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Role of MP MRI and Virads Score in Assessment of T Stage of Bladder Tumours

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I. INTRODUCTION

Urinary bladder cancer represents a global health problem.[1] It accounts for about two-thirds of all urinary cancers and is the ninth most common cancer worldwide,althoughthe rates in different parts of the world vary.[2] It is almost 3-4 times more common in men than in women in most populations. Bladder cancer incidence and mortality rise sharply with age and about two-thirds of cases occur among persons 65 years and older.[3]

Risk factors for bladder cancer are smoking, chronic cystitis, pelvic irradiation, cyclophosphamide, genetic predisposition, some occupations, aniline dyes, schistosomal infection and urachal remnants.[4-6] Most arise from the lateral wall or posterior wall (base) of the urinary bladder. Pattern of growth of urothelial tumours can be exophytic or endophytic or a combination of both and when exophytic, can be papillary or solid/nodular.[7]

Urothelial tumours represent 90% of all bladder tumours and encompass a spectrum from benign papillomas to highly aggressive anaplastic cancers. Urothelial cancer, mostly found in its pure form, however is known to show divergent differentiation. Squamous cell carcinoma comprises about 5% of all the malignant bladder tumours and adenocarcinoma of the bladder is rare.

The most commonly used staging system is the staging proposed by American Joint Committee on Cancer. Non-invasive papillary urothelial carcinoma is designated as pTa ; while stages pT1 , pT2 ,pT3 and pT4 refer to invasion into the lamina propria, muscularis propria, peri-vesical tissue and adjacent organs respectively. Non-invasive flat urothelial carcinoma i.e. carcinoma-in-situ is stage Tis.[8]

Cystoscopy is the gold standard for the detection of bladder cancer.Radiographicimagingis a significant part of bladder cancer staging.[9] Exfoliative (urine) cytology is of little practical value in the initial evaluation of most bladder tumours because of its accessibility to formal biopsy. The transurethral resection of bladder tumour (TURBT) is diagnostic, prognostic and often therapeutic.

The Vesical Imaging-Reporting and Data System (VI-RADS) scoring system was created in 2018 to standardize imaging and reporting of bladder cancer staging with multiparametric MRI. The system provides a five-point VI-RADS score, which suggests the likelihood of detrusor muscle invasion. Muscle-invasive disease carries a worse prognosis and requires radical surgery. [10]

In our study we aim to correlate VIRADS score on multiparametric MRI and pathological tumour staging on histopathological examination (HPE) after surgical treatment and to study accuracy of preoperative multiparametricMRI VIRADS scoring in detecting muscle invasiveness.

II. MATERIALS AND METHODS

A prospective study of 35 patients admitted with solid bladder mass diagnosed on USG was done between Aug 2019 to December 2022, at Department of Urology, B. J. medical college & civil hospital Ahmedabad. Patients who didn't undergo MRI (due to Contrast allergy, implants etc) and Patients who have undergone TURBT previously were excluded.

A detailed history and Physical examination was done along with all necessary routine investigations. All patients were subjected to Multi-parametric MRI (1.5T) of pelvis which is the combination of T1 weighted image (T1WI), high resolution T2 weighted image (T2WI) and Diffusion weighted imaging (DWI) and Dynamic contrast enhanced imaging (DCE).

All patient underwent TURBT within 2 weeks of MRI in department of Urology at civil hospital, Ahmedabad. Tumour stage from the Biopsy was compared with preoperative VIRADS score of Multiparametric MRI to assess accuracy of detecting Muscle invasive of the disease with an objective scoring system. Sensitivity, specificity, positive predictive value and Negative predictive value were calculated.

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III. OBSERVATIONS AND RESULTS

The age of patients in our study ranged from 32 - 85 years with a mean of 61 years .33 (94.2%) patients were male and 2 (5.7%)patients were female.2 (5.7%) patients were less than 40 years of age, 13(37.1 %) patients were between age of 41-60 years,20 (57.1%)patients were more than 60 years of age. The most common presentation was Haematuria in 28(80%), followed by Voiding difficulty in 8 (22.8%), burning micturition in 4 (11.4%) and 4 (11.4%) with acute urinary retention.

The size of the bladder mass on MRI ranged from 8 – 84mm with a mean of 38.3 mm. 13 (37.14%) patients had size less than 3 cm, 18 (51.42%) patients had size from 3-6cm, 4 (11.42%) patients had size more than 6 cm. Of the 35 patients, 5(14.28%) had mass on anterior wall of bladder, 13 (37.14%) had mass on right postero-lateral wall of bladder, 14 (40%) had mass on left posterolateral wall of bladder,3 (8.5%) had mass on base of bladder.

