Original Article

Predictive Value of Transrectal Ultrasonic Doppler and Elastographic Features in Prostate Cancer Detection in Lagos University Teaching Hospital

Abstract

Introduction: This study aimed at determining the predictive value (PV) of transrectal ultrasonic Doppler and elastographic features in prostate cancer (PCa) detection among patients in Lagos University Teaching Hospital. **Materials and Methods:** This prospective study involved patients that underwent evaluation for PCa. Participants had digital rectal examination (DRE), prostate-specific antigen (PSA) assay, and transrectal ultrasound-guided prostate biopsy using colour Doppler (CD) and elastography. All cores were sent for histopathology. Data were analysed using Statistical Package for the Social Sciences Version 22.0. CD and elastography PV in PCa detection and their relationships to the Gleason score (GS) were analysed ($P < 0.05$). **Results:** Seventy men (aged between 45 and 87 years) were enrolled. Forty-three (61.4%) patients had PCa with a mean age of 69.37 ± 8.22years. The sensitivity, specificity, positive PV (PPV), negative PV (NPV) and accuracy of CD were 8.50%, 97.44%, 64.10%, 66.42% and 66.31%, respectively. The sensitivity, specificity, PPV, NPV and accuracy of elastography were 84.21%, 94.59%, 88.89%, 92.11% and 91.07%, respectively. **Conclusion:** There is a significant association between decreased elasticity (elastography) and PCa detection but a weak association between increased vascularity (CD) and PCa detection. A positive correlation exists between extent of prostatic stiffness and GS.

Keywords: *Elastography, prostate biopsy, prostate cancer, transrectal ultrasound*

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Introduction

Prostate cancer (PCa) is the commonest non-cutaneous cancer among Nigerian men and the second most common cause of death from cancer in men worldwide.[1] PCa is uncommonly diagnosed before age of 50yrs and after this age, its incidence increases exponentially.[2] Serum PSA, DRE and transrectal ultrasound (TRUS) of the prostate are currently used for PCa screening. If any of the foregoing is abnormal, a TRUS-guided prostate biopsy is performed for diagnostic confirmation.

Despite the fact that the current paradigm of PCa screening has led to a decrease in advanced disease and cancer-related mortality, these techniques have limitations in terms of sensitivity and specificity, leading to missed cancers that are clinically significant and the over-detection of clinically insignificant cancers. The latter leads to the over-treatment of PCa and in the process exposes patients to unnecessary side effects related to treatment. A clinically significant cancer has been defined as a tumour with a volume greater than 0.5cm^3 and a Gleason score of ≥7.[3]

In view of perceived limitations in current screening tests, new techniques are needed to improve the detection of clinically significant PCa while at the same time limiting the over-detection of clinically insignificant lesions. TRUS-guided needle prostate biopsy using local anaesthesia remains the standard approach to the definitive diagnosis of PCa.[4] Prostate biopsy via the bulk of the tumour contains more tissue which allows more accurate characterisation for pathologic interpretation. Therefore, modalities that allow for visualisation of PCa may help in image-guided prostate biopsy.

PCa is associated with angiogenesis and neovascularisation which is seen as an increase in microvessel density. It has been observed that as a result of this fact, a

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disturbed perfusion of malignant tissue compared with normal prostate tissue is present. Bigler *et al.*[5] published increased microvessel density in PCa specimens following radical prostatectomy. In addition to colour Doppler ultrasonography (CDUS), contrast-enhanced ultrasound (CEUS) imaging was developed to image perfusion.

PCa is also associated with increased cellular density, glandular architecture loss and increased collagen deposition in the stroma surrounding the tumour which may result in a firmness or induration appreciated on DRE. These findings result in reduced tissue elasticity and may be detectable by elastography. The two types of ultrasound elastography are strain (quasi-static) elastography (SE) and shear wave (Aixplorer) elastography (SWE).

In SE, cyclical mechanical compression and decompressions of the prostate gland are performed using a TRUS probe. In SWE, an acoustic radiation force is generated by a focused ultrasound beam, resulting in a shear wave that propagates through the interrogated tissue. Stiffness can be measured on the basis of the velocity at which the waves propagate through the tissue, with faster velocities through harder tissue. This allows for local measurements of prostate tissue stiffness in quantitative values.

This study, therefore, seeks to determine the PV of ultrasonic CD and elastography in PCa detection in LUTH. The findings of this study may provide a means of preventing PCa over-diagnosis while enhancing the diagnosis of clinically significant PCa.

