NANO-BME Seminar

Time: 4:00PM Thursday, Apr 27

Location: EEP 253 and https://sdsmt.zoom.us/j/99157370492

4:00-4:20PM

Inducing Tumor Endothelial Leakiness to Enhance Drug Delivery Using Cd146-Targeted Gold Nanorods and Mild Hyperthermia

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The enhanced permeability and retention (EPR) effect has been utilized as a major strategy for the delivery of nano-therapeutics and anticancer drugs to tumors. However, this effect is not always reliable, as some tumors do not possess the leaky endothelium that is required for the EPR effect. In order to reduce absolute reliance on the EPR effect, inducing endothelial leakiness at the tumor site could be exploited as a potential strategy to increase the effectiveness of nanomedicine-based or conventional anticancer therapies. Gold nanorods (AuNRs) are highly biocompatible, easy to be surface-functionalized, and have unique photothermal properties. The cluster of differentiation 146 (CD146), a cancer cell adhesion molecule, is over-expressed on the surfaces of tumor endothelial cells. When combining CD146-targeted AuNRs with mild hyperthermia, we hypothesize that the synergistic effects can induce a greater degree of endothelial leakiness at the tumor site, which facilitates the delivery of nano-therapeutics and anticancer drugs to tumors.

4:20-4:40PM

Stem-Cell Based Craniofacial Bone Tissue Regeneration

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Craniofacial tissue injuries, diseases, and defects impact an estimated 1 billion patients globally. Functional reconstruction of craniofacial defects is a major clinical challenge in craniofacial sciences, especially in complex situations involving traumatic injury, cranioplasty and oncologic surgery [3]. Research and development in the are of bone augmentation has provided suggestions of tissue engineering as a viable treatment option for craniofacial bone regeneration. Tissue engineering strategies have been widely used to encourage vascularization, and, more recently, to improve innervation through host tissue recruitment or revascularization/innervation of engineered tissues [2]. Stem cell therapy with bone marrow-derived mesenchymal stem cells is a promising tissue engineering strategy to promote regeneration of craniofacial bone. A trial of eighteen patients (10 patients with traumatic injury and 8 patients with a cleft palate) presenting with missing teeth associated with horizontal alveolar bone deficiencies were included in a randomized controlled clinical trial. Participants in the study either received stem cell therapy or conventional autogenous block grafts. [1] Overall, the study concluded success bone gain in both patient populations. However, mean growth in the patient population with the stem cell therapy was one-half less than the patient population with the conventional autogenous block graft. Despite the cell-therapy not being as successful as the control, it shows a promising future for the further development and potential of stem-cell therapy for tissue regeneration of craniofacial bone.

References

[1] Bajestan MN, Rajan A, Edwards SP, Aronovich S, Cevidanes LHS, Polymeri A, Travan S, Kaigler D. Stem cell therapy for reconstruction of alveolar cleft and trauma defects in adults: A randomized controlled, clinical trial. Clin Implant Dent Relat Res. 2017 Oct;19(5):793-801. doi: 10.1111/cid.12506. Epub 2017 Jun 28. PMID: 28656723.

[2] Li Y, Fraser D, Mereness J, Van Hove A, Basu S, Newman M, Benoit DSW. Tissue Engineered Neurovascularization Strategies for Craniofacial Tissue Regeneration. ACS Appl Bio Mater. 2022 Jan 17;5(1):20-39. doi: 10.1021/acsabm.1c00979. Epub 2021 Nov 29. PMID: 35014834; PMCID: PMC9016342.

[3] Thrivikraman G, Athirasala A, Twohig C, Boda SK, Bertassoni LE. Biomaterials for Craniofacial Bone Regeneration. Dent Clin North Am. 2017 Oct;61(4):835-856. doi: 10.1016/j.cden.2017.06.003. PMID: 28886771; PMCID: PMC5663293.

4:40-5:00PM

Nanoparticles in the Diagnosis and Treatment of Vascular Aging and Related Diseases

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Vascular aging is the loss of arterial elasticity and reduced arterial compliance which can be a result of smoking, being overweight, stress, unhealthy diet, high blood pressure, diabetes, or high cholesterol. Current diagnostic treatment of vascular aging involves the detection of biomarker levels and angiography by using methods such as gel electrophoresis, enzyme-linked immunosorbent assay, quality reverse transcription PCR (RT-PCR), etc. These methods are very expensive and have poor accuracy, weak specificity, and low sensitivity. Therefore, the use of nanoparticles such as liposomes, solid lipid nanoparticles (SNL), nanostructured lipid carriers (NLCs), and nanoemulsion assist in the treatment of vascular aging and related disorders because they are great drug carriers, have high specificity, excellent stability, good specificity, fast response, and cost-effectiveness. These nanoparticles enhance the diagnostic and therapeutic effect while reducing the side effects by increasing the drug accumulation at pathological sites while decreasing the drug accumulation in healthy tissues. Recently, Nanoparticle-mediated anti-oxidative therapy has emerged as a promising method for the treatment of vascular aging and related diseases. In this strategy, the nanoparticles target the mitochondria and scavenge excessive reactive oxygen species (ROS) and therefore help in the treatment of atherosclerosis.

References:

[1] Hui Xu, Shuang Li and You-Shuo Liu. Nanoparticles in the diagnosis and treatment of vascular aging and related diseases. https://www.nature.com/articles/s41392-022-01082-z

[2] Yumin Qiu, Yuanya Liu and Dr. Jun Tao. Progress of Clinical Evaluation for Vascular Aging in Humans. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8016347/