

## ORIGINAL ARTICLE

## RENAL CELL CARCINOMA: MRI AND HISTOPATHOLOGICAL SUBTYPE CORRELATION

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## ABSTRACT

**Introduction:** Renal cell carcinoma (RCC) is the most common malignant tumor involving the kidney. Approximately 40% of patients with RCC eventually die from progression of this disease, making it the most lethal urologic malignancy. Determining the subtypes of RCC is among major goal in preoperative radiological work up in further management. MRI has advantages of having inherent soft tissue contrast, detection of blood and lipid products and excellent sensitivity to detect small amounts of intravenous contrast.

**Methodology:** In this article, study of histopathological and MRI imaging features of various subtypes of RCC is discussed emphasizing role of MRI in characterization and presurgical staging of renal masses.

**Results:** MRI is particularly helpful in evaluating small lesions which cannot be studied by Ultrasonography (USG) or Computed tomography (CT). Percutaneous biopsy is a minimally invasive method to diagnose renal tumors with accuracy upto 70 to 90%. Apart from diagnosing lesions, MRI along with histopathological subtype is very crucial to decide severity and prognosis of RCC and to guide treatment protocol.

**Conclusion:** RCC is divided into various subtypes according to histopathological examination like clear cell, papillary, collecting duct, chromophobe, multilocular cystic and unclassified variety. Accurate characterization of renal masses is essential to ensure appropriate case management and to assist in staging and prognosis.

**Keywords:** Renal cell carcinoma (RCC), Magnetic resonance imaging (MRI), Clear cell carcinoma, Tumor to cortex enhancement index, Bosniak grading system

## INTRODUCTION

Renal masses are being discovered with increasing frequency due to the large number of cross sectional studies being performed in clinical practice<sup>1</sup>. Determining the histopathological subtype of renal cell carcinoma better guides further management of tumor<sup>2</sup>. MRI study of renal mass helps not only determining histopathological subtype of RCC but also differentiates the renal cell carcinoma from metastasis in kidneys which significantly changes further diagnostic algorithm for the patient and guides physician to go for other diagnostic tool for primary detection<sup>3</sup>. Comparison of pre and post contrast T1-weighted images is the key to the detection and characterization of renal mass<sup>4</sup>. Determining the subtypes of RCC is essential for predicting prognosis and managing therapeutic strategies<sup>6</sup>. In the preoperative radiological work-up, MRI is the best modality for providing important information to diagnose RCC subtypes<sup>7</sup>. MRI is also helpful in detecting recurrence of RCC from new malignancy in patient treated with partial nephrectomy or kidney salvageable therapeutic management with or without chemotherapy taken<sup>8</sup>.

## METHODOLOGY

Patients presenting with complaints of hematuria, abdominal pain or abdominal lump went under screening procedures and diagnosed as renal mass.

We reviewed MR imaging findings and pathological diagnoses in 50 patients encountered over period of 1 year in our institution. MR imaging examinations are performed with a phased array body coil with the patient supine. Each examination includes coronal half Fourier single-shot fast spin echo image (MAGNETOM Essenza 1.5 Tesla MRI Scanner from SIEMENS at AatmaJyoti MRI Centre, New Civil Hospital, Surat) There are three indispensable components of renal MRI: breath hold imaging, three dimensional (3D) gradient echo pulse sequence and fat detection techniques<sup>1</sup>. The detection of fat is critical in characterizing renal masses<sup>2,3</sup>. Macroscopic fat is assessed using frequency selective fat suppression techniques<sup>4</sup>, intracytoplasmic vacuoles containing lipids, is assessed using chemical shift imaging, available only in gradient-echo imaging<sup>5</sup>.

Exclusion criteria: Patient with pacemaker implant, prosthetic cardiac valve implants, claustrophobia and allergy to contrast.

**RESULTS**

We studied MRI imaging features and histo-pathological diagnosis in 50 patients with RCC. Maximum number of patients were from age group of 70 to 80 years. There were 32 males and 18 females among study groups.

**Table 1: Age and Gender wise distribution of patients**

Age group (years)	Male	Female	Total
< 20	2	0	2
20 – 30	1	1	2
30 – 40	3	1	4
40 – 50	5	3	8
50 – 60	6	4	10
60 – 70	7	4	11
70 – 80	8	5	13

