Crossing the Disciplinary Divide - To Chase The Phantom of Bladder Permeability

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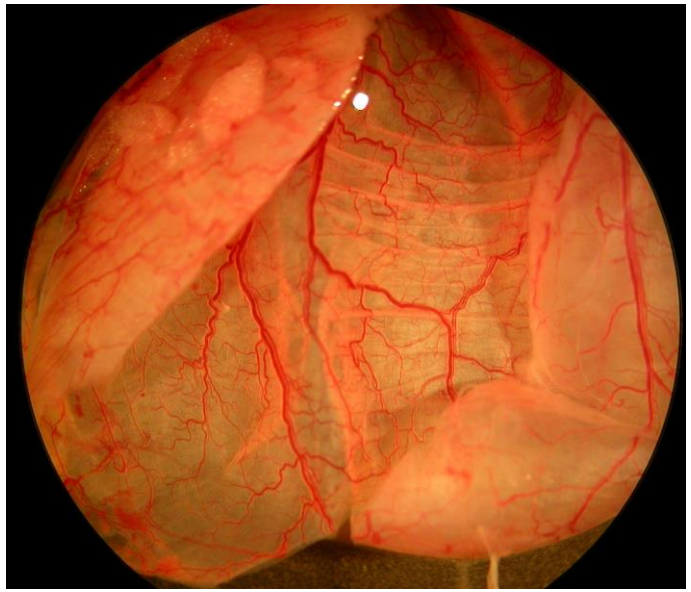
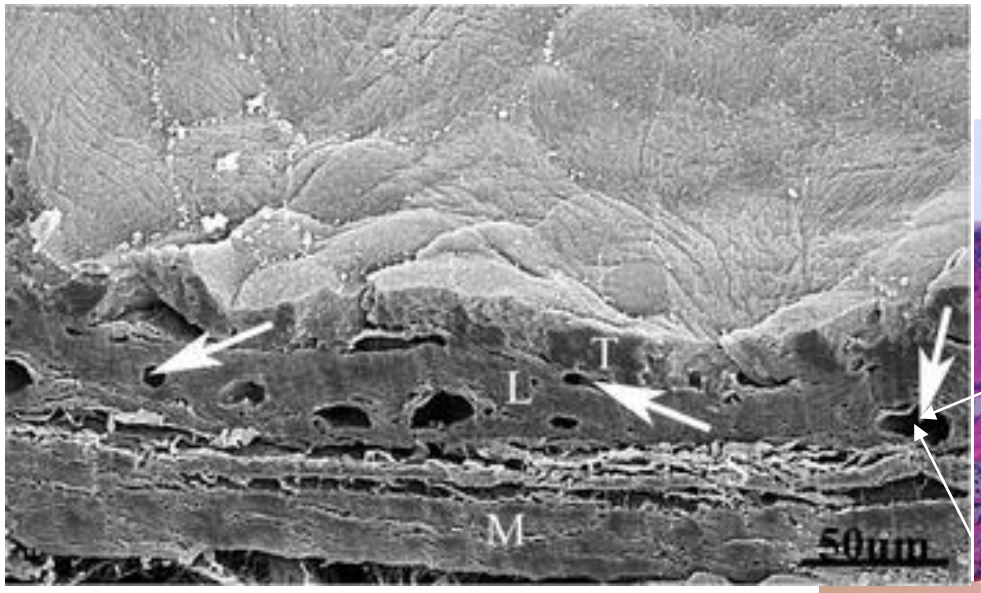
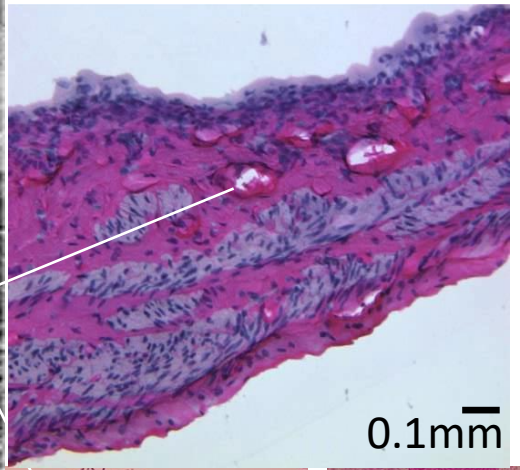
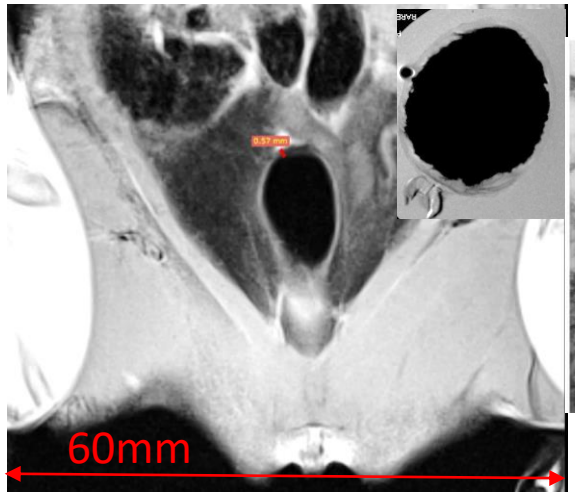
Bladder Wall Architecture & Permeability

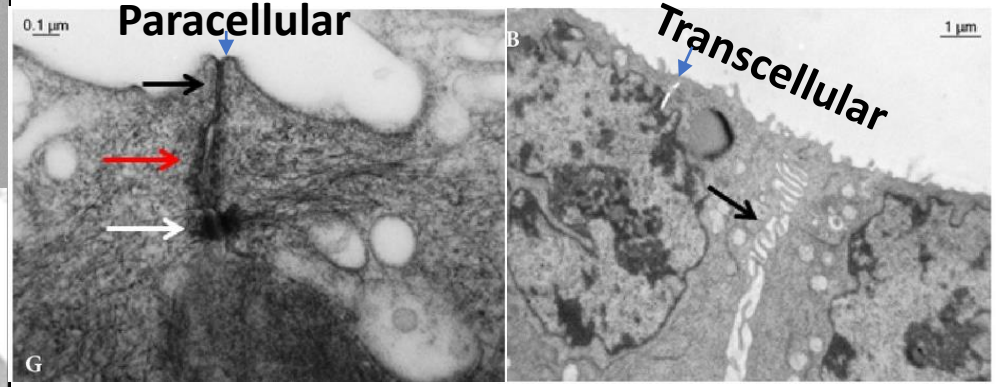
- Conc. In **Blood ?**
- Conc. In **Bladder**





