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Human assembloids to study the basic principle of human diseases

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Current technology for human organoids is limited in that it fails to provide essential patterning cues and adequate signals to induce the complexity of the mature human tissues. Recently, we created "human assembloids" derived from two vital tissues in our body, brains and epithelial tissues, and established novel conceptual framework to overcome the major limitations of current organoid technology. These assembloids exhibit the characteristics of mature tissues in the context of cell compositions at the single-cell transcriptome level, and recapitulate the in vivo tissue dynamics and complex cellular interplays during the various physiological and pathological conditions. By developing patient specific mix-and-match human assembloids combined with integrated genetic and epigenetic analysis, our recent works further provided new mechanical insights into the development of various human diseases from cancers to neurological diseases, which is controlled by complex interaction between multiple cell types at distinct developmental and pathological stages in human tissues. Our study also proposed an innovative preclinical model system to study a range of human diseases, whose understanding of pathogenesis requires an organoid system that is capable of representing mature characteristics of functional human tissues with multiple cell types.