Diagnostic value of trans rectal ultra-sonography in comparison with MR imaging in detection and characterization of prostatic lesions

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ABSTRACT

- **Aim:**To evaluate the diagnostic accuracy of MRI techniques in detection and characterization of different prostatic lesions in comparison with TRUS.

- **Patient and Methods:**This prospective study include TRUS and MRI prostate of 30 adult male patients presented by different prostatic lesions obtained by using 1.5Tmachine, using pelvic phased array coil and/or endorectal coil. Pulse sequences include conventional (T1W&T2W) , MR spectroscopic imaging (MRSI), diffusion-weighted imaging (DWI) and/or dynamic contrast-enhanced MRI (DCE-MRI). The mp MRI results are correlated with TRUS results using histopathological reports obtained after TRUS biopsies as standard for reference

- **Results**: for malignant prostatic lesions diagnosis , It was found that MRIhas 100%sensitivity ,53%specificity ,68.2% positive predictive value ,100% negative predictive value and 76.7 % overall accuracy while TRUS has 40%sensitivity , 53.3 %specificity ,46.2% positive predictive value ,47.1% negative predictive value and 46.8 % overall accuracy compared with histopathological findings

- **Conclusion** Multiparametric MRI approach that combines anatomic T2-weighted imaging with functional data appears to be one of the most promising techniques for prostatic lesions detection compared with TRUS

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INTRODUCTION:

-Worldwide, diseases of Prostate gland are responsible for significant morbidity and mortality among adult males. Most frequently encountered diseases affecting prostate are Prostatitis, Benign prostatic hyperplasia and Prostatic cancer. **(1)** Prostate cancer is one of the most common malignancies in elderly men and it is one of the leading causes of cancer-related mortality.**(2).**

By 1990 ,trans rectal ultrasound (TRUS) has emerged as the best imaging modality of the prostate .Its use led to an improved understanding and demonstration of intra glandular anatomy. For long time ,TRUS is used screening, diagnosis and monitoring of benign disease , prostatic cancer and for guiding biopsy from the suspicious lesions. **(2)**.

The implementation of multi parametric MRI(mpMRI) into a screening program currently seems to be the most promising technique to improve the early detection of clinically significant PC**.(3)**.

Recently, great interest has been shown in mpMRI, which combines anatomic T2-weighted (T2W) imaging and T1Wwith MR spectroscopic imaging (MRSI), diffusion-weighted imaging (DWI) and/or dynamic contrast-enhanced MRI (DCE-MRI).**(4).**

The combination of anatomic, biologic and functional dynamic information offered by mpMRI improve many aspects of PC management. There is a real need for clinicians to base therapeutic decisions not only on predictive methods and nomograms that include PSA, digital rectal examination (DRE) findings, and TRUS biopsy findings, but also on imaging.**(4).**

PATIENTS AND METHODS

Thirty adult male patients aged between 43-80 years with urinary symptoms (urinary frequency, dysuria, weak stream, hesitancy, urgency, nocturia, incomplete emptying, terminal dribbling, overflow or urge incontinence , complete urinary retention, body aches and sometimes fever and problems during sexual intercourse) related to and /or presented by any prostatic lesions were enrolled in our study after written informed consent and approval of ethical committee.This Study was conducted in Sohag University Hospitals from August 2016 to March 2017.

The patients who had the following criteria will be included in the study: age of an adult men at least 18 years or over at risk of prostate lesions ,fit to undergo all protocol procedures and had elevated PSA

The patients who have the following criteria will be excluded from the study: Previous history of prostate surgery, general contraindications to MRI as metal implant, pacemaker implant, claustrophobia and renal impairment estimated GFR <50 and general contraindications to TRUS as piles and acute painful perianal disorders

The following *Investigations* were done for each patient ; Abdominal sonography ,TRUS color Doppler, Prostate - specific antigen (PSA) and histopathology of TRUS guided prostatic biopsy or trans perineal biopsy of patients with suspected cancer prostate.

All patients will be subjected to TRUS as screening of different prostatic pathologies by APLIO 500 TOSHIB device and MRI prostate by ACHIVA PHILLIPS 1.5 T, device at Sohag University Hospital using Pelvic phased array coil and/or endo rectal coil without prior bowel preparation.