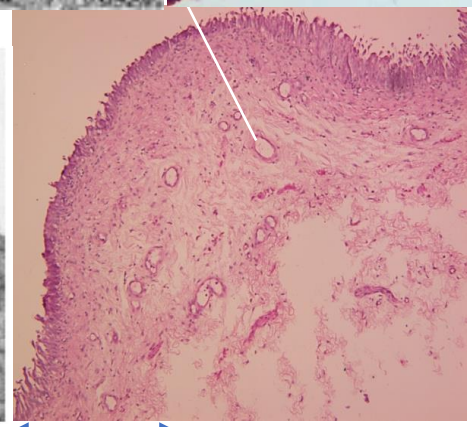


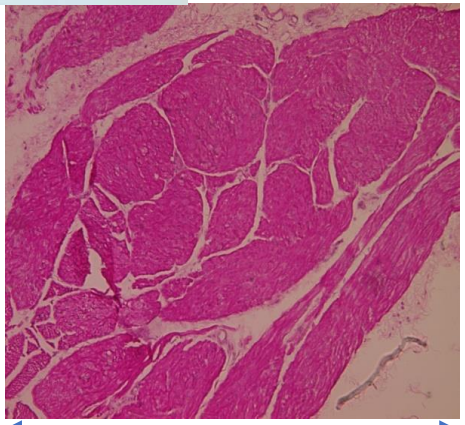




Normal

Diseased





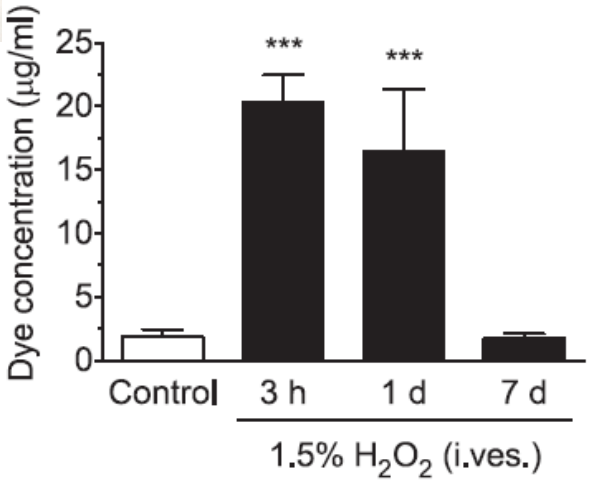
Microsc Microanal. 2013;19(6):1428-35. BJU Int. 2015 Sep;116(3):468-77.

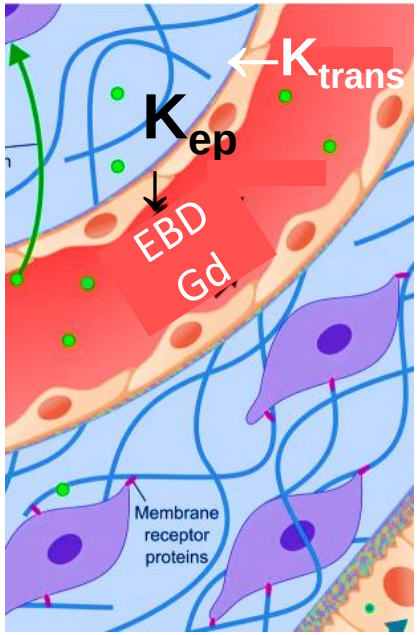
Why Cross the Disciplinary Divide ?

