ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 3.4
IJAR 2014; 1(1): 581-584
www.allresearchjournal.com
Received: 15-04-2014
Accepted: 21-05-2014

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To study strain elastography and transrectal ultrasonography in the detection of prostate cancer

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Abstract
Introduction and Background: The research and development of healthcare are greatly influenced by prostate cancer, as it is the second most common cancer in males and the second leading cause of cancer-related deaths. The evaluation of prostate cancer has primarily depended on digital rectal examinations and PSA levels due to the inconvenient placement of the prostate.
Material and Methods: We evaluated a cohort of 30 individuals who had elevated PSA levels and abnormal DRE results and were sent to our clinic. Data was collected by researchers at the Department of Radio-Diagnosis, Tagore Medical College, Chennai, Tamil Nadu, India during the period spanning from October 2013 to September 2014. Following a comprehensive explanation of the potential repercussions of the biopsy, all patients were required to grant informed permission. Preoperative antibiotics were administered as a preventive precaution.
Results: In this prospective study, a cohort of 30 patients exhibiting abnormal digital rectal examination findings and elevated prostate-specific antigen (PSA) levels were subjected to a series of diagnostic procedures. These procedures included transrectal real-time strain elastography, transrectal ultrasonography, a systematic 12-core biopsy, and targeted biopsies performed on abnormal areas identified through transrectal real-time strain elastography and transrectal ultrasound. The histological diagnosis was compared with the interpretations derived from each of these procedures.
Conclusion: The findings of this study indicate that elastography has more sensitivity in detecting cancers when compared to ultrasonography. Additionally, elastography demonstrates a robust negative predictive capability, hence contributing to the prevention of unnecessary biopsies. The combined utilization of elastography and ultrasonography enhances the quality of cancer detection through the precise identification of malignant tumors and the facilitation of guided biopsies.

Keywords: Strain elastography, transrectal ultrasonography, prostate cancer

Introduction
Prostate cancer has garnered considerable attention from the medical community due to its status as the second most prevalent form of cancer among males and its substantial impact on both morbidity and mortality rates. In the past, the measurement of prostate specific antigen (PSA) levels was conducted alongside a digital rectal examination as a diagnostic tool for prostate cancer [1]. This can be attributed to the inconvenient positioning of the prostate gland, which hinders direct observation. The utilization of this approach for data analysis was inadequate. The emergence of ultrasound technology has enabled the assessment of the prostate in a unique manner. Prostate biopsies are deemed essential in order to validate the diagnosis of prostate cancer in individuals exhibiting heightened levels of prostate-specific antigen (PSA) and atypical findings during digital rectal examination. Furthermore, it is necessary for patients to have abnormal findings during a digital rectal examination [2-4].
Transrectal ultrasonography, also referred to as TRUS, is the preferred technique for imaging the prostate gland. Ultrasound-detectable malignancies frequently exhibit a hypoechoic appearance when contrasted with normal prostatic tissue. The sensitivity and specificity of TRUS are limited due to the prevalence of benign hypoechoic foci. The utilization of TRUS has been found to be beneficial in providing visual guidance throughout the execution of a multi-core prostate biopsy [5-7].
Prostate cancer commonly presents as a firm and indented growth. A technology capable of mapping the prostate's flexibility has the potential to be valuable in finding and diagnosing malignant regions within the prostate gland.

The identification of prostate cancer can be facilitated by utilizing ultrasound elastography's data on tissue stiffness, which can also guide the selection of samples [8, 9].

The objective of this prospective study is to examine the utilization of transrectal ultrasonography for evaluating prostate cancer, as well as to test the effectiveness of elastography in accurately identifying and directing biopsies from concerning lesions within a clinical context. The pathology diagnosis will serve as the reference standard for our findings [10]. The primary aims of the study were to evaluate the efficacy of transrectal ultrasonography in accurately detecting prostate malignant tumors. This study is to evaluate the efficacy of strain elastography in prostate cancer for the purpose of identifying lesions and determining the appropriate locations for biopsies.

Materials and Methods

We evaluated a cohort of 30 individuals who had elevated PSA levels and abnormal DRE results and were sent to our clinic. Data was collected by researchers at the Department of Radio-Diagnosis, Tagore Medical College, Chennai, Tamil Nadu, and India during the period spanning from October 2013 to September 2014. Following a comprehensive explanation of the potential repercussions of the biopsy, all patients were required to grant informed permission. Preoperative antibiotics were administered as a preventive precaution.

Inclusion Criteria

- High suspicion for prostate cancer despite prior negative biopsies.
- Elevated PSA level.
- Abnormal findings on digital rectal examination.

Exclusion Criteria

- Patients on anticoagulation with an international normalized ratio.
- Patients with severe bleeding diatheses.
- Patients with inflammatory bowel illness.
- Patients without rectum or ileo-anal pouch following surgery.
- Patients unwilling to consent to a biopsy.

