DIAGNOSTIC ACCURACY OF DIFFUSION WEIGHTED MAGNETIC RESONANCE IMAGING IN DIAGNOSING URINARY BLADDER CARCINOMA

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ABSTRACT
Objectives: To determine the diagnostic accuracy of diffusion weighted magnetic resonance imaging in diagnosing urinary bladder carcinoma, taking histopathology as gold standard.
Methodology: This study was conducted at Department of Diagnostic Radiology & Department of Urology, Sheikh Zayed Hospital, Rahim Yar Khan from February 2019 to July 2019. A total of 162 patients presenting with hematuria (RBCs >100 on urine complete examination) and presence of irregular soft tissue structure projecting into bladder lumen from a fixed mural site on ultrasonography and age 20-60 years of either gender were included. Patients with operated for urinary bladder cancer, biopsy proven urinary bladder carcinoma and any contraindication to MRI were excluded. All the patients were then undergoing DW-MRI and presence or absence of urinary bladder carcinoma is noted. The DW-MRI findings were correlated with histopathology findings.
Results: In DW-MRI positive patients, 74 (True Positive) had urinary bladder cancer and 11 (False Positive) had no urinary bladder cancer on histopathology. Among 77, DW-MRI negative patients, 01 (False Negative) had urinary bladder cancer on histopathology whereas 76 (True Negative) had no urinary bladder cancer on histopathology (p=0.0001). Overall sensitivity, specificity, positive predictive value, negative predictive value and diffusion weighted magnetic resonance imaging in diagnosing urinary bladder carcinoma, taking histopathology as gold standard was 98.67%, 87.36%, 87.06%, 98.70% and 92.59% respectively.
Conclusion: This study concluded that DW-MRI is a highly sensitive and accurate non-invasive modality for diagnosing urinary bladder cancer.

Keywords: urinary bladder cancer, diffusion weighted magnetic resonance imaging, sensitivity.

INTRODUCTION

There were an estimated 55,600 new instances of bladder cancer and 15,100 fatalities from this disease in the United States in 2012. This makes bladder cancer the second most frequent genitourinary cancer in the country.[1] Muscle-invasive bladder cancer (MIBC) accounts for one-third of all cases at diagnosis, and radical cystectomy has traditionally been the gold standard for treating locally advanced MIBC. However, a shift toward bladder-sparing strategies using a variety of therapeutic modalities has occurred due to growing concern for patients' quality of life.[2] Staging of bladder cancer requires both clinical and radiological evaluations, with the latter constituting a crucial component of the treatment plan.[3] Although cystoscopy with biopsy remains the gold standard for staging bladder cancer because of its high sensitivity in detecting lesions and the potential for tumor resections,[4] its invasive nature, its limitation in detecting flat lesions, and its inability to assess extra-vesical tumor invasion are significant limitations.[5]

Multiple MRI techniques, in addition to more traditional ones, have been included into standard radio diagnostic practice in recent years.[6] Diffusion-weighted magnetic resonance imaging (DWI) is one such imaging technique, assessed in the context of functional MRI and relies on the assessment of the accelerated or decelerated microscopic diffusion motions in the protons of the water molecules present in tissue. There is no need for contrast in the images acquired from these brief periods of time.[7,8] Researchers in a wide range of fields have noted DWI's potential as a diagnostic technique for spotting and characterizing tumors in organs including the breast, prostate, bladder, cervix, colon, ovary, pancreas, and liver. These investigations also demonstrated that the cellularity of malignant tumors results in significantly higher diffusion limitation and significantly lower levels of ADCs compared to that of benign tumours.[7-9]

According to the findings of Ceylon K and colleagues,[10] the prevalence of urinary bladder cancer was found to be 67.79%, and the sensitivity and specificity of DW-MRI in identifying urinary bladder cancer were found to be 90% and 93% respectively. According to the findings of another study, the sensitivity of DWI in the identification of malignant UB lesions was 100%, while its specificity was 76.5 percent, and its accuracy was 93.6 percent.[11] Abou-El-Ghar et al[12] conducted a research in which 130 patients with extensive hematuria received T2 weighted MRI, DWI, and, after 48 hours, cystoscopy. Of those 130 patients, 106 were diagnosed with bladder cancer. It was discovered that DWI had a sensitivity of 98.5% when it came to detecting the tumor mass all by itself, and that it had a positive predictive value of 100%.

Because the studies that have been described above have shown variable results and controversy exists in the diagnostic accuracy of diffusion weighted magnetic resonance imaging in diagnosing urinary bladder carcinoma, there needs to be a re-evaluation of the role that diffusion weighted magnetic resonance imaging plays in diagnosing urinary bladder carcinoma.

