(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 6, Issue 6 , Page No: 221-228
November-December 2023

IJMSCR

The Role Of Power Doppler Imaging With Trasrectal Ultrasonogram Guided Biopsy In The Detection Of Prostate Cancer

[1]Dr. Ravindra Reddy Bandi, [2]Dr. J. Ravikanth
[1]Consultant Radiologist, [2]Senior Consultant & Head,
Department of Radiodiagnosis, Yashoda Hospitals, Hyderabad, Telangana, India

***Corresponding Author:**
Dr. Ravindra Reddy Bandi,
Consultant Radiologist, Department of Radiodiagnosis, Yashoda Hospitals, Hyderabad, Telangana, India

Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Background: Prostate cancer is common in our aging population and most cancers are now definitively detected by transrectal ultrasound (TRUS)-guided prostatic needle biopsy. TRUS alone has limited potential to identify prostatic cancer because of frequent multifocality of cancer within the prostate, the variable sonographic appearance of prostatic tumors, the poor specificity of focal ultrasonic abnormalities, and the substantial percentage of isoechoic prostate cancers (which cannot be differentiated from adjacent benign tissues with imaging).Developments in TRUS equipment over the past decade include the use of color and power Doppler, higher frequencies, broad bandwidth technologies, and harmonic, contrast harmonic, and pulse inversion imaging. All of these improvements may enhance detection of subtle focal sonographic abnormalities within the prostate. **Aim of the study:** To evaluate the role of trans rectal ultrasound with power Doppler imaging guided biopsy in comparison with grey scale imaging in the detection of prostate cancer, extended sextant biopsy being the reference standard.**Methods**: The study was conducted in the year 2022,in Department of Radiodiagnosis, Yashoda Hospitals**,** Hyderabad, Telangana, India . All the patients were evaluated by TRUS. On the day prior to the procedure, ciprofloxacin 500mg bd and metronidazole 400 mg tds was prescribed, which was continued for 2 days post procedure. PC(proctoclysis) enema was given on the day of the procedure. Intravenous pethidine was given as analgesic if the patient did not tolerate pain. PDI was performed using the same ultrasound system as for conventional TRUS. The power Doppler gain was set to a point below the range at which blood flow in the neurovascular bundles was identified with no background artefact. Scanning to detect flow was continued for 10 min in each patient. The vascularization of a hypoechoic lesion in the PZ was evaluated by comparison with that of the area surrounding it. When a hypoechoic lesion contained more vessels than other PZ areas, it was defined as a hypervascular area. Equivocal and isoechoic lesions were defined as hypervascular area when these lesions were seen as abnormal vascular areas. **Results** : The PSA value of the patients ranged from 3 ng / ml to 632 ng / ml with a mean value of 41.4 ng / ml. The mean prostate volume was 32.7g in the range between 12 and 155g. 75% of patients with PSA between 4 and 10 ng/ml were negative for malignancy. Even with a PSA of > 50 ng/ml had negative result for malignancy. Most of the patients with cancer were in the PSA range of 21-50ng/ml. The sensitivity of hypoechoic nodule in the detection of prostate cancer is 62.7%, Specificity is 66.7%, Positive Predictive value 72.3% and Negative predictive value is 56%. **Conclusion:.** Contrast-enhanced ultrasound shows promising results allowing an assessment of tumour microvascularity, but further trials are in progress to evaluate its role. Molecular techniques depicting tumour neovascularity are an exciting prospect on the horizon.Real-time elastography has been demonstrated to improve cancer detection based on changes in tissue stiffness. In addition, a novel MR/ultrasound fusion mode is under evaluation. These new techniques may help target prostate cancer, allowing fewer biopsy cores to be

performed and facilitating the detection of the important life-threatening aggressive cancers rather than indolent cancers.

