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iPSCs More Effectively Differentiate into Neurons on PLA Scaffolds with High Adhesive Properties for Primary Neuronal Cells

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Abstract : Adhesive properties of scaffolds, which predominantly depend on the chemical and structural features of their surface, play the most important role in tissue engineering. The basic requirements for such scaffolds are biocompatibility, biodegradation, high cell adhesion, which promotes cell proliferation and differentiation. In many cases, synthetic polymers scaffolds have proven advantageous because they are easy to shape, they are tough, and they have high tensile properties. The regeneration of nerve tissue still remains a big challenge for medicine, and neural stem cells provide promising therapeutic potential for cell replacement therapy. However, experiments with stem cells have their limitations, such as low level of cell viability and poor control of cell differentiation. Whereas the study of already differentiated neuronal cell culture obtained from newborn mouse brain is limited only to cell adhesion. The growth and implantation of neuronal culture requires proper scaffolds. Moreover, the polymer scaffolds implants with neuronal cells could demand specific morphology. To date, it has been proposed to use numerous synthetic polymers for these purposes, including polystyrene, polylactic acid (PLA), polyglycolic acid, and polylactide-glycolic acid. Tissue regeneration experiments demonstrated good biocompatibility of PLA scaffolds, despite the hydrophobic nature of the compound. Problem with poor wettability of the PLA scaffold surface could be overcome in several ways: the surface can be pre-treated by poly-D-lysine or polyethyleneimine peptides; roughness and hydrophilicity of PLA surface could be increased by plasma treatment, or PLA could be combined with natural fibers, such as collagen or chitosan. This work presents a study of adhesion of both induced pluripotent stem cells (iPSCs) and mouse primary neuronal cell culture on the polylactide scaffolds of various types: oriented and non-oriented fibrous nonwoven materials and sponges – with and without the effect of plasma treatment and composites with collagen and chitosan. To evaluate the effect of different types of PLA scaffolds on the neuronal differentiation of iPSCs, we assess the expression of NeuN in differentiated cells through immunostaining. iPSCs more effectively differentiate into neurons on PLA scaffolds with high adhesive properties for primary neuronal cells.

Keywords : PLA scaffold, neurons, neuronal differentiation, stem cells, polylactid
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