ORIGINAL ARTICLE

Diagnostic Accuracy of Diffusion Weighted Magnetic Resonance Imaging for Detection of Prostate Cancer Keeping Histopathology as Gold Standard

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ABSTRACT

Background: Prostate cancer is considered the most common tumour among males. In recent years, there has been a shift towards noninvasive techniques for diagnosing prostate cancer through diffusion weighted imaging (DWI). It can avoid unnecessary biopsy in many cases.
Aim: To evaluate the diagnostic accuracy of DWI for prostate cancer diagnosis, keeping histopathology as the gold standard.
Methods: This cross-sectional study was conducted in the radiology department of Bahawal Victoria Hospital, Bahawalpur, from May 2023 to October 2023. We conducted a cross-sectional study in the radiology department of BVH, Bahawalpur, from May 2023 to October 2023. Prior approval was taken from the institutional ethical review board. 55 patients were included with elevated PSA levels and symptoms suspicious for prostate cancer. The DWI imaging was evaluated for prostate cancer, and the final results were compared with histopathological diagnosis.
Results: The mean age of patients was 59.85±5.60 years. The sensitivity, specificity, and diagnostic accuracy of DWI for prostate cancer diagnosis were 84.2%, 83.3%, and 83.6%, respectively.
Conclusion: DWI is an alternative, noninvasive technique for the diagnosis of prostate cancer with high diagnostic accuracy.
Keywords: histopathology, diffusion weighted imaging (DWI), prostate-specific antigen (PSA).

INTRODUCTION

Prostate cancer is one of the most common malignancies among males and ranks third in number[1]. Its incidence has been on the rise in recent times, with an increase of new cases to nearly half a million per year[2]. It is considered the second most common cancer causing deaths following lung carcinoma[3]. There is worldwide variation among the incidence rates and overall cancer deaths from prostate cancer[4]. The prostate gland is divided into various anatomical zones, with the peripheral zone (70%) considered to be the most common site for malignancy[5].

Early detection of prostate cancer is related to a good prognosis and reduced mortality[6]. In recent times, various diagnostic investigations have been evolved for detecting prostate cancer in its initial stages. The most routinely used investigations include serum prostate-specific antigen (PSA), transrectal ultrasonography (TRUS), magnetic resonance imaging (MRI), and TRUS-guided biopsy. In some studies, it is reported that diffusion weighted (DWI) MRI can be used as an alternative tool to avoid biopsy for prostate cancer detection[4].

DWI can be used as an alternative imaging technique with proven diagnostic accuracy for determining the tumour extent and localisation in the prostate gland[8]. Apart from the prostate gland, DWI has emerged as a reliable imaging modality for detection of malignancy in tissues like the breast, urinary bladder, ovary, and liver. DWI can detect malignant tumours because of their characteristic diffusion restriction with low apparent diffusion coefficient (ADC) values[9].

The diagnostic accuracy of DWI in prostate cancer detection varies among the previously published literature. The sensitivity and specificity reported in various studies range from 25-95% and 36-100%, respectively. A meta-analysis published in the past showed that sensitivity and specificity in detection of prostate cancer by DWI were 69% and 89%, respectively[8].

Due to the rising incidence of prostate cancer in our Pakistani population, it is imperative to conduct such studies related to noninvasive and cost-effective techniques. The objective of this study was to determine the diagnostic accuracy of DWI in detection of prostate cancer with histopathology as the gold stand

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standard. It can be a helpful tool in our population to detect prostate cancer in the early phase and could be a noninvasive alternative in the future.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Radiology Department, Bahawal Victoria Hospital, Bahawalpur from May 2023 to October 2023. Approval from the institutional ethical review board was obtained prior to starting the study.

During the study period, a total of 55 patients were included. The age group of our patients was between 45 and 78 years. All these patients were having one or more symptoms suspicious for prostate cancer. They have elevated serum PSA levels of >4ng/mL with symptoms of haematuria, urinary incontinence, or enlarged prostate on digital rectal examination. All the patients underwent MRI with DWI protocol. The exclusion criteria included patients with a known history of prostate cancer or who had received any prior treatment (hormonal, radiation, or surgical) and a recent biopsy. The analysis was made with DWI imaging by experienced consultant radiologists with at least 3 years of post-fellowship experience in our department. The final report of the MRI scan with the DWI protocol was then co-related with the histopathology diagnosis.

DWI protocol imaging was done on a 1.5 TESLA machine with phased array body coils. All patients then underwent a TRUS or TURP-guided biopsy. A preformed proforma was used to record all the relevant data like demographics, clinical history, DWI, and histopathology report findings. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy for DWI were determined keeping histopathology as the gold standard.

