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Research Article

Application of R.E.N.A.L Nephrometry Score in Planning Type of Surgery and Predicting Complications in RCC Patients in Gezira Hospital

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Abstract

Background: Adult renal cell carcinomas account for 80–85% of all renal tumors, making them the most common primary renal tumors. As a method for categorizing renal masses by anatomical characteristics, R.E.N.A.L score is suggested to study the effect on surgical approach in addition to perioperative outcomes and complications.

Methods: A cross-sectional prospective hospital-based study enrolled 48 RCC patients in GHRDS in the period between September 2020 and September 2021. Data regarding demographics, histological subtypes, surgical approach, intraoperative and postoperative complications were collected. Based on R.E.N.A.L score, the complexity of renal tumors is grouped into low, moderate, and high.

Results: The study sample size was 48. Twenty-five participants (52.1%) were men with a mean age of 51 years. Most cases had clear cell RCC 22 (45.8%) and papillary RCC 19 (39.6%). Thirty-nine (81.5%) patients underwent radical nephrectomy (flank incision [extraperitoneal] in 32 [82.1%] and midline incision [transperitoneal] in 7 [17.3%]), and 9 (18.5%) patients underwent partial nephrectomy. One-third of the patients 15 (31.2%) had intraoperative complications and 7 (14.6%) had postoperative complications. All intraoperative and most postoperative complications were associated with radical nephrectomy ($P = 0.001$). According to complexity, 21 (43.8%) patients had moderate complexity, 15 (31.2%) high complexity, and 12 (25%) low complexity.

Conclusion: Most RCC patients had moderate complexity and were subjected to radical nephrectomy. High complexities were linked to decision of radical nephrectomy, intraoperative and postoperative complications. More prospective research with large sample size and multi-centered studies is essential to ensure generalizability of study findings.

Keywords: Renal Cell Carcinoma, Gezira Hospital for Renal Diseases and Surgery, Sudan, R.E.N.A.L nephrometry scoring system

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1. Introduction

Kidney cancer, or renal cell carcinoma (RCC), is a common type of cancer that affects many people around the world. One of the reasons for its increasing incidence is the use of advanced imaging technologies that can detect tumors at an early stage. The main treatment for localized tumors is surgery, which can be done by removing part or all of the affected kidney. This can be done either by making a large cut (open surgery) or by making small holes (laparoscopic surgery) in the body or by robot-assisted surgery [1].

Over the past 20 years, partial nephrectomy (PN) has gained widespread use [2]. PN is a surgery that removes only the tumor and some surrounding tissue, while leaving most of the kidney intact. This surgery has many benefits over total nephrectomy (TN), which removes the whole kidney. PN can help preserve kidney function, lower the risk of chronic kidney disease, improve heart health, and reduce death rates. Therefore, PN is the preferred choice for tumors that are smaller than 4 cm (T1a). It can also be used for tumors that are between 4 and 7 cm (T1b), as it has similar results to TN in terms of cancer control [4]. PN is especially helpful for patients who have only one kidney or who have more complicated cases such as larger or multiple tumors [5]. Many studies have shown that saving more kidney tissue can improve long-term kidney function, even in patients who have two healthy kidneys and normal kidney function [6].

Laparoscopic partial nephrectomy (LPN) is a type of PN that uses small holes instead of a large cut to access the kidney. LPN has some advantages over open partial nephrectomy (OPN), such as faster recovery, shorter hospital stay, less pain, better cosmetic results, and comparable cancer outcomes over five years. However, LPN also has some challenges, such as difficulty in stopping bleeding and closing the wound due to limited visibility and more complex stitching [6].

Sometimes, during surgery, it may be necessary to change from PN to TN because of some problems that interfere with the operation. Some factors that can predict this change are the size, shape, position, location, and depth of the tumor. These factors are used to calculate the R.E.N.A.L score, which is a system that classifies and compares tumors based on how difficult they are to remove [6].

The R.E.N.A.L score can also help predict how likely it is to have problems during or after OPN. It can help decide whether surgery or other treatments are more suitable for kidney tumors. Other factors such as age, life expectancy, and other health conditions are also considered when making treatment decisions for kidney tumors. If surgery is chosen, it is important to consider the potential for problems during or after surgery [7].

