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Assessing the validity of Prostate Imaging Reporting and Data System version 2 (PI-RADS v2) scoring system in diagnosis of peripheral zone prostate cancer

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ABSTRACT

The purpose: Assessing the accuracy of multi parametric magnetic resonance (mp-MRI) after application of PI-RADS V2 for diagnosis of prostate cancer as comparison to pathological results of trans rectal ultra-sound (TRUS) guided biopsy.
Patients and methods: 138 prostatic lesions in 23 patients were retrospectively assessed and analyzed with Trans rectal ultra-sound (TRUS) guided biopsy results. Those patients underwent multi parametric magnetic resonance (mp-MRI) with application of PI-RADS V2 reporting system. The sensitivity, specificity, validity, negative predictive value and positive predictive value were calculated for PI-RADS V2 reporting system compared to biopsy-proven pathological results.
Results: 92 out of 138 lesions were positive for Peripheral zone cancer prostate. PI-RADS V2 reporting system proved 88.04% sensitive & 93.4% specific for diagnosis of prostate cancer with negative predictive value & positive predictive value of 100%.
Conclusion: Our results proved that mp-MRI of prostate using PI-RADS v2 scoring system had high sensitivity and specificity in diagnosis of prostate cancer and PI-RADS V2 scoring system using mp-MRI is recommended as a non-invasive diagnostic tool compared to TRUS guided biopsy.

1. Introduction

Prostate cancer ranks as the second most common cancer in male population with expected incidence doubling by 2030 [1]. Prostate cancer incidence increase with age, representing an incidence of 34% at 5th decade and reaching up to 70% at the age of 80.The demographic changes as increase in life expectancy, have resulted in the increased incidence of the prostate cancer. Yet the 5-years survival rates have increased in the past 25 years from 69% reaching about 99%. This could be attributed to the advancements in the early diagnosis and treatment of prostate cancer [2].

The major problem faced in the management of prostate cancer was the inability of early diagnosis of the cases that can be life threatening later on [3]. The techniques by and large used for the early detection of prostate cancers were digital rectal examination and serum prostate- specific antigen (PSA) levels and both were found to be suboptimal and insufficient for an early detection [4]. PSA was proved to be better than the digital rectal examination in diagnosis of prostate cancer yet it had low specificity (36%) due to its high false positive results in benign conditions as benign prostatic hyperplasia (BPH) and prostatitis [5,6].

Histopathological examination played the main role in determining the patient prognosis, but, even with staging and grading of cancer using histological assessment after radical prostatectomy, the outcome was variable [3]. The Gleason score was the pathological grading system used in cancer prostate. It was used for 40 years uptill now. It was considered as one of best prognostic factors in cancer prostate [7].

Trans-rectal U/S guided (TRUS) biopsies were used to define Gleason score before management of prostate cancer patients [7]. TRUS biopsies were accurate in defining Gleason score and became part of the routine screening system for the patient with suspected prostate cancer [7]. However, biopsy-proven Gleason grade was subject to sampling error. It was reported that after radical prostatectomy the biopsy- proven Gleason grade is increased in 54% of patients [8].

Abbreviations: PZ, peripheral zone; CG, central gland; CZ, central zone; FOV, field of view; PSA, prostate- specific antigen; TZ, transition zone.

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The diagnostic tools previously used were inaccurate for risk stratification so lead to less optimal choice for therapy. There was a cardinal need of a new diagnostic tool for prostate cancer that would help in early detection, localization and even sampling of lesions [5].

Magnetic resonance imaging (MRI) of the prostate is an emerging method for the detection of prostate cancer [9]. Recent advancements in multi-parametric magnetic resonance imaging (mp-MRI) that combine both anatomical and functional data have showed higher advantages in the detection and characterization of prostate cancer. Several studies have proven that functional imaging techniques improve the accuracy of MRI in detection and localization of prostate cancer [10]. Multi-parametric MRI (mpMRI) was MR prostate including T1 and high-resolution T2-weighted (T2w)sequences for morphological assessment combined with functional imaging (i.e. diffusion-weighted imaging (DWI), MR spectroscopy (MRS) and dynamic contrast enhanced imaging (DCE)) [9]. The European Society of Urogenital Radiology (ESUR) published a scoring system depending on data from mp-MRI prostate which named Prostate Imaging Reporting and Data System (PI-RADS) with an aim to set standardized reports and techniques for interpreting mp-MRI [9]. Later on the American college of radiology, ESUR and AdMeTech foundation committee recognized limitation in PI-RADS scoring system and announced an updated version, PI-RADS V2 [1]. Spectroscopy was omitted in version 2 and DCE was given a minor role [11]. PI-RADS V2 utilizes a 5-point scale to estimate the likelihood of clinically significant cancer in each lesion and it is as following:

- PI-RADS 1 – Very low (clinically significant cancer is highly unlikely to be present)
- PI-RADS 2 – Low (clinically significant cancer is unlikely to be present)
- PI-RADS 3 – Intermediate (the presence of clinically significant cancer is equivocal)
- PI-RADS 4 – High (clinically significant cancer is likely to be present)
- PI-RADS 5 – Very high (clinically significant cancer is highly likely to be present) [11]

DWI represented the main sequence in assessment of PZ lesions, With the DCE represented the secondary sequence. Secondary sequence was used in cases with PI-RADS 3 score in primary sequences, which were then upgraded in score to PI-RADS 4 or kept as PI-RADS 3 depending on the data achieved from secondary sequence.

