American Society of Anesthesiologist classification, then standard laboratory investigations were ordered.

A contrast enhanced CT scan was carried out for each patient and the tumor stage as well as the RENAL nephrometry score (low, moderate, or high) were assigned by a single radiologist according to what is described by Kutikov and Uzzo (5). The treating surgeons were blinded from the nephrometry score assigned for each patient. Patients with single functioning kidney or multiple/bilateral tumors or those with renal masses more than 7 cm (T1) were excluded from the study. In addition, patient with abnormal renal function were ruled out. Five patients were excluded and 83 completed the study.

Each case was discussed by all the three urologists of our team to reach a decision whether to proceed with partial or radical nephrectomy. All the three surgeons were unaware of the nephrometry scores assigned by the radiologist. Thirty patients were decided to undergo RN since the start while 53 were planned to have PN. The operation was then carried out by one of the team urologists according to the patient referral records.

An anterior subcostal trans-peritoneal approach was utilized in all cases. The renal artery and vein were first identified and a vessel loop placed around them. For patients assigned for RN the pedicle was then ligated selectively and severed followed by nephrectomy. While for those assigned for PN a clamp was placed across the renal artery after the kidney has been fully mobilized, and the tumor resected. A frozen section pathology was sent to check for the resection margins. The frozen sections were examined by the same pathologist. Once the tissue is sent for the frozen section examination, the renal defect was closed without awaiting the results. In the two cases where the margins were positive, decisions were made to convert to RN. None of the patients was stented intraoperatively.

Intraoperative details recorded include operative time (OT), estimated blood loss (EBL), ischemia time (IT) and complications like vascular or adjacent organ injury. Postoperative hospital stay and renal function were recorded as well.

Statistical package for social science version 20, Chicago, IL (SPSS 20) was used for data entry and analysis. Continuous variables were presented as mean ± standard deviation (SD) and discrete variables were presented as numbers (%). Chi-square test (or Fischer exact test when appropriate) was used to test the significance of association for discrete variables. One-way ANOVA was used to test significance of association between continuous variables. Regression analysis was used to predict outcome from some variables. P-value of 0.05 was considered significant and used to reject the null hypothesis.

Results

Eighty-eight patients were recruited throughout the study period. Five were excluded either due having a non-localized disease or an underlying renal/systemic comorbidity. Out of the remaining 83 patients, 30 were decided to undergo RN since the start. Three of those decided to undergo PN were converted per-operatively to RN (one was found to have more extensive disease and two were having positive margin on frozen section pathology). The final number of patients who underwent PN is 50 (fig.1).

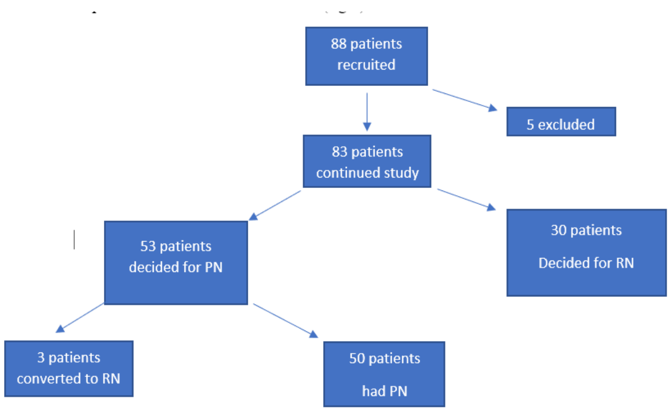

Figure 1: consort flow chart for patients recruited in the study

In table 2 the association between the type of surgery and RNS value was tested using qui square, concordance. Significant associations were found between low RNS and PN and high RNS and RN respectively. Kappa analysis confirmed the agreement/concordance between the type of nephrectomy and the measured nephrometry score as shown in table 3.

No significant difference was seen between the three groups in relation to the patients' age, gender distribution, BMI, preoperative renal function and Hb level, as well as the overall performance status.

Demographic and Pre, intra, and postoperative data for patients who underwent PN are summarized in tables 4 and 5.

Analysis of the intraoperative and postoperative data showed no significant differences in all studied parameters except for the EBL. EBL was significantly higher in the low RNS group (315 ± 22.36 ml) and lowest in the intermediate RNS group (265 ± 37.55 ml). Pearson test failed to show a significant relationship between the post-operative e GRF and neither IT nor EBL. Although no significant differences among the three groups were found in relation to the OT and IT, it is noted that these two parameters as well as EBL follow the same trend in the three groups (they are found to be highest in the low group and lowest in the intermediate group).