Beside minimizing blood loss, operative time, and hospital stay, Laparoscopic Partial Nephrectomy (LPN) offers various advantages over Open Partial Nephrectomy (OPN), including reduced reliance on painkillers and lower risk of complications associated with larger incisions on the flank. Furthermore, LPN demonstrates comparable oncologic outcomes to OPN. However, LPN may pose challenges in terms of hemostasis and system closure due to limited exposure and more complex suturing [8]. Recently, the R.E.N.A.L system was employed at GHRDS from 2020 to 2021 to examine its efficacy in predicting the type of surgery and perioperative complications in patients with renal cell carcinoma (RCC).

2. Methods

2.1. Study design

This study was a prospective hospital-based cross-sectional study.

2.2. Area of study

The current study was conducted at Gezira Hospital for Renal Diseases and Surgery, located in Wad Medani, Sudan.

2.3. Study duration

The study period was September 2020–September 2021.

2.4. Study population

The study included all RCC patients during the time of the study.

2.5. Inclusion criteria

1. Patients aged >18 years

2. RCC patients who underwent nephron sparing surgery or radical nephrectomy at GHRDS

3. On regular follow-up

2.6. Exclusion criteria

1. Absence

2. Refusal to participate

2.7. Sample size

Patients with RCC who underwent nephrectomy throughout the study periods, i.e., 48.

2.8. Methods and tools:

Data were collected by questionnaires consisting of: demographic data, histological subtypes, types of surgical approach, and intraoperative and postoperative events. Calculation and interpretation of the R.E.N.A.L score was calculated and interpreted individually in each case using the MDCALC software (https://www.mdcalc.com/renal-nephrometry-score).

2.9. Study variables

2.9.1. Study variables

1. Demographics: Age, gender

2. Tumor side

3. Histological subtypes

4. Type of surgical approach

5. Ischemia time

6. Intraoperative complications

7. Postoperative complications

2.9.2. Dependent variables

1. Tumor complexity

2.10. Analysis of the data

Data were analyzed using the SPSS Version 21.0. Microsoft Excel 2010 was used to design figures and tables. In order to determine significance, Chi-Square test was used. A P-value of 0.05 was considered significant.

TABLE 1: Demographic characteristics of RCC patients in GHRDS (Sep 2020–Sep 2021; n = 48).

Personal characteristics	Response	N	%
Age (yr) mean (Min–Max)		51 (27–75)	
Sex	Men ♂	25 y	52.1 y
	Women ♀	23 y	47.9 y

TABLE 2: Characteristics of RCC patients who underwent radical nephrectomy in GHRDS (Sep 2020–Sep 2021; n = 39).

Radical nephrectomy	N	%
Side		
Left	23	58.9
Right	16	41.1
Procedure characteristics		
Flank incision	32	82.1
Midline incision	7	17.9

TABLE 3: Characteristics of RCC patients who underwent partial nephrectomy in GHRDS (Sep 2020–Sep 2021; n = 9).

Partial nephrectomy	N	%
Side		
Left	6	66.7
Right	3	33.3
WIT	18 min	

TABLE 4: Diversion from OPN to RN among RCC patients in GHRDS (Sep 2020–Sep 2021; n = 9).

Conversion to radical nephrectomy	N	%
Yes	1	11.1
No	8	88.9

3. Results

In 48 patients with RCC, 25 (52.1%) were males and 23 (47.9%) were females with men-to-women ratio of 1.1:1. An average age of 51 years was recorded (Table 1).

TABLE 5: Association between intraoperative complications and surgical interventions in RCC patients in GHRDS (Sep 2020–Sep 2021).

Intraoperative complication	Intervention		P-value
	Partial nephrectomy	Radical nephrectomy	
Bleeding	0 (0%)	7 (100%)	0.001
Organ injury	0 (0%)	4 (100%)	
Both	0 (0%)	4 (100%)	

TABLE 6: Association between postoperative complications and surgical interventions in RCC patients in GHRDS (Sep 2020–Sep 2021).

Postoperative complication (SSI)	Intervention		P-value
	Partial nephrectomy	Radical nephrectomy	
Yes	1 (14.3%)	6 (85.7%)	0.001
No	8 (19.5%)	33 (80.5%)	

TABLE 7: Relation between complexity and surgical interventions among RCC patients in GHRDS (Sep 2020–Sep 2021).