Materials and Methods

The study was prospectively conducted in the urology unit of Lagos University Teaching Hospital (LUTH) between January and December 2021. The sample size was estimated to be 43 (at attrition rate of 40%) using Cochran's formula. All male patients who presented for evaluation of their prostatic diseases had serum total PSA assay and DRE performed on them. The study protocol was approved by the Lagos University Teaching Hospital Human Research and Ethics Committee (LUTHHREC). Inclusion criteria were the presence of elevated PSA (>4ng/mL) or abnormal prostatic finding(s) on DRE or both. Seventy patients met the inclusion criteria and gave consent to participate in the study.

Each patient was worked up for TRUS-guided prostate biopsy using unit protocol of preparation viz. stoppage of anticoagulants and anti-platelets, administration of rectal suppository (Bisacodyl 10 mg) the night before the procedure and prophylactic intravenous antibiotics (Levofloxacin 500 mg stat + metronidazole 500 mg stat) prior to the procedure.

With the patient in left lateral decubitus position, 2% Xylocaine jelly was instilled intrarectally for topical anaesthesia and TRUS of the prostate was performed using a digital ultrasound scanner (S22; SonoScape Medical Corp., Guangdong, China) with real-time tissue elastography unit EZU-TE3 and high frequency (7.5MHz) endorectal end-fire transducer.

All the patients underwent TRUS (greyscale, CD and SE) in the same session. Greyscale images were assessed for prostate size and volume, and the presence of intra- and extra-prostatic anatomic changes. Also, using the CD and elastographic features, areas of increased vascularity and decreased elasticity (including grading the degree of stiffness using a colour-coding system) were noted, respectively, and documented. Doppler findings with grey-scale features were graded into five as follows: 5 – definitely abnormal (i.e., a focal hypoechoic mass was present on grey-scale images or obvious increase in flow was present on Doppler images); 4 – probably abnormal (i.e., a probable hypoechoic mass was present on grey-scale images or a mild increase in flow was present on Doppler images); 3 – indeterminate (i.e., abnormal echotexture without definite mass was present on grey-scale images or subtle increase in flow was present on Doppler images); 2 – probably normal (i.e., heterogeneity on grey-scale images or minimal asymmetry in flow, which might simply represent a normal variation on Doppler images); and 1 – definitely normal (i.e., homogeneous appearance on grey-scale images and symmetric flow pattern on Doppler images).[6]

For elastography, the interpretation was according to elastography scoring system as follow: score 1 – there is no blue area or star-like blue in outer glands; score 2 – the mosaic or little symmetrical blue area in bilateral outer glands, the blue area is less than 5 mm in diameter; score 3 – a little symmetrical blue area in bilateral outer glands, the diameter of blue area greater or equal to 5 mm; score 4 – asymmetric blue area in bilateral outer glands, the diameter of blue area greater than or equal to 5mm; score 5 – asymmetric blue area in bilateral outer glands, the blue area of more than 50%, the blue area greater than or equal to 50% of single outer gland area.[7]

After these, a peri-prostatic nerve block was done and an endorectal probe was placed first at the areas of abnormal vascularity and elasticity, and biopsies were effected using an 18G Tru cut needle. Then, a systematic biopsy protocol was followed to complete extended (12) cores.

Relevant information including demographic data, examination findings, indications for biopsy and results of histopathology were obtained using a pro forma. The data were analysed with Statistical Package for the Social Sciences (SPSS) version 22.0. The results are described in statistical indices (sensitivity, specificity, PPV, NPV and accuracy). For statistical analysis, a 2-tailed test, Chi-squared test, Receiver Operating Characteristic (ROC) curve and Pearson's correlation coefficient were used with the $P < 0.05$ considered as significant.

Results

A total of seventy patients were studied with the age range of 45–87 years and a mean age of 67.54 ± 7.91years. Histopathology confirmed prostatic adenocarcinoma in forty-three patients (61.4%) and benign prostatic hyperplasia (BPH) in 27 patients (38.6%). The mean age of patients with PCa was 69.37 ± 8.22 years while it was 64.69 ± 6.56 years for patients with BPH. Thirty-seven (86.0%) of the patients with PCa were above the sixth decade of life. The age groups from 60 to 69 and 70 to 79 years (i.e., the seventh and eighth decade of life) accounted for 81.4% of the study population with PCa [Figure 1].

