Imaging/Radiology: Uroradiology II

Podium 22

Saturday, April 29, 2023   **3:30 PM-5:30 PM**

PD22-01

THE GLIMPSE STUDY: GLOBAL VARIATION IN THE QUALITY OF MULTIPARAMETRIC MAGNETIC RESONANCE IMAGING OF THE PROSTATE FROM THE PRIME TRIAL

Aqua Asif*, Alexander, NG; Francesco Giganti, Vinson Wai-Shun Chan, Marimo Rossiter, Arjun Nathan, Pramit Khetrapal, Louise Dickinson, Shonit Punwani, Chris Brew-Graves, Alex Freeman, Mark Emberton, Caroline M. Moore, Clare Allen, Veeru Kasivisvanathan, Prime Quality Improvement Group, London, United Kingdom

INTRODUCTION AND OBJECTIVE: Multiparametric MRI (mpMRI) is standard-of-care in patients with clinical suspicion of prostate cancer (PCa). However, there is still high variability in MRI quality. We aim to offer the first global 'GLIMPSE' into prostate mpMRI quality variation, analysing data from the PRIME Trial, and to determine whether basic modifications to MRI protocols could optimise diagnostic quality.

METHODS: PRIME is a prospective, international, multicentre, level 1-evidence diagnostic study. It aims to recruit 500 men to evaluate whether biparametric MRI is non-inferior to mpMRI in detecting clinically significant PCa. For each scanner, centres were invited to submit 5 consecutive MRI scans of patients with suspected PCa, the detailed MRI protocol, PI-RADS v2.1 scores and pathology results. These were evaluated in consensus by 2 expert radiologists, blinded to the MRI and biopsy results. MRI quality was assessed for each scanner using the PI-QUAL scoring system — a Likert scale using PI-RADS v2.1 recommendations and each MR sequence (DWI, T2-WI and DCE). A PI-QUAL score 5/5 means the scan is of optimal diagnostic quality, using all 3 sequences; 3/5 means at least 2 sequences together are of this, whilst 1/5 means all sequences are below the minimum standard. Feedback was provided for scanners not reaching PI-QUAL 5 to improve MRI quality and centres were invited to resubmit new images using modified protocols for re-evaluation.

RESULTS: 66 centres from 22 countries across 5 continents expressed an interest to take part in PRIME, 42 (64%) of which took part in the GLIMPSE study. 391 scans from 71 different scanners were evaluated, 54 (76%) were 3T systems, and 5 (7%) used an endorectal coil. On initial review, 9/71 (13%) scanners scored PI-QUAL 3, 39/71 (55%) scored PI-QUAL 4 and 23/71 (32%) scored PI-QUAL 5. All scanners were of adequate diagnostic quality for T2-WI and DWI sequences, whilst only 58/71 (82%) were for DCE sequences. Recommendations were primarily made for DCE sequences (62%, 44/71), followed by DWI (35%, 25/71) and T2-WI (25%, 18/71). After feedback and modifications, MRI quality increased on final review with 62/71 (87%) of scanners reaching PI-QUAL 5 compared to only 32% at initial review.

CONCLUSIONS: The GLIMPSE Study offers the first global overview into prostate MR image quality variation. Initial MRI quality was fair, with room for improvement, particularly with DCE imaging. With basic changes in-line with PI-RADS recommendations, global MRI quality can be easily improved.

PD22-02

HISTOPATHOLOGY-INFORMED RADIOLOGY BIOMARKERS IMPROVE ARTIFICIAL INTELLIGENCE-BASED DETECTION OF AGGRESSIVE PROSTATE CANCER ON MAGNETIC RESONANCE IMAGING

Indrani Bhattacharya*, Stanford, CA; Karin Stacke, Linköping, Sweden; Richard Fan, James Brooks, Mirabela Rusu, Geoffrey Sonn, Stanford, CA

INTRODUCTION AND OBJECTIVE: Artificial Intelligence (AI) methods for aggressive prostate cancer detection on Magnetic Resonance Imaging (MRI) can help standardize radiologist interpretations. However, existing methods are often inaccurate, partly due to the use of radiology features alone without considering histopathology. Histopathology images contain definitive information about the presence and aggressiveness of cancer. Identifying correlations between radiology and histopathology images of the same tissue enables understanding the radiologic appearance of cancer and the discovery of histopathology-informed radiology biomarkers that emphasize cancer features, improving aggressive prostate cancer detection.

METHODS: We developed an AI system that uses correlation learning to identify histopathology-informed MRI biomarkers using MRI and histopathology images of patients who underwent radical prostatectomy. The learned histopathology-informed MRI biomarkers are then used by the AI system to selectively identify and localize aggressive and indolent prostate cancer on MRI. Once trained, these MRI biomarkers can be extracted in new patients without pathology, aiding clinical diagnosis. We trained the system using 75 patients who underwent radical prostatectomy, and 24 patients with normal prostates (no cancer on biopsy). We evaluated the system on a lesion level using 40 patients who underwent radical prostatectomy. True positives were assessed using ground truth lesion outlines, while false positives were assessed using prostate sextants without cancer.

RESULTS: Our proposed system improved aggressive prostate cancer detection over a baseline method without histopathology-informed MRI biomarkers (ROC-AUC: 0.90 ± 0.22 vs. 0.86 ± 0.28), correctly detecting 94% of aggressive cancers, while correctly predicting 51% of negative sextants as cancer-free. The system had fewer false positives and better overlap with cancer labels than the baseline method.

CONCLUSIONS: MRI biomarkers that correlate with histopathology images emphasize aggressive cancer features and improve detection on MRI. These biomarkers can be identified from radiology and histopathology images, and do not need histopathology images during testing, making them clinically useful.
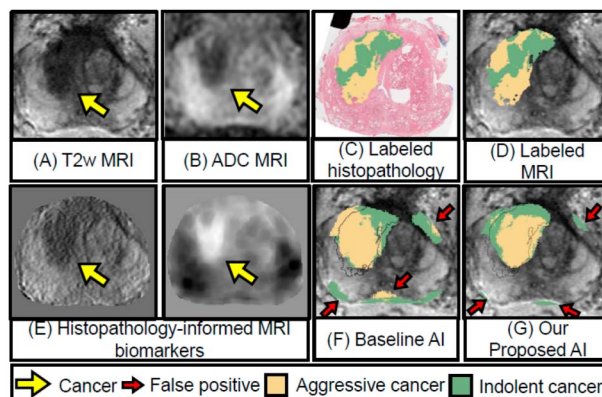

Figure: Histopathology-informed radiology biomarkers (E) emphasize cancer on radiology images, with cancer tissue having less texture variations than normal tissue. These biomarkers are identified by learning correlations between radiology (A-B) and corresponding histopathology images (C). Our proposed AI system incorporating these MRI biomarkers (G) and trained with labels mapped from histopathology onto MRI (D), reduces false positives and improves aggressive prostate cancer detection over a baseline system without these biomarkers (F).