Spheroid

A spheroid, or ellipsoid of revolution, is a quadric surface obtained by rotating an ellipse about one of its principal axes; in other words, an ellipsoid with two equal semi-diameters.

Spheroids are a type of three-dimensional cell modeling that better simulate a live cell's environmental conditions compared to a two-dimensional cell model, specifically with the reactions between cells and the reactions between cells and the matrix.

Incremental hypoxia inside the growing tumor mass drives epigenetic drug resistance by activating non-genetic repair of anti-apoptotic DNA, which could be impaired by drug treatment. Hence, rescuing inter-tumor hypoxia by oxygen-generating microparticles may promote susceptibility to anti-tumor drugs. Moreover, a tumor-on-a-chip model a enables user-specified alternation of clinic-derived samples. This study utilized patient-derived glioblastoma tissue to generate cell spheroids with size variations in a 3D microchannel network chip (Glioblastoma chip). As the spheroid size increased, epigenetic drug resistance was promoted with inward hypoxia severance, as supported by the spheroid size-proportional expression of hypoxia-inducible factor-1a in the chip. Loading anti-hypoxia microparticles onto the spheroid surface significantly reduced drug resistance by silencing the expression of critical epigenetic factor, resulting in significantly decreased cell invasiveness. The results were confirmed in vitro using cell line and patient samples in the chip as well as chip implantation into a hypoxic hindlimb ischemia model in mice, which is an unprecedented approach in the field [1].

Transplantation of preassembled three-dimensional (3D) spheroids of mesenchymal stem cells (MSCs) and vascular endothelial cells (ECs) results in significantly improved cell retention and survival compared with conventional mixed-cell suspensions. The transplanted 3D spheroids exhibit notable neuroprotective, proneurogenic, proangiogenic and anti-scarring potential as evidenced by clear extracellular matrix structure formation and paracrine factor expression and secretion; this ultimately results in increased structural and motor function recovery in the brain of an ischemic stroke mouse model. Therefore, transplantation of MSCs and ECs using the 3D cell spheroid configuration not only reduces cell loss during cell harvesting/administration but also enhances the resultant therapeutic benefit, thus providing important proof-of-concept for future clinical translation [2].

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Baek S, Yu SE, Deng YH, Lee YJ, Lee DG, Kim S, Yoon S, Kim HS, Park J, Lee CH, Lee JB, Kong HJ, Kang SG, Shin YM, Sung HJ. Quenching Epigenetic Drug Resistance Using Anti-hypoxic Microparticles in Glioblastoma Patient-derived Chips. Adv Healthc Mater. 2021 Dec 28:e2102226. doi: 10.1002/adhm.202102226. Epub ahead of print. PMID: 34963195.
2)
Hsu TW, Lu YJ, Lin YJ, Huang YT, Hsieh LH, Wu BH, Lin YC, Chen LC, Wang HW, Chuang JC, Fang YQ, Huang CC. Transplantation of 3D MSC/HUVEC spheroids with neuroprotective and proangiogenic potentials ameliorates ischemic stroke brain injury. Biomaterials. 2021 Mar 24;272:120765. doi: 10.1016/j.biomaterials.2021.120765. Epub ahead of print. PMID: 33780686.