ORIGINAL RESEARCH ARTICLE

Predictive Value of Transrectal Ultrasound in the Diagnosis of Prostate Cancer

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A B S T R A C T

Introduction: Prostate cancer incidence is on the rise worldwide with a significant number of patients being diagnosed with advanced disease. Transrectal ultrasound (TRUS) is increasingly becoming important in the routine evaluation of patients with suspected prostate cancer because of improvements in its technology. The role of TRUS in the detection of suspicious lesions aside from its use in guiding prostate biopsies, has been brought to question by some studies. Thus study was done to correlate TRUS with histopathology of biopsy specimens so as to determine how accurate it is in diagnosing prostate cancer.

Material and Methods: Adult male patients in whom digital rectal examination (DRE) findings indicated prostate biopsy underwent TRUS and subsequently had digitally-guided trucut sextant prostate biopsy. TRUS findings were then correlated with histopathology results. Data analysis was conducted using Statistical Package for Social Sciences (SPSS) version 16 and tests of correlation at 95% confidence limit, and p-value of ≤ 0.05 were conducted.

Results: Forty five (45) adult male patients with mean age of 68.1 years and modal age group of 61 – 70 year were studied. The mean prostate volume was 88.5±70.0 cm^3. Over 71% of patients had prostate glands with mixed echogenic features distantly followed by isoechoic features (15.6%) ($p > 0.01$). Nearly 80% of the 32 patients who had mixed echogenic lesions had a histology of prostate cancer while all the patients with hyperechoic lesions had a benign histology.

Conclusion: The cancer detection rate of TRUS was found to be 73.3% in this study. TRUS, though not an accurate test is still relevant in the diagnosis of prostate cancer.

Key words: Correlation, Predictive Value, Prostate Cancer, Transrectal Ultrasound

INTRODUCTION

Prostate cancer incidence is estimated to be rising by 3% per annum worldwide and has been termed by expert epidemiologists as the 'oncological time bomb'.[1] In Africa, the incidence was previously thought to be low but this has been disproved by results from several studies carried out in different parts of the continent.[2,3] Most patients have disease that has extended beyond the confines of the gland at the time of diagnosis.[4] In a study of prostate cancer patients over 10 years published earlier by Bassey and colleagues[5] in Calabar, over 20% of patients were noted to have presented with metastatic prostate cancer. Early detection therefore is very important in the management of this disease. Modalities available for detection are digital rectal examination (DRE), prostate specific antigen (PSA) and transrectal ultrasound (TRUS) with the final diagnosis being made using histology of prostate biopsy specimens.

TRUS of the prostate was first reported by Wild and Reid in 1955 and popularized by Watanabe et al. in the early 1970s.[6,7] Since then TRUS has increasingly becoming an important tool in the routine evaluation of patients suspected of having prostate cancer. This is because of the advances in ultrasound machine technology and intracavitary transducers with increasingly higher frequencies.[8] However, the role of TRUS in the detection of suspicious lesions has been brought to question by some authors in their publications with some actually regarding TRUS as being only useful as a guide for prostate biopsy.[9,10] TRUS is a procedure that uses sound waves to create a video image of the prostate gland. A small, lubricated probe placed in the rectum releases sound waves, which create echoes as they enter the prostate. The echoes that bounce back are sent to a computer that translates the pattern of echoes into a picture of the prostate.[11] Isoechoic areas, which represent normal tissue, echo the same amount of sound waves as they received. Hypoechoic areas send back significantly fewer echoes than they received and often indicate the presence of cancer. Hyperechoic areas send back significantly more echoes than they receive and often indicate the presence of prostatic calcifications, or calculi in the prostate.[11] The normal prostate gland has a homogenous, uniform echopattern. Most ultrasound-detected lesions found to be carcinoma are described as hypoechoic regions with irregular borders. However, not all hypoechoic regions

in the peripheral zone are CaP. Potential hypoechoic lesions also include prostatitis, prostatic infarction, dilated glands, smooth muscle bundles, scarring, and prostatic intraepithelial neoplasia.[12] Carcinoma may be undetectable by ultrasound or even hyperechoic.[13,14] Only 60% of prostate cancers appear hypoechoic on ultrasound while most of the remaining cancers appear isoechoic with respect to the surrounding parenchyma. The etiology of hypoechogenicity is currently believed to be due to the replacement of the prostatic stroma with infiltrating glandular elements.[15] The limitations of TRUS include frequent multifocality of cancer within the prostate, variable sonographic appearance of prostatic tumors, especially the substantial percentage of isoechoic prostate cancers and mostly the fact that it is operator dependent.[16] Thus study was done to correlate TRUS with histopathology of biopsy specimens so as to determine how accurate it is in diagnosing prostate cancer.

