ORIGINAL RESEARCH PAPER

Radio-Diagnosis

"USE OF MULTIPARAMETRIC-MRI WITH PI-RADS IN EVALUATION OF PROSTATIC DISORDERS IN CORRELATION WITH CLINICAL OUTCOME "

KEY WORDS: DWI, ADC, USG, DCE, ESUR, PI-RADS, PSA, ROC, 3D, mpMRI, GBCA, MRS, MRI, DRE, TZ, PZ, T2W, T1W, CZ, AS, SV, Rt., Lt., a, mp, p

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ABSTRACT

use of multiparametric-MRI with PI-RADS in evaluation of prostatic disorders in correlation with clinical outcome is showing more accurate outcome in term of accurate diagnosis, localization of lesion with help of sector map anatomy, risk stratification and Ca prostate staging. There is new opportunity is open for focal biopsy and treatment of prostate cancer. We are using combination of diagnostic MRI with follow up till curative treatment in the combination of STIR sequence for better outcome with diffusion weighted MRI, T2-weighted imaging, dynamic contrast-enhanced imaging and MR spectroscopy in mp-MRI assessment of prostate cancer. DWI and T2W imaging with help of blood PSA level is mainstay for diagnosis of prostate cancer in this study. We are using 1,5 Tesla MRI Machine.as we know that assessment on Multiparametric-MRI is subjective so use of the newly developed standardized reporting Prostate Imaging and Reporting Archiving Data System scoring system and knowledge about prostate pathology is helpful for accurate interpretation of prostate pathology. This study is focus on clinical outcome with the help diagnostic mp-MRI.

INTRODUCTION-

for diagnosis of initial prostatic pathology Currently, in India we are using ULTRASONOGRAPHY with the help of digital rectal examination and blood PSA level. with the help of frequent prostate lesion biopsy here is increase detection of prostate pathology and reduce mortality. There was previously very a smaller number of cases from rural India due to less awareness regarding prostate pathology. With introduction of new imaging modalities and health awareness there is increasing trend of early diagnosis of prostate pathology.

This has happened with new immerging problem of overdiagnosis and overtreatment as well. because many of these pathologies are clinically insignificant and diagnosis with help of USG has high chance of missing cancer with TRUS biopsy until they grow to significant large size, leading to delayed diagnosis. Use of Multiparametric magnetic resonance imaging (mp-MRI) with PI-RADS in evaluation of prostatic disorders in correlation with clinical outcome is emerging modality for accurate assessment of prostate pathology and prostate biopsy, which is very helpful in staging of and treatment as well as in follow up study. Combination of T2-weighted imaging (T2WI), diffusion-weighted imaging (DWI), dynamic contrast-enhanced (DCE) imaging and MR spectroscopy (MRS), is emerging in recent years. We are using combination of diagnostic MRI with follow up till curative treatment in the combination of STIR sequence for better outcome with diffusion weighted MRI, T2-weighted imaging, dynamic contrast-enhanced imaging and MR spectroscopy in mp-MRI assessment of prostate cancer. DWI and T2W imaging with help of blood PSA level is mainstay for diagnosis of prostate cancer in this study. We are using 1,5 Tesla MRI Machine.

MATERIAL AND METHOD-

Fifty patients with history of prostate pathology/ cancer/ BPH 40-85 years of ages are subjected to study presented to the department of radiodiagnosis and imaging within a span of 2 years (November 2018 to October 2020) which included outpatients, inpatients, referral patients of Government general hospital, Kurnool medical college, Kurnool. This is a **Prospective study** with **Inclusion criteria** Patients presenting with prostate pathology and **Exclusion Criteria is** Patients below 40 years, Cardiac failure and Previous allergic reaction to contrast media.

IMAGING TECHNIQUES- The study performed was on Philips INGENIA1.5 Tesla MRI (MAGNETIC RESONANCE IMAGING) scanner. PI-RADS assessment uses a 5-point scale based on the likelihood that a combination of mpMRI findings on T1, T2W, DWI, ADC and DCE correlates with the presence of a clinically significant prostate pathology for each lesion in the prostate gland. Scanning of prostate in T1W -axial, T2W -axial and sagittal, DWI -axial with b0, b800, b1000 and b1400 values, ADC -axial, DCE -axial if any focal lesion present and STIR axial.

