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Multimodal Magnetic Resonance Imaging and Spectroscopy for Prostate cancer Screening and Staging

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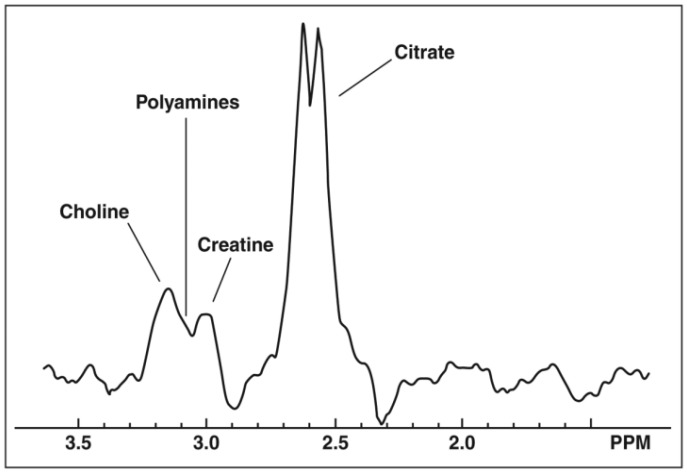
• Purpose

Prostate cancer screening and staging is important

Does mpMRI enhance clinical diagnosis?

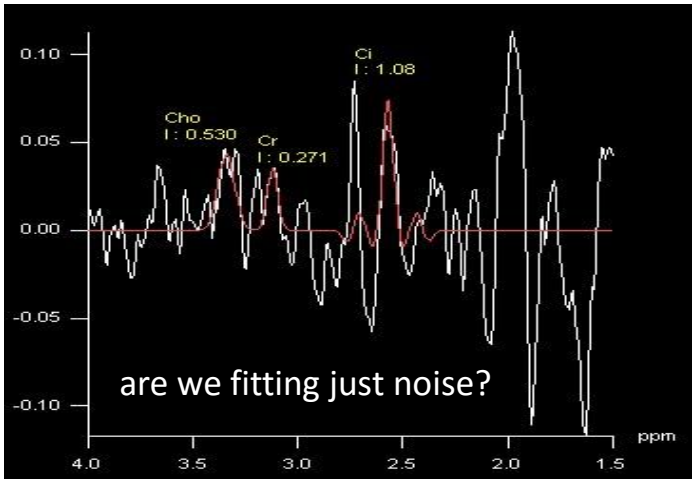
Existing protocols: How robust are they?



Good

Vs

bad spectrum



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• Purpose – Beyond T2w

Spectroscopy

- 🙂 detect chemical imbalances
- 🙂 PCa biomarkers
- 😕 complexity
- 😕 poor data quality
- 😕 robust biomarker quantification?

Diffusion

- 🙂 detect changes in cellularity
- 😕 Gaussian diffusion may be wrong
- 😕 low signal at high b-value
- 😕 EPI readout distortion

Perfusion

- 🙂 biomarkers of vascularization
- 😕 Gd contrast agents safety

Improve robustness of clinical protocol

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• Methods

MRSI

Spine & pelvic coil used (NO endorectal coil)

3D CSI spectra analysis using PRESS

(Cho + Cr)/Cit calculations with in house & scanner software

DWI

DWI images (20 slices) for 4 b-values (0-1000)

Vendor supplied EPI diffusion sequence used

Spine & pelvic coil used

• Results

Theory: (Cho + Cr)/Cit decreased for PC

Suspected malignancy

Patient	Mean Value (malignant)	Mean Value (healthy)
P041	1.998±1.532	2.858±0.861
P048	0.667±0.328	2.507±0.412
P051	0.580±0.415	5.900±2.620
P058	2.549±0.365	1.248±1.120

Patient	Mean Value (malignant)	Mean Value (healthy)
P041	0.684±0.737	0.631±0.096
P048	-	1.176±1.008
P051	0.248±0.359	0.567±0.187
P058	2.239±0.688	0.533±0.345

Non-suspicious / healthy

Patient	Mean Value (PP1)	Mean Value (PP2)	Average diff.
P042	2.319±2.296	1.193±1.802	2.221±2.193
P055	1.537±1.558	0.422±0.444	1.396±1.466
P065	1.632±0.605	0.649±0.679	1.377±0.520
P076	1.619±1.423	0.639±1.266	0.960±0.991

PP1: FFT + Gaussian fitting
PP2: PP1 + zerofiling, filter, baseline, phase, frequency
PP3: PP1 + filter, zero-filing
PP4: PP2

