

ID06:

Prediction of hypoxia-associated peptides from hematoxylin and eosin histological images

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Tumor hypoxia is a major driver of poor prognosis and treatment resistance in head and neck squamous cell carcinoma (HNSCC), where it induces extensive transcriptional and proteomic reprogramming. However, comprehensive molecular hypoxia profiling is rarely implemented in routine HNSCC care due to cost and time constraints, whereas hematoxylin and eosin (H&E) staining remains standard for all patients. Deep learning models applied to H&E whole-slide images can predict outcome in HNSCC, but their biological interpretability and explicit linkage to hypoxia biology remain limited. This project follows a two-stage strategy. During development, we combine several molecular and imaging techniques including spatial transcriptomics, hypoxia fluorescence imaging, and, where available, mass spectrometry imaging on the same tumor sections to build a detailed map of where hypoxia occurs and how it looks at the molecular level. This map is then used to teach AI models to recognize the same hypoxia patterns directly on the matched H&E images, and to summarize them in a single, interpretable H&E-based hypoxia score. In application, the score can be calculated from routine H&E slides alone, without any additional molecular tests. The goal is to derive explainable, H&E-based hypoxia scores for biologically informed patient stratification with respect to local control, overall survival, and response to radiotherapy and immunotherapy, and to uncover mechanisms of hypoxia-driven treatment failure as candidates for therapeutic targeting. Multimodal spatial profiling of intratumoral hypoxia thus has the potential to support precision oncology in HNSCC by resolving spatial heterogeneity and enabling risk-adapted, hypoxia-directed treatment strategies.



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Special requirements for applicants:

- Programming experience (preferentially in python) will be required.
- Experience with artificial intelligence or machine learning modelling will be a plus.