

Role of Diffusion Weighted MRI in Evaluation of Urinary Bladder Cancer in Iraqi Patient in Correlation with Histopathological Grade.

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Abstract

Background: Bladder cancer is a common urologic cancer that has the highest recurrence rate of any malignancy. MRI (magnetic resonance imaging) is a vital complementary diagnostic device in the diagnosis, staging, and follow up of bladder cancer.

Objectives: The main purpose of this study was to explore the diagnostic effectiveness of pelvic MRI including ADC (apparent diffusion coefficient) and DWI (diffusion weighted imaging) in the assessment of bladder cancer grade and thus helping in patients' management.

Methods: A cross sectional study comprised forty preoperative patients complaining of hematuria referred to the urology consulting clinic in martyr Ghazi Al-Hariri hospital in Baghdad during the period from January 2015 to September 2016. Their age ranged from 43 to 74 years. Their MRI findings were reviewed and correlated with the corresponding histopathology results.

Results: By reviewing the MRI finding in forty patients, we see that 60% show low grade tumor, while 40% had high grade tumor. This is classified according to their ADC map which revealed that all patients with high grade tumor had their tumor is above $9 \times 10^{-3} \text{ mm}^2/\text{second}$ while those with low grade tumor had value greater than above value. Wall invasion on T2WI (T2 weighted imaging) is seen in 33% of low grade tumor and 81% of high grade tumor, in contrary to DWI that identify wall invasion in 21% and 43% of the tumors respectively.

Conclusion: ADC map and DWI using b-value of 0 and 1000 respectively are of greater value in localization, evaluation and prediction of histological grade of bladder cancer.

Keywords: diffusion weighted MRI, apparent diffusion Coefficient, urinary bladder cancer, histopathological grade.

I. Introduction

Urothelial carcinomas are mainly located in the bladder and to lesser extent in upper urinary tract including renal collecting system and ureters. Bladder cancer accounts for 90–95% of urothelial carcinoma. [1,2] Bladder cancer is a frequent malignancy of the lower urinary tract, showing an incidence of 10.1 per 100,000 for men and 2.5 per 100,000 for women [3]. Transurethral resection of the bladder tumor (TURBT) is the standard treatment for non-muscle-invasive cancer, by which the urologist should provide the pathologist complete sampling of the tumor, the underlying bladder wall, and the edges of the resection [4]. The pathologist should report specifically the histology type, the grade, the depth of lamina propria invasion, and the presence of muscle in the specimen [5].

Bladder cancer also may show divergent histopathology, of which 90% of cases in the United States and western Europe presenting is urothelial carcinoma [either as pure transitional cell carcinoma (TCC) or as TCC with focal squamous or glandular differentiation] and 3% to 6% as pure squamous cell carcinoma (SCC) [6]. In recent clinical practice, contrast-enhanced computed tomography and MRI have become the most widely-used imaging modalities for radiological evaluation of the upper urinary tract and bladder. [7] MRI is superior to computed tomography in loco regional staging because of its superior soft tissue delineation. [8, 9] DW-MRI is a type of functional imaging, which is increasingly being applied in the detection, characterization and staging of bladder cancer, also provides helpful information for the diagnosis of urothelial carcinoma in a non-invasive manner. [10,11] Growing evidence has emerged showing that DW-MRI can serve as an imaging biomarker for characterizing the pathophysiology of cancer. [8] In DWI malignant lesions characteristically show high signal intensity because of the dense cellularity, tissue disorganization and decreased extracellular space that are typical characteristics of cancerous tissue, all of which restrict water diffusion. [11,12] On DW-MRI with high b-values of 800–1000 s/mm², urothelial carcinomas in the upper urinary tract and bladder generally show a homogenous, hyperintense signal reflecting homogenous histological

characteristics, whereas the signals from the surrounding tissues, including the urine, renal parenchyma and surrounding tissues, are well-restrained.[13]

