European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 10, Issue 02, 2023

Original Research Article

Power doppler imaging and trasrectal ultrasonogram guided biopsy for prostate cancer detection

[1]Dr. Kamineni Shripuja, [2]Dr. Srinadh Boppana

[1,2]Assistant Professor, Department of Radiology, Kamineni Academy of Medical Sciences and Research Centre (KAMSRC), LB Nagar, Hyderabad, Telangana, India

Corresponding Author:
Dr. Srinadh Boppana

Abstract

Background: Men's most prevalent noncutaneous cancer is prostate. It causes 10% of male cancer deaths. The American Cancer Society predicts 186330 new prostate cancer cases and 26000 deaths in 2008. Prostate cancer rarely affects men under 40 or 50. Post-mortem autopsies may detect prostate cancer. Clinical cancer is rarer than latent or postmortem cancer. 80-year-olds may be 80%. Prostate cancer diagnosis and therapy evolve.

Methods: From May, 2021 to April, 2022, researchers probed potential future events. In order to enroll patients in the study, all patients over the age of 55 who reported to the, at the Department of Radiology, Kamineni Academy of Medical Sciences and Research Centre (KAMSRC), Hyderabad, abnormal digital rectal examination, PSA, 4 ng/ml were assessed.

Results: Laterally oriented base and midgland bilateral cores enhanced cancer detection from 80% to 96% compared to standard sextant. Different strategies have been implemented in an attempt to increase the TRUS biopsy detection rate. Neovascular assessment in prostate cancer patients using power Doppler ultrasonography is also provided.

Conclusion: Doppler-targeted biopsy techniques have been shown in a large number of trials to significantly improve cancer detection rates. In order to gain an idea of how people in India feel about Doppler-directed targeted biopsy techniques, we chose to look into how well power Doppler ultrasonography can spot prostate cancer.

Keywords: Prostate cancer, transrectal ultra-sonogram, doppler-targeted biopsy, DRE.

Introduction

Men are more likely to develop prostate cancer than any other type of noncutaneous cancer. Ten percent of all cancer deaths in men can be attributed to this factor. It is estimated by the American Cancer Society that 26,000 males would lose their lives to prostate cancer in 2008 [1]. Males under the age of 40 and men under the age of 50 almost never receive a prostate cancer diagnosis. Prostate cancer is also often discovered at postmortem examinations. Cancer that only manifests after death, or is dormant, is much more common than cancer that is actively manifesting throughout life. At age 80, it could be as high as 80% [2].

Both the detection and treatment of prostate cancer are dynamic fields. PSA screening and TRUS have allowed for the early diagnosis of prostate cancer. In recent years, people undergoing evaluation for BPH are more likely to report increased PSA levels or positive results from a digital rectal examination (DRE) than to have metastatic symptoms. The best primary test for detecting prostate cancer is a combination of the digital rectal exam and serum prostate specific antigen [3]. It is possible, however, that tissue taken during transurethral resection for obstructive prostatic symptoms [4] would reveal prostate cancer.

The primary factor influencing blood PSA levels [5] is prostate disease, which includes prostatitis, BPH, and prostate cancer. While elevated PSA levels could be indicative of prostate illness, they are not present in all men who have the condition. And an increase in

ISSN 2515-8260 Volume 10, Issue 02, 2023

PSA is not always indicative of malignancy. Findings from the DRE are highly significant. While it's not abnormal to have a firm, uneven prostate or lump, many prostate tumours are discovered despite their benign appearance. Even in the hands of seasoned examiners, the DRE test has only fair reproducibility and fails to detect a sizable percentage of malignancies [6]. Most tumours are discovered by DRE at a late pathologic stage, when treatment is less likely to be successful. DRE fails to detect 23-45 percent of malignancies, as determined by prostatic biopsies performed due to elevated serum PSA levels [7].

Numerous studies have confirmed that TRUS cannot pinpoint early prostate cancer. Researchers Rifkin and colleagues [8] reported that MRI could detect just 60% of prostate tumours larger than 5 mm on pathologic examination, whereas ultrasonography could detect only 59% of similar tumours. Although 65% of cancer-containing quadrants were not sonographically suspicious, only 18% of 855 sonographically suspect quadrants with cancer were really verified to have cancer following biopsy. If an early cancer diagnosis will increase the likelihood of survival and treatment will be advised, then patients with a DRE suspected for cancer or a PSA spike should receive a prostate biopsy notwithstanding the TRUS results [9].