Keywords: Power Doppler Imaging ; Trans Rectal Ultrasonogram Guided ; Prostate Biopsy ; Detection Prostate Cancer

Introduction

Prostate cancer is the most common noncutaneous cancer among males. It accounts for 10% of cancer related deaths in males. According to the American Cancer Society, 186330 new cases will be diagnosed in 2008 and 26000 men will die from prostate cancer. [1] Prostate cancer is rarely diagnosed in men younger than 40 years, and it is uncommon in men younger than 50 years. Prostate cancer is also found during autopsies performed following other causes of death. The rate of this latent or autopsy cancer is much greater than that of clinical cancer. In fact, it may be as high as 80% by age 80 years. The diagnosis and treatment of prostate cancer continues to evolve. With the development of prostate-specific antigen (PSA) screening and TRUS, prostate cancer is being diagnosed earlier in the disease course[2].In the present era, most patients present because of abnormalities in Prostate Specific Antigen (PSA) level or positive digital rectal examination (DRE) findings while evaluating for BPH, rather than metastatic symptoms. The combination of DRE and serum PSA is the most useful first-line test for assessing the presence of prostate cancer in an individual. However, prostate cancer can be an incidental pathologic finding when tissue is removed during transurethral resection to manage obstructive prostatic symptoms.[3] The presence of prostate disease (prostate cancer, BPH, and prostatitis) is the most important factor affecting serum levels of PSA. PSA elevations may indicate the presence of prostate disease, but not all men with prostate disease have elevated PSA levels. Furthermore, PSA elevations are not specific for cancer.[4] Findings from the DRE are crucial. An irregular firm prostate or nodule is typical, but many cancers are found in prostates that feel normal. DRE is a test with only fair reproducibility even in the hands of experienced examiners that misses a substantial proportion of cancers.[5]DRE detects most cancers at an advanced pathologic stage, when treatment is less likely to be effective. DRE misses 23% to 45% of the cancers that are subsequently found with prostatic biopsies done for serum PSA elevations. The original sextant biopsy scheme (one core from the base, mid, and apex bilaterally) significantly improved cancer detection, over digitally directed biopsy of palpable nodules and TRUS guided biopsy of specific hypoechoic lesions[6,7]

Methods: The study was conducted in the year 2022,in Department of Radiodiagnosis, Yashoda Hospitals**,** Hyderabad, Telangana, India . All the patients were evaluated by TRUS. On the day prior to the procedure, ciprofloxacin 500mg bd and metronidazole 400 mg tds was prescribed, which was continued for 2 days post procedure. PC(proctoclysis) enema was given on the day of the procedure. Intravenous pethidine was given as analgesic if the patient did not tolerate pain. PDI was performed using the same ultrasound system as for conventional TRUS. The power Doppler gain was set to a point below the range at which blood flow in the neurovascular bundles was identified with no background artefact. Scanning to detect flow was continued for 10 min in each patient. The vascularization of a hypoechoic lesion in the PZ was evaluated by comparison with that of the area surrounding it. When a hypoechoic lesion contained more vessels than other PZ areas, it was defined as a hypervascular area. Equivocal and isoechoic lesions were defined as hypervascular area when these lesions were seen as abnormal vascular areas.Exclusion criteria:No consent for study,Persistent urinary tract infection,Untreated coagulopathy.After obtaining informed consent all the patients were enrolled into the study. Routine clinical evaluation was done as per the proforma and the findings were recorded.Patients were examined using the SSD2000 System (Aloka, Japan); PDUS was carried out with a Power Flow Unit and 7.5 MHz broadband endoluminal probe. The patients were

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examined in the left lateral decubitus position. All patients underwent greyscale TRUS of the entire prostate gland in the sagittal plane, from the right to left lateral aspects of the gland and in the axial plane from the seminal vesicles to the apex. The size and weight of the gland were calculated from the anteroposterior, transverse and cranio caudal measurements (0.52 × D1 × D2 × D3).PDI was performed using the same ultrasound system as for conventional TRUS. The power Doppler gain was set to a point below the range at which blood flow in the neurovascular bundles was identified with no background artefact. Scanning to detect flow was continued for 10 min in each patient. The vascularization of a hypoechoic lesion in the PZ was evaluated by comparison with that of the area surrounding it. When a Hypoechoic lesion contained more vessels than other PZ areas, it was defined as a hypervascular area. Equivocal and isoechoic lesions were defined as hypervascular area when these lesions were seen as abnormal vascular areas.All patients underwent systematic core biopsies initially at the hypervascular areas and hypoechoic areas if seen and then extended sextant biopsy was taken from the prostate. 18 G (Bard Urological, Covington, GA) automatic core biopsy needles were used. Biopsy samples from each site were placed in separate containers of formalin and labelled as to the site of origin. The biopsy results were analysed statistically to evaluate the differential efficacy of the hypoechoic nodule and hypervascular areas.

