SAR Journal of Surgery

Abbreviated Key Title: *SAR J Surg*
Home page: https://sarpublication.com/journal/sarjs/home
DOI: https://doi.org/10.36346/sarjs.2025.v06i02.004

ISSN 2707-7748 (P)
ISSN 2709-6912 (O)

Original Research Article

Renal Cell Carcinoma, Pattern of Presentation, Treatment, and Outcomes. Experience of East Oncology Center, SUDAN

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Article History: | Received: 07.03.2025 | Accepted: 12.04.2025 | Published: 15.04.2025 |

Abstract: Renal cell carcinoma (RCC) is the most common malignant tumor of the kidney, with a rising global incidence. The epidemiology, clinical presentation, and management outcomes of RCC vary across different regions, especially in low-resource settings. This study aims to analyze the demographic patterns, clinical characteristics, treatment modalities, and outcomes of RCC patients at East Oncology Center (EOC) in Sudan. A retrospective study was conducted at East Oncology Center, Sudan, including all patients diagnosed with RCC between 2013 and 2024. Data were collected from hospital records, covering demographic characteristics, clinical presentation, risk factors, diagnostic workup, treatment modalities, and outcomes. A total of 71 patients were included, with a mean age of 57 years (range: 18–100 years). Males constituted 54.9%. The most common presenting symptoms were flank pain (93%), hematuria (33%). Clear cell carcinoma was the predominant histological subtype (52.1%), with more than 70% of patients diagnosed at a locally advanced or metastatic stage. Surgical treatment was performed in 70.4% of cases. The median follow-up period was 23.3 months, with an overall survival rate of 33.8%. This study provides insights into the epidemiology and management of RCC in a low-resource setting. A high proportion of patients presented with advanced-stage disease, highlighting the need for early detection strategies. Further research and resource optimization are required to improve RCC outcomes in Sudan.

Keywords: Renal cell carcinoma, treatment, outcome, Sudan, oncology.

INTRODUCTION

The biological nature of renal masses varies, including benign, indolent, or aggressive malignancies (Campbell *et al.*, 2021a). More than 80% of kidney cancer cases are renal cell carcinoma (RCC), making it the most prevalent type (Das *et al.*, 2024). It is primarily divided into clear cell, chromophobe, and papillary. Each type has unique morphological traits, clinical characteristics, and prognostic implications (Campbell *et al.*, 2021a).

Over the past three decades, RCC incidence rates have increased, with the highest prevalence in industrialized nations thought to be caused by longer life expectancies and the use of axial imaging (Campbell *et al.*, 2021b). Hypertension, smoking, obesity, and renal disorders are risk factors for RCC. Numerous family diseases can raise the likelihood of developing RCC; the most prevalent and important cause of clear cell RCC (ccRCC) is von Hippel-Lindau (VHL) disease (So *et al.*, 2023).

It might be difficult to diagnose kidney cancer in a patient. Incidental detection has essentially supplanted the traditional trio of flank pain, gross hematuria, and palpable abdominal tumor as the

initial presentation of RCC (Powles *et al.*, 2024; Vasudev *et al.*, 2020). Majority of the lesions are now detected incidentally by an ultrasonography while screening for other problems (Pattern of Renal Cell Carcinoma-A Single Center Experience in Nepal, n.d.). Nowadays, about 50% of renal masses are discovered incidentally (Campbell *et al.*, 2021b).

Accurate staging of RCC requires a contrast-enhanced CT scan of the chest, abdomen, and pelvis; nonetheless, all patients must have histological confirmation prior to beginning systemic therapy (Powles *et al.*, 2024). Given the substantial prognostic and therapeutic consequences of its histological subtype, the histological categorization of RCC is crucial (Muglia & Prando, 2015).

For localized malignancy, either a radical or partial nephrectomy is recommended (Mohd *et al.*, 2022). As our knowledge of the biology and pathophysiology of the illness has grown over the past few decades, systemic therapy [the main therapeutic approach for metastatic RCC (mRCC)] has changed quickly (Bosma *et al.*, 2022).

In an attempt to help risk-stratify patients and support clinical guidelines in directing therapy, laboratory investigations and other patient and disease characteristics are used to create scoring and prognostic systems, involving the International Metastatic RCC Database Constrium (IMDC) and Memorial Sloan Kettering Cancer Center (MSKCC) models (Bosma *et al.*, 2022; Powles *et al.*, 2024).