On mpMRI, None had VIRADS 1 category, 9 (25.71%) had VIRADS 2 category, 18(51.42%) had VIRADS 3 category, 3 (8.5%) had VIRADS 4 category, 5(14.28%) had VIRADS 5 category

All patients underwent TURBT within 2 weeks of multiparametricMRI, histology, grade and tumor stage were noted. Out of 35 patients 34 (97.14%) patients had Transitional cell carcinoma and 1(2.85%) patient had squamous cell carcinoma. 1 (2.85%) patient had papillary urothelial neoplasia of low malignant potential (PUNLMP), 17 (48.57%) patient had low grade tumor and 16 (45.71%) patient had high grade tumor and 1 patient (2.85%) had moderately differentiated squamous cell carcinoma. 7(20%) patients had Ta tumor, 21(60%) Patients had T1 tumor, 7(20%) Patients had T2 tumor.

Out of 9 patients who had VIRADS 2 lesion, 4 patients had Ta tumour and 5 patients had T1 tumour. 18 patients had VIRADS 3 lesion out of which 15 patients had T1 tumour and 3 patients had Ta tumour.3 patients had VIRADS 4 lesion out of which 1 patient had T1 tumour and 2 patient had T2 tumour.5 patients had VIRADS 5 lesion all of which had T2 tumour on TURBT specimen. All the lesions having VIRADS score of 1,2 and 3 were free of muscle invasion on TURBT specimen.3 patient had VIRADS 4 lesion of which 2 was muscle invasive and 1 was free of muscle invasion. All VIRADS 5 patients had muscle invasion on TURBT specimen.The optimal criteria to detect muscle invasive bladder cancer using youden's index was final VIRADS score >3.

Table 1 - Correlation of VIRADS score with Tumour staging

VIRADS SCORE ON MRI/ TUMOUR STAGE	Ta	T1	T2	TOTAL
1	0	0	0	0
2	4(44.4%)	5(55.5%)	0	9
3	3(16.6%)	15 (83.3%)	0	18
4	0	1 (33.3%)	2 (66.6%)	3
5	0	0	5 (100%)	5

The sensitivity, specificity, Positive predictive value, Negative predictive value of MultiparametricMRI in detecting muscle invasiveness was found to be 100%, 96.42%. 86.5 % and 100% respectively if VIRADS score >3 is taken into consideration

IV. DISCUSSION

Urothelial (transitional cell) carcinoma is the most common type of bladder cancer, accounting for approximately 90% of cases.Non-urothelial bladder cancers include squamous cell carcinoma, adenocarcinoma, small cell carcinoma, and mixed histology tumors, with squamous cell and adenocarcinomas making up the majority of nonurothelial tumors. Physical examination findings are often unremarkable in patients with bladder cancer unless there is advanced or metastatic disease, which may demonstrate a palpable bladder mass.[11]

The initial evaluation of a patient with suspected bladder cancer relies on cystoscopy, assessment of renal function, and imaging of the upper urinary tract, preferably with computed tomography (CT) urography or Multiparametric MRI.[12]

The VIRADS scoring system is a standardized approach to imaging and reporting

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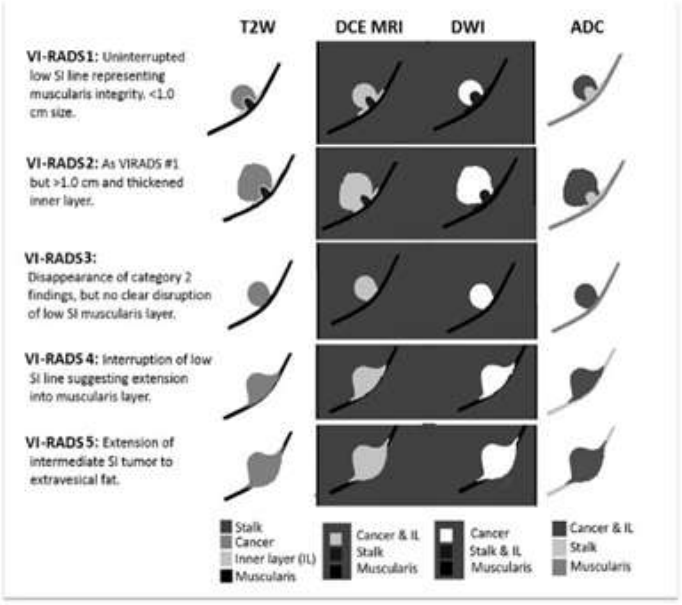
mpMRI from bladder cancer, defining the risk of muscle-invasive disease. The scoring is applicable preferably to untreated patients before TURBT or at least 2 weeks after diagnostic TURBT or intravesical treatment. A 5-point VIRADS score is generated using the individual T2W, DWI, and DCE MRI categories and suggests the probability of muscle invasion. [10,13, 14]



