Nephrometry Scoring System Selects Candidates for Radical Nephrectomy Versus Nephron Sparing Surgery for Treatment of Renal Masses and Predicts Surgical and Oncological Outcome

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Abstract

Background: In the past, management of renal masses was based on surgeon’s own experience and preference till the innovation of RENAL scoring system.

Objective: To ensure the sensitivity of preoperative application of RENAL scoring system on patients having renal tumors and to assess correlation with the surgical technique.

Design, Setting, and Participants: Controlled Clinical Trial with combined prospective and retrospective study of 85 patients using the non-probability convenience sampling, open and laparoscopic Radical/Partial nephrectomy are the standard of care for management of renal tumors. R.E.N.A.L. nephrometry scoring system was applied preoperatively on all the renal mass lesions on the CT films and on the excised specimens postoperatively during the period between January 2018 and April 2019, Patient selected to be operated upon must be diagnosed to have solid/cystic renal tumor.

Inclusion Criteria: Resectable renal tumors’ patients Fit for anesthesia and for standard open surgical procedures with no distant metastasis.

Exclusion Criteria: Medical problems hinders anesthesia and Advanced metastatic tumors.

Surgical Procedure: Standard open and laparoscopic radical and nephron sparing surgery (NSS).

Outcome measurements and statistical analysis: Utility values for RENAL system when applied on solid and cystic renal mass lesions and its sensitivity by comparison its application on the CT films and on the specimens.

Results and Limitations: Using Student t and Fisher exact methods 85 patients’ data were analysed as follows; from 85, 26 patients underwent nephron sparing surgery (NSS) from those 26, 10 (11.76%) were categorized as mild complexity group and 16 (18.82%) were moderate complexity, the other 59 patients from total 85 underwent radical nephrectomy, from those 59, 15 (17.64%) moderate complexity and 46 (54.11%) were high complexity, none of the mild complexity group who all underwent NSS showed complications as regards bleeding, not free margin or urine leak, one 1.1% of patients of score 7 with NSS showed transient rise in creatinine, four 4.7% of score 8 with NSS showed bleeding and urine leak, seven 8.4% of score 9 with NSS showed complications, none of the patients of score 10 or 11 who all underwent radical nephrectomy showed complications, three 3.52% of score 12 showed not free safety margin.

Complications and sequelae of applying RENAL system are within the general known complications of radical and nephron sparing surgeries.

Conclusions: RENAL nephrometry score system is an objective method to help in the decision of surgical approach to resect organ confined solid and cystic renal tumors.

Patient Summary: In this study we looked for the patients with kidney masses and applied a specific calculator to these masses to find out the best method of surgical treatment whether to remove the kidney completely or to just remove the mass and leave the rest of the kidney tissue working while insuring the safety of the patient and found satisfactory results.
Introduction

Prevalence of renal masses increased due to advances of imaging modalities, so, the classic triad of pain, hematuria and palpable renal mass is not present except in advanced cases [1].

There are multiple options for managing renal masses, particularly for those with small renal mass. Surgery is the gold standard for treatment of localized RCC [2-6].

Nephron-sparing surgery has become an established treatment for renal tumors, particularly when preservation of renal parenchyma is critical as in single functioning kidney and bilateral synchronous pathology [2-3].

Treatment of renal tumors depends on description of tumor anatomy and the experience of the surgeon. So Alexander Kutikov and Robert G. Uzzo have described the R.E.N.A.L. Nephrometry score in 2009 [7].

RENAL nephrometry score which was one of the first systems created to provide standardized descriptive system for renal masses based on radiologic findings. Target of these nephrometry scoring systems was to make comparative studies between operative results and give standard anatomical data of the tumor [7-9].

This system is standard because it describes the tumor anatomical features as Radius, Exo/Endophytic, Nearness of the tumor the collecting system, Location of the tumor to renal poles and being anterior or posterior [7].

Application of R.E.N.A.L. nephrometry scoring preoperatively may be used as a guide to the complexity and choice of surgery for solid and cystic renal masses and for patient counselling, with reference to postoperative outcomes. Widespread use of this score may act as communication tools among specialists [10-13].

Materials and Methods

Studying of data of 85 patients who are fit for anaesthesia and having resectable non-metastatic solid and cystic renal tumors was done during the period of January 2018 to April 2019.

Routine preoperative assessment of the patients and CT scan with intravenous contrast.

R.E.N.A.L. system was applied on mass lesions in CT preoperatively and on the excised specimens postoperatively as follows;

Radius; one point is given to tumors that are less than or equal 4 cm, two points are given to those that more than 4 cm not exceeding 7 cm, and those that measure 7 cm and more are given 3 points.

The relationship between the renal tumor and the surface of the renal cortex is described by Exophytic/Endophytic component.

Not all renal tumors are spherical, so the safest way to calculate this score is by imagination of where the renal cortex would normally be if the mass is not present as renal tumours distort the normal contour of the kidney.

