ORIGINAL ARTICLE

DIAGNOSTIC ACCURACY OF CONTRAST ENHANCED CT FOR DETECTION OF RENAL CELL CARCINOMA TAKING HISTOPATHOLOGY AS GOLD STANDARD

Faiza Akram[1], Arfa Mazhar[2], Hamza Javed[3], Muhammad Fayyaz[4], Ayub Khan[5], Khalil Ahmad[6]

[1]Department of Radiology, Ayub Medical College, Abbottabad, [2]Department of Radiology, King Abdullah Teaching hospital, Mansehra, [3]Pakistan Red Crescent Society, [4]Dentistry Department Ayub Medical College, Abbottabad, [5]Health Department, Government of KP-Pakistan, [6]Free lancer

Background: Renal cell carcinoma being the commonest primary renal malignancy of adulthood accounts for approximately 80–90% renal malignant lesions. The purpose of radiological imaging modalities when devising the treatment options for renal masses is crucial as it significantly influence the clinical outcome and prognosis of the disease. Subjective impression by a radiologist for diagnosing a mass lesion is known to be critical and its precision is improved by contrast enhanced CT as demonstrated by certain retrospective analyses. We aimed to ascertain the diagnostic accuracy of contrast enhanced computed tomography to diagnose renal cell cancers by verifying through histopathology reported diagnoses. **Methods:** This Cross-sectional (validation) study was carried out in Radiology and Urology departments of Ayub Teaching Hospital; Abbottabad, from 1st November 2020 to 30th April 2022. The study population included all admitted symptomatic patients with age range 18–70 years of either gender. The patients were subjected to detailed clinical examination and history and an ultrasound and contrast enhanced CT abdomen and pelvis. CT scans were reported under supervision of single consultant radiologist. Data was analysed in SPSS version 20.0. **Result:** Mean age of the patients was 38.88±11.62 years ranging from 18–70 years and mean duration of symptoms was 54.64±49.171 ranging from 3–180 days. All of the total 113 patients underwent contrast enhanced CT scan and later operated to confirm the diagnoses by histopathology. The comparison yielded true positive (TP) cases to be 67, True Negative (TN) 16, False Positive (FP) 26, and 4 False Negative (FN) as per CT scan diagnoses. CT scan had a diagnostic Accuracy of 73.45% with 94.37% sensitivity and 38.10% specificity. **Conclusion:** Contrast-enhanced CT has a high sensitivity for making the diagnosis of renal cell carcinoma; however, its specificity is low. A multidisciplinary approach is necessary to overcome the low specificity. Therefore, collaboration between radiologists and urologic oncologists should be considered while devising treatment plan for patients.

Keywords: Validity parameters; Diagnostic Accuracy; Renal cell carcinoma; Contrast enhanced CT; Histopathology

Citation: Akram F, Mazhar A, Javed H, Fayyaz M, Khan A, Ahmad K. Diagnostic accuracy of contrast enhanced CT for detection of renal cell carcinoma taking histopathology as gold standard. J Ayub Med Coll Abbottabad 2023;35(1):84–7.

DOI: 10.55519/JAMC-01-11432

INTRODUCTION

Renal cell carcinoma (RCC) being the most frequently encountered primary renal system malignancy of adulthood accounts for approximately 80–90% renal malignant lesions.[1] About 3.38 hundred thousand cases of RCC are diagnosed annually globally.[2] Majority of the patients of RCC are asymptomatic but can present with a multitude of symptoms as the tumour metastasize.[3] Increased incidental findings of RCC and other abdominal malignancies have been reported in the recent past due to more often use of imaging modalities, especially renal masses of <4 cm.[4,5] Screening computed tomography (CT) of 3000 patients done for screening colonic pathologies reported an incidental finding of renal lesion of >1 cm size in 14% of their study sample.[6]

Almost every imaging modality has limitation of being unable to reliably differentiate between benign or malignant nature of any lesion as well as extent of spread of the tumor.[7,8] imaging modalities of choice for renal system includes ultrasonography, CT and magnetic resonance imaging (MRI).[9,10] Contrast enhanced CT scans are preferred for assessing the stage of renal lesions as it can better characterize the extent of spread of renal lesion as well as the nature of the mass being solid or cystic.[11,12] About 90% of the malignant renal lesions are RCC.[13,14] Most common type of RCC is clear cell (75%), then papillary carcinoma (7–15%) and chromophobe RCC (≈5%), while distal ducts and

medullary region carcinomas to gather accounts for <1% of the tumours.[7,15,16] RCC are locally invasive tumours that can metastasize and the most common sites for metastasis is regional lymphatics, lungs, bone, liver and brain etc.[4,17]

