⇉ IMAGING

Visualizing hypoxia

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A new method for visualizing hypoxia in prostate cancer tumours, using pixel-wise integration of images that reflect oxygen consumption and supply, has been described in a paper published in *Cancer Research*. The implementation of this technique — termed consumption and supply-based hypoxia (CSH) imaging — into clinical practice is feasible and could aid treatment decisions in men with this disease.

Overall, 114 men with prostate cancer undergoing radical prostatectomy were included in this study. Patients received pimonidazole, a marker of hypoxia, before surgery and analysis of staining showed that it was significantly associated with clinicopathological features. Comparison of the apparent diffusion coefficient (ADC) and fractional blood volume (fBV) images, which were generated by exploiting intravoxel incoherent motion signal in diffusion-weighted MRI, showed that they correlated with cell density and blood vessel density, respectively, on histological images. Thus, ADC and fBV can be used as measures of cell density and blood vessel density, respectively, in prostate tumours.

On the basis of this observation, an algorithm was created from the ADC and fBV images to combine the images of oxygen consumption and supply into a single hypoxia image. A pixel-wise plot was generated for each tumour. An optimal line for discriminating pixels that represented hypoxia was defined using an iterative procedure using data from patients with paired diffusion-weighted image (DWI) and pimonidazole data. The fraction of pixels below the optimized line was used as a measure of the hypoxic fraction predicted by CSH. Hypoxia data was visualized in an image by using the distance of a pixel to the optimized discrimination line to create a hypoxia score for each pixel. This score indicated the possibility that the pixel represented hypoxia and was colour coded. Visually, CSH images showed good agreement with pimonidazole staining.

This CSH imaging technique was validated in an independent cohort of patients with paired DWI and pimonidazole data. The hypoxic fraction was positively associated with lymph node metastasis, tumour stage, Gleason score, and tumour extent. CSH imaging could also be applied to histological cell density and blood vessel images, showing good correlation.

This new method creates images of hypoxia in prostate cancer by using pixel-wise integration of DWIs to visualize oxygen consumption and supply in tumours. These images can also identify aggressive disease and can be applied to histopathology assays. Integrating this imaging modality into the clinic could aid treatment decisions in men with prostate cancer.

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ORIGINAL ARTICLE Hompland, T. et al. Combined MR imaging of oxygen consumption and supply reveals tumor hypoxia and aggressiveness in prostate cancer patients. *Cancer Res.* https://doi.org/10.1158/0008-5472.CAN-17-3806 (2018)