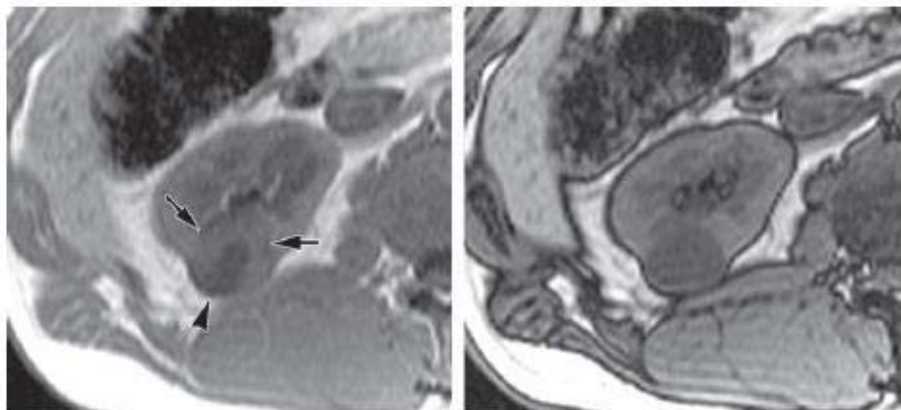
Clear cell subtype is most common subtype diagnosed in highest 30 patients. Papillary subtype was diagnosed in eight patients. Five patients had chromophobe variety whereas multilocular cystic variety was detected

in four patients. Two patients had unclassified variety. Collecting duct variant is rare and diagnosed only in single patient.

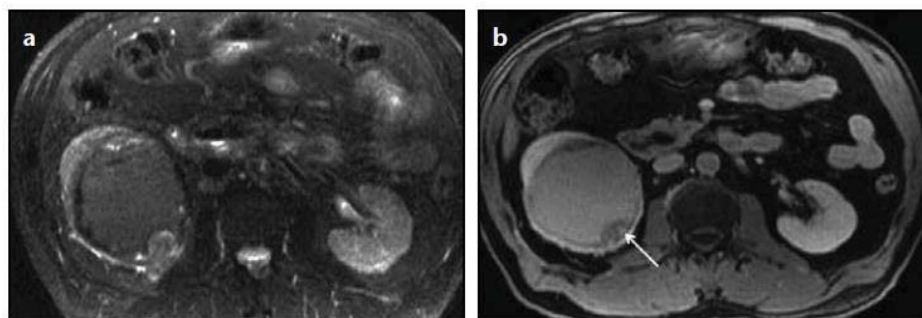
**Table 2: Subtype of Renal cell carcinoma**

	No. (%)
Clear cell	30 (60)
Papillary	8 (16)
Chromophobe	5 (10)
Multilocular cystic	4 (8)
Unclassified	2 (4)
Collecting duct	1 (2)

MRI is particularly helpful in evaluating small lesions which cannot be studied by Ultrasonography (USG) or Computed tomography (CT). Percutaneous biopsy is a minimally invasive method to diagnose renal tumors with accuracy upto 70 to 90%. Apart from diagnosing lesions, MRI along with histopathological subtype is very crucial to decide severity and prognosis of RCC and to guide treatment protocol.



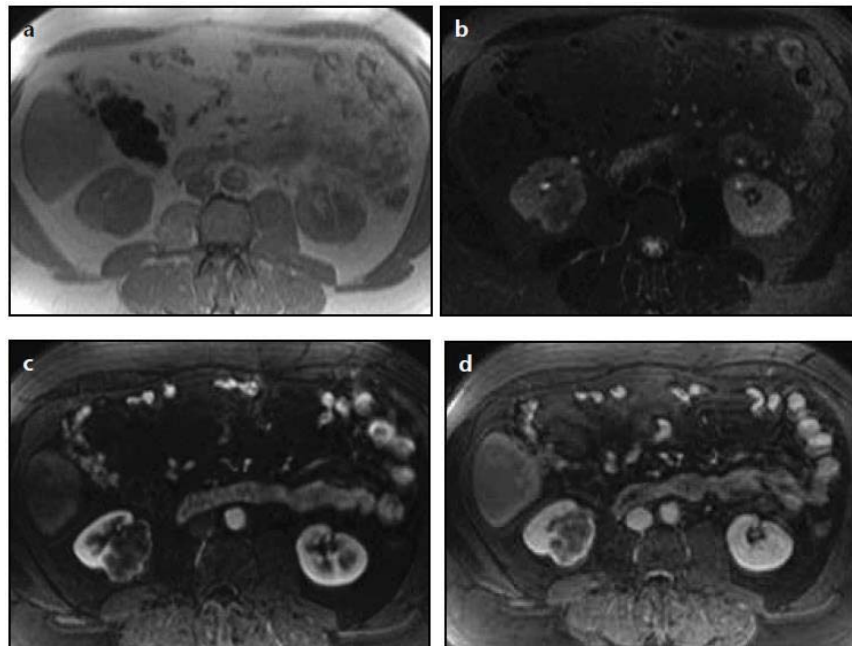
**Figure 1. Clear cell RCC (a)** Axial in-phase T1-weighted MR image shows a right renal mass with a thick rim of tumor with signal intensity of the rim is similar to that of the renal cortex and central lowsignal- intensity area. **(b)** On an axial opposed-phase T1-weighted MR image, the mass appears homogeneous and is hypointense relative to the renal cortex.