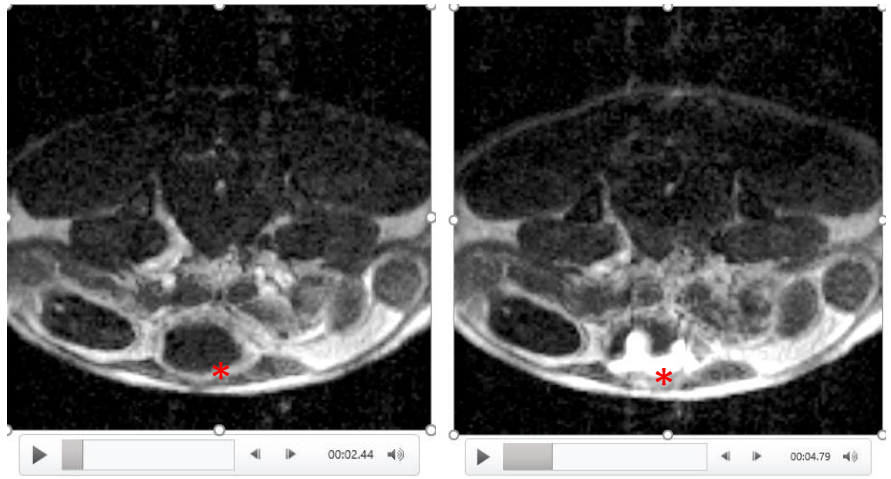
Evans blue dye EBD

Paracellular 961 Daltons

A) Urothelial permeability

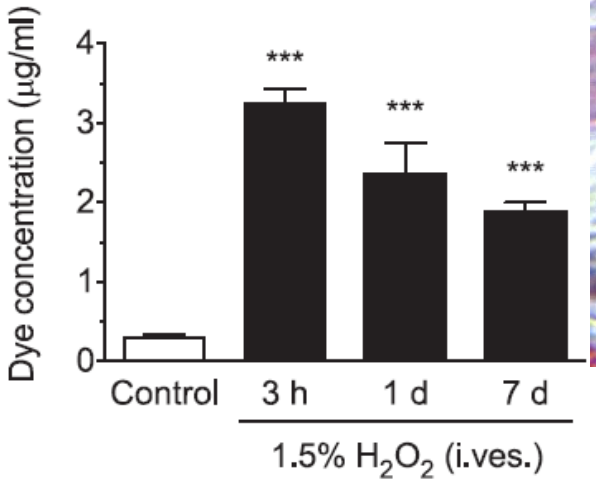


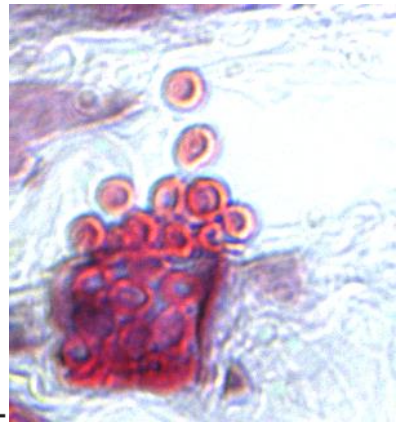


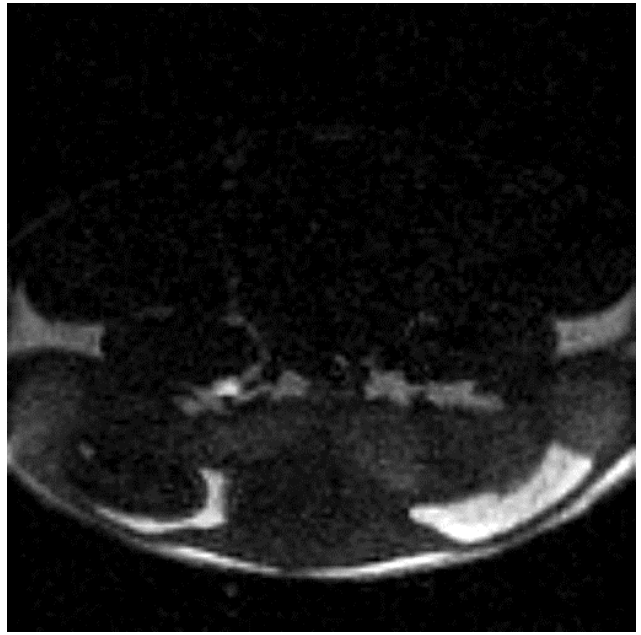


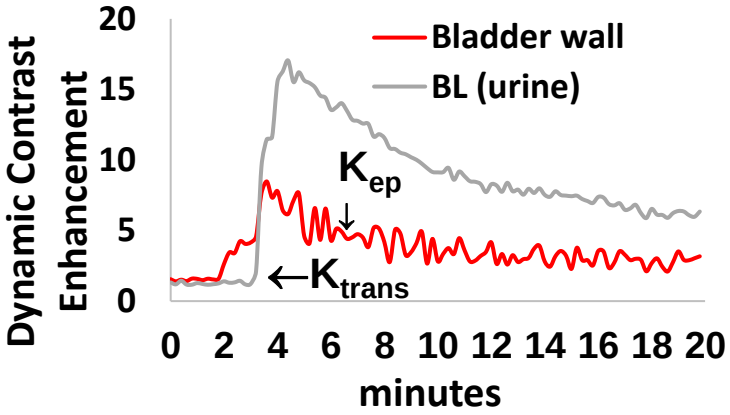
Gadobutrol
607 Daltons
Paracellular

B) Vascular permeability



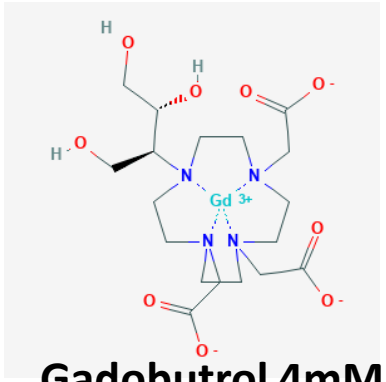




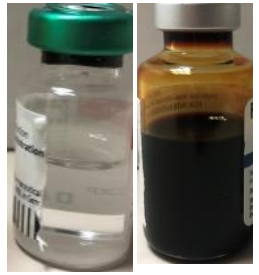


Homan et al J Pharmacol Sci, **121:** 327, 2013;