The majority (84%) were symptomatic and they presented with lower urinary tract symptoms (LUTS); storage or voiding symptoms and most times both. The mean duration of LUTS was 36.26 ± 14.69months. Ten (23.3%) patients presented with features suggestive of metastasis. Twenty-six (60.5%) patients had co-morbidities while 17 (39.5%) had no co-morbidities. Of the 43 patients with PCa, thirty (70.0%) patients had prostate with benign features [Table 1].

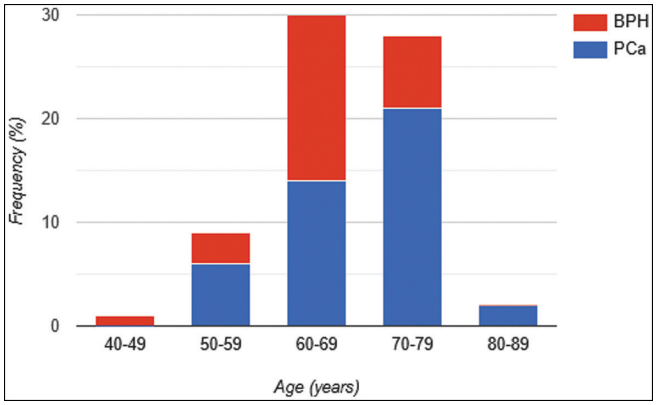

Figure 1: Age distribution of the patients

Table 1: Clinical features at presentation

Clinical features	Findings	Frequency (%)
Symptoms	LUTS	36(84.0)
	Low back pain	5(11.6)
	Haematuria	1(2.3)
	Bone pain	1(2.3)
Physical findings	Abnormal DRE	30(70.0)
	Paraparesis	3(7.0)
	Lower limb oedema	2(4.7)

Overall, the accuracy, sensitivity, specificity, PPV and NPV of DRE were 81.43%, 74.42%, 92.59%, 94.12%, and 69.44%, respectively.

In this study, the PSA range was 3.10 to 1634.00ng/mL with a median of 31.00ng/mL. The PSA range, mean and median for the patient with PCa was 8.3 to 1634ng/mL, 167.71 ± 335.29ng/mL and 62.00ng/mL, respectively. The majority (95.3%) of patients with PCa had PSA greater than 10ng/mL. The range, mean, and median prostate volume of all recruited patients were 21.63 to 205 mL, 79.35 ± 45.05 mL, and 66.97 mL, respectively. The range of prostate volume in patients with PCa was 30.0 to 205.0 mL with a mean of 74.46 ± 43.38 mL [Table 2].

The histology of the 43 patients who had PCa had varying Gleason's grades and scores. The most frequent Gleason's score was 9, accounting for 17 (39.5%) of the cases. The other Gleason's scores and their frequencies were 6, 7, 8, 10 and 7(16.3%), 10(23.3%), 8(18.6%), and 10(2.3%), respectively [Table 3]. The International Society of Urology Pathologists (ISUP) group grading of the patients showed that ISUP group 5 was the most common with 19 (43.2%) patients. The other group grading and their rate of occurrence were 1, 2, 3, 4 and 7(16.3%), 8(18.6%), 2(4.7%), 7(16.3%), respectively.

Ultrasonic colour Doppler in prostate cancer detection

Out of 840 prostatic zones and corresponding core biopsies (this is gotten from extended core prostate biopsy, that is, 12 cores per patient, where the total number of patients was 70), Doppler identified 25 (3%) of increased vascularity that were eventually histopathologically cancerous (true positive). Five hundred and thirty-two (63.3%) areas did not have increased vascularity and had no cancer (true negative). Fourteen (1.7%) zones had increased vascularity on Doppler but were not malignant (false positive). Cancer was found in 269 (32%) areas with no increased vascularity (false negative).

The sensitivity, specificity, PPV, NPV and accuracy of increased vascularity as determined by Doppler were 8.50%, 97.44%, 64.10%, 66.42% and 66.31%, respectively [Table 4].