OBSERVATION-

Table 7 – T1W Correlation With Prostate Pathology Findings

T1W Final Diagnosis						
			final diagnosis with mpMRI correlation			Total
			BPH	Ca Prostate	prostatitis	
T1W	hyper	Count	0	1	0	1
		% within final diagnosis	0.0%	6.3%	0.0%	2.0%
	hypo	Count	33	15	0	48
		% within final diagnosis	100.0%	93.8%	0.0%	96.0%
	isointense	Count	0	0	1	1
		% within final diagnosis	0.0%	0.0%	100.0%	2.0%

Total	Count	33	16	1	50
	% within final diagnosis	100.0%	100.0%	100.0%	100.0%

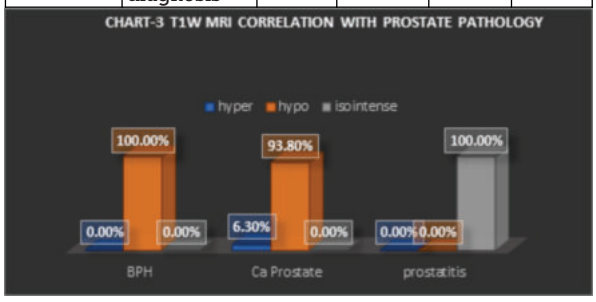


Table 8 – T2W Correlation With Prostate Pathology

T2W final diagnosis						
			final diagnosis with mpMRI correlation			Total
			BPH	Ca Prostate	prostatitis	
T2W	heterogenous hypo	Count	1	2	0	3
		% within final diagnosis	3.0%	12.5%	0.0%	6.0%
	Heterogenous hyper	Count	1	3	0	4
		% within final diagnosis	3.0%	18.8%	0.0%	8.0%
	hypo	Count	31	9	0	40
		% within final diagnosis	93.9%	56.3%	0.0%	80.0%
	hyper	Count	0	2	1	3
		% within final diagnosis	0.0%	12.5%	100.0%	6.0%
Total		Count	33	16	1	50
		% within final diagnosis	100.0%	100.0%	100.0%	100.0%

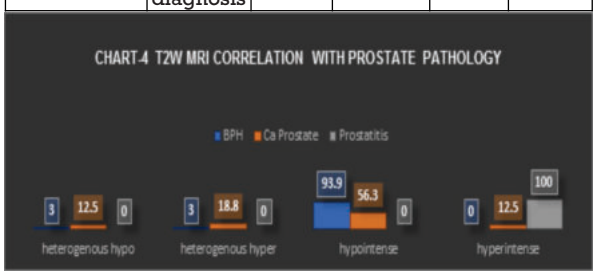


Table 9 – ADC Correlation With Prostate Pathology Findings

ADC final diagnosis						
			final diagnosis with mpMRI correlation			Total
			BPH	Ca Prostate	prostatitis	
ADC	hyper	Count	32	3	0	35
		% within final diagnosis	97.0%	18.8%	0.0%	70.0%
	hypo	Count	1	13	1	15
		% within final diagnosis	3.0%	81.3%	100.0%	30.0%
Total		Count	33	16	1	50
		% within final diagnosis	100.0%	100.0%	100.0%	100.0%

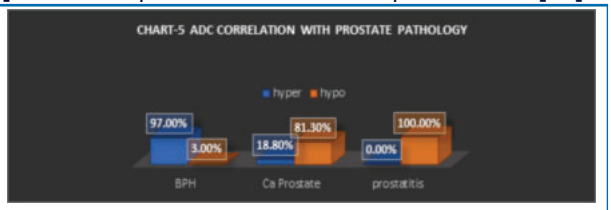


Table 10 – DWI Correlation With Prostate Pathology

DWI final diagnosis						
			final diagnosis with mpMRI correlation			Total
			BPH	Ca Prostate	prostatitis	
DWI	hyper	Count	0	13	1	14
		% within final diagnosis	0.0%	81.3%	100.0%	28.0%
	hypo	Count	33	3	0	36
		% within final diagnosis	100.0%	18.8%	0.0%	72.0%
Total		Count	33	16	1	50
		% within final diagnosis	100.0%	100.0%	100.0%	100.0%