The East Oncology Centre (EOC) in Gadarif state, Eastern Sudan, was established in 2015 and began functioning in 2016. It is one of the 12 cancer centers set up across Sudan between 2008 and 2021 as part of a national effort to expand oncology services. The Gadarif center provides medical oncology services, which primarily including chemotherapy, hormonal therapy, and palliative care. More advanced treatments, like radiation therapy, are not yet available.

To our knowledge, this is the first study to assess the status of diagnosis, treatment, and outcomes of RCC in eastern Sudan. The purpose of this study is to assess the state of RCC care in order to facilitate the creation and implementation of future policies that will standardize the practice with the goal of enhancing patient care and treatment outcomes.

MATERIALS AND METHODS

This is a retrospective study conducted at EOC in Sudan, covering the period from November 2013 to December 2024. The study includes all patients diagnosed with RCC during this period. Data were retrieved from hospital records, including; demographic data, clinical presentation and patient characteristics, risk factors, diagnostic workup, treatment modalities, and outcomes. Data were analyzed using (StataCorp. 2021. Stata Statistical Software: Release 17). Descriptive statistics were used for demographic and clinical characteristics. The study was approved by the medical ethics committee of the University of Gadarif, Faculty of Medicine, Sudan (Ref. No.: RC. Q2.1.6.2). Patient confidentiality was maintained throughout the study by anonymizing all data before analysis.

RESULTS

A total of 71 patients with RCC were included. The mean age was 57.0 years (SD 16.8). Males constituted 54.9% of the sample (39/71). Urban and rural residents were nearly equally represented (36/71 [50.7%] and 35/71 [49.3%], respectively).

Diagnoses spanned from 2013 to 2024, with the largest proportion recorded in 2024 (21/71, 29.6%). Figure 1 shows that the most frequently reported risk factors were smoking (17/71, 23.9%), hypertension (16/71, 22.5%), and a family history of cancer (15/71, 21.1%), though nearly half of the patients reported no identifiable risk factor (32/71, 45.1%).

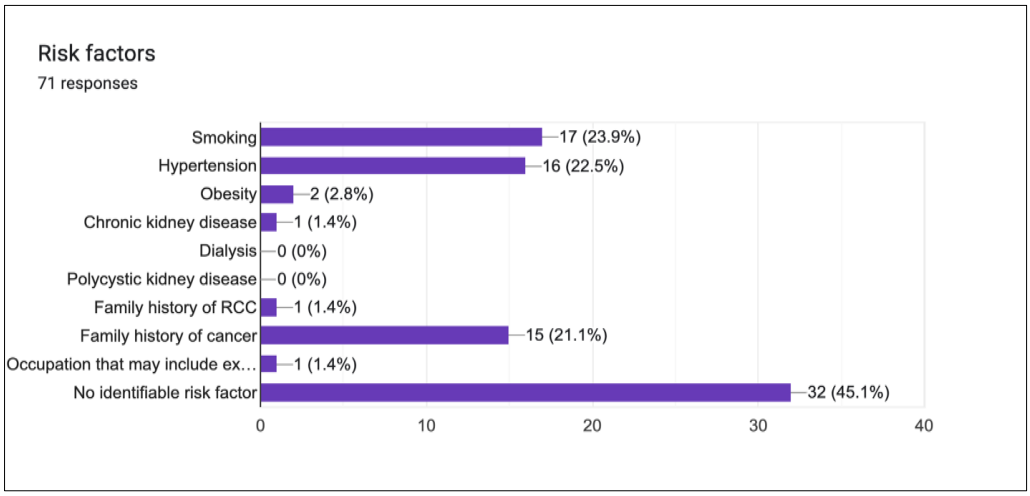

Figure 1: Risk factors

Flank pain was the predominant presenting symptom (66/71, 93.0%) followed by hematuria (22/71, 31%) (Figure 2).