Patients and methods

This is a cross sectional study that comprised forty preoperative patients complaining of hematuria referred to the urology consulting clinic in martyr Ghazi Al-Hariri hospital in the medical city complex in Baghdad during the period from January 2015 to September 2016, their age ranged from 43 to 74 years. All patients were subjected to pelvic MRI performed by Philips 1.5 tesla machine using T1, T2, fat suppression, ADC map and DW (b -value1000) sequences, in axial, coronal and sagittal planes ,except DWI was done in axial plane. Patients were examined in supine position with full bladder state before and after intravenous gadolinium injection. The presence or absence of mass lesion were assessed: including their position and wall invasion, then ADC map was calculated for each patient, ADC map or histogram is calculated by drawing a 20 mm² area in the center of tumor using b -value 0 and histogram is displayed showing x and y axes, the mean ADC value is shown in form of (10⁻³mm²/second).

All patient underwent transurethral resection of bladder tumors; whether under general or spinal anesthesia. In the operation room, the patient is placed in dorsal lithotomy position, then a thorough endoscopic evaluation of the urethra, prostate (in male), and bladder is done. The bladder is filled with 1.5% glycine irrigant; once the tumor is identified, using resectoscope, deep resection (near perforation) using a cutting current on the loop resection, then sufficient tissue is sent for histopathology.

The MRI findings were correlated with the corresponding histopathological results.

Exclusion criteria:

1. Patient with extravesicle primary pelvis cancer
2. Patients previously diagnosed to have bladder cancer and referred for follow up.

II. Results

Forty patients presenting with hematuria were included in this study .Their age were ranged between 43 and 74 years (mean 58 years).

Figure1 and 2

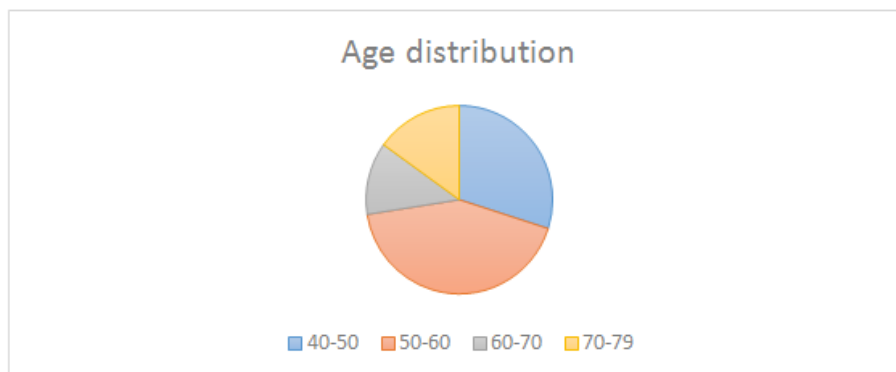


Figure 1 age distribution: most patients are in 6th decade

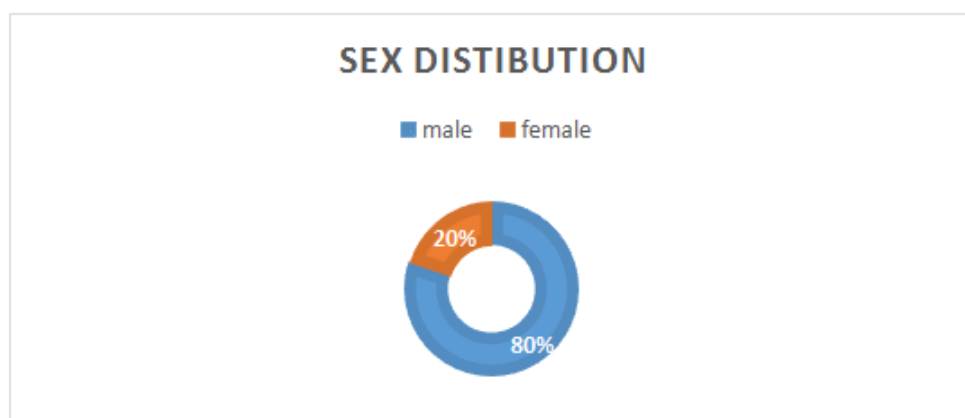


Figure 2: sex distribution:

