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TRANSRECTAL ULTRASONOGRAPHY AND MAGNETIC RESONANCE IMAGING (MRI) CORRELATION IN PATIENTS HAVING PROSTATIC PATHOLOGY.

Radio-Diagnosis

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ABSTRACT

Aims & Objectives : To analyse the role of TransRectal Ultrasound and its correlation with Magnetic Resonance Imaging findings in patients having prostatic pathology.

Material & Method: a total one hundred patients with suspected prostatic pathology were evaluated from Jan.2020 to Dec.2020 in a tertiary care providing hospital in Ahmedabad,Gujarat part of western india.Patients were evaluated for prostatic disease on both ultrasound(Usg) & magnetic resonance imaging(MRI).

Result: With increased life expectancy the cases of prostatic pathologies are in increasing trend,therefore it is very much necessary to have a precise diagnosis of prostatic pathology. Various prostatic diseases were evaluated on ultrasound and magnetic resonance imaging in the present study. The findings were analysed and a confirmatory diagnosis was made.

Discussion: Both ultrasound & magnetic resonance imaging of the prostate are complementary to each other in arriving at a diagnosis.

Conclusion: Transrectal ultrasound and magnetic resonance imaging of the prostate is crucial in the evaluation of prostatic pathology.It also helps in the follow-up of cases.

KEYWORDS

Benign Hyperplasia of Prostate, Magnetic Resonance Imaging (Magnetic Resonance Imaging), Prostatitis, Prostate carcinoma, TransRectal Ultrasound(TRUS)

INTRODUCTION:

In male, the prostate is in continuity with the bladder neck, and the prostatic urethra courses through it. The prostate weighs approximately 20g by the age of 20 and has the shape of an inverted cone, with the base at the bladder neck and the apex at the urogenital diaphragm.

The prostatic urethra does not follow a straight line as it runs through the centre of the prostate gland but it is actually bent anteriorly approximately 35 degrees at the verumontanum.

The contemporary classification of the prostate into different zones was based on the work of McNeal6 into four different anatomical zones [1].

o The peripheral zone
o The central zone
o The transitional zone
o The anterior zone

With the increase in life expectancy the incidence of prostatic diseases is increasing.Transrectal ultrasonography plays a crucial role in the diagnosis and management of suspicious prostatic lesions. In present day scenario Transrectal ultrasound is an important modality for imaging the prostate gland, predominantly used for determining prostate size, zonal anatomy, and guiding prostate biopsies and is considered as the pivotal imaging test for the prostate, providing clinically important information regarding any pathology including Benign Prostatic Hyperplasia, prostatitis, obstructive infertility and prostate cancer.The ultrasound findings were further confirmed with the help of magnetic resonance imaging.

MATERIAL & METHOD:

The current study is a prospective study conducted in the department of radio diagnosis of a medical college,a tertiary care center providing hospital in Gujarat,part of western india.A total of hundred patients were evaluated over a period of twelve months from January 2020 to December 2020.The proforma was made to include Registration no,patients Name, age , clinical symptoms and its duration , any family history of prostatic disease, Past history of any surgery or biopsy, weight loss,haematuria,difficulty in passing urine,or complete retention. Inclusion and exclusion criterias were made.Patients were also asked about any metallic implant in their body as it contraindicated for Magnetic Resonance Imaging study. Magnetic Resonance Imaging is performed on 1.5T Magnetic Resonance Imaging using abdominal phase array coil . Standard sequences like Axial T1 WI,Axial,sagittal & coronal T2WI,Diffusion WI and Contrast enhances images were taken.Ultrasound was performed on Logiq P5 machine with transrectal transducer with frequency of 8 mhz.Axial and coronal images were taken.When needed color Doppler was also applied.

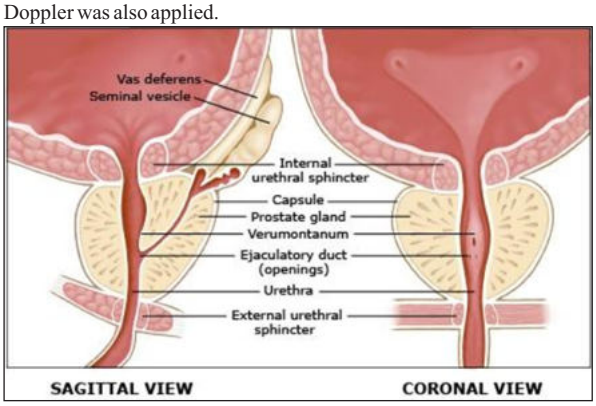


IMAGE 1 [2].