The purpose of radiological imaging modalities when devising the treatment options for renal masses is crucial as it significantly influence the clinical outcome and prognosis of the disease.[6] So far diagnostic accuracy and staging precision of kidney tumours has been scrutinized and explored by using various investigative modalities, including ultrasonography, MRI and CAT scan.[18,19] Subjective impression by a radiologist for diagnosing a mass lesion is known to be critical and its precision is improved by contrast enhanced CT as demonstrated by certain retrospective analyses.[9,10,20,21] CT, being the conventional prime imaging modality for the work-up of RCC, furnish exceptional anatomical details by giving virtual stereoscopic reconstructed images.[4,12]

We aimed to ascertain the diagnostic accuracy of contrast enhanced computed tomography to diagnose renal cell cancers by verifying through histopathology reported diagnoses. The outcomes from our data may provide evidence to support the use of contrast enhanced CAT scan as radiological modality of choice for pre-surgery assessment of renal cell malignancy and thus machinate a prim management plan in order to reduce the associated morbidity and mortality.

MATERIAL AND METHODS

This Cross-sectional (validation) study was carried out in Radiology and Urology departments of Ayub Teaching Hospital; Abbottabad, from 1st November 2020 to 30th April 2022. A sample size of 113 was calculated using the Epiinfo web-based sample size calculator. After obtaining approval from the hospital medical ethics committee, data was collected using non-probability consecutive sampling technique from all symptomatic patients aged 18–70 years, presenting to urology and radiology departments of ATH during the study period. Patients known to have solitary kidney, CRF or patients on dialysis were excluded from this study. The purpose, benefits and risks involved in study as well as the purpose of the research were rationalized to the patients. When agreed upon, written educated consent was acquired from the patients. All patients were subjected to detailed clinical examination and history and ultrasound abdomen and pelvis. Once ultrasound was done, the patients were referred to contrast enhanced CT scan. Departmental protocols were followed for performing the contrast enhanced CT. All CT scans were reported under supervision of single expert radiologist having minimum experience of 5 years. After surgery, histopathology was performed and a copy of the report was obtained to compare the CT diagnoses with the gold standard. All the above-mentioned data was jotted down on a pre-designed *proforma.*

Data was analysed using SPSS version 20.0. Mean and standard deviation were calculated for continuous variables, while frequency and percentages were calculated for categorical variables. Diagnostic validity of contrast enhanced CT with regard to sensitivity, specificity; positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy were calculated from a 2x2 table by taking histopathology as gold standard.

RESULTS

Among 113 patients included, 48.7% (55) were male and 51.3% (58) were female. The mean age of the study participants was calculated at 38.88±11.62 years. Our study population in the age range of 31–70 years was 70.8% while the mean duration of symptoms was 54.64±49.171 days, as shown in table-1.

Figure-1 shows the frequency of main signs and symptoms with which patients presented to the urology clinic. The most common symptom was flank pain present in 90% patients while least common symptom was weight loss found in 49% patients.

Table-2 shows the cross tabulation between frequency of diagnosis of renal carcinoma on CT versus the frequency of diagnosis on histopathology. Out of the total 113 patients, 67 were true positive (TP), 16 True Negative (TN), 26 False Positive (FP), and 04 False Negative (FN) as per CT scan-based diagnoses.

Table-3 shows the validity parameters of CT scan to diagnose a case of renal mass as renal carcinoma. These parameters were calculated by comparing the CT based diagnoses with the gold standard that is histopathology. We found that CT scan had a diagnostic Accuracy of 73.45% with 94.37% sensitivity and 38.10% specificity.

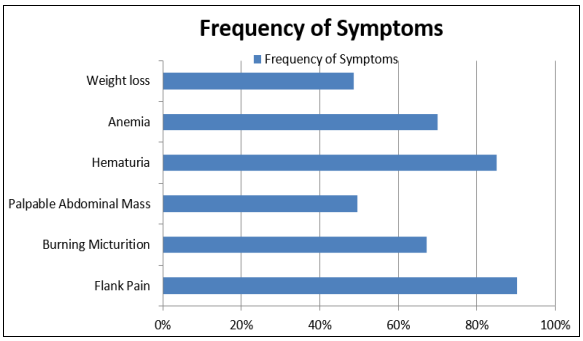

Figure-1: Frequency of main signs and symptoms

Table-1: Age distribution and duration of symptoms (in days)

