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Renal Cell Carcinoma: A Comprehensive Review of Diagnosis and Staging

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Abstract **Original Research Article**

Background: Renal cell carcinoma (RCC) is the most common malignant tumor of the kidney, with varying histopathological subtypes and clinical presentations. Early diagnosis and accurate staging are crucial for optimal management and improved patient outcomes. This study aims to comprehensively review the diagnosis and staging of RCC in Bangladeshi patients. ***Methods:*** This cross-sectional study was conducted at the Department of Urology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, over a one-year period from February 2024 to February 2025. A total of 40 patients diagnosed with RCC were included. Data on demographic characteristics, clinical presentation, imaging findings, histopathological subtypes, tumor staging, and treatment modalities were collected and analyzed. ***Results:*** The majority of patients (65%) were older than 50 years, with a male predominance (72.5%). Flank pain (55%) and hematuria (45%) were the most common symptoms, while 37.5% of cases were detected incidentally. Contrast-enhanced CT was the most frequently used imaging modality (80%). Clear cell RCC was the predominant histological subtype (67.5%). Tumor staging revealed that 37.5% of cases were T1, while 40% had advanced-stage disease (T3/T4). Radical nephrectomy was the most common treatment (55%), followed by partial nephrectomy (25%). ***Conclusion:*** RCC in Bangladeshi patients predominantly presents at advanced stages, emphasizing the need for improved early detection strategies. Imaging, particularly CT, plays a crucial role in diagnosis and staging. Surgical resection remains the primary treatment. Further studies are needed to explore long-term outcomes and optimize treatment approaches.

Keywords: Renal cell carcinoma, Diagnosis, Staging, Imaging, Nephrectomy.

INTRODUCTION

Renal cell carcinoma is the most common malignant renal tumor and comprises about 85% of all renal malignancies [1]. It arises from the renal tubular epithelium and demonstrates a broad spectrum of histological subtypes, clinical presentations, and different prognosis. Early stages of RCC are usually asymptomatic and may be incidentally diagnosed during imaging studies for other conditions [2]. These symptoms include hematuria, flank pain, and a palpable mass, which together constitute the classic triad of RCC. Other manifestations may include systemic symptoms such as weight loss, fever, hypertension, and paraneoplastic syndromes, making the clinical diagnosis complex and challenging [3, 4].

The global incidence of RCC has been rising over the past few decades, partly due to improvements in imaging modalities leading to increased incidental detection [5]. However, mortality rates remain high, especially for those cases diagnosed at advanced stages [6]. In Bangladesh, the epidemiology of RCC is not well documented, but hospital-based data indicate an increasing burden of the disease. Late presentation, along

with limited access to advanced diagnostic techniques and financial constraints, leads to delays in diagnosis and subsequently poor treatment outcomes [7]. The demographic and clinical characteristics of RCC patients in Bangladesh need to be identified to improve early detection and management strategies [8].

Imaging techniques such as ultrasonography, contrast-enhanced computed tomography, and magnetic resonance imaging are the mainstay of diagnosis of RCC [9]. Computed tomography remains the gold standard for diagnosing and staging RCC and provides important information on tumor size, location, vascular involvement, and metastatic spread [3]. Histopathological examination has remained so far the only definitive diagnostic modality. Clear cell carcinoma is the most common histological subtype followed by papillary and chromophobe RCC [10]. TNM system devised by AJCC is the most widely used classification and prognosis of RCC. Tumour size, lymph node involvement and distant metastases highly influence treatment modality and patient survival.

Treatment strategies for RCC have evolved significantly over the years. Surgery remains the cornerstone of management: radical nephrectomy is preferred in large or invasive tumors, while partial nephrectomy is increasingly performed in small renal masses to preserve renal function [8]. Results using targeted therapies with TKI-sunitinib and pazopanib and immune checkpoint inhibitor-nivolumab were encouraging in the metastatic and high-risk settings [5]. However, all these therapies have not yet been made widely available, and even when they are, many are unaffordable in resource-poor settings like Bangladesh. Sometimes, for selected small, indolent tumors, particularly in elderly patients or those patients with a high risk from additional comorbidities, active surveillance may be recommended [11].

Despite advancements in the diagnosis and treatment of RCC, prognosis for the most part is related to the stage at presentation [4]. Early-stage RCC has an excellent prognosis, with high survival rates after surgical intervention; conversely, advanced disease carries a poor prognosis. Thus, early diagnosis, correct staging, and timely therapeutic measures play a significant role in enhancing patient survival [9, 12]. In view of the paucity of regional data on RCC, this study was done to provide an overview of diagnosis and staging of RCC in Bangladeshi patients. Demographic pattern analysis, clinical features, imaging findings, histopathological subtypes, and staging were done in this study to improve the understanding of RCC presentation in Bangladesh and contribute to the optimization of diagnostic and treatment approaches.

