BladderPath

Image Directed Redesign of Bladder Cancer Treatment Pathways

MRI BladderPath protocol

MR equipment

MRI 1.5T with multichannel phased array external surface coil and the patients lying supine.

Image acquisition

Optimal bladder distension is achieved by instructing the patient to void no later than 2 hours prior to imaging. Lack of bladder distension will limit the detection of small tumours secondary to detrusor muscle thickening. Artefact from bowel peristalsis can be minimised by using anterior saturation bands.

T_1W-SE, T_2W-TSE, HR-T_2W-TSE, DWI and DCE MRI are key components. Images should include the whole bladder, pelvic nodes and proximal urethra. In males, prostate, and in females, the uterus, ovaries, fallopian tubes and vagina should also be included. T_1W SE axial is used to identify haemorrhage and clot in the bladder and bone metastasis.

If possible, administration of Buscopan is recommended and should be performed according to the local policy.

In general, small deviations from the scanning parameters are allowed (i.e. changing bandwidth, FOV or acquisition matrix). Especially when planning scans perpendicular to the tumour base, as these might require adjusting FOV and matrix to avoid wrapping. It is suggested in these situations to keep the total voxel dimensions as close as possible to suggested values.

Phase and slice oversampling values should also be treated as guidance due to their high dependence on the patient's size and the orientation of acquired images.

T2 Weighted imaging

High resolution T_2W images without fat suppression obtained with FSE or TSE sequences, in three orthogonal planes with one plane perpendicular to the tumour base, a small FOV and a large matrix. A thickness of 3-4 mm is recommended to maximise spatial resolution while maintaining SNR.

Diffusion weighted imaging

DWI images should be in the orientation perpendicular to the tumour base. A high b value is needed (800-1000) is needed to visualize the bladder cancer. If your centre currently acquires DWI with b values >1000, we recommend to do that using a separate acquisition sequence.

Dynamic contrast enhanced imaging

3D acquisition with fat suppression (e.g. VIBE, LAVA, THRIVE) is ideal due to higher spatial resolution. Pre and post contrast images are obtained in transverse plane with isotropic spatial resolution. Reconstruction of images in the plane perpendicular to the tumour base should be performed on the scanner. Gadolinium based contrast agent is administered using a power injector system at a dose of 0.1 mmol/kg of body weight at the rate of 2.0 ml/s. Acquire the first DCE (single measurement) sequence as a pre-contrast reference. Injection should begin with the multi-dynamic DCE acquisition at a temporal resolution <20s to depict the early enhancement of the inner layer followed by tumour enhancement. The bladder tumour, mucosa and submucosa enhance early (~20 s after contrast injection), but the muscle layer enhances late (1 min). If the scanner cannot perform under these parameters, it is important to keep the acquisition time no longer than 20s; lowering spatial resolution is acceptable, however, keeping isotropic voxel size is highly advisable.

Parameter settings at 1.5 T

	T1W SE	T2W TSE	HR T2W TSE **	DWI	DCE MRI-VIBE***
TR (ms)	760	5000	4750	4500	5.47(shortest)
TE (ms)	11	76	105	88	2.39 (shortest)
Flip angle (degree)	180	90	150	90	10
FOV (cm)	400x400	230x230	160x160	270x270	320x240
Matrix	204x256	256×256	256x256	109×128	160×160
Voxel size (mm)	2.0 x 1.6	0.9 x 0.9	0.6 x 0.6	2.5 x 2.1	2.0 x 2.0
Phase Oversampling	30%*	50%*	100%*	30%*	0%*
Slice Oversampling	---	---	---	---	16.7%*
Slice thickness (mm)	5	4	3-4	4	2.0
Number of Slices	25*	27*	23*	23*	48*
Slice gap (mm)	1.25 (25%)	0.4 (10%)	0.3-0.4 (10%)	0.4 (10%)	0
Orientation	transverse	sagittal	perp tumour	perp tumour	transverse
Number of averages	3	2	3	10	1
Bandwidth (Hz/Px)	186	130	130	1698	290
Acquisition time	2:36	2:37	4:37	5:30	0:20
Acceleration Fact.	2	2	2	2	2
b values				0–800–1000	

* Adjust to avoid wrapping or to obtain suitable coverage.
** Repeat at least in one more orthogonal plane.
*** Acquire 1 measurement for the pre-contrast and approx. 12-measurement (to add up to 4 min) sequence with contrast as instructed.

An example exam card with all available parameter for a 1.5T Siemens Avanto VB19 scanner is provided in a separate PDF file.

References

1. Rajesh A, Sokhi HK, Fung R et al. Bladder cancer: Evaluation of staging accuracy using dynamic MRI. Clin Rad 2011 Dec; 66:12,1140-1145.
2. Panebianco V, Narumi Y, Altun E et al. Multiparametric Magnetic Resonance Imaging for Bladder Cancer: Development of VI_RADS. Eur Urol. 2018 Sep; 74(3); 294-306