

# Metabolic Phenotyping of Prostate Cancer Using Hyperpolarized $^{13}\text{C}$ MRI

Radiology: Imaging Cancer 2023; 5(1):e239001 • <https://doi.org/10.1148/rycan.239001> • ©RSNA, 2023

## Take-Away Points

- **Major Focus:** To evaluate differences in tumor metabolic phenotype using hyperpolarized carbon 13 (HP  $^{13}\text{C}$ )-pyruvate MRI in patients with low- or intermediate-risk prostate cancer.
- **Key Results:** HP  $^{13}\text{C}$ -pyruvate MRI detected occult prostate lesions not visible at conventional proton MRI. In intermediate-risk prostate cancer, HP  $^{13}\text{C}$ -lactate signal was driven by tumor epithelial cell-specific metabolism rather than stromal cell metabolism, demonstrating metabolic compartmentalization.
- **Impact:** HP  $^{13}\text{C}$ -lactate signal may noninvasively separate clinically significant from indolent disease in patients with intermediate-risk prostate cancer by detecting metabolic heterogeneity caused by varying percentages of Gleason pattern 4 disease.

In patients with low- or intermediate-risk prostate tumors, percentage of Gleason pattern 4 is an important factor in determining treatment. Sushentsev et al prospectively assessed 15 low- or intermediate-grade (Gleason score 6 or 7) prostate tumors in 10 patients using HP  $^{13}\text{C}$ -pyruvate MRI. They compared hyperpolarized imaging with conventional proton MRI and with whole-mount histopathologic prostate specimens.

The authors found that detectable HP  $^{13}\text{C}$ -lactate signal from metabolism of HP  $^{13}\text{C}$ -pyruvate was produced only in regions of histologically confirmed tumor. HP  $^{13}\text{C}$  MRI

detected occult prostate lesions that were not visible at multiparametric proton MRI. These results are consistent with those of previous HP  $^{13}\text{C}$  MRI prostate cancer studies and add to growing evidence that HP  $^{13}\text{C}$  MRI might more accurately evaluate multifocal disease.

As in previous studies, HP  $^{13}\text{C}$ -lactate MRI signal was associated with monocarboxylate transporter and lactate dehydrogenase enzyme expression levels measured with immunohistochemistry staining. Spearman analysis also revealed strong correlations of lactate signal-to-noise ratio (SNR) with percentage of Gleason pattern 4 disease ( $r_s = 0.65$ ,  $P = .03$ ) and tumor epithelial cell number ( $r_s = 0.80$ ,  $P = .002$ ); however, HP  $^{13}\text{C}$ -lactate SNR did not correlate with tumor-associated stromal cell number or tumor epithelium-to-stroma ratio.

These findings suggest specificity for HP  $^{13}\text{C}$  MRI in detecting malignant cells in prostate tumors. HP  $^{13}\text{C}$  MRI may noninvasively stratify low- or intermediate-risk tumors based on percentage Gleason pattern 4, thus potentially affecting management decisions.

—SURREIN S. DEEN

## Highlighted Article

Sushentsev N, McLean MA, Warren AY, et al. Hyperpolarised  $^{13}\text{C}$ -MRI identifies the emergence of a glycolytic cell population within intermediate-risk human prostate cancer. *Nat Commun* 2022;13(466). doi: <https://doi.org/10.1038/s41467-022-28069-2>