Results: above not consistent with theory

Highly dependent on post-processing

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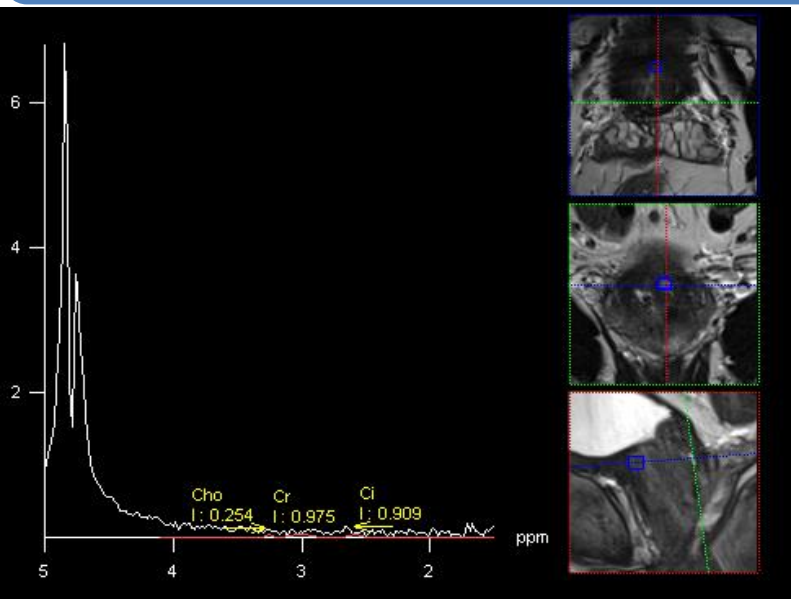
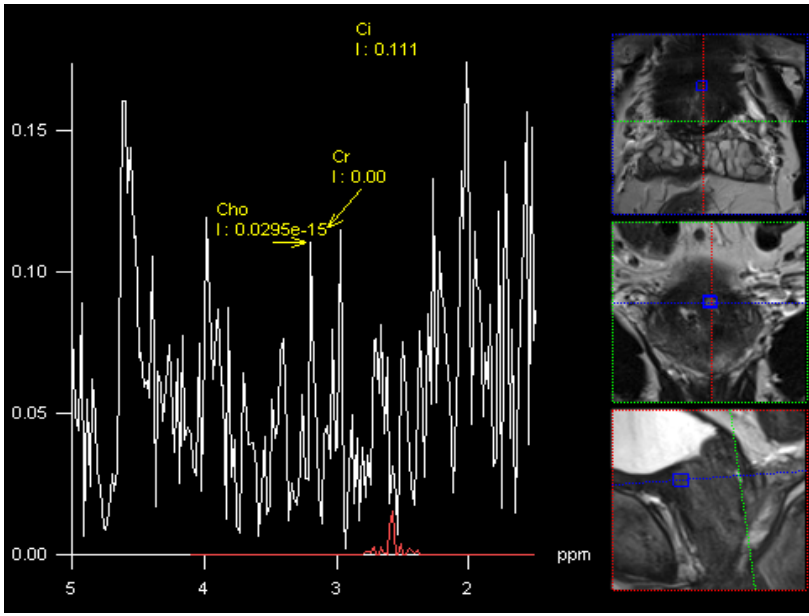
• Results - MRSI



- poor shimming and frequency non-resonant
- CHESS water suppression fails
- highly noisy spectra

Close up



- we are essentially fitting noise
- Biomarker values unreliable

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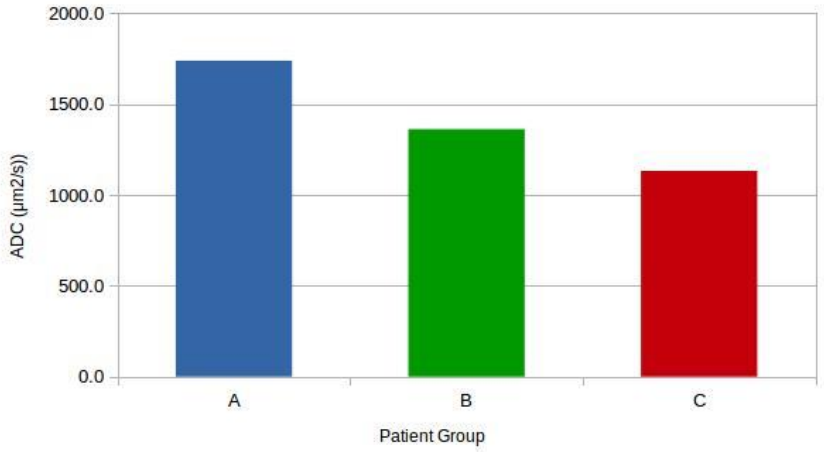
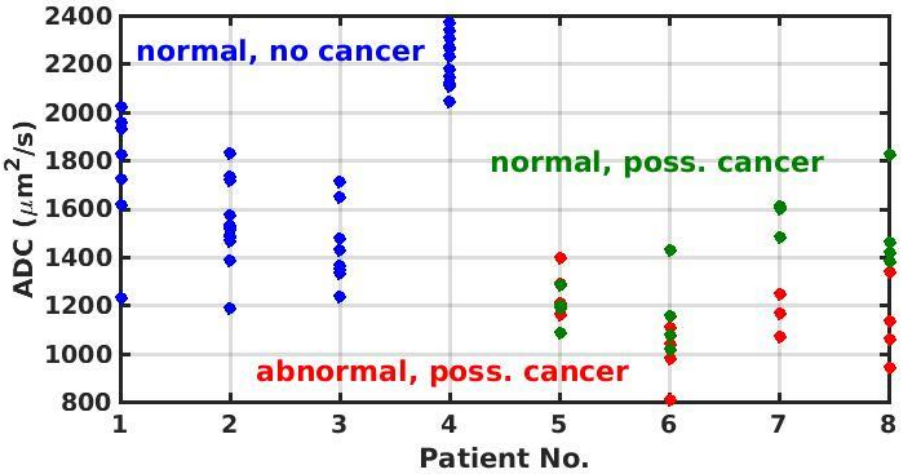
• Results - DWI

