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Role of MRI in Evaluation of Patients Clinically Diagnosed as Benign Prostatic Hyperplasia and Clinico-Pathological Correlation

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ABSTRACT

Bladder outlet blockage is linked to BPH, a prevalent health issue affecting older men. BPH symptoms often appear after the age of 40, and by the time a person reaches 60, 50-60% of them will have the condition.Lower urinary tract symptoms, such as nocturia, urgency, and frequent voiding, are commonly experienced by BPH patients. Additionally, voiding symptoms may include straining, weak stream, hesitation, and intermittent voiding. To establish role of MRI in assessment of patients clinically diagnosed as BPH and lay down its importance in the workup of these patients. This observational cross sectional study was performed in the Department of Radio-diagnosis and Imaging, Burdwan Medical College and Hospital, Burdwan from 1st APRIL 2021 to 30th September 2022. A total of 100 consecutive patients were evaluated and subjected to MRI of the prostate gland, after being clinically assessed and diagnosed as BPH at the Department of Urology, Burdwan Medical College and Hospital. 80% cases showed BPH as radiological diagnosis, thereby correlating with clinical diagnosis. Most of the cases(95%) had pathologies in transitional zone, most common site of BPH occurence. Type 3 was the most common radiological type of BPH followed by type 1 and 2. On biopsy, 20% patients with PIRADS score 3 shown cancer, compared to 50% with score of 4 and 75% with a score of 5, hence proving higher PIRADS score corresponds to a higher risk of cancer. We draw the conclusion that magnetic resonance imaging (MRI) is a crucial imaging modality for assessing the key characteristics of BPH. Thanks to its multi-planner capability and better soft tissue contrast, it aids in the correct diagnosis of disease. Interpreting the pictures, however, requires an understanding of the normal architecture of the prostate and peri-prostatic tissue as well as the imaging characteristics of different prostatic pathologies.

INTRODUCTION

Bladder outlet blockage is linked to BPH, a prevalent health issue affecting older men. BPH symptoms often appear around age 40, and by the time a person reaches 60, 50-60% of them will have the condition[1].

Lower urinary tract symptoms, such as nocturia, urgency, and frequent voiding, are commonly experienced by BPH patients. Additionally, voiding symptoms may include straining, weak stream, hesitation, and intermittent voiding. Although, USG is the most often used imaging modality in BPH patients due to its affordability and ability to yield valuable information in the majority of cases, it is not always reliable in determining the zonal architecture of the prostate or the lobar categorization of BPH patients.

Because of its higher soft tissue contrast resolution, MRI can distinguish between different phenotypes of BPH by drawing a picture of the lobar architecture. Stromal and glandular enlargements are features of BPH. The primary results of glandular enlargement include obstructive symptoms and an increase in prostate size, which is referred to as the "static effect." The "dynamic effect" is the result of stromal expansion with an increase in the parenchyma's resistance[2]. BPH is characterized by expansile nodules, which include the proliferation of stroma, newly formed glandular structures, or both of these (mixed type BPH nodule)[3]. BPH nodules can be seen as ranging from hypointense to hyperintense on T2-weighted images depending on the ratio of stromal to glandular components.

On T2- weighted images, the tissues with higher water content appear hyperintense, while those with less water content appear hypointense. Thus, hyperintense appearance of a BPH nodule is caused by cystic ectasia and hyperplastic glandular components, which are filled with secretion, while hypointense appearance is caused by fibromuscular components[4].

USG, CT, and MRI are the imaging modalities accessible for prostate in addition to clinical examination. USG cannot accurately define the correct zonal architecture and lobar distribution in BPH; CT carries a radiation risk. An extensive "one-stop shop" examination of pelvic anatomy, periprostatic anatomy, and prostatic anatomy is made possible by MRI. This kind of simultaneous coverage of tissue details is not possible with either TRUS or CT[5].

There are variations in lobar involvement of prostate in BPH patients. MRI with its better soft tissue contrast resolution can effectively delineate lobar classification of BPH, stromal/glandular ratio which may prove beneficial in choosing appropriate management strategy.

MATERIALS AND METHODS

After the approval of the ethics committee of Burdwan Medical College and Hospital and permission of The West Bengal University of Health sciences, the data for the study were collected from patients referred to MRI scan at Dept of Radiodiagnosis and Imaging, Burdwan Medical College and Hospital, Burdwan.