Ultrasonic elastography in prostate cancer detection

Two hundred and forty (28.6%) sites with decreased elasticity as determined by elastography were confirmed malignant by histopathology (true positive). Five hundred and however turned out to be non-cancerous (false positive). Forty-five

Table 2: Mean age, prostate volume and PSA

	Histology	*N*	Mean	Std. deviation	*T*	*P* Value
Age (years)	PCa	43	69.372	8.2145	2.533	0.014
	BPH	27	64.630	6.5642	0	
Prostate volume (mL)	PCa	43	74.4609	43.38156	-0.667	0.501
	BPH	27	81.3433	38.04324		
PSA (ng/mL)	PCa	43	16.7130	335.28946	2.332	0.023
	BPH	27	16.80	10.18463		

(5.4%) areas had normal elasticity on elastography but histology revealed cancer (false negative). The sensitivity, specificity, PPV, NPV and accuracy of increased stiffness (decreased elasticity) as determined by elastography were 84.21%, 94.59%, 88.89%, 92.11% and 91.07%, respectively [Table 5]. The mean elastographic score for patients with PCa was 4.186 while it was 2.519 in patients with BPH [Table 6].

Ultrasonic elastography vs Doppler in prostate cancer detection

Both elastography and CD demonstrated the highest strength in the ability to correctly determine the absence of cancer [Tables 4 and 5]. Even though, the specificity of elastography and CD in predicting PCa were similar; 94.59% and 97.44%, respectively. The accuracy, sensitivity, PPV and NPV of elastography in the detection of PCa were 91.07%, 84.21%, 88.89% and 92.11% which were excessively higher than 66.31%, 8.50%. 64.10%, and 66.42% found in the Doppler study, respectively.

The area under ROC curve for elastography was 0.935 and 0.543 for Doppler. The elastographic curve is closer to 1 [Figure 2] which signifies higher accuracy.

Relating the Gleason score to the ultrasonic elastographic score (degree of stiffness)

There was no patient with GS between 8 and 10 who had elastographic score below 4. Conversely, there was no patient with GS of 6 and 7 who had elastographic score of 5 [Figure 3].

There is a positive correlation between the Gleason score and elastographic score which is statistically significant ($P < 0.05$) as depicted in Table 7 below.

Table 3: Distribution of histological grading

	Frequency	%
Gleason score		
6.0	7	16.3
7.0	10	23.3
8.0	8	18.6
9.0	17	39.5
10.0	1	2.3
Total	43	100.0

Table 4: Predictive value of colour Doppler in prostate cancer detection

	Doppler score	
	Value	**95% CI**
Sensitivity	8.50%	5.58% to 12.30%
Specificity	97.44%	95.74% to 98.59%
Positive likelihood ratio	3.32	1.75 to 6.28
Negative likelihood ratio	0.94	0.90 to 0.97
Disease prevalence	35.00%	31.77% to 38.33%
Positive predictive value	64.10%	48.53% to 77.18%
Negative predictive value	66.42%	65.58% to 67.25%
Accuracy	66.31%	63.00% to 69.50%
AUC	0.543	

Table 5: Predictive value of elastography in prostate cancer detection

	Elastographic score	
	Value	**95% CI**
Sensitivity	84.21%	79.45% to 88.24%
Specificity	94.59%	92.37% to 96.32%
Positive likelihood ratio	15.58	10.96 to 22.14
Negative likelihood ratio	0.17	0.13 to 0.22
Disease prevalence	33.93%	30.73% to 37.24%
Positive predictive value	88.89%	84.91% to 91.92%
Negative predictive value	92.11%	89.92% to 93.85%
Accuracy	91.07%	88.94% to 92.91%
AUC	0.935	

Discussion

PCa is the most frequently diagnosed malignancy afflicting Nigerian males. Early studies on the disease reported it constituted 11% of all male cancers in the country.[8] This study established that the prevalent age for PCa in Lagos is 50-87 years. The mean age and peak age of PCa incidence in this study are comparable to that found in other studies locally and in other parts of the world.[8,9] In an earlier study at this centre by Anunobi *et al.*,[9] the results revealed an age range