The following sequences were done axial T1Wi , axial ,sagittal and coronal T2wi , axial DWi , MRS of any suspected lesion compared with normal gland and sometimes peri and post contrast T1Wi and T1 fat suppression in axial ,coronal and sagittal planes

Statistical analysis

The collected data were statistically analyzed using Statistical Package for the Social Science (SPSS) version 16 program and expressed in tables and charts regarding sensitivity, specificity and accuracy of mpMRI in comparison with those of TRUS using histopathological findings as standard of reference

RESULTS:

It was found that with MRI 18 (60%) of cases are diagnosed with prostate cancer (13 proved to be cancer and other 5 cases were 3 atrophic prostatitis

and 2 granulomatous prostatitis) , 4 (13.3%) case are diagnosed as cystic lesion , 4 (13.3%) case are diagnosed as BPH and last 4 (13.3%) are suspicious with (2 of them proved to be cancer and 2 infarction) table (1)

It was found that with TRUS a 4 (13.3%) of cases are diagnosed as malignant lesions, 4 (13.3%) case are diagnosed as cystic lesion , 11(36.7%) case are diagnosed as BPH and last 11 (36.7%)are suspicious & for biopsy table (2)

For malignant prostatic lesions MRI had overall accuracy higher than that of TRUS 76.7% and 46.8% respectively. It was found that MRI has 100%sensitivity ,53%specificity ,68.2% positive predictive value and 100% negative predictive value table (3) while TRUS has 40%sensitivity , 53.3 %specificity ,46.2% positive predictive value and 47.1% negative predictive value table (4).

Table1: MRI Diagnosis

Pathology	MRI Diagnosis	No	Percent
Benign	Cystic lesion	4	26.7%
	BPH	4	26.7%
	Prostate cancer	5	33.3%
	Suspicious	2	13.3%
	Total	15	100.0%
Malignant	Prostate cancer	13	86.7%
	Suspicious	2	13.3%
	Total	15	100.0%

Table 2: TRUS Diagnosis

Pathology		No	Percent
Benign	Cystic lesion	4	26.7%
	Suspicious & for biopsy	7	46.7%
	BPH	4	26.7%
	Total	15	100.0%
Malignant	Suspicious & for biopsy	4	26.7%
	BPH	7	46.7%
	Malignancy	4	26.7%
	Total	15	100.0%

Table 3: MRI Diagnostic accuracy for malignant prostatic lesions

Pathology		No	Percent
Benign	True negative	8	53.3%
	True positive	—	—
	False negative	—	—
	False positive	7	46.7%
	Total	15	100.0%
Malignant	True positive	15	100.0%
Sensitivity			100%
Specificity			53.3%
Positive predictive value			68.2%
Negative predictive value			100%
Accuracy			76.7%

Table 4: TRUS Diagnostic accuracy for malignant prostatic lesions

Pathology		No	Percent
Benign	True negative	8	53.3%
	False positive	7	46.7%
	False negative	—	—
	True positive	—	—
	Total	15	100.0%
Malignant	True positive	6	40.0%
	False positive	2	13.3%
	False negative	7	46.7%
	Total	15	100.0%
Sensitivity			40%
Specificity			53.3%
Positive predictive value			46.2%
Negative predictive value			47.1%
Accuracy			46.8%

ILLUSTRATED CASES;

