Patient-derived organoids in human cancer: A platform for fundamental research and precision medicine

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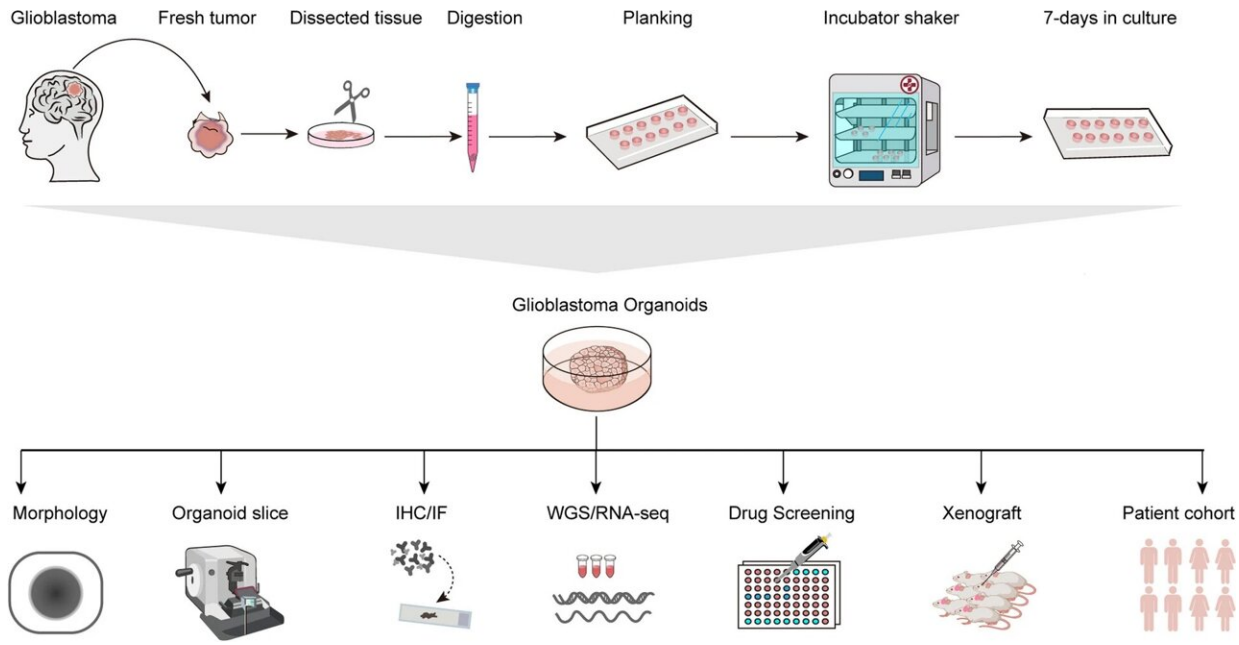

The GBM organoids culture process and subsequent analysis are illustrated schematically. A rapid and dependable technique has been described to create GBM organoids, confirmed by morphology and further verified with immunohistochemistry and immunofluorescence experiments. These organoids have promising applications to functional assays, including WGS and RAN-seq analyses, drug screening, derivation of orthotopic xenografts, and individualized treatment. Credit: *Molecular Biomedicine* (2024). DOI: 10.1186/s43556-023-00165-9

Organoids, formed as intricate three-dimensional (3D) structures, hold the capacity to originate from a wide array of cellular sources, ranging from embryonic stem cells (ESCs) and induced pluripotent stem cells (iPSCs) to somatic stem cells and even cancer cells.

These 3D tissues, fabricated on a small scale within laboratory settings, closely resemble the native organs in terms of their structure and functionality. Serving as a powerful bridge between conventional in vitro models and in vivo models, this technology exhibits immense potential for clinical applications, particularly in the field of cancer.

In a study published in the journal *Molecular Biomedicine*, researchers first introduced the developmental timeline of organoids, then pointed out that organoids have garnered significant attention and interest in the fields of life sciences and medical research due to their unique application value and broad market potential. While not entirely equivalent to genuine human organs, organoids have successfully replicated the structure and function of real tissues.

Organoids are produced by cultivating adult stem cells with specific spatial arrangements in vitro. In this review, the team outlined the primary operational steps for culturing and identifying PDOs generated from surgically resected GBM tissue.

The team also indicated that cancer PDOs effectively recapitulate the histopathologic characterization of parental tumors. Additionally, organoids do exhibit a degree of preservation of the genomic features found in their parental tumors, albeit with certain distinctions between them. Generally, a higher number of CAN and SNV genes were observed in the organoids compared to the parental tumors.

Next, the team compared organoids to preclinical tumor models. In comparison, organoids, with their composition and structure more

similar to primary tissues and ability to enable complex cellular interactions in a 3D environment, are better suited to address questions that cannot be resolved by in vivo models.

The team also revealed the potential of patient-derived tumor organoids in predicting the response of tumor patients to chemotherapy, radiotherapy, and targeted therapy. Despite the numerous advantages of organoids over other in vitro models, their use is still subject to limitations.

The application of organoids in clinical and fundamental research is also elaborated by the authors. For the former, organoids can be applied to personalized therapy, drug screening, and identification of therapeutic targets. For the latter, organoids can be applied to human tumor model systems, insightful investigation of disease mechanisms, identification of novel cancer biomarkers, drug discovery, and toxicology studies.

Currently, organoid culture technology is experiencing a technological explosion and a surge in scientific research results. The industry's growth potential is vast, yet it also confronts significant challenges. At the end of the review, the authors described the current challenges and future directions.

This study was led by Dr. Shanqiang Qu (Institute of Brain Disease, Nanfang Hospital, Southern Medical University) and Rongyang Xu (The First Clinical Medical College of Southern Medical University), and other members of the Laboratory for Precision Neurosurgery, Nanfang Hospital, Southern Medical University.

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