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ACCURACY OF DIFFUSION-WEIGHTED MRI (DW-MRI) IN PROSTATE CANCER DETECTION TAKING HISTOPATHOLOGY AS GOLD STANDARD

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ABSTRACT

Objective: To evaluate how accurately diffusion weighted MRI (DW-MRI) can identify malignant prostate lesions, using histopathology as the definitive standard for diagnosis.

Methods: This cross-sectional validation study including 148 patients suspected of prostate cancer was conducted in radiology unit of Sindh Institute of Urology and Transplantation from July-2024 to September-2024. In all patients DW-MRI was performed and the DW-MRI findings were correlated with histopathology findings to determine the diagnostic accuracy of DW-MRI.

Results: Mean age was 51.3±10.6 years. Out of 148, 107 (72.2%) presented with hematuria, and 125 (84.4%) presented with urinary retention. Regarding diagnostic accuracy, DW-MRI was 88.1% specific, 85.1% sensitive, with 76.9% PPV and 92.7% NPV. The overall diagnostic accuracy was 87.2%.

Conclusion: DW-MRI carries a good sensitivity and specificity for diagnosis of malignant prostate lesions. Therefore, it can be used to assess early meta-static spread in prostate cancer patients and help us to better decide the treatment goals.

Keywords: Diffusion weighted MRI, Prostate cancer, malignant lesions.

INTRODUCTION

Prostate cancer ranks as the second most prevalent cancer among men and stands as the sixth leading cause of cancer-related mortality overall.[1] Annually, about 1.2 million new cases of prostate cancer are identified, and global fatalities attributable to the disease surpass 350,000, establishing it as one of the primary causes of cancer mortality in men. The prognosis for a prostate cancer patient is significantly diverse and contingent upon the tumor grade and stage at initial diagnosis. Prostate cancer screening is the principal method for identifying localized prostate cancer in asymptomatic patients, the stage at which the disease may be cured.[2] Detection of serum prostate-specific antigen (PSA) is the principal method for screening prostate cancer but it has low specificity and high false positive detection rate.[3,4] Consequently, PSA-based screening for prostate cancer remains contentious.

T2-weighted magnetic resonance imaging, which is the conventional method of magnetic resonance imaging, offers very good anatomical information on the prostate. However, it cannot differentiate between malignant lesions from prostatic inflammation and benign lesions therefore T2-imaging has low specificity.[5] The use of functional magnetic resonance imaging techniques can help differentiate between benign and malignant tumors more accurately. The DW-MRI approach is one of these promising methods for the diagnosis of

prostate cancer. DW-MRI makes it possible to gain information about the cellular structure of the tissue through the utilization of this imaging approach, which assists in distinguishing the malignant tissue from the normal and inflammatory tissues.[6-8]

The aim of present study was to determine the diagnostic accuracy of DW-MRI for diagnosis of malignant prostate lesions.

METHODS:

This cross-sectional validation study including 148 patients was conducted in radiology unit of Sindh Institute of Urology and Transplantation from July-2024 to September-2024. Approval from hospital IRB was obtained. We included patients of age 18-70 years with suspicion of prostate cancer i.e. those with symptoms of hematuria, urinary retention and PSA level >4.0 ng/ml. While patients with prior history of prostate cancer, or having pelvic mass lesions infiltrating the prostate were excluded. Study sample size was calculated by taking estimated frequency of malignant lesions among suspected cases 30.51%, expected sensitivity of DW-MRI 86.7% and expected specificity 87.8%,[7] and taking desired precision level 10%.

DW-MRI was performed using 1.5 Tesla Magneton Harmony machine equipped with prostate coil. Diffusion pictures were acquired with a single-shot echo planar imaging procedure in axial orientation to encompass the whole pelvis. The following parameters were utilized in the process: Time to echo 84 milliseconds, slice thickness 4 millimeters, the field of view 30 centimeters, intersection gap 1 millimeter, the matrix is 256 by 256, and the b value 50 to 800 sec/mm^2.

