SF 06 GU-04 Update in prostate imaging

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# Multiparametric MR imaging for prostate cancer

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Prostate cancer is one of common male cancer. Purpose of screening and imaging of prostate cancer is early detection and accordingly improvement of patients' survival. Trans rectal ultrasonography, manual endorectal examination, serum prostate specific antigen (PSA) checks are current screening methods, but these methods suffer from substantial false-negative rate. Even systemic prostate biopsy misses diagnosis and suffers from underestimation of extent and histologic grade of disease. The review will deal with the role of multiparametric MRI for detection and management of prostate cancer.

## I. Anatomic MRI

T1 and T2-weighted MRI are anatomic sequence of prostate MRI. T1WI has limited value in delineation of tumor and zonal anatomy. T1WI is useful in detecting hemorrhage associated with biopsy. Biopsy related hemorrhage usually interferes with the MR diagnosis of prostate cancer. T2WI is work-horse of prostate MR imaging. It provides with high soft tissue resolution for tumor visualization, zonal anatomy, and other structures around the prostate. On T2WI, cancer is seen as low signal intensity foci. But, other non-tumorous condition such as prostatitis, hemorrhage, atrophy, benign hyperplasia, post-treatment change can be seen as low signal intensity. In addition, cancer in central gland is hard to detect because the signal intensity of central gland in T2WI is also low.

The sensitivity and specificity of T2WI for cancer detection are 27–100% and 32–99% respectively.

## II. Functional MRI

Functional MRI include diffusion weighted MRI (DWI), magnetic resonance spectroscopy imaging (MRSI), and dynamic contrast-enhanced MRI (DCE-MRI).

DWI detects the Brownian motion of free water within tissues. It was initially utilized in the detection of acute cerebrovascular stroke. In oncology, tumor tissue with higher cellular density has more diffusion restriction and the diffusion restriction can be detected in DWI. The DWI is quantified by apparent diffusion coefficient (ADC). Prostate cancer shows low signal intensity in ADC maps. The sensitivity and specificity of DWI are 57–93.9% and 57–100% respectively. Recently there were reports about the correlation of ADC and the Gleason scores.

MRSI displays the chemical composition of the prostate gland through metabolites (citrate, choline, and creatine). The prostate cancers demonstrate increased levels of choline and diminished levels of citrate. The ratio of choline to citrate is used as and malignancy index. With integration of MRSI into multiparametric MRI the diagnostic performances were shown to increase.

DCE-MRI depicts vascularity and permeability changes in the prostate gland and cancer. Prostate cancer tends to included neoangiogenic vessels and usually shows early and intense enhancement and de-enhancement patterns. DCE-MRI is acquired with fast T2WI before and after injection of contrast material. $K^{trans}$ (transendothelial transport of contrast medium from vascular compartment to the tumor interstitium) and $k_{ep}$ (reverse transport parameter of contrast medium from the extracellular space back to the plasma space) are usually used quantitative permeability parameters calculated from a mathematical fitting of [Gd]-time curves. The tumors have higher permeability values, but there is

substantial overlap between tumor and normal prostatic tissue. In addition, these parameters suffer from lower reproducibility and comparability. DCE-MRI has wide range of sensitivity (46–96%) and specificity (74–96%).

## IV. Multiparametric MRI

It is evident that no single MRI sequence is sufficient to detect prostate cancer. There were some researches showing that combination of multiparametric MRI has higher yield lesion detection in prostate cancer. In applying the multiparametric MRI sequence, the complexity of this methods and learning periods make the need for automated diagnostic methods, future study for combining the features of all the parameters is needed.

## V. MR Imaging-guided Biopsy

Systemic biopsy is prone to lower sensitivity and down grade of histology, which results in inaccurate Gleason score. MR-guided prostate biopsy with use of multiparametric MR imaging has been studied by many researchers and showed increased detection rate. Both direct MR guidance and experimental fusion of MRI and US data showed increased cancer detection rate.

## VI. Summary

Integrated evaluation of anatomic and functional MR imaging technique is current considered the best way to detect and manage prostate cancer. The education of complex multiparameters to newcomer and developing new concise way to interpretate these parameters are needed in the future.