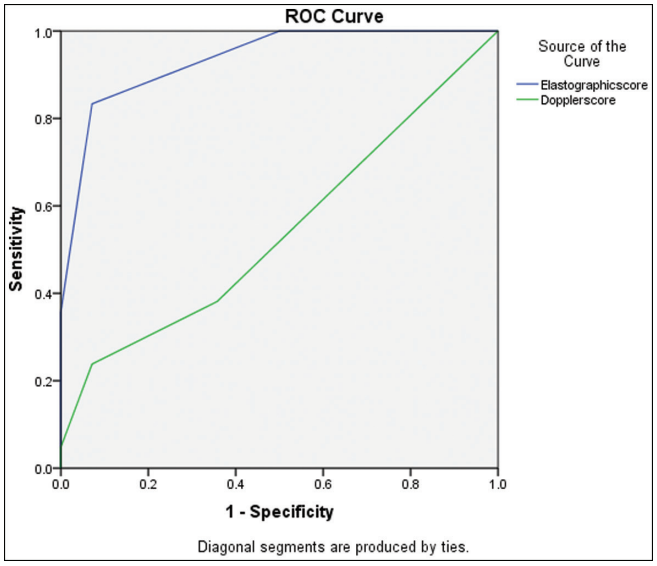

Figure 2: Receiver operating characteristic curve

Table 6: Mean elastographic score

		N	Mean	Std. deviation	t	*P* Value
Elastographic score	Adenocarcinoma	43	4.186	0.6988	10.354	0.000
	Benign	27	2.519	0.5798		

of 40–98 years, mean age of 66 years and peak prevalence in the 60–69 year age group. Similarly, Ajape *et al.*[10] in Ilorin also found a mean age at presentation of 68.4 ± 10.1 years.

Six (14.0%) patients of the 43 were aged < 60years this agrees with the submission by Fournier *et al.*[11] that such cancer is rare before age 50, but its frequency increases with age. Although the youngest patient with PCa in this study was 50 years old, investigators from Zaria reported PCa in a 30-year-old patient.[12] This age distribution and the mean age both confirm that age is a known risk factor in the development of PCa. The mean age of patients with PCa was 69.4 years and 65.4 years for patients with negative biopsies. The difference was statistically significant (P <0.05).

The majority (84%) of the patients were symptomatic and they presented with lower urinary tract symptoms (LUTS); storage or voiding symptoms and most times both. The mean duration of LUTS was 36.26 ± 14.69 months. This is inconsistent with what was reported by Ajape *et al.*[10] about a decade ago in which 91.0% of the patients presented with LUTS. The mean duration of symptoms in their study was 10.5 months. The dissimilarity may be a pointer to variation in health seeking behaviour of patients from different locations. However, it may also mean that patients in this study have less worrisome symptoms or had previously been presented to other facilities. Ten (23.3%) patients presented with bone pain, lower limb oedema, and/ or paraparesis, which were suggestive of advanced disease. In this study, 60.5% of patients with PCa had co-morbidities, 44.2% had hypertension, and 11.6% had both hypertension and diabetes. Thus, hypertension was the main co-morbidity in this study. This is comparable to the findings by Ofoha *et al.*[13] who showed that 48.1% of men with PCa had co-morbidities. Of these co-morbidities, hypertension was seen in 39.5% and 8.6% had both hypertension and diabetes. In addition, these co-morbidities are age-related just as PCa. Also, care must be taken in preparing these patients for prostate biopsy as many are on anti-clotting drugs.

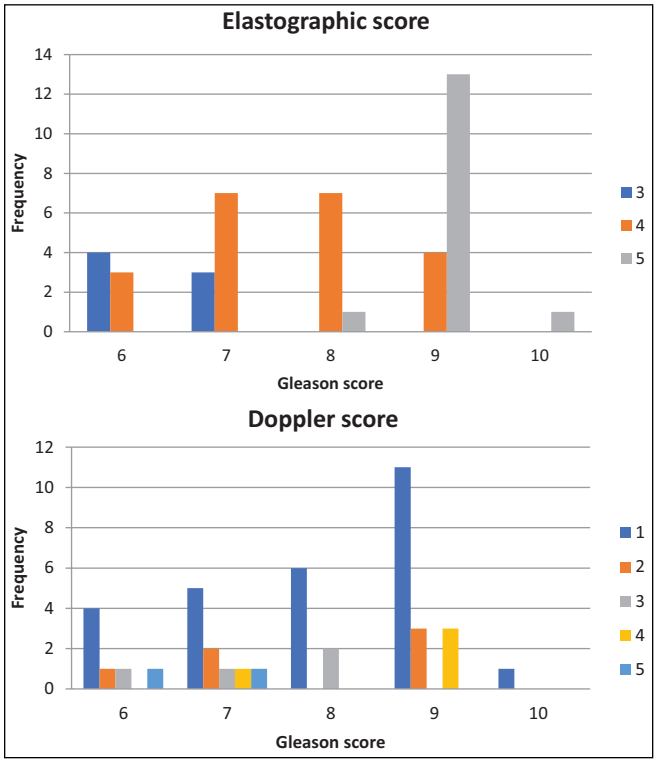

Figure 3: (A) Association between Gleason score and elastographic score. (B) Association between Gleason score and colour Doppler score

