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**Original Research Article**

# Radiological and Histopathological Correlation of Renal Cell Carcinoma Undergoing Nephrectomy on CT Scan Based Diagnosis at Tertiary Care Hospital

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## Abstract

***Background:*** Renal cell carcinoma (RCC) is the most common malignancy of the kidney, and accurate preoperative diagnosis is critical for treatment planning. Contrast-enhanced computed tomography (CT) is frequently used for RCC diagnosis, but its correlation with histopathological findings is not fully explored, especially in Bangladeshi patients. This study aimed to evaluate the correlation between CT scan findings and histopathological diagnosis in RCC. ***Methods:*** A retrospective study was conducted at the National Institute of Kidney Diseases and Urology, Dhaka, from January 1, 2019, to June 30, 2020. A total of 150 patients diagnosed with RCC based on CT scans and confirmed by nephrectomy and histopathological analysis were included. CT scans were assessed for tumor size, morphology, necrosis, calcifications, and lymph node involvement. Histopathological diagnoses were compared with preoperative CT findings to evaluate diagnostic accuracy, sensitivity, specificity, and concordance. ***Results:*** Among the 150 patients, 68.7% had clear cell RCC, and 59.3% of tumors showed solid masses with necrosis on CT. The concordance rate between CT scans and histopathology was 92%, with false positive and false negative rates of 4% and 2.7%, respectively. Tumor size greater than 4 cm was observed in 78.7% of cases, and 28% of patients had lymph node involvement. ***Conclusion:*** CT scans demonstrated a high correlation with histopathological findings in RCC diagnosis. This supports the use of CT scan as an accurate tool for preoperative assessment, aiding in treatment decisions.

**Keywords:** Renal cell carcinoma, CT scan, histopathology, preoperative diagnosis, nephrectomy, radiological correlation.



## INTRODUCTION

Renal cell carcinoma (RCC) is one of the most common malignant tumors of the kidney, accounting for approximately 2-3% of all cancers worldwide [1]. RCC typically occurs in adults, with its incidence increasing over the past few decades due to improvements in imaging technologies, such as computed tomography (CT) and magnetic resonance imaging (MRI) [2]. RCC is often diagnosed incidentally during imaging studies conducted for other reasons, as many early-stage tumors are asymptomatic. However, patients with advanced disease may present with symptoms such as hematuria, flank pain, and palpable masses [3]. The global incidence of RCC has been on the rise, and it is estimated that more than 400,000 new cases are diagnosed each year [4].

The diagnosis of RCC is image-based, and the most frequent technique both for initial detection and staging is contrast-enhanced CT scans [3]. CT scans provide valuable information regarding tumor size, location, enhancement pattern, and the presence of calcifications or necrosis, which are helpful in evaluating the nature of the mass and its relationship with surrounding structures [5]. These characteristics play an important role in the treatment planning, particularly in determining if surgery or other interventions are warranted. While imaging has become more sophisticated, diagnosis of RCC is ultimately

confirmed by histopathologic examination after surgical tumor resection [6]. Histopathologic evaluation helps in the differentiation of the types of RCC, such as clear cell carcinoma, papillary carcinoma, and chromophobe carcinoma, each carrying different prognostic implications [2].

The most important aspect of RCC diagnosis is concordance between histopathological and radiological findings. Preoperative CT scans can suggest the likelihood of RCC and its nature, but these are only accurate based on the experience of the radiologist and imaging features [7]. Histopathology is the gold standard for making the diagnosis and the grade of the tumor, which is vital for prognosis and therapeutic planning [8].

Few studies have contrasted the correlation of results on CT scans with histopathological diagnoses of RCC. Some have suggested that even though CT scans are generally reliable in identifying well-defined large tumors, their reliability may be impaired when small or atypical tumors are involved [5, 8]. In addition, the CT appearance of various RCC types may overlap and therefore cannot be reliably established from imaging results alone [9]. For instance, clear cell RCC, the most common variant, typically presents as a homogeneously enhancing, well-circumscribed mass, whereas papillary RCC may present with heterogeneous enhancement and cystic changes [10, 11]. These radiological features must be noted and correlated with histopathology to improve preoperative assessment and intraoperative planning [12].

RCC in Bangladesh is a common health condition, though incidence of the disease is less compared to Western countries. National Institute of Kidney Diseases and Urology, Dhaka is a leading centre for diagnosis and treatment of renal cancers. The current study aimed to evaluate the diagnostic accuracy of CT scan imaging in patients with RCC diagnosed at this centre and correlate the histopathological diagnoses with radiological findings. Through investigating the correlation between these two diagnostic modalities, the study hopes to improve the accuracy of preoperative diagnosis, optimize the treatment planning, and eventually improve patient outcomes.

