

Diagnostic Imaging Pathways - Renal Cell Cancer (Staging)

Population Covered By The Guidance

This pathway provides guidance on the staging of adult patients with renal carcinoma confirmed by biopsy or previous imaging.

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Quick User Guide

Move the mouse cursor over the **PINK** text boxes inside the flow chart to bring up a pop up box with salient points.

Clicking on the **PINK** text box will bring up the full text.

The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

Pathway Diagram

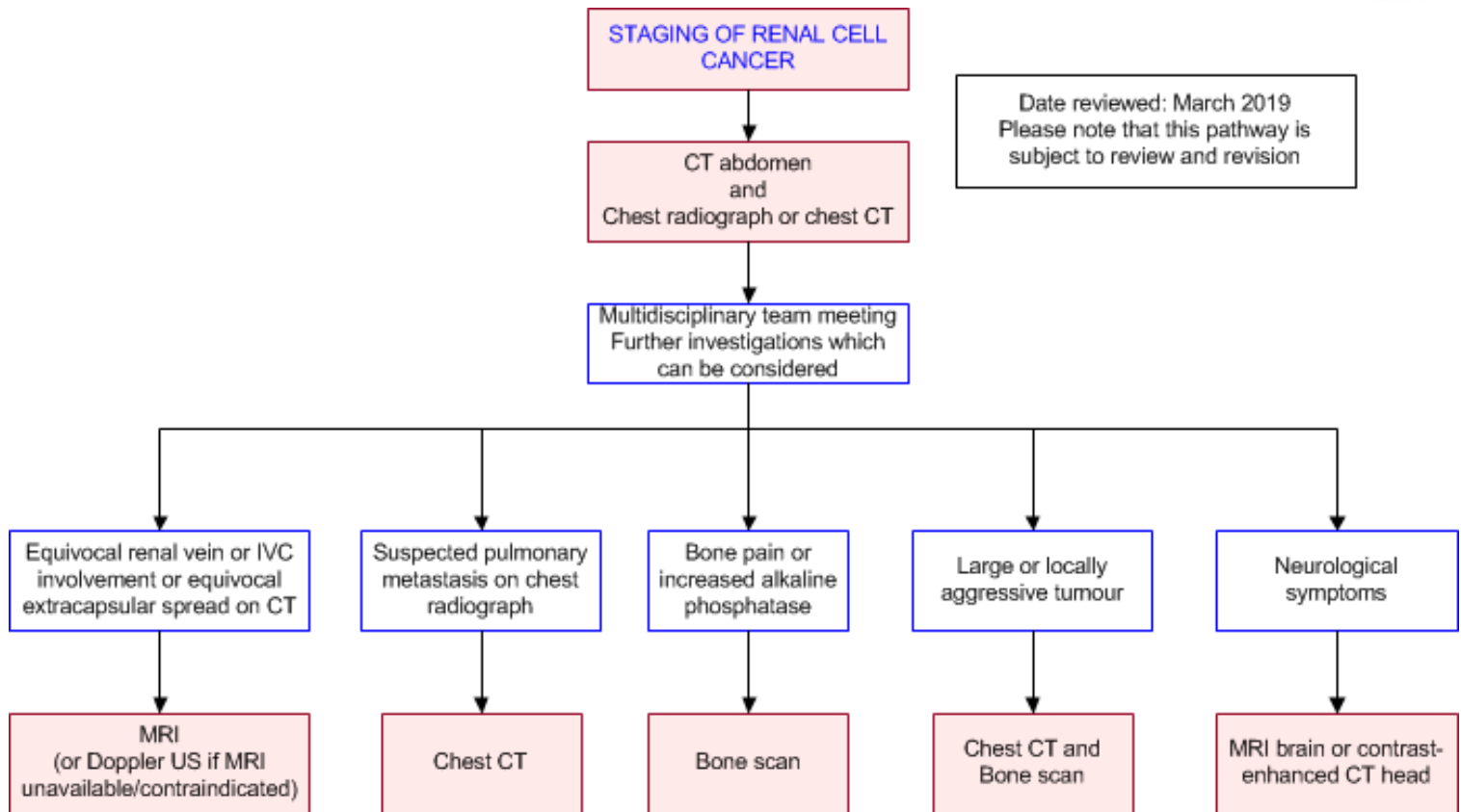


Image Gallery

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Renal Cell Carcinoma

Image 1 (Computed Tomography): Large right kidney mass with central necrosis consistent with renal cell carcinoma. There is tumour extension into the right renal vein (arrow).

2a



Renal Cell Carcinoma

Image 2a: Nephrectomy showing a circumscribed and encapsulated renal cell carcinoma arising from the lower pole of the kidney. The cut surface shows a heterogeneous appearance typical of malignancy with patchy areas of necrosis (blue arrow) and haemorrhage (red arrow).

2b



Image 2b (H&E, x10): Histological section of a conventional clear cell renal cell carcinoma showing sheets and nests of malignant cells with intervening thin-walled vessels. The cells demonstrate irregular and hyperchromatic nuclei surrounded by abundant clear cytoplasm (clear cells).

Teaching Points

- Imaging plays a key role in renal cell carcinoma (RCC) staging to plan the most appropriate therapy
- The American Joint Committee on Cancer's Tumour, Node, Metastasis (TNM) classification is currently the most widely used staging system [1-3](#)
- Contrast-enhanced CT of the abdomen is the primary investigation in RCC staging [4,5](#)
- MRI has a similar staging accuracy to CT, however, it is generally only used when CT is contraindicated, for further tumour characterisation when findings are equivocal on CT, or in patients who require recurrent imaging (e.g. young patients with hereditary syndromes affecting the kidneys such as Von-Hippel Lindau) [4](#)
