3D培养在神经胶质瘤研究中的应用

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Title: Application of 3D culture in glioblastoma research

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摘要: 传统的肿瘤研究依赖于肿瘤细胞系构建肿瘤模型，并在细胞基础上测定肿瘤细胞的耐药性等，但在临床实验中大多数肿瘤药物以失败告终，其中最主要的原因是细胞系不能模拟肿瘤细胞在人体内微环境的特性，3D培养技术在肿瘤研究中的应用愈加广泛。本文主要从3D培养在神经胶质瘤研究中的应用进行综述。

Abstract: Traditional oncology research relies on tumor cell lines to construct tumor models,and it determines tumor cell resistance on the basis of cells.However,most of the oncology drugs have failed in clinical trials.The most important reason is that cell lines can' t simulate the characteristics of tumor cells in the human microenvironment,so the application of 3D culture technology in cancer research is more extensive.This article mainly introduces the application of 3D culture technology in glioblastoma research.

参考文献/REFERENCES

[1] Der Worp HB,Howells DW,Sena ES,et al.Can animal models of disease reliably inform human studies [J] .Plos Medicine,2010,7(3):e1000245.
[2] Hutchinson L,Kirk R.High drug attrition rates-where are we going wrong [J] ?Nature Reviews Clinical Oncology,2011,8(4):189-190.
[3] Katt ME,Placone AL,Wong AD,et al.In vitro tumor models:Advantages,disadvantages,variables,and selecting the right platform [J] .Frontiers in Bioengineering and Biotechnology,2016,4(12):00012.
[4] Aggarwal BB,D Danda.Models for prevention and treatment of cancer:Problems vs promises [J] .Biochemical Pharmacology,2009,78(9):1083-1094.
[5] Hait WN.Anticancer drug development:the grand challenges [J] .Nature Reviews Drug Discovery,2010,9(4):253-254.
[6] Baker BM,Chen CS.Deconstructing the third dimension-how 3D culture microenvironments alter cellular cues [J] .Journal of Cell Science,2012,125(13):3015-3024.
[7] Manome Y,Mizuno S,Akiyama N,et al.Three-dimensional cell culture of glioma and morphological comparison of four different human cell lines [J] .Anticancer Research,2010,30(2):383-389.
[8] Harma V,Virtanen J,Makela R,et al.A comprehensive panel of three-dimensional models for studies of prostate cancer growth,invasion and drug responses [J] .Plos One,2010,5(5):e10431.
[9] Myungjin Lee J,P Mhawech-Fauceglia.A three-dimensional microenvironment alters protein expression and chemosensitivity of epithelial ovarian cancer cells in vitro [J] .Laboratory Investigation,A Journal of Technical Methods and Pathology,2013,93(5):528-542.
[10] Chitcholtan K,Asselin E,Parent S,et al.Differences in growth properties of endometrial cancer in three dimensional (3D) culture and 2D cell monolayer [J] .Experimental Cell Research,2013,319(1):75-87.
[11] Longati P,Jia X,Eimer J,et al.3D pancreatic carcinoma spheroids induce a matrix-rich,chemoresistant phenotype offering a better model for drug testing [J] .BMC Cancer,2013,13(1):95.
[12] Zschenker O,T Streichert.Genome-wide gene expression analysis in cancer cells reveals 3D growth to affect ECM and processes associated with cell adhesion but not DNA repair [J] .PloS One 2012,7(4):e34279.
[13] Zhong J,Bach CT,Shum MS,et al.NEDD9 regulates 3D migratory activity independent of the Rac1 morphology switch in glioma and neuroblastoma [J] .Molecular Cancer Research,2014,12(2):264-273.
[14] Levin VA,Panchabhai S,Shen L,et al.Protein and phosphoprotein levels in glioma and adenocarcinoma cell lines grown in normoxia and hypoxia in monolayer and three-dimensional cultures [J] .Proteome Science,2012,10(1):5.