Schematic illustration of mpMRI appearances of VI-RADS scores 1–5 using T2, DCE MRI, DWI, and ADC weighted images. ADC = apparent diffusion coefficient; DCE = dynamic contrast enhancement; DWI = diffusion-weighted imaging; MRI = magnetic resonance imaging;mpMRI = multiparametric MRI; SI = signal intensity

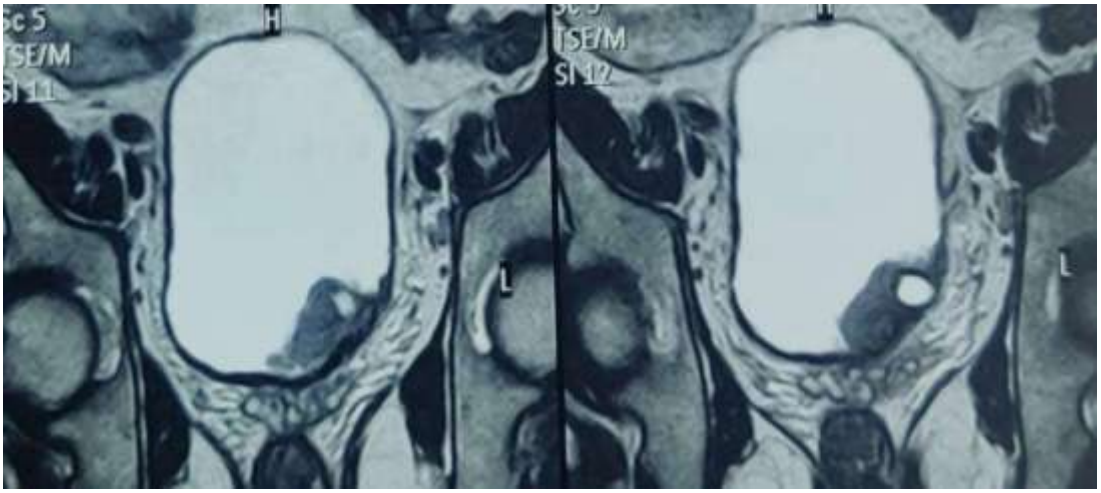


FIG 1: A 55 year old male with VIRADS 3/5 lesion in left posterolateral wall with no clear disruption of low SI muscularis propria.

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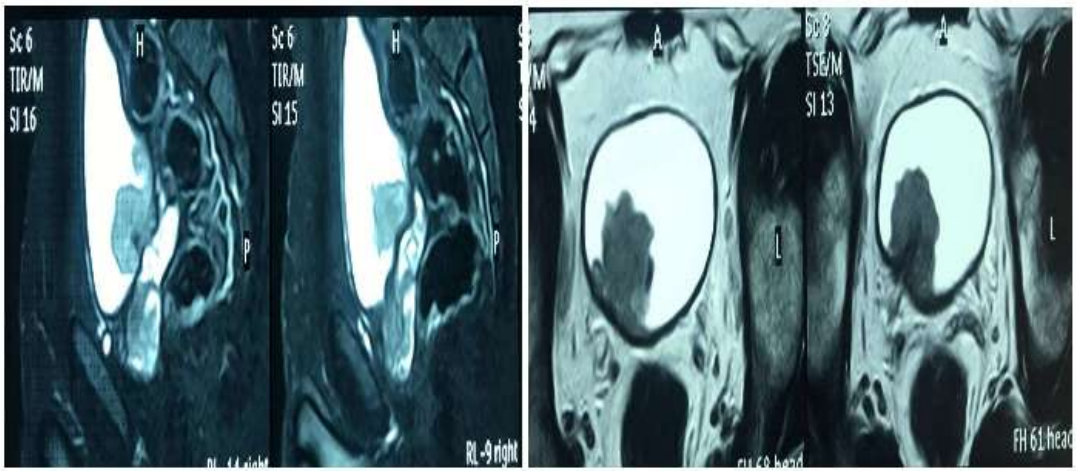

FIG 2:A 40 year old male with VIRADS 4/5 multiple polypoidal lesion in right postero-lateral wall high signal intensity thickened layer with disruption of muscularis propria but without obvious evidence of extravesical extension

The current standard for diagnosis and staging BC is TURBT.[15] Cystoscopy has improved with enhanced intravesical imaging, such as photodynamic diagnosis and narrow band imaging, and better awareness of its importance in BC care.[16] However, many tumors are under staged by TURBT or detrusor is missing, and so complimentary improvements in imaging are welcomed. [17,18]