Measure the distance between tumor’s outermost point and renal cortex <1> and the distance between tumour's most endophytic point and renal cortex <2>.

If <1> is greater than <2> so the tumour is Exophytic and vice versa.

One point for masses that are 50% exophytic or more. Two points for those that are <50% exophytic. Three points for the totally submitted in the renal parenchyma.

The nearness of tumour's innermost point and the closest fat sinus or collecting system is checked in secretory phase CT.

Tumours 7mm or more from the collecting system or renal fat sinus are given one point. Two points are given to those that are >4mm but <7mm away. Three points for <4mm from the nearest collecting system or fat sinus.

The anterior tumours are assigned "a" while the posterior ones are assigned "p". Using axial CT cuts to detect whether the renal tumour is anterior or posterior by drawing an imaginary line parallel to the direction of the renal hilar structures equally dividing the renal parenchyma into anterior and posterior planes.

The location component describes the relation of the tumour to the renal polar line which is an imaginary plane where the medial renal parenchyma firstly intersected with the renal sinus fat, collecting system or vessels especially in coronal CT.

One point for tumours that are completely above or below the polar lines, Two for those that are crossing <50%.

Three for those that are completely between polar lines or cross polar lines >50% of the tumours radius.

When the tumour is hilar "h" is added to the score giving it more complexity.

RENAL system is subdivided according to complexity into low [4-6], moderate [7-9] and high [10-12].

Results

85 patients were included in this thesis and subdivided according to the type of surgery into Radical cases and Nephron sparing cases.

The mean age among radical nephrectomy cases were 57.9 ±13.4 years, while the mean BMI was 24.4 ±1.6, with males representing 57.4% of cases (Table 1-12 and Figure 1).

|                        | Mean  | ±SD  | Minimum | Maximum |
|------------------------|-------|------|---------|---------|
| Pre-Hemoglobin         | 11.56 | 1.86 | 8.4     | 16      |
| Pre-Creatinine         | 1.07  | 0.34 | 0.4     | 2       |
| Pre Nephrometry score  | 10.21 | 1.07 | 7       | 12      |
| Complexity             |       |      |         |         |
| Mild                   | 0     | 0.00%|         |         |
| Moderate               | 15    | 24.60%|        |         |
| High                   | 46    | 75.40%|        |         |

Table 1: Preoperative data among Radical nephrectomy cases.
Post Nephrometry score 10.43 1.07 7 12
Post-S.Creainine 1.37 0.74 0.4 6
Post-Hemoglobin 10.35 1.47 7 14
Safety margin Free 58 95.10%
3 4.90%
Post urine leakage Yes 0 0.00%
61 100.00%
Re intervention Yes 3 4.90%

Table 2: Intra and post-operative data among radical cases.

The mean operative time was 4.52 hours, average blood loss 362.30 cc, blood loss in drain 252.46 cc, application of the score on specimens with mean score 10.43, 3 patients were complicated with not free safety margins and needed intervention.

| Mean ±SD | Minimum | Maximum | Median | IQR |
|----------|---------|---------|--------|-----|
| Hemoglobin change | 1.21 ±1.99 | -2.2 | 7 | 0 | 2.5 |
| Hemoglobin % change | 8.91 ±15.46 | -22.22 | 46.67 | 9.09 | 20 |
| creatinine change | 0.3 ±0.73 | -0.7 | 4.4 | 0.2 | -0.09 | 0.49 |
| creatinine % change | 39.29 ±77.89 | -60 | 328.57 | 20.3 | -8.26 | 50 |

Table 3: Change in hemoglobin, creatinine and nephrometry score after operation among radical cases.

46 cases showed no change in score comparing application of the study on CT and specimens while 15 showed up score.

Personal data among (NSS) cases.

The mean age among (NSS) cases were 57.5 ±10.8 years, while the mean BMI was 24.6 ±1.8, with males representing 62.5% of cases.

| Complexity | Mean ±SD | Minimum | Maximum |
|------------|----------|---------|---------|
| Pre-Hemoglobin | 12.39 ±1.54 | 10 | 16 |
| Pre-S.Creainine | 1.09 ±0.43 | 0.4 | 2.1 |
| Pre Nephrometry score | 6.92 ±1.79 | 4 | 9 |

Table 4: Pre-operative data among (NSS) cases.

Nephrometry score 6.96 ±1.82 | 4 | 9 |
Creatinine 1.9 ±0.93 | 1 | 5 |
Hemoglobin 10.29 ±1.44 | 8 | 12.7 |
Safety margin Free 22 | 84.61% |
4 | 15.38% |
urine leakage Yes 8 | 30.76% |
18 | 69.23% |
Re intervention Yes 3 | 11.53% |
23 | 88.46% |
Recurrence Yes 0 | 0.00% |
26 | 100.00% |

Table 5: Intra and post-operative data among (NSS) cases.