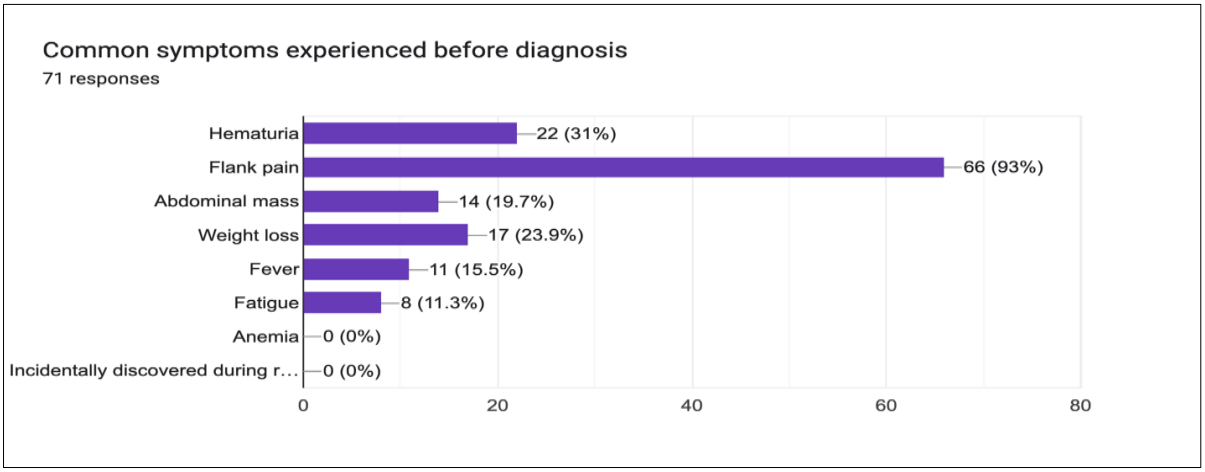

Figure 2: Common presenting symptoms

Initial diagnosis was most commonly made using ultrasound (70/71, 98.6%) and CT scan (64/71, 90.1%) (Figure 3).

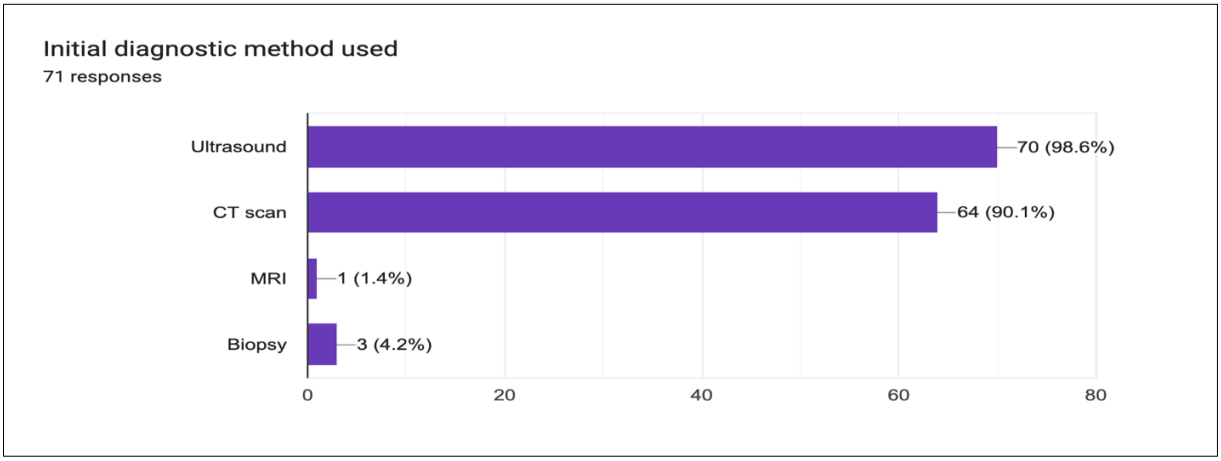

Figure 3: the initial diagnostic method used

Tumors were nearly evenly distributed between the right (34/71, 47.9%) and left (35/71, 49.3%) kidneys. Clear cell was the most frequent histological subtype (37/71, 52.1%). Tumor grade was unavailable in two-thirds of cases (47/71, 66.2%); among those graded, well-differentiated tumors were the most common (11/71, 15.5%). Stage IV disease was the most frequent clinical stage at diagnosis (30/71, 42.3%) (Table 1).