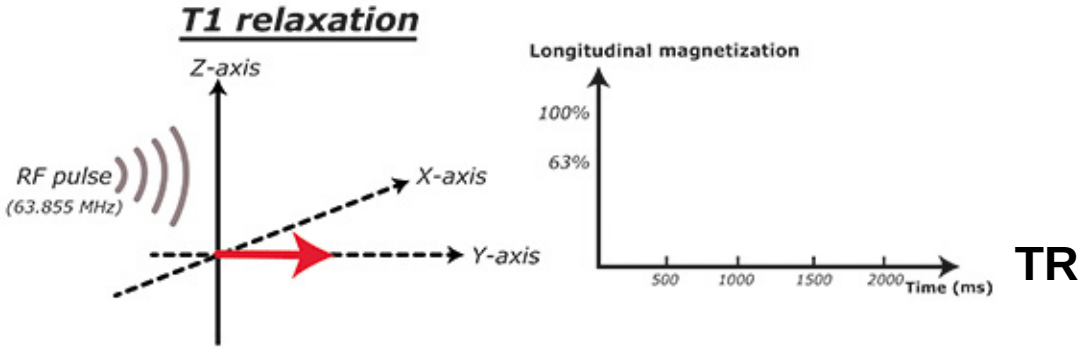
Instillation of Gadobutrol Mixture



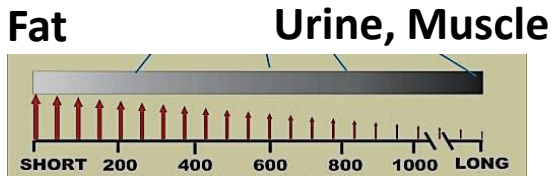
Gadobutrol 4mM
607 Daltons



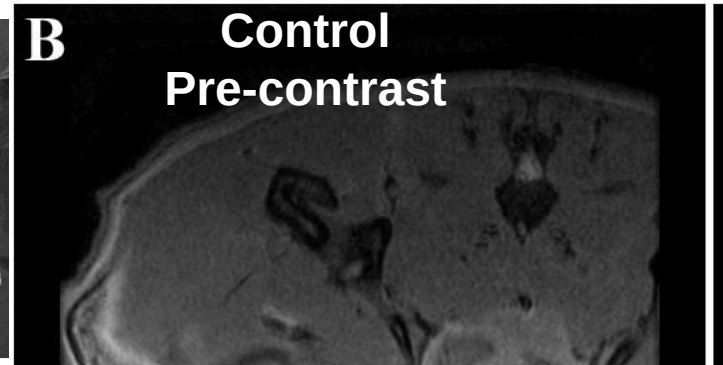
+ Ferumoxytol 5mM
731 KiloDaltons

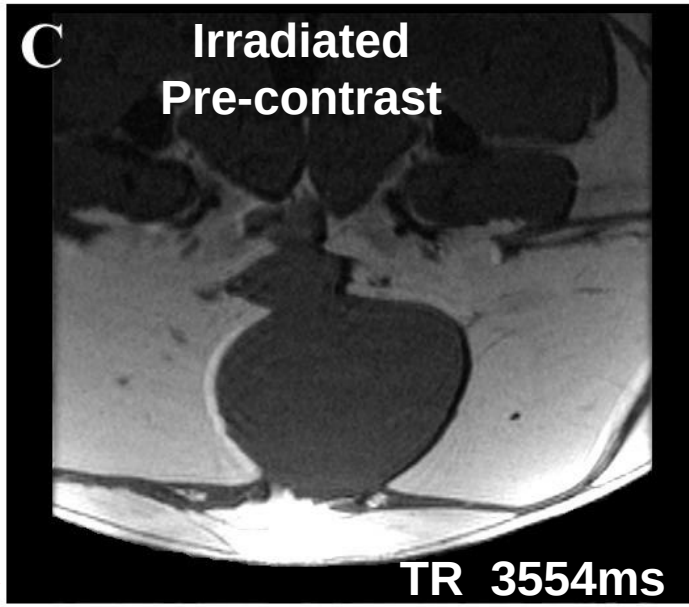


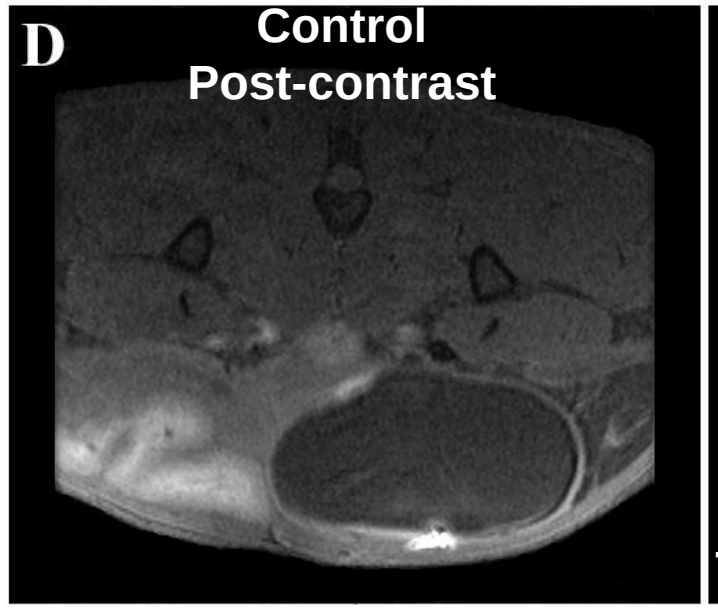
TR

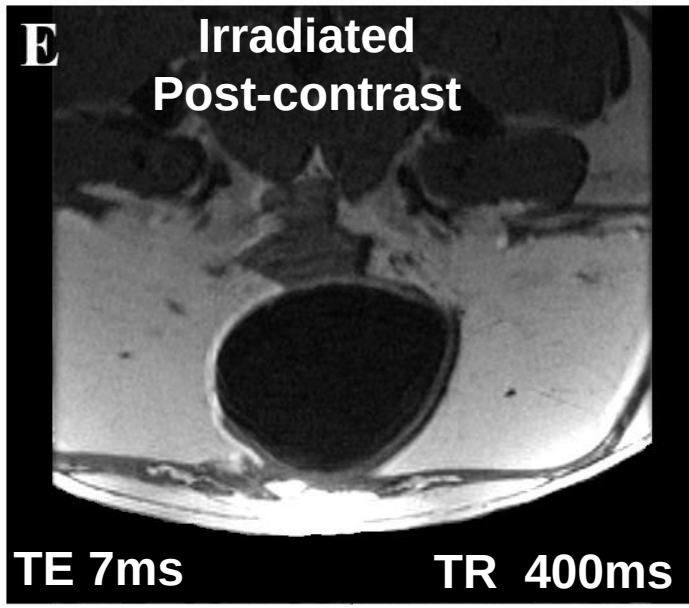


$$S=M_0(1-e^{-TR/T1}).e^{-TE/T2}$$





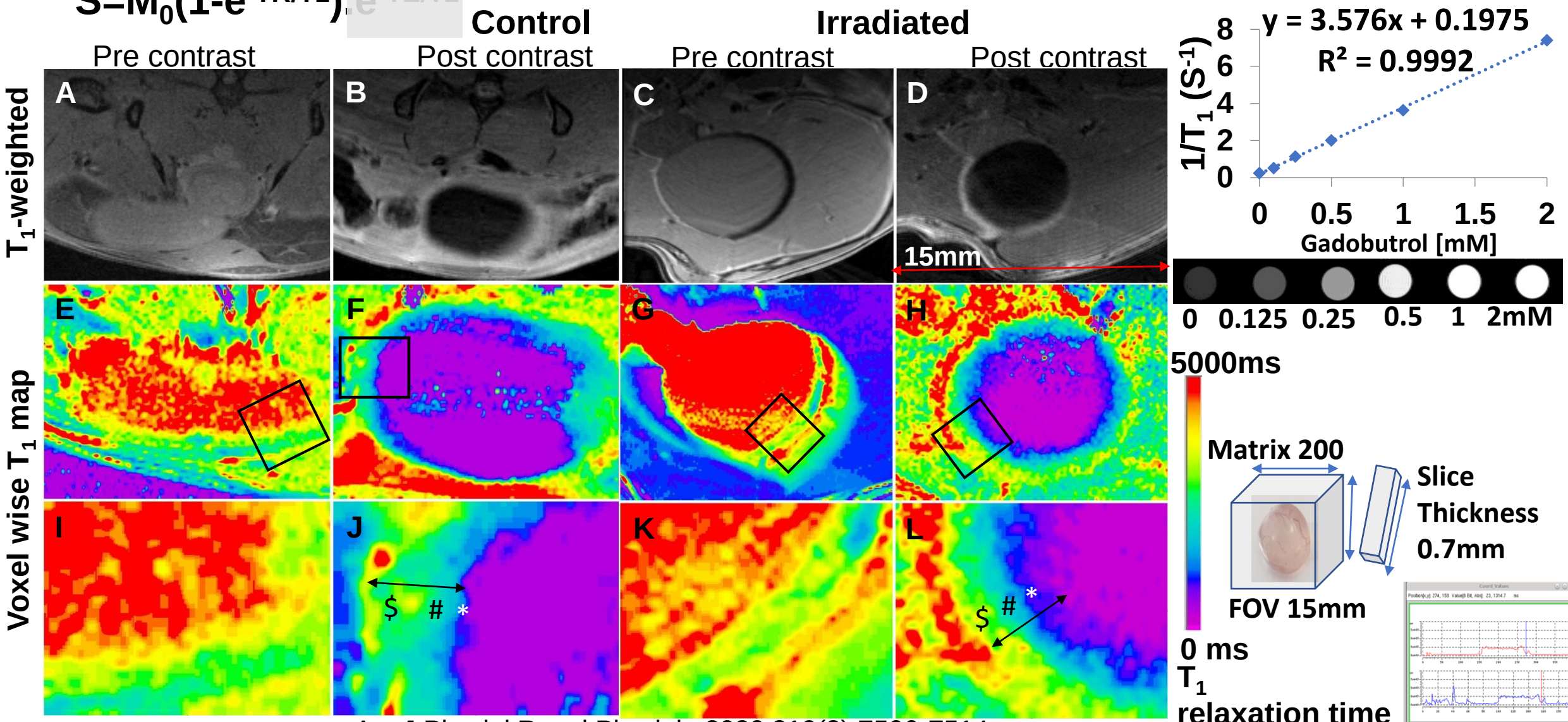