Intervention	Complexity			P-value
	Low complexity	Moderate	High complexity	
Radical nephrectomy	3 (7.7%)	21 (53.8%)	15 (38.5%)	0.001
Partial nephrectomy	9 (100)	0 (0%)	0 (0%)	

TABLE 8: Relation between complexity in RCC patients in GHRDS and intraoperative events (Sep 2020–Sep 2021).

Intraoperative complication	Complexity			P-value
	Low complexity	Moderate	High complexity	
Bleeding	0 (0%)	2 (28.6%)	5 (71.4%)	0.001
Organ injury	0 (0%)	1 (25%)	3 (75%)	
Both	0 (0%)	2 (50%)	2 (50%)	
No	12 (36.4%)	16 (48.5%)	5 (15.1%)	

TABLE 9: Association between complexity in RCC patients in GHRDS and postoperative events (Sep 2020–Sep 2021).

Postoperative complication (SSI)	Complexity			P-value
	Low complexity	Moderate	High complexity	
Yes	1 (14.3%)	1 (14.3%)	5 (71.4%)	0.001
No	11 (26.8 %)	20 (48.8%)	10 (24.4%)	

Twenty-seven patients (56%) had left RCC and 21 patients (44%) had right RCC (Figure **1**).

Clear cell RCC 22 (45.8%) and papillary RCC 19 (39.6%) were the major histological subtypes among our study cases (Figure **2**).
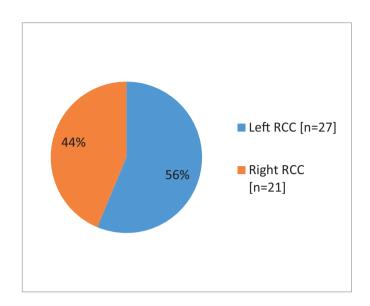
Figure 1: Tumor sides among RCC patients in GHRDS (Sep 2020–Sep 2021; *n* = 48).
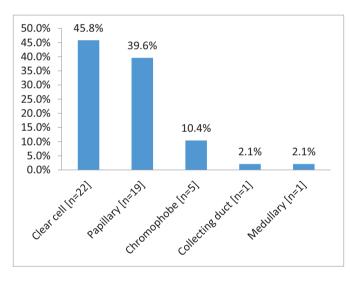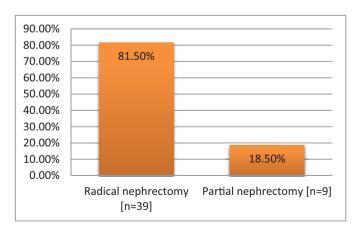

Figure 2: Histological subtypes of RCC patients in GHRDS (Sep 2020–Sep 2021; *n* = 48).
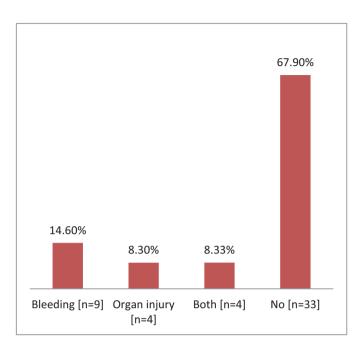

Figure 3: Types of surgical intervention among RCC patients in GHRDS (Sep 2020–Sep 2021; *n* = 48).

Figure 4: The distribution of intraoperative complications among RCC patients in GHRDS (Sep 2020–Sep 2021; *n* = 48).
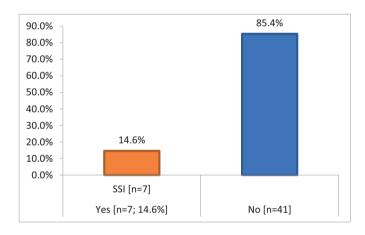

Figure 5: Distribution of postoperative complications among RCC patients in GHRDS (Sep 2020–Sep 2021; *n* = 48).

Regarding surgical interventions, 39 (81.5%) patients underwent radical nephrectomy and 9 (18.5%) patients underwent PN (Figure **3**).

Among patients who underwent radical nephrectomy, 23 (58.9%) had surgery in the left side and 16 (41.1%) in the right side. The procedure characteristics were flank incision (extraperitoneal) in 32 (82.1%) patients and midline incision (transperitoneal) in 7 (17.3%) patients (Table 2).

