Research Article

Role of Conventional and Functional Mri in Pre-Treatment Assessment of Prostate Cancer

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Introduction

Prostate cancer is one of the most common malignancies in elderly men. The lifetime probability of developing prostate cancer is one in six. Most prostate cancers grow slowly and early detection can lead to a complete cure. The diagnosis of prostate cancer based mostly on the results of ultrasonography (US)-guided trans-rectal biopsy. Because of the low accuracy of US for prostate cancer detection and localization, a random biopsy is usually performed instead of a targeted biopsy. However, a random biopsy has several disadvantages. For example, it may lead to an increase in complications because of the unnecessary sampling of normal prostate tissue. Moreover, may miss cancer located outside the routine biopsy site. In addition, there may be difficulty in determining the site of a previous biopsy when repeating biopsy in a patient with a previous negative result and continuously high prostate-specific antigen levels. For these reasons, an imaging modality needed that allows the accurate detection and localization of prostate cancer, as well as local staging, guidance of biopsy and adequate follow up after treatment.[١,٢&٣]

Although T٢-weighted MR imaging used widely for the pre-treatment work-up of prostate cancer. This technique is limited by unsatisfactory sensitivity and specificity for cancer detection and localization. To improve the diagnostic performance of MR imaging in evaluations for prostate cancer, various other techniques were been applied. These include diffusion-weighted imaging, dynamic contrast material enhanced MR imaging, and MR spectroscopy.[٤,٥]

Methods

Methods: Every patient was subjected to the following: ١- Full history taking. ٢- Clinical examination: inclining digital rectal examination. ٣- Laboratory investigation: PSA (total & ratio) ٤- Radiological assessment: transrectal US/biopsy, MRI Trans-rectal ultrasound guided biopsy protocol.

Multi-parametric MRI examination: - MR studies were performed on ١.٥T units (Siemens medical systems: MAGNETOM AVANTO (١.٥T/١٨ channels) & Philips Medical Systems: ACHIEVA (١.٥T/٨ channels) using pelvic phased array coils Conventional MRI: T٢-weighted turbo spin-echo images. T١ WI axial plan: to avoid artifacts form post biopsy hemorrhages and. (TR/TE: ٦٥٠/٧).

Diffusion/ADC calculation DW images were acquired in the axial plane using the single-shot echo-planar imaging technique. Diffusion-encoding gradients were applied at b values of ٠, ٦٠٠, ٨٠٠ and ١٠٠٠ s/mm٢ along the three orthogonal directions of motion-probing gradients. ADC maps were automatically constructed on a pixel by-pixel basis (٠ and ١٠٠٠ s/mm٢). The acquisition time of DWI was within ٣ min.[٦,٧&٨].

MR spectroscopy protocol MRS of the prostate is typically performed with a combination of Point-resolved spectroscopy (PRESS) volume localization and ٣D chemical shift imaging (CSI).

Results

The patients divided into two groups according to the final histopathological

diagnosis, Group I included ١٤ patients with benign prostatic lesions and Group II included ٣٦ patients with prostatic carcinoma.

Table (١): Age related findings

Age groups	No. patients	Malignant	Benign
٥٠-٦٠yrs	٨	٧	١
>٦٠-٧٠yrs	٢٧	١٩	٨
>٧٠-٨٠yrs	١٥	١٠	٥
Total	٥٠	٣٦	١٤

Group I (benign lesions)
Distribution of MRI findings regarding their location

Table (٢): PI-RAD score of benign lesions located at the central gland (N=٤). Each abnormality with T٢ & DWI/ADC scores as well as total PI-RAD score

No of Patients	T٢ score	DWI/ADC score	Total PI-RADS score
٢	٢	٤	٢
١	٣	٢	٣
١	١	١	١

Table (٣): PI-RAD score of benign lesions located at the peripheral zone (N=١٠).

No. of patients	DWI/ADC score	T٢ score	total PI-RADS score
٣	١	٢	١
٦	٢	٢	٢
١	٢	٣	٢

Figure ١ A) axial T٢ with near symmetrical hypo-intensities. B) axial ADC map the same level shows mild restriction with high ADC value.
Group II (malignant lesions)

Table (٤): Distribution of malignant lesions regarding their location.

Location	No. of patients
Central gland	٦
Peripheral zone	٣٠

Table (٥): PI-RADS score of malignant lesions located at the central gland (N=٦).

No. of patients	T٢ score	DWI/ADC score	total PI-RADS score
٣	٤	٤	٤
١	٤	٣	٤
٢	٥	٥	٥

Table (٦):

No. of patients	DWI/ADC score	T٢ score	total PI-RADS score
٥	٣	٤	٣
١٣	٤	٣	٤
١٢	٥	٥	٥

Figure (٢): axial T٢ ill-defined area of hypo-intensity with definite borders (erased charcoal sign), B) axial DWI at high b-value & C) axial ADC shows marked focal diffusion restriction at the same area.
PI-RAD score of malignant lesions located at the peripheral zone (N=٣٠).

