MR Spectroscopic Imaging of Prostate Cancer

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Clinical History

- 71 year old man with elevated PSA (5.7 ng/ml)
- Biopsy showed GS 4+5 right midgland PZ
- MRI obtained for local staging
Post-biopsy Prostate Imaging

-Post-biopsy hemorrhage presents as high T1 signal intensity (SI) and low T2 SI, mimicking cancer (yellow arrows).

-T1 Halo Sign (white arrow): post-biopsy hemorrhage outlining the tumor (focal area spared of hemorrhage).
1.6 cm focus of restricted diffusion corresponds to the area that is suspicious on T1 and T2-weighted MR images (arrow).
- Parametric maps show a focal area of early enhancement and early washout that corresponds to the abnormality described on previous slides (arrows).
MR Spectroscopic Imaging

Selected Region: 95.12 cc
Size: 57.9 RL 40.9 AP 36.0 SI mm
Center: -0.1 RL -20.5 AP 8.6 SI mm

CSI Resolution: 0.04 cc
Size: 5.4 RL 2.7 AP 2.7 SI mm
Center: 2.6 RL -19.0 AP 7.4 SI mm

Metabolites displayed:
CH/Cr
C/C/G

1=Def Norm
2=Prob Norm
3=Equivocal
5=Def Abnor
A=Atrophy
U=Un-useable
B=Biop Art
MENU OFF

choline

citrate
Imaging Summary

- Right midgland posterior peripheral zone
- 1.6 cm circumscribed focus of low T2 SI
- No definite extraprostatic extension
- Better delineated on T1, DWI and DCE
- Marked restricted diffusion on the ADC map
- Early enhancement and rapid washout on DCE
- PI-RADS v2 = 5

- On MRSI, voxels located over the lesion demonstrate increased choline and decreased citrate peaks.
MRSI

- Provides metabolic profile of tissue within prostate
- **Choline** → elevated levels related to increased cell membrane turnover associated with neoplastic proliferation
- **Citrate** → Abundantly found in normal prostatic tissue
The Dow Jones analogy!

1 = probably benign
2 = possibly benign
3 = equivocal
4 = possibly malignant
5 = probably malignant

Uphill is good! Downhill is bad!
Benefits of MRSI

MRSI has been shown to improve:
- tumor localization, volume estimation, and grade
- detection of residual disease following radiotherapy

Controversy:
An ACR sponsored multicenter trial found that 1.5T MRI/MRSI does poorly at detecting or localizing small, low grade tumors.
Another study showed that DCE MRI can detect small, low grade prostate tumors with greater overall accuracy than MRI/MRSI.
Challenges of MRSI

Difficult technique
- requires specially trained technologists
- relatively long acquisition time
- requires endorectal coil

Reduced diagnostic accuracy in the setting of:
- small masses (<0.5cc)
- post-biopsy hemorrhage
Future Directions of MRSI

• Hyperpolarized C13
• Evaluation of metabolic activity based on enzymatic conversion
• Metabolic conversion of pyruvate into lactate is used to image cancer
• Measurement of lactate levels following injection of C13 labeled pyruvate may help to detect and characterize the aggressiveness of prostate cancer.
References