RESULTS :

Our study included 100 patients. The patient age ranging from 30 to 90 years (Mean age 60 years).

65 patients complained of voiding difficulty and passage of streamline urine or dribbling of urine.

62 patients presented fever, dysuria, nocturia and urgency and 38

patients presented with blood in urine and difficulty in micturition.

Diseases affecting prostate are as follows:

Prostadynias:

This is described when symptoms of prostatitis are present, but there is no evidence of prostate infection or inflammation.

Benign Prostate Hyperplasia :

It is a clinical condition in which there is increase in prostatic volume. Normal prostate volume measures 24-25 cc.

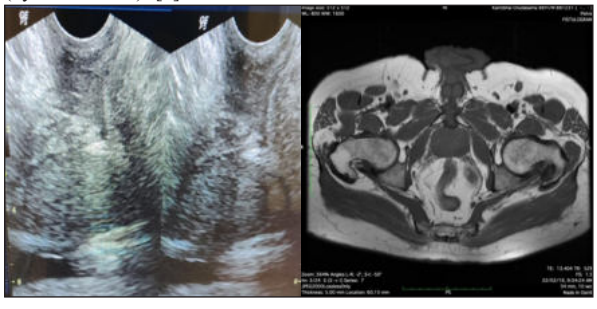
Benign prostatic hyperplasia is due to glandular and stromal hyperplasia.

There are various method for measuring Prostate volume e.g. serial planimetry, orthogonal plane, rotational body (single plane, ellipsoid) and three-dimensional methods. Step-section planimetry is assumed to be the most accurate method of determining prostate volume, but it is time consuming and requires cumbersome special equipment[3].

Benign Prostate hyperplasia types on Magnetic Resonance Imaging are as follows**:**

Type 0 - an equal to or less than 25 cm prostate showing little or no zonal enlargements;
Type 1 - bilateral transition zone enlargement;
Type 2- retrourethral enlargement;
Type 3 - bilateral transition zone and retrourethral enlargement;
Type 4 - pedunculated enlargement;
Type 5 - pedunculated with bilateral transition zone and/or retrourethral enlargement;
Type 6 - subtrigonal or ectopic enlargement;
Type 7- other combinations of enlargements

Lower Urinary Tract Symptoms is thought to be due to glandular (epithelial) hyperplasia producing increased bulk compressing the posterior urethra (static effect) and/or stromal hyperplasia resulting in increased muscular tone around the urethra producing a similar result (dynamic effect) . [4]



A B

C

Fig 1 (a) shows axial and sagittal sections of TRUS images of prostate .

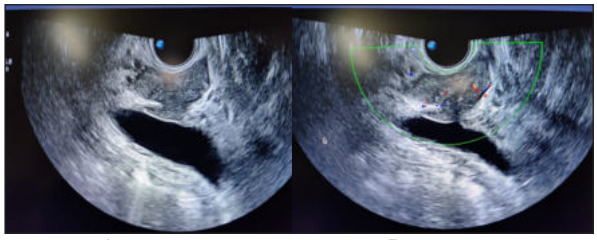
This 66 year old male presented with complaint of difficulty in micturition.The prostate shows homogeneous echotexture and increased volume, suggestive of Benign Prostatic Hyperplasia. Fig (b)(c) shows T1W axial and T2W coronal images.The patient presented with difficulty in urinaration and lower abdominal pain. The MRI findings are consistent with that of TRUS findings.

Prostatitis:

Prostatitis refers to inflammation of the prostatic gland.

Prostate is vulnerable to inflammation in urinary tract, because there are waste stimuli in urine, possible microbes colonization, and potential urinary tract stones with related mechanical obstruction. These all contribute to the potential inflammation of prostate.[5]

Characteristic ultrasonographic patterns [6] can often be obtained, even in patients affected by prostatodynia, in whom all the other clinical and laboratory findings were absent. They consist of:
(a) Inhomogeneous echo-structure of the prostate;
(b) constant dilatation of the periprostatic venous plexus, greater than 150 mm2;
(c) dilated, elongated seminal vesicle with thickening of their inner septa (they are sometimes asymmetrical), and
(d) bladder neck hypertrophy.