Results

A total of 129 patients were included in the study period. 75 patients (58%) had cancer detected in the biopsy

Table-1: Age group of patients

Age Group	Number
<55	1(0.7%)
56-60	33(25.5%)
61-65	39(30.2%)
66-70	33(25.5%)
71-75	12(9.3%)
76-80	11(8.8%)
Grand Total	129(100%)

TABLE :1 The mean age group of the patients was 65.63 years in the age range between 55 and 80 years. The most common age group involved was between 56 and 70 years involving 80% of the patients.49 of the 129 (37%) patients had a normal DRE.

Table-2: PSA group of patients

PSA Group(ng/ml)	Number
<4	1(0.7%)
4--10	14(10.8%)
11--20	37(28.6%)
21-50	58(44.9%)

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>50	19(15%)
Grand Total	129(100%)

The PSA value of the patients ranged from 3 ng / ml to 632 ng / ml with a mean value of 41.4 ng / ml.

Table-3: Prostate volume of patients

Prostate volume	Number
<25 g	55(42.6%)
26-50 g	62(48%)
>50 g	12(9.4%)
Grand Total	129(100%)

The mean prostate volume was 32.7g in the range between 12 and 155g.

Table-4: Relation of cancer with age group

Age Gp (Yrs)	Ca present	No Ca	Total
<55	1	0	1
56-60	15	18	33
61-65	19	20	39
66-70	19	14	33
71-75	12	0	12
76-80	9	2	11
Grand Total	75	54	129

Table :4 The proportion of patients who are negative for cancer are proportionately more in the age group 56-60 years. The highest incidence of cancer was in the age group 66-70 years. All the patients in the age group above 70 years had cancer. However, the difference in age distribution was not statistically significant.

Table-5: Relation of cancer with PSA group

PSA Gp(ng/mi)	Ca present	No Ca	Total
<4	1	0	1
4--10	2	12	14
11--20	21	16	37
21-50	38	20	58
>50	13	6	19
Grand Total	75	54	129

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TABLE :5 75% of patients with PSA between 4 and 10 ng/ml were negative for malignancy. Even with a PSA of > 50 ng/ml had negative result for malignancy. Most of the patients with cancer were in the PSA range of 21-50ng/ml.

Table-6: Relation of prostate volume with cancer

Prostate vol.	Ca present	No Ca	Total
<25	29	26	55
26-50	38	24	62
>50	8	4	12
Grand Total	75	54	129

Table-7: Relation of DRE with cancer

DRE	Ca present	No Ca	Total
+ ve	56	24	80
- ve	19	30	49
Grand Total	75	54	129

TABLE :7 Correlation between Hypoechoic area and carcinoma

Hypo. area	Ca present	No Ca	Total
Yes	47	18	65
No*	28	36	64
Grand Total	75	54	129

*- Absent hypoechoic area / negative biopsy

The sensitivity of hypoechoic nodule in the detection of prostate cancer is 62.7%, Specificity is 66.7%, Positive Predictive value 72.3% and Negative predictive value is 56%.

Table-8: Relation of hypervascular area with cancer

Hypervasculari ty	Ca present	No Ca	Total
Yes	66	12	78
No*	9	42	51
Grand Total	75	54	129

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*- Absent hypervascular area / negative biopsy

The sensitivity, specificity, PPV, NPV of hypervascular area in the detection of ca prostate are 88.5%, 79.8%, 84.6%, 82.3% respectively.

Table-9: Relation of hypervascularity in hypoechoic area with cancer

Hypervascularity in hypoechoic lesion	Ca present	No Ca	Total
Yes	34	1	35
No	41	53	94
Grand Total	75	54	129

The sensitivity, specificity, PPV, NPV of hypervascularity in the hypoechoic nodule in the detection of ca prostate are 45.3%, 98%, 97%, 56.3% respectively.

