Multiparametric MR imaging of the Prostate
Pitfalls in Interpretation

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KEYWORDS

• MR imaging • Prostate MR imaging • Multiparametric • Prostate cancer • Pitfalls in interpretation

KEY POINTS

- Normal anatomic structures such as the normal central zone, anterior fibromuscular stroma, capsular insertions, surgical capsule, and periprostatic venous plexus may be misinterpreted as prostate cancer.
- Benign lesions such as focal prostate atrophy, prostatitis, transition zone nodules, benign prostatic hyperplasia nodules in the peripheral zone, and prostate calcifications may confound the diagnosis of prostate cancer.
- Prostate hemorrhage can persist for several weeks to months after biopsy and may mimic prostate cancer.
- It is crucial for radiologists to be aware of these pitfalls for accurate interpretation of multiparametric prostate MR imaging.

INTRODUCTION

Prostate cancer is the most common diagnosed cancer in males and is the second cause of cancer related death in men.[1] Screening for prostate cancer includes serum prostate-specific antigen (PSA) and digital rectal examination. Diagnosis of prostate cancer is done with transrectal ultrasound (TRUS)-guided prostate biopsy, and the TNM (tumor, node, and metastasis) stage is obtained from these variables. Multiparametric MR imaging (mpMRI) has shown significant clinical utility, not only in the diagnosis and staging of prostate cancer, but also in the workup of high-risk patients with elevated PSA with multiple negative prostate biopsies.[2] It is used to guide focused biopsies of high-risk targets, either as fusion targeted (ultrasound + MR imaging) or magnetic resonance-guided biopsy. In patients with biopsy-proven low-grade disease, mpMRI is used to complement or replace TRUS biopsy in active surveillance.

mpMRI examination of the prostate is best performed on a high field magnetic resonance unit with or without an endorectal coil and after administration of an antispasmodic agent to reduce bowel motion-related artifacts. The standard set of pulse sequences for mpMRI for the application of PI-RADS v2 includes multiplanar T2W, diffusion-weighted imaging (DWI), and dynamic contrast-enhanced MR imaging (DCE-MR imaging). Magnetic resonance spectroscopy is not formally included in PI-RADS v2 protocols or image assessment.[3]

Evaluation of mpMRI of the prostate gland has several pitfalls, with both normal anatomic structures and abnormal benign entities having similar imaging characteristics features as prostate cancer. When present, these lesions and pseudolesions can present diagnostic challenges. Knowledge of the magnetic resonance features of these mimics and their characteristic locations where

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Radiol Clin N Am ■ (2017) ■–■
https://doi.org/10.1016/j.rcl.2017.10.009

they occur within the prostate can help differentiate these entities from prostate carcinoma.

NORMAL CENTRAL ZONE

The contemporary prostate zonal anatomy is based on the classical work done by McNeal,[4] who proposed different prostate zones. The seminal vesicles are located superiorly to the prostate and drain into the mid prostatic urethra via the ejaculatory ducts in the region of the verumontanum. The central zone is distinct from the transition zone. It surrounds the ejaculatory ducts and is located posterior to the transition zone and the urethra proximal to the verumontanum and extends to the prostate base adjacent to the seminal vesicles.[5]

The central zone forms a homogenous low T2W structure that is symmetric on either side of ejaculatory ducts, and low uniform ADC mimicking magnetic resonance features of prostate cancer (**Fig. 1**). On DCE-MR imaging, however, the central zone shows a type 1 (progressive) or type 2 (plateau) enhancement.[6] The central zone is symmetric on axial and coronal T2W sequences. When the transition zone is hypertrophic, it extends superiorly from the verumontanum and compresses and displaces the central zone superiorly and laterally to the base, just inferior to the seminal vesicles.[7] If the hypertrophy is asymmetric, this can cause asymmetric displacement of the central zone, which may be mistaken for prostate cancer. Its enhancement on DCE-MR imaging can be helpful in its differentiation from cancer, especially when there is asymmetry of the central zone.

Central zone cancers account for 0.5% to 2.5% of all prostate cancers. They tend to have a higher Gleason grade, are likely to invade the seminal vesicles, and have extracapsular extension (**Fig. 2**). They are also prone to biochemical recurrence after prostatectomy.[8] Therefore, their differentiation from normal central zone is critical.

ANTERIOR FIBROMUSCULAR STROMA

The anterior fibromuscular stroma (AFMS) forms the anterior surface of the prostate located anterior to the transition zone. It is composed of connective tissue, smooth muscle, and some skeletal muscle. There is a smooth transition from the capsule to the AMFS, with the AFMS increased in thickness medially. In most cases (89%), the AFMS forms the only anterior covering of the prostate. Laterally, the AFMS fuses with the lateral pelvic fascia and covers the outermost regions of the lateral and anterior surfaces of the prostate in most cases (85%).[9]

AFMS typically has low signal on T2-weighted and high b value DW images and ADC maps (**Fig. 3**). Therefore, can either obscure or mimic PCa.[10] On DCE-MR imaging, the AFMS shows a type 1 (progressive) enhancement curve. AFMS is the most delayed enhancing component of the prostate because of its fibrous and muscular histology.

In an analysis of radical prostatectomy specimens, pure anterior cancers account for 20% of all cancers, and in cases of multifocal cancer pure anterior cancers are involved at least 50% of the time. Anterior cancers tend to have higher rates of extracapsular extension.[11] Anterior cancers are hyperintense on high b-value DWI, and usually have a type 3 enhancement pattern that can help with differentiation (**Fig. 4**).[10]

CAPSULAR AND FASCIA INSERTION AT MIDLINE OF THE PERIPHERAL ZONE

Posterior prostatic fascia and seminal vesicles fascia (Denonvillier fascia) are composed of

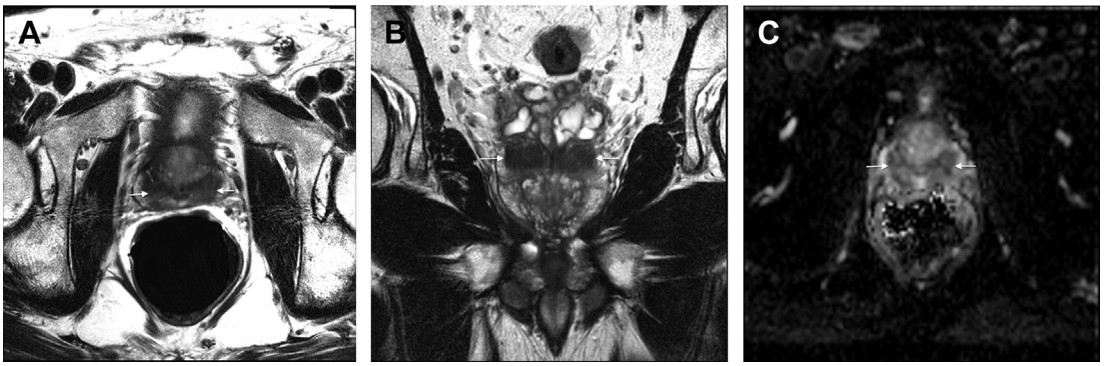

Fig. 1. 64-year-old man with elevated PSA. (*A, B*) Axial and coronal T2W images show the normal central zone near the base of the prostate as symmetric low-intensity structures (*arrows*). (*C*) ADC maps of the area show the same area as areas of low ADC (*arrows*).