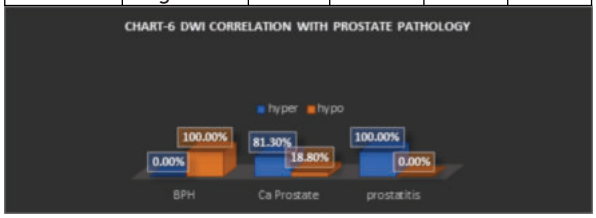
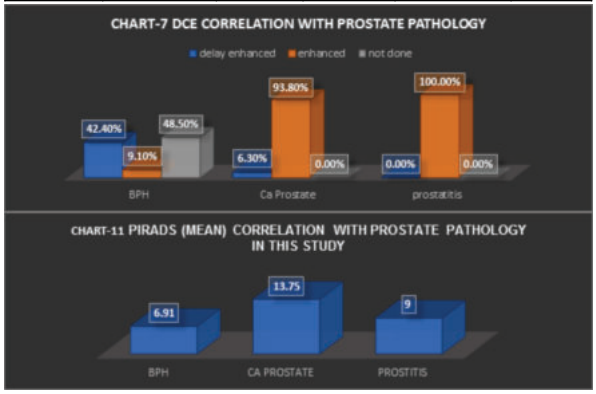
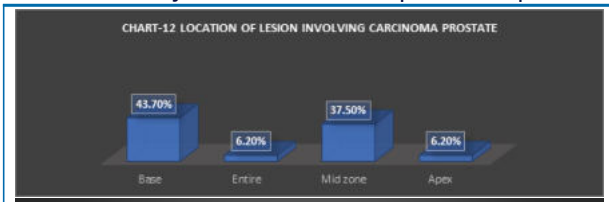
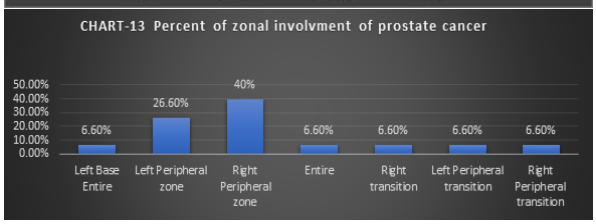


Table 11 – DCE Correlation With Prostate Pathology

DCE final diagnosis					
		final diagnosis with T2W and DWI correlation			Total
		BPH	Ca Prostate	prostatitis	
DCE	Count	14	1	0	15
	% within final diagnosis	42.4%	6.3%	0.0%	30.0%
	Count	3	15	1	19
	% within final diagnosis	9.1%	93.8%	100.0%	38.0%
	Count	16	0	0	16
	% within final diagnosis	48.5%	0.0%	0.0%	32.0%
Total	Count	33	16	1	50
	% within final diagnosis	100.0%	100.0%	100.0%	100.0%







mpMRI FINDINF OF PROSTATE PATHOLOGY

Case1: 80-year-old male patient presented with difficulty in micturition, increased frequency and dribbling of urine. On USG grade-II prostatomegaly noted. PSÁ level was 47ng/dl.

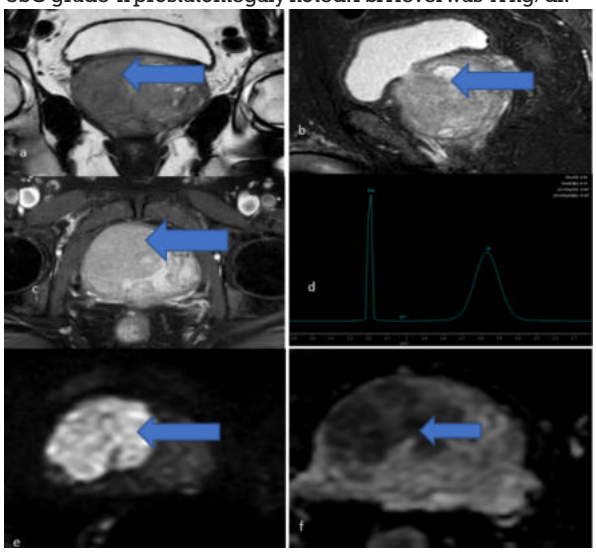


Figure 1: a- T2W axial image homogenous hypointense lesion in the base of right TZ and Rt. PZ, **b-** STIR coronal image showing homogenous hyperintense lesion, **c**- T1 FAT SAT axial image + contrast shows homogenous hyperintense lesion, **d**- MR spectroscopy showing elevated choline, **e**- DWI b1200 image showing diffusion restriction, **f**- ADC showing area of hypointensity. Reported as PIRADS IV. On follow up after prostectomy HPE proved as Ca prostate.