Among patients who underwent PN, 6 (66.7%) had left side surgery, 3 (33.3%) had right side surgery, and 18 mins was the mean WIT (Table 3). One-third of the patients (*n* = 15) had intraoperative complications, bleeding was seen in 7 (14.6%) patients, adjacent
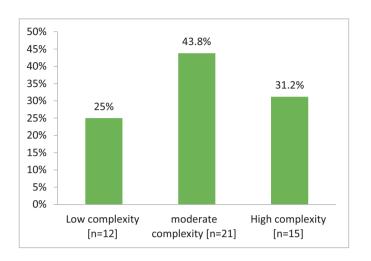
Figure 6: Complexity of RCC among GHRDS (Sep 2020–Sep 2021; *n* = 48).

organ injury in 4 (8.3%), and both in 4 (8.3%) patients (Figure **4**). Conversion from partial to radical nephrectomy was found in one (11.1%) patient (Table 4). Postoperative complications were presented in 7 (14.6%) patients and all of them were surgical site infection (SSI; Figure **5**).

Regarding complexity, 21 (43.8%) patients had moderate complexity, 15 (31.2%) had high complexity, and 12 (25%) patients had low complexity (Figure **6**).

The patients who had intraoperative bleeding (*n* = 7), organ injury (*n* = 4), and both complications (*n* = 4) underwent radical nephrectomy (*P* = 0.001; Table 5).

Majority of cases with postoperative SSI (*n* = 6) underwent radical nephrectomy and one underwent PN (*P*-value = 0.001; Table 6).

The relation between interventions and complexity showed that majority of radical nephrectomy patients had moderate (53.8%) and high complexities (38.5%), while all patients with PN (*n* = 9) had low complexity (*P*-value = 0.001; Table 7).

Majority of cases with intraoperative bleeding (71.4%) and organ injury (50%) tended to have high complexities (*P*-value = 0.001; Table 8).

Most of the patients with postoperative SSI (71.4%) had high complexities (*P*-value = 0.001; Table 9).

4. Discussion

This study aimed to determine R.E.N.A.L scoring system as predictor for surgical approach type and perioperative complications in 48 RCC patients. The average age was 51 years ranging from 27 to 75 years and all had undergone open surgery. This finding confirmed that RCC is more common in older ages and agreed with the Sudanese

study of SalihYahia *et al*., where majority of patients with RCC were found to be in their fifth decade of life (81%) [9]. Also, Jae *et al*. reported among 113 patients with RCC, the average age was 53.5 years [7]. According to Cancer Statistic Review concluded by Siegel, usually RCC occurs between the ages of 50 and 70 as it is a tumor of older age groups [10].

The present study reports that RCC was common in males more than females (52.1% vs 47.9%). This could be explained by males being more exposed to RCC risk factors, such as smoking, more than females. In general, the Statistic Review of Siegel RL noticed approximately 2:1 male-to-female ratio [10]. In SalihYahia *et al*.'s study, among Sudanese patients with RCC, 60% were men and 40% were women [9]. Furthermore, Soares *et al*. in Brazil [6], Jae Seung *et al*. in Korea [7], and Reddy *et al*. in UK [11] reported the predominance of RCC among males. This study revealed that most of the subjects (56%) had tumors in left kidneys. Similar findings were reported by Jae Seung *et al*. in Korea, where 55.4% of tumors were found in the left kidney [7]. Histopathologically, clear-cell RCC (45.8%) and papillary RCC (39.6%) were the major histological subtypes among our study cases. There are over 14 subtypes of RCCs defined by the updated 2016 WHO classification; major subclasses included clear-cell RCC (40–80%) and papillary RCC (10–15%) [12]. Similarly, the Sudanese study of SalihYahia *et al*. reported that clear-cell and papillary RCCs were the commonest RCC subtypes [9]. Overall, these histopathological patterns percentages are similar to the international works [13, 14]; however, the incidence of clear cell type was as low as 33.3% in Nigeria [15]. Concerning interventions, most of the cases (81.5%) underwent radical nephrectomy and 9 (18.5%) patients underwent PN. This might indicate the late presentation of the patients. However, in other studies like Soares *et al*. (partial = 84.8; radical = 15.2%) and Shao-Hao *et al*. (partial = 56.3%; radical = 43.7%), majority of the cases underwent PN [6, 16].