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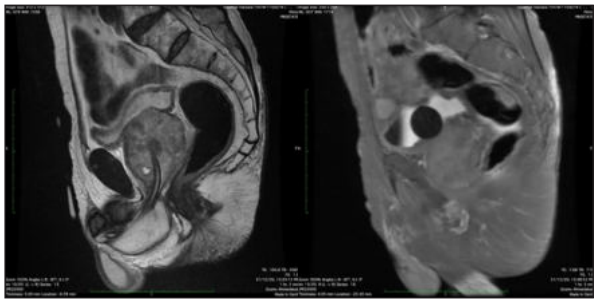


C D

Fig 2

A 65 yr old male patient presenting with complaint of lower abdominal pain, dysuria and burning micturition. He had catherisation for prolonged period.Transrectal ultrasound examination shows no significant finding except for mildly increased blood flow on colour doppler study.On T2W sagittal images (c), presence of heterogeneous echopattern is noted within parenchyma, which shows subtle enhancement on contrast images (d), suggestive of Prostitis.

Prostatic Abscess :

Transrectal ultrasound has a good sensitivity for diagnosing large, walled-off abscesses but in the initial stages of abscess formation, it may be inconclusive. Magnetic Resonance Imaging shows a hypointense signal on T1W and a hyperintense signal on T2W images,with peripheral contrast enhancement.

Prostatic abscess formation is usually preceded by infection caused by flowing organism :*Chlamydia trachomatis* and *Trichomonas vaginalis*.

Therapeutic procedures, such as permanent catheter positioning, could favor the spread of germs into prostatic ducts and subsequent abscess collection caused by atypical and anaerobic germs.[7]

Prostatic abscesses have become relatively uncommon due to the increased use of antibiotic therapy in patients with prostatitis. It tends to affect diabetics and immunosuppressed patients. Most patients affected are around 50 to 60 years old [8].

The mean Apparent Diffusion Coefficient values in the abscesses were very low compared not only with normal published values of the peripheral zone but also with cancerous tissue. [9]

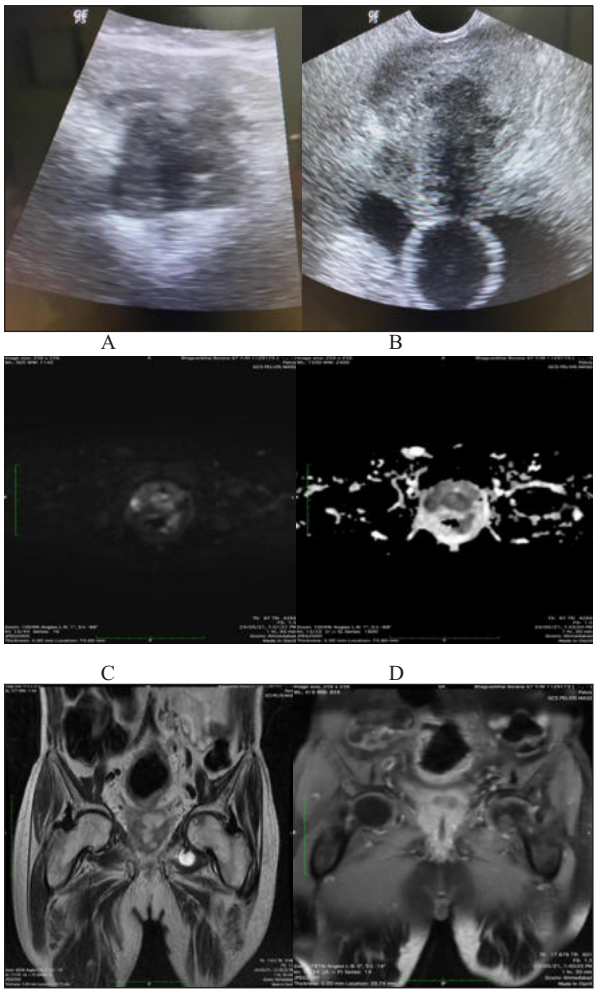


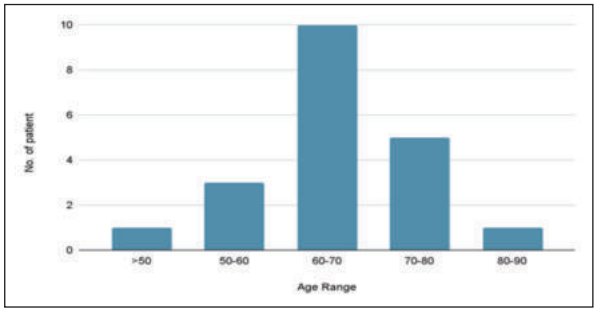
Fig 3

A case of 71 year old male patient suffering from dysuria, lower abdominal pain, few episodes of hematuria, fever and weightloss. On Trans abdominal ultrasound images (a) , presence of small ill defined intraparenchymal hypoechoic lesion is noted.As compared to abdominal ultrasound , image resolution improves to a greater extent in Trans Rectal sonography (b).