This will help in filling the lacuna in the literature and provide valued input for clinicians, researchers, and policymakers. The findings will aid in the development of targeted awareness programs, improvement of diagnostic facilities, and optimization of treatment protocols to improve patient outcomes. This study has focused on RCC diagnosis and staging in Bangladeshi patients with the aim of providing a backdrop for future studies and guiding evidence-based clinical decisions in the management of renal malignancies.

METHODOLOGY AND MATERIALS

This cross-sectional study was conducted at the Department of Urology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, over a one-year period from February 2024 to February 2025. A total of 40 patients diagnosed with renal cell carcinoma (RCC) were included based on histopathological confirmation. Patients with metastatic RCC who had already undergone treatment and those with incomplete medical records were excluded. Data collection was performed using a structured case record form, including demographic details, clinical presentation, imaging findings, histopathological subtypes, tumor staging, and treatment modalities.

Clinical assessment involved a detailed history and physical examination, with particular attention to symptoms such as hematuria, flank pain, and palpable mass. Imaging studies included ultrasonography, contrast-enhanced computed tomography (CT), and magnetic resonance imaging (MRI) where necessary. The diagnosis was confirmed through histopathological examination of nephrectomy specimens or biopsy samples, and tumor classification was performed according to the World Health Organization (WHO) criteria. Staging was determined based on the American Joint Committee on Cancer (AJCC) TNM classification.

Treatment modalities were recorded, including radical or partial nephrectomy, targeted therapy, immunotherapy, or active surveillance. Surgical procedures were performed following standard guidelines, and adjuvant therapy decisions were based on tumor characteristics and patient condition. Statistical analysis was performed using SPSS software, with categorical variables expressed as frequencies and percentages. Informed consent was taken from all participants before enrollment. Patient confidentiality was strictly maintained throughout the study.

RESULTS

Table I: Demographic Characteristics of Study Participants

Characteristic	Number (n=40)	Percentage (%)
Age (years)		
- ≤50	14	35.00%
- >50	26	65.00%
Gender		
- Male	29	72.50%
- Female	11	27.50%
Smoking Status		
- Smoker	21	52.50%
- Non-Smoker	19	47.50%
Hypertension	24	60.00%
Obesity (BMI >30)	11	27.50%

Table I presents the demographic characteristics of the 40 RCC patients included in the study. The majority of patients (65%) were above 50 years of age, with a male predominance (72.5%). Smoking was common, with 52.5% of participants identified as smokers. Hypertension was observed in 60% of cases, while obesity (BMI >30) was present in 27.5% of patients.

Table II: Clinical Presentation and Imaging Findings

Clinical Feature / Imaging Modality	Number (n=40)	Percentage (%)
Hematuria	18	45.00%
Flank Pain	22	55.00%
Palpable Mass	10	25.00%
Incidental Finding	15	37.50%
Paraneoplastic Syndrome	6	15.00%
Imaging Modality Used		
Ultrasound	22	55.00%
Contrast-Enhanced CT	32	80.00%
MRI	9	22.50%
PET-CT	3	7.50%

Table II outlines the clinical presentation and imaging findings of the RCC patients. The most common symptom was flank pain (55%), followed by hematuria (45%) and palpable mass (25%). Incidental detection occurred in 37.5% of cases, while paraneoplastic syndromes were noted in 15%. Among imaging modalities, contrast-enhanced CT was the most frequently used (80%), followed by ultrasound (55%). MRI was performed in 22.5% of cases, whereas PET-CT was less commonly utilized (7.5%).

Table III: Histopathological Subtypes and Tumor Staging

Parameter	Number (n=40)	Percentage (%)
Histopathological Subtype		
Clear Cell RCC	27	67.50%
Papillary RCC	7	17.50%
Chromophobe RCC	4	10.00%
Other Rare Variants	2	5.00%
Tumor Staging (TNM)		
T1 (≤7 cm, confined to kidney)	15	37.50%
T2 (>7 cm, confined to kidney)	9	22.50%
T3 (Perinephric/major veins invasion)	10	25.00%
T4 (Beyond Gerota's fascia)	6	15.00%

Table III presents the histopathological subtypes and tumor staging of RCC patients. Clear cell RCC was the most common subtype (67.5%), followed by papillary RCC (17.5%) and chromophobe RCC (10%), while rare variants accounted for 5% of cases. Tumor staging revealed that 37.5% of patients had T1 tumors (≤7 cm, confined to the kidney), whereas 22.5% had T2 tumors (>7 cm, confined to the kidney).

Advanced stages were also prevalent, with T3 (perinephric/major vein invasion) in 25% and T4 (tumor extending beyond Gerota's fascia) in 15% of cases.