Results: A cohort of 30 individuals exhibiting atypical digital rectal examinations and heightened levels of prostate specific antigens were subjected to transrectal ultrasonography, transrectal real-time strain elastography, and a cross-sectional 12-core biopsy. Supplementary focused biopsies were obtained from anomalous regions identified using transrectal real-time strain elastography and transrectal ultrasound.

Table 1: Where several forms of harmless

Types of benign lesions	Frequency	Percentage
Benign Prostatic Hyperplasia	15	50.00
Prostatitis	15	50.00
Total	30	100

Table 2: Dispersion of tumors by age

Age	Benign	Malignant	Cases	%
50-60	6	3	9	30
60-70	4	4	8	27
70-80	3	5	8	27
80-90	2	3	5	16
Total	15	15	30	100

Table 3: Distribution of lesions based on PSA level

PSA (ng/mL)	Benign	Malignant	Cases	%
< 10	8	3	11	37
10-20	2	3	5	16
20-30	2	4	6	20
>30	3	5	8	27
Total	15	15	30	100

Table 4: Prostatic size and the pattern of tumor development

Prostate size (Cm^3)	Benign	Malignant	Cases	%
< 30	5	5	10	33
30-40	3	5	8	26
40-50	4	3	7	23
> 50	3	2	5	17
Total	15	15	30	100

Table 5: Clinically-based lesions distribution

Clinical findings	Benign	Malignant	Frequency	%
Lower urinary tract symptoms	10	10	20	67
Hematuria	5	5	10	33
Total	15	15	30	100

Table 6: Diagnostic efficacy

	Sensitivity	S Specificity	Positive Predictive Value (%)	Negative Predictive Value (%)
TRUS	79.64	82.35	79.64	82.35
Elastography	100	50	62.59	100

Discussion

In this prospective study, a cohort of 30 patients presenting with an abnormal digital rectal examination and elevated levels of prostate-specific antigen were subjected to a series of diagnostic procedures. These procedures included transrectal ultrasonography, transrectal real time strain elastography, a systematic 12-core biopsy, and targeted biopsies derived from abnormal regions identified through transrectal real time strain elastography and transrectal ultrasound. This study compared the histological diagnosis with the interpretations provided by each of the aforementioned methodologies [15-12]. The age of the participants in our study varied from 53 to 88. The study sample consisted predominantly of individuals aged 60 years and above. The findings of Jemal *et al*. align with the notion that the incidence of prostatic disease tends to rise in correlation with advancing age. Based on our investigation, it was found that the median age for malignant tumors was 72 years, whereas the median age for benign tumors was 67 years. According to our research findings, the prevailing clinical manifestation of prostatic illness is characterized by lower urinary symptoms such as urgency, hesitancy, and increased frequency of micturition. Within our sample of 24 participants, it was observed that 13 individuals exhibited benign conditions affecting the lower urinary tract, whereas 11 individuals displayed malignant abnormalities. The occurrence of hematuria was observed in 6 cases, with 3 cases being benign and 3 cases being malignant [11-14].

The sample population consisted of two types of lesions: 16 benign lesions and 14 malignant lesions. The entirety of the malignant growths was attributed to prostate adenocarcinoma tumors. Out of the total number of benign lesions, 16 were identified, with 10 being BPH and 6 being prostatitis. The PSA levels in our sample varied between 4 ng/ml and higher. According to Thompson *et al.* and Schroder *et al.*,

individuals diagnosed with benign prostatic hypertrophy, inflammatory disorders of the prostate, and prostatic cancer have been documented to exhibit prostate-specific antigen (PSA) values exceeding 4 ng/ml. The study conducted revealed that the median prostate-specific antigen (PSA) levels for malignancies were 57ng/mL, whereas the median PSA levels for benign illnesses were 25.4ng/mL.

The study revealed a significant variation in prostate size, with a median of 38.1 mm3 and a range of 8 to 89 mm3. In this study, a total of seven individuals diagnosed with high grade prostatomegaly were included, with volumes varying between 52 and 89 cm3. Two patients presented with benign prostatic hyperplasia (BPH), two patients presented with both prostatitis and BPH, and three patients presented with prostatic cancer. Chung *et al.* have provided evidence supporting the notion that prostate enlargement is a reliable indicator of malignancy in both benign prostatic hyperplasia (BPH) and prostate cancer. Following the recommendation of Levine *et al.*, we performed a 12-core systematic biopsy on all of our patients. The efficacy of a 12-core biopsy in diagnosing prostate cancer was demonstrated to surpass that of the more prevalent sextant biopsy [15-17].