Case (1) Male 45 yrs. Patient with midline prostatic cyst

Case (2): Prostate cancer in a 57-year-old man (Gleason score = 3+4, PSA level = 21 ng/mL [mg/L]).
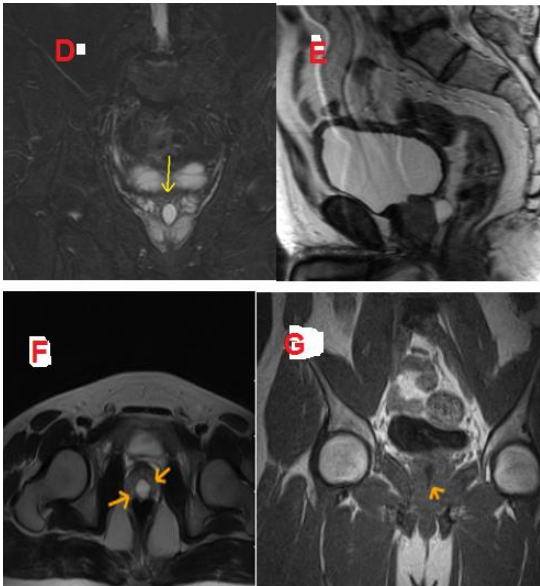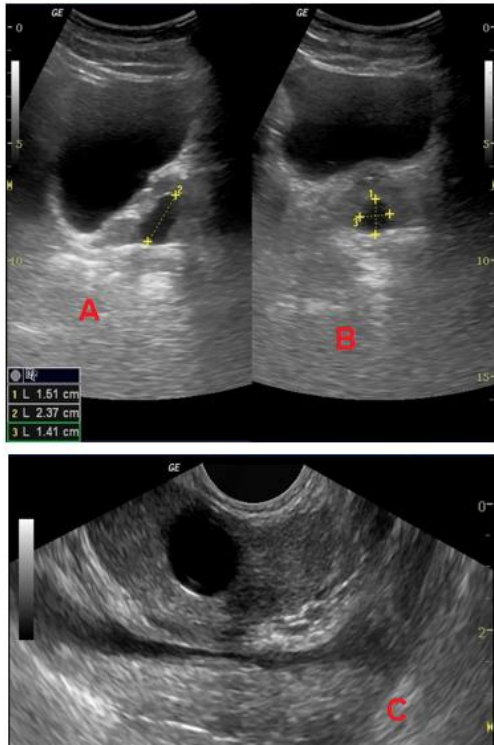
Trans abdominal (a,b) and trans rectal © ultrasound show midline prostatic cyst with clear content no septations nor soft tissue component .Conventional MRI of the prostate shows mid line fluid intensity cystic lesion looks high SI at coronal STIR image (d) , Sagittal T2WI (e) and axial T2WI (f) and low SI at coronal T1WI (g).
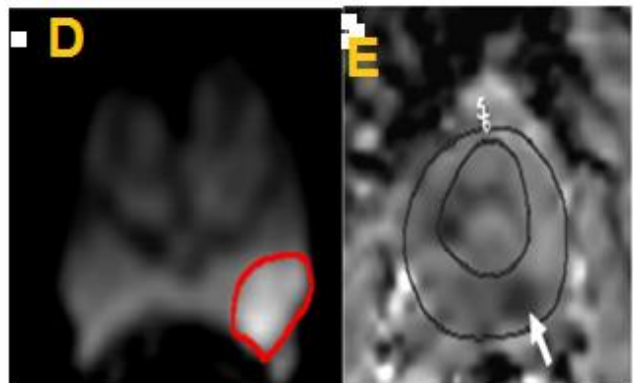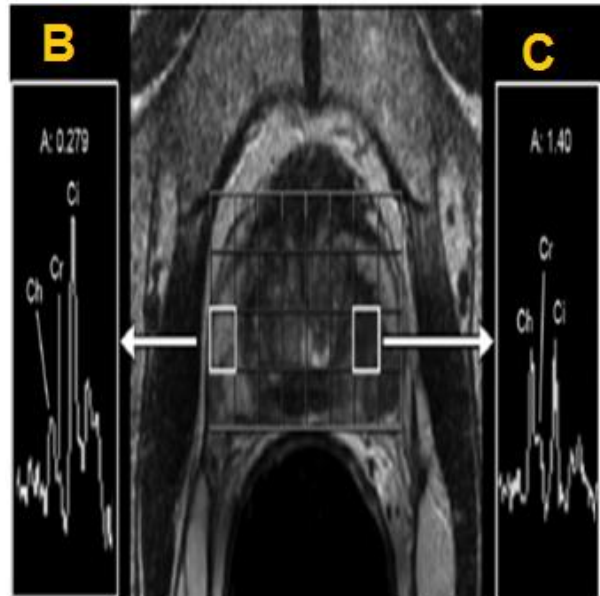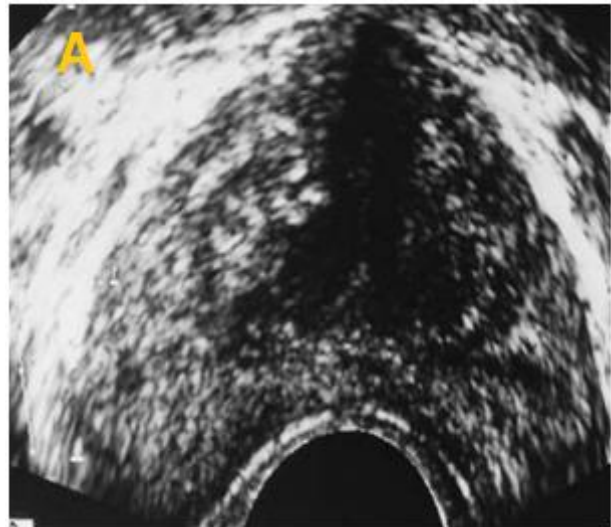
Gray scale TRUS (a)shows diffusely heterogeneous echogenicity of the prostate, especially on the left side