Magnetic Resonance Imaging finding of the same patient shows well defined altered signal intensity collection which appears hyperintense on T2WI (e) and shows peripheral enhancement on post contrast study (f). The lesion has few areas of hyperintensity on DWI and low ADC signal in corresponding areas.

On pathological correlation, WBC counts were raised. The patient was diagnosed with prostatic abscess.

Prostate Cancer:



Bar diagram showing age wise distribution of prostate cancer.

Prostate cancer is primarily a disease of the elderly with more than three quarter of the cases occurring in men above 65 years of age. This disease has become a major health problem globally during the last few decades. Studies have shown that prostate cancer is the second most frequently diagnosed cancer in men worldwide and the fifth most common cancer overall. It is disheartening to note that approximately 4.04 million years of healthy life are lost globally due to prostate cancer alone. It is also the sixth leading cause of cancer deaths in men. [10]

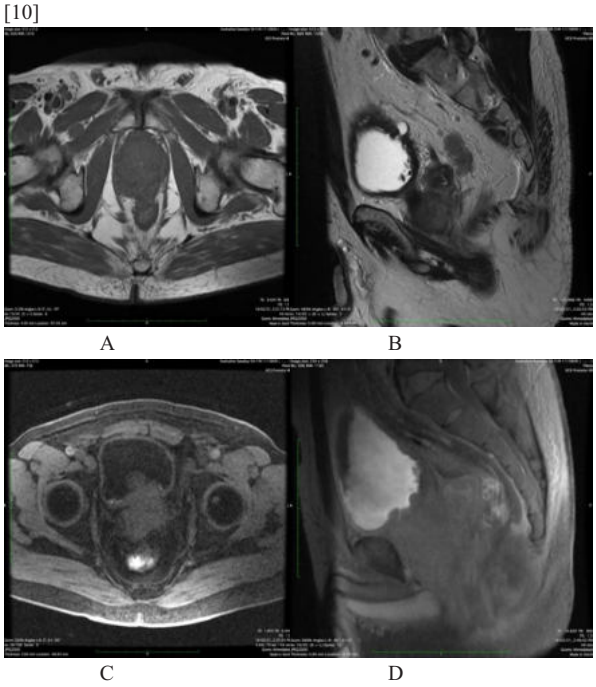


Fig 5

MRI images of a 58 years old patient having lower abdominal pain , hematuria, recurrent UTI, weight loss.

The Magnetic Resonance Imaging reveals enlarged prostate and heterogeneously enhancing diffuse altered signal intensity lesion involving posterior lobe on both sides.

The lesion appears diffusely hypointense on T1WI (a) and heterogeneously hyperintense on T2W sagittal (b) and shows heterogeneous enhancement on contrast study (c) & (d) .There is presence of capsular breach noted by above mentioned lesions more on right side s/o periprostatic growth.

The lesion also involves both seminal vesicles and also invaginate into the base of bladder as evident by figure (c) and (d).

As seen in figure (b), there is diffuse irregular wall thickening involving urinary bladder with small diverticulum, which resulted into recurrent UTI.

DISCUSSION:

Transrectal sonography detected many patients having prostodynia as compared to Magnetic Resonance Imaging. This means patients were given false negative results. On Magnetic Resonance Imaging evaluation of these patient, underlying pathology were detected. Hence, Transrectal ultrasound can be used as effectively as screening tool.

Table 1 Shows Diagnosis Made By TRUS And MRI In Our Study Population.

