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To Assess The Role of Diffusion Weighted Magnetic Resonance Imaging in Differentiating Benign From Malignant Prostate Lesions With Histopathological Correlation.

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Abstract:

Background&Method: This is a prospective study conducted in the Department of Radio Diagnosis, Index medical college hospital and research centre. 50 patients suspicion of prostatic pathologies were included in the study. A sample size of 50 was selected using purposive sampling technique.All the 50 patients were subjected for the multi-parametric MRI sequences including T1 and T2 weighted anatomical imaging, functional imaging using diffusion weighted MRI with ADC value calculation.The machine used in this study is GE SIGNA EXPLORER 1.5 Tesla MRI with phased array body coil.

Result: Majority of lesions 37 (74%) on diffusion weighted imaging were hyperintense while 13 (26%) were hypointense. Out of 37 hyperintense lesions 24 (92.31%) were malignant on histopathology and 13 (54.16%) were benign on histopathology. 13 (26%) lesions appeared hypointense on diffusion weighted imaging 2 (7.69%) were malignant on histopathology while 11 (45.83%) lesions were benign on histopathology.
This indicated benign lesions tends to both hyperintense and hypointense on diffusion weighted imaging, benign lesions those appeared hyperintense on diffusion weighted imaging had inflammatory properties ,that was confirmed on histopathology. Malignant lesions tends to be hyperintense on diffusion weighted imaging.

Conclusion: Based on the findings of this study it can be concluded that DWI with ADC calculation in patients with raised PSA levels is a valuable , feasible and non-invasive method for detection and characterization of benign and malignant prostatic lesions with high sensitivity and specificity besides high predictive values and diagnostic accuracy. Multi-parametric MRI with included Diffusion Weighted Imaging along with calculation of ADC values results in best characterization of prostatic lesions and calculation of PIRADS score.

Keywords:diffusion weighted, MRI, prostate lesions &histopathological.

Study Designed: Cross sectional and correlative study.

1. INTRODUCTION

Worldwide, diseases of Prostate gland are responsible for significant morbidity and mortality among adult males. . Most frequently encountered diseases affecting prostate are prostatitis , benign prostatic hyperplasia and Prostatic cancer [1].
It is estimated that number of males in the U.S who will experience prostatitis during their lifetimes range up to 50%[2]. By the age of 60, 50% of men have BPH, and by 90 years of age, the prevalence has increased to 90%. As such it is often thought of essentially as a 'normal' part of aging [3].
Carcinoma of prostate is one of the leading causes of cancer death among aged men. It is the most common non-cutaneous cancer among men [4].
The incidence of prostate cancer is on the rise primarily because of increased application of screening tests using prostate-specific antigen (PSA) and also partly because of the increase in life expectancy [5].
Most of the prostate cancers are slow-growing and indolent rather than being aggressive and hence they seldom produce any symptoms until the advanced stage. Hence, early diagnosis of prostate cancer can lead to improved treatment outcomes besides aiding in the selection of multiple treatment options available.
Traditionally, the methods employed include a prostate-specific antigen assay (PSA), Digital rectal examination (DRE) and transrectal ultrasound guided biopsy (TRUS). The confirmatory diagnosis of prostate cancer can only be made by taking a biopsy which is usually a 8-core TRUS biopsy. However, all these methods have their own limitations and disadvantages.
PSA assay levels lack sensitivity and specificity while the DRE is a crude technique with a low positive predictive value and high inter- observer variability. Studies have shown that TRUS biopsy can miss upto 20% of prostate because of under sampling of anterior prostate, apex and midline resulting in high false negativity [6].
About 70% of initial biopsies performed in men with raised PSA levels are negative for prostate cancer hence increasing the burden of negative biopsies and increased screening costs [7].

2. MATERIAL & METHOD

This is a prospective study conducted in the Department of Radio Diagnosis, Index medical college hospital and research centre. 50 patients suspicion of prostatic pathologies were included in the study from Feb. 2020 to Aug. 2021. A sample size of 50 was selected using purposive sampling technique.

METHOD OF COLLECTION OF DATA:

All the 50 patients were subjected for the multi-parametric MRI sequences including T1 and T2 weighted anatomical imaging, functional imaging using diffusion weighted MRI with ADC value calculation.

The machine used in this study is GE SIGNA EXPLORER 1.5 Tesla MRI with phased array body coil.