Case 2: 83-year-old male patient presented with haematuria, difficulty in micturition with increased frequency and dribbling of urine. On USG grade-II prostatomegaly was given. PSA level 47ng/dl, mpMRI showing extraprostatic extension

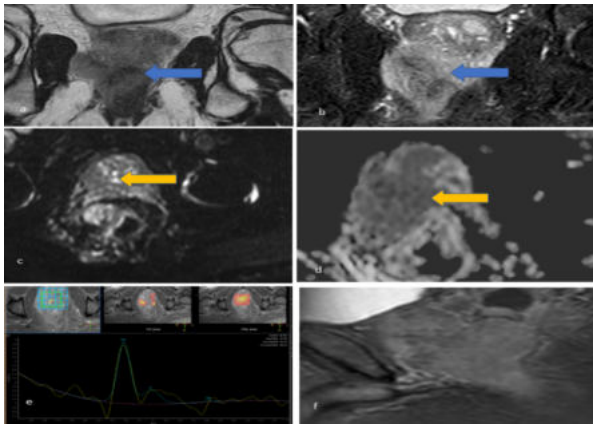


Figure 2: a- T2W coronal image (blue arrow) showing homogenous hypointense lesion at Rt. PZ of midgland with extraprostatic extension **b** coronal STIR image blue arrow showing homogenous hyperintense lesion with extraprostatic extension, **c, d**- DWI b1200 and ADC blue arrow showing area of diffusion restriction. yellow arrow showing extraprostatic extension to rectum, yellow arrow showing extraprostatic extension to rectum, **e**- MR spectroscopy showing elevated choline, **f-** sagittal image T1 FAT SAT + contrast shows heterogenous enhancement of the lesion. mp-MRI reported as PIRADS5 V. On follow up after prostatectomy HPE proved as Ca prostate.

Case 3: 80-year-old male patient presented with difficulty in micturition with frequency and dribbling of urine. On USG grade-III prostatomegaly noted. On mpMRI we reported as probably ca prostate base of left peripheral zone. PSA level 26ng/dl.

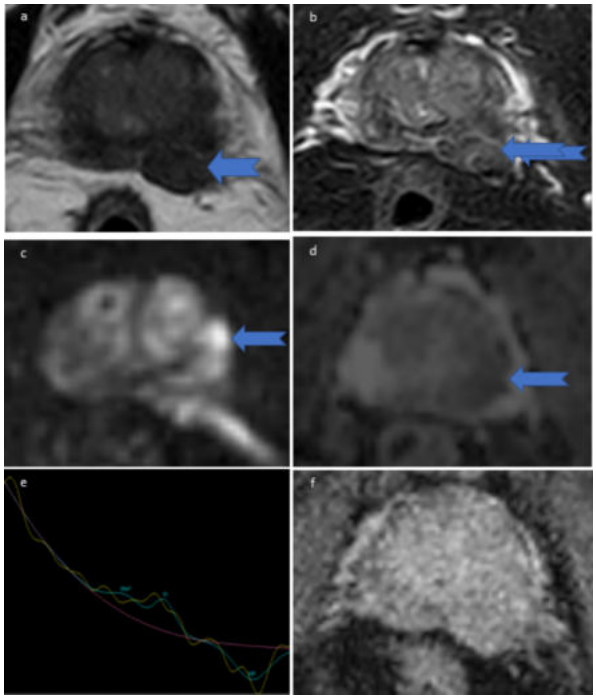


Figure 3: a- T2W coronal image shows homogenous hypointense lesion noted in left PZ at base. **b**- STIR coronal image homogenous hypointense lesion, **c, d**- axial DWI b1000 and ADC images shows diffusion restriction. **e**- MR spectroscopy showing elevated choline and normal citrate level, **f-** T1W fat sat sagittal image + contrast showing homogenous contrast enhancement **g-** axial image DCE shows type 2 graph represents rapid enhancement. It was reported as PIRADS-V. **h**-low power H & E-stained slide showing adenocarcinoma of prostate, **I** -high power H&E-stained slide showing adenocarcinoma of prostate.

