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RENAL NEPHROMETRY SCORES IN RADICAL AND NEPHRON SPARING SURGERY : INITIAL EXPERIENCE IN ARMED FORCE'S TERTIARY CARE CENTRE.

Surgery

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ABSTRACT

Most new cases of localized RCC are detected incidentally as an enhancing renal mass on cross-sectional imaging. Options for the management of renal masses include excision by partial or radical nephrectomy, ablation or active surveillance in the elderly or infirmed. Nephrometry scoring system represents the first method introduced to attempt to standardize the reporting of salient anatomy of an enhancing renal mass as well as provide a platform to objectify treatment decision-making, minimizing individual subjectivity and judgment. Increasing evidence suggests a relationship may exist between renal mass anatomy and pathology and it has important prognostic value for disease outcome.

Methods: This study was designed as a hospital based prospective study with the aim to study the use of R.E.N.A.L. Nephrometry score in evaluating treatment options of solid renal masses and in predicting tumor histology and grade.

Results: Out of 40 patients, 19 patients underwent partial nephrectomy and 21 patients underwent radical nephrectomy. Tumors with increasing Nephrometry Score sums as well as increasing individual component scores were more likely to undergo RN than PN. Patients undergoing an open PN had more complex lesions as quantified by Nephrometry. The proportion with clear cell histology also increased with R.E.N.A.L score, from 2/6 (33.3%) in patients with low R.E.N.A.L scores (4–6) up to 15/17 (88.24%) for patients with high R.E.N.A.L scores(10–12) .

Conclusion: The R.E.N.A.L. nephrometry score of a solid renal mass shows a significant association with our choice of surgery. As the complexity of lesion (nephrometry score) increases the rate of radical nephrectomy increases and rate of partial nephrectomy decreases. Proportion with clear cell histology and Fuhrman's grade also increases with R.E.N.A.L score.

KEYWORDS

Renal cell carcinoma (RCC), RENAL Score, Radical nephrectomy (RN), Partial nephrectomy(PN)

INTRODUCTION

The biology of renal cell carcinoma (RCC) is heterogeneous . Although approximately one third of all renal masses present with systemic disease, many localized renal masses appear to follow a relatively slow growing clinical course.(1) Most new cases of localized RCC are detected incidentally as an enhancing renal mass on cross-sectional imaging. Options for the management of renal masses include excision by partial or radical nephrectomy, ablation or active surveillance in the elderly or infirmed.(2)

The recommended management of T1a tumors has evolved significantly over recent decades with partial nephrectomy being offered to suitable patients with small renal tumors. A laparoscopic partial nephrectomy (LPN) has a higher complication rate compared to open radical nephrectomy, varying between 5.5 and 38%.(3) This is in part attributable to risk of urinary fistula (4.4%) and technical difficulty(8). Current literature indicated that a laparoscopic partial nephrectomy(LPN) remains underused worldwide(9,10) but specialist centers are progressing quickly towards minimally invasive (laparoscopic and robotic) partial nephrectomy.(4)

The R.E.N.A.L.(radius, exophytic/endophytic properties, nearness of tumor to the collecting system or sinus in mm , anterior/posterior location relative to polar lines). Nephrometry scoring system represents the first method introduced to attempt to standardize the reporting of salient anatomy of an enhancing renal mass as well as provide a platform to objectify treatment decision-making, minimizing individual subjectivity and judgment.(5) Although there are other reported renal tumor methodologies, such as the PADUA (preoperative aspects and dimensions used for anatomic classification) and CI (centrality index) systems, the Nephrometry score is the first objective system that quantifies the complexity of the renal tumor.(6,7) Since its introduction, the R.E.N.A.L. nephrometry scoring system has been shown to provide important preoperative and perioperative information used to predict long term outcomes and is increasingly being incorporated into clinical trials similar to the Response Evaluation Criteria In Solid Tumors guidelines (RECIST). (8)

Increasing evidence suggests a relationship may exist between renal mass anatomy and pathology.(9,10,11) FUHRMAN grade, the most widely used grading system for RCC, has important prognostic value for disease outcome.(12,13) A lower R.E.N.A.L nephrometry score is associated with the likelihood of benign diagnoses or RCCs of lower stage and grade, and papillary rather than clear cell subtype. This may therefore be a useful tool in guiding the management of SRMs. (Small Renal Mass)

In our present study we evaluate the relationship between a tumor's Nephrometry Score and the treatment rendered. We also assessed the relationship of the R.E.N.A.L nephrometry score to histological findings.