Study area: Department of Radiodiagnosis, Burdwan medical college and Hospital, in collaboration with Department of Urology, Burdwan medical college and Hospital.

Study population: The study was done on patients clinically diagnosed as BPH referred from the Dept. of Urology, Burdwan Medical College and Hospital. They were subjected to MRI prostate.

Study variables

Independent variables:

- Age
- Religion
- Marital status
- Socio economic status Clinical presentations
- T2WMR score
- DWI/ADC score
- Zonal distribution of BPH
- Bladder lumen projection

Dependent variables:

- Radiological diagnosis
- Radiological types of BPH
- PIRADS score
- Biopsy outcome

Study design: A Descriptive Cross-sectional study.

Period of study:

- From 1st APRIL 2021 to 30th September 2022
- First 3 months had been utilised for preparation. Next 10 months had been utilised for data collection.
- Next 3 months had been utilised for data analysis. Last 2 months had been utilised for report writing.

Inclusion criteria:

- Male patients
- Age >40 years
- Patients clinically suspected as BPH

Exclusion criteria:

- Patients who have undergone prostatectomy, pelvic radiation or undergoing medical treatment for BPH
- Patient of diagnosed prostate carcinoma

- Any metallic implant which is activated by electric, magnetic or mechanically
- Patients with claustrophobia
- Patient not giving valid consent

Sample size: Sample size was calculated using the formula:

$$n = \frac{(Z)^2\ P(1-P)}{d^2}$$

Where:

n = Sample size
Zα = Standard normal variate at α = 0.05 level is 1.96
P = Proportion of probable prevalence and d is the absolute precision

Using the above formula sample size came out to be approximately 100.

RESULTS

Among the 100 participants peripheral zonal distribution of BPH were seen in 5% and Transitional zonal distribution seen in 95% cases. Among 100 patients only 12% showed Bladder lumen projection of the median lobe. Among the 100 patients 80% were having benign lesion, 10% were having intermediate, 6% were having high and rest 4% were having very high risk for malignancy. Above table and diagram showed that most common radiological type of BPH was Type 3 (62.5%) followed by Type 1 (28.7%). Among the 20 biopsy cases 40% showed positive result for malignancy. Among total 100 patients 21% were having PIRADS score 1, 59% having PIRADS score 2, 10% having PIRADS score 3, 6% having PIRADS score 4 and 4% having PIRADS score 5. Among total 100 patients 20% under gone biopsy who were having PIRADS score 3-5. Among the 8 biopsy proven prostate cancer 50% were in peripheral zone and 50% were in transitional zone (Table 1-3).

DISCUSSION

This observational cross sectional study was performed in the Department of Radio-diagnosis and Imaging, Burdwan Medical College and Hospital, Burdwan from 1st APRIL 2021 to 30th SEPTEMBER 2022. A total of 100 consecutive patients were evaluated and subjected to MRI of the prostate gland, after being clinically assessed and diagnosed as BPH at the Department of Urology, Burdwan Medical College and Hospital.

The patients were assessed based on detailed MRI findings like characteristics of lesion on T2WI, DWI-ADC sequences; zones of prostate involved, lobar distribution according to radiological types of BPH.

Based on a study of 100 clinically confirmed instances of BPH, it was shown that 10% of patients were between the ages of 40 and 50, 21% were

Table 1: Distribution of the study population according to zonal distribution of BPH (n = 100), bladder lumen projection of the median lobe

Parameters		Frequency	Percentage
Zonal distribution of BPH	Peripheral zone	5	5.0
	Transitional zone	95	95.0
Bladder lumen projection	No projection	88	88.0
	Projection present	12	12.0
Radiological diagnosis	Benign prostatic hypertrophy (BPH)	80	80.0
	Lesion with high risk for malignancy	6	6.0
	Lesion with intermediate risk for malignancy	10	10.0
	Lesion with very high risk for malignancy	4	4.0
	Total	100	100.0

Table 2: Distribution of the study population according to Radiological type of BPH (n = 80) and biopsy outcome

Parameters		Frequency	Percentage
Radiological type of BPH	1	23	28.7
	2	5	6.2
	3	50	62.5
	4	1	1.3
	5	1	1.3
Biopsy outcome	Negative	12	60.0
	Positive	8	40.0
Zonal distribution of biopsy positive	Peripheral zone	4	50.0
	Transitional zone	4	50.0
	Total	8	100.0