DISCUSSION-

The present study includes the study of a total of 50 patients of prostate pathology. Benign prostatic hyperplasia was 33 in number, carcinoma of prostate was 16 and 1 case of prostatitis constituting 66%, 32% and 2% respectively. In our study detection of prostate cancer with use of T2W MRI in correlation of another parameter Seems to be very important to exclude prostate cancer. MpMRI is the recommended modality for the local staging of prostate cancer. We found significant correlation of T2W MRI with prostate pathology. As mention in our study showing 96.9% patient with T2W hypointensity was shows BPH with mpMRI corelation. Whereas 68.8 % patient with T2W MRI hypointensity was shoed prostate cancer.

When combined with image-guided biopsy, mpMRI will help physicians accurately tailor treatment options, such as

surgery, radiation, and even focal therapy. Thus, mpMRI of the prostate should play a significant role in the precision therapy of prostate cancer. In our study we found significant correlation of ADC MRI with prostate pathology. Our study showing 81.3% patient with ADC MRI hypointensity was showing prostate cancer with mpMRI corelation. Whereas 97 % patient with ADC MRI hyperintensity was showing BPH. In our study we found significant correlation of DWI MRI with prostate pathology. Our study showing 81.3% patient with DWI MRI hypointensity was showing prostate cancer with mpMRI corelation. Whereas patient with BPH was not showing significant correlation with DWI. In our study we found significant correlation of DCE with prostate pathology. Our study showing 93.8% patient with prostate cancer showing DCE with mpMRI corelation. Whereas 42.4% patient with BPH was showing delayed enhancement.

In our study group, most of the patient with prostate pathology are come with age between 60 to70 years. Follow by 70 to 80 years of age. In our study group most of the patient was diagnosed with BPH as 66 % patients of our study. Only one patient of this study group was found to be suffering prostatitis as he presented with pain and mild fever and was successfully treated with analgesics and antibiotics. On subsequent follow up patient was asymptomatic. One patient of carcinoma of prostate of our study group was presented with extraprostatic extension with capsular breach. On post op biopsy and follow up patient was proved to adenocarcinoma of prostate. We found one patient of carcinoma of prostate with metastasis to left femur and multiple inguinal lymph node enlargement. our study showing most common location of prostate cancer is base 43.7% follow by midzone 37.5%. In this study out of 16 patients of carcinoma of prostate, in 7 patients base of prostate involve, in 6 patient midzone is involve. In one patient of carcinoma of prostate apex is involve and in one patient entire prostate is involve. In one patient no lesion detected on mpMRI and post op biopsy turn out positive for malignancy.

In this study out of 16 patients of carcinoma of prostate right peripheral zone involve in 6 patients follow by Left Peripheral zone involve in 4 patients. In this study entire prostate involve in one patient, Left Peripheral and transition zone involve in one patient and Right Peripheral and transition zone one patient. Most of the patient with prostatic pathologies showed hypointense lesion on T2W MRI. Specially malignancies are hypointense on T2W MRI. In our study with the help of 1.5 T MRI we found 9x8 mm size smallest lesion which turn out adenocarcinoma on follow up scan. In our study majority of patients, we found suspicious lesion on peripheral zone of base of prostate. Because base the largest part of prostate gland. Largest involvement of prostate in our study was diffuse involvement of prostate of size 225 cc. We use sector map anatomy in our reports to specifically locate the suspicious lesion because sector map divides prostate in 39 region which is universally accepted and thus helps us to specifically locate region of interest. In this study we found DCE of suspicious showing type 2 graph which is not specific for malignancy but with correlation of T2W MRI and DWI it seems to be helpful in suspicious lesion. We use STIR sequence in few our patient, it was helpful to identify lesion in correlation with T2W MRI. As it is supressing the fat signal in future it may adjunct T2W MRI imaging to identify edema of lesion in our study we found hyperintensity which was hypointense in T2W MRI and to localize the precise location of lesion. STIR is also be useful in case of prostatitis as it can identify edema and its ability to supress fat. so, it is our suggestion to include STIR sequence in regular mpMRI protocol. We also found that STIR sequence can also helpful to rule out surrounding lesion and metastasis. And collection which is associated with another inflammatory lesion. During reporting we found PSA level is very important to detect and analyse lesion as we can identify the lesion with more focused way. we found in our study diffusion weighted magnetic resonance imaging is very powerful tool to conform diagnosis. Mean PSA level for prostate cancer is 40.55 ng/ml and mean PIRADS SCORE for prostate cancer is 13.75, which suggests that patients with increasing age and high blood PSA levels are ideal candidates for mpMRI to diagnose prostate pathology. Most common location of prostate cancer is base of prostate 43.7% (seven patients) followed by midzone of prostate 37.5% (six patient). In one patient apex is involved and another patient entire prostate is involved. Out of 16 patients of carcinoma of prostate right peripheral zone involved in 6 patients, followed by Left Peripheral zone involved in 4 patients.

