Brain organoids

- Optimizing GBM organoid construction with hydrogel-based models: GelMA-HAMA scaffold supports GBM organoids with clonal growth for drug screening
- Profiling Glioma Stem Cell Dynamics via 3D-Based Cell Cycle Reporter Assays
- Transcriptome meta-analysis of valproic acid exposure: A new approach in human brain organoids
- Human Cortical Organoids with a Novel SCN2A Variant Exhibit Hyperexcitability and Differential Responses to Anti-Seizure Compounds
- A hexamer tandem repeat RNA embedded within an SVA retrotransposon drives R-loop formation and neurodegeneration
- A scalable 3D packaging technique for brain organoid arrays toward high-capacity bioprocessors
- Cholinergic neuron-to-glioblastoma synapses in a human iPSC-derived co-culture model
- Biomanufacturing in low Earth orbit: A paradigm shift

Brain organoids are three-dimensional tissue cultures derived from human pluripotent stem cells, such as induced pluripotent stem cells (iPSCs) or embryonic stem cells. These organoids are designed to mimic certain aspects of the developing human brain, providing researchers with a valuable tool for studying brain development, neurological disorders, and potential therapeutic interventions.

Key aspects and features of brain organoids

Pluripotent Stem Cell Differentiation:

The process begins with the differentiation of pluripotent stem cells into neural progenitor cells, which have the potential to develop into various cell types found in the brain.

Self-Organization:

Brain organoids undergo a process of self-organization, where the cells aggregate and differentiate into distinct brain regions and cell types. This mimics aspects of embryonic brain development. Cellular Diversity:

Organoids exhibit cellular diversity similar to that of the developing human brain, including neurons, astrocytes, and oligodendrocytes. This diversity allows researchers to study the interactions between different cell types. Modeling Brain Development:

Brain organoids provide a unique platform for studying the complex processes involved in brain development, including the formation of neural structures, neuronal migration, and the establishment of functional neuronal circuits. Disease Modeling:

Researchers use brain organoids to model neurological disorders, such as Alzheimer's disease, Parkinson's disease, and microcephaly. By introducing disease-specific mutations or using cells derived from patients with neurodevelopmental disorders, scientists can study disease mechanisms and test potential therapies. Drug Screening and Testing:

Brain organoids are utilized for drug screening and testing, providing a more physiologically relevant model compared to traditional two-dimensional cell cultures. This allows researchers to assess the efficacy and safety of potential drug candidates in a system that better recapitulates the human brain. Ethical Considerations:

The use of brain organoids has raised ethical questions, especially as they exhibit some level of organization and functionality. Debates center around issues such as consciousness, the potential for unintended consequences, and the ethical treatment of these models. Challenges and Limitations:

Despite their potential, brain organoids have limitations. They do not fully replicate the complexity of the adult human brain, lack certain structural features, and face challenges related to reproducibility and standardization. Brain organoids represent a valuable tool for advancing our understanding of brain development, studying neurological disorders, and exploring potential therapeutic avenues. Ongoing research continues to refine and improve the technology, addressing challenges and expanding its applications in neuroscience and medicine.

Brain organoids are becoming increasingly valuable for studying normal cortical neurogenesis and various congenital human brain diseases, and have gradually facilitated the translation of basic science research to clinical applications. For example, glioma organoids have been used to study tumor biology and drug response, and are progressively being applied to investigate other neurosurgery-associated diseases [1)]

[1)]
Blue R, Miranda SP, Gu BJ, Chen HI. A Primer on Human Brain Organoids for the Neurosurgeon. Neurosurgery. 2020 Sep 15;87(4):620-629. doi: 10.1093/neuros/nyaa171. PMID: 32421821.