https://www.startradiology.com/the-basics/mri-technique/index.html; Am J Physiol Renal Physiol. 2020;319(3):F506-F514

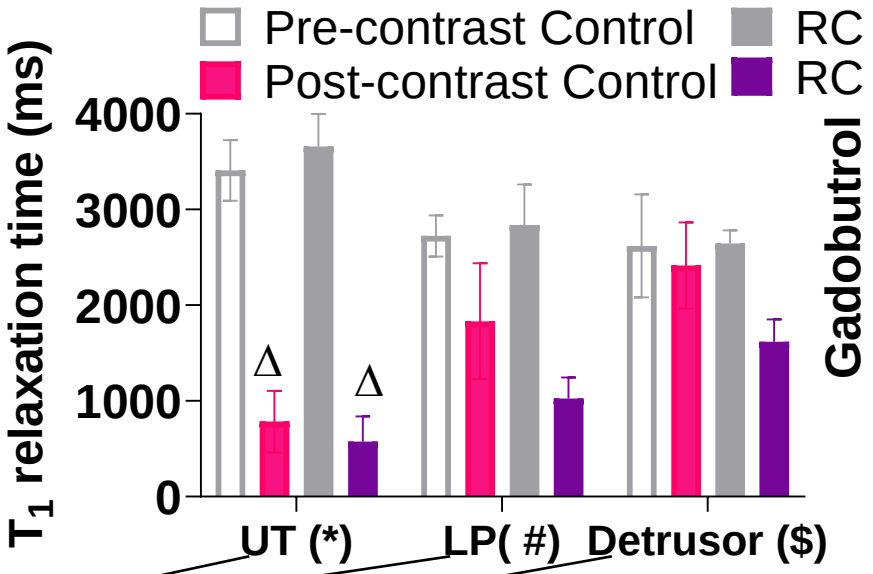
Voxel-wise T_1 mapping at 9.4T

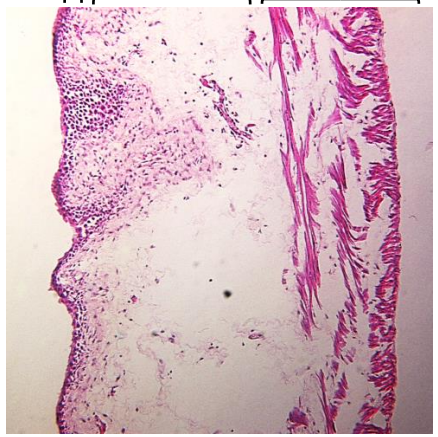
$S=M_0(1-e^{-TR/T1}).e^{-TE/T2}$

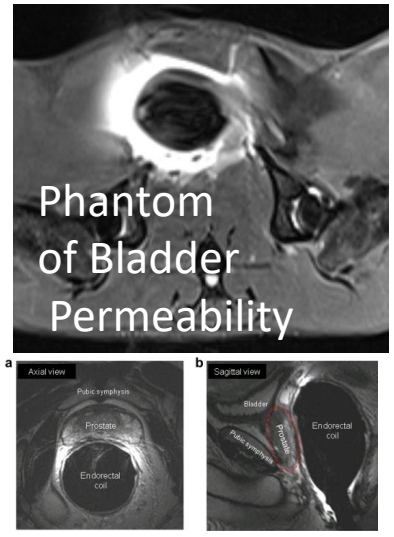


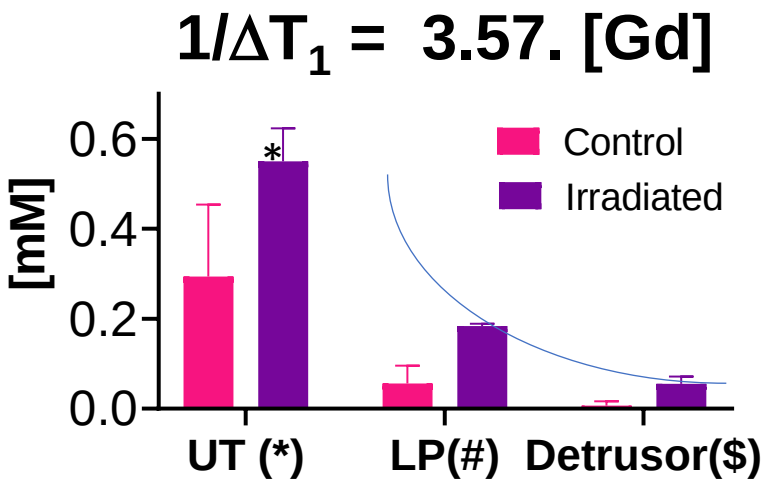
Am J Physiol Renal Physiol. 2020;319(3):F506-F514