Of the 43 patients with PCa, thirty (70.0%) patients were found to have abnormal prostatic findings on DRE while 13 (30.0%) patients had prostate with benign features. The accuracy, sensitivity, specificity, PPV and NPV of DRE in PCa detection was 77.14%, 74.42%, 81.48%, 86.49%, and 66.67%, respectively. Ojewola *et al.*,[14] in a study that evaluated the usefulness of DRE in the diagnosis of PCa in an unscreened population, found a similar sensitivity (75.7%). The specificity (44.7%), PPV (51.9%), NPV (70.0%), and accuracy (58%) in their study were lower than the figures in this study which could be a result of wide difference in the sample sizes of these studies (168 vs 70).

In this study, the PSA range for patients with PCa was 8.3 to 1634ng/mL. This is similar to the findings by other authors who reported high PSA values in men of African origin.[13] A mean PSA value of 167.71 ± 335.29ng/mL was observed in this study. The range of prostate volume in this study was 21.63 to 205 mL with a mean and median of 79.35 ± 45.05 mL and 66.97 mL, respectively. This is similar to the mean prostate volume (83.8 ± 37.7 mL) by Badmus *et al.*[15] in Ife, Southwest Nigeria. The prostate size as measured by trans-rectal ultrasound in patients

Table 7: Area under curve of receiver operating characteristic comparing sensitivity and specificity of elastography and CDUS

Area under the curve					
Test result variable(s)	Area	Std. error[a]	Asymptotic Sig.[b]	Asymptotic 95% confidence interval	
				Lower bound	Upper bound
Elastographic score	0.935	0.028	0.000	0.880	0.991
Doppler score	0.543	0.069	0.549	0.407	0.678

The test result variable(s): Elastographic score, Doppler score has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased

[a]Under the nonparametric assumption

[b]Null hypothesis: true area = 0.5

with PCa had a mean size of 74.46 ± 43.38 mL with a range of 30.0 to 205.0 mL. The histological type in all the malignant prostatic tissue was adenocarcinoma. This as well entirely agrees with the findings of other studies that adenocarcinoma of the prostate is the commonest histological variant.[9]

The normal prostate gland has little flow which is usually symmetrical. Angiogenesis is one of the ways for tumour progression. The formation of vascular networks by delivering growth factors, nutrients, and oxygen plays a pivotal role in the growth of solid tumours.[16] The rationale behind the use of CDUS is to detect tumour neovascularity which is critically involved in both the local growth and their eventual dissemination. Tissues that are cancerous usually grow more rapidly than healthy prostatic tissues and demonstrate increased blood flow as compared to normal tissues and benign lesions. CDUS may reveal an increased number of visualised vessels (microvessel density), along with an increase in flow rate, size and irregularity of vessels within PCa.[17] The sensitivity, specificity, PPV, NPV and accuracy of increased vascularity in detecting PCa as determined by ultrasonic Doppler was 8.50%, 97.44%, 64.10%, 66.42% and 66.31%, respectively. Cornud *et al.*[18] who demonstrated that sensitivity and specificity of CDUS were 78% and 80%, respectively, also declared that CDUS is valuable in PCa detection, especially in the PSA range of 4-10ng/mL. Khanduri *et al.*[19] found sensitivity, specificity, PPV and NPV to be 100%, 92.6%, 86.7%, and 100%, respectively, using TRUS with colour Doppler. Their higher detection rate could be from the smaller sample size of 40 (PCa cases were 13) when compared with this study. Santos *et al.*,[20] investigated 84 patients in their study and realised that the sensitivity, specificity, and positive and negative predictive values (PVs) of grey-scale US when correlated to histopathological results were 67.7%, 52.8%, 45.6% and 73.6%, respectively. When only colour Doppler findings were taken into consideration, sensitivity, specificity, and positive and negative PVs were, respectively, 58.0%, 79.2%, 62.0% and 76.3%. They also observed that associating the CD study to the routine US yielded an increase in specificity (from 52.8% to 79.2%) and in the positive PV (from 45.6% to 62.0%), but, on the other hand, there was a decrease in sensitivity (from 67.7% to 58.0%). This study had higher specificity of 97.4% and a far lower sensitivity of 8.5%.

