Tissue-engineered intervertebral disc and chondrogenesis using human nucleus pulposus regulated through TGF-β1 in platelet-rich plasma

鄧文炳
Chen WH;Lo WC;Lee JJ;Su CH;Lin CT;Liu HY;Lin TW;Lin WC;Huang TY;Deng WP

Abstract

Human intervertebral disc (IVD) degeneration often initiated from the human nucleus pulposus (hNP) with aging leading to IVD destruction and extracellular matrix (ECM) depletion. Previously, we have successfully employed transforming growth factor-β1 (TGF-β1) to promote chondrogenesis of mesenchymal progenitor cells (MPCs) and immortalized human mesenchymal stem cells. In this study, we examine the role of TGF-β1 in platelet-rich plasma (PRP) on disc regeneration, including proliferation, redifferentiation, and the reconstitution of tissue-engineered NP. hNP cells were isolated from volunteers with different ages and cultured in the presence of PRP. We found that the most effective concentration for hNP proliferation was 1 ng/ml TGF-β1 in PRP, which was further applied in the following experiments. hNP cell proliferation in all age groups were increased time-dependently by PRP and cell morphologies showed aggregation. The mRNA of Sox9, type II collagen, and aggrecan were all significantly upregulated by PRP through RT-PCR. Glycosaminoglycan (GAG) accumulation reached the highest value at day 7 and continued to day 9 culture. PRP promoted NP regeneration via the Smad pathway was also determined and highly activated p-Smad2/3 at 30 mi n and continuously sustained to 120 min. Immunostaining of type II collagen indicates that PRP participates in chondrogenesis of tissue-engineered NP with collagen scaffolds. We concluded that growth factors in PRP can effectively react as a growth factor cocktail to induce hNP proliferation and differentiation, and also promote tissue-engineered NP formation. These findings are the first to demonstrate that PRP might be a therapeutic candidate for prevention of disc degeneration.