

# Recommendations for cross-sectional imaging in cancer management, Second edition

Bladder cancer and other urothelial tumours

Faculty of Clinical Radiology

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## Bladder cancer

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### Clinical background

Bladder cancer is the most common tumour of the urinary tract. It is usually a disease of the 6th and 7th decades, and the incidence is rising. More than 90% of tumours are transitional cell carcinomas (TCC) involving the lateral bladder walls and trigone; adenocarcinomas are often associated with a patent urachus. Approximately one-third of patients have multifocal disease at presentation, and the entire mucosa is considered as being unstable (that is, field changes are present). The latter is associated with an increased risk of developing invasive and recurrent disease.

Superficial, non-invasive bladder tumours may be treated with local therapy such as cystoscopic resection, diathermy, or intravesical chemotherapy. Invasive disease confined to the bladder wall or with minimal extravesical spread is suitable for treatment by cystectomy alone. However, with more advanced disease, combination treatment with chemotherapy and/or radiotherapy may be used to downstage disease before surgery, or with palliative intent.

Regional nodal spread is to the nodes of the true pelvis; that is, the internal and external iliac groups. Nodal spread to the common iliac or retroperitoneal groups is regarded as metastatic.

### Who should be imaged?

Once a diagnosis of invasive bladder cancer has been established from cystoscopic biopsy, the imaging modality for formal staging depends on treatment intent. If patients are considered suitable for radical treatment, MRI is the preferred modality. Where there is suspicion of locally advanced or metastatic disease precluding radical treatment, CT is recommended.

### Staging objectives

To identify evidence of:

- Full thickness mural involvement by tumour
- Extent of extravesical tumour spread
- Regional lymph node involvement
- Metastatic adenopathy
- Evidence of peritoneal dissemination of disease.

### Staging

MRI is superior to CT for staging bladder cancer, due to its ability to demonstrate muscle wall invasion or penetration. Its multiplanar imaging capacity allows assessment of tumour involvement of adjacent organs. MRI is the imaging modality of choice for staging patients considered suitable for radical treatment; that is, cystectomy or radical radiotherapy. In those patients who are not suitable for radical treatment or where there is clinical suspicion of locally advanced or metastatic disease, CT of the abdomen and pelvis is suitable of staging purposes.<sup>1</sup>

#### **MRI**

MRI of the abdomen and pelvis should be performed. T2W sequences give high contrast between tumour and intravesical urine while T1W images give sharp demarcation of the outer contour of the bladder against pelvic fat. Dynamic contrast-enhanced T1W fat-saturated sequences demonstrate tumour, invasion and multifocality. Overview sequences of the pelvis and retroperitoneum assess for nodal metastases and hydronephrosis.

Anti-peristaltic agents may be helpful. An abdomino-pelvic surface coil should be used when available.

### Protocol for imaging of bladder and other urothelial tumours

Sequence	Plane	Slice thickness	Field of view	Principle observations
T1W	Axial whole pelvis	6 mm	Large	Nodal and bone assessment
T2W	Axial/coronal/sagittal – two of three orientations depending on tumour site	3–5 mm	Small	Primary tumour assessment
T1W gradient echo with fat suppression before and immediately after contrast medium	As above	3–5mm	Small (scan immediately in the arterial phase 30 seconds)	Depth of tumour invasion/transmural and extravesical spread
T2W	Axial	6 mm	Large abdomen and pelvis	Lymph nodes. Visceral metastasis, Hydronephrosis, Ascites

#### CT

Contrast-enhanced images of the abdomen and pelvis are required to assess the primary tumour, its relationship to adjacent structures, and interrogation of the retroperitoneum and pelvis for adenopathy, and the liver for the presence of metastases.

- Oral administration of 1 litre of water as a contrast agent, of which 400 ml is to be drunk immediately before going onto the scanner (see Tips).
- 100–150 ml of intravenous iodinated contrast medium injected at 3–4 ml/sec.
- MDCT is commenced at 70–80 seconds post-injection to assess the abdomen and pelvis.
- A maximum slice thickness of 5 mm is required using spiral technique.
- Using MDCT, slice thickness will depend on scanner capability. In general, sections are acquired at 1.25–2.5 mm and reformatted at 5 mm for viewing.
- For unusual histological tumour types such as small cell bladder cancers, scanning of the thorax should also be performed.

Values of  $CTDI_{vol}$  should normally be below the relevant national reference dose for the region of scan and patient group (see Appendix and

section on Radiation protection for the patient in CT in Section 2).

#### PET-CT

<sup>18</sup>F-DG PET-CT has a very limited role in the assessment of bladder cancer and other urothelial tumours as the radiotracer is excreted within urine physiologically. It may be useful in highly selected patients for assessment of metastatic ureteric carcinoma, in difficult management situations or when standard imaging is inconclusive.<sup>2</sup>

#### Follow-up

CT is the primary imaging modality for follow-up with the same protocol as above. Where combination therapy is used, timing of follow-up will be dictated by chemotherapy cycles and planned surgery. With primary surgical management, there is no clear evidence base to dictate frequency and duration of follow-up. Reassessment at six months and one year is often undertaken; subsequent imaging depends on disease status and patient symptoms.

