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The evolving role of multi-parametric MRI in the evaluation of bladder cancer: Revealing what lies beneath the surface

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ABSTRACT

Conventional staging for bladder cancer involves CT and TURBT, and is thought to understage up to fifty-percent of T1 tumours. This report details the case of a 64-year-old male who whilst on cystoscopic surveillance for high grade bladder cancer, underwent a multi-parametric MRI Bladder due to clinical suspicion of occult muscle invasive disease. Despite minimal urothelial changes at cystoscopy, MRI demonstrated a well-defined T3 lesion. The patient proceeded to radical cystectomy and final pathology verified the MRI findings. The role of MRI in bladder cancer is yet to be defined but should be considered if clinical suspicion for understaging exists.

1. Introduction

The 5-year survival for non-muscle invasive BC (NMIBC) (≤T1) is 96%, 69% for muscle invasive BC (MIBC - T2), and 37% if there spread through the bladder wall into peri-vesical fat (T3).[1] The poor prognosis of MIBC highlights the importance of prompt, accurate staging in order to facilitate timely radical treatment. This case report highlights the benefit of multi-parametric magnetic resonance imaging (mp-MRI) to improve the accuracy of local staging and aid selection for early radical therapy.

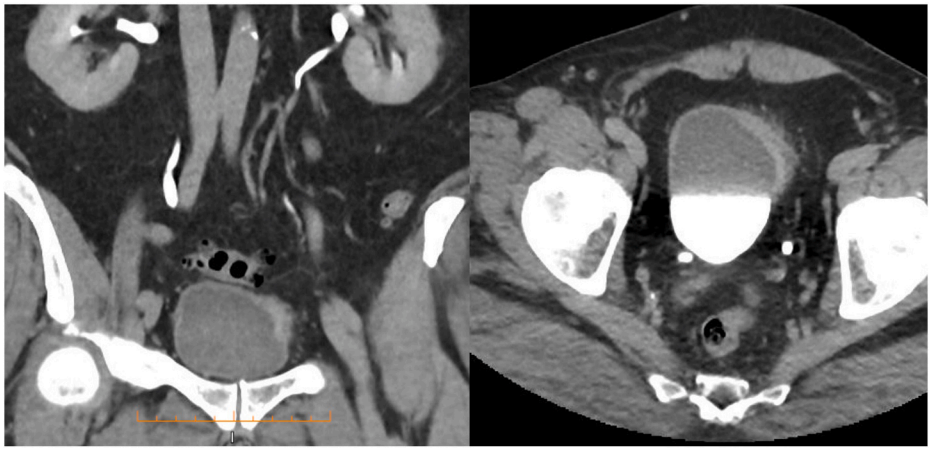

Fig. 1. CT IVP performed 12 months after initial diagnosis (after intra-vesical BCG and several cysto-biopsies). Non-specific focal thickening of the left lateral wall is seen.