Theory: ADC decreases in PCa

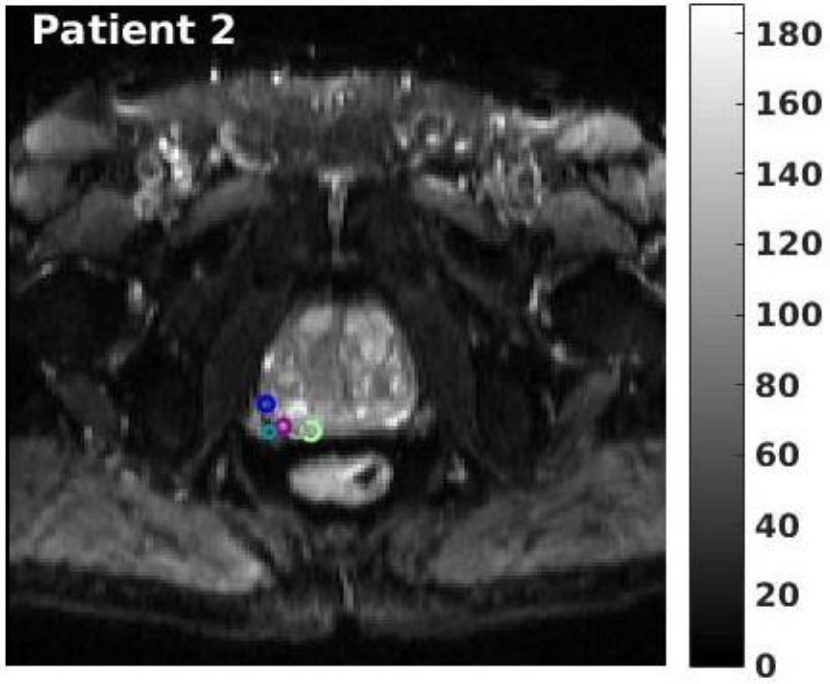
For the aggregate the results agree to theory

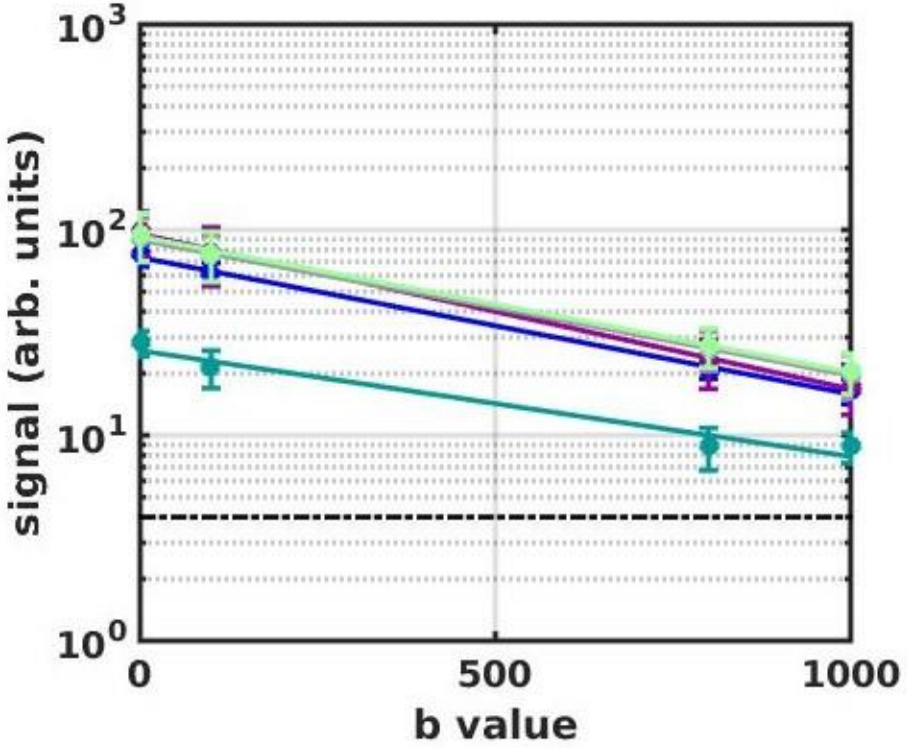




The more detailed analysis reveals a lot of variability

• Results - DWI





- No evidence of non-Gaussian diffusion at low b-values contrary to what has been observed in literature
- Mostly good SNR and decent linear fit

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• Conclusions

Existing clinical protocol needs improvement

- T2w images mainly used
- MRSI has potential but is currently unreliable for biomarker quantification in clinical settings
- DWI data have high SNR ratios and good linear fits
- Dynamic Contrast Enhancement could add more diagnostic value