Mean operative time was 5.29 hours, average blood loss was 506.25 cc, average blood loss in drain was 458.33 cc, mean score was 6.96, 4 cases were complicated with not free safety margins, 8 with urine leak from which 3 required intervention, No recurrences detected.
Table 6: Change in hemoglobin, creatinine and nephrometry score postoperatively among (NSS) cases.

| Type of surgery | Radical | Partial |
|-----------------|---------|---------|
| Hemoglobin      | Mean ±SD| Mean ±SD |
| Change          | 15.67   | 15.77   | -10    | 43.75  | 16.67  | 0   | 27.3 |
| Creatinine      | 0.8     | 0.95    | -0.1   | 4.2    | 0.4    | 0.25 | 1 |
| Nephrometry     | 103.35  | 162.15  | -9.09  | 650    | 50     | 23.61| 100 |

Change in nephrometry score
- No change: 25 (26.15%)
- Increased: 1 (3.84%)

Table 7: Comparison between the two study groups in pre-operative data.

27 patients (31.7%) out of 85 own moderate complexity nephrometry score, those patients were studied as follows:

Only one case (1.1%) of 5 moderate complexity cases of score 7 who underwent NSS was complicated with transient creatinine rise, 4 cases (4.7%) of 5 cases of score 8 were complicated with bleeding (intraop. And postop.) And safety margin not free, 7 cases (8.4%) of 17 cases with score 9 were complicated with bleeding and not free safety margin.

Table 8: Comparison between the two groups in intra and post-operative data.

| Type of surgery | Radical | Partial |
|-----------------|---------|---------|
| Hemoglobin change | 1.21    | 1.99    | 1(0-2.5) | 2.1 | 2.22 | 2(0-3) | .125* | NS |
| Hemoglobin % change | 8.91    | 15.46   | 9.1(0-20) | 15.67 | 15.77 | 16.6(0-27.3) | .129* | NS |
| Creatinine change | 0.3     | 0.73    | 0.2(0-1.0) | 0.8 | 0.95 | 0.4(0.3-1) | .001* | HS |
| Creatinine % change | 39.29   | 77.89   | 20.3(8.3-50) | 103.35 | 162.15 | 50(23.6-100) | .005* | HS |

Change in nephrometry score
- No change: 46 (75.40%)
- Increased: 15 (24.60%)

Table 9: Comparison between the two groups in change in hemoglobin, creatinine and nephrometry score postoperatively.

| Nephrometry score | P* |
|-------------------|----|
| No change         |     |
| Increased         | 0.03** | S |
|                          | Mean ±SD |    |
|--------------------------|----------|----|
| Safety margin            |          |    |
| Free                     | 9.26     | 2.04| 0.69|
| Not free                 | 9.57     | 1.27|    |
| Postoperative urine leakage |        |    |
| Yes                      | 8.38     | 1.06| 0.176|
| No                       | 9.38     | 2.04|    |
| Re intervention          |          |    |
| Yes                      | 9.33     | 2.5 | 0.065|
| No                       | 9.28     | 1.96|    |

Table 10: Relation between Nephrometry score and each of safety margin, Post-operative urine leakage and re-intervention.

| Nephrometry score | Postoperative-serum Creatinine | intraoperative blood loss | post-operative blood loss |
|-------------------|--------------------------------|---------------------------|---------------------------|
| Radical           | -0.163                         | -0.065                    | -0.241*                   |
| NSS               | 0.136                          | 0.554                     | 0.027                     |

Table 11: Correlation between Nephrometry score and each of intraoperative blood loss, Postoperative-Serum Creatinine and post-operative blood loss.

| Nephrometry score | Number of cases | Type of surgery | complications |
|-------------------|-----------------|-----------------|---------------|
|                   |                 |                 | No            |
| 4                 | 4               |                 | No            |
| 5                 | 1               |                 | No            |
| 6                 | 5               |                 | No            |
| 7                 | 5               |                 | No            |
| 8                 | 5               |                 | No            |
| 9                 | 17              |                 | 1 transient rise in creatinine |
| 10                | 25              |                 | 4 bleeding and urine leak with NSS |
| 11                | 16              |                 | 3 bleeding |
| 12                | 7               |                 | No            |
|                   |                 |                 | No            |
|                   |                 |                 | 3 not free margin |

*student t test
 Patients in the high complexity group of Cost et al., underwent NSS, in contrast to our high complexity group who all underwent radical nephrectomy [13].

Explanations for this are the difference between sample size and demographic characteristics and the different pathologies of the resected renal tumors, as 86.5% of the renal tumors in our study were renal cell carcinoma against only 16.4% in Cost’s.

Conclusion

RENAL scoring system is a good tool for making decision for treating renal masses as follows:

Mild complexity group is better treated with NSS, score 7 moderate complexity renal tumors are more likely to be treated with NSS while scores 8 and 9 are better treated with radical surgery. High complexity group is better treated with radical surgery.

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