DCE-MRI was interpreted as positive or negative focal enhancement with no curves as before [1].

For PI-RADS 5 scoring lesion should be >1.5 cm in size, with extra prostatic extension or invasion [1].

Our purpose was to assess the accuracy of multi parametric magnetic resonance (mp-MRI) after application of PI-RADS V2 for diagnosis of prostate cancer in comparison to pathological results of trans rectal ultra-sound (TRUS) guided biopsy.

2. Patients & methods

This study conducted on 23 patients, presented with prostatic carcinoma diagnosed by TRUS-guided biopsy, after approval of Ethical Committee of our university with Informed consent from patients or guardians of patients who we invited to participate in the research.

Patients with positive TRUS-guided biopsy were included in our study, yet all Patients with acute renal failure were excluded.

2.1. The routine MRI procedure was

MR imaging is performed on 1.5 T magnet (Philips Achieva 1.5T SE) by using an endo-rectal coil (Medrad® Prostate eCoil™ MR Endorectal Coil) combined with cardiac coil(SENSE Cardiac coil 5 element). The acquired images transferred to offline workstations (extended workspace "EWS").

2.1.1. Patient preparation

Reassurance of the patient from the entrance to the scanning room must be a rule, including proper knowledge of the whole process. A stable venous line must be available, this requiring an 18–20 gauge needle placed into an antecubital vein. The multi-parametric MR examinations are supervised by a radiologist. Patients with no contraindication will receive 20 mg I.M injection of butylscopolamine (Buscopan) used to avoid motion artifacts caused by bowel peristalsis. After digital rectal examination, the endo-rectal coil is inserted while the patient is in the left lateral decubitus position. The balloon surrounding the coil is distended by air to a volume of 80–100 ml.

2.1.2. MRI imaging protocol

First we start with Axial T2-weighted turbo spin-echo sequence (TR 3.2 s, TE 120 ms, Flip angle 90, FOV 160 × 160 mm, slice thickness 3.0/0.3 and ACQ voxel size 0.42/0.42/3.0 mm) Followed by coronal T2-weighted turbo spin-echo sequence (TR 6.5 s, TE 115 ms, FOV 140 × 140 mm, slice thickness 3.0/0.0 and ACQ voxel size 0.73/0.73/3.0 mm). Then sagittal T2-weighted turbo spin-echo sequence (TR 5 s, TE 120 ms, FOV 160 × 160 mm, slice thickness 4.0/1.0 and ACQ voxel size 0.50/0.50/4.0 mm). Followed by axial T1-weighted turbo spin-echo sequence (TR 496 msc, TE 10 ms, FOV 160 × 160 mm, slice thickness 3.0/0.3 and ACQ voxel size 0.76/0.76/3.0 mm) The prostate is then imaged with a multishot echoplanar DW sequence and three orthogonal diffusion gradients (TR 3.44 s, TE 74 ms, FOV 160 × 160 mm, slice thickness 6.0/0.6 ACQ voxel size 1.25/1.25/6.0 mm with b values, 0, 50, 500, 800, 1500 s/mm 2). Contrast-enhanced MR imaging performed by acquiring T1Fast Field Echo images (TR 5 ms, TE 2 ms, flip angle 15°, slice thickness 4.0/−2.0, FOV 313 × 313 mm and ACQ voxel size 1.22/1.22/4.0 mm) at 20 points in time with a temporal resolution of 4.8 s. after injection of a bolus of 0.1 mmol gadopentetate dimeglumine/Kg of body weight injected into an antecubital vein followed by 20 ml of isotonic saline solution (both at injection rates of 2.5 ml/s).

The results of MRI assessed as regard: Assess the prostate on conventional T2 weighted images to detect any hypo-intense focal lesion describing its pattern and size to differentiate between PI-RADS 4 & 5 where size >1.5 cm considered PI-RADS 5 and assess if there was any capsular abutment or invasion, neuro-vascular bundle invasion, seminal vesicles central, bilateral or unilateral invasion and if there was urethral or urinary bladder invasion which raise PI-RADS to score 5. On T1, weighted images assure that there were no hemorrhagic lesions. Followed by focal lesion characterization on DWI which represent the main sequence for PZ focal lesion interpretation in version 2, and finally contrast-enhanced MRI to further characterize focal lesion as focal enhancement pattern raise PI-RADS 3 TO PI-RADS 4. All results reported according to PI-RADS system version 2.

2.2. Post processing

The acquired images transferred to offline workstations (extended workspace "EWS"); (Syngo MR and Philips Medical Systems). Two radiologist assess the data (one lecturer and the other was professor), The lecturer had 3 years of experience in mp-MRI prostate and the professor had more than 7 years of experience