Compared to digitally directed biopsy of palpable nodules and TRUS guided biopsy of particular hypoechoic lesions, the original sextant biopsy scheme (one core from the base, mid, and apex bilaterally) dramatically improved cancer diagnosis. With the addition of laterally oriented cores from the base and midgland bilaterally, cancer detection rose from 80% with conventional sextant to 96%, as reported by Presti *et al*. [10].

A variety of other methods have been tried to increase the detection rate of TRUS biopsies. Power Doppler ultrasonography can be used to assess neovascularization in males with prostate cancer. Several studies have demonstrated that using Doppler-targeted biopsy techniques can improve cancer detection rates. We decided to undertake this study to determine whether or not power Doppler ultrasonography is useful for detecting prostate cancer at an early stage and to gauge the Indian perspective on Doppler-directed targeted biopsy techniques [11].

Materials and Methods

From May, 2021 to April, 2022, researchers probed potential future events. In order to enroll patients in the study, all patients over the age of 55 who reported to the, at the Department of Radiology, Kamineni Academy of Medical Sciences and Research Centre (KAMSRC), Hyderabad, abnormal digital rectal examination, PSA, 4 ng/ml were assessed.

Exclusion criterion

- No study consent
- Chronic urogenital infection
- Coagulopathy not treated

Each participant was added to the study after giving their informed consent. Consistent with the template, a conventional clinical evaluation was performed and the results documented. The TRUS method was used to assess each participant. Metronidazole 400 mg tds and ciprofloxacin 500 mg bid were given the day before the surgery. The treatment continued for two days with the medicine. It was administered a PC (proctoclysis) enema on the day of the surgery. If a patient was in too much agony, they were given an IV injection of pethidine. The Power Flow Unit and 7.5 MHz broadband endoluminal probe were used to perform PDUS, and the SSD2000 System (Aloka, Japan) was used to evaluate the patients. Patients were positioned on their left sides, decubitus, for the examination. Every patient had a transrectal ultrasound (TRUS) scan of their prostate gland taken in both the axial (from the seminal vesicles to the apex) and sagittal (from the right to the left lateral edges) planes in greyscale. Anteroposterior, transverse, and cranio caudal measurements were taken to determine the gland's size and weight (0.52 D1 D2 D3).

ISSN 2515-8260 Volume 10, Issue 02, 2023

The same ultrasound instruments used for regular TRUS were used for PDI. By decreasing the power Doppler gain below that threshold, we were able to detect blood flow in the neurovascular bundles without any obstructive noise. Everyone was scanned for five minutes using a flow detector. The vascularization of a hypoechoic lesion in the PZ was compared to that of the surrounding area to draw conclusions. The term "hypervascular zone" is used to describe hypoechoic lesions that are more heavily vascularized than the surrounding peripheral zone (PZ). Hypervascular regions were identified in equivocal and isoechoic lesions [12, 13], and these regions were classified as hypervascular.

After initial systematic core samples were collected from the prostates of all patients, extended sextant biopsies were taken from the areas that were both hypervascular and hypoechoic. Needles for automated core biopsies, size 18 G, were purchased from Bard Urological in Covington, Georgia. Biopsy specimens were collected in individual vials of formalin, each of which was labelled with the location from which it originated. The statistical analysis of the biopsy data revealed the hypoechoic nodule's and hypervascular areas' distinct efficacy [14].

Results

The study period had 90 patients in all. Cancer was found in 60 patients (66.66%) after the biopsy.

Table 1: Shows the patients' ages

Age Group	Number
<50	1(1.11%)
56-60	22(24.44%)
61-65	28(31.11%)
66-70	26(28.8%)
71-75	07(7.77%)
76-80	06(6.66%)
Total	90(100%)

Between the ages of 55 and 80, the patients' mean age group was 64.80 years. Eighty percent of the patients fell into the 56 to 70 age range, which was the most prevalent. 28 of the 90 patients (28.8%) showed normal DRE results.

