Cerebral organoid

A cerebral organoid, or brain organoid, describes an artificially grown, in vitro, miniature organ resembling the brain. Cerebral organoids are created by culturing pluripotent stem cells in a three-dimensional rotational bioreactor, and they develop over the course of months

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Using induced pluripotent stem cell (iPSC)-derived human brain organoids, we attempted to simplify the complexities and demonstrate formation of forebrain-associated bilateral optic vesicles, cellular diversity, and functionality. Around day 30, brain organoids attempt to assemble optic vesicles, which develop progressively as visible structures within 60 days. These optic vesicle-containing brain organoids (OVB-organoids) constitute a developing optic vesicle's cellular components, including primitive corneal epithelial and lens-like cells, retinal pigment epithelia, retinal progenitor cells, axon-like projections, and electrically active neuronal networks. OVB-organoids also display synapsin-1, CTIP-positive myelinated cortical neurons, and microglia. Interestingly, various light intensities could trigger photosensitive activity of OVB-organoids, and light sensitivities could be reset after transient photobleaching. Thus, brain organoids have the intrinsic ability to self-organize forebrain-associated primitive sensory structures in a topographically restricted manner and can allow interorgan interaction studies within a single organoid [1)].

Liu et al., generated cerebral organoids using human induced pluripotent stem cells (iPSCs) for evaluation of neurotoxicity. Cerebral organoids were treated with different concentrations of vincristine for 48 hours and their expansion was measured. They also assayed various cell markers, microtubule associated proteins, and matrix metalloproteinases (MMP) in cerebral organoids. After treatment for 48 hours, they observed dose-dependent neurotoxicity, including reduced neuron and astrocyte numbers at high concentration. Vincristine treatment also impaired the microtubule-associated protein tubulin, and fibronectin, and downregulated MMP10 activity. Further analysis using the STRING database found that, both MMP10 and fibronectin bind with MMP9 experimentally, and text-mining indicated an interaction between MMP10 and fibronectin. The organoid model system allowed quantitative investigation of the effects of vincristine treatment. The findings indicated vincristine exhibited dose-dependent neurotoxicity, inhibited fibronectin, tubulin, and MMP10 expression in cerebral organoids [2)].

Brain tumor organoid

Brain tumor organoid

1)
Gabriel E, Albanna W, Pasquini G, Ramani A, Josipovic N, Mariappan A, Schinzel F, Karch CM, Bao G, Gottardo M, Suren AA, Hescheler J, Nagel-Wolfrum K, Persico V, Rizzoli SO, Altmüller J, Riparbelli MG, Callaini G, Goureau O, Papantonis A, Busskamp V, Schneider T, Gopalakrishnan J. Human brain organoids assemble functionally integrated bilateral optic vesicles. Cell Stem Cell. 2021 Aug 12:S1934-5909(21)00295-2. doi: 10.1016/j.stem.2021.07.010. Epub ahead of print. PMID: 34407456.
2)
Liu F, Huang J, Liu Z. Vincristine impairs microtubules and causes neurotoxicity in cerebral organoids.

Neuroscience. 2018 Dec 29. pii: S0306-4522(18)30873-X. doi: 10.1016/j.neuroscience.2018.12.047. [Epub ahead of print] PubMed PMID: 30599272.