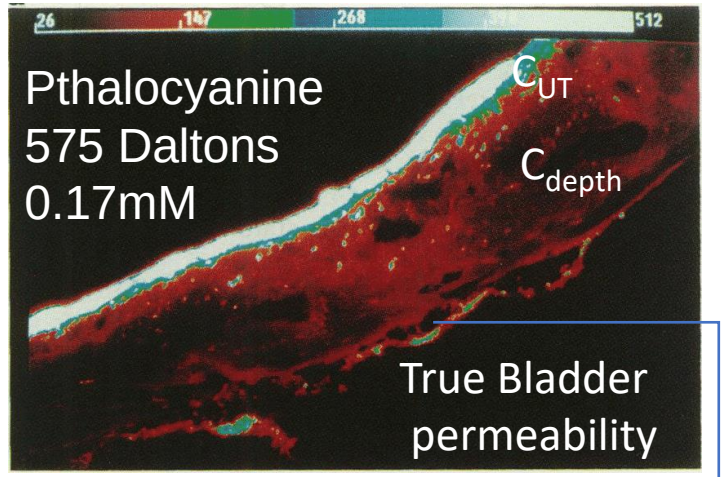
Data Mining for Permeability Assay

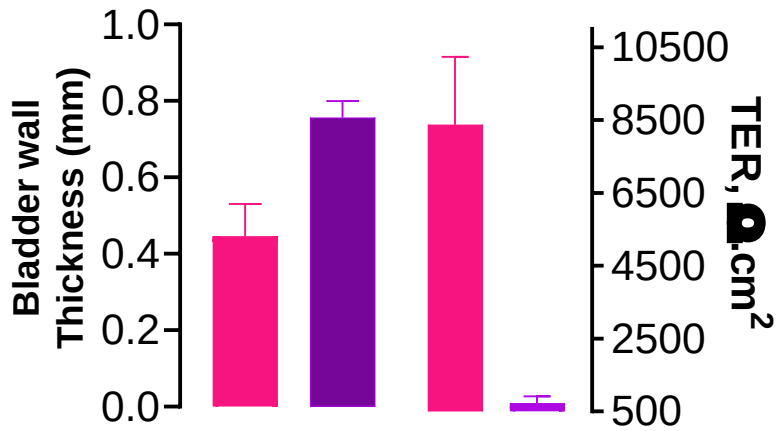


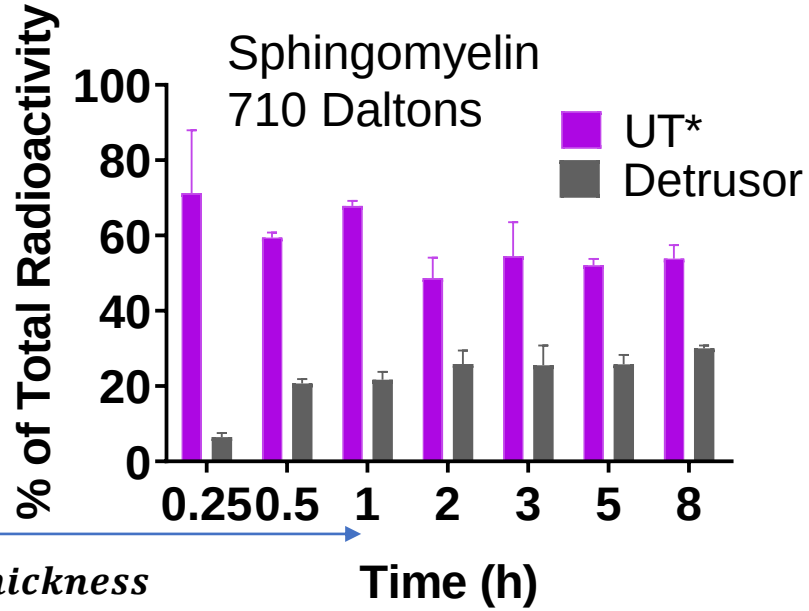






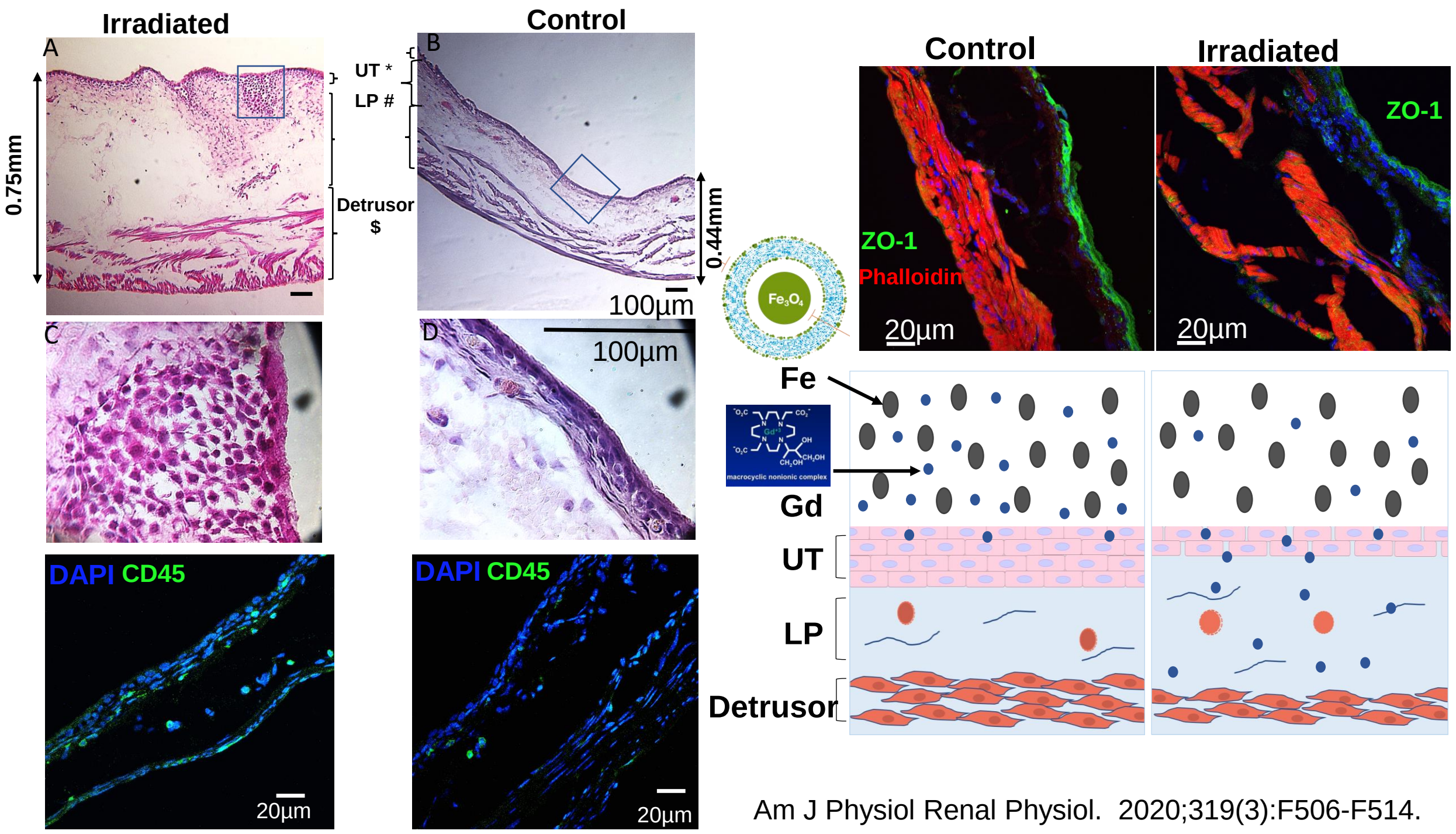






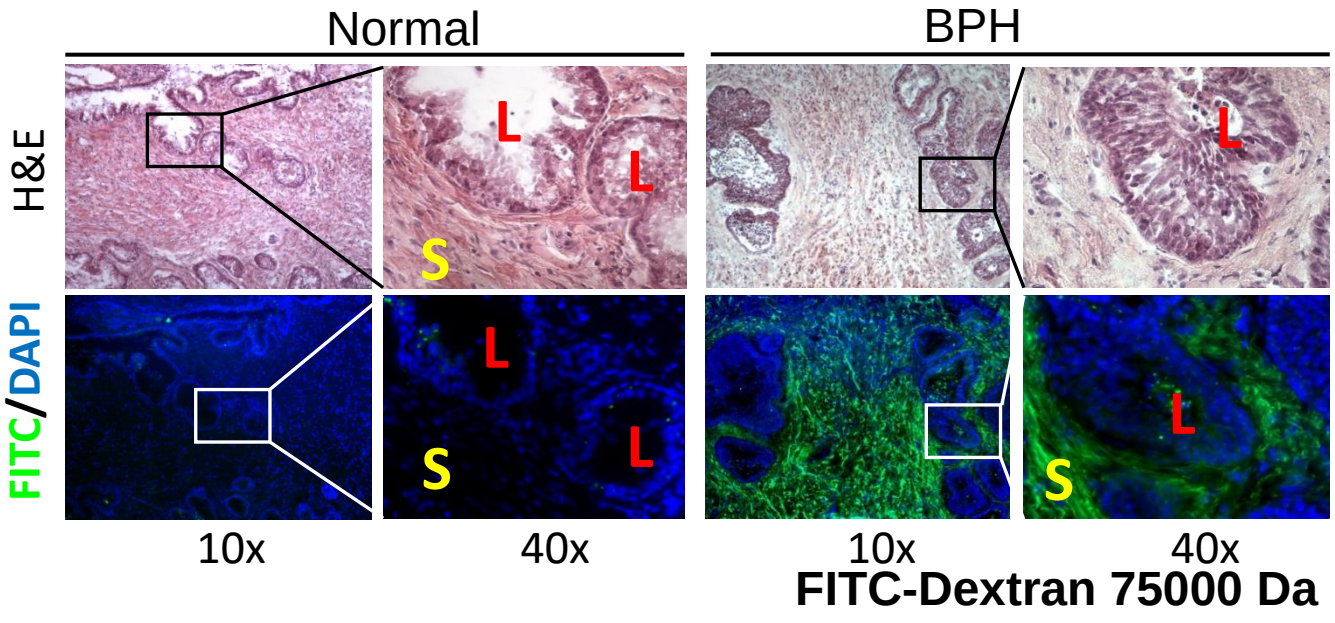
$$C_{Depth} = (CUT - Cb)\, e^{-\frac{0.693}{\frac{w1}{2}} UT\ thickness} + Cb$$

Br J Cancer 1991; **64**(5):875-879. Brachytherapy. 2013;12(1):30-7. *Cancer research* 1993; 53: 3314-20. *J Urol* 2008, **179**(4S):62