[15] Petersen OW,Ronnovjessen L,Howlett AR,et al.Interaction with basement membrane serves to rapidly distinguish growth and differentiation pattern of normal and malignant human breast epithelial cells [J] .Proceedings of the National Academy of Sciences of the United States of America,1992,89(19):9064-9068.
[16] Tibbitt MW,Anseth KS.Dynamic microenvironments:The fourth dimension [J] .Science Translational Medicine,2012,4(160):160ps24.
[17] Allen MD,Jones JL.Jekyll and Hyde:The role of the microenvironment on the progression of cancer [J] .The Journal of Pathology,2011,223(2):163-177.
[18] Cirri P,Chiarugi P.Cancer associated fibroblasts:The dark side of the coin [J] .American Journal of Cancer Research,2011,1(4):482-497.
[19] Fgajewski T,Schreiber H,Fu Y.Innate and adaptive immune cells in the tumor microenvironment [J] .Nature Immunology,2013,14(10):1529-2908.
[20] Halama N,Zoernig I,Berthel A,et al.Tumoral immune cell exploitation in colorectal cancer metastases can be targeted effectively by anti-CCR5 therapy in cancer patients [J] .Cancer Cell,2016,29(4):587-601.
[21] Calabrese C,Poppleton H,Kocak M,et al.A perivascular niche for brain tumor stem cells [J] .Cancer Cell,2007,11(1):69-82.
[22] Bellail AC,Hunter SB,Brat DJ,et al.Microregional extracellular matrix heterogeneity in brain modulates glioma cell invasion [J] .The International Journal of Biochemistry & Cell Biology,2004,36(6):1046-1069.
[23] Zamecnik J.The extracellular space and matrix of gliomas [J] .Acta Neuropathol,2015,110(5):435-442.
[24] Smalley KS,Lioni M,Noma K,et al.In vitro three-dimensional tumor microenvironment models for anticancer drug discovery [J] .Expert Opinion on Drug Discovery,2008,3(1):1-10.
[25] Wu X,Petershall J,Bose S,et al.Human bronchial epithelial cells differentiate to 3D glandular acini on basement membrane matrix [J] .American Journal of Respiratory Cell and Molecular Biology,2011,44(6):914-921.
[26] Terashima J,Goto S,Hattori H,et al.CYP1A1 and CYP1A2 expression levels are differentially regulated in three-dimensional spheroids of liver cancer cells compared to two-dimensional monolayer cultures [J] .Drug Metabolism and Pharmacokinetics,2015,30(6):434-440.
[27] Bellis AD,Bernabe BP,Weiss MS,et al.Dynamic transcription factor activity profiling in 2D and 3D cell cultures [J] .Biotechnology and Bioengineering,2013,110(2):563-572.
[28] Zuellig RA,Cavallari G,Gerber P,et al.Improved physiological properties of gravity-enforced reassembled rat and human pancreatic pseudo-islets [J] .Journal of Tissue Engineering and Regenerative Medicine,2017,11(1):109-120.
[29] Obara C,Tomiyama K,Takizawa K,et al.Characteristics of three-dimensional prospectively isolated mouse bone marrow mesenchymal stem/stromal cell aggregates on nanoculture plates [J] .Cell and Tissue Research,2016,366(1):113-127.