Therefore, we choose to investigate the efficacy of diffusion-weighted magnetic resonance imaging (DW-MRI) for the diagnosis of urinary bladder cancer, using histology as the gold standard. Although it has been previously known, the available studies have shown conflicting results; therefore, my study will not only put an end to the debate but also allow for its routine use in determining the pre-operative status of urinary bladder cancer; this will allow for the most appropriate treatment options and post-operative management plans to be chosen for these patients, reducing their risk of complications and death.

METHODOLOGY

This investigation was done at the Department of Diagnostic Radiology & Department of Urology, Sheikh Zayed Hospital, Rahim Yar Khan from February 2019 to July 2019. 162 patients with hematuria (RBCs >100 on urine full evaluation) and an irregular soft tissue

formation extending into the bladder lumen from a fixed mural location were included.
Urinary bladder cancer patients who had surgery, patients whose cancer had been confirmed by a biopsy, and patients who had a medical condition that made MRI unsafe were all disqualified from participation. Patients then get DW-MRI scans to check for cancer of the urinary bladder. Histopathology results were compared to those from DW-MRI.
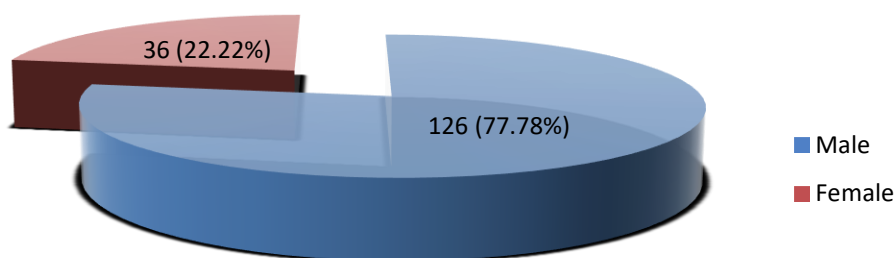
RESULTS

Age range in this study was from 20-60 years with mean age of 43.48 ± 8.49 years. Majority of the patients 102 (62.96%) were between 41 to 60 years of age.

Out of these 162 patients, 126 (77.78%) were male and 36 (22.22%) were females with ratio of 3.5:1 (Figure I). Mean duration of disease was 7.33 ± 1.82 months. The mean BMI was 29.08 ± 2.42 kg/m2.

All the patients were subjected to Diffusion weighted magnetic resonance imaging (DW-MRI). DW-MRI supported the diagnosis of urinary bladder cancer in 85 (52.45%) patients and no urinary bladder cancer in 77 (47.53%) patients. Histopathology findings confirmed malignant lesions in 75 (46.30%) cases where as 87 (53.70%) patients' revealed no urinary bladder cancer. In DW-MRI positive patients, 74 (True Positive) had urinary bladder cancer and 11 (False Positive) had no urinary bladder cancer on histopathology. Among 77, DW-MRI negative patients, 01 (False Negative) had urinary bladder cancer on histopathology whereas 76 (True Negative) had no urinary bladder cancer on histopathology(p=0.0001) as shown in Table I.

Overall sensitivity, specificity, positive predictive value, negative predictive value and diffusion weighted magnetic resonance imaging in diagnosing urinary bladder carcinoma, taking histopathology as gold standard was 98.67%, 87.36%, 87.06%, 98.70% and 92.59% respectively.

Figure-I: Distribution of patients according to Gender (n=162).

Table-I: Summary of Results.

	Positive result on Histopathology	Negative result on Histopathology	P-value
Positive on DW-MRI	74 (**TP**)*	11 (**FP**)**	
Negative on DW-MRI	01 (**FN**)***	76 (**TN**)****	**0.0001**

*-TP=True positive **-FP=False positive ***-FN=False negative ****-TN=True negative

Sensitivity: 98.67%
Specificity: 87.36%
Positive Predictive Value (PPV): 87.06%
Negative Predictive Value (NPV): 98.70%
Diagnostic Accuracy: 92.59%