#### Tips

- An empty bladder should be avoided, as under such circumstances it is not possible to

assess the primary tumour. For CT, the patient should be scanned with a full bladder for optimal assessment. Due to the time required for an MRI study, the bladder should only be partly full at the start of the examination, to avoid movement artefact.

- A catheterised patient should have the catheter clamped well before scanning to ensure a full bladder.
- The site of the primary tumour within the bladder will determine the optimal imaging plane. Reformatted CT images help evaluation of the dome of the bladder.
- For tumours involving the ureteric orifices, careful scrutiny for potential ureteric spread is important as this may alter management.
- If a synchronous ureteric or pelvic transitional cell cancer (TCC) is suspected, then CT urography should be performed (see below).

## Upper urinary tract tumours

### Clinical background

Upper tract transitional cell cancers (TCC) are usually suspected to be present following investigations of patients presenting with haematuria. A filling defect in the collecting system on intravenous urogram (IVU) is the typical finding of TCC; ureteroscopy and biopsy are usually undertaken to confirm the diagnosis, and CT is performed for staging the tumour. If ureteroscopy has been unsuccessful, CT is appropriate for further assessment. Nephroureterectomy is the treatment of choice for transitional tumours of the renal pelvis and ureters – either as the primary modality or in combination with chemotherapy where there is evidence of metastatic disease at staging.

### Who should be imaged?

CT is recommended in all patients with suspected upper tract TCC for both diagnostic and staging purposes. CT or MR urography should be used for imaging suspected lower ureteric tumours. The above recommendations apply regardless of treatment intent.

### Staging objectives

- To identify the primary tumour site, its size and tumour extent.
- To identify if multifocal lesions are present.
- To detect nodal metastases.
- For surveillance of the remainder of the urinary tract.

### Staging

CT urography is the imaging modality of choice for the investigation and assessment of suspected urothelial tumours involving the pelvicalyceal systems and upper ureters. This can be carried out as a full triple-phase study (pre-contrast, nephrographic phase through kidneys and delayed studies of abdomen and pelvis) or as a dual-phase injection study (see below) to reduce radiation dose.

### CT urography

Contrast-enhanced images of the abdomen and pelvis allow assessment of enhancement within the suspected primary tumour, local staging, interrogation of the retroperitoneum and pelvis for lymphadenopathy and the liver for the presence of metastases.

The entire urothelial system to the bladder base should be imaged due to the risk of multiple lesions.

#### *For upper urothelial tumours*

- Oral administration of 1 litre of water as a contrast agent and for ureteric distension, of which 400 ml to be drunk immediately before going onto the scanner (see Tips).
- Unenhanced scans through the kidney and proximal ureters are crucial to identify calculi or tumour surface calcium.
- 50–75 ml of intravenous iodinated contrast medium injected at 3–4 ml/sec. Wait six minutes and give another 50–75 ml of intravenous iodinated contrast medium injected at 3–4 ml/sec.
- MDCT of the abdomen and pelvis is commenced at 70–80 seconds after the second injection. The dual-phase injection means that the urinary tract enhancement is in a combined nephron-pyelographic phase.
- A maximum slice thickness of 5 mm is required using spiral technique.
- Using MDCT, slice thickness will depend on scanner capability. In general, sections are acquired at 1.25–2.5 mm and reformatted at 5 mm for viewing. The urinary tract, but especially the ureters should be evaluated using multi-planar rendering (MPR) images.

Values of  $CTDI_{vol}$  should normally be below the relevant national reference dose for the region of scan and patient group (see Appendix and section on Radiation protection for the patient in CT in Section 2).

### Protocol for imaging of lower urothelial tumours

Plane	Slice thickness	Field of view	Reason	Principle observations
T2W	Axial	8–10 mm	Large abdomen	Hydronephrosis and adenopathy
T2W	Axial	6–8 mm	Large pelvis Tumour extent and relationships Nodal involvement	
Heavily T2W fast spin-echo sequence	Coronal	Thick slab	Large	Identify level of ureteric obstruction
T2W	Coronal–oblique	2 mm	Small through tumour	Assess primary tumour extent

### MRI

#### *For lower urothelial tumours*

Anti-peristaltic agents may be helpful. An abdomino-pelvic surface coil should be used where available.

### Follow-up

CT is the primary imaging modality for follow-up after nephroureterectomy for upper tract TCC or where there is evidence of metastatic disease. In patients receiving systemic treatment for metastatic disease, the timing and frequency of reassessment is usually determined by chemotherapy schedules and planned surgery. For early-stage disease treated with primary surgery, there is no clear evidence base for

timing and frequency of follow-up, which is therefore often dictated by patient symptoms.

### Tips

- It is essential to review the pre-contrast images to exclude calculus disease.
- The pyelogram phase images are helpful to differentiate urothelial from renal cortical tumours.
- Saline load (oral or IV) and/or IV furosemide help ureteric distension and visualisation.
- The thick slab HASTE sequence allows appropriate MR planning of the thin section T2W sequence through the lower ureteric tumour.

## References

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1. The Royal College of Radiologists. *iRefer: Making the best use of clinical radiology*, 7th edn. London: The Royal College of Radiologists, 2012. ([www.irefer.org.uk](http://www.irefer.org.uk))
2. The Royal College of Physicians and The Royal College of Radiologists. *Evidence-based indications for the use of PET-CT in the United Kingdom 2013*. London: Royal College of Physicians, 2013.

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