Sr no.	Disease	Modality	No of patient
1	Prostodynia	TRUS	12
		MRI	8
2	Prostitis	TRUS	6
		MRI	8
3	Prostatic abscess	TRUS	4
		MRI	6
4	Benign Prostatic Hyperplasia	TRUS	50

		MRI	45
5	Prostate carcinoma	TRUS	28
		MRI	33
Total TRUS done		TRUS	100
Total MRI done		MRI	100

In our population of subjects, 1 subject had BPH Type 0, there were 32 patients with BPH type 1. Type 2 BPH was found in 2 subjects. 15 subjects were accounted to have type V BPH. Types 1 and 5 BPH were most common (63% and 31% respectively). We found no men with Type 3 Type 4 isolated pedunculated BPH.

If intraprostatic (intracapsular) tissue pressure is very high and vesicourethral sphincter remains competent to it , it causes change in the axial contour of the prostate from normal triangular to oval progressing to disproportionate elongation in the anteroposterior diameter relative to transverse diameter. [11]

On the contrary, if the vesicourethral sphincter becomes incompetent secondary to extreme prostatic tissue pressure, the prostate decompresses itself by herniating through the internal sphincter into the bladder.These processes can be observed with ultrasound imaging as well in MRI. In smaller prostates, TRUS is good enough, but in large volume glands, detailed anatomy is far superior with MRI-especially in the evaluation of intravesical inTRUSion where the distinction between herniation and trigone elevation without herniation through the bladder neck may be important.

The observations are similar to the study conducted by Neil F. Wasserman, Benjamin Spilseth, Jafar Golzarian. [11]

Study conducted by Vaishnavi Narayanamurthy and her team , the MRI Prostate Volume demonstrated a good to excellent correlation with the Anatomical Prostate Weight as compared to TRUS. This correlation was also established in our study.[12]

In our study predisposing factors were found in 6 men with prostatic abscess, with diabetes in 5 of them and history of prolong catherization in one of them. This is consistent with findings of study conducted by L Barozzi, P. Pavlica and De Matteis. [7]

Prostate is the second leading site of cancer among males in large Indian cities[13].

In our study, twenty five patients (25%) showed heterogeneous enhancement with variable extension & involvement and were diagnosed to have prostate cancer which was further confirmed after biopsy. Sixty patients (60%) were having voiding difficulty and were diagnosed with Benign Prostatic Hyperplasia. The Apparent Diffusion Coefficient values were significantly lower in prostate cancer than in the prostitis[14]. T2WI combined with DWI and MR Spectroscopy had the 252 highest diagnostic performance with a sensitivity, specificity and accuracy of 91.9%, 90.8%, and 88.2% respectively[15]. Review of DW MR images in addition to T2-weighted images helped radiologists to improve both specificity and positive predictive value for the diagnosis of Seminal vesicle involvement.

Magnetic Resonance Imaging Prostate is one of the most effective modality in diagnosis of primary prostate mass lesions, its extension, major organ involvement, staging & grading.

Newer modalities including contrast-enhanced modes and 8 elastography as well as fusion techniques for increasing the sensitivity of Transrectal ultrasound-guided prostate-targeted biopsies are discussed along with their role in the diagnosis and management of prostate cancer.

A study was conducted by Robert L, Bree et al [16] and he concluded that the appearance of Benign Prostate hyperplasia is variable on ultrasound and depends on the histopathological changes. Diffuse enlargement of the transition zone with homogenous echoes will be seen in fibromuscular hyperplasia, inhomogenous echoes, in cases showing combination of fibromuscular and adenomatous element, hyperechoic nodules in cases of prostatic adenoma . In our study out of 100 cases, 50 patients were diagnosed with Benign Prostate hyperplasia, 42 patients[84%] showed diffuse homogenous hypoechogenicity of transition zone, 6 patients [12 %] showed hyperechoic nodules in the transition zone. 2 patient [4 %] showed inhomogenous echotexture of transition zone.

In our case series, all 50 patients [100%] of Benign Prostate hyperplasia had smooth and intact capsule . The results are almost consistent with results of the study conducted by Mathew D. Rifkin et al [17].

In a study conducted by Fred Lee et al [18] , eight hyperechoic nodules of which seven were proved to be benign prostatic hyperplasia by histopathology. Similarly,in our series we came across six hyperechoic nodules and all of them turned out to be benign lesions on histopathological examination. So our results are closely matching with his results.

The mean age of patients with prostatic cancer was 69 yrs in Fred Lee et al studies which is 65 yrs in our study.