Table 1: Tumor characteristics

		Frequency
Laterality	Left	35 (49.3%)
	Right	34 (47.9%)
	Bilateral	1 (1.4%)
	No data available	1 (1.4%)
Tumor size	More than 10 cm	23 (32.4%)
	4 to 7 cm	17 (23.9%)
	7.1 to 10 cm	12 (16.9%)
	No data available	12 (16.9%)
	Less than 4 cm	7 (9.9%)
Histological subtype	Clear cell	37 (52.1%)
	Papillary	21 (29.6%)
	Collecting duct	3 (4.2%)
	Chromophobe	1 (1.4%)
	No data available	9 (12.7%)
Tumor grade	Well differentiated	11 (15.5%)

	Moderately differentiated	7 (9.9%)
	Poorly differentiated	6 (8.5%)
	No data available	47 (66.2%)
Tumor stage	Stage I (T1 N0M0)	8 (11.3%)
	Stage II (T2 N0M0)	11 (15.5%)
	Stage III (T3 or N1)	20 (28.2%)
	Stage IV (T4, N2, or M1)	30 (42.3%)
	No data available	2 (2.8%)

Radical nephrectomy was performed in 63.4% of cases (45/71). The mean follow-up duration was 23.3 months (SD 37.6). At last follow-up, 19.7% of patients were disease-free (14/71) and 23.9% had died (17/71); follow-up status was unavailable for 42.3% of the cohort (30/71) (Table 2).

Table 2: Treatment received and outcome

		Frequency
Treatment received	Surgery (radical nephrectomy)	45 (63.4%)
	Surgery (partial nephrectomy)	5 (7%)
	Targeted therapy (TKI)	27 (38%)
	Immunotherapy	4 (5.6%)
	Palliative care	25 (35.2%)
	No treatment received	2 (2.8%)
Current patient status	Disease-free	14 (19.7%)
	Stable disease	8 (11.3%)
	Progression of disease	2 (2.8%)
	Deceased	17 (23.9%)
	No data available	30 (42.3%)

DISCUSSION

With around 430,000 new cases and over 175,000 deaths from kidney cancer in 2020, the World Health Organization (WHO) reports that kidney cancer is a major worldwide health concern (Bencina *et al.,* 2024; Bosma *et al.*, 2022). RCC is a urological cancer of a poor prognosis, mostly because metastatic disease is incurable (Angulo *et al.,* 2024). In patients with advanced RCC, metastasis is the leading cause of death (Park, 2023).

RCC comes in over ten histological subtypes, with ccRCC accounting for over 80% of adult malignant kidney tumors and the majority of cancer-related mortality (Mohd *et al.,* 2022; Powles *et al.,* 2024). Many RCCs are clinically silent and are discovered at an advanced or metastatic stage, therefore even though early detection is known to be crucial for obtaining the best results, many patients still present with advanced illness (Roy *et al.,* 2024; Vasudev *et al.,* 2020).

Our patients in this study still come with the traditional symptoms of flank pain (93%), hematuria (31%), and bdominal mass (19.7%), even though the majority of RCCs are found incidentally and at an early stage. Furthermore, their high tumor stage at presentation (stages 3 and 4 account for over 70%) is indicative of comparatively substandard medical care and a lack of awareness of the disease.

Given the substantial anticipated increase in incidence, there is increasing interest in investigating the possibility of kidney cancer screening (Vasudev *et al.,* 2020).

In order to properly describe and clinically stage a solid or complicated renal cystic mass, clinicians need acquire high-quality, multiphase, cross-sectional abdominal imaging in order to evaluate the tumor's complexity, level of contrast enhancement, and fat content (Campbell *et al.,* 2021b).

The majority of the patients in our research have a CT scan to check for suspected renal masses after first being evaluated by ultrasonography for urological symptoms including flank pain and hematuria. This study focuses on the late presentation of RCC since patients frequently arrived late to the urologist after receiving care from general practitioners, medical assistants, or on their own.

More individualized treatment plans require the combination of advanced molecular methods and traditional histology diagnostics (Moch *et al.,* 2022). There is little information on how best to treat non ccRCC, and treatment guidelines frequently follow the same methodology as for ccRCC (Naik *et al.,* 2024).

It is observed that, in contrast to the known 80% frequency, the frequency of ccRCC in this cohort is comparatively lower than that in the literature (52.1%). This might affect the course of the disease and the outcome of treatment. Furthermore, additional study may be necessary to elucidate this peculiar distribution by

examining the relationship between risk factors, possible inherent factors, and the nature of the disease.