Varaiable	Categories	Number	Percentage (%)
Echogenicity	Mixed	32	71.1
	Isoechoic	7	15.6
	Hypoechoic	4	8.9
	Hyperechoic	2	4.4
	Total	45	100.0
Sonologic Diagnosis	CaP	30	66.7
	BPH	15	33.3
	Total	45	100.0

Table-1: Transrectal Ultrasound Features

MATERIAL AND METHODS

Consecutive adult male patients seen in the Urology unit of the University of Calabar Teaching Hospital Calabar over a period of one year, with lower urinary tract symptoms and other symptoms suggestive of prostate cancer and in whom DRE findings indicated prostate biopsy, were included in this study. Ethical approval was obtained from the ethical committee of the hospital. All patients already diagnosed with or on management for prostate cancer were excluded from the study**.** Transrectal ultrasound using Sonoscape 6000® digital colour doppler ultrasound system with a 5 MHz EC9-5 endocavitary transducer was performed. Insertion of the probe was preceded by a DRE to assess the anal sphincter and adequacy of the rectal space. With the patient in left lateral position, the probe was gently introduced with generous lubrication. The prostate was imaged in both transverse and sagittal planes. The echogenicity of the prostate was noted. Volume measurement of the prostate (using the formula: height x length x width x $\pi/6$)[64] and assessment of the shape and capsule of the prostate were carried out. Patients with abnormal DRE and TRUS findings with or without total PSA elevation had digitally-guided automated transrectal prostate biopsy after a prophylactic antibiotic therapy of oral Ciprofloxacin 500mg had been given thirty (30) minutes prior to the procedure. While in the left lateral position a

Echogenicity Category	Histologic Diagnosis		Total	Regression Coefficient (B)	95% Confidence Interval For B		Odds Ratio	P-Value
	BPH	CaP						
Constant				.9			2.6	.01
Hyperechoic	2	0	2					0.24
Hypoechoic	3	1	4	-22.1	-0.0	+0.0	0.0	0.99
Isoechoic	4	3	7	-2.0	0.1	1.4	0.1	0.09
Mixed	9	23	32	-1.2	.05	1.6	0.3	0.15
Total	18	27	45					

Table-2: Correlation (Logistic regression) of Echogenicity with Histological Diagnosis

Irregular Prostate Outline	Histologic Diagnosis		Total	Regression Coefficient (B)	95% Confidence Interval For B		Odds Ratio	P-Value
	BPH	CaP						
Constant				1.1			3.0	.01
No	11	6	17	-1.7	.1	.7	.2	.01
Yes	7	21	28					
Total	18	27	45					

Table-3: Correlation (Logistic regression) of Irregular Prostate Outline on TRUS with Histological Diagnosis

Sonologic Diagnosis	Histologic Diagnosis		Total	Regression Coefficient (B)	95% Confidence Interval For B		Odds Ratio	P-Value
	BPH	CaP						
Constant				1.0			2.8	.01
BPH	10	5	15	-1.7	.17	.7	.2	.01
CAP	8	22	30					
Total	18	27	45					

Table-4: Correlation (Logistic Regression) between Sonologic Diagnosis and Histologic Diagnosis

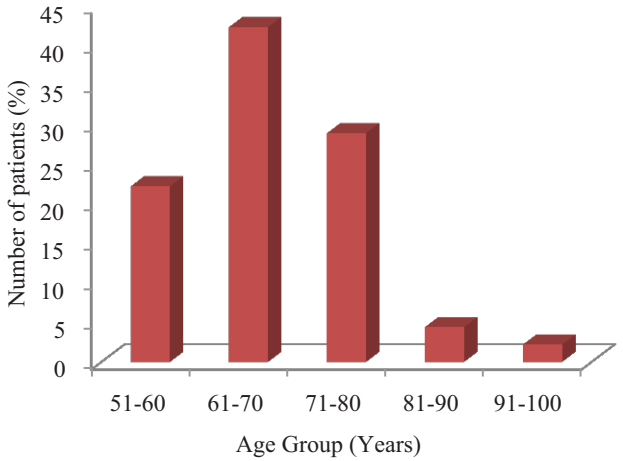

Figure-1: Age Distribution of Patients

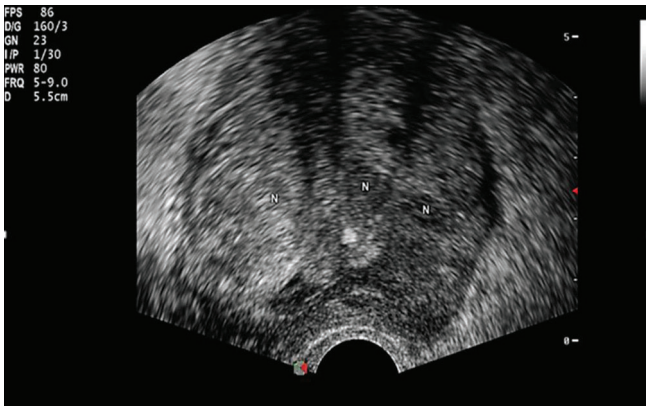

Figure-2: Image of a predominantly heterogenous prostate gland with focal areas of hypoechoic lesions (N) in an 80 year man.

well lubricated left index finger was used to guide a size 18G biopsy needle mounted on an automated spring loaded biopsy gun into the rectum to access the prostate. Six cores of prostatic tissue were obtained (2 each from the apex, mid-portion and base of the gland), fixed in Bouin solution and sent for histological analysis.