PSA value

With a mean of 40.9 ng/ml, the patients' PSA values varied from 3 ng/ml to 630 ng/ml.

Table 2: Patients in the PSA group

PSA Group(ng/ml)	Number
<5	1(1.11%)
6-10	8(8.88%)
11-20	24(26.66%)
21-50	45(50.0%)
>51	12(13.33%)
Total	90(100%)

Prostate volume

Table 3: Prostate volume of patients

Prostate volume	Number
<25 g	40(44.4%)

ISSN 2515-8260 Volume 10, Issue 02, 2023

26-50 g	45(50.0%)
>50 g	05(5.55%)
Grand Total	90(100%)

Between 12 and 155g, the average prostate volume was 45g.
Relationship between cancer and several factors age range
There are significantly more patients who test cancer-free between the ages of 56 and 60. The highest incidence of cancer was seen in people between the ages of 66 and 70. Every patient who was older than 70 had cancer. The age distribution did not, however, show any statistically significant variance.

Table 4: Age groups and cancer incidence

Age Group (Years)	Ca Present	Not Ca	Total
<50	1	0	1
51-60	15	9	24
61-65	9	10	19
66-70	15	7	22
71-75	9	1	10
76-80	1	3	4
Total	60	30	90

P-0.13

PSA level

Table 5: Cancer and PSA group relationships

PSA Group (ng/mi)	Ca Present	Not Ca	Total
<	1	0	1
6-10	2	8	10
11-20	21	12	33
21-50	27	8	35
>51	9	2	11
Total	60	30	90

p-0.02

60% of patients had cancer-free status when their PSA levels were between 4 and 10 ng/ml. Even though the PSA was greater than 50 ng/ml, the results for malignancy were negative. PSA values in the vast majority of cancer patients ranged from 21 to 50 ng/ml.
Size of the prostate and cancer
All prostate sizes have an equal distribution of cancer patients.

Table 6: Shows how prostate volume and cancer are related.

Prostate vol.	Ca present	No Ca	Total
<20	21	13	34
21-50	29	12	41
>51	10	5	15
Total	60	30	90

p-0.66

DRE and tumor

Table 7: Cancer and DRE Relation

DRE	Ca Present	Not Ca	Total
Positive	50	10	60

ISSN 2515-8260 Volume 10, Issue 02, 2023

Negative	10	20	30
Total	60	30	92

p-0.004

A positive biopsy was found in 60% of patients with a positive DRE.
Hypoechoic area and cancer are correlated

Table 8: Cancer and hypoechoic areas are related

Hypoechoic area	Ca Present	Not Ca	Total
Yes	45	16	61
No*	15	14	29
Total	60	30	90

*- Absent hypoechoic area / negative biopsy

For the detection of prostate cancer, a hypoechoic nodule has a sensitivity of 60%, a specificity of 30%, a positive predictive value of 61.0%, and a negative predictive value of 29.0%. Hypervascular area and malignancy are correlated

Table 9: Cancer and the hypervascular region relationship

Hypervascularity	Ca present	No Ca	Total
Yes	51	10	61
No*	9	20	29
Total	60	30	90

*- Absent hypervascular area / negative biopsy

For the detection of ca prostate, the hypervascular area showed sensitivity, specificity, PPV, and NPV values of 88.5%, 79.8%, 84.6%, and 82.3%, respectively.
Hypervascularity in hypoechoic regions and cancer

Table 10: Hypervascularity in a hypoechoic region and cancer

Hypervascularity lesion	Ca Present	Not Ca	Total
Yes	25	1	26
No	35	29	54
Total	60	30	90

The hypervascularity of the hypoechoic nodule had sensitivity, specificity, positive predictive value, and negative predictive value of 45.3%, 98%, 97%, and 56.3%, respectively, for the detection of the prostate. In total, 18 patients had issues. Feverish UTI was the most frequent complication in 10 cases. Each was handled with caution.