CONCLUSION-

We studied 50 cases of prostate pathologies which were evaluated radiologically at the Department of Radiodiagnosis and Imageology, Kurnool Medical College, Kurnool for two years (November 2018 – October 2020). The following conclusions were drawn. Most of the patients diagnosed with prostate pathology are between 60 and 70 out of which 66% of patients were diagnosed with Benign prostatic hyperplasia, 32% were diagnosed with prostate cancer, and only 2% were diagnosed with prostatitis. Out of 50 patients of prostate pathology, 16 patients turned out with carcinoma of prostate. We concluded that most prostate pathologies are hypointense on T1W MRI. 96.9% of patients with T2W hyperintensity showed BPH in comparison to 68.8 % patient with T2W hypointensity confirmed as prostate cancer. Our study concluded that 81.3% of patients with ADC hypointensity and DWI hyperintensity turned out to be prostate cancer. In comparison, 97 % patient with ADC hyperintensity was confirmed as BPH. Whereas patients with BPH was not showing a significant correlation with DWI. 93.8% of patients with prostate cancer shows early contrast enhancement (type 2) curve on dynamic contrast study in comparison, 42.4% of patients with BPH was showing delayed enhancement. Increased prostate volume associated with increased incidence of prostate cancer. In our study 62.5% of prostate cancer shows grade-IV prostatomegaly. In comparison, only 6.3% of prostate cancer detected in grade-I prostatomegaly.

Mean PSA level for prostate cancer is 40.55 ng/ml and mean PIRADS SCORE for prostate cancer is 13.75, which suggests that patients with increasing age and high blood PSA levels are ideal candidates for mpMRI to diagnose prostate pathology. Most common location of prostate cancer is base of prostate 43.7% (seven patients) followed by midzone of prostate 37.5% (six patient). In one patient apex is involved and another patient entire prostate is involved. Out of 16 patients of carcinoma of prostate right peripheral zone involved in 6 patients, followed by Left Peripheral zone involved in 4 patients. Entire prostate is involved in one patient, Left Peripheral and transition zone involvement is seen in one patient and Right Peripheral and transition zone in one patient. One patient did not show any lesions in mpMRI but post-operative biopsy turned out positive for malignancy. In Our study with the help of mpMRI the smallest lesion we detected is 9X8 mm Size in right peripheral midzone of prostate. In our study with the help of P.S.A. level and U.S.G. correlation, mpMRI has 93.7% specificity and 94% sensitivity for detecting carcinoma prostate.

SUMMARY-

Prostate pathology with increasing age is encountered frequently in everyday practice. Characterization of these lesions remains problematic despite advances in imaging. U.S.G. and P.S.A. level only cannot allow specific diagnosis of prostate pathology. MpMRI with use of sector map, other parameters like USG, PSA level, histological and clinical examination is cornerstones in diagnosing of prostate cancer. Main advantage of mpMRI is to identify an area of abnormality for biopsy planning. Thus, histological and surgical/ medical follow-up play a significant role in arriving at a complete diagnosis.

Abrivation:-

DWI = Diffusion weighted imaging, ADC=Apparent Diffusion Coefficient, USG=Ultrasonography, DCE=Dynamic contrast enhancement, ESUR = European Society of Urogenital Radiology, PI-RADS = Prostate Imaging Reporting and Data System, PSA = Prostate-specific antigen, ROC = Receiver operating characteristic , 3D = Three-dimensional, mpMRI =Multiparametric magnetic resonance imaging , GBCA =Gadolinium-based contrast agent, MRS= Magnetic Resonance spectroscopy, MRI= Magnetic resonance imaging, DRE = Digital rectal examination, TZ =Transition zone, PZ= Peripheral zones, T2W =T2-weighted imaging, T1W = T1-Weighted, CZ= Central zone, AS= Anterior fibromuscular stroma, SV= Seminal vesicles, Rt. = Right, Lt. = Left, a= Anterior, mp= Medial posterior , p= Posterior.

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