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Original Research Article

Assessment of Suspicious Malignant Prostate Lesions using Transrectal Ultrasonography and Color Doppler, with Histopathological Correlation.

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Abstract:

Introduction: Prostate carcinoma ranks second in global and Indian male malignancy statistics. Transrectal ultrasonography (TRUS) plays a pivotal role in localizing and characterizing prostatic lesions, facilitating guided biopsies. Incorporating Color Doppler TRUS enhances detection rates by assessing lesion vascularity, particularly in Doppler-targeted biopsy strategies.

Aims and Objectives: 1. To investigate the role of TRUS and Color Doppler in characterizing and localizing malignant prostatic lesions. 2. To correlate findings from TRUS and Color Doppler with histopathological results to assess diagnostic accuracy.

Materials and Methods: This diagnostic study was conducted in the Department of Radiology at Nalanda Medical College Hospital, Patna, Bihar from September 2022 to August 2023. It included 52 patients selected from those admitted to Nalanda Medical College Hospital with clinically suspected malignant Prostatic lesions referred for TRUS guided Prostate biopsy. A transrectal probe equipped with a biopsy gun holder was carefully inserted for systematic sampling, typically 12 samples depending on prostate size. TRUS findings were then compared with histopathological examination of the biopsy specimens from the prostate.

Results: Out of the total patients evaluated using TRUS with Colour Doppler, 48% were diagnosed as benign and 52% as malignant. TRUS with Colour Doppler identified 22 cases as malignant. Out of these, 5 were benign according to histopathology. TRUS with Colour Doppler identified 23 cases as benign. Out of these, 2 were malignant according to histopathology.

Discussion: TRUS combined with Colour Doppler demonstrated high sensitivity and specificity in diagnosing prostate malignancy, likely due to its focus on detecting vascularity and asymmetry of vascularity. These features were strongly associated with malignancy in our study, guiding the targeted sampling approach.

Conclusion: In conclusion, Colour Doppler TRUS demonstrates superior sensitivity, specificity, PPV, and NPV compared to gray scale TRUS for detecting prostate malignancy. Therefore, Colour Doppler TRUS is recommended for diagnosing suspected prostate malignancy and guiding biopsies for histopathological confirmation. Its higher NPV effectively rules out prostate malignancy, potentially reducing unnecessary invasive biopsies.

Introduction

Prostate carcinoma ranks as the second most common malignancy in men globally and in India, and is the sixth leading cause of cancer-related death among males worldwide. As life expectancy increases, so does the incidence of prostatic diseases, with prostate cancer cases in India projected to double by 2020. [1,2] Advances in diagnostic modalities such as serum Prostate Specific Antigen (PSA) levels and imaging techniques including Trans Abdominal Sonography (TAS), Trans Rectal UltraSonography (TRUS), Computed Tomography (CT), and Magnetic Resonance Imaging (MRI) have improved early detection and treatment outcomes for prostate cancer. [3]

The current screening protocol for prostate carcinoma includes Digital Rectal Examination (DRE), Serum PSA testing, and TRUS followed by TRUS-guided biopsy. DRE, while able to detect irregular firm or nodular prostates typical of carcinoma, often misses cases detectable only through biopsy prompted by elevated PSA levels, particularly in early stages when treatment can be most effective. [4]

Serum PSA serves as the primary screening tool for prostate cancer, although elevated levels may indicate various prostatic conditions including cancer, benign prostatic hyperplasia, and prostatitis. Notably, not all individuals with prostatic disease

exhibit elevated PSA, and raised PSA levels are not exclusive to prostate cancer.

TRUS plays a crucial role in localizing and characterizing prostatic lesions, facilitating guided biopsy from suspicious areas. The addition of Color Doppler TRUS to evaluate lesion vascularity has shown promising results in improving the detection rate during TRUS-guided biopsies, contributing to increased cancer detection rates. [5,6]

Studies examining the combined use of gray scale TRUS and Color Doppler have reported varying diagnostic efficacy, with sensitivity ranging from 33% to 88% and specificity from 57% to 85% in diagnosing prostate cancer. The high negative predictive value of TRUS suggests its potential to reduce unnecessary biopsies. [7,8]

This study evaluates gray scale TRUS and Color Doppler findings in suspected malignant prostatic lesions, correlating them with histopathological results to assess the diagnostic accuracy of TRUS in clinical practice.

Aims and Objectives

1. To investigate the role of TRUS and Color Doppler in characterizing and localizing malignant prostatic lesions.
2. To correlate findings from TRUS and Color Doppler with histopathological results to assess diagnostic accuracy.