The available treatment options are constantly changing and include immunotherapy, targeted treatment, radiation, and surgery (So *et al.,* 2023). Surgery is typically an effective treatment for localized RCC, however mRCC is more troublesome and has shown itself resistant to traditional chemotherapy (Hall *et al.,* 2020). It is advisable to use a prognostic model because of the unpredictable clinical course of RCC; one of the most popular models is the IMDC prognostic risk group (Frazer *et al.,* 2024; Powles *et al.,* 2024).

For localized renal masses, the most common surgical techniques are partial nephrectomy (PN) and radical nephrectomy (RN), with expectant post-resection monitoring without the use of adjuvant therapy (Campbell *et al.,* 2021b; Naik *et al.,* 2024). When appropriate, PN is the preferred treatment for the cT1a renal tumor. It has been shown to a positive oncologic outcome and reduces the incidence of chronic kidney disease (CKD) (Campbell *et al.,* 2021b).

The majority of patients in our research receive surgical treatment (RNs, 63.4% and PNs, 7%). Surgery may be performed as a palliative or debulking technique in many situations due to the advanced stage for the majority of patients, particularly when alternative systemic therapy options are unavailable or too expensive. Although PN is more effective than RN at lowering the risk of CKD, its frequency is lower; this might be because to the advanced state at presentation or a shortage of qualified persons to perform the surgery.

There are several subtypes of mRCC, each with unique morphological, genetic, clinical, and prognostic characteristics (Choi *et al.,* 2024). For more than 20 years, cytokines like interleukin 2 (IL-2) and interferon alpha (INFa) were the standard of care for mRCC; however, low response rates, little survival advantages, and severe toxicity led to the emergence of substitute therapeutic alternatives (Hawkins *et al.,* 2020). The anticancer action of IL-2 and INFa, as well as the discovery of spontaneous remission of metastatic disease following removal of the primary RCC, led to an understanding of RCC as an immunogenic tumor (Bosma *et al.,* 2022; Mohd *et al.,* 2022). As a result, the notion of immunoscore (the measurement of specific lymphocytes in the tumor center) was created as a prognostic indicator to assist identify patients who might benefit from immunotherapy and forecast the chance of recurrence (Naik *et al.,* 2024).

In the last five years, there have been notable advancements in the treatment of mRCC due to the growing understanding of the molecular basis of RCC (Frazer *et al.,* 2024). For patients at favorable risk, combined immunotherapy (IO) and tyrosine kinase inhibitors (TKI) or TKI monotherapy are now recommended by updated recommendations for the first-line care of mRCC. For patients at intermediate and poor risk it is advised to use dual IO-IO or IO-TKI (Bosma *et al.,* 2022).

Given the large proportion of advanced illness, our analysis finds that the use of systemic treatment is restricted (TKI, 38%, and IO, 5.6%). The majority of patients with advanced illness cannot access or afford these modalities, which might contribute to the worse outcome by raising the disease's mortality rate.

The limitations of this study on renal cancer in Eastern Sudan primarily stem from its retrospective nature, which inherently depends on the accuracy and completeness of pre-existing medical records. Unfortunately, deficient documentation in many patient files posed a significant challenge, leading to potential gaps in critical data such as detailed clinical histories, diagnostic evaluations, and follow-up outcomes. Moreover, the reliance on historical data limits the ability to control for confounding variables, potentially affecting the robustness of the findings. These limitations highlight the need for improved record-keeping systems and prospective studies in the future to provide more comprehensive insights into renal cancer in this region.

CONCLUSIONS

This study provides valuable insights into the clinical characteristics, and treatment outcomes of RCC at EOC in Sudan. A significant proportion of patients presented with advanced-stage disease, reflecting potential delays in diagnosis and limited access to oncology services. Despite surgical intervention and systemic therapy, survival outcomes remain suboptimal compared to reports from high-resource settings. These findings emphasize the urgent need for improved awareness, early detection strategies, and enhanced treatment accessibility for RCC patients in Sudan. Future studies with larger cohorts and prospective designs are recommended to further understand RCC progression and optimize management strategies in similar low-resource environments.

Aknowledgement

We would like to acknowledge the faculty of Medicine, Gadarif University, and the deanship of scientific research at Prince Sattam bin Abdulaziz University for supporting this work.

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