The investigation conducted by TRUS identified hypoechoic localized lesions in a total of 14 patients. Ten lesions had heightened vascularity, while four lesions displayed normal vascularity. According to Apple *et al.*, the ultrasound findings of prostatic tumors exhibited significant variability. The use of TRUS alone is insufficient for the detection of prostate cancer. While the majority of hypoechoic lesions are harmless, specific malignancies can be identified as hypoechoic patches that can be differentiated from normal homogeneous parenchyma. Certain types of tumors exhibit hyperechoic characteristics, while numerous malignancies in their initial phases display isoechoic characteristics, rendering them indistinguishable from the surrounding healthy tissue. The analysis conducted revealed that TRUS exhibits a positive predictive value of 78.57 percent and a negative predictive value of 81.25 percent. During our study, we identified 11 out of the 14 hypoechoic lesions using TRUS, which were proven to be adenocarcinoma of the prostate. The remaining 3 lesions were determined to be benign. There were three instances in which TRUS failed to identify lesions. In contrast to the findings reported by Terris *et al.*, which indicated a sensitivity of 53.3% and specificity of 75% for TRUS, our investigation demonstrated a sensitivity of 78.57% and specificity of 81.25%. Greyscale ultrasonography of the prostate in these instances showed asymmetrical heterogeneous strain without any visible lesions. Hertological examination revealed that all of these lesions were noncancerous [18-20].

A total of eleven grade III Elastography lesions were identified within the sample. Upon conducting elastography on these patients, a distinct and non-correlated focal asymmetric stiff lesion was observed, which was not associated with any hypoechoic region on gray scale ultrasonography. Histologically, 8 of these lesions were determined to be noncancerous, whereas 3 were identified as malignant. Elasticography grade IV was assigned to five of the lesions examined in our analysis. Ultrasound imaging detected hypoechoic lesions characterized by central rigidity and peripheral strain. The histopathology analysis confirmed that all of these growths were malignant. Six of the lesions examined in our study were categorized as elastography grade V. The observed phenomenon on gray scale exhibited hypoechoic characteristics, with noticeable stiffness observed both within the hypoechoic lesion and at its boundaries. All of these lesions were determined to be malignant through histopathological analysis. The first reference for our study was the elastographical approach proposed by Kamoi *et al.* 27% of the male participants in our study, namely eight out of 30, exhibited normal elastography results. These findings align well with the studies conducted by Aigner *et al.* A mere three out of the total forty-three patients included in their study, who exhibited normal elastography, progressed to develop malignancy. Conversely, all of the cases with normal elastography examined in our analysis confirmed to be benign. Out of the total of 22 persons who had aberrant results on elastography, specifically 14 of them were ultimately diagnosed with cancer. A total of eight occurrences of false-positive outcomes were observed when employing real-time elastography. Upon elastography, all of these lesions were categorized as having an intermediate risk for cancer. However, histology analysis indicated that 5 of them were benign prostatic hyperplasia, while 3 were classified as prostatitis [19-20].

We discovered that the positive predictive value of elastography was 63.64%, which contrasts with the research by Aigner *et al.* Based on elastography, it was determined that all lesions categorized as Grade IV and V exhibited malignant characteristics. Our findings showed that elastography had a low negative predictive value and a high sensitivity. The results of Aigner *et al.* were corroborated by the sensitivity of 74% and the negative prediction value of 93%. Additionally, we discovered that if only lesions with higher grades on elastography are taken into account for detecting malignancy, elastography can obtain a perfect 100% specificity and 100% positive predictive value. Although the available evidence is limited, the available data indicates that real-time elastography exhibits greater efficacy compared to TRUS in the detection of prostate cancer. Given the heightened certainty regarding the lack of cancer, we may infer that elastography has the potential to be a valuable method for reducing the necessity of invasive diagnostic procedures such as biopsies [20-22].

Conclusion

Transrectal ultrasonography is a valuable tool in the detection and diagnosis of prostate malignant tumors. Elevated vascularity and hypoechoic lesions serve as highly responsive markers for malignancy. The sensitivity, specificity, positive predictive value, and negative predictive value of transrectal ultrasound in the detection of prostate cancer were found to be 78.57%, 81.25%, 78.57%, and 81.25% respectively. In the context of prostate cancer detection, elastography demonstrated a sensitivity rate of 100%, specificity rate of 50%, positive predictive value of 63.64%, and negative predictive value of 100%. The enhancement of elastography specificity to 100% can be achieved by exclusively considering Grade IV and Grade V lesions as malignant. Elastography exhibits superior sensitivity and a greater negative predictive value in excluding malignancies, hence diminishing the necessity for unnecessary biopsies, in comparison to ultrasonography. The use of elastography and ultrasound in conjunction enhances the rate of cancer detection by aiding in the identification of malignant tumors and offering guidance for biopsies.

Funding: None

Conflict of Interest: None

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