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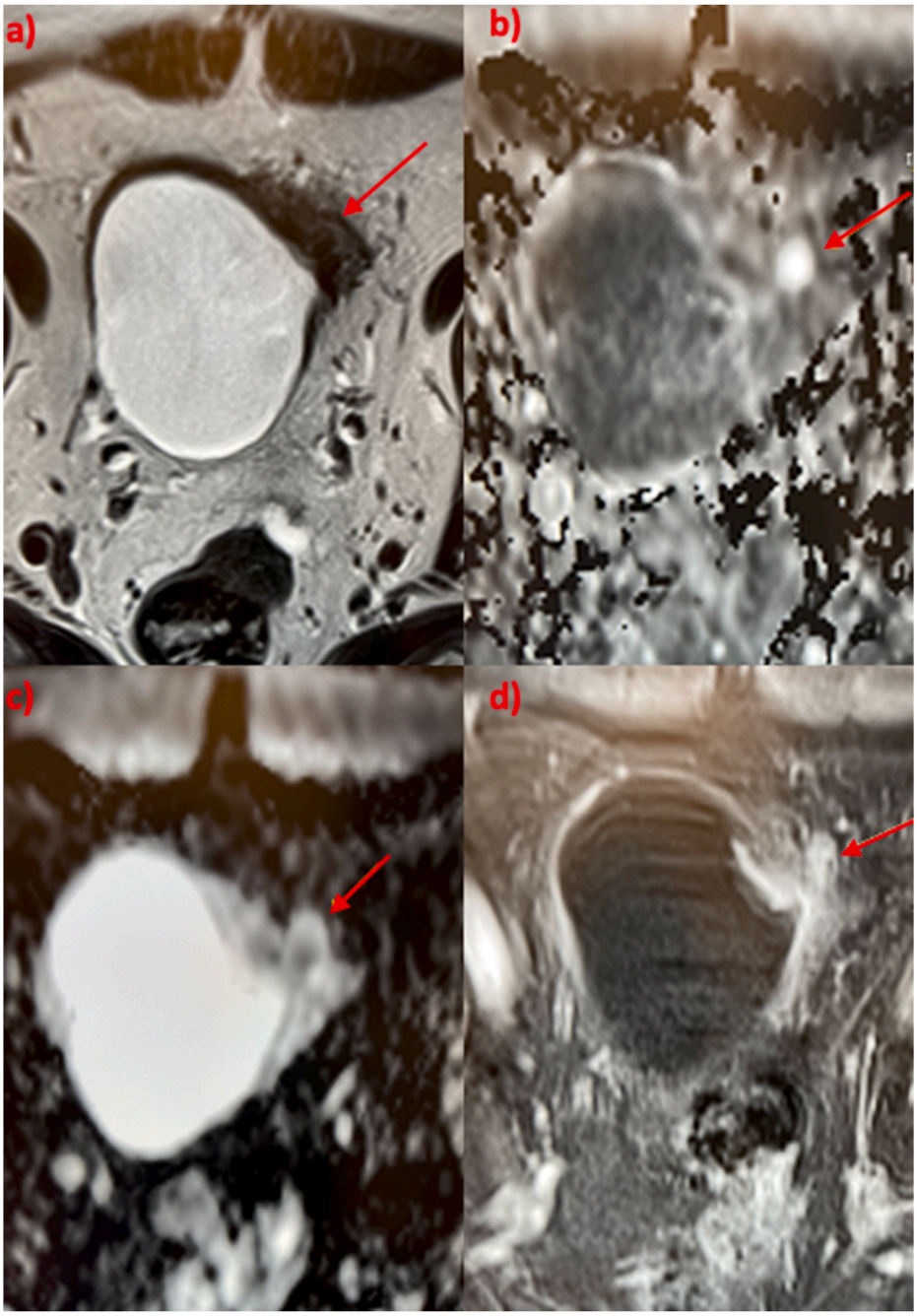

Fig. 2. MRI Bladder performed 12 months after initial diagnosis (a) T2 weighted imaging demonstrates abnormal signal intensity and thickening affecting the muscularis and extending into the peri vesical fat. The diffusion weighted imaging shows diffusion restriction with bright signal in the extravesical nodule (b) and dark signal on the ADC map compatible with tumour recurrence (c). The muscularis demonstrates the opposite findings compatible with fibrosis or inflammation. (d) 30 second post-contrast image shows early enhancement in the extravesical nodule.

Current T-staging of BC involves bi-manual examination during transurethral resection of bladder tumour (TURBT) plus histopathological analysis to determine depth of invasion. TURBT understages up to 48% of T1 lesions.[2] Conventional imaging via CT and USS has poor accuracy for local T-staging.

2. Case presentation

A 64-year-old male presented with haematuria. A CT Intra-venous Pyelogram (IVP) demonstrated a 2.7cm enhancing lesion on the left anterolateral bladder with surrounding bladder thickening. Rigid cystoscopy revealed a 2.5cm papillary lesion on the left lateral wall, another papillary lesion at the dome and carpet-like-change in a left posterior wall diverticulum. TURBT was performed with complete macroscopic clearance.

Histopathology revealed high-grade (HG) T1 Urothelial Carcinoma on the left lateral wall, HGTa at the dome and diverticulum. Re-resection demonstrated residual HGTa; detrusor muscle was present and not involved. He received induction intra-vesical BCG. He had four cystobiopsies over the next 12 months which were negative for malignancy. Surveillance CT IVP and cytology were also normal.

At his fifth cystoscopy there was no overt recurrence. A patch of flat erythema, cystoscopically thought to be cystitis, was biopsied revealing HGT1 disease. A CT IVP demonstrated non-specific bladder wall thickening. As can be seen in Fig. 1, it was not clear on the CT whether this was due to residual malignancy, fibrosis from recent intra-vesical therapy or inflammation from recent cysto-biopsy. The patient was discussed in a multi-disciplinary meeting and proceeded to mpMRI to assess for occult MIBC.