Materials and Methods

This prospective study conducted at Nalanda Medical College and Hospital, Patna, Bihar included 52 consecutive patients with clinically suspected malignant prostate lesions referred for TRUS-guided prostate biopsy from September 2022 to August 2023.

Methodology:

Examination Technique: After confirming no rectal abnormalities with DRE, TRUS was performed using a GE Voluson S6 ultrasound system with a high-frequency (5-8 MHz) endocavitary probe (E8C). Ultrasound gel was applied over a sheath-covered probe, which was gently inserted into the rectum. Grey scale imaging was initially performed, followed by Colour Doppler to assess focal lesions, echo patterns, and vascularity in both axial and sagittal planes.

Biopsy Technique:Biopsy was guided by TRUS using the same probe equipped with a biopsy gun holder. A 18-gauge x 25 cm BARDS automatic spring-loaded biopsy gun was used for sampling. Systematic sampling of 6-12 samples was performed depending on prostate size, with additional samples taken from suspicious or vascular areas.

Histopathological Correlation:TRUS findings were correlated with histopathological examination of the prostate biopsy specimens.

Inclusion Criteria:- Patients with clinically suspected prostate malignancy based on abnormal DRE and elevated serum PSA levels who underwent TRUS with Colour Doppler and guided biopsy.

Exclusion Criteria:- Patients with suspected infective/inflammatory lesions or benign conditions of the prostate.

- Patients without available TRUS or histopathological findings for correlation.

- Patients positive for retroviral infections or hepatitis B and C due to lack of ultrasound transducer sterilization facilities.

Statistical Analysis:

- Descriptive statistics included frequency (in %) for qualitative variables and mean +/- standard deviation (SD) for quantitative parameters.

- Diagnostic measures such as sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy were calculated using standard statistical methods.

Results

TRUS with Colour Doppler Diagnosis: Out of the total patients evaluated using TRUS with Colour Doppler, 48% were diagnosed as benign and 52% as malignant.

Correlation of TRUS with Colour Doppler vs. Histopathology: Malignant Cases: TRUS with Colour Doppler identified 22 cases as malignant. Out of these, 5 were benign according to histopathology. Benign Cases: TRUS with Colour Doppler identified 23 cases as benign. Out of these, 2 were malignant according to histopathology.

TRUS with Colour Doppler shows improved sensitivity (81.5%) and specificity (92%) compared to gray scale TRUS alone.

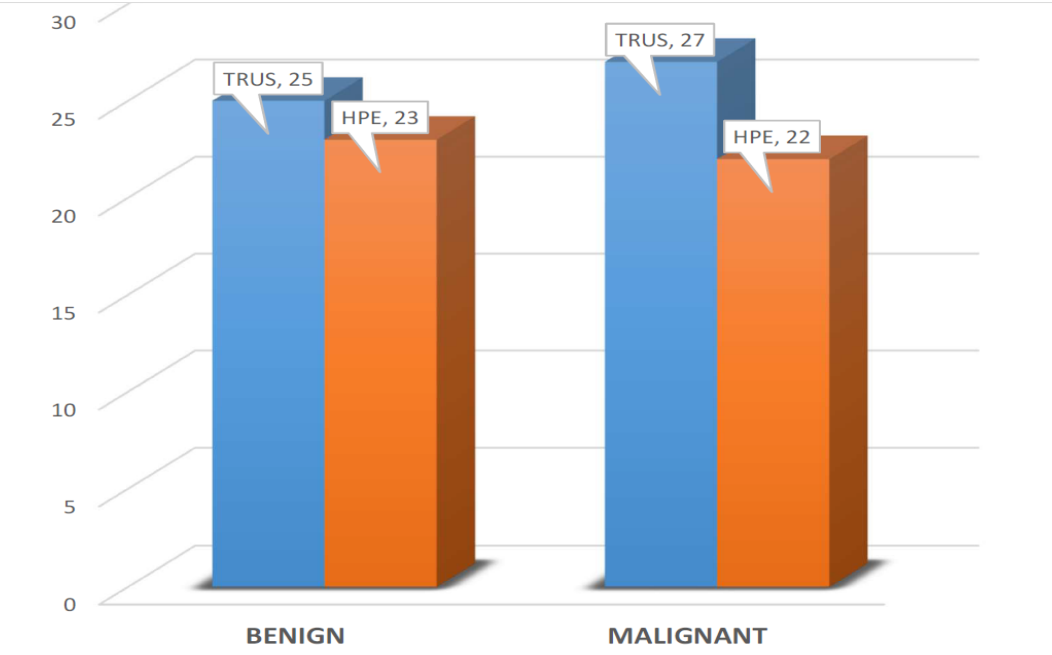
The positive predictive value (PPV) is relatively high at 91.7%, indicating that when TRUS with Colour Doppler identifies a lesion as malignant, there is a strong likelihood it is correct.