Left (b): MR spectroscopic image from endorectal MR imaging at 1.5 T shows a benign spectral pattern, with relatively high citrate (Ci) level and low choline (Ch) level, in an area of high T2 signal intensity in the right mid gland. Surgery demonstrated benign tissue. Cr = creatine.

Right©: MR spectroscopic image shows a malignant spectral pattern, with increased choline level and reduced citrate level (and thus an increased [choline + creatine]/citrate ratio [A]) in an area of low T2 signal intensity in the left mid gland. Surgery demonstrated malignant tissue

D) DW-MRI of the same case shows restriction at cancer which is highlighted in red

E)ADC maps shows outlines for whole prostate and central gland with the lesion is a focally restricted area on the ADC maps (arrow)

Case (3): Biopsy-proved adenocarcinoma in the central zone in both lobes of the prostate in a 67-year-old man.
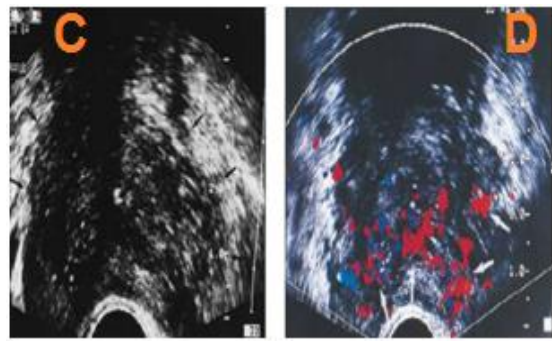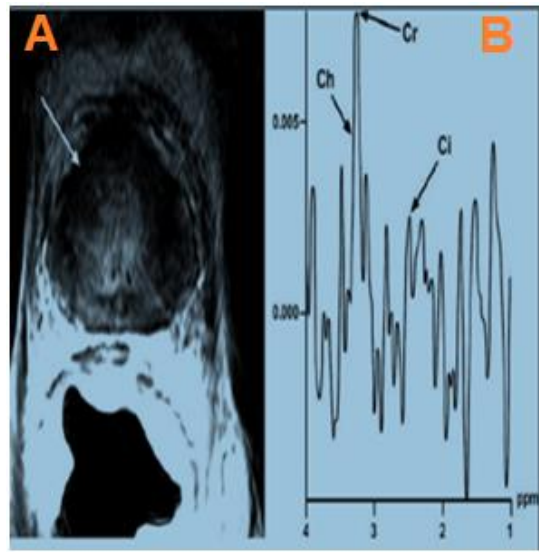

(a) Axial T2-weighted MR image shows areas of abnormally low signal intensity (arrow), a finding that is not definitively indicative of cancer. MR spectroscopic image (b) show high ratios (in arbitrary units) of choline (Ch) and creatine (Cr) to citrate (Ci) in this area (arrows in a). The findings were indicative of cancer, which was diagnosed at targeted biopsy

Gray scale TRUS © and CDUS (d) revealed that Almost the entire prostate shows low echogenicity with irregular outer margin (small arrows). And prominent flow signals are present on the entire peripheral portion of prostate (arrows).