In our study, on ultrasound examination, 11 of 20 malignant lesions were heterogeneously hypoechoic forming 55 %, 7 out of 20 appeared heterogeneously hyperechoic mass lesions forming 35 % and 2 of 20 were seen as isoechoic lesions forming 10 %. Katsuto Shinohara et al [19] in their series reported 67% of cancers presenting as hypoechoic lesions, 32% as isoechoic lesions and 1% as hyperechoic lesions.

Most of the study materials showed 70% of carcinomas arise from the peripheral zone, 20% in the transition zone and 10 % in the central zone. In our study out of 20 malignant lesions 12 were seen in the peripheral zone (60%), 3 in the transition zone (15%) and 5 cases were arising from central zone (25%). This disparity may be because of different representative volumes.

A tumour occupying most of the prostate may not be visible on ultrasonography. This is called superscan phenomenon, where a tumour virtually replaces the entire prostate so that there is little normal tissue for comparison, as a result the gland has uniform echo pattern and the cancer is not appreciated.

In our study we identified 2 isoechoic malignancy mainly because of the surface irregularity of the prostate. In a study conducted by Katsuto Shinohara et al, he reported that an obviously irregular asymmetric gland often is suggestive of malignancy even in the absence of an identifiable hypoechoic lesion.

In a study conducted by Katsuto Shinohara et al, all sonography evident cases of prostate carcinoma were palpable by digital rectal examination[19] which closely relates to finding in our study i.e., out of 20 cancers 17 were palpable lesions.

In our study also 4 cases of transcapsular extension was detected by MR where Transrectal ultrasound detected only 2 cases and thus the staging was changed from stage 2 to stage 3. Hence , MR is more sensitive than Transrectal ultrasound in detection of Transcapsular extension and spread. It is consistent with results of Yu iria et al and McNeal JE et al [20] studies.

Studies done by Shigeno K et al [21] shows the use of colour doppler imaging when used along with Transrectal ultrasound , the hyper vascular malignant lesion could be located more accurately and it increases the sensitivity and negative predictive value in detecting carcinoma prostate. Inflammatory lesions also show increased vascularity. In present study out of 20 malignant lesions,12 showed increased vascularity and 6 out of 20 benign lesions also showed increased vascularity, which proved to be of inflammatory cause.

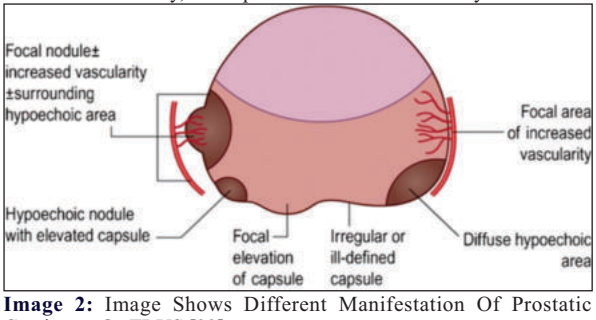
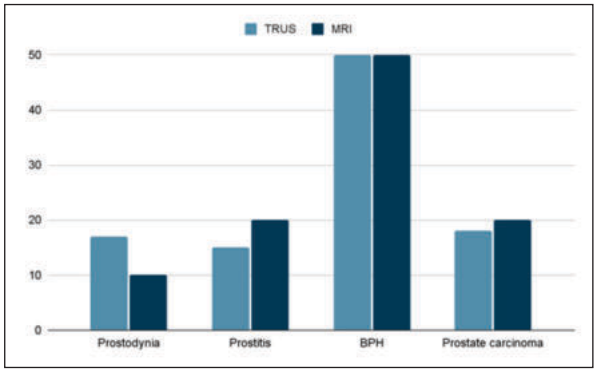


Image 2: Image Shows Different Manifestation Of Prostatic Carcinoma On TRUS.[22]



Comparative Study Of Different Prostatic Pathology On TRUS And MRI.

CONCLUSION:

In India where prostate pathologies are very common, imaging is an integral part of management of these patients. Transrectal ultrasound and Magnetic Resonance Imaging evaluation of prostate pathology is very widely used. Imaging not only is a useful tool for screening, it also aids in the follow up of these patients to look for any complication and response to therapy. A judicious combination of clinical, imaging, endoscopic and histological features should be used. Contrast-enhanced colour Doppler US and elastography may have the potential to improve prostate cancer detection, grading and staging [23]. However, further clinical trials will be needed to determine the promise of these new US advances.

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Conflict Of Interest: None declared

Ethical Approval: Institutional Ethical Committee GCS Medical College & Research Centre

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