- CT of the chest is useful when there is suspicion of pulmonary metastases and is routinely performed in RCC staging at some centres [3](#)
- Most bone and brain metastases are symptomatic at diagnosis and therefore bone and brain imaging is usually only performed when indicated [3](#)

Staging of Renal Cell Carcinoma (RCC)

- Accurate pre-operative staging is important to determine the most appropriate treatment and to estimate prognosis
- The American Joint Committee on Cancer's Tumour, Node, Metastasis (TNM) classification is the most widely used RCC staging system, having largely replaced the Robson classification [6-8](#)
- Staging of the primary tumour (T stage) requires identification of the tumour: [9,10](#)
 - Location
 - Size
 - Organ confinement
 - Presence and extent of tumour invasion or thrombus into the renal vein and inferior vena cava (IVC)
- Assessment of lymph node involvement (N stage) and metastatic disease (M stage) are also important [9,10](#)
- Tumour size is critical in staging RCCs that are confined to the kidney
 - Smaller tumours confer a significant survival benefit over larger tumours and partial nephrectomy can be considered [6](#)
- Extrarenal tumour extension into perinephric or renal sinus fat, and venous infiltration/thrombus (T3 or higher) are negative prognostic factors [6](#)
- Metastatic lesions are found in 20-30% of patients at time of diagnosis [11](#)
- The most common sites of distant metastases are the lungs, bone, retroperitoneal and mediastinal lymph nodes, liver, and brain [6](#)
- There are a number of different histologic subtypes of tumour including: [1,12](#)
 - Clear cell (75-85%)
 - Papillary (10-15%)
 - Chromophobe (4-5%)
- Different subtypes are associated with different frequency and patterns of metastatic spread. This has implications for therapy and prognosis [3,13-15](#)



Staging of RCC (AJCC/UICC TNM classification, 7th edition) [1,16-18](#)

Primary Tumour (T)
T1
T1a
T1b
T2
T2a
T2b
T3
T3a
T3b
T3c
T4
Nodal Disease (N)
N0
N1