Table IV: Treatment Modalities Administered

Treatment Modality	Number (n=40)	Percentage (%)
Radical Nephrectomy	22	55.00%
Partial Nephrectomy	10	25.00%
Targeted Therapy	6	15.00%
Immunotherapy	5	12.50%
Active Surveillance	3	7.50%

Table IV summarizes the treatment modalities administered to RCC patients. Radical nephrectomy was the most common intervention (55%), followed by partial nephrectomy in 25% of cases. Targeted therapy was used in 15% of patients, while immunotherapy was given to 12.5%. Active surveillance was the least frequent approach, applied in 7.5% of cases.

DISCUSSION

The present study has described the demographic, clinical, histopathological, and therapeutic features of renal cell carcinoma in a series of 40 Bangladeshi patients. In general, this reflects the epidemiology and current management trends on a worldwide scale, with peculiar regional characteristics. This discussion contextualizes the findings within the wider literature and explores their clinical implications.

The study population was predominantly male, 72.5%, in agreement with global data indicating that RCC is more common in males than females, as outlined by Padala *et al*. and Jonasch *et al* [13, 14]. Most of the patients were above 50 years of age, 65%, which reflects the fact that the incidence of RCC increases with advancing age, as indicated by DeCastro and McKiernan [15]. Of interest, smoking and hypertension were predominant, 52.5% and 60%, respectively, among the participants, both of which are established risk factors for RCC, according to Petejova and Martinek and Pantuck *et al* [16, 17]. Another significant risk factor, obesity, was found in 27.5% of the patients, which is slightly lower than that of Western populations. As stated by Padala *et al*., by identifying such factors, more emphasis can be placed on the prevention of RCC through modifiable risk factors such as smoking and hypertension [13].

Clinical presentations in this series included flank pain, 55%, and hematuria, 45%, in concordance with the classic triad of symptoms for RCC as described by Jonasch *et al* [14]. A significant number of cases, 37.5%, were found incidentally-a finding that points to the increased use of abdominal imaging for other conditions, a trend observed by Novacescu *et al* [18]. This trend points to the importance of imaging in the early detection of RCC, since incidental tumors are often localized and associated with better outcomes, according to Escudier *et al* [19].

The most common modality utilized was a contrast-enhanced CT, at 80%, reflecting its status as the gold standard for RCC diagnosis and staging according to Vikram *et al* [20]. Ultrasound was used in 55%, but this is rather less sensitive and was often used as an initial screening tool. Abou Elkassem *et al*., quoted that MRI and PET-CT were done only in difficult cases, which included venous invasion or when the lesion remained indeterminate [21]. Results that underscored the role of a tailored approach to imaging for each individualized patient.

Clear cell RCC was the predominant subtype (67.5%) as reported worldwide by Garje *et al*., followed by the papillary RCC variant in 17.5% and chromophobe RCC in 10% [22]. The rare variants totaled 5% of cases. These findings were in line with the distribution in literature and indeed revealed the heterogeneity of RCC, as noted by Czarnecka *et al* [23].

Tumor staging indicated that 37.5 % of the patients had T1 tumors, which is considered as localized disease, while 25 and 15% had T3 and T4 tumors, respectively, signifying advanced disease. Lymph node involvement or N1 was recorded in 27.5% of cases, while distant metastasis or M1 in 17.5%. These findings indicate the importance of early-stage disease discovery as it implies a good prognosis by Nguyen and Campbell [24]. The high rate of advanced stages at diagnosis might simply reflect delayed diagnosis, common in resource-constrained settings.

Radical nephrectomy stood out as the most utilized treatment option at 55%, followed by partial nephrectomy at 25%; these figures show the trend in the surgical management of localized RCC, as discussed by Escudier *et al* [19]. Targeted therapy was applied in 15% and immunotherapy in 12.5% of the advanced cases, which aligns with the updated guidelines on metastatic or high-risk RCC from Escudier *et al* [19]. Active surveillance for small, indolent tumors accounted for 7.5% of the cases, which is a trend towards conservative management in appropriate cases, as noted in Novacescu *et al* [18].

The study has a number of implications for clinical practice: First, the high prevalence of modifiable risk factors like smoking and hypertension speaks to the need for public health interventions in order to lower the incidence of RCC. Second, a large number of incidentally detected tumors point to the potential role of imaging in early diagnosis. Third, the clear-cell predominant RCC and advanced-stage tumors raise the importance of timely and appropriate histopathological evaluation and staging.

Limitations of the study

This study has several limitations. The small sample size (n=40) may limit the generalizability of the findings. Additionally, the single-center design may introduce selection bias. Future multicenter studies with larger cohorts are needed to validate these findings and explore regional variations in RCC presentation and management.