Table 3: Distribution of the study population according to PIRADS score and need for Biopsy (n=100)

	Additional investigation (biopsy)		
PI-RADS score	Done (%)	Not done (%)	Total (%)
1.0	0 0.0	21 26.3	21 21.0
2.0	0 0.0	59 73.8	59 59.0
3.0	10 50.0	0 0.0	10 10.0
4.0	6 30.0	0 0.0	6 6.0
5.0	4 20.0	0 0.0	4 4.0
Total	20 100.0	80 100.0	100 100.0

between the ages of 51 and 60, 30% were between the ages of 61 and 70, and 39% were older than 70. This suggests that as people age, the incidence of BPH rises. Similar findings were obtained by Wang *et al*.[6] in their study, which showed that the incidence of BPH was 2.9, 29.0, 44.7, 58.1 and 69.2%, respectively, in the age categories of 40-49, 50-59, 60-69, 70-79 and 80 years and older. It supports our result that the incidence of BPH rises with advancing age.

In this study 80 cases were directly diagnosed as BPH on MRI based on their findings. Overall size of the prostate gland was increased. Bilateral transitional zones were enalarged with completely encapsulated nodules or mostly encapsulated nodules or circumscribed homogeneous nodules without diffusion restriction.

All radiologically diagnosed cases (80) showed that predominant zone involved was transitional zone. This finding was supported by the finding that histologically, BPH describes a proliferative process of both the stromal and epithelial elements of the prostate gland. BPH arises in PUGs in the fourth decade and then continues to the TZ, which is the main site of BPH[7].

In our study, out of 80 radiologically diagnosed BPH cases 50 cases (62.5%) were type 3 BPH , 23 cases (28.7%)were type 1 BPH and 5 cases (6.2%)were type 2 BPH. Randall[8] previously described a classification for BPH in 222 postmortem cases and classified the enlarged regions of prostate. Based on this classification, the US and MRI classifications of BPH were described. BPH types on MRI are as follows: type 0, an equal to or less than 25 cm3 prostate showing little or no zonal enlargement; type 1, bilateral TZ enlargement (35%); type 2, retrourethral enlargement (10%); type 3, bilateral TZ and retrourethral enlargement (46%); type 4, solitary or multiple pedunculated enlargement; type 5, pedunculated with bilateral TZ and/ or retrourethral enlargement; type 6, subtrigonal or ectopic enlargement; and type 7, other combinations of enlargements. This substantiates our finding of Type 3 BPH as the commonest type; followed by type 1 BPH as second most common.

Based on MRI results, 80% of the 100 patients had benign lesions (BPH), 10% had lesions with intermediate risk, 6 percent had high risk, and the remaining 4 percent had extremely high risk for malignancy. Accordingly, the largest number of patients (80%) with BPH on MRI out of 100 clinically diagnosed instances.

In our study, 20 cases which showed suspicious findings on MRI undergone biopsy; among them 8 cases (40%) were histologically proved to be malignant lesion. Mean PIRADS score of Biopsy proven prostate cancer was 4.13 and mean PIRADS score of biopsy negative cases was 3.42. There was statistically significant difference in PIRADS score among the groups as $p<0.05$.

20% of the 10 patients with a PIRADS score of 3 had a biopsy that revealed cancer, compared to 50% of the 6 patients with a score of 4 and 75% of the 4 patients with a score of 5. A higher PIRADS score corresponds to a higher risk of cancer. In their study, Mazzone found that, at the index-lesion level, the detection rates of clinically relevant malignancy were 13% for PI-RADS 3, 40% for PI-RADS 4, and 69% for PI-RADS 5. These results are close to results of study by Oerther *et al*.[9] who reported cancer detection rates for PI-RADSv2.1 on lesion level with 20% for PI-RADS 3 and 52% for PI-RADS 4. For PI-RADS 5, they reported a higher pooled summary measure with 89%.

Therefore, it was clear from our study's examination of all the data that the incidence of BPH rises with age after the age of 40. With its superior soft tissue resolution capability, magnetic resonance imaging (MRI) is able to assess various aspects of benign prostatic hyperplasia (BPH), allocate lesions based on zonal distribution, categorize various forms of BPH using a radiological classification scheme and determine whether a hypertrophied median lobe is responsible for bladder lumen protrusion. Lesions were categorized based on their degree of suspicion of malignancy using PI-RADS scoring, and when a biopsy was required, the results demonstrated a strong association with PI-RADS grading.