Discussion

Prostate cancer is the most common non cutaneous cancer involving men. Nowadays, most of the prostate cancer is diagnosed incidentally, at least in the western countries. In our country most of the patients present with symptoms such as LUTS or other metastatic symptoms.[8] As the diagnostic modalities such as serum PSA and DRE have significant false positive and false negative rates, histological diagnosis by TRUS guided biopsy is considered the gold standard to diagnose prostate cancer.[9] Though it is considered the primary investigation, it has only 85% sensitivity and 80% specificity, even with extended core biopsy.To increase the yield various associated modalities are used, such as the power Doppler imaging. [10] Only 10% of the patients had prostate size of more than 50ml. this shows that size of the prostate does not signify the presence or absence of malignancy. The mean prostate size was 32.7 grams ranging from 12 to 155 ml. Prostate size did not correlate with the presence of ca prostate, correlation coefficient -0.06.Serum PSA is the other important investigation done to diagnose prostate cancer. PSA ranged from 3 ng/ml to 756ng/ml.[11] The mean PSA was 41.4 ng/ml. The mean serum PSA in cancer positive patients was 44.26ng/ml and 18.2 ng/ml in cancer negative patients. Though PSA more than 4 ng/ml is considered to be suggestive of ca prostate, the higher incidence of infections (prostatitis) in Indian patients may cause elevation of serum PSA. So a high PSA may not be suggestive of cancer until it is proved by biopsy. [12]More than 70% of patients with PSA >20 ng/ml had carcinoma prostate.56 out of 75 patients with carcinoma had positive DRE. This gives a sensitivity of 76%. This is considered high comparing the literature values of between 40 to 70%. This might be due to the predominant presentation of patients with higher tumour stages in the Indian scenario.Hypoechoic area directed biopsy was the modality of diagnosis practiced in the late 1980s51-52. The hypoechoic nodule directed biopsies were found to have a sensitivity of around 70% and specificity on the range of 60%. In our study, the sensitivity was 62.7%, Specificity was 66.7%, Positive Predictive value 72.3% and Negative predictive value was 56%.. this shows the poor efficacy of hypoechoic nodule directed biopsy in the detection of prostate cancer.[13] Tumours are found to be hypervascular due to the neovascularity. Power Doppler imaging, which deciphers the tissue vascularity, may be used in the evaluation of vascularity of lesions. Biopsies directed towards the hypervascular areas were found to have a higher sensitivity of around 90% and specificity of 85% in various studies[14] In our study, the sensitivity was 88.5% for detection of cancer in comparison with

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extende sextant biopsy. This shows that hypervascular area directed biopsy definitely scores over hypoechoic area directed biopsy in the detection of prostate cancer. [15]Overall 58% patients were detected to have cancer. It is higher when compared to the literature, which varies from 36% to 55%. The higher percentage in our study could be due to the large number of patients with both elevated PSA and positive DRE. The Indian patients moreover present late compared with the west. The overall sensitivity of power Doppler in the detection of prostate cancer in our study was 88.5 % similar to the previous studies. The specificity of 79.8% was comparable with the world literature. The positive predictive value of 84.6% was similar to other studies. [16]The negative predictive value of 82.3% was comparably less than the world literature which varies from 78 to 94%.The complication rate in our study was 10%. This is equal to those reported in literature. The most common complication was UTI, which was managed conservatively with antibiotics. These infections do occur even after antibiotic prophylaxis, so patients need to be counselled prior to procedure. 4 patients had minimal hematuria which was managed conservatively.[17,18]

Conclusion

To conclude, transrectal ultrasound with power Doppler imaging guided biopsy is more sensitive and specific compared to grey scale imaging. Extended core biopsy protocol though, still remains the gold standard. We would like to recommend hypervascular area directed biopsies combined with standard extended core biopsies to increase the yield.Power Doppler imaging guided hypervascular area directed biopsy gives a better diagnostic yield there by reducing the number of repeat biopsies.Power Doppler imaging guided hypervascular area directed biopsy is efficient in the detection of prostate cancer in comparison with hypoechoic nodule directed biopsy.

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