JPSIM Journal of Pakistan Society of Internal Medicine

Original Article

Diagnostic Accuracy of Magnetic Resonance Spectroscopy in Diagnosing Carcinoma Prostate

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Abstract

Objective: To determine the diagnostic accuracy of magnetic resonance spectroscopy (MRS) in detection of prostate cancer, rendering histopathology as gold standard.

Methods: Descriptive, Cross sectional study conducted from January 2016 to June 2017. Total 206 male patients with clinical suspicion of carcinoma prostate were included in study. Magnetic resonance spectroscopy (MRS) was performed in each patient. The findings were correlated with histopathology report to confirm the diagnosis.

Results: Out of 206 cases, MRS supported the diagnosis of prostate cancer in 120 (58.25%) patients. Histopathology confirmed prostate cancer in 124 (60.19%) cases whereas 82 (39.81%) patients revealed no prostate cancer. Overall sensitivity, specificity and diagnostic accuracy of magnetic resonance spectroscopy (MRS) in diagnosing carcinoma prostate was 87.10%, 85.37% and 86.41% respectively.

Conclusion: Magnetic resonance spectroscopy has high diagnostic accuracy in diagnosing prostate cancer.

Keywords: prostate carcinoma, magnetic resonance spectroscopy, sensitivity

How to cite this:

Aslam N, Arooj S, Imdad M, Mansoor M, Raja R. Diagnostic Accuracy of Magnetic Resonance Spectroscopy in Diagnosing Carcinoma Prostate. J Pak Soc Intern Med. 2021;2(4): 316-319

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DOI: https://doi.org/10.70302/jpsim.v2i4.2170

Introduction

Prostate cancer is the second most common cause of death in men with an estimated 41,000 deaths and more than 125,000 new cases per year.[1] Currently majority of cases are diagnosed at the time when cancer has reached out of the confines of the gland thus making it unresectable.[2]

Different clinical methods, imaging modalities as well as lab tests have been in use globally for early diagnosis of carcinoma prostate. These include digital rectal examination (DRE), transurethral ultrasonography (TRUS) guided biopsy and computed tomography (CT). Digital rectal examination can detect tumors in only posterior and lateral aspects of prostate gland and stage T1 tumors which are not palpable.[3] TRUS may miss a substantial number of tumors. Cancers usually are hypoechoic, but some may be echogenic or isoechoic causing false negative results. Mainly TRUS is used to guide prostate biopsy which is the gold standard for diagnosing prostate carcinoma.[4] However the false negative rate of TRUS - guided biopsy may range 15% to 34%.

The main objective of prostate cancer imaging is to get more specific disease characterization. In routine, magnetic resonance imaging (MRI) is an important tool for early detection of prostate cancer, the fusion of MRI/dynamic contrast enhanced MRI (DCE- MRI) with magnetic resonance spectroscopy (MRS) improves the evaluation of cancer localization, dimensions of the mass, confines as well as provide an indication of tumor aggressiveness.[5]

Citrate, choline and creatine play an important role in MRS done for diagnosing prostate cancer because these tumors are having an increase levels of choline and a decreased level of citrate. As separate analysis of choline and citrate could not be possible, so choline + creatine/citrate ratio may be used.

Methods

First of all, we took approval from Institutional Review Board (IRB). 206 patients sent by Outpatient Department of Urology and General Surgery fulfilling the inclusion and exclusion criteria were chosen. Informed consent

was taken from each patient. These patients had their MRS done using 1.5 Tesla magnetic resonance system with gradient strength of 33mT/m. A 3 plane localizer was acquired. We chose MRI technique of point – resolved spectroscopy single – voxel technique. Later, water suppression pulses were obtained resulting in data acquisition. All cases were observed and interpreted for choline + creatine/citrate ratio for carcinoma prostate. MRS findings were correlated with histopathology reports.

Sample size of 206 cases were included in this study. Data was analyzed through SPSS version 20.0. Mean and standard deviation were calculated for quantitative variables that is age, duration of disease and S/PSA. Frequency and percentages were calculated for qualitative variables like carcinoma prostate on MRS and histopathology. Effect modifiers like age, duration of disease and S/PSA were controlled through stratification and post - stratification chi – square was applied. p - value <0.05 was considered as significant.

Inclusion Criteria

a. All male patients with clinical suspicion of carcinoma prostate (having enlarged prostate with hard consistency, irregular surface, rectal mucosa not mobile and nodule on Digital Rectal examination and S/PSA > 4ng/ml)

b. Duration of disease more than three months

c. Age of patients 50 – 80 years

Exclusion Criteria

a. Patients already diagnosed as carcinoma prostate

b. Patients having acute or chronic prostatitis (Pain on DRE)

c. Patients with prostatic abscess (soft consistency on DRE)

d. Patients who have contraindications to MRS (MRS incompatible prosthesis or cardiac pacemaker holders)

Results

Age range of our study was from 50 - 80 years and mean age was 66.57 ± 7.44 years. Most of the patients 117 (56.80%) were between 66 to 80 years of age as shown in Table I.