RESULTS

Fifty five male patients fulfilling the inclusion criteria were included in the study. The mean age of patients was 59.85±5.60 years (Table 1). The mean PSA levels recorded among patients were 6.58ng/ml±1.77. The most common symptoms seen in our study population was urinary retention 63% followed by hematuria 16%. Positive DWI findings for prostate cancer was seen in 26 patients, while 19 were diagnosed with prostate cancer on histopathology.
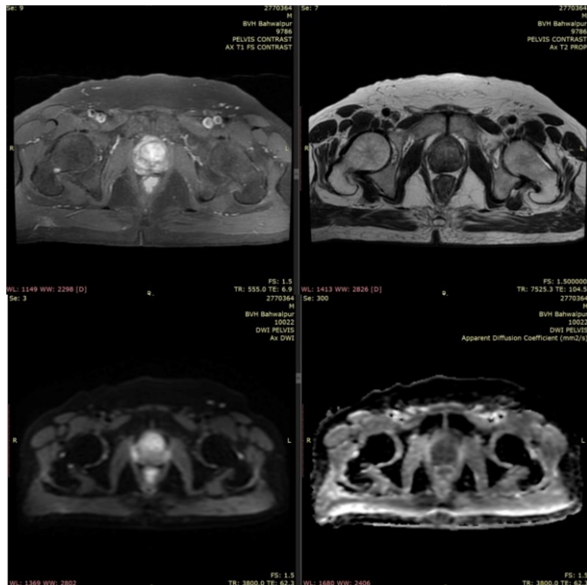
Figure showing abnormally enhancing lesion involving prostate gland on T1 post contrast study with restricted diffusion on DWI and low ADC value

The sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of DWI protocol for diagnosing prostate cancer were 84.2%, 83.3%, 72.7%, 90.9%, and 83.6 %, respectively (Table 2).

Table 1: Patient characteristics

Parameters	Mean±SD / Frequency
Age	59.85±5.60 years
PSA	6.58 ng/ml ± 1.77
DWI for malignancy	22 patients (40%)
Histopathology (Malignant)	19 patients (34.5%)

Table 2. Diagnostic accuracy of DWI for prostate cancer diagnosis

Diagnostic Accuracy Parameters	Percentages
Sensitivity	84.2%
Specificity	83.3%
Positive Predictive Value (PPV)	72.7%
Negative Predictive Value (NPV)	90.9%
Diagnostic Accuracy	83.6%

DISCUSSION

As the incidence of prostate cancer is on the rise worldwide, it has become very important to localise and detect the tumour in the early stages[10]. Also, prostate cancer is becoming one of the leading causes of mortality among men in recent times, especially in the Asian population. For early detection and localisation of prostate cancer, MRI with DWI protocol has emerged as the preferred choice of investigation.

There are high false-positive rates of TRUS-guided prostate biopsy reported in literature, and to overcome this, MRI can be used as an alternative noninvasive technique with high diagnostic accuracy[11]. MRI of the prostate is now the preferred choice of modality for imaging prostate cancer with dynamic contrast studies and spectroscopy techniques along with ADC protocol[12].

The DWI protocol depends on the spontaneous movement of water molecules in the body's cellular environment. The movement of water molecules across cells is called diffusion, and its restriction is caused by the cell membrane. Single-shot echo-planar imaging spin-echo sequences are commonly utilised for diffusion-weighted imaging (DWI). The gradient pulse strength is quantified by using the b value. Typically, two b-values are acquired to calculate apparent diffusion coefficient (ADC) maps[13]. There is marked restriction of diffusion in areas where the tumour cells are densely packed, appearing bright on DWI and dark on ADC. There are differences in values of ADC, with lower values in malignant tumours than in benign prostate lesions. DWI is more sensitive to detect tumours in the peripheral zone rather than the transitional zone of he prostate[14]. Study done by Metens et al. Showed that high b values, i.e., 1500 mm2,are important to detect maximum tumours in prostate[15]. Both DWI and ADC mapping are helpful in detecting extra capsular extension of tumour and involvement of seminal vesicles[16]. As reported previously in a study on 283 patients, 39 patients had seminal vesicle extension, and all of them showed lower ADC values[17].

Our study reported that most patients were between 54 and 65 years of age, which is consistent with previous studies showing that prostate cancer is more prevalent in older patients with an average age of 66 years[18]. The sensitivity and specificity of DWI in detecting prostate cancer vary in previous published literature. Some meta-analyses reported ranges of sensitivity and specificity from 29 to 90 and 39 to 100%, respectively[19]. Our study reported sensitivity and specificity of 86% and 89%, respectively, which is consistent with published reports in the past.

There are certain limitations of our study, which include a small sample size, a single institutional study, and technical challenges, including motion artefacts or imaging quality issues.

CONCLUSION

Our study concludes that DWI can be an important noninvasive technique to detect prostate cancer and also provide relevant information about tumour localisation with its extension and staging. DWI has high diagnostic accuracy with detection of occult malignant lesions in areas like the transitional zone of the prostate. A larger sample size and multi-institutional studies are needed in the future for the generalisation of findings, providing more reliable insights into the utility of DWI as a diagnostic tool in clinical practice.

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