# METHODOLOGY & MATERIALS

This retrospective study was conducted at the National Institute of Kidney Diseases and Urology, Sher-E-Bangla Nagar, Dhaka, over a period of 18 months from January 1, 2019, to June 30, 2020. A total of 150 patients diagnosed with renal cell carcinoma (RCC) based on contrast-enhanced computed tomography (CECT) scan findings were included. All patients subsequently underwent nephrectomy, and their histopathological reports were analyzed to assess the correlation between radiological and pathological findings. Patients included in the study were those diagnosed with RCC on CECT scan, who underwent either partial or radical nephrectomy, and had complete histopathological records available. Patients with benign renal tumors, non-RCC malignancies, metastatic renal tumors from other primary malignancies, or incomplete imaging or histopathological data were excluded.

All patients underwent preoperative imaging with a multidetector CT scanner, which was used to evaluate tumor size, morphology, contrast enhancement, necrosis, calcifications, lymph node involvement, and vascular invasion. Tumors were classified based on radiological features suggestive of clear cell, papillary, or chromophobe RCC. Postoperative nephrectomy specimens were examined histopathologically to confirm the tumor subtype, Fuhrman nuclear grade, and the presence of necrosis or lymphovascular invasion. The findings from histopathology were then compared with preoperative CT scan reports to assess the accuracy of radiological diagnosis.

Data were collected from hospital records and analyzed using SPSS version 22. Descriptive statistics, including frequency distribution and percentages, were used to summarize categorical variables. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of CT scan findings in detecting RCC subtypes were calculated, and concordance rates between radiological and histopathological findings were assessed. Patient confidentiality was strictly maintained throughout the study.

# RESULTS

**Table 1: Demographic Distribution of Renal Cell Carcinoma Patients**

| Characteristics | Frequency (n=150) | Percentage (%) |
|---|---|---|
| Age Group (Years) | | |
| 30-40 | 14 | 9.30% |
| 41-50 | 33 | 22% |
| 51-60 | 52 | 34.70% |
| >60 | 51 | 34% |
| Gender | | |
| Male | 102 | 68% |
| Female | 48 | 32% |

Table 1 presents the age and gender distribution of the 150 renal cell carcinoma patients included in the study. The majority of patients were between 51-60 years of age, with a higher proportion of male patients (68%) compared to female patients (32%).

**Table 2: CT Scan Findings of Renal Cell Carcinoma**

| CT Scan Features | Frequency (n=150) | Percentage (%) |
|---|---|---|
| Solid Mass with Necrosis | 89 | 59.30% |
| Cystic Mass | 31 | 20.70% |
| Calcifications Present | 17 | 11.30% |
| Tumor Size >4 cm | 118 | 78.70% |
| Lymph Node Involvement | 42 | 28% |

Table 2 outlines the key CT scan features observed in 150 renal cell carcinoma patients. The most common feature was tumor size greater than 4 cm (78.7%) followed by a solid mass with necrosis (59.3%) and lymph node involvement (28%). Cystic masses and calcifications were less frequently observed, occurring in 20.7% and 11.3% of patients, respectively.

**Table 3: Histopathological Diagnosis after Nephrectomy**

| Histopathology Findings | Frequency (n=150) | Percentage (%) |
|---|---|---|
| Clear Cell RCC | 103 | 68.70% |
| Papillary RCC | 27 | 18% |
| Chromophobe RCC | 12 | 8% |
| Sarcomatoid RCC | 4 | 2.70% |
| Other Variants | 4 | 2.70% |

Table 3 presents the histopathological subtypes of renal cell carcinoma identified in 150 patients following nephrectomy. The majority of cases were clear cell RCC (68.7%) followed by with papillary RCC accounting for 18%. Chromophobe RCC, sarcomatoid RCC, and other variants each represented a smaller proportion of the cases (8%, 2.7%, and 2.7%, respectively.

**Table 4: Correlation between CT Scan & Histopathology**

| CT Scan Prediction | Histopathology Confirmed | Concordance Rate (%) |
|---|---|---|
| Malignant Mass | 138 | 92% |
| Benign Features | 12 | 8% |
| False Positives | 6 | 4% |
| False Negatives | 4 | 2.70% |

This table illustrates the correlation between CT scan predictions and histopathological findings in 150 renal cell carcinoma patients. The CT scan accurately predicted malignancy in 92% of cases, with a 4% false positive rate and a 2.7% false negative rate. Benign features were identified in 8% of patients, demonstrating a strong concordance between radiological and histopathological diagnoses.