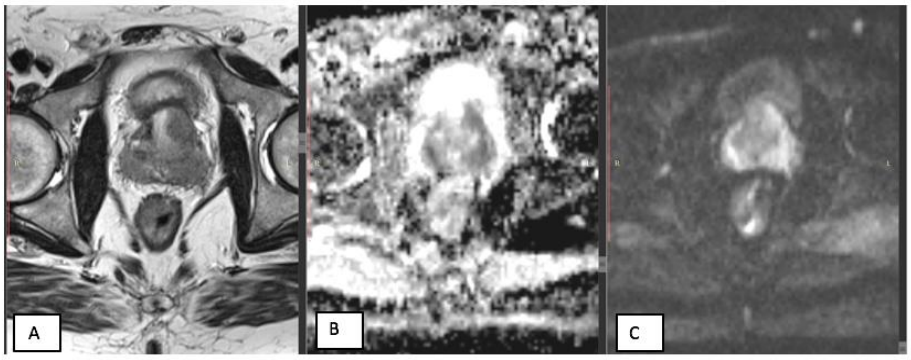

Figure ٣: A) axial & coronal T٢, show multiple hypo-intense lesion seen at the peripheral zone basal segments at both sides as well as anterior segments at the left side. B&C) axial DWI/ADC shows marked restriction correlated with T٢ hypo-intensity.

Table (٧): Most common sites of extra-glandular extensions:

Extra-capsular spread	Number patients
seminal vesicles	١٢
NVB	١٠
recto-prostatic angle	٦
bladder base & urethra	٤

Discussion

This study included ٥٠ male patients with clinical suspicious of prostatic carcinoma. The commonest age group (>٦٠-٧٠yrs) included ٢٧ patients followed by age group (>٧٠-٨٠yrs) included ١٥ patients. Digital rectal examination (DRE), trans-rectal ultrasound, total PSA and PSA ratio (between free and compound form of PSA) are used for assessment. In a study was done by (Dirk Beyersdorff., ٢٠٠٢) he found that DRE results indicated prostate cancer in six of the ٤٤ patients. Prostatic specific antigen (PSA) is a valuable measurable indicator for assessment of prostate cancer; however, Total PSA has low specificity to differentiate between malignant and benign lesions with wide zone of overlap (normal level <٤ng/ml, suspicious >١٠ng/ml). Multiple varieties of PSA measurement are used nowadays aiming to improve prediction of abnormalities and the

specificity of PSA. PSA density (level of PSA correlated with the volume of the prostate gland). PSA velocity measures the annual rise of the PSA levels, >٠.٧٥ng/ml/yr is a significant raise. PSA ratio compound/free form (more increase of compound form more likely to be malignant), the higher specificity is the PSA ratio F/C <٢٥٪ free form highly suspicious & for whom on follow up (watchful waiting) is PSA velocity[٦]. In our study, DRE and total PSA alone are of low accuracy (٥٢-٥٤٪) in detection and characterization of malignant changes. This markedly improved when correlated with PSA ratio. This elevates the accuracy up to ٩٤٪. This is matched with (Nicholas P, Francois C, ٢٠١١) who reports that risk factors/PSA correlation that is >٢٥٪, had low risk for prostate carcinoma. So, the most effective combination for follow assessment of prostatic carcinoma is DRE/PSA ratio with annual level of PSA level.[٩&١٠]

Diffusion MRI examination of the prostate gland is more helpful in evaluation of the peripheral zone lesions compared to the central gland lesions. Mostly due to the different histological composition as the peripheral zone is formed from glandular tissue & the hypertrophied central gland is formed from mixed stromal and glandular tissue. Benign stromal nodules had diffusion restriction.

MR spectroscopy depends upon the different metabolite activity within normal and abnormal prostatic tissue. Normal spectrum of the normal prostatic tissues shows elevated Ci (Citrate) peak with reduced Choline & Creatine levels. There is an important ratio between Cho/Ci, which I seen < ٠.٦ in normal tissue and is seen elevated >١ in malignant lesions. In some situations, like stromal BPH nodule Ci peak in central gland may be reduced, prostatitis in the peripheral zone alters Cho/Ci ratio and peri-urethral zone normally may show elevated Cho peak. MR spectroscopy is of great value in follow up to evaluate metabolic activities compared with pre-treatment baseline MR-spectroscopy. Two techniques are used for MR spectroscopy, single voxel and multi-voxel techniques. The multi-voxel technique is used to cover the entire gland while single voxel is used for selected areas. Time of single voxel is less than multi-voxel unless multiple areas are selected for evaluation. In view, the multi-focal nature of the prostate cancer, multi-voxel technique is the technique of choice. [١١&١٢]

Conclusion

Despite prostatic biopsy is still the gold standard technique in diagnosis of prostate cancer. The combination of multi-parametric MR and prostatic biopsy is very beneficial, as mp-MRI will add multiple advantages like reduced risk of re-biopsy and associated complications, evaluated extra-capsular spread which is the most important factor in treatment planning of prostate carcinoma; mp-MRI is used to assess clinical staging of PCa patients.

Finally, further work up with MR for increased sensitivity and specificity like using end rectal coil, high field ٣T & MRI guided biopsy are advised.

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