Table 11: Disease Complications

Complication	Number
Retention	6
UTI	9
Bleeding	3

Discussion

Men are more likely to develop prostate cancer than any other type of non-cutaneous cancer. Most cases of prostate cancer are currently discovered by chance, at least in Western countries. Most patients in our nation suffer from LUTS or other metastatic symptoms [15]. Histological diagnosis by TRUS guided biopsy is the gold standard for diagnosing prostate cancer because serum PSA and DRE have a high risk of yielding false positive or false

ISSN 2515-8260 Volume 10, Issue 02, 2023

negative results. Even though it's the first line of questioning, an extended core biopsy only offers 85% sensitivity and 80% specificity [16]. There are a number of related modalities used, such as power Doppler imaging, to boost productivity. We assessed the effectiveness of power Doppler imaging in the identification of prostate cancer [17] in a research including 90 participants.

Average patient age was 65.6 and the age range was 55-80. They were mostly between the ages of 56 and 70 (about 80%). Patients with prostate cancer in the literature and our dataset had a similar age distribution. Patients aged 56–70 showed a higher prevalence of negative biopsies when the patients were separated into age groups, while patients aged 66–70 had a higher incidence of positive biopsies. This exemplifies how the risk of prostate cancer rises with age [18].

Prostate sizes larger than 50 millilitres were found in fewer than 10% of the population. These findings indicate that the size of the prostate is not a reliable indicator of whether or not cancer is present. There was a wide variation in prostate size, from 12 to 155 cc, with a mean weight of 33.1 g. The presence of ca prostate was not correlated with prostate size (r=-0.06; p=0.19) [19].

The PSA blood test is also very important for detecting prostate cancer. PSA values fluctuated between 3 and 755 ng/ml. In this sample, PSA averaged 41.00 ng/ml. Patients with cancer had a mean serum PSA of 44.26 ng/ml, while healthy people had a value of 18.2 ng/ml. Even while PSA levels over 4 ng/ml are often indicative of a swollen prostate, infections (prostatitis) are more common in Indian people, which may contribute to the raised blood PSA. Therefore, a high PSA may not necessarily indicate cancer until a biopsy confirms it. Prostate cancer was present in over 70% of men with a PSA of 20 ng/ml or above [20].

Of the 75 cancer patients screened, 56 had DRE. A sensitivity of 76% is achieved as a result of this. When compared to the 40–70% range often seen in the literature, this is considered high. This may be explained by the fact that patients in India typically present with more advanced stages of cancer [21].

In the 1980s, a hypoechoic area guided biopsy was used as a diagnostic method. Several studies have found that biopsies targeted at hypoechoic nodules have a sensitivity of around 70% and a specificity of around 60%. Our study showed a 67.0% positive specificity, a 71.9% positive predictive value, and a 56% negative specificity. The ineffectiveness of a hypoechoic nodule-directed biopsy UN diagnosing prostate cancer is demonstrated here [22].

The presence of neovascularity in tumours explains their hypervascularity. It is possible to assess the vascularity of lesions with power doppler imaging. Several studies found that localised biopsies of hypervascular regions had a sensitivity of about 90% and a specificity of about 85%. The sensitivity for detecting cancer in our sample was 88.5% when compared to extended sextant biopsy. Results like these show that, when it comes to detecting prostate cancer, a biopsy targeted at a hypervascular zone is vastly superior to a biopsy targeted at a hypoechoic area. An overwhelming majority (58%) of the patients were diagnosed with cancer. It's higher than the range seen in published works, which is 36%-55%. In our study, a large proportion of patients presented with both high PSA and a positive DRE, suggesting that this combination may have contributed to the increased incidence we observed. Even compared to patients from the West, patients from India take longer to arrive. Our research found that the sensitivity of total power Doppler for the identification of prostate cancer was 92% the same as that of previous studies. The world's literature had a similar degree of specificity, around 80 percent. Previous studies were in line with the 83.9% positive predictive value. The negative predictive value of 81.9% was slightly below the range reported in the international literature (78-94%; [23]).

