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Effect of BMP-2 peptide conjugated TiO2 nanoparticle on osteogenic expression through biomimetic Zein PDA nanofibrous scaffold

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A biomimetic Zein polydopamine (PDA) based nanofiber scaffold was fabricated to deliver BMP-2 peptide conjugated TiO2 nanoparticles in a sustained manner for investigating its osteogenic differentiation potential. To prolong the retention time of biomolecules at the target site, BMP-2 peptide has been conjugated to TiO2 nanoparticles using a hetero bifunctional cross linker owing to its high surface to volume ratio. The conjugation efficiency was confirmed by various characterization techniques such as XPS, FT-IR and Raman spectroscopic analysis. The effect of biochemical cues from BMP-2 peptide and nano topographical stimulation of electrospun Zein PDA nanofibers were examined for its enhanced osteogenic expression of human fetal osteoblast (hFOB) cells. The highly interconnected nanofibrous matrix with its unique material composition attributes for the sustained delivery of bioactive signals, improved cell adhesion, mineralization and differentiation. Further, alkaline phosphatase activity, mineralization and the expression of osteogenic markers revealed that the fabricated nanofibrous scaffold possess better cell - biomaterial interactions compared to the control. These promising results demonstrate the potential of the composite nanofibrous scaffold as an effective biomaterial substrate for bone regeneration.

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Hypoxia-responsive methoxy poly (ethylene glycol)-*block*-poly [glutamic acid-co-6-(2-nitroimidazole) hexyl amine] nanoparticles for potential tumor microenvironment-targeted delivery of doxorubicin

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Tumor microenvironment-targeted nano drug delivery vehicles are gaining mounting attention in the field of biomedical sciences. The hypoxic response of the tumorous cells due to very low partial pressure of oxygen (some time less than 2.5 mm of Hg) in the tumor tissues makes hypoxia responsive drug delivery system as the more appealing in cancer chemotherapy. Based on these considerations, we synthesized hypoxia responsive polymeric materials methoxy poly(ethylene glycol)-*block*-poly [glutamic acid-co-6-(2-nitroimidazole) hexyl amine] [mPEG-*b*-P(LG-*co*-NID)] by *co*njugation of the hydrophobic nitroimidazole derivative (NID) [6-(2-nitroimidazole) hexyl amine] with the pendant carboxylic group of poly(ethylene glycol)-*block*-poly(L-glutamic acid) (mPEG-*b*-PLG). The structure and degree of substitution were confirmed by proton NMR, FTIR and UV-Vis spectroscopy. The degree of substitution was found to enhance with the increase in nitro imidazole derivative to polymer ratio. The hypoxia response of the material was evaluated by UV-Vis spectroscopy and zeta potential measurements. Doxorubicin was hydrophobically encapsulated in the micellar core of the hypoxia responsive nanoparticles. The drug loaded micelles showed faster release in hypoxic condition as compared to normoxic conditions. Moreover, the developed polymeric system was found non-toxic to MCF-7 cell line thus suggesting its biocompatibility and suitability as drug delivery device.

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