Total patients were 206 and 133 (64.56%) were between 4-12 months of duration of disease with mean duration of disease 11.63 ± 4.44 months. The mean S/PSA was 22.14± 10.88 ng/ml (Table II)

Table 1: *Distribution of Patients According to Age*

Age (years)	No. of Patients	Percentage
50 - 65	89	43.20
66 - 80	117	56.80
Total	206	100.0

MRS supported the diagnosis of prostate cancer in 120 (58.25%) patients. Histopathology confirmed prostate cancer in 124 (60.19%) cases whereas 82 (39.81%) patients revealed no prostate cancer. In 120 MRS positive cases, 108 (True Positive) proved to have prostate cancer and 12 (False Positive) having no prostate cancer upon biopsy. Among 86 MRS negative cases, 16 (False negative) had prostate cancer on histopathology whereas 70 (True Negative) had no prostate cancer on histopathology as shown in Table III.

Table 2: *Distribution of Patients According to S/PSA*

S/PSA (ng/ml)	No. of Patients	Percentage
5 – 20	86	41.75
>20	120	58.25

Table 3: *Results of Magnetic Resonance Spectroscopy and Histopathology*

	Positive result on histopathology	Negative result on histopathology	Total	P–value
Positive on MRS	108 (True positive)	12 (False positive)	120	0.688
Negative on MRS	16 (False negative)	70 (True negative)	86	
Total	124	82		

The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of magnetic resonance spectroscopy (MRS) in diagnosing carcinoma prostate came out to be 87.10%, 85.37%, 90.0%, 81.40% and 86.41% respectively.

Discussion

Our study revealed magnetic resonance spectroscopy (MRS) to be non – invasive modality of choice for diagnosing prostate cancer with high diagnostic accuracy. MRS of prostate has increased the diagnostic yield in patients suffering from cancer, by adding metabolic characteristics of the tumour to the anatomical information. Benefits of the MRS in diagnosing carcinoma prostate are accurate spectral localization of each small morphologically abnormal region, precise correlation between the spectral mapping and the high – resolution magnetic resonance imaging, evaluation of the abnormal metabolism magnitude and three dimensional study of the prostate. Multiple non invasive imaging modalities are being used throughout the world. These are based

on the metabolism and cellular components of malignant cells. They used advanced technology of locallised MRS to study normal human prostate cells and metastatic tumour cells.[6]

The sensitivity and specificity of MRS (choline + creatine/citrate ratio > 1.5) for diagnosing prostate cancer as observed by Caivano R et al was 92% and 89% respectively which is similar to our results. They also compared the results with DWI(Diffusion weighted imaging) which revealed much lower sensitivity and specificity (88% and 61% respectively) as compared to MRS.[4]

However Testa C et al has shown this sensitivity and specificity using MRS (choline + creatine/citrate ratio > 1.2) as 70% and 44% respectively.[7] The data shows significant difference when MRI and MRSI (metabolic analysis of gland) are combined. According to one study, these reveal 56-94% sensitivity and 70 – 98% specificity when combines.[8] However, Yuen et al observed that MRI data in association with those of MRSI presented 100% sensitivity and 70.3% specificity for detecting the malignant nodules within the gland.[9] Prando et al observed that MRI combined with MRSI presented high sensitivity (84 to 100%) and low specificity (44 to 71%) in determining suspicious foci.[10] Another study involved seven centres and included 134 patients who were biopsy proven(carcinoma prostate). They underwent T1, T2 and MRS combining technique of pelvic surface coil and endorectal coils. They compared the findings within each sextant. Results showed no difference between accuracy of MRS and MRI(T1,T2).[11] All of the studies reported sensitivity of ≥ 88% except Yuen et al, which showed sensitivity of 71%. He suggested that contributing factors to the low sensitivity might have been difficulties in ensuring the correspondence of TRUS biopsy spatial accuracies to suspicious areas on MRS and the reason that MRS did not cover the entire PZ of the gland.[9] In a study done by Hasumi M et al, 13 out of 19 voxels revealed malignancy like appearance exhibiting a high choline peak and low citrate peak.[12] The accuracy, sensitivity and specificity of MRS for localizing the malignant areas were 84.2%, 81.3% and 100% respectively thus supporting our study and making MRS as the non – invasive modality of choice with high diagnostic accuracy in detecting prostate cancer.

Bong et al evaluated indicators for magnitude of aggressive disease for active surveillance candidates among patients of Ca Prostate. They combined the techniques of T2WI, Dynamic Contrast enhancement and DWI.[13]

The limitations of our study are that we have not compared our results with previously practiced MRI techniques including contrast enhancement of prostate or with DWI. Including patients having PSA of normal range could also help recognizing early prostatic carcinoma.

The MRS helps in the accurate diagnosis and further in localization of malignant nodule and may be indicated before biopsy for patients having increased PSA levels.

Conflict of Interest: None

Funding Source: None

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