Two cases were found to have positive margins on frozen section and were converted to RN. Both belong to the high RNS group.

The number of complications recorded was small that makes statistical analysis unreliable. However, vascular and adjacent organ injuries were noted only in the high RNS group. The same applies also to urine leak requiring ureteric stenting

Table 1: number of patients underwent radical vs. partial nephrectomy according to their total RNS and value of nephrometry score parameters

	Low score	moderate score	High score	Total score (pts) (mean±SD)	N value (mean±SD) cm	N value pts	R value (mean±SD) cm	R value pts
Radical nephrectomy	0	11	22	9.9±2.01	2.2±0.32	2.6±0.29	6.1±1.73	2.7±0.38
Partial nephrectomy	25	15	10	6.6±1.62	5.3±1.07	1.2±0.22	3.7±0.89	1.9±0.21
P-value				0.001	0.001		0.002	

Pts= points on nephrometry scoring system

Table 2: Chi-square test correlating the type of nephrectomy vs. nephrometry score

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	27.991*	1	.000		
Continuity Correction**	25.165	1	.000		
Likelihood Ratio	36.278	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	27.500	1	.000		

* 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.65.
** computed only for 2×2 tables.

Table 3: symmetric measures to define the degree of agreement/ concordance between the type of nephrectomy and the nephrometry score

	Value	Asymptotic Standard Error*	Approximate T**	Approximate Significance
Measure of Agreement (Kappa)	.659	.092	5.291	.000
N of Valid Cases	57			

* Not assuming the null hypothesis.
**Using the asymptotic standard error assuming the null hypothesis.

% agreement (%concordance) = (22+25) ×100/57= 86% [values between 69.6%-90.8% indicate good concordance/ agreement].

Table 4: preoperative data

	Low RNS	Moderate RNS	High RNS	P value
No. of patients	25 (50%)	15 (30%)	10 (20%)	
age years	49±11.3	46±12.8	48 ±11.25	0.336
gender (male:female)	11:14	6:9	5:5	0.366
BMI	27.2±4.1	26.4±3.9	26.9±3.6	0.412
eGFR	66.4±11.2	70.1±13.7	78.9±14.3	0.381
Hb level (g/dl)	11.2±4.3	13.9±2.9	13.11 ± 2.8	0.619
side (right:left)	10:15	8:7	6:4	0.530
ASA score ≥3, no. (%)	9 (36%)	4 (27%)	3 (30%)	0.491

BMI: body mass index; ASA: American society of anesthetists: eGFR Glomerular filtration rate

Table 5: intraoperative and postoperative data

Parameters	Low RNS	Moderate RNS	High RNS	P value
Operative time (min)	192 ± 22.73	170.4 ± 29.11	187.2 ± 18.73	0.077
Ischemia time (min)	28.48 ± 3.82	24.71 ± 4.33	26.80 ± 2.96	0.094
Hospitalization (days)	4.6 ± 0.54	3.69 ± 0.85	4.28 ± 0.66	0.353
Estimated blood loss (ml.)	315 ± 22.36	265 ± 37.55	294 ± 33.82	0.016
Post-op eGFR*	61.7±10.6	63.1±10.9	73.8±11.7	0.418
Positive margin**	0	0	0	
Vascular injury	0	0	3	
Adjacent organ injury	0	0	1	
Wound related complications	2	1	1	
Significant urine leak requiring stenting	0	0	1	
Ileus	1	0	0	
Hematuria more than 24 hours	1	2	2	

* Two months after surgery.
** On final histopathology report

Discussion

Kultikov and Uzzo introduced the RENAL nephrometry scoring system in 2009 as a reproducible system to describe renal masses and objectify treatment decision-making (5). The spectrum of use for this system, however, has broadened recently to predict for perioperative complications, functional and pathological outcomes of PN and compare the outcomes of various techniques used like open, laparoscopic and even robotic assisted PN (6,7). The availability and improved imaging techniques has led to more renal masses being discovered in early stages (T1a) in the process of investigating various complaints related to the genitourinary and other systems, the term incidentaloma is used to describe such a finding (8). PN has become the gold standard treatment modality for these incidentalomas (9). The improved surgical techniques and instrumentation, on the other hand, extended the use of PN to tumors of 7 cm or even more (10). In centers where the case load is low and laparoscopic expertise and/or instruments are missing, open PN is still the standard of care (11). Our center is one of these centers in which we still use open surgical techniques to perform both PN and RN.