CONCLUSION

This study provides a comprehensive overview of the demographic, clinical, histopathological, and therapeutic aspects of RCC in a Bangladeshi cohort. The findings align with global trends while highlighting unique regional characteristics. Early detection, accurate staging, and tailored treatment strategies are essential for improving outcomes in RCC patients. Addressing modifiable risk factors and enhancing access to advanced diagnostic and therapeutic modalities should be prioritized in resource-limited settings.

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REFERENCES

1. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. CA: a cancer journal for clinicians. 2011 Mar;61(2):69-90.
2. Bahadoram S, Davoodi M, Hassanzadeh S, *et al*. Renal cell carcinoma: an overview of the epidemiology, diagnosis, and treatment. G Ital Nefrol. 2022 Jun 20;39(3).
3. Nezami BG, MacLennan GT. Clear cell renal cell carcinoma: a comprehensive review of its histopathology, genetics, and differential diagnosis. International Journal of Surgical Pathology. 2024:10668969241256111.
4. Meskawi M, Sun M, Trinh QD, *et al*. A review of integrated staging systems for renal cell carcinoma. European urology. 2012 Aug 1;62(2):303-14.
5. Koul H, Huh JS, Rove KO, *et al*. Molecular aspects of renal cell carcinoma: a review. American journal of cancer research. 2010 Dec 18;1(2):240.
6. Mahmud S, Abbas TO, Mushtak A, Prithula J, Chowdhury ME. Kidney cancer diagnosis and surgery selection by machine learning from CT scans combined with clinical metadata. Cancers. 2023 Jun 14;15(12):3189.
7. Morshid A, Duran ES, Choi WJ, Duran C. A concise review of the multimodality imaging features of renal cell carcinoma. Cureus. 2021 Feb;13(2).
8. Warren AY, Harrison D. WHO/ISUP classification, grading and pathological staging of renal cell carcinoma: standards and controversies. World journal of urology. 2018 Dec;36:1913-26.
9. Low G, Huang G, Fu W, Moloo Z, Girgis S. Review of renal cell carcinoma and its common subtypes in radiology. World journal of radiology. 2016 May 5;8(5):484.
10. Hsieh JJ, Purdue MP, Signoretti S, *et al*. Renal cell carcinoma. Nature reviews Disease primers. 2017 Mar 9;3(1):1-9.
11. Shuch B, Bratslavsky G, Linehan WM, *et al*. Sarcomatoid renal cell carcinoma: a comprehensive review of the biology and current treatment strategies. The oncologist. 2012 Jan 1;17(1):46-54.
12. Elkassem AA, Allen BC, Sharbidre KG, *et al*. Update on the role of imaging in clinical staging and restaging of renal cell carcinoma based on the AJCC 8th edition, from the AJR special series on cancer staging. American Journal of Roentgenology. 2021 Sep 24;217(3):541-55.
13. Padala SA, Barsouk A, Thandra KC, *et al*. Epidemiology of renal cell carcinoma. World Journal of Oncology. 2020;11(3):79.
14. Jonasch E, Gao J, Rathmell WK. Renal cell carcinoma. BMJ. 2014;349:g4797 .
15. DeCastro GJ, McKiernan JM. Epidemiology, clinical staging, and presentation of renal cell carcinoma. Urologic Clinics of North America. 2008;35(4):581-92.
16. Petejova N, Martinek A. Renal cell carcinoma: Review of etiology, pathophysiology and risk factors. Biomedical Papers. 2016;160(2):183-94.
17. Pantuck AJ, Zisman A, Belldegrun AS. The changing natural history of renal cell carcinoma. The Journal of Urology. 2001;166(5):1611-23.
18. Novacescu D, Feciche BO, Cumpanas AA, *et al*. Contemporary clinical definitions, differential diagnosis, and novel predictive tools for renal cell carcinoma. Biomedicines. 2022;10(11):2926.
19. Escudier B, Porta C, Schmidinger M, *et al*. Renal cell carcinoma: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. Annals of Oncology. 2019;30(5):706-20.
20. Vikram R, Beland MD, Blaufox MD, *et al*. ACR appropriateness criteria renal cell carcinoma staging. Journal of the American College of Radiology. 2016;13(5):518-25.
21. Abou Elkassem AM, Lo SS, Gunn AJ, *et al*. Role of imaging in renal cell carcinoma: A multidisciplinary perspective. Radiographics. 2021;41(5):1387-407.
22. Garje R, Elhag D, Yasin HA, *et al*. Comprehensive review of chromophobe renal cell carcinoma. Critical Reviews in Oncology/Hematology. 2021;160:103287.

23. Czarnecka AM, Kornakiewicz A, Kukwa W, Szczylik C. Frontiers in clinical and molecular diagnostics and staging of metastatic clear cell renal cell carcinoma. Future Oncology. 2014;10(6):1095-111.

24. Nguyen CT, Campbell SC. Staging of renal cell carcinoma: past, present, and future. Clinical Genitourinary Cancer. 2006;5(3):190-7.