The most commonly given treatment is medical management with α-adrenergic blocking agents, 5α-reductase inhibitors or both Open surgery, transurethral electrovaporization (TUEVP), transurethral incision and therapeutic ultrasound (TURP) are currently limited to men with moderately severe to severe symptoms accompanied by signs of obstruction, as well as those exhibiting complications related to obstruction, such as urinary retention, renal insufficiency, or recurrent infection. Patients who do not respond to medicinal therapy are also recommended to undergo surgical or minimally invasive procedures.

Alternative therapies include thermal therapies, transurethral needle ablation using radiofrequency (RF) energy, laser or high-intensity focused ultrasound (HIFU) to shrink the enlarged lateral lobes (transition zones [TZ]) of the prostate. The details of these treatments are beyond the scope of this review.

It is clear that a number of minimally invasive procedures primarily target the expanded "lateral lobes" (transition zones), omitting to consider the impact of midline expansion on the ability to void. Regarding the possible outcomes of treatment techniques, a number of recent articles have stressed the significance of evaluating intravesical intrusion of median lobe (retrourethral) enlargement as a distinct entity from lateral lobe (bilateral TZ) expansion[10].

CONCLUSION

We draw the conclusion that magnetic resonance imaging (MRI) is a crucial imaging modality for assessing the key characteristics of BPH. Thanks to its multi-planner capability and better soft tissue contrast, it aids in the correct diagnosis of disease. Interpreting the pictures, however, requires an understanding of the normal architecture of the prostate and peri-prostatic tissue as well as the imaging characteristics of different prostatic pathologies. It has been determined that the transition zone is the most frequent location for BPH occurrence, and that MRI is a useful tool for defining the zonal distribution of BPH. MRI accurately classifies BPH into many radiological categories based on the lobar categorization system; type 3 BPH is the most prevalent type, followed by Type 1. Patients with suspicious lesions and higher PI-RADS score i.e, (3-5) after biopsy confirmation showed that there is a significant correlation between PI-RADS score and biopsy positive prostate cancer cases. From our study it is also evident that chance of detection of prostate cancer increases with increased PI-RADS score.

REFERENCES

1. Berry, S.J., D.S. Coffey, P.C. Walsh and L.I. Ewing, 1984. The development of human benign prostatic hyperplasia with age. J Urol., 132: 474-479.
2. Wasserman, N.F., 2006. Benign prostatic hyperplasia: A review and ultrasound classification. Radiol. Clin. North AM., 44: 689-710.
3. Wasserman, N.F., B. Spilseth, J. Golzarian and G.J. Metzger, 2015. Use of MRI for lobar classification of benign prostatic hyperplasia: potential phenotypic biomarkers for research on treatment strategies. AJR Am. J. Roentgenol., 205: 564-571.
4. Ling, D., J.K. Lee, J.P. Heiken, D.M. Balfe, H.S. Glazer and B.L. McClennan, 1986. Prostatic carcinoma and benign prostatic hyperplasia: Inability of MR imaging to distinguish between the two diseases. Radiology, 158: 103-107.
5. Robert, R., 2005. Edelman. In: Clinical Magnetic Resonance Imaging, 3rd Edn., Saunders, pp: 2909-2910.
6. Wang, W., Y. Guo, D. Zhang, Y. Tian and X. Zhang, 2015. The prevalence of benign prostatic hyperplasia in mainland China: evidence from epidemiological surveys. Sci. Rep., Vol. 5, 10.1038/srep13546.
7. McNeal, J.E., 1978. Origin and evolution of benign prostatic enlargement. Invest. Urol., 15: 340-345.
8. Randall, A., 1931. Surgical pathology of prostatic obstructions. Baltimore: Williams and Wilkins.
9. Oerther, B., H. Engel, F. Bamberg, A. Sigle, C. Gratzke and M. Benndorf, 2022. Cancer detection rates of the PI- RADSv2.1 assessment categories: systematic review and meta-analysis on lesion level and patient level. Prostate Cancer Prostatic Dis., 25: 256-263. 10.1038/s41391-021-00417-1.
10. Tan, Y.H. and K.T. Foo, 2003. Intravesical prostatic protrusion predicts the outcome of a trial without catheter following acute urine retention. J. Urol., 170: 2339-2341.