[30] Van-TienBui,LeThi Thuy.Ordered cylindrical micropatterned Petri dishes used as scaffolds for cell growth [J] .Journal of Colloid and Interface Science,2017,513(1):161-169.
[31] Sundstrom L,Biggs T,Laskowski A,et al.OrganDots-an organotypic 3D tissue culture platform for drug development [J] .Expert Opinion on Drug Discovery,2012,7(6):525-534.
[32] Avci NG,Fan Y,Dragomir A,et al.Delta-24-RGD induces cytotoxicity of glioblastoma spheroids in three dimensional PEG microwells [J] .IEEE Transactions on Nanobioscience,2015,14(8):946-951.
[33] Ma J,Zhang X,Liu Y,et al.Patterning hypoxic multicellular spheroids in a 3D matrix - a promising method for anti-tumor drug screening [J] .Biotechnology Journal,2016,11(1):127-134.
[34] Ansari N,Muller S,Stelzer EH,et al.Quantitative 3D cell-based assay performed with cellular spheroids and fluorescence microscopy [J] .Methods in Cell Biology,2013,113(1):295-309.
[35] Chao Qi,Jia Liu,Yang Jin,et al.Photo-crosslinkable,injectable sericin hydrogel as 3D biomimetic extracellular matrix for minimally invasive repairing cartilage [J] .Biomaterials,2018,163(1):89-104.
[36] Heffernan JM,Overstreet DJ,Le LD,et al.Bioengineered scaffolds for 3D analysis of glioblastoma proliferation and invasion [J] .Annals of Biomedical Engineering,2015,43(8):1965-1977.
[37] Kyle M Koss,Matthew A.Improved 3D hydrogel cultures of primary glial cells for in vitro modelling of neuroinflammation [J] .J Vis Exp,2017,130：56615.
[38] Lv D,Yu S,Ping Y,et al.A three-dimensional collagen scaffold cell culture system for screening anti-glioma therapeutics [J] .Oncotarget,2016,7(35):56904-56914.
[39] Gomezroman N,Stevenson K,Gilmour L,et al.A novel 3D human glioblastoma cell culture system for modeling drug and radiation responses [J] .Neuro-oncology,2016,19(2):229-241.
[40] Ma NK,Lim JK,Leong MF,et al.Collaboration of 3D context and extracellular matrix in the development of glioma stemness in a 3D model [J] .Biomaterials,2016,78(1):62-73.
[41] Ma L,Barker J,Zhou C,et al.Towards personalized medicine with a three-dimensional micro-scale perfusion-based two-chamber tissue model system [J] .Biomaterials,2012,33(17):4353-4361.
[42] Guangyao Xiong,Honglin Luo.A novel in vitro three-dimensional macroporous scaffolds from bacterial cellulose for culture of breast cancer cells [J] .Journal of Biomaterials and Nanobiotechnology,2013,4(1):316-326.
[43] Kievit FM,Florczyk SJ,Leung M,et al.Chitosan-alginate 3D scaffolds as a mimic of the glioma tumor microenvironment [J] .Biomaterials,2010,31(22):5903-5910.
[44] Tabu K,Muramatsu N,Mangani C,et al.A synthetic polymer scaffold reveals the self-maintenance strategies of rat glioma stem cells by organization of the advantageous niche [J] .Stem Cells,2016,34(5):1151-

