
Optimising Prostate Cancer Diagnosis with MRI-Based Risk Stratification



Prostate cancer is one of the most common malignancies among men, and early detection is crucial for optimising treatment outcomes. However, a major challenge in prostate cancer diagnosis lies in distinguishing clinically significant prostate cancer (csPCa) from indolent cases that may not require immediate intervention. Traditional diagnostic methods, such as prostate-specific antigen (PSA) testing and digital rectal examination (DRE), have limitations, often leading to unnecessary biopsies or missed diagnoses.

Magnetic resonance imaging (MRI) has increasingly been integrated into risk stratification protocols to improve diagnostic accuracy and guide biopsy decisions. The Prostate Imaging Reporting and Data System (PI-RADS) helps categorise lesions, but MRI findings are not always definitive, particularly in cases where background changes obscure cancerous lesions. To address these limitations, researchers have investigated additional biomarkers that may enhance MRI-based risk assessment.

A recent study explored the integration of zonal-specific PSA density (PSAD) and the Prostate Signal Intensity Homogeneity Score (PSHS) into MRI-based evaluation. These parameters could refine patient selection for biopsy by reducing false-negative MRI results and improving differentiation between benign and malignant conditions.

Zonal-Specific PSA Density: A More Targeted Approach

PSA density (PSAD), calculated by dividing serum PSA levels by prostate volume, has been widely used to assess prostate cancer risk. However, traditional total gland PSA density (PSAD-T) does not account for the differing contributions of benign prostatic hyperplasia (BPH) and cancerous tissue. This study investigated zonal-specific PSA densities, including transition zone PSA density (PSAD-TZ) and peripheral zone PSA density (PSAD-PZ), to determine whether these refinements could improve diagnostic accuracy.

Among the PSA density variants examined, PSAD-TZ demonstrated superior diagnostic performance for detecting csPCa compared to PSAD-T and PSAD-PZ. The study found that PSAD-TZ had the highest area under the curve (AUC) in receiver operating characteristic (ROC) analysis, indicating its stronger predictive capability. PSAD-TZ also appeared to be less influenced by age-related changes compared to other PSA density measures, making it a potentially more reliable indicator of cancer risk in older patients, where PSA elevation may often be attributed to benign conditions.

By incorporating PSAD-TZ into prostate cancer risk assessment, clinicians may be able to identify high-risk patients more effectively while avoiding unnecessary biopsies in those with benign prostate enlargement. This approach could help refine clinical decision-making, reducing both overdiagnosis and overtreatment.

The Role of PSHS in MRI Interpretation

One of the challenges in prostate MRI interpretation is the presence of background changes in the peripheral zone, which can obscure or mimic cancerous lesions. The Prostate Signal Intensity Homogeneity Score (PSHS) is designed to quantify these background changes, providing an additional parameter to assess the reliability of MRI findings.

In this study, patients with low PSHS scores, indicating greater background signal intensity changes, were found to be at an elevated risk of undetected csPCa when their MRI results were negative or indeterminate (PI-RADS ≤ 3). This suggests that in cases where MRI interpretation is

challenging due to diffuse inflammatory or post-inflammatory changes, PSHS may help identify patients who require further evaluation despite initially reassuring imaging findings.

The findings also demonstrated that PSHS had no strong correlation with PSA or PSAD variants, suggesting that it provides an independent measure of diagnostic uncertainty rather than directly reflecting PSA elevation. This further highlights the potential value of incorporating PSHS into risk stratification strategies, particularly for cases where standard MRI evaluation alone may not provide sufficient clarity.

Combining MRI, PSAD-TZ and PSHS for Improved Risk Stratification

The study proposed a novel risk stratification model integrating PI-RADS, PSAD-TZ and PSHS to improve prostate cancer detection and reduce false-negative MRI results. The analysis revealed that patients with a PI-RADS score of ≤ 3 , an elevated PSAD-TZ and a low PSHS score were at a significantly higher risk of harbouring csPCa despite their MRI findings appearing indeterminate or negative.

This refined approach could enhance the accuracy of biopsy recommendations by better identifying cases where MRI alone may not be sufficient for ruling out csPCa. In clinical practice, adopting this combined model could improve patient outcomes by ensuring that high-risk individuals receive appropriate follow-up while minimising unnecessary biopsies for those at lower risk.

As image quality plays a critical role in MRI-based prostate cancer detection, the integration of additional objective measures such as PSAD-TZ and PSHS could help mitigate some of the inherent limitations of imaging alone. This is particularly relevant in cases where MRI interpretation is complicated by inflammatory changes or other benign alterations that may obscure true malignancies.

MRI-based risk stratification has significantly improved the detection of csPCa, yet challenges remain in minimising false-negative results and reducing the number of unnecessary biopsies. The integration of zonal-specific PSAD, particularly PSAD-TZ, alongside PSHS and PI-RADS scoring, presents a promising advancement in prostate cancer risk assessment.

By adopting this combined approach, clinicians may be able to refine patient selection for biopsy, improving diagnostic accuracy and optimising prostate cancer management. Future research should further validate these findings in larger, multi-centre studies to determine the most effective cut-off values for PSAD-TZ and PSHS in routine clinical practice. The continued evolution of MRI-based risk stratification, supported by emerging biomarkers, holds significant potential for enhancing prostate cancer diagnosis and treatment decision-making.

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