STATISTICAL ANALYSIS

Data was analysed using Statistical Package for Social Sciences (SPSS) version 16. Tests of correlation (Logistic regression and Pearson's chi square) at 95% confidence limit and p-value of ≤ 0.05 were conducted**.**

RESULTS

Forty five (45) adult male patients with mean age of 68.1 years and age range of 52 – 93 years were studied. Most patients (42.2%) were within the 61 – 70 year age group. (Figure 1)

The mean prostate volume on TRUS was 88.5±70.0 cm^3 with a range of 13.0 – 375.9 cm^3. Most patients (71.1%) had prostates with mixed echogenic features, followed by isoechoic features (15.6%) ($p > 0.01$). Twenty two out of the 30 patients with histologic diagnosis of prostate cancer had an irregular prostate outline on TRUS ($p < 0.01$). (Tables 1, 2 and 3)

Twenty two patients (73.3%) out of 30 with sonologic diagnosis of prostate cancer had a positive histologic diagnosis. ($p < 0.01$) **(Table 4)**

DISCUSSION

In this 12-month prospective study, the mean age was 68.1years with a standard deviation of 9.1 years. The age range was 52 – 93 years with peak age range being 61-70 years which accounted for 42.2% of patients with 77.8% of patients being above 61years of age. Osegbe[3] had earlier reported a mean age of 68.3 years in a similar study in Lagos while Lopes et al[8] recorded a mean age of 68.4 years in Portugal. Both studies recorded similar results as ours. Our study revealed a mean prostate volume of 88.5cm^3 with range of 13.0cm^3 – 376.0cm^3 with majority of patients having mixed echogenicity (71.1%). Ahmed and colleagues[17] in Zaria found a mean prostate size of 66.8g with a range of 15–219g. Eri and colleagues[18] in Norway recorded a mean prostate volume of 58.0ml with range of 26.6 – 164.8 ml. The mean prostate volumes recoded in both Nigerian studies were larger and the ranges wider than those of the Norwegian study. Most patients (71.1%) had prostate glands with mixed echogenic features, followed distantly by isoechoic features (15.6%). Mixed echogenicity on TRUS correlated more with a histologic diagnosis of CaP as 71.9% of the 32 patients who had mixed echogenic features had a histology of prostate cancer. Over forty-two (42.9) percent of patients with isoechoic lesions were found to have CaP, while 25% of those with hypoechoic lesions had a final diagnosis of CaP. None of those with hyperechoic lesions were found to have prostate cancer on histology. Hypoechoic nodules located in the peripheral region have been shown to have the highest predictive value in the detection of prostate cancer[19] and more studies in the past had noted hypoechoic lesions to correlate more with a histologic diagnosis of CaP.[15,20] This was the pattern also recorded in the Zaria study where hypoechoic lesions were found to correlate more with a histologic diagnosis of CaP. Our findings however were different as recorded above. In a study by Ellis and colleagues[21] on 1001 patients in Seattle USA, hypoechoic lesions were more than twice as likely as isoechoic lesions to contain malignancy on biopsy but even then, as high as 37.6% of the cancers were found in isoechoic sectors. They found that performing biopsy of only hypoechoic sectors would have misdiagnosed 24.6% of the patients with prostate cancer. Our findings have gone on to further prove the fact that a significant proportion of prostate cancer cases can be missed when the focus is on hypoechoic nodules. Rather, loss of homogeneity should be considered as being more suggestive even though a significant proportion of cancers were also found in isoechoic lesions in our study. All the hyperechoic lesions in our study were found to be benign. Ahmed et al as well as Lee et al[17,22] had previously recorded similar findings in earlier studies. Irregular prostate outline on TRUS was found to have a statistically significant positive correlation with histologic diagnosis of prostate cancer as 75% of patients with irregular capsular outline had a histology of CaP ($p < 0.05$). Therefore the presence of an irregular prostate outline on TRUS should strongly suggest the presence of CaP. Twenty two patients

out of 30 with sonologic diagnosis of prostate cancer had a histologic diagnosis of prostate cancer ($p < 0.01$), giving a cancer detection rate of 73.3%. In a similar study carried out by Lopes et al[8] in Brazil, suspicious nodules were detected in 34 patients out of which 25 were malignant giving a positive predictive value of 74%[8]. Sibley et al[23] had reported that when pathology reports were correlated with the findings on DRE and TRUS, both DRE and TRUS were positive in 46% of subjects, DRE was negative and TRUS, positive in 30% and DRE was positive when TRUS was negative or equivocal in 14% of subjects. The diagnostic accuracy rate for prostate cancer in another study by Ahmad and Dadgar was 67.27%. The cancer detection rate recorded in our study was comparable with that in the study by Lopes et al and higher than that recorded by Sibley and Ahmad and Dadgar.

CONCLUSION

Transrectal ultrasound findings in this study have been found to correlate well with a histopathologic diagnosis of prostate cancer with the cancer detection rate of TRUS found to be 73.3%. Specific features like irregularity of the prostate correlated independently with a histology of prostate cancer. TRUS of the prostate, though with limited potential, is still quite relevant in the diagnosis of prostate cancer in addition to being used as a guide for prostate biopsies.

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