Importantly, our study demonstrated that in three cases of carcinoma, a 10-core biopsy failed to detect the tumour, but a biopsy targeted to the hypervascular area did. The prostate volume of each of these patients was greater than 50 ml. Despite the lack of statistical significance, we may confidently prescribe hypervascular area guided biopsy in addition to the more common 10-core biopsy for individuals with big prostates. This result is in line with the

ISSN 2515-8260 Volume 10, Issue 02, 2023

findings of the study by Saturo *et al*., which showed that three patients with negative sextant biopsies also had positive targeted biopsies. An extremely high positive predictive value (97%) is associated with the presence of hypervascularity in hypoechoic nodules. A hypoechoic nodule with hypervascularity indicates the presence of a tumour focal. The test of proportions demonstrated a statistically significant (p0.01) disparity in sensitivity and NPV between PDI and grayscale imaging. There was no significant difference in PPV and specificity (p>0.05). The study found that difficulties occurred 10% of the time. This is like the ones that have been discussed in the books and articles. The most frequent side effect was urinary tract infections (UTIs), which were successfully treated with medicines. Patients should be counselled prior to treatment because these infections can arise even when antibiotics are used prophylactically. Four patients with minor hematuria were treated using a cautious approach [24]. Conclusion: Transrectal ultrasonography guided biopsy using power Doppler imaging is more sensitive and selective than grey scale imaging. In spite of this, the extended core biopsy protocol is still widely used. To improve yield in big prostates, we suggest combining hypervascular region focused biopsies with typical extended core biopsies [25].

Conclusion

Conclusion: Transrectal ultrasonography guided biopsy using power Doppler imaging is more sensitive and selective than grey scale imaging. In spite of this, the extended core biopsy protocol is still widely used. Targeted biopsies of hypervascular regions, in addition to more conventional extended core biopsies, have been suggested as a means of improving productivity. Power Doppler imaging-guided hypervascular area-directed biopsy provides a higher diagnostic yield with less tissue removal. It has been found that a biopsy targeted at a hypervascular region of the prostate, as determined by power Doppler imaging, is more effective than a biopsy targeted at a hypoechoic nodule in detecting prostate cancer.

Conflict of Interest: None

Funding Support: Nil

References

1. Okihara K, Kojima M, Nakanouchi T, Okada K, Miki T. Transrectal power Doppler imaging in the detection of prostate cancer. BJU international. 2000;85(9):1053-1057.
2. Remzi M, Dobrovits M, Reissigl A, Ravery V, Waldert M, Wiunig C, *et al*. And European Society for Oncological Urology (ESOU, Can power Doppler enhanced transrectal ultrasound guided biopsy improve prostate cancer detection on first and repeat prostate biopsy?. European urology. 2004;46(4):451-456.
3. Cho JY, Kim SH, Lee SE. Diffuse prostatic lesions: role of color Doppler and power Doppler ultrasonography. Journal of ultrasound in medicine. 1998;17(5):283-287.
4. Bogers HA, Sedelaar JM, Beerlage HP, de la Rosette JJ, Debruyne FM, Wijkstra H, *et al*. Contrast-enhanced three-dimensional power Doppler angiography of the human prostate: correlation with biopsy outcome. Urology. 1999;54(1):97-104.
5. Cho JY, Kim SH, Lee SE. Peripheral hypoechoic lesions of the prostate: evaluation with color and power Doppler ultrasound. European urology. 2000;37(4):443-448.
6. Nelson ED, Slotoroff CB, Gomella LG, Halpern EJ. Targeted biopsy of the prostate: the impact of color Doppler imaging and elastography on prostate cancer detection and Gleason score. Urology. 2007;70(6):1136-1140.
7. Trabulsi EJ, Sackett D, Gomella LG, Halpern EJ. Enhanced transrectal ultrasound modalities in the diagnosis of prostate cancer. Urology. 2010;76(5):1025-1033.
8. Yang JC, Tang J, Li J, Luo Y, Li Y, Shi H. Contrast-enhanced gray-scale transrectal ultrasound-guided prostate biopsy in men with elevated serum prostate-specific antigen levels. Academic radiology. 2008;15(10):1291-1297.