PULSE SEQUENCE AND IMAGING PLANE.

A three-plane localizer was obtained for planning of the various sequences. A T2W fast spin-echo was obtained in the sagittal, coronal and axial plane. A T1W fast spin echo was obtained in the axial plane.

An axial T1 image with gadolinium as contrast agent was acquired.

This was followed by by DWI obtained through a multi section spin- Echo single shot echo planar sequence in the transverse plane, using bvalues of 0 and 1000 sec/mm2 . A T2W fat suppressed was obtained in axial plane.

Analysis of ADC was an automated process, available as an application in our scanner. Calculation of ADC was made for each voxel of an image and was displayed as a parametric (ADC) map. ADC measurements was then recorded for a given region by drawing regions of interest (ROI) on the ADC map. An average of three ADC values were taken of index lesion for calculation of mean ADC value.

INCLUSION CRITERTA:

1. Patients above 50 years of age.
2. Patients with lower urinary tract symptoms i.e. frequency of micturition, hesitancy, urgency.
3. Hard/enlarged prostate on digital rectal examination.
4. Enlarged prostate on ultrasound abdomen.
5. Raised prostate-specific antigen (PSA) levels (>4 ng/ml)
6. Patients in whom histopathological findings are available for correlation.

EXCLUSION CRITERIA:

1. Patients who were post hormonal/radiotherapy, had undergone prostatic biopsy less than 6 weeks before the MRI. On MR imaging-haemorrhagic area in prostate, mass lesions infiltrating the prostate from outside.
2. General contraindication to MRI such as those with pace makers,cochlear implants and other electromagnetic implants in the body ,claustrophobia etc.
3. Patient not willing to sign informed consent form.
4. Patients in whom histopathological findings are not available for correlation.

3. RESULTS

TABLE /GRAPH 01:AGE DISTRIBUTION AMONG CASES.

S. No.	Age in years	Number	Percentage
1	**50-60**	**17**	**34**
2	**60-70**	**21**	**42**
3	**70-80**	**08**	**16**
4	**80-90**	**04**	**08**

TABLE/GRAPH 02: HISTOPATHOLOGICAL DIAGNOSIS OF LESIONS

HISTOPATHOLOGY	**NUMBER**	**PERCENTAGE**
BENIGN	24	48%
MALIGNANT	26	52%

Of the 50 patients with prostatic lesions included in our study 24 lesions (48%) were benign and 26 lesions (52%) were malignant on histopathology.

TABLE/GRAPH 03: PATHOLOGICAL DISTRIBUTION OF BENIGN LESIONS

BENIGN LESION	**NUMBER**	**PERCENTAGE**
PROSTATE ABSCESS	2	8.33%
CHRONIC PROSTATITIS	1	4.16%
BPH+CP	6	25%
BPH	15	62.50%

Of the 24 benign lesions out of total 50 patients , majority are of Benign prostatic hyperplasia followed by BPH with chronic prostatitis. Least number of lesions are of chronic prostatitis without benign prostatic hyperplasia.

TABLE/GRAPH 04: RELATION BETWEEN PSA AND MEAN ADC IN COMPARISON WITH HISTOPATHOLOGY.

PSA(ng/ml)	**NUMBER**	**PERCENTAGE**	**MEAN ADC**	**BENIGN**	**MALIGNANT**
4--25	**23**	**46%**	**1.04**	**19**	**4**
26-50	**11**	**22%**	**0.92**	**4**	**7**
>50	**16**	**32%**	**0.74**	**1**	**15**

Our study included 3 groups of prostate specific antigen 4-25 ng/ml , 26-50 ng /ml , and >50 ng /ml. Most of the patients 23 (46%) belong to PSA range 4-25 ng/ml ,this group has mean ADC value of 1.04 x 10-3 mm2/s on histopathological examination 19 of them (82.60 %) out of 23 turned out to be benign and 4 of them (17.39 %) out of 23 turned out to be malignant.
11 patients (22 %) have PSA range 26-50 ng/ml , this group has mean ADC value of 0.92 x 10-3 mm2/s on histopthological examination 4 of them(36.36%) out of 11 turned out to benign and 7 of them (63.63%) out of 11 turned out to be malignant.

