

"Bladder tumors: The role of MRI in staging and treatment planning".

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Introduction

Bladder cancer is the second most common neoplasm of the urinary tract worldwide, with only prostate cancer being more common. It accounts for 6–8% of malignancy in men and 2-3% in women, with the highest incidence rates in North American and Europe, as well as areas with endemic schistosomiasis in Africa and the Middle East. It is more common in men than women and typically occurs in patients over the age of 50. Although exposure to certain organic chemicals is associated with the development of bladder cancer, the most important factor is smoking, which triples the risk of developing a urothelial cancer.

Diagnosis and Treatment

Following presentation, typically with painless haematuria or other urinary symptoms, investigation and diagnosis is made on urine cytology and cystoscopy with biopsy. At this time, upper tract ultrasound is used to detect renal masses or obstruction. Most tumors are urothelial in origin, with squamous cell, adenocarcinoma and other histological types being less common. Urothelial tumors are multifocal in approximately a third of cases and may involve the ureters or pelvicalyceal systems. Superficial tumors, confined to the mucosa, have a better prognosis but tend to recur locally and may become invasive in up to 20% of cases. Invasive tumors infiltrate the bladder muscle and have a worse prognosis.

Treatment options depend on the type of tumor and presence of invasion. Superficial disease is predominantly managed with local therapies delivered at cystoscopy. However, patients with multiple recurrences and/or multi-focal disease may be considered for more aggressive treatment, including radical cystectomy. Treatment of invasive disease varies, with options including radiotherapy, cystectomy and chemotherapy.

Staging of Disease and Imaging

The TNM staging classification is used. Cystoscopy with biopsy and pathological evaluation are used for staging superficial tumors. However, clinical evaluation is limited in muscle invasive tumour and imaging plays an important role in these cases. The goals of imaging are:

- To define the extent of tumour invasion into the bladder wall and surrounding tissues
- To identify regional and distant metastatic disease
- To assess response to chemotherapy
- To detect recurrent disease

MR in staging disease

Technique

The bladder should be moderately full. An anti-peristaltic agent should be used to reduce motion artefacts. A T1 weighted large field of view survey of the abdomen and pelvis is used to identify hydronephrosis and retroperitoneal lymph nodes. A phased array surface coil should be used for the high resolution images of the pelvis. T2-weighted imaging in the axial, sagittal and coronal planes are supplemented by gradient echo T1-fat saturated dynamic (pre and) post gadolinium images, usually in the axial plane. Diffusion weighted imaging may also be used.

Appearance of the bladder and tumour tissue

The normal bladder wall is of low signal intensity on T1 and T2 weighted images. The mucosa may occasionally be distinguished as an enhancing inner layer on post contrast examinations. There is normally a smooth border between the outer wall of the bladder and the perivesical fat. Bladder tumors are of low signal intensity on T1 and intermediate signal intensity on T2 weighted images. Invasion of the muscle layer is detected by evaluation of the T2W images, with interruption of the dark line of muscle. On dynamic post contrast images, the muscular layer of the bladder does not enhance as much as tumor, aiding the assessment of muscle invasion. Polypoid tumors may be readily identified but in some cases, bladder wall thickening may be the only sign of tumor, particularly in patients who have undergone previous resection. In these cases, delineation of the extent of tumor can be more challenging. On diffusion weighted imaging, tumors typically demonstrated restricted diffusion. Early studies suggest that the addition of DWI may help to improve staging accuracy.

MR is not accurate in distinguishing superficial tumors involving only the mucosa (T1) from early muscle invasion (T2a). MR may be able to distinguish superficial muscle invasion (T2a) from deep muscle invasion (T2b) in many cases. Invasion into the perivesical fat can be identified when there is macroscopic invasion (T3b) but microscopic invasion (T3a) cannot be reliably identified. MRI is accurate in staging more advanced disease, such as invasion of adjacent organs, indicating T4 disease. The diagnosis of nodal metastatic disease relies on size criteria but sensitivity is low, as normal sized nodes may contain metastatic deposits.

Recognized Pitfalls

Pitfalls for interpretation include: detection of small tumors less than 1cm; tumors with minimal elevation from the bladder surface; differentiation of bladder mucosal inflammation and tumour, which may result in overcalling T3 disease; inability to detect microscopic invasion of perivesical fat, resulting in understaging; underdistension or overdistension of the bladder, which may result in difficult interpretation of bladder muscle invasion.

Role of MRI in treatment planning

The accurate delineation of tumor extent will allow the clinician to determine the treatment options for the patient. Where radical cystectomy is being considered, ruling out macroscopic extension into the perivesical fat is essential. In some cases, chemotherapy may be used to down-stage the tumor to render the bladder operable. In these cases, MRI is used to evaluate response to chemotherapy, with re-staging prior to potential cystectomy. Where radiotherapy is being considered, the extent of tumor and nodal disease may determine the delineation of the radiotherapy fields.

Suggested reading

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