3-Dimensional Poly(LLA-co-TMC) Scaffolds Functionalized with Hyaluronic Acid Enhanced Cell-Material Interactions

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Abstract

Synthetic degradable polymers such as poly (L-Lactide) (PLLA) and poly trimethylene carbonate (PTMC) and their copolymers have been used to fabricate scaffolds in tissue engineering applications. However, they present with major drawbacks, including inherent hydrophobicity and acidic by-products. These drawbacks could affect the cell-scaffolds' interactions and host responses post-transplantation. Hyaluronic acid (HA), a non-sulfated glycosaminoglycan, has excellent hydrophilic properties and is known to play important roles in the extracellular matrix particularly during wound healing. In the current study, the effect of HA coating to improve the cell-scaffold interactions was investigated. Human bone marrow stem cells (hBMSC) were isolated and characterized based on multi-lineage differentiation as well as immunophenotype using flow cytometry. hBMSC were seeded onto 3-dimensional poly(LLA-co-TMC) scaffolds coated with three different concentrations of HA solution (0.1%, 0.25% and 0.5%). Non-coated scaffolds were used as control. Cellular responses were evaluated by studying cell attachment, viability and proliferation. Chemical analysis for the release and degradation of HA in cell culture medium was also quantified using cetyltrimethylammonium bromide turbidimetric method (CTM). DNA quantification exhibited higher cell number at all timepoints in 0.5% HA group than the other groups, while Live/Dead staining indicated that scaffolds coated with 0.5% HA promoted cellular infiltration into the pores of the scaffold. Western blotting showed phosphorylated focal adhesion kinase (FAK) CTM showed that HA was released into medium immediately, and that residual HA could be detected for a longer time in 0.5% HA group. Collectively, the data indicate that poly(LLA-co-TMC) scaffolds coated with 0.5% HA can significantly enhance the cellular interactions, which in return can improve the efficacy of tissue-engineered constructs.