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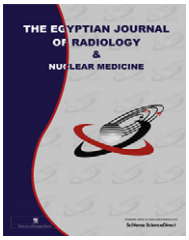

ORIGINAL ARTICLE

The role of three dimensional transrectal ultrasonography (3-D TRUS) and power Doppler sonography in prostatic lesions evaluation

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KEYWORDS

Three dimensional;
Ultrasound;
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Abstract *Aim of work:* To evaluate the role of three dimensional (3D), two dimensional (2D) as well as power Doppler transrectal ultrasound (TRUS) in diagnosis of different prostatic lesions.
Patients and methods: 2-D TRUS, power Doppler and Transrectal 3-D US were performed for 100 patients between April 2009 and April 2010. All patients had been examined clinically with digital rectal examination (DRE) and had serum prostatic specific antigen (PSA) level (total and free). Patient age ranges from 42 to 67 years and the mean age was 55 years. TRUS guided biopsies were done for 77 cases showing any of the followings: abnormal focal lesion with ultrasound, abnormal vascularity with power Doppler exam, abnormal DRE, elevated serum total PSA >4 ng/ml or when the percent-free PSA is 10% or less in an outpatient setting. The results were recorded and analyzed.
Results: 3-D TRUS was more sensitive, specific and more accurate than 2-D TRUS in detecting prostate cancer as it showed estimated sensitivity 78.9% and specificity 94.8% with total accuracy 90.9% with respect to an estimated sensitivity 63.1%, specificity 86.2% and total accuracy 80.5% with 2-D TRUS and was more accurate than 2-D ultrasound in identifying the capsular breaks with an estimated sensitivity 80% with respect to 40% with 2-D TRUS.
Power Doppler showed 84.2% sensitivity in detecting prostatic cancer and was of 100% sensitivity in detecting prostatitis. 3-D TRUS was more accurate in estimating the volume of adenoma in cases of BPH with an estimated error not more than +6% with respect to an estimated error not more than +18% for 2-D TRUS.

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Conclusion: 3-D transrectal ultrasound and power Doppler sonography have specific diagnostic capabilities which added significantly to the ultrasound in detecting and staging of prostatic cancer and in the planning for management .They proved highly valuable in the diagnosis of prostatitis and 3-D TRUS was more accurate than 2-D TRUS in estimating the volume of adenomas in patients with BPH.

1. Introduction

Watanabe et al. first introduced TRUS as a clinical investigation for prostate evaluation, since that date and with advancement of ultrasound technology TRUS, became the standard imaging modality for prostatic diseases (1,2). The advances in ultrasound technology machines, particularly the progress in the high frequency transducers, advancement in computer technology and Doppler techniques, made TRUS more reliable for prostate cancers detection (3).

Prostate cancer does not have a uniform appearance on the ordinary two dimension 2-D gray scale images, as malignancies located in the outer (peripheral and central zones) or inner (transition zone) gland have different histologic and biologic appearances so this will be reflected differently on US images (4).

Three dimensional 3-D TRUS demonstrate the anatomic delineation of the prostate and lesions within it and demarcate the structures around the prostate, in three planes simultaneously, the sagittal plane, horizontal (or axial) plane, as well the coronal plane. This enables the physician to reproduce a high resolution image of three dimensions on the US monitor or personal computer in few seconds (3,5).

3-D TRUS allows better assessment of prostate size and its internal zones improve the biopsy yield during transrectal biopsy and increase the sensitivity and specificity for prostate cancer detection over the traditional 2-D gray scale ultrasound. Also it measures accurately the tumor size thus helps in the plane of treatment and the follow up, this improves the outcome and reduces the side effects (6–9).

Color Doppler sonography increases the sensitivity of ultrasound in the detection of prostatic cancer by increasing the positive predictive value from 53% to 77% and in other series it became 80.6% however the presence of inflammation can increase the false positive rate because of associated hyperemia (3,10). The combination of power Doppler with 3-D TRUS increases the rate of cancer detection with optimization of biopsy cores as it helps in targeting areas presenting with abnormal blood flow. Also it helps in detection of extracapsular infiltration by detecting perforating vessels in the capsule with overall accuracy of 92% (11).

2. Aim of work

To evaluate the role of three dimensional (3D), two dimensional (2D) as well as power Doppler transrectal ultrasound (TRUS) in diagnosis of different prostatic lesions.

3. Patients and methods

2-D TRUS, power Doppler sonography and 3D TRUS were performed for 100 patients between April 2009 and April 2010. All patients were referred from urology department and were complaining of lower urinary tract obstructive or irritative symptoms and underwent history taken with international prostatic symptoms score (IPSS) sheet and or they had abnormal digital rectal examination (DRE) and or they had elevated serum prostatic specific antigen (PSA) level. Patient age ranges from 42 to 67 years and the mean age was 55 years.

The patient was examined in left lateral decubitus knee-chest position (11), using 3-D mechanical high frequency transrectal volume probe, GE logiq 7 ultrasonic machine (Milwaukee, WI, USA).

The volume estimation of prostate with 2-D transrectal ultrasonography was done by an ellipsoidal volume calculation. The prostate is considered ellipsoidal in shape and the volume (mL) is $0.523 \times \text{width}$ (cm) $\times$ height (cm) $\times$ length (cm), (the widths and heights were measured on axial planes and craniocaudal length on sagittal plane at their greatest diameter), while with 3D we use the 2 plane contour method (2,6).

Consequently the entire gland and its periprostatic tissues (especially fat planes in apical region, and middle lobe in large glands) were examined from apex to base including the seminal vesicles. Gray scale sagittal scanning was then performed from left to right. Every abnormality imaged in both axial and sagittal planes (12,13).

Power Doppler interrogation was performed in the axial plane from apex to base. The color window must cover the entire gland. Finally, biopsies were performed for 77 cases showing suspicious areas within the prostate during 2-D,3-D TRUS, abnormal flow pattern with power Doppler sonography and for cases with abnormal DRE or elevated serum total PSA >4 ng/ml or when the percent-free PSA is 10% or less after taking patient consent. The patients were instructed to take antibiotics before and after the procedure, to stop any anticoagulants or non steroidal anti-inflammatory drugs and to do an enema before the procedure. Eight tissue samples were taken from different prostatic regions (6 tissue samples were taken from the midlobe parasagittal planes bilaterally at the base, middle and apical prostatic zones and 2 samples from the lateral aspect of each lobe) in addition tissue samples were taken from the suspicious focal lesions or from the seminal vesicles suspected tumor infilteration observed during transrectal ultrasound. TRUS and TRUS guided biopsy were performed in an outpatient setting.

We started the examination by 2D transrectal ultrasound followed by power Doppler ultrasonography to the region of interest to evaluate the presence of hyperemia and there after the 3D ultrasound was activated and the region of interest was scanned with subsequent multiplanar image analysis and surface rendering. 2-D TRUS, power Doppler and 3-D TRUS exams were done by blind operator to the data received from the DRE and PSA serum level.