1162.
[45] Sbrana T,Ahluwalia A.Engineering ouasi-Vivo□ in vitro organ models [J] .Advances in Experimental Medicine and Biology,2012,745(1):138-153.
[46] Lloyd AC Chapman,Jonathan P Whiteley.Mathematical modelling of cell layer growth in a hollow fibre bioreactor [J] .Journal of Theoretical Biology,2017,418(1):36-56.
[47] Pond D,McBride AT.Microstructurally-based constitutive modelling of the skin - Linking intrinsic ageing to microstructural parameters [J] .Theoretical Biology,2018,444(1):108-123.
[48] Yilong Tang,Yan Xu.The combination of three-dimensional and rotary cell culture system promotes the proliferation and maintains the differentiation potential of rat BMSCs [J] .Scientific Reports,2017,7(1):192.
[49] Smith S,Ward JH,Tan C,et al.Endothelial-like malignant glioma cells in dynamic three dimensional culture identifies a role for VEGF and FGFR in a tumor-derived angiogenic response [J] .Oncotarget,2015,6(26):22191-22205.
[50] Huang Y, Tong L,Yi L,et al.Three-dimensional hydrogel is suitable for targeted investigation of amoeboid migration of glioma cells [J] .Molecular Medicine Reports,2018,17(1):250-256.
[51] Rao SS,Dejesus J,Short AR,et al.Glioblastoma behaviors in three-dimensional collagen-hyaluronan composite hydrogels [J] .ACS Applied Materials & Interfaces,2013,5(19):9276-9284.
[52] Bajetto A,Pattarozzi A.Different effects of human umbilical cord mesenchymal stem cells on glioblastoma stem cells by direct cell interaction or via released soluble factors [J] .Frontiers in Cellular Neuroscience,2017,11(1):312.
[53] Oliveira MN,Pillat MM.Kinin-B1 receptor stimulation promotes invasion and is involved in cell-cell interaction of co-cultured glioblastoma and mesenchymal stem cells [J] .Sci Rep,2018,8(1):1299.
[54] Dai X,Ma C,Lan Q,et al.3D bioprinted glioma stem cells for brain tumor model and applications of drug susceptibility [J] .Biofabrication,2016,8(4):045005.
[55] Wang C,Tong X,Yang F,et al.Bioengineered 3D brain tumor model to elucidate the effects of matrix stiffness on glioblastoma cell behavior using PEG-based hydrogels [J] .Molecular Pharmaceutics,2014,11(7):2115-2125.
[56] Nguyen DT,Fan Y,Akay YM,et al.Investigating glioblastoma angiogenesis using A 3D in vitro GELMA microwell platform [J] .IEEE Transactions on Nanobioscience,2016,15(3):289-293.
[57] Wittig R,Richter V,Wittigblaich SM,et al.Biosensor-expressing spheroid cultures for imaging of drug-induced effects in three dimensions [J] .Journal of Biomolecular Screening,2013,18(6):736-743.
[58] Yang N,Yan T,Zhu H,et al.A co-culture model with brain tumor-specific bioluminescence demonstrates astrocyte-induced drug resistance in glioblastoma [J] .Journal of Translational Medicine,2014,12(1):278.
[59] Chiblak S,Tang Z,Campos B,et al.Radiosensitivity of patient-derived glioma stem cell 3-dimensional cultures to photon,proton,and carbon irradiation [J] .International Journal of Radiation Oncology Biology Physics,2016,95(1):112-119.
[60] Weikun Xiao,Rongyu Zhang.Brain-mimetic 3D culture platforms allow investigation of cooperative effects of extracellular matrix features on therapeutic resistance in glioblastoma [J] .Cancer Research,2017,78(5):1358-1370.
[61] Paolo Codega,Ingo K,Mellinghoff,et al.Dissecting glioma invasiveness in a 3D-Organotypic model [J] .Trends in Molecular Medicine,2017,23(9):776-777.
[62] Ullrich C,Daschil N,Humpel C,et al.Organotypic vibrosections:Novel whole sagittal brain cultures [J] .Journal of Neuroscience Methods,2011,201(1):131-141.
[63] Vescio RA,Redfern CH,Nelson TJ,et al.In vivo-like drug responses of human tumors growing in three-dimensional gel-supported primary culture [J] .Proceedings of the National Academy of Sciences of the United States of America,1987,84(14):5029-5033.
[64] Jung S,Kim H,Lee J,et al.Brain tumor invasion model system using organotypic brain-slice culture as an alternative to in vivo model [J] .Journal of Cancer Research and Clinical Oncology,2002,128(9):469-476.
[65] Kucheryavykh LY,Kucheryavykh YV,Rolonreyes K,et al.Visualization of implanted GL261 glioma cells in living mouse brain slices using fluorescent 4-(4-(dimethylamino)-styryl)-N-methylpyridinium iodide (ASP+) [J] .BioTechniques,2012,53(5):305-309.
[66] Nora Pencheva,Mark C.Identification of a druggable pathway controlling glioblastoma invasiveness [J] .Cell Reports,2017,20(1):48-60.
[67] Chuang H,Lohaus R,Hanisch U,et al.Coculture system with an organotypic brain slice and 3D spheroid of carcinoma cells [J] .Journal of Visualized Experiments,2013,80(80):e50881.
[68] Chadwick EJ,Yang DP,Filbin MG,et al.A brain tumor/organotypic slice co-culture system for studying tumor microenvironment and targeted drug therapies [J] .Journal of Visualized Experiments,2015,105(1):e53304.

备注/Memo: -

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