Prostate disease affects a large portion of the population, and it is stimulating research aimed at developing new techniques for studying it. Recently devised is transrectal elastography, which uses ultrasound to analyse the mechanical properties of a tissue based on the relative elasticity of its components, the premise being that normal and pathological tissues will have different elasticity coefficients.[21] Unlike grey-scale US, which assesses structures based on differences in acoustic impedance, elastography allows in-depth palpation of structures, visually defining them according to their relative hardness. The principle of elastography is that tissue compression produces strain (displacement) within the tissue and that strain is smaller in stiffer tissue than in more compliant tissue. Compared with normal prostate tissue, the malignant focus has increased cell density and therefore a change in tissue elasticity.[22] Thus, sites of increased stiffness, that is, reduced elasticity suggest neoplasia. The mean elastographic score for patients with PCa was 4.2 while it was 2.5 for those with BPH. The difference is statistically significant (P <0.05). This corresponds to the cut-off value of the transrectal real-time elastographic score which is 3 i.e., scores of 4 and 5 are highly suggestive of malignancy.[7]

The PCa detection rate based on increased prostatic stiffness as determined by elastography in this study defined by sensitivity, specificity, PPV, NPV and accuracy were 84.21%, 94.59%, 88.89%, 92.11% and 91.07%, respectively. These were higher than the elastography PVs reported by Salomon *et al.*[23] as sensitivity, specificity, PPV, NPV and accuracy which were 75.4%, 76.6%, 87.8%, 59%, and 76%, respectively. The elastography PCa detection rate in this research is also higher than the findings by Zhu *et al.*[24] where overall sensitivity, specificity and accuracy were 67.6%, 89.5% and 82.7%, respectively. This is regardless of the fact that both later studies evaluated the diagnostic performance of elastography in correlation with radical prostatectomy histopathology. However, the higher diagnostic accuracy may be related to the fact that patients in this study have higher PSA and tumour burden with the majority presenting with late disease.

Thirty (3.6%) zones showed increased stiffness on elastography, however, turned out to be non-cancerous (false positive). False positivity, as reported by König *et al.*[25] may be encountered in some non-cancerous conditions that give rise to a stiffer prostatic tissue producing pathologic elastograms during elastography. Examples of such pathologic conditions include prostatolithiasis, chronic prostatitis, fibrosis, atrophy or benign nodes of prostate hyperplasia.

The accuracy of a test is the proportion of the screened population that will be correctly labelled as either diseased or disease free. Simply defined, a ROC curve is a plot of the sensitivity versus 1 − specificity of a diagnostic test. The different points on the curve correspond to the different cut points used to determine whether the test results are positive. An Area Under Curve (AUC) value of 0.5 depicts no discriminatory ability (or poor predictor/ association) whereas AUC value of 1 connotes a perfect predictor.[26] Alongside with other diagnostic efficiency tools, elastographic area under the receiver operating characteristic curve (AUC) was 0.935 which revealed that the foregoing ultrasonic feature was not just very precise at detecting PCa but also more accurate than CDUS with an AUC of 0.543. This is statistically significant (P < 0.05). Hence, increased vascularity as detected by CDUS has a weak association with PCa detection.

The most frequent Gleason's score was 9, accounting for 17 (39.5%) of the cases. There is a consistency in recent studies that the detection rate using elastography increases

with higher Gleason grades. Zhu *et al.*[24] reported a better detection for Gleason >7 compared to Gleason <7. This study also showed that 60% of patients with PCa had a Gleason score of ≥8 and elastographic score of ≥4. This is due to the fact that high-grade tumours have higher cell density resulting in stiffer tissue (decreased elasticity). Positive detection rates of PCa in Gleason scores 6, 7, and 8–9 were reported as 60%, 69.2%, and 100%, respectively.[27] Hence, it helps to prevent over-diagnosis – diagnosis of indolent PCa or clinically insignificant PCa. This study found a statistically significant positive correlation between the Gleason score and elastographic score.

Conclusion

This study showed a significant association between decreased prostatic elasticity (as determined by strain elastography) and PCa detection but a weak association between increased vascularity (as elicited by CDUS) and PCa detection. In addition, there is a strong positive correlation between the extent of stiffness of the prostate and the Gleason score (correlation coefficient – 0.778). We, therefore, recommend the combination of grey-scale transrectal ultrasound with colour Doppler and elastography in prostate biopsy to improve the detection of clinically significant PCa.

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Conflicts of interest

There are no conflicts of interest.

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