Case (4); a 71-year-old man with BPH and PSA level = 21 ng/mL [mg/L])
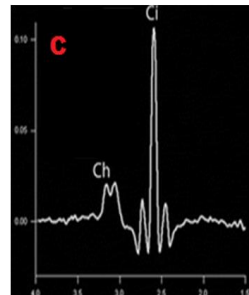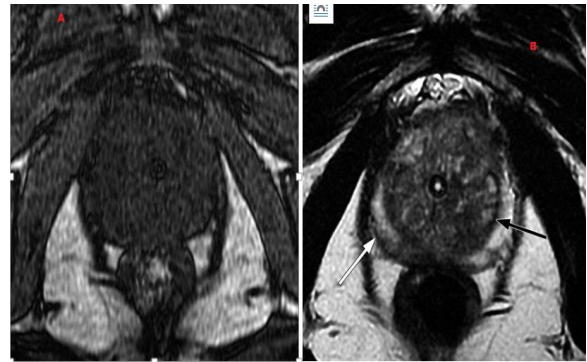
Axial. T1-weighted image (A) shows homogeneous intermediate signal intensity (SI) of both central gland and peripheral zone (PZ). T2-weighted image (B) shows characteristic appearance of central gland and PZ, which are clearly individualized. Central gland (black arrow) has predominant high SI, with nodules of varied SI. PZ (white arrow) has predominant high SI, tenuous hypo intense areas, and no nodules,(C) MR spectroscopic image shows a benign spectral pattern, with high citrate (Ci) level and low choline (Cho) level
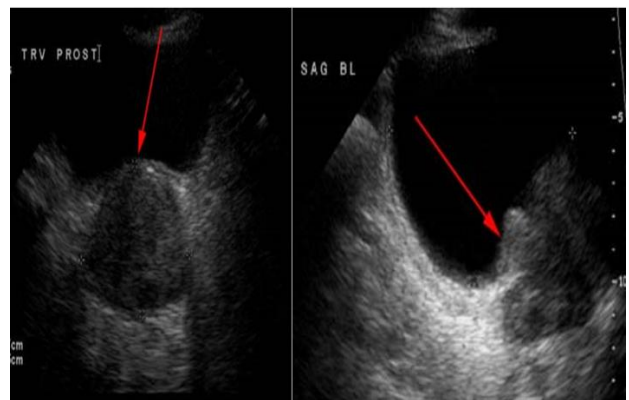
Gray scale ultrasound images of the bladder in sagittal (1) and transverse (2) show an enlarged prostate gland creating a bulge in the bladder base (arrows) representing prostatic enlargement. There are no specific findings of carcinoma on ultrasound

DISCUSSION:

In our study, by using conventional MRI almost half the cases 17 (56.7%) had enlarged transitional zone with abnormal peripheral zone 15 of them were proved to be prostate cancer and 2 granulmatous prostatitis , 2 cases had enlarged TZ with abnormal SI at PZ &TZ were proved to be prostatic infarction 4cases shows fluid intensity signal (cystic lesions) , 4 cases had enlarged central gland without any abnormal SI (BPH) and last 3 cases shows normal TZ and gland size with patchy mild hypo intense signal at PZ (prostatic atrophy)

By MR diffusion there was restriction in 21 (70%) cases with7 only of them were benign which are 2 cystic lesions(prostatic abscess)with 5 (atrophic and granulmatous prostatitis), while 14 cases were malignant with restriction and only one histopathologically proved to be prostate cancer with no restriction.

By MRI spectroscopy showed 20 cases shows abnormal values of{(Cho + CR) \ CIT} ratio, 17 (56.7%) cases were showing results suggesting cancer(15 case histopathologically proved to be prostatic carcinoma and 2 cases were granulmatous prostatitis) , 3 cases were border line and histopathologically proved to be benign lesions (prostatic atrophy) and only 10 cases were normal .