MpMRI demonstrated a 30 × 11 × 25mm lesion affecting the left

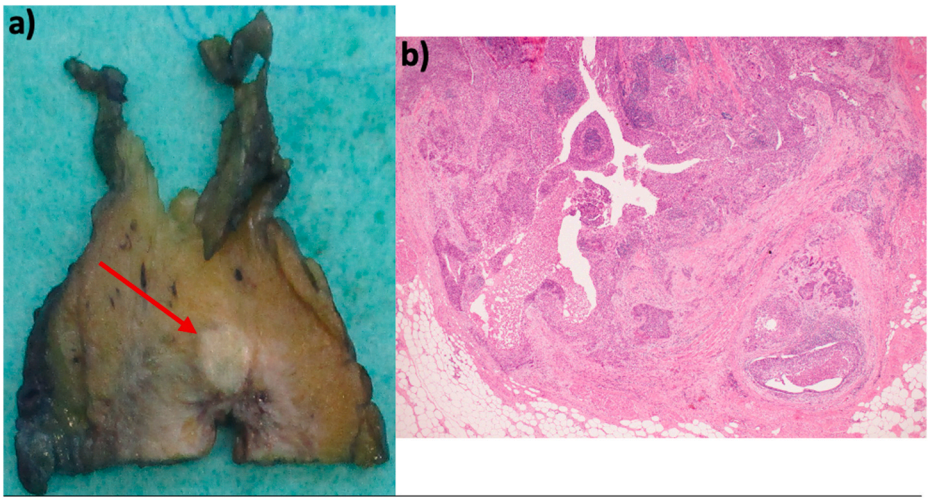

Fig. 3. (a) Macroscopically the RC specimen showed an 18 × 9X15mm ulcerated lesion at the left dome of the bladder invading into peri-vesical fat (b) Microscopically, it was confirmed to be a poorly differentiated urothelial carcinoma with invasion into peri-vesical fat.

anterolateral bladder wall. The T2 sequence demonstrated abnormal signal intensity and thickening affecting the muscularis and extending beyond the bladder for a depth of 8 mm (Fig. 2a). On the diffusion weighted imaging/apparent diffusion co-efficient mapping there was true diffusion restriction in a 6 mm nodule of peri-vesical fat outside the bladder (Fig. 2 b & c), but no restricted diffusion in the muscularis of the wall. At 30 seconds post contrast enhancement, there was early enhancement in the extra vesical nodule (Fig. 2 d) but not in the muscularis. The findings in the nodule were compatible with VIRADs 5 change and T3 disease, whilst the changes in the muscularis were more compatible with fibrosis.

Based on these findings, he underwent Radical Cystectomy (RC) rather than the alternative of further intra-vesical therapy. Final histopathology confirmed pT3aN0R0 urothelial carcinoma with squamous differentiation (Fig. 3 a & b). Additionally, there was granulation tissue and BCG granuloma within the muscularis surrounding the site of the tumour which was consistent with the suspected fibrosis seen on MRI.

3. Discussion

The striking feature of this case is the overt T3 lesion demonstrated on mpMRI despite minimal urothelial change visible during cystoscopy. This is likely due to the tumour initially being understaged at the initial TURBT. The presence of muscle in the re-resection specimen was falsely reassuring, as the muscle present in the re-resection may not have been at the site of the base of the initial tumour.

In 2010, Fritsche et al. demonstrated that 50% of T1 disease was upstaged to MIBC on RC specimens.[2] TURBT remains the conventional staging modality for BC, however its limitation in differentiating T1 from T2 disease highlights the need for a paradigm shift in BC staging. The use of mpMRI in BC staging was first described in the 1990's but its role was initially limited by wide variation in MRI protocols and lack of standardized reporting. In 2018 Pannebianco et al. published Vesical Imaging-Reporting and Data System (VI-RADS) criteria, a standardised approach to reporting mpMRI for BC, in European Urology.[3] It has since been validated by several prospective studies and two meta-analyses, demonstrating 87–92% sensitivity and 79–87% specificity in differentiating MIBC from NMIBC.[4] Despite these results, mpMRI is still not routinely used or incorporated into best practice guidelines.

The BladderPath study is an ongoing randomised control trial comparing standard care (TURBT) to mpMRI combined with a flexible cystoscopic biopsy under local anaesthetic. The presumptive The preliminary results of this study have demonstrated that it is feasible to eliminate the need for TURBT, although further research is required to improve the specificity of mpMRI for identifying MIBC.[5]

A further potential role of mpMRI in BC is enhancing patient selection for neoadjuvant chemotherapy by differentiating T2 from T3 disease. Patients with T3 disease are significantly more likely to harbour micrometastatic disease, and thus benefit more from neoadjuvant therapy. There are also emerging studies which suggest complete responders to systemic therapy could be considered for bladder conserving therapy with mpMRI surveillance.

4. Conclusions

The learning point of this case is that had mpMRI been performed earlier in the clinical course, definitive surgical treatment could have been expedited. The utility of mpMRI for local staging of BC is an emerging topic and its role is not yet defined. This case clearly demonstrates the pitfalls of TURBT and the advantages of mpMRI in equivocal cases. Large, multi-centre prospective studies are required to assess the utility of mpMRI in BC staging. We recently commenced our own prospective multi-centre trial, MRI Before Cystoscopy (The MBC Trial), at our centre to help address this important clinical question.

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