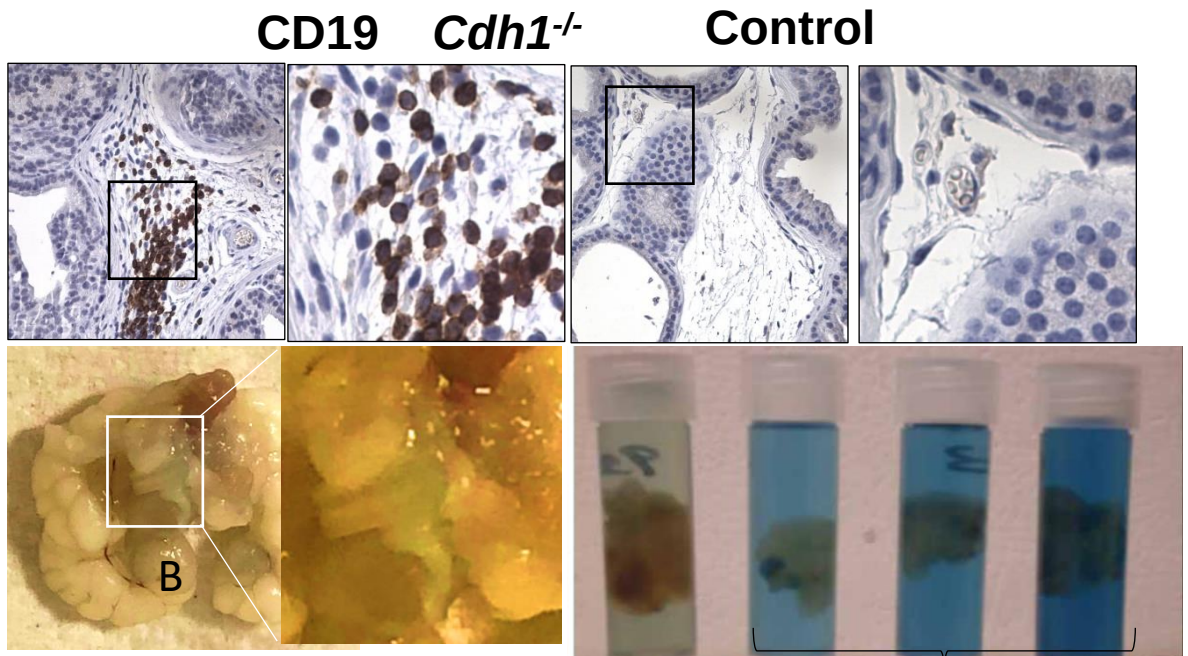


Am J Physiol Renal Physiol. 2020;319(3):F506-F514.

Bladder To Prostate (BPH)



FITC-Dextran 75000 Da



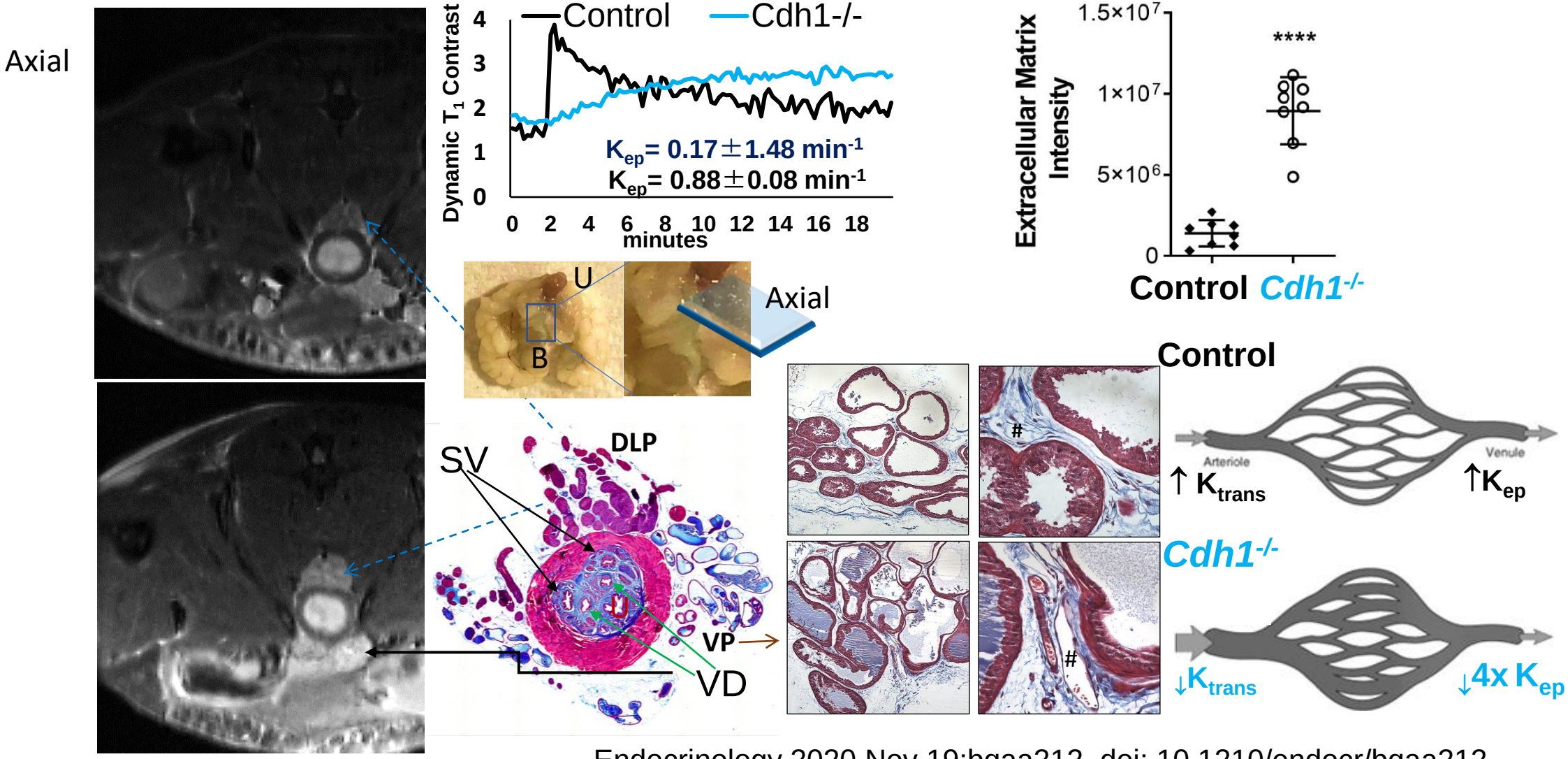
Evans blue dye 961Da + Albumin 69000Da

Prostate-specific deletion of Cdh1 induces murine prostatic inflammation and bladder overactivity- Endocrinology

- What comes first- prostatic inflammation or prostatic permeability ?
- What is the effect of molecular targeted drugs on PI and permeability ?
- Clinical feasibility of MRI based permeability assay using gadolinium analog?

Endocrinology 2020 Nov 19:bqaa212. doi: 10.1210/endocr/bqaa212.
Eur Urol. 2007;51(4):1119-27

Replace EBD with Gadobutrol Injection at 7T



Endocrinology 2020 Nov 19:bqaa212. doi: 10.1210/endocr/bqaa212.

Conclusions

- Crossing the disciplinary divide can virtually predict histology and function of diseased bladder and prostate
- Voxel-wise T_1 mapping can be a potential pain-free alternative to PST and biopsy of BPS/IC patients
- mpMRI for prostate cancer- when tweaked with basic research insights can advance our understanding of BPH/LUTS

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NIA- AG062971