The sensitivity of MRI diagnosis in this study with 15 cases are true positive with percentage of 50%, 8 cases are true negative with percentage of 26.7% and 7 cases are false positive with percentage of 23.3%.Our results support the findings of systematic reviews that assess the diagnostic accuracy of MP-MRI *(5,6)*. The reviews declared sensitivities of 58–96%, negative predictive value of 63–98% and specificity of 23–87%. The ranges were broad because of the single centre nature of the studies, each of which invoked different target conditions on different reference standards

The meta-analysis of the 10 included studies showed a higher diagnostic accuracy for T2-weighted imaging combined with DWI (sensitivity and specificity of 0.72 and 0.81, respectively) than for T2-weighted imaging alone (0.62 and 0.77). The major strength of this diagnostic meta-analysis is that

this study is the first meta-analysis to investigate the accuracy of the combination of anatomic T2-weighted imaging and two functional techniques, DWI and MRS or DCE-MRI, as recommended by the ESUR guidelines *(7)*.This diagnostic meta-analysis showed that the accuracy of multiparametric MRI shows potential for the detection of prostate cancer. Although the FN rate of 26% still might be too high, TRUS-guided biopsy tends to miss tumors as well, with detection rates of 10–19% on repeat TRUS-guided biopsy *(8)* and up to 59% on MRI-guided biopsy after two negative TRUS-guided biopsy sessions *(9)*.

By using TRUS in our study, we found that about 13 cases have enlargement with nodule with percentage of 43.3%, 13 cases have enlargement without nodule with percentage of 43.3% and 4 cases have cystic lesion with percentage of 13.3%. 18 of cases were diagnosed as malignancy with percentage of 13.3%, 4 case were diagnosed as cystic lesion with percentage of 13.3%, 11 case were diagnosed as BPH with percentage of 36.7% and last 11 were suspicious & for biopsy with percentage of 36.7%.

In this study, the sensitivity of TRUS diagnosis with 6 cases are true positive with percentage of 20%, 8 cases are true negative with percentage of 26.7%, 9 cases are false positive with percentage of 30% and 7 cases are false negative with percentage of 23.3%, *Futterer et al. (2015)* said that MP-MRI was more accurate than TRUS-biopsy in terms of both sensitivity (93% *vs* 48%) and negative predictive value (89% *vs* 74%). TRUS-biopsy showed better specificity in their study (41% *vs* 96%) and positive predictive value (51% *vs* 90%).

In this study prostate cancer represents about 13.3 % of cases, as 22.2 % of cases are diagnosed by TRUS while MRI diagnosed 100% of cases with significant difference between the two groups. It shows that cystic lesion represents about 13.3 % of cases, as 100 % of cases are diagnosed by MRI and also TRUS diagnosed 100% of cases with insignificant difference between the two groups. It also shows that BPH represents about 13.3 % of cases, as 100 % of cases are diagnosed by MRI and while TRUS diagnosed 36.4 % of cases with significant difference between the two groups. We found also that

malignancy represents about 13.3 % of cases, as 26.7 % of cases are diagnosed by TRUS while MRI diagnosed 100% of cases with significant difference between the two groups. It shows that benign lesion represents about 26.7% % of cases, as 100 % of cases are diagnosed by MRI and also TRUS diagnosed 53.3% of cases with significant difference between the two groups. It also shows that suspicious represents about 16.7 % of cases, as 71.4 % of cases are diagnosed by MRI and while TRUS diagnosed 45.5 % of cases with significant difference between the two groups. True positive represents about 20 % of cases, as 40 % of cases are diagnosed by TRUS while MRI diagnosed 100% of cases with significant difference between the two groups. It shows that true negative represents about 26.7% % of cases, as 100 % of cases are diagnosed by MRI and also TRUS diagnosed 100% of cases with insignificant difference between the two groups. It also shows that false positive represents about 23.3 % of cases, as 100 % of cases are diagnosed by MRI and while TRUS diagnosed 77.8 % of cases with significant difference between the two groups.

CONCLUSION:

The combination of anatomic, biologic and functional dynamic information offered by multi-parametric MRI promises to make it successful imaging tool for improving many aspects of prostatic lesions detection and characterization. There is a real need for clinicians to base therapeutic decisions not only on predictive methods and nomograms that include PSA, digital rectal examination (DRE) findings, and trans-rectal ultrasound (TRUS) biopsy findings, but also on imaging.Multi-parametricMRI, T2W and T1W with MR spectroscopic imaging (MRSI), diffusion-weighted imaging (DWI) and/or dynamic contrast-enhanced MRI (DCE-MRI) provides noninvasive diagnostic tool for detection and characterization of prostatic lesions

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