The negative predictive value (NPV) is 82.1%, suggesting that when TRUS with Colour Doppler identifies a lesion as benign, it is correct in the majority of cases.

b. Gray scale TRUS with Colour Doppler diagnosis

TRUS with Colour Doppler diagnosis	Number of patients	Percentage
Benign	25	48%
Malignant	27	52%

		Histopathology		
		Malignant	**Benign**	**Total**
TRUS Gray scale with Colour Doppler	**Malignant**	**22**	**5**	**27**
	Benign	**2**	**23**	**25**
	Total	**24**	**28**	**52**



Correlation of TRUS and color doppler with histopathology.

Statistics	Value	95% CI
Sensitivity	92%	73.00% to 98.97%
Specificity	82%	63.11% to 93.94%
Positive Predictive Value	81%	66.33% to 90.76%
Negative Predictive Value	92%	75.11% to 97.77%
Accuracy	87%	74.21% to 94.41%

Discussion

In the current study, benign prostatic lesions were predominantly observed in the age group of 50-70 years, with a mean age of 65.8±9 years. Prostate cancer was most frequently found in patients over 65 years old, with a mean age of 71.5±6.5 years. These findings are consistent with the research conducted by Fred Lee et al., which reported a mean age of 69 years for prostate cancer cases. [9]

In our study, out of 25 cases of benign prostatic hyperplasia (BPH), 6 patients (24%) exhibited homogeneously hyperechogenicity, while 19 patients (76%) showed heterogeneous echotexture. Among those with heterogeneous patterns, 12 patients (63%) had heterogeneously hyperechogenicity and 7 patients (37%) had heterogeneously hypoechogenicity. These findings align with the research conducted by Robert L. Bree et al., which underscores the varied echogenic patterns of BPH correlating with histopathological changes. [10]

Regarding focal lesions, 19 patients had identifiable nodules, with 10 (53%) being hyperechoic nodules all proven benign. Among the 9 (47%) hypoechoic nodules, 7 (78%) were malignant and 2 (22%) were benign. Notably, 91% of nodules in the transition zone were benign, while 86% in the peripheral zone were malignant, consistent with findings by Desouza et al. [11].

Our study calculated the sensitivity and specificity of gray scale TRUS for detecting prostate malignancy as 75% and 64% respectively. This is comparable to findings by R. Malik et al. [4], who reported 87% sensitivity and 72% specificity. When combining gray scale with Colour Doppler TRUS, our study demonstrated higher sensitivity (92%) and specificity (82%), consistent with studies indicating improved localization of malignant lesions and enhanced sensitivity, as highlighted by Shigeno K et al. [6].

Studies have shown varied diagnostic efficacy of TRUS and Colour Doppler combinations, with sensitivity ranging from 33% to 88% and specificity from 57% to 85%. In our study, the emphasis on evaluating vascularity and its asymmetry significantly contributed to the accurate detection of malignancies and guided biopsy sampling, echoing findings by Khanduri et al. [12].

Overall, TRUS combined with Colour Doppler proved effective in diagnosing prostate malignancy in our study, leveraging vascularity assessment to achieve high sensitivity and specificity, thereby reducing unnecessary biopsies. When focal lesions and significant vascularity are absent despite high clinical and biochemical suspicion, further evaluation such as MRI of the prostate is warranted to localize lesions for targeted biopsy.

Conclusion

In conclusion, prostate cancer predominantly affects elderly individuals over the age of 65, with a mean age of 71.5±6.5 years. Benign prostatic lesions typically exhibit hyperechoic characteristics, whereas malignant lesions tend to appear hypoechoic. Malignant lesions are more frequently observed in the peripheral zone of the prostate, whereas benign lesions are more common in the transitional zone.

The presence of focal and asymmetrical increased vascularity detected by Color Doppler TRUS in the absence of focal lesions suggests prostate malignancy, whereas symmetrical vascularity elevation may indicate an inflammatory condition such as prostatitis.

Our study demonstrates that Color Doppler TRUS offers higher sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) compared to gray scale TRUS for detecting prostate malignancy. Therefore, we recommend Color Doppler TRUS for diagnosing

suspected prostate malignancy and guiding subsequent biopsies for histopathological confirmation. The higher NPV of Color Doppler TRUS in ruling out prostate malignancy suggests its potential to reduce unnecessary invasive biopsy procedures in such cases.

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