Metastatic Disease (M)
M0
M1

Stage I	T1N0M0
Stage II	T2N0M0
Stage III	T1-2N1M0 OR T3N(any)M0
Stage IV	T4N(any)M0 OR T(any)N(any)M1

- Treatment of RCC can include: [3.12.19-21](#)
 - Partial nephrectomy - preferred in organ-confined tumours up to 7cm (T1a-b) to better preserve general kidney function and lower the risk of developing metabolic or cardiovascular disorders
 - Radical nephrectomy - recommended for T2 and above tumours
 - Radiofrequency ablation or cryoablation to small cortical tumours - especially in patients who are frail, with high surgical risk, a solitary kidney, compromised renal function, hereditary RCC or multiple bilateral tumours
 - Active surveillance in elderly patients with significant co-morbidities or with a short life-expectancy with a solid renal tumour

Plain Chest Radiograph (CXR)

- Given that the most common site of metastasis is the lungs, staging should include imaging of the chest [2](#)
- There is current controversy as to whether this should be in the form of plain chest radiography or chest CT
- CXR is useful as a screening tool to detect pulmonary metastasis, particularly in stage T1 disease when the overall incidence of pulmonary metastases is less than 5% [6.42](#)
- Small pulmonary metastases are easily missed on chest radiographs and therefore in high-risk patients chest CT is preferred [5.6](#)
- A study by Lim et al. to evaluate the role of chest CT concluded that plain chest radiography is sufficient for pulmonary staging in patients with small tumours (T1).

For patients with a nodule on chest radiograph, with chest symptoms suggestive of endobronchial metastasis, or with extensive regional disease a chest CT is preferred [43](#)

- Current National Comprehensive Cancer Network (America) guidelines recommend a chest radiograph in the initial staging workup, however, European guidelines recommend chest CT as a routine [5,19,44](#)

Magnetic Resonance Imaging (MRI) abdomen

- MRI is generally used as a problem-solving tool rather than a first-line imaging modality for RCC staging due to its higher cost, lower availability, and increased complexity. It is also used when CT is contraindicated (e.g. pregnancy or severe allergy to iodinated contrast medium) or in patients who require recurrent imaging (e.g. young patients with hereditary syndromes affecting the kidneys such as Von-Hippel Lindau, tuberous sclerosis) [6,19,25,45](#)
- Provides excellent soft-tissue contrast resolution and similar staging accuracy to CT
 - 78-87% for MRI compared to 80-83% for CT [25,46-49](#)
- Useful in lesions that have equivocal contrast enhancement on CT and haemorrhagic lesions
- Both MRI and CT demonstrate good agreement with surgical T-stage and M-stage. They are both poor in evaluating N-stage because nodal involvement is generally based on size criteria and metastatic spread to normal sized lymph nodes is often missed [50,51](#)
- Both contrast-enhanced CT and MRI have equal sensitivity in detecting venous involvement, however, when there are equivocal findings for venous thrombus on CT, MRI may still be helpful [5,6,52](#)
- MRI is superior in assessing the cranial extent of venous thrombus as CT does not always demonstrate sufficient opacification of the IVC to accurately evaluate extension [45,53,54](#)
- MRI is superior to CT in detecting involvement of the renal capsule, perinephric fat, and Gerota's fascia. Therefore, MRI may be useful to delineate between stage T2 and T3a, as well as T3 and T4 when this is not adequately defined on CT [36,45,55](#)
- MRI can also distinguish benign from malignant renal tumours with a sensitivity of 86% and specificity of 78%, and can accurately differentiate clear cell from papillary RCCs [13,14,50,56-58](#)

Doppler Ultrasound (US)

