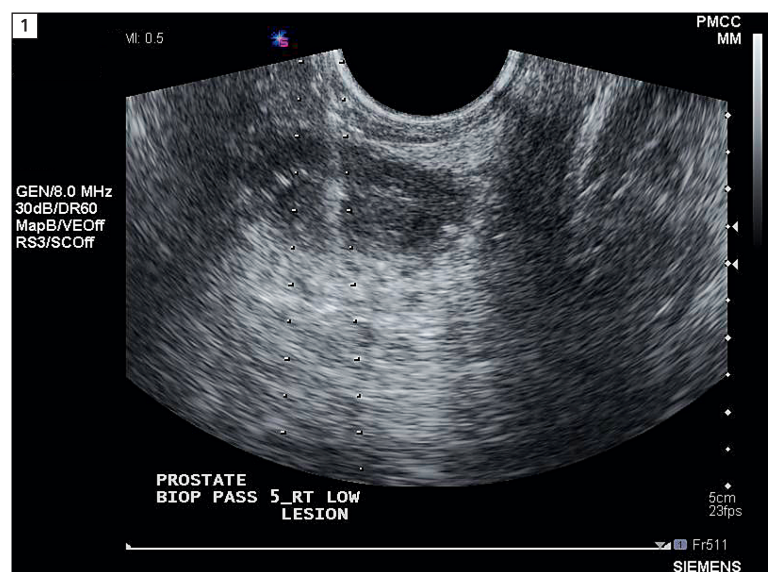
Case Report: Echo Planar Diffusion Imaging for Detection of Prostate Cancer Recurrence Otherwise Occult to Imaging

Sarah Foster, M.D.; Nick Ferris, M.D.

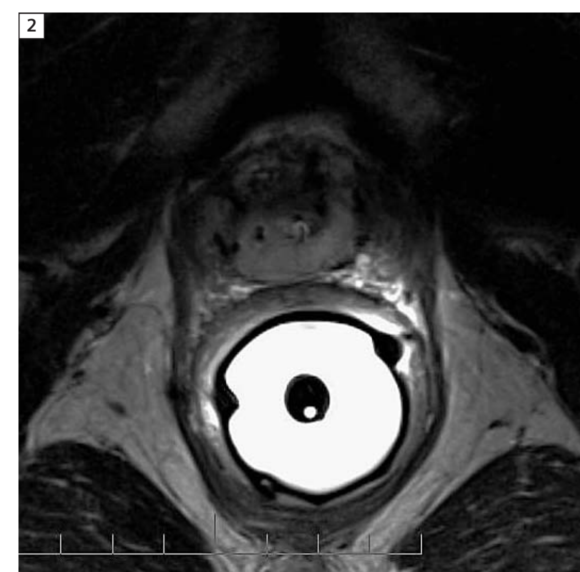
Department of Diagnostic Radiology, Peter MacCallum Cancer Center, Melbourne, Australia