This study tried to investigate the validity of RENAL nephrometry score in making decisions to choose between PN and RN to treat renal masses, and predicting the perioperative outcomes. We found that for low complexity renal masses PN is almost always feasible, and for high complexity masses RN seems to be the mostly chosen approach. For moderately complex masses the nephrometry score is of little use as nearly half of the cases underwent PN and the other half underwent RN (57% vs. 43%). Naya et al. correlated the decision on the type of surgical resection of 142 patients with T1a renal masses to their RNS. They described a significantly higher score in the RN group compared to the PN group, a result that matches ours. They, however, did not classify their patients into the three standard complexity groups described by the original scoring system (12). In 2013, Oh et al. calculated the RNS for more than 200 patients with renal masses who have been treated by open and laparoscopic, partial and radical nephrectomies and found significantly different RNS sum of scores between RN and PN (8.89 vs. 6.09, P=0.0001) (13).

The independent role of each component of the RNS in predicting the type of surgical approach was investigated also. Mass radius (R) and nearness to the renal hilum (N) differ significantly between the PN and RN groups. The other three components of the RNS, on the other hand, failed to show significant differences between the two groups. In their retrospective analysis of data of patients who underwent surgery for renal masses from 2008 to 2014, Shin and colleagues described a significant difference in both the (N) and (R) values between patients treated by PN and RN (1.95 vs. 2.81 pts and 1.14 vs. 2.02 respectively, P=0.0001) (14). Chen-Yu Wu et al. studied the individual RNS components in relation to the perioperative complications and reported that R and N, as well as the sum of the total score were the only significant factors (4). Similar results were reported by Yeon et al. in their study on patients with renal masses treated robotically (15). Both groups, however, did not correlate these parameters to the choice of surgery as all of their patients were treated by PN.

RNS complexity grouping was used to compare the complications rates for patients treated with PN only since the complications rates and spectrum is different for RN. In our data, the three complexity groups differed significantly only in the EBL. It was highest in the low RNS group and lowest in the moderate RNS group (315 vs. 265 ml). Most of the studies that analyzed the PN complications in relation to RNS, however, described the highest EBL to be in the high NRS group (16,17,18,19). Roushias and his group, on the contrary, described the highest EBL to be in the moderate RNS group (20). An explanation for our result might be through the fact that intraoperative ultrasound was not available for use to precisely localize the mass which might have caused unnecessary dissection and blood loss. This fact has reflected itself also on the OT and IT. Although we could not find a significant difference in OT and IT between the three complexity groups, they were highest in the low group. Hyan et al. also could not find a significant difference in the OT between the three group (210,197, and 202 min respectively) (19). We were able to notice a similar trend for OT, IT, EBL and hospitalization time. they all are highest in the low RNS group and lowest in the medium RNS group. This association seems logic since when the OT increases there will be more blood loss and a patient who bleeds more will require more time to be ready to be go home.

The number of patients who had complications was low and difficult to justify statistical analysis. However, patients who sustained major complications (vascular or adjacent organ injury, urine leak requiring stenting, and positive margin on frozen section) were all from the high RNS group. Hyan and his colleagues also failed to find different complication rates between the three RNS groups in their analysis of the data of 141 patient treated with PN (19). A similar result was reported by Park et al. in 2014 (16).

The limitation to this study includes the use of open techniques due to lack of facilities and skills of laparoscopic renal surgery. This renders comparisons made with other studies less accurate because most of the studies included solely or partially laparoscopically treated patient. The low complication rate can be considered as another limitation to this study. This might be attributed to the meticulous dissection and secure techniques used intraoperatively. This low complication rate made it difficult to perform statistical tests and draw inferences on them. Our study, on the other hand, is a prospective study unlike all literature found on this subject which are exclusively retrospective. It also has a fair distribution of patients in the complexity groups compared to as low as 3.9 and 5% in the high score group in some studies (19,20).

Conclusion

RENAL nephrometry score could be considered a reproducible and reliable tool to assign patients with renal masses for PN or RN. It might be used also to predict the outcome and intra- and post-operative complications despite some variability in its correlation to these outcomes. Overall score, mass radius (R) and nearness to hilum (N) are more influential on decision making and outcome prediction than other parameters of this scoring system. Further studies are required to probe its use to predict renal function after mass resection in single functional kidneys.

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Conflict of Interest

Authors declare no conflict of interest.

Data availability

Data are available upon reasonable request.

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