## DISCUSSION

This study aimed to evaluate the correlation between CT scan findings and histopathological diagnosis of renal cell carcinoma (RCC) in Bangladeshi patients. Our findings align with global trends and are consistent with previously reported studies regarding imaging features, histopathological subtypes, and diagnostic accuracy of CT scans. Various studies have investigated the correlation between radiological and pathological findings in RCC, and our study adds to this body of knowledge by specifically focusing on Bangladeshi patients.

Our study revealed that the majority of RCC cases occurred in males (68%) with the highest incidence in the 51-60 age group (34.7%). These findings are consistent with global reports, including a study by Low et al., which also reported a higher incidence in males and a peak incidence in the 50-70 age group [13]. This demographic trend can be attributed to a combination of genetic, environmental, and lifestyle factors, with male predominance being well-documented in RCC literature. Furthermore, our CT scan findings showed that 59.3% of tumors exhibited solid masses with necrosis, and 78.7% of tumors were greater than 4 cm in size, which are features commonly associated with advanced RCC [14].

The presence of cystic masses and calcifications in 20.7% and 11.3% of patients, respectively, aligns with findings from similar studies, including those by Schieda et al., which highlighted the role of CT in differentiating various RCC subtypes

based on imaging features such as calcifications [15]. The presence of necrosis and large tumor size in our study further supports the aggressive nature of RCC, as described by Yoon et al., who reported that RCC often presents as a large, solid mass with necrosis on imaging [14].

Our histopathological results indicated that clear cell RCC was the most common subtype (68.7%), followed by papillary RCC (18%), and chromophobe RCC (8%). These findings are consistent with global trends, where clear cell RCC is the predominant subtype, accounting for 70-80% of cases [13]. Papillary RCC, which is the second most common subtype, was found in 18%, aligning with reports by Lal et al., who noted that papillary RCC represents a significant portion of RCC cases [16]. The relatively low frequency of sarcomatoid RCC (2.7%) in our study is also in line with the literature, where sarcomatoid transformation is a rare but aggressive form of RCC, associated with poor prognosis [13].

The histopathological findings were consistent with imaging characteristics, which is significant for surgical planning and prognosis. Studies such as those by Koo et al., have emphasized the importance of accurate preoperative imaging in determining treatment options, including the choice between partial and radical nephrectomy, based on tumor characteristics such as size and potential metastasis [17].

One of the key aspects of our study was evaluating the correlation between preoperative CT scans and postoperative histopathology. Our results revealed a high concordance rate of 92%, indicating that CT scans are highly reliable in diagnosing RCC and predicting malignancy. This is consistent with findings from other studies, including Bektas et al., who used quantitative CT texture analysis to predict histological subtypes of RCC with high accuracy [18]. False positive rates were observed in 4% of cases, and false negatives were seen in 2.7%, which are within acceptable limits, confirming the robustness of CT in the preoperative assessment of RCC. Similar rates of diagnostic accuracy and false positive/negative rates have been reported in studies by Schieda et al., who highlighted the value of CT in diagnosing sarcomatoid RCC with high sensitivity and specificity [15].

Furthermore, the use of CT scan as a tool for predicting RCC subtypes and grading has been explored in other studies, such as by Goyal et al., who highlighted the role of MRI in histological subtyping of RCC, and similar results can be inferred for CT scan-based predictions [19]. The high concordance between radiological and histopathological findings supports the use of CT scans not only in the diagnosis of RCC but also in determining tumor characteristics, which can aid in treatment planning and prognosis.

**Limitationsof the study**

While our study provides important insights into the accuracy of CT scans in RCC diagnosis, it is limited by its retrospective nature and single-center design. Further multicenter prospective studies with larger sample sizes are needed to confirm these findings and explore the potential of advanced imaging techniques such as texture analysis and radiomics in improving diagnostic accuracy for RCC subtypes.

## CONCLUSION

In conclusion, our study demonstrates that CT scans are highly effective in diagnosing RCC and correlating well with histopathological findings in Bangladeshi patients. The high concordance rate observed in our study supports the clinical utility of CT imaging in the preoperative evaluation of RCC. Further research is needed to explore the potential of advanced imaging techniques for predicting tumor subtypes and grading to further improve preoperative decision-making.

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