Parameters	N	Min	Max	Mean	Std. Deviation
Age	113	18	70	38.88	12.620
Duration (days)	113	3	180	54.64	49.171

Table-2: Cross tabulation of diagnosis on CT with histopathology

Diagnosis on CT	Diagnosis on Histopathology		Total
	Present	Absent	
Present	67	26	93
Absent	4	16	20
Total	71	42	113

Table-3: Validity parameters of CT for diagnosis of renal carcinomas

Sensitivity	94.37%
Specificity	38.10%
PPV	72.04%
NPV	80.00%
Accuracy	73.45%

DISCUSSION

The mean age of the patients was 38.88±12.620 ranging from 18–70 years and mean duration of symptoms was 54.64±49.171 ranging from 3–180 days while in frequency of age group, 33 (29.2%) were from age group of 18–30 years and 80(70.8%) were from age group of 31–70 years. The frequency of gender there were 55 (48.7%) male and 58 (51.3%) female. These findings are in correlation with the current literature.[10,14]

In our study, the sensitivity of the CT scan was 94.37% and Specificity was 38.10%. The positive and negative predictive values were 72.04% and 80.88% respectively. The overall diagnostic accuracy of CT scan was calculated to be 73.45%. Our results are very close to the so far published literature. A study conducted by Jae Heon Kim *et al*., in the Soonchunhyang University hospital, included 68 patients found that 60 (88.2%) of them had RCC and eight had innocuous disease. The sensitivity and specificity of contrast enhanced CT for predicting RCC was found to be 79.7% and 44.4% respectively and the diagnostic accuracy rate of contrast enhanced CT was 79.41%.[22] A systematic review article assessed the diagnostic performance of contrast enhanced CT for renal cancers and reported the median sensitivity and specificity to be 88% (interquartile range [IQR] 81–94%) and 75% (IQR 51–90%).[23]

Alejandro Sanchez *et al* in their review article on management of small renal masses suggested that a multiphasic enhanced imaging modality such as MRI or CT should be used for the initial workup of renal masses.[4] Although, the sensitivity of CT scan to detect a renal carcinoma is high, but the specificity is very low. Therefore, one can miss a serious renal cancer using just CT scan as a modality for diagnosis of a renal lesion. Therefore, collaboration between radiologists and urology oncologists should be considered while devising treatment plan for patients with renal malignancy.

CONCLUSION

Contrast-enhanced CT has a high sensitivity for making the diagnosis of renal cell carcinoma; however, its specificity is low. A multidisciplinary approach is necessary to overcome the low specificity. Therefore, collaboration between radiologists and urology oncologists should be considered while devising treatment plan for patients.

AUTHORS' CONTRIBUTION

FA, AM: Conceptualization of the study design, proof reading. HJ, MF: Data collection, data analysis, data interpretation. AK, KA: Data collection, write-up.

REFERENCES

1. Surveillance Epidemiology and End Results. SEER Stat Fact Sheets. [Internet]. National Cancer Institute. [cited 2021 Feb 18]. Available from: http://seer.cancer.gov/statfacts/html/kidrp.html
2. Ursprung S, Beer L, Bruining A, Woitek R, Stewart GD, Gallagher FA, *et al*. Radiomics of computed tomography and magnetic resonance imaging in renal cell carcinoma—a systematic review and meta-analysis. Eur Radiol 2020;30(6):3558–66.
3. Ljungberg B, Albiges L, Abu-Ghanem Y, Bensalah K, Dabestani S, Fernández-Pello S, *et al*. European association of urology guidelines on renal cell carcinoma: the 2019 update. Eur Urol 2019;75(5):799–810.
4. Coy H, Hsieh K, WU W, Nagarajan MB, Young JR, Douek ML, *et al*. Deep learning and radiomics: the utility of Google TensorFlow™ Inception in classifying clear cell renal cell carcinoma and oncocytoma on multiphasic CT. Abdom Radiol 2019;44(6):2009–20.
5. van Oostenbrugge TJ, Fütterer JJ, Mulders PFA. Diagnostic Imaging for Solid Renal Tumors: A Pictorial Review. Kidney Cancer 2018;2(2):79–93.
6. Deng Y, Soule E, Samuel A, Shah S, Cui E, Asare-Sawiri M, *et al*. CT texture analysis in the differentiation of major renal cell carcinoma subtypes and correlation with Fuhrman grade. Eur Radiol 2019;29(12):6922–9.