16 patients (32 %) have PSA >50 ng/ ml , this group has mean ADC value 0.74x10-3 mm2/s , on histopathological examination only 1 lesion (6.25%) out of 16 turned out to be benign rest 15 lesions (93.75%) were malignant.
This indicates that as the serum PSA level increases mean ADC value decreases and there is increase risk toward malignancy.
Patients with serum PSA level >50 ng/ml have 93.75 % chances of malignancy , those in the range 26-50 ng/ml have 63.63 % chance of malignancy.Patients with serum PSA level in the range have least chances of malignancy.

TABLE /GRAPH 05: COMPARISON OF APPEARANCE OF LESIONS IN DIFFUSIONWEIGHTED IMAGING WITH HISTO-PATHOLOGICAL DIAGNOSIS.

APPEARANCE ON DWI	NUMBER	PERCENTAGE	MALIGNANT	BENIGN
HYPERINTENSE	**37**	**74%**	**24/90.31%**	**13/54.16%**
HYPOINTENSE	**13**	**26%**	**2/7.69%**	**11/45.83%**

Majority of lesions 37 (74%) on diffusion weighted imaging were hyperintense while 13 (26%) were hypointense. Out of 37 hyperintense lesions 24 (92.31%) were malignant on histopathology and 13 (54.16%) were benign on histopathology. 13 (26%) lesions appeared hypointense on diffusion weighted imaging 2 (7.69%) were malignant on histopathology while 11 (45.83%) lesions were benign on histopathology.
This indicated benign lesions tends to both hyperintense and hypointense on diffusion weighted imaging, benign lesions those appeared hyperintense on diffusion weighted imaging had inflammatory properties ,that was confirmed on histopathology. Malignant lesions tends to be hyperintense on diffusion weighted imaging.

4. DISCUSSION

The age group commonly affected were those in the age group of 60-70 years.This result was in concordance with the study done by Bangalore RamalingiahVaniet al [8].
Among the 50 cases, 26 cases were histopathologically proved to be malignant and 24 cases were proved to be benign.Among 24 lesions that were proved benign in histopathological study most common pathology encountered was benign prostatic hyperplasia which was found in 15 (62.50 %). Only case was of chronic prostatitis without BPH. The number of cases of chronic prostatitis with and prostatic abscess were 6 (25%) and 2 (8.33%) respectively.
This result was in concordance with the study done by BaidyaRet al[9].Most common presenting complaints in both benign and malignant lesions was lower urinary tract symptoms [LUTS] which was found in26 (52 %) of total 50 patients . Haematuria and lower back pain was noted in 50 % of patients with malignant lesions. Fever was present in few cases that turned out to have inflammatory properties on histo -pathological examination.
Most common DRE finding in our study of 50 patients was enlarged firm and nodular prostate which was observed in 24 (48%) of patients of which 9 lesions turned out to be malignant

and 15 were benign on histopathological examination. Hard ± nodular,asymmetrical,fixed prostate was observed in 24 patients out of which 17 (70%) patients have malignancy in histopathology. This conclude that patient with hard prostate on DRE have more chances of having malignancy. This result was in agreement with prospective, cross-sectional and descriptive study done by Chodak GW et al [7].

In the study conducted by us total 13 lesions (26 %) are located in peripheral zone , 32 % lesions i.e. 16 are located in transitional zone of prostate , maximum number of lesions 21 (42 %) are located both in transitional as well as peripheral zone of prostate. The result of study were in concordance with the study done by Lee CH et al [10].

They observed maximum number of lesions in transition and peripheral zone followed by lesions in transition zone.The histopathological diagnosis revealed 26 lesions 52 % as malignant,these lesions on MRI imaging were mostly located in peripheral zone,15 lesions (30 %) are benign prostatic hyperplasia most commonly located in transitional zone. 6 lesions (12 %) were benign prostatic hyperplasia with chronic prostatitis on histopathology, 2 lesions (4 %) were prostatic abscess, 1 lesion was (2 %) was chronic prostatitis. The pathologies which were most commonly affecting prostate gland werebenign prostatic hyperplasia, prostatitis and prostate cancer.

5. CONCLUSION

Based on the findings of this study it can be concluded that DWI with ADC calculation in patients with raised PSA levels is a valuable , feasible and non-invasive method for detection and characterization of benign and malignant prostatic lesions with high sensitivity and specificity besides high predictive values and diagnostic accuracy.Multi-parametric MRI with included Diffusion Weighted Imaging along with calculation of ADC values results in best characterization of prostatic lesions and calculation of PIRADS score.

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