MATERIAL AND METHODS

This study was designed as a hospital based prospective study with the aim to study the use of R.E.N.A.L. Nephrometry score in evaluating treatment options of solid renal masses and in predicting tumor histology and grade. The institutional Review Board clearance was taken prior to the conduct of the study. The records of all the patients treated in the Urology department between February 2014 to February 2017 were reviewed.

INCLUSION CRITERIA

1. All patients with clinical T1 stage renal cell carcinoma.
2. All surgically fit patient who had given informed consent for operation.

EXCLUSION CRITERIA

1. All patients who deny informed consent will be excluded from the study.
2. All patients who had metastatic lesion or clinical stage > T1.

The demographic profile of all the patients included in the study were recorded which included age, sex and occupation. Beside these parameters symptoms of haematuria, flank pain, weight loss, fever, malaise, loss of appetite, bone pain was taken. Personal history like smoking, alcoholism and family history of renal carcinoma was taken. Routine general physical and detailed abdominal examination was done. Routine blood tests, ultrasonography and CT scan were done for every patients.

Preoperative R.E.N.A.L. Nephrometry scoring done for every patient to evaluate the relationship between a tumor's Nephrometry Score and the treatment rendered (Open Partial Nephrectomy, Laparoscopic

partial Nephrectomy, Radical Nephrectomy) for solid renal mass .

The R.E.N.A.L. score was described in 2009 and includes the assessment of tumour (R)adius (size at the maximal diameter), (E)xophytic/ endophytic properties, (N)earness of tumour to the collecting system or sinus, (A)nterior/posterior descriptor, and (L)ocation relative to polar lines. Standardised points (1-3 points per descriptor) were assigned onto each parameter, except the anterior or posterior component as originally described by Kutikov and Uzzo.(12) Radius was measured as the maximum diameter of the tumour in centimeters and points were allocated as 1 (≤4 cm), 2 (>4 but <7 cm), and 3 (≥7 cm). Exophytic/endophytic points assigned were 1 when 50% or more of the tumour was exophytic, 2 when less than 50% was exophytic, and 3 when it was entirely endophytic. For non- spherical or asymmetrically located tumours, the predominant feature on any axis (not just the axial or coronal axis) was considered with reference to the renal cortex. The N component was measured as the distance of the deepest portion of the tumour to the collecting system and points were allocated as 1 (≥7 mm), 2 (>4 but <7 mm), and 3 (invading, touching or within 4 mm). Anterior/posterior location of the tumour was designated as a non-numerical suffix that describes the location of the tumour with respect to the kidney midline plane as assessed on axial images. When the mass was located at the tip of the renal poles or lay on the coronal plane where a meaningful anterior or posterior designation was not possible, the suffix "x" was assigned. The location score was assigned as the position of the mass relative to polar lines. The polar line was assigned as the plane of the kidney above or below which the medial lip of parenchyma was interrupted by the renal sinus fat, vessels or the collecting system and best located in the coronal plane. Two polar lines were measured for each renal unit.

All components except for the(A) descriptor are scored on 1,2,or 3,-scale.The suffix "X" is assigned to the tumor if an anterior or posterior designation is not possible. An additional suffix "h" is used to designate a hilar location of the tumor (abutting the main renal artery or vein). Masses with Nephrometry scores totaling 4-6 were considered low complexity for resection, 7-9 were considered moderate complexity and 10-12 were considered high complexity. The range of complexity of a renal tumor's Nephrometry score is from the simplest 4a(1+1+1+a+1) to the most complex 12ph(3+3+3+ph+3).(12)

R.E.N.A.L. NEPHROMETRY SCORING SYSTEM

Component	SCORE		
	1 Point	2 Points	3 Points
R (radius, maximal diameter) (cm)	≤ 4	> 4 but < 7	≥ 7
E (exophytic/ endophytic)	≥ 50 % exophytic	< 50% exophytic	Completely endophytic
N (nearness to collecting system/renal sinus) (mm)	≥ 7	> 4 but < 7	≤ 4
A (anterior/posterior locator)	No points given. Descriptor of "a," "p," or "x" assigned to describe mass location.		
L (location relative to polar lines)	Entirely below lower polar or above upper polar line	Mass crosses polar line	50% of mass is across polar line or mass is entirely between polar lines or mass crosses axial midline

After calculating the Nephrometry score, nephrectomy (open or partial) was done with either laparoscopic or open technique. Complications were recorded during intraoperative and immediate postoperative period . Following operative intervention, pathological reports were reviewed to determine tumour histological type, stage, Fuhrman grade.