DISCUSSION

This study was conducted to determine the diagnostic accuracy of diffusion weighted magnetic resonance imaging in diagnosing urinary bladder carcinoma, taking histopathology as gold standard. Age range in this study was from 20-60 years with mean age of 43.48 ± 8.49 years. Majority of the patients 102 (62.96%) were between 41 to 60 years of age. Out of these 162 patients, 126 (77.78%) were male and 36 (22.22%) were females with ratio of 3.5:1. All the patients were subjected to Diffusion weighted magnetic resonance imaging (DW-MRI). DW-MRI supported the diagnosis of urinary bladder cancer in 85 (52.45%) patients and no urinary bladder cancer in 77 (47.53%) patients. Histopathology findings confirmed malignant lesions in 75 (46.30%) cases where as 87 (53.70%) patients' revealed no urinary bladder cancer. In DW-MRI positive patients, 74 (True Positive) had urinary bladder cancer and 11 (False Positive) had no urinary bladder cancer on histopathology. Among 77, DW-MRI negative patients, 01 (False Negative) had urinary bladder cancer on histopathology whereas 76 (True Negative) had no urinary bladder cancer on histopathology (p=0.0001). Overall sensitivity, specificity, positive predictive value, negative predictive value and diffusion weighted magnetic resonance imaging in diagnosing urinary bladder carcinoma, taking histopathology as gold standard was 98.67%, 87.36%, 87.06%, 98.70% and 92.59% respectively.

In a retrospective study on 160 patients underwent MRI, 127 (79.4%) tumors were detectable by MRI. In all patients with detectable tumors, on a stage-by-stage basis, 96 (75.6%) of 127 patients received the correct diagnosis. With DW-MRI, accurate diagnosis was obtained in 80 (80.0%) of 100 cases; without DWI in only 16 (59.3%) of 27 cases (P = 0.026). For T staging, the accuracy for distinguishing muscle invasion (T $\leqq$_ 1 vs T $\geqq$_ 2) with DW-MRI (83.0%) was superior to that without DW-MRI (66.7%). The accuracy for distinguishing perivesical fat invasion (T $\leqq$_2 vs T $\geqq$_3) with DW-MRI (98.0%) was also superior to that without DW-MRI (92.6%). The ADC values were significantly related with tumor diameter (<3 cm vs $\geqq$_ 3 cm,P < 0.001), histopathological grade (low grade vs high grade, P < 0.001), T stage ($\leqq$_T1 vs $\geqq$_T2,P < 0.001), and operative method (transurethral resection vs total cystectomy, P < 0.001).[13]

Ceylon K et al[10] found prevalence of urinary bladder cancer as 67.79% and sensitivity and specificity of DW-MRI in diagnosing urinary bladder cancer as 90% and 93% respectively. In another study, the sensitivity, specificity and accuracy of DWI in the diagnosis of malignant UB lesions was 100%, 76.5% and 93.65%, respectively.[11] In a study carried out by Abou-El-Ghar et al,12 130 (106 with bladder carcinoma) patients with gross hematuria underwent T2 weighted MRI, DWI and, after 48 h, cystoscopy. The sensitivity of DWI in detecting the tumour mass by itself was found to be 98.5% and the positive predictive value was 100%.

In a study carried out by Abou-El-Ghar et al[14] on 130 patients with hematuria, cystoscopy was considered as a standard reference. The sensitivity, specificity, PPV, NPV, and accuracy of DW-MRI were 98.5, 93.3, 100, 92.3, and 97%, respectively. The authors found excellent agreement between DW-MRI and conventional cystoscopy. Reviewers could identify almost all bladder lesions and missed only two lesions that were less than 4 mm in diameter. El-Assmy et al[15] studied the feasibility of using DW-MRI in bladder cancer follow-up after transurethral resection of the prostate. In 47 patients, cystoscopy identified 34 bladder lesions in 24 patients, and in the remaining 23 the bladder looked normal. The sensitivity, specificity, accuracy, PPV, and NPV of DW-MRI for identifying bladder tumors were 91.6% (22/24), 91.3% (21/23), 91.5% (43/47), 91.6% (22/24), and 91.3% (21/23), respectively.

In a meta-analysis, the prevalence of muscle invasive urinary bladder cancer was found to be 33.46% and sensitivity and specificity of DW-MRI in differentiating muscle invasive from non-muscle invasive urinary bladder cancer as 85.0% and 90.0% respectively.[16] In another study, the sensitivity, specificity and diagnostic accuracy of DW-MRI for differentiating muscle invasive from non-muscle invasive urinary bladder cancer were 88.0%, 85.0% and 87.0%, respectively.[17]

We concluded that DW-MRI is a highly sensitive and accurate non-invasive modality for diagnosing urinary bladder cancer, and has improved patient care by early screening, timely and proper treatment and avoiding unnecessary diagnostic biopsies, which consequently reduces patients' morbidity and mortality. So, we recommend that diffusion weighted MRI should be used routinely as a prime modality for pre-operative status of urinary bladder cancer for selecting proper treatment option and post-operative management plan for these particular patients which will result in reducing the morbidity and mortality of these patients.

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