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AI-Assisted Detection and PI-RADS Classification: Current Status

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This lecture reviews the current status of AI-assisted lesion detection and PI-RADS classification in prostate MRI. In patients undergoing prebiopsy MRI, interreader variability remains a key limitation, and the management of indeterminate PI-RADS 3 lesions is particularly controversial. This has motivated growing interest in AI as a potential triage tool or second reader. AI models in this space vary widely: some use bpMRI while others use full mpMRI, and outputs range from lesion detection to binary risk classification (PCa vs. non-PCa, ciPCa vs. csPCa) to multiclass prediction based on PI-RADS or ISUP grade.

A systematic review of 29 studies (2019–2023), mostly retrospective and single-center, using T2WI and DWI/ADC as primary inputs, reported sensitivities of 56.1–96% and specificities of 31–87.1% for csPCa detection, varying by threshold, dataset, and reference standard. Several deep learning models achieved performance comparable to PI-RADS ≥4 assessments, showed noninferior sensitivity to radiologists against whole-mount histopathology, and outperformed general or junior readers. AI assistance has also been shown to reduce PI-RADS 3 assignment rates, lower interreader variability, and shorten reading time—benefits most pronounced among less experienced readers.

The PI-CAI challenge, the largest validation study to date (62 radiologists vs. numerous international AI submissions), found that an ensemble of the top five algorithms outperformed the average radiologist at a PI-RADS ≥3 threshold (PPV 68.0% vs. 53.2%; NPV 93.8% vs. 90.2%), though it narrowly missed noninferiority against expert readers (specificity 68.9% vs. 69.0% at matched sensitivity). A follow-up study of 61 readers found that AI assistance improved AUC from 0.882 to 0.916, with gains in both sensitivity and specificity, again greatest among nonexpert readers.

Finally, the bpMRI-vs-mpMRI debate is addressed: many algorithms perform well without DCE, and bpMRI may offer accuracy comparable to mpMRI, though the added value of DCE for lesion detection and reader confidence remains debated. Given the practical advantages of bpMRI—shorter scan time, lower cost, and avoidance of gadolinium-related concerns—AI-assisted csPCa detection is expected to play an increasingly important role in future prostate MRI workflows.

Keywords: *Prostate MRI, Artificial intelligence, PI-RADS*