STATISTICALANALYSIS

Statistical analysis was carried out with the help of SAS 9.2 and SPSS V15.0 (Statistical Package for Social Sciences, Version 15.0). Data were summarized as Mean ± SD for quantitative data and Number (Percentage) for qualitative data. Data were analyzed with Student's unpaired t test for comparison of means of quantitative data. Chi square test, Chi square test with continuity correction and Fisher Exact Probability tests were applied to compare percentages. One way ANOVA (F test) was applied to compare means of more than 2 groups. Scheffe post hoc test was applied to compare 2 means.

RESULT

Clinical parameters such as age, gender distribution, preoperative creatinine level and laterality of tumor showed no statistical significance between the groups. Out of 40 patients 19 patients underwent partial nephrectomy and 21 patients underwent radical nephrectomy. Tumors with increasing Nephrometry Score sums as well as increasing individual component scores were more likely to undergo RN than PN ($p<0.0001$). Tumors treated by RN had a mean Nephrometry sum of 9.38 (median=10, SD=1.09); while, tumors treated by a PN had a mean Nephrometry Score of 7.53 (median=7, SD=1.47). Examination of the individual components of Nephrometry Score reveals that as a tumor's size (R), central proximity/ nearness (N), and location (L) scores increase, RN was more likely be done (all $p<0.001$). In our study, 6 (15%) patients had a low complexity tumor (Nephrometry Score 4-6); 17 (42.5%) patients had a moderate complexity tumor (Nephrometry Score 7-9), and 17 (42.5%) patients had a high complexity tumor (Nephrometry Score 10-12). Stratified by Nephrometry Score, RN was performed in 16.7%, 41.2%, and 76.4%of low, moderate, and high complexity lesions. The overall partial nephrectomy (PN) rate in the entire cohort (n=40) was 47.5%(19/40) of which nearly half (11/19) were performed using laparoscopic approach including 50%, 47.1%%, and 0% of low, moderate, and high complexity lesions. In 19 patients who underwent partial nephrectomy, 8 (42.1%) patients and 11(57.89%) patients were treated with a open PN and an lap PN, respectively. Patients undergoing an open PN had more complex lesions as quantified by Nephrometry ($p<0.0001$) (mean score=8.50, median=8.5, SD=1.31). The mean Nephrometry Score for lesions treated by lap PN was 6.82 (median=7, SD=1.17). Comparing the individual components of Nephrometry reveals that patients treated with an open PN had an increasing size (R), nearness to the collecting system or sinus (N), and location (L) component score (p-values = 0.041,0.041, 0.03 respectively). Warm Ischaemic time was significantly higher for patients with higher nephrometry scores in the partial nephrectomy group (16.20 mins vs 22.90 mins vs 26.50mins, $P< 0.001$). Overall complications were low including haemorrhage requiring transfusion(3) urinary leakage (n=1) and bleeding warranting embolisation (n=1). Two patients required open conversion and two patients had haemorrhage requiring transfusion in the Partial nephrectomy group. The proportion with clear cell histology also increased with R.E.N.A.L score, from 2/6 (33.3%) in patients with low R.E.N.A.L scores (4–6) up to 15/17 (88.24%) for patients with high R.E.N.A.L scores(10–12) . Conversely, papillary RCC decreased with increasing lesion complexity (from 66.67% in low score to 11.76% in moderate score). Fuhrman grade 1 tumors represented 4/6 (66.7%) in low and 2/15(13.3%) in high complexity lesions . Conversely, there is no grade 3 lesion in low score (0.0%) compared with 5/15 (33.3%%) high complexity lesions, respectively

DISCUSSION

Nephrometry score (NS) is a means to objectify the salient anatomic features seen on cross sectional imaging of a given renal mass in an effort to compare outcomes and develop metrics for treatment decision-making. With recent advances in technical skills and easier tumor handling followed by better suturing technique, it has given the surgeons more confidence in operating tumors with high NS.