7. Nakashima K, Kitagawa Y, Izumi K, Mizokami A, Gabata T, Namiki M. Diagnostic accuracy of pre-operative imaging findings in presumed clinical T1a renal cell carcinomas. Oncol Lett 2016;11(5):3189–93.
8. Rossi SH, Prezzi D, Kelly-Morland C, Goh V. Imaging for the diagnosis and response assessment of renal tumours. World J Urol 2018;36(12):1927–42.
9. Sankineni S, Brown A, Cieciera M, Choyke PL, Turkbey B. Imaging of renal cell carcinoma. Urol Oncol 2016;34(3):147–55.
10. Schieda N, Lim RS, Krishna S, McInnes MD, Flood TA, Thornhill RE. Diagnostic accuracy of unenhanced CT analysis to differentiate low-grade from high-grade chromophobe renal cell carcinoma. Am J Roentgenol 2018;210(5):1079–87.
11. Schieda N, Lim RS, McInnes MD, Thomassin I, Renard-Penna R, Tavolaro S, *et al*. Characterization of small (<4 cm) solid renal masses by computed tomography and magnetic resonance imaging: Current evidence and further development. Diagn Interv Imaging 2018;99(7-8):443–55.
12. Nie P, Yang G, Wang Z, Yan L, Miao W, Hao D, *et al*. A CT-based radiomics nomogram for differentiation of renal angiomyolipoma without visible fat from homogeneous clear cell renal cell carcinoma. Eur Radiol 2020;30(2):1274–84.
13. Pozzessere C, Bassanelli M, Ceribelli A, Rasul S, Li S, Prior JO, *et al*. Renal cell carcinoma: the oncologist asks, can PSMA PET/CT answer? Curr Urol Rep 2019;20(11):68.
14. Moch HP, Ulbright TM, Reuter V. WHO Classification of Tumours of the Urinary System and Male Genital Organs. Lyon, France: International Agency for Research on Cancer. Eur Urol 2016;70(1):93–105.
15. Moch H, Cubilla AL, Humphrey PA, Reuter VE, Ulbright TM. WHO Classification of Tumours of the Urinary System and Male Genital Organs. 4th Edition. Lyons, France: IARC, 2016; p.14–43.
16. Salameh JP, McInnes MD, McGrath TA, Salameh G, Schieda N. Diagnostic accuracy of dual-energy CT for evaluation of renal masses: systematic review and meta-analysis. Am J Roentgenol 2019;212(4):W100–5.
17. Sanchez A, Feldman AS, Hakimi AA. Current management of small renal masses, including patient selection, renal tumor biopsy, active surveillance, and thermal ablation. J Clin Oncol 2018;36(36):3591.
18. Sanyal SR, Arora A, Nisreen A, Mohamed K, Mohammad SK, Baruah D. Imaging Tips and Tricks in Management of Renal and Urothelial Malignancies. Indian J Radiol Imaging 2022;32(2):213–23.
19. Rosa F, Verardo I, Barbagallo S, Perugin G, Martinetti C, Basso L, *et al*. A practical guide for a correct staging of renal cancer: what urologists want to know. [Internet]. European Congress Radiology-ECR 2019/ C-1015 [cited 2021 Dec 28];2498 words. Available from: https://epos.myesr.org/esr/poster/10.26044/ecr2019/C-1015
20. Chiarello MA, Mali RD, Kang SK. Diagnostic accuracy of MRI for detection of papillary renal cell carcinoma: A systematic review and meta-analysis. AJR Am J Roentgenol 2018;211(4):812–21.
21. Wang ZJ, Westphalen AC, Zagoria RJ. CT and MRI of small renal masses. Br J Radiol 2018;91(1087):20180131.
22. Kim JH, Sun HY, Hwang J, Hong SS, Cho YJ, Doo SW, *et al*. Diagnostic accuracy of contrast-enhanced computed tomography and contrast-enhanced magnetic resonance imaging of small renal masses in real practice: sensitivity and specificity according to subjective radiologic interpretation. World J Surg Oncol 2016;14(1):260.
23. Vogel C, Ziegelmüller B, Ljungberg B, Bensalah K, Bex A, Canfield S, *et al.* Imaging in suspected renal-cell carcinoma: systematic review. Clin Genitourin Cancer 2019;17(2):e345–55.

Submitted: October 17, 2022	*Revised: December 16, 2022*	*Accepted: December 23, 2022*

Address for Correspondence:

Arfa Mazhar, Department of Radiology, King Abdullah Teaching hospital, Mansehra-Pakistan
Email: bato.jani@gmail.com