After radiology the biopsy samples of prostate were sent for histopathology evaluation and DW-MRI findings were correlated with histopathology reporting.

Data analysis was performed using SPSS V23. 2×2 Table was formulated to determine the diagnostic accuracy of DW-MRI.

RESULTS:

Mean age was 51.3±10.6 years. Out of 148, 107 (72.2%) presented with hematuria, and 125 (84.4%) presented with urinary retention. Regarding diagnostic accuracy, DW-MRI was 88.1% specific, 85.1% sensitive, with 76.9% PPV and 92.7% NPV. The overall diagnostic accuracy was 87.2% (Table 1).

Table 1. Diagnostic Accuracy of DW-MRI.

DW-MRI Findings	Histopathology Findings		Total
	Malignant	Non-malignant	
Malignant	40	12	52
Non-Malignant	7	89	96
Total	47	101	148

Specificity	= 88.1%
Sensitivity	= 85.1%
PPV	= 76.9%
NPV	= 92.7%
Diagnostic Accuracy	= 87.2%

DISCUSSION:

The commonest malignancy and the main cause of death connected to cancer among men is prostate cancer. The growing older population has resulted in notable increase in new incidences of prostate cancer.[9] Proper handling and complete tumor resolution call for precise localization, early identification, and suitable staging. The exact characterizing of disease depends on anatomical and molecular imaging data.[10] Before surgical removal, the serum PSA level and TRUS-guided biopsy are performed for histological diagnosis; yet, the high false-negative rate of TRUS-guided biopsy poses a major problem in future management combined with patients' poor tolerance for intrusive treatments. A non-invasive technique with great diagnostic accuracy is

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therefore very necessary to solve these difficulties. In this regard, MRI of the prostate is the recommended modality because of its spectroscopic features, dynamic contrast investigations, and complete sequences.[11] While the problem of missing cancers in the anterior and apical portions of the prostate gland continues to be a serious challenge, overdiagnosis and overtreatment continue to be significant difficulties as well. The process of locating tumors in the transition zone has its challenges with an abundance of difficulties.[12]

In present study, DW-MRI was found to have sensitivity of 85.1%, and specificity of 88.1%.

Siddiqui et al. conducted a study including 272 male patients on diagnostic accuracy of DW-MRI for detection of malignant prostate lesions. The authors detected malignant lesions in 95 (34.93%) patients on DW-MRI and in 83 (30.51%) patients on histopathology reporting. The authors reported sensitivity of 86.7% and specificity 87.8%.[13]

Wu et al. conducted a study revealing that the sensitivity and specificity of DW images combined with T2-weighted imaging for prostate cancer detection were 72% and 81%, respectively. In contrast, T2-weighted images alone demonstrated a sensitivity of 62% and a specificity of 77%.[14]

Tan et al. in another study reported that DW-MRI is associated with higher diagnostic values with sensitivity of 69% and specificity 89%, in comparison to T2-images alone that had only 70% sensitivity and 83% specificity.[15]

DWI is particularly effective for assessing peripheral lesions compared to central ones. The prostate, a highly complex organ, experiences structural changes at microscopic levels in the early stages of various prostate diseases. In DWI, the concept of Brownian motion—the natural movement of water molecules—plays a crucial role, as this movement is greatly affected by the surrounding biological environment. Diffusion refers to how far water molecules can move. The limitation on this movement is often tied to the density of the tissue cells, as cell membranes primarily restrict diffusion. The success of DWI in detecting prostate cancer hinges on several factors: glandular atrophy, tightly organized cellular structures, and increased parenchymal density—all leading to diminished water diffusion in cancerous prostate tissues compared to normal ones.[16-18]

CONCLUSION:

DW-MRI carries a good sensitivity and specificity for diagnosis of malignant prostate lesions. Therefore, it can be used to assess early meta-static spread in prostate cancer patients and help us to better decide the treatment goals.

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