- When venous extension is not clearly defined on CT and MRI is unavailable, Doppler US can be used as a complementary technique to assess venous extension into the renal vein, IVC or right side of the heart [59](#)
- Doppler US is, however, inferior to MRI for detecting venous thrombus with a sensitivity of 75% and specificity of 96% for US compared to 86-94% and 75-100% respectively for MRI [4](#)
- US can also be useful to differentiate solid and cystic renal masses [6,60](#)
- Limitations of US include:
 - Bowel gas and large body habitus often limit visualisation of the renal vein, IVC and retroperitoneal lymph nodes [26,45,55](#)
 - The primary mass may be incompletely visualised

- Acoustic shadowing can occur from partially calcified cysts/masses
- Haemorrhagic cysts can demonstrate variability in echogenicity
- Isoechoic small renal tumours can be missed
- US is therefore rarely used for local staging of RCC [6](#)

Computed Tomography (CT) Chest

- The lungs are the most common site for distant metastases [44](#)
- CT of the chest is the most accurate imaging modality to detect small pulmonary metastases and metastases to mediastinal lymph nodes [6](#)
- Currently, no clear consensus exists as to whether CT chest should be performed as part of the routine RCC staging workup or whether plain chest radiography is sufficient
- The European Association of Urology and the European Society for Medical Oncology guidelines recommend that all patients have a staging CT chest [19](#)
- American guidelines recommend that plain chest radiography should be performed for all patients and CT chest should be reserved for those patients with a high risk of pulmonary metastases or with suspicious findings on chest radiograph [6,44](#)
- Risk of pulmonary metastasis increases as the size of the primary tumour increases and, although there is no universally accepted criteria, chest CT is justified for larger primary tumours, when the plain chest radiograph is suspicious or positive, or when the patient has chest symptoms [5,6,44](#)
- Larcher et al. reviewed CT chest findings in 1946 patients with RCC and concluded that preoperative chest CT could be avoided in patients with favourable RCC clinical characteristics at diagnosis because of their extremely low risk of pulmonary metastases. They proposed a system of determining preoperative risk based on T stage, N stage, presence/absence of systemic symptoms, platelet and haemoglobin counts [44](#)
- They propose that patients with ? T1b tumours, patients with N1 tumours, patients with systemic symptoms or patients with anaemia and thrombocytopenia should be selected for chest CT [44](#)
- Using their cut-off criteria, a negative chest CT would be spared in 37% of cases while a positive chest CT would be missed in 0.2% of cases [44](#)

Bone Scan

- Not recommended as a routine part of RCC staging [21,61,62](#)
- Bone metastases are seen in approximately 30% of patients with metastatic disease and are symptomatic in the majority of patients [61](#)
- The European Association of Urology and National Comprehensive Cancer Network (America) guidelines recommend a preoperative staging bone scan only in patients with bony symptoms, with advanced disease, or with abnormal laboratory findings (e.g. elevated alkaline phosphatase) [5,6,26,61](#)
- Based on these guidelines, however, the decision to perform a bone scan remains a subjective assessment [61](#)
- Larcher et al. performed a study of 2008 patients with RCC to determine the risk of a positive bone scan using preoperative variables such as T stage, N stage, presence/absence of symptoms, platelet and haemoglobin counts. They determined that when performing bone scans only in those patients with an estimated risk of a

positive result of 5% or above, negative bone scans could be avoided in 80% of patients and 2% of positive bone scans would be missed [61](#)

MRI brain or contrast-enhanced CT scan of the head

- Brain metastases are seen in up to 17% of patients with metastatic RCC and most of these patients have neurological symptoms [6](#)
- Therefore patients with acute neurological signs or symptoms should have a MRI of the brain or a contrast-enhanced CT scan of the head [5,6](#)
- There is no evidence to justify the routine use of brain MRI, however, it can be used to detect asymptomatic occult brain metastases in patients who have advanced RCC [6](#)

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	Ultrasound



	Nuclear Medicine Nuclear Medicine Bone Scan
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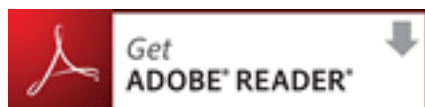
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