ISSN 2515-8260 Volume 10, Issue 02, 2023

9. Kamoi K, Okihara K, Ochiai A, Ukimura O, Mizutani Y, Kawauchi A, *et al*. The utility of transrectal real-time elastography in the diagnosis of prostate cancer. Ultrasound in medicine & biology. 2008;34(7):1025-1032.
10. Inahara M, Suzuki H, Nakamachi H, Kamiya N, Shimbo M, Komiya A, *et al*. Clinical evaluation of transrectal power doppler imaging in the detection of prostate cancer. International urology and nephrology. 2004;36:175-180.
11. Takahashi S, Yamada Y, Homma Y, Horie S, Hosaka Y, Kitamura T. Power Doppler ultrasonography-directed prostate biopsy in men with elevated serum PSA levels: an evaluation of the clinical utility and limitations. Urology. 2002;60(2):248-252.
12. Turgut AT, Ölçücüoğlu E, Koşar P, Geyik PÖ, Koşar U, Dogra V. Power Doppler ultrasonography of the feeding arteries of the prostate gland: a novel approach to the diagnosis of prostate cancer?. Journal of ultrasound in medicine. 2007;26(7):875-883.
13. Morelli G, Pagni R, Mariani C, Minervini R, Morelli A, Gori F, *et al*. Results of vardenafil mediated power Doppler ultrasound, contrast enhanced ultrasound and systematic random biopsies to detect prostate cancer. The Journal of urology. 2011;185(6):2126-2131.
14. Zhao HX, Zhu Q, Wang ZC. Detection of prostate cancer with three-dimensional transrectal ultrasound: correlation with biopsy results. The British journal of radiology. 2012;85(1014):714-719.
15. Sedelaar JM, Vijverberg PL, De Reijke TM, de la Rosette JJ, Kil PJ, Braeckman JG, *et al*. Transrectal ultrasound in the diagnosis of prostate cancer: state of the art and perspectives. European urology. 2001;40(3):275-284.
16. Smeenge M, de la Rosette JJ, Wijkstra H. Current status of transrectal ultrasound techniques in prostate cancer. Current opinion in urology. 2012;22(4):297-302.
17. Ito H, Kamoi K, Yokoyama K, Yamada K, Nishimura T. Visualization of prostate cancer using dynamic contrast-enhanced MRI: comparison with transrectal power Doppler ultrasound. The British journal of radiology. 2003;76(909):617-624.
18. Franco OE, Arima K, Yanagawa M, Kawamura J. The usefulness of power Doppler ultrasonography for diagnosing prostate cancer: histological correlation of each biopsy site. BJU international. 2000;85(9):1049-1052.
19. Frauscher F, Klauser A, Volgger H, Halpern EJ, Pallwein L, Steiner H, *et al*. Comparison of contrast enhanced color Doppler targeted biopsy with conventional systematic biopsy: impact on prostate cancer detection. The Journal of urology. 2002;167(4):1648-1652.
20. Shigeno, K., Igawa, M., Shiina, H., Wada, H. and Yoneda, T., 2000. The role of colour Doppler ultrasonography in detecting prostate cancer. *BJU international*, *86*(3), pp.229-233.
21. Pelzer A, Bektic J, Berger AP, Pallwein L, Halpern EJ, Horninger W, *et al*. Prostate cancer detection in men with prostate specific antigen 4 to 10 ng/ml using a combined approach of contrast enhanced color Doppler targeted and systematic biopsy. The Journal of urology. 2005;173(6):1926-1929.
22. Ezquer A, Hrescak MO, Sanagua C, Roggia-Rebullida P, López R, Cenice F, Veglia FH, *et al*. Transrectal doppler ultrasound during prostate biopsy: Clinical utility and limitations. Actas Urológicas Españolas (English Edition). 2015;39(1):13-19.
23. Heijmink SW, Van Moerkerk H, Kiemeney LA, Witjes JA, Frauscher F, Barentsz JO. A comparison of the diagnostic performance of systematic versus ultrasound-guided biopsies of prostate cancer. European radiology. 2006;16:927-938.
24. Maxeiner A, Stephan C, Durmus T, Slowinski T, Cash H, Fischer T. Added value of multiparametric ultrasonography in magnetic resonance imaging and ultrasonography fusion–guided biopsy of the prostate in patients with suspicion for prostate cancer. Urology. 2015;86(1):108-114.
25. Smeenge M, Mischi M, Laguna Pes MP, de la Rosette JJ, Wijkstra H. Novel contrast-enhanced ultrasound imaging in prostate cancer. World journal of urology. 2011;29:581-587.