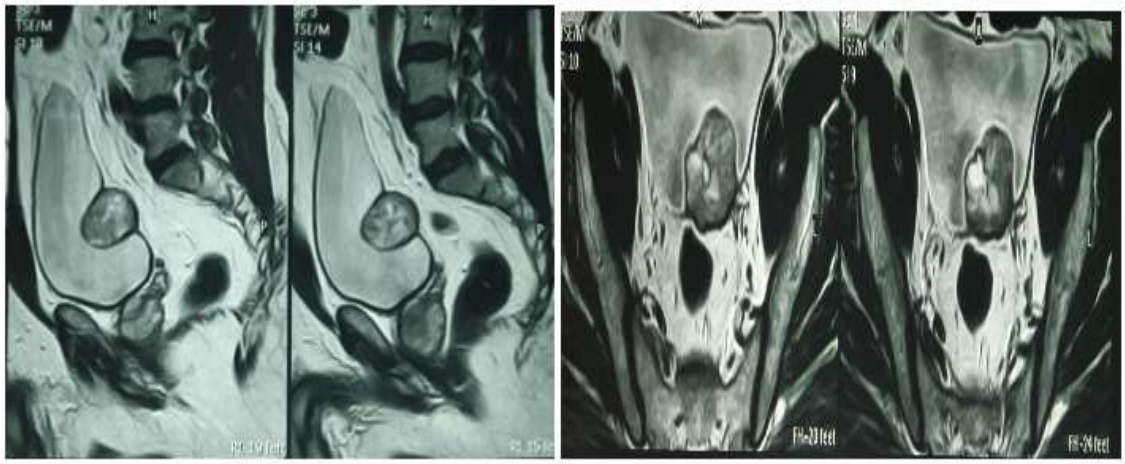

FIG 3: A 55 year old male with polypoidal lesion in left posterolateral wall with disruption of muscularis propria low signal intensity line with evident extravesical extension classified as VIRADS 5/5 lesion

An image-guided approach could identify and simultaneously stage a bladder tumour, such that a cystoscopy might be skipped and patients be taken directly to TURBT. While histological confirmation remains the cornerstone of BC diagnosis,[19] this pathway might be faster than reliance on TURBT.[20] For MRI to be a significant factor in clinical care, it has to be reproducible and feasible in the general hospital setting.

In our study no patients had VIRADS 1 lesion.9 patients had VIRADS 2 lesion out of which 44.4% patients had Ta tumour and 55.5% patients had T1 tumour. 18 patients had VIRADS 3 lesion out of which 83.3% patients had T1 tumour and 16.6% patients had Ta tumour.3 patients had VIRADS 4 lesion out of which 33.3% patient had T1 tumour and 66.6% patient had T2 tumour.5 patients had VIRADS 5 lesion all of which(100%) had T2 tumour on TURBT specimen. Andre vaz et al.[21] included 30 patients all lesion with VIRADS 1,2,3 found to have no muscle invasion and muscle invasion was identified in 50% of patients having VIRADS score of 4.85.7% of patients of VIRADS 5 score had muscle invasion. Giovanni barchetti et al.[22] had lesions with VIRADS 2,3,4,5 have muscle invasiveness in 5%,40%, 83%, 89% respectively.

The sensitivity, specificity, Positive predictive value, Negative predictive value of Multiparametric MRI in detecting muscle invasiveness was found to be 100%, 96.42%. 87.5 % and 100% respectively if VIRADS score >3 is taken into consideration.Andre Vaz et al.[21]reported a sensitivity of 100% and negative predictive value of 100% whereas Giovanni barchetti et al.[22]reported a sensitivity of 82%, specificity of 94% and negative predictive value of 93% of multiparametric MRI in detecting muscle invasiveness. All studies have taken cut off of VIRADS>3 to define muscle invasiveness of bladder tumour.

V. CONCLUSION

In conclusion, VIRADS scoring on multiparametricMRI gives us accurately the objective value to determine bladder tumour muscle invasion level with good sensitivity and specificity particularly in patients with VIRADS 4 and above. Multiparametric MRI will help in identifying the tumour stage in large, multiple, difficult to resect bladder tumours and expedite radical treatment after 'diagnostic' TURBT . On the other hand in small size tumours multiparametric- MRI would not be of much help and will increase an additional cost as the surgeon will already be doing a 'curative' TURBT. Utilizing preoperatively multiparametric MRI VIRADS score we can reduce unnecessary Re-TURBT and associated morbidity.

Despite the growing use of MRI in local staging of Bladder cancer, there is a lack of standardization in terms of observer dependency, protocol and reporting. Accuracy of VIRADS in some special tumour location such as dome and trigone may pose some specific problems to the reader. MultiparametricMRI needs further evaluation in patients with carcinoma -insitu of bladder and for lymphnode staging and distant staging. The original structural description in the VI-RADS includes only exophytic (polypoid) and sessile (broad-based) tumours. Therefore, we suggest that suspicious focal bladder wall thickening be included in the VI-RADS categorization of morphology.

However cystoscopy remains the gold standard means of post-treatment follow- up, multiparametricMRI needs to be evaluated in recurrent tumours, follow up of patients of carcinoma bladder and evaluating response to chemotherapy as a non-invasive alternative.

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