Background

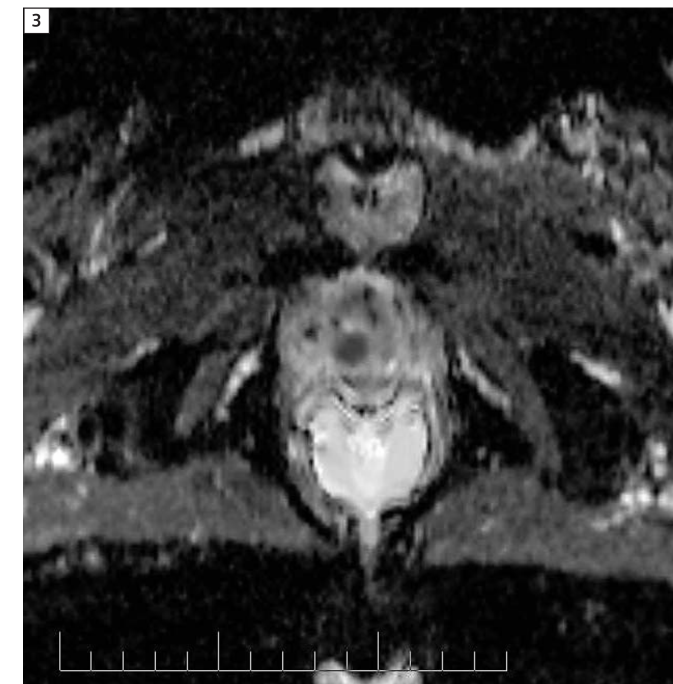
Imaging of the "post-treatment" gland for prostate cancer can be especially challenging. Treatment for non-operable prostate cancer includes various combinations of chemotherapy (anti-androgen therapy), targeted radiation therapy, and brachytherapy (implanted seeds).
The majority of prostate cancers arise from the peripheral zone. Normal tissue in the peripheral zone has higher signal intensity on T2-weighted imaging than the central, transitional and periurethral zones. Malignancy can be detected on MRI as a low signal region within otherwise high signal peripheral zone tissue.
The peripheral zone can, however, demonstrate focal or diffuse low signal in a number of clinical situations. Benign prostatic hypertrophy often results in a compressed peripheral zone which may have altered signal. Treatment for prostate cancer with anti-androgen therapy can result in diffuse low signal within the peripheral zone. Radiation therapy can also result in low signal, either diffusely or focally, depending on the radiation port. These changes are thought to reflect fibrous replacement of the normally glandular tissue. Additionally, brachytherapy seeds result in metallic susceptibility artifacts which obscure fine detail and can impair interpretation of certain MRI sequences, such as diffusion imaging or MR spectroscopy, within the prostate.
MRI of the post-treatment gland can thus be difficult, as areas of low signal may represent recurrent/residual disease, or merely be part of the spectrum of therapy change.
Ultrasound detection of prostate cancer can also be difficult in a hypertrophied gland due to the heterogeneity of tissue, making location of a discrete lesion challenging. Many lesions are ultrasound-occult.



1 TRUS guided biopsy.



2 T2-weighted TSE sequence.



3 ADC map demonstrating focal restriction of water diffusion.

4 High b-value image at b = 800 s/mm².

A dilemma thus arises when a post-treatment patient presents with an increasing PSA level, suspicious for recurrence. The imaging many times is not sensitive or specific enough to confidently locate the residual or recurrent disease location to help steer biopsy.
We are trialling diffusion-weighted MR imaging at 3T to aid in improving detection of disease recurrence. The theory is that highly cellular tumor tissue will demonstrate significantly restricted diffusion, compared with normal stromal and glandular tissue.

Case scenario

The patient presented with a rising PSA following brachytherapy for stage T2a N0 M0 Gleason 6 prostate cancer. The disease was initially located in the right apex of the gland. The patient had a repeat MRI for restaging.
We scanned the patient using the Siemens 3T MAGNETOM Trio.
Sequences included:

- T1 TSE transverse
- T2 TSE transverse, coronal and sagittal,
- EPI Diffusion transverse with b-values of 50, 400 and 800, TR 4200 ms, TE 85 ms, matrix 192/144, 4 mm slice thickness; ADC-maps were reconstructed automatically from these with the system software.

A region of significantly restricted diffusion was detected in the right apex of the gland. At T2-weighted imaging, only a subtle low signal focus could be seen at this site. The T2-weighted sequences alone would have been difficult to interpret, as the peripheral zone demonstrated diffusely low T2 signal intensity, as well as some artifact at the site of the brachytherapy seeds.
The patient went on to have ultrasound imaging of the prostate, which did not distinguish a focal lesion in the prostate apex.
The prostate was biopsied under ultrasound guidance with samples obtained from the base, mid portion and apex of the gland, with extra samples from the right apex to correlate with the abnormal region of restricted diffusion on MRI. The biopsy confirmed recurrent prostate adenocarcinoma within the right apex, as suspected from the MRI.

Conclusions

Diffusion-weighted imaging using the Siemens 3T MAGNETOM Trio was helpful in identifying disease which would otherwise have been occult to imaging. This helped guide a successful ultrasound-guided biopsy to confirm disease recurrence. This has significant implications for the patient's prognosis, and decisions regarding further treatment.
Diffusion imaging has its limitations. False positive results can occur in the setting of haemorrhage, infection or artifact from implanted metal. When the findings are taken in the correct clinical setting, however, diffusion-weighted imaging may be a powerful adjunct to the detection of residual or recurrent disease in prostate adenocarcinoma.

Contact
Sarah Foster, M.D.
Department of Diagnostic Radiology
Peter MacCallum Cancer Center
St Andrew's Place
East Melbourne, Victoria 3002
Australia
Sarah.Foster@petermac.org