Accuracy of multiparametric MRI for mapping prostate cancer by Gleason score

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Target audience: Radiologists, radiation oncologists

Purpose: To assess prospectively the ability of multiparametric (mp) MRI to map intraprostatic adenocarcinoma (Pca) of varying Gleason scores and to independently assess the mapping accuracy of the individual components of mp-MRI.

Methods: *Patients:* Twenty-two consecutive patients with histologically-proven Pca had mp-MRI of the prostate performed at 3.0 T before prostatectomy. *MRI:* T2w images were acquired using a respiratory-triggered, fat-saturated fast spin echo sequence (TE=92 ms, echo train length 14, FOV=22 cm, matrix 416x224, slice thickness 4 mm). DW-images were acquired using reduced-FOV single-shot echo-planar imaging (b-values 0, 50, 100, 200, 400, 800, and 1600 s/mm with 2, 4, 8, 12, and 12 excitations, respectively, TR/ET = 4000 ms/67 ms, FOV=20x10 cm, matrix 128x64, 5mm slice thickness).[1] Dynamic contrast-enhanced (DCE) images were acquired using a differential subsampling with Cartesian ordering method (TR/TE = 4.3 ms/1.9 ms, FOV 30 cm, matrix 256 x 256, 2x2 acceleration, 1.6 mm slice thickness, 2.8 s temporal resolution).[2] *Tumor delineation*: Three radiologists blinded for histology delineated probable tumor based on mp-MRI, and on T2w, DCE, diffusion-weighted imaging (DWI) (b800, b1600), and apparent diffusion coefficient maps separately. The zonal boundary of the prostate was delineated on T2w by an independent fourth radiologist and the outlines were handed to the pathologist who delineated the true tumor on these outlines and assigned a Gleason score. *Data analysis:* Delineations on MRI were registered with histopathology tumor maps to assess correlation and agreement of tumor volumes, and true/false negative/positive fractions of the volumes delineated on MRI. Interrater reliability was assessed by calculating intraclass correlation coefficients. Significant tumor was defined as Gleason score ≥4+3, the rest was classified as non-significant tumor.

Results: Two patients were excluded from analysis due to artifacts from a hip prosthesis obscuring part of the prostate (*n*=1) and cancellation of prostatectomy (*n*=1). In the remaining 20 patients, mp-MRI slightly overestimated the volume of significant tumor with a strong correlation and a fair to good agreement (r=0.73, mean bias 1.42 ml, 95% limits of agreement -5.68 – 8.54 ml, ICC 0.63). The mean overlapping significant tumor volume fractions were 25% for T2, 45% for b800, 45% for b1600, 43% for ADC, 42% for DCE, and 47% for mp-MRI (Fig. 1 and Fig. 2). Interrater reliability for overlapping tumor volume fraction was excellent, with an ICC of 0.76 (95% CI 0.57 – 0.88).

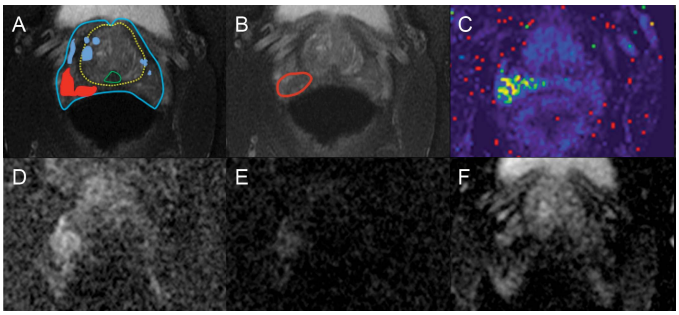

Figure 1. Tumor outline on pathology (A) registered to tumor outlined on mp-MRI (B). There is overlap for high grade tumor (red area in A) and no overlap for lower grade tumor (blue areas in A).Overlap with significant tumor was 36% in this case. B = T2w, C = DCE, D = B800 DWI, E = B1600 DWI, F = ADC map

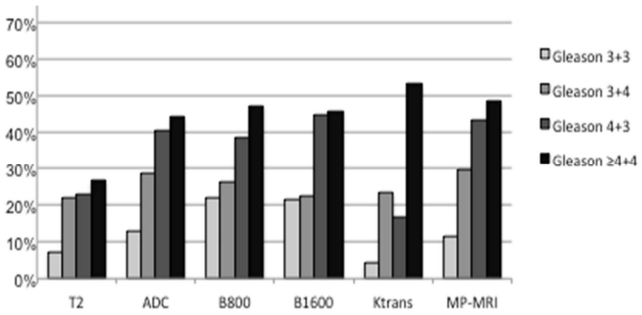

Figure 2. True positive ratio (overlap) for different sequences and different Gleason scores.

Conclusion: All sequences were much more accurate in imaging higher grades (significant tumor) than lower grade tumor. DWI and ADC maps were most accurate in imaging PCa overall, and DCE imaged higher grade tumor most accurately. T2W gave poorer results than either DWI or DCE. The multiparametric approach resulted in only marginally better results than DWI in this study.

References:
[1] Saritas EU, et al. Magn Reson Med 2008 60: 468-473. [2] Saranathan M, et al. J Magn Reson Imaging 2012 35: 1484-1492.

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