Wong M, Cho K, Ho K *et al* published data of 74 patients of which 38 underwent partial nephrectomy (group 1) and 36 underwent radical nephrectomy (group 2). There were 41 males and 33 females and showed that no statistical differences were found between the groups in terms of gender distribution, age, preoperative creatinine level.(17) Our perioperative results are also comparable to those of Wong M, Cho K, Ho K *et al.* Similarly **Canter D, Kutikov A, Manley B *et al*** in 2011 also showed that tumors treated by RN had a mean Nephrometry sum of 9.67,while tumors treated by a PN had a mean Nephrometry Score of 7.49 and tumor's size (R), central proximity/ nearness (N) and location (L) scores increase, RN was more likely to be utilized.(14) Our study is also comparable to the same. Study published by **Henry**

M. Rosevear, Paul T. Gellhaus *et al* in 2011 also showed that of the patients undergoing partial nephrectomy (PN), 58.2%, 38.5% and 3.3% had low (4–6), medium (7–9) or high (10–12) nephrometry scores, respectively, compared with 7.6%, 49.4% and 43.0%, respectively, in the group of patients undergoing RN, suggesting that as the score increases radical nephrectomy more likely to be done.(15) In our study it is not significantly different than the study by **Henry M. Rosevear, Paul T. Gellhaus *et al.*** In our study there was no association between endophytic/exophytic (E) component but hilar (h) component more often associated with RN ($p<0.001$). Similarly Wong M, Cho K, Ho K, Wong K *et al* also showed there was no significant difference in terms of exophytic components for radical nephrectomy and partial nephrectomy group. (17) Funahashi Y1, Murotani K2, Yoshino Y1, Sassa N in Feb 2015 showed that tumor size (R), distance from the sinus(N), hilar designation(H), and R.E.N.A.L nephrometry score were associated with decision of laparoscopic partial nephrectomy. In conclusion, they revealed that distance from the sinus(N) was important for the surgical planning of partial nephrectomy. (19) Similarly in our study of the 19 patients who underwent partial nephrectomy, 8 (42.1%) patients and 11(57.89%) patients were treated with open PN and lap PN respectively. Patients undergoing an open PN had more complex lesions as quantified by Nephrometry ($p<0.0001$) 8.50. The mean Nephrometry Score for lesions treated by lap PN was 6.82.

The WIT(Warm ischaemia time) remains a consideration when operating on such complex tumors with data showing higher WIT while compared to low and intermediate complexity tumors. Similarly **Pruthi D, Drachenberg D, McGregor T** in 2014 also showed correlation of Nephrometry score with warm ischemic time (WIT) in laparoscopic cases low 26 min, intermediate 31 min, high 34 min. (18) Conversely **Park D, Hwang J, Kang M, Oh J** in 2014 conducted analysis using clinical data of 98 patients who underwent open PN. The median cold ischemic time did not differ significantly among the 3 groups (36.0 minutes in low, 40 minutes in moderate and 43 minutes in the high-complexity group, $p = 0.421$).So they concluded the nephrometry score, as used in an open PN series under cold ischemia, was not significantly associated with ischemia time. (16)

In our study complications are higher in partial nephrectomy group than radical nephrectomy group (55.7% in PN and 16.7% in RN). Conversely **Rosevear H, Gellhaus P et al** in 2011 showed that overall complications were higher among the patients having RN vs PN (58% vs 42%, $P = 0.02$), with the majority of complications occurring in the postoperative period. (15) In our study the proportion with clear cell histology also increased with R.E.N.A.L score from 33.3% in patients with low R.E.N.A.L scores (4–6) up to 88.24% for patients with high R.E.N.A.L scores (10–12) . Conversely, the probability of the potentially more indolent papillary RCC decreased with increasing lesion complexity (from 66.67% in low score to 11.76% in moderate score). Which was same in the study of **Satasivam P, Sengupta S , Rajarubendra N et al** in 2011. (20) In our study Fuhrmans grade 1 tumours represented 66.7% in low and 13% in high complexity lesions which was also concluded by **Satasivam P, Sengupta S , Rajarubendra N et al** .

The limitations of our study remain the small number of patients and short follow up. However, the purpose of this study was to assess feasibility and reproducibility of performing such complex surgery, and we found that the short term perioperative outcomes remain within acceptable limits.

CONCLUSION

The R.E.N.A.L. nephrometry score of a solid renal mass shows a significant association with our choice of surgery (partial vs radical) and our approach to surgery (open vs laparoscopic) particularly in patients receiving partial nephrectomy. As the complexity of lesion (nephrometry score) increases the rate of radical nephrectomy increases and rate of partial nephrectomy decreases. Comparing the individual components of Nephrometry reveals that patients treated with an open PN had an increasing size (R), nearness to the collecting system or sinus (N), and location (L) scores in comparison to laparoscopic partial nephrectomy. Warm Ischaemic time was significantly higher for patients with higher nephrometry scores in the partial nephrectomy groups. Proportion with clear cell histology also increases with R.E.N.A.L score and the probability of the potentially more indolent papillary RCC decreased with increasing lesion complexity. The Fuhrman's grade also increases with increase in nephrometry score.

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