Low ADC value (below 9×10^{-3} mm²/second) is registered in high grade tumor and this will represent 40% of preoperative patients, while low grade tumor value (10×10^{-3} mm²/second) is seen in 16 preoperative patients, DWI using *b*-value 1000 shows restricted diffusion –high Signal- in both in comparison to urine. Correlation between ADC map and histopathological grade are displayed in table 1

Table 1: ADC map results in correlation with tumor grade

ADC map	Low grade	High grade
Low ADC value	24/40 (60%)	0
High ADC value	0	16/40(40%)

Now regarding wall invasion detected during the study by comparing DWI to T2WI: As the DWI is a functional study depending on water particles movement, for this it has lower detection capability than structural T2WI for macroscopic muscle invasion and perivesical extension, by that only 21% of low grade tumor and 43% of high grade lesion shows wall invasion by DWI while the reality is 33% in low grade tumor and 81% of high grade tumor had muscle invasion by analyzing T2WI and when comparing that with histopathological stage.

Table 2: Macroscopic muscular wall invasion DWI Versus T2WI in comparison with histopathology

Wall invasion	Low grade tumor	High grade tumor
T2W	8/24 (33%)	13/16 (81%)
DWI	5/24 (21%)	9/16 (56%)

III. Discussion

Bladder carcinoma is a heterogeneous neoplasm, presenting as either superficial disease (80%) or muscle-invasive disease (20%). Only 10% to 30% of superficial tumors (pTa and pT1) will progress to invasive disease, whereas muscle-invasive tumors (pT2-pT4) have a much less favorable prognosis. So the more advanced the diagnostic modality is the more helpful it will be to determine whether patients have bladder cancer that can be treated locally or requires more aggressive, surgical treatment [14-18].

The advances in MRI examination and the introduction of DWI is considered a great improvement for disease diagnosis and follow up, DWI is one of the techniques and as it's a functional study depends on movement of water particles, a lesion where water molecules can diffuse freely shows low-signal intensity on DW-MRI and reverse is true, thus DW-MRI has been applied in the early detection of microstructural and functional changes.[19]

In our study the bladder tumor in general had restriction in their water movement, so reveals high signal on DWI, for that DWI is best for tiny tumor localization, while the ADC map used to characterize its value using the histogram and thus can determine its grade by correlation the value with histopathological results, tumor with low ADC value is considered high grade while those with high value are considered low and this is in agreement with study that was done by Takeuchi *et al.* reported that the ADC values of grade 3 bladder cancers were significantly lower than those of grade 1 or 2 bladder cancers. [20] Regarding the macroscopic wall invasion, still T2WI better than DWI in assessment of focal wall and extravesicle extension as the T2WI is a structural image where muscular wall is hypointense and tumor is hyperintense so wall invasion is clarified, while DWI is functional imaging and can to lesser degree assess wall invasion by depending the difference in restriction between the restricted tumor and non-restricted normal wall. From the above results we can use DWI alone with no need of intravenous gadolinium contrast media especially in tired elderly with impaired renal indices. MRI is often described as a "safe" modality due to the fact that, unlike x-ray based modalities, ionizing radiation is not encountered. However, there are hazards intrinsic to the MR environment that must be acknowledged and excluded. Most reported cases of MR related injuries and the few fatalities that have occurred have apparently been the result of failure to follow safety guidelines or have resulted from the use of inappropriate or outdated information related to the safety aspects of biomedical implants and devices.[21]

IV. Conclusion

MRI is an efficient, safe tool in diagnosing, grading and staging of urothelial cancer, specifically when superadded by using DWI and when accompanied by thorough and competent pathological results. It is thus recommended as an initial investigation in any patient presenting with bladder mass.

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