Among patients who underwent radical nephrectomy, 58.9% had surgery on left side, and procedure characteristics were flank incision (extraperitoneal) in 82.1% and midline incision (transperitoneal) in 17.3% of the patients. Also, 66.7% of the patients who had radical nephrectomy had surgery on the left side and 18 mins was the mean time for the warm ischemia. In the current study, one-third of the patients (31.2%) had intraoperative complications such as bleeding in 14.6%, organ injury in 8.3%, and both of them in 8.3% of patients. Additionally, conversion from partial to radical nephrectomy was found in 11.1% of patients. In the study of Jae Seung *et al*., only 5.3% of patients had intraoperative complications and all of them were organ injury, and the conversion rate was 1.7% [7]. Regarding postoperative complications, 14.6% of patients had complications

and all of them were surgical site infection (SSI). Reddy *et al*. and André *et al*. found similar rates, where postoperative complications were reported in 12.5% and 11.3% of the patients, respectively [11, 17]. In contrast, Renato *et al*. reported postoperative complications in only 3% of the patients [18]. It is worth noticing that, from a total of 15 patients who had intraoperative complications (all were radical nephrectomy), tumor radius of >10 cm was reported in 11 patients (73.3%); similarly, tumor radius of >10 cm was seen in 71.4% of the patients with postoperative complications; however, this may be attributed to the prolonged time of surgery. Additionally, most intraoperative and postoperative complications were associated with radical nephrectomy, however, this may be attributed to the fact that the tumor complexity of 92.3% of radical nephrectomy patients was moderate or high. Depending on complexity, 43.8% of patients had moderate complexity, 31.2% had high complexity, and 25% of patients had low complexity. This distribution was similar to the studies of Soares *et al*. [6], Supriya *et al*. [19], and Chen-Yu *et al*. [20]. This study reveals that the R.E.N.A.L scoring system is an objective method to aid in decision-making regarding the surgical approach to organ-confined renal tumor resection. Majority of the patients who underwent radical nephrectomy had moderate (53.8%) and high complexities (38.5%), while all patients with PN (n = 9) had low complexity (P-value = 0.001). These results were in complete agreement of those of Stella *et al*. [8], Supriya *et al*. (19), and Mohamed *et al*. [9], where low complexity patients were most often subjected to PN. Interestingly, this study revealed that high complexities were correlated with both intraoperative and postoperative complications (P < 0.05). In details, majority of the patients with intraoperative bleeding (71.4%), organ injury (50%), and postoperative SSI (71.4%) had high complexities. Correspondingly, similar findings were reported by Supriya *et al*. [19], Reddy *et al*. [11], and Chen-Yu *et al*. [20], where high complexities were significantly linked to complications (P < 0.05). However, Jae Seung *et al.* in Korea reported that complications cannot be predicted by R.E.N.A.L score [7].

5. Limitations

1. R.E.N.A.L score composed mainly of anatomic factors ignoring the patient's factors such as BMI and comorbidities (like coagulopathy and chronic illnesses) that may increase the risk of perioperative events.

2. Difficulty in calculating R.E.N.A.L score from the images, but fortunately, in GHRDS, a radiology department with expert radiologists was available and all referred

patients were freely rescanned with only hard image films to calculate the complexity.

3. The study was a single-centered study.

4. Relatively small sample size due to the study being single-centered.

To avoid potential biases introduced by the single-center design and small sample size, we were very strict in the selection criteria, and operations were done in three different hospital units.

6. Conclusion

This study concludes that most of the RCC patients had moderate and high complexity scores, and they were subjected to radical nephrectomy. Moreover, there was an association between high complexity scores and RN decision, as well as complications intra and postoperatively. Intraoperative and postoperative complications were highly associated with tumor radius of >10 cm. In other words, R.E.N.A.L nephrometry scoring system is a valid predictor for the type of surgery and complications intra and postoperatively. The study suggested that R.E.N.A.L score can help predict surgical approach and perioperative complications; thus, we recommend that all patients with RCC should undergo a preoperative R.E.N.A.L assessment based on our context. The results of this study need to be verified by further large-scale research.

After completion of this study, the policy in GHRDS has been changed and all patients with low complexity RCCs now undergo PN unless there is a contraindication, which is different from the past when all patients with RCC were being subjected to radical nephrectomy.

More prospective research with large sample size and multi-centered studies is essential to ensure generalizability of the study findings.

Acknowledgements

Ethical Consideration

The study was approved by the SMSB, GHRDS authority. All patient's data were used namelessly.

Competing Interests

None declared.

Availability of Data and Material

Materials collected from GHRDS and can be provided upon request.

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