**Figure 2. Papillary RCC a, b.** Axial T2-weighted STIR turbo spin echo **(a)** and axial postcontrast VIBE **(b)** images show a rhabdoid variant of papillary RCC. A huge hemorrhagic right renal mass with solid mural component is observed **(a, b)**. There is heterogeneous signal intensity on T2-weighted image **(a)**. On postcontrast there is minimal heterogenous enhancement of the mural nodule **(b, arrow)**.



**Figure 3. Transitional Cell Carcinoma** (a) Thin-section 3D T1-weighted view of the right kidney on a coronal subtraction image shows enhanced filling defects within the renal pelvis (arrows) (b) T2-weighted MR urogram shows filling defects in the renal pelvis (arrow) and lower ureter (small arrowheads). Note the dilatation of the ureter (large arrowhead) distal to the filling defects (“goblet sign”).



**Figure 4. Collecting duct RCC** Axial T1-weighted GRE (a), T2-weighted STIR turbo spin echo (b), and axial postcontrast 3D VIBE (c, d) images show a collecting duct RCC. A right mid-lower pole renal mass with ill-defined borders slightly protruding through the pelvicalyceal system. It is slightly hypointense on T1-weighted GRE (a) and hypointense on T2-weighted image (b) compared with the renal cortex. Heterogenous enhancement at the periphery of the lesion is prominent, and delayed enhancement is demonstrated on postcontrast images (c, d).

## DISCUSSION

We studied MRI imaging features and histopathological diagnosis in 50 patients with RCC. Clear cell subtype is most common subtype diagnosed in highest 30 patients. Papillary subtype was diagnosed in eight patients. Five patients had chromophobe variety whereas multilocular cystic variety was detected in four patients. Two patients had unclassified variety. Collecting duct variant is rare and diagnosed only in

single patient. Male patients were 37 while 13 female patients had renal cell carcinoma. Incidence of carcinoma was increased with increasing age with median age 52 years.

Clear cell variant is responsible for 70% of all RCC with unfavorable prognosis<sup>6</sup> with 30 patients detected. Multicentricity and bilaterality are rare (5%) in sporadic cases.<sup>7</sup> Necrosis, hemorrhage and cysts are the



main causes of varying appearances on MRI. Postcontrast images demonstrate a lack of enhancement in areas of necrosis and marked enhancement in the viable components of the tumor<sup>9</sup>. Considerable loss of signal intensity within the solid portions of clear cell RCCs on opposed phase images compared with in-phase images is detected in up to 60% of clear cell RCC<sup>10</sup>. In contrast-enhanced MRI with heterogeneous enhancement in the arterial phase continuing with or without washout, the degree of contrast enhancement may help distinguish clear cell RCC from non-clear cell subtypes. Papillary RCC tend to be solid, large, well-defined, and slow-growing tumors<sup>11</sup>. They frequently exhibit bilaterality (4%) and/or multifocality (22.5%). It exhibits hypointensity and provides an accurate distinction from clear cell RCC, which typically exhibits heterogeneously increased signal intensity on T2-weighted images<sup>12</sup>. A fibrous capsule is typically present in papillary RCCs<sup>13</sup>. Papillary RCC shows hypo- or avascularity on angiography<sup>14</sup>. Chromophobe RCC is the third most common subtype and accounts for approximately 4%–11% of RCCs. They might appear hypointense on T2-weighted images compared with renal parenchyma<sup>15</sup>. Cystic changes can be observed within a solid tumor, and central necrosis might be absent, even in very large chromophobe carcinomas.<sup>16</sup> Collecting duct carcinoma is rare, accounting for less than 1% of cases, and an aggressive RCC subtype. This carcinoma has a very unfavorable prognosis.<sup>17</sup> Almost all tumors exhibit focal cortical extension, and some even exhibit perirenal extension<sup>18</sup>. They have a tendency to display infiltrative patterns, preserving renal contour rather than an expansile growth. Unclassified variety is a diagnostic category for RCC that does not fit readily into any other category and is a diagnosis of exclusion. It accounts for 4%–5% of RCC subtypes. There are some features that may help identify a tumor as unclassified: sarcomatoid cells without recognizable epithelial elements, mucin production, mixtures of epithelial and stromal elements, and unrecognizable cell types. This category has the worst prognosis among RCC subtypes. Multilocular cystic RCC is characterized by septated, variable-sized cysts separated from the kidney by a fibrous capsule<sup>20</sup>.

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