Promoting neuro-supportive properties of astrocytes with epidermal growth factor hydrogels

ABSTRACT

Biomaterials provide novel platforms to deliver stem cell and growth factor therapies for central nervous system (CNS) repair. The majority of these approaches have focused on the promotion of neural progenitor cells and neurogenesis. However, it is now increasingly recognized that glial responses are critical for recovery in the entire neurovascular unit. In this study, we investigated the cellular effects of epidermal growth factor (EGF) containing hydrogels on primary astrocyte cultures. Both EGF alone and EGF-hydrogel equally promoted astrocyte proliferation, but EGF-hydrogels further enhanced astrocyte activation, as evidenced by a significantly elevated Glial fibrillary acidic protein (GFAP) gene expression. Thereafter, conditioned media from astrocytes activated by EGF-hydrogel protected neurons against injury and promoted synaptic plasticity after oxygen–glucose deprivation. Taken together, these findings suggest that EGF-hydrogels can shift astrocytes into neuro-supportive phenotypes. Consistent with this idea, quantitative-polymerase chain reaction (qPCR) demonstrated that EGF-hydrogels shifted astrocytes in part by downregulating potentially negative A1-like genes (Fbln5 and Rt1-S3) and upregulating potentially beneficial A2-like genes (Clcf1, Tgm1, and Ptgs2). Further studies are warranted to explore the idea of using biomaterials to modify astrocyte behavior and thus indirectly augment neuroprotection and neuroplasticity in the context of stem cell and growth factor therapies for the CNS. Stem Cells Translational Medicine 2019 Biomaterials provide novel platforms to deliver stem cell and growth factor therapies for central nervous system repair. Our data suggest that epidermal growth factor-containing hydrogels can shift astrocytes into potentially beneficial A2-like phenotypes that may augment neuroprotection and neuroplasticity during the recovery phase after brain injury.

Keyword: Biomaterials; Reactive astrocytes; Neuroplasticity; Stroke recovery