The Anti-inflammatory and Matrix Restorative Mechanisms of Platelet-Rich Plasma in Osteoarthritis

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Abstract

Background: Intra-articular (IA) treatment with platelet-rich plasma (PRP) for osteoarthritis (OA) results in improved patient-reported pain and function scores.

Purpose: To measure the effects of PRP and high molecular weight hyaluronan (HA) on the expression of anabolic and catabolic genes and on the secretion of nociceptive and inflammatory mediators from OA cartilage and synoviocytes.

Study Design: Controlled laboratory study.

Methods: Synovium and cartilage harvested from patients undergoing total knee arthroplasty were co-cultured with media of PRP or HA. Tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6), and IL-1β were measured in the media by enzyme-linked immunosorbent assay. Hyaluronan synthase-2 (HAS-2), matrix metalloproteinase-1 (MMP-1), MMP-13, and TNF-α genes were measured in synoviocytes by reverse transcription polymerase chain reaction (RT-PCR). Collagen type I α1 (COL1A1), COL2A1, aggrecan (ACAN), and MMP-13 gene expression were measured in cartilage by quantitative RT-PCR.

Results: Media TNF-α concentration was decreased in PRP and HA compared with control cultures (PRP = 6.94 pg/mL, HA = 6.39 pg/mL, control = 9.70 pg/mL; P ≤ .05). Media IL-6 concentration was decreased in HA compared with PRP and control (HA = 5027 pg/mL, PRP = 5899 pg/mL, control = 5613 pg/mL; P ≤ .05). Media IL-1β was below detectable concentrations (<0.1 pg/mL) in all samples. Synoviocyte MMP-13 expression was decreased in PRP compared with HA and control (PRP = 10.1, HA = 12.8, control = 13.5; P ≤ .05). Synoviocyte HAS-2 expression was increased in PRP compared with HA and control (PRP = 12.1, HA = 9.8, control = 8.7; P ≤ .05). Cartilage ACAN expression was increased in HA compared with PRP, but neither was different from control (PRP = 8.8, HA = 7.7, control = 7.6; P ≤ .05). COL1A1 expression was increased in HA compared with PRP, but neither was different from control (PRP = 14.9, HA = 13.5, control = 12.9; P ≤ .05). Neither platelet nor leukocyte concentration had a significant effect on outcome measurements (gene or protein expression data) in cartilage or synoviocytes (P > .05).

Conclusion: Both PRP and HA treatments of OA joint tissues result in decreased catabolism, but PRP treatment also resulted in a significant reduction of MMP-13, an increase in HAS-2 expression in synoviocytes, and an increase in cartilage synthetic activity compared with HA. These results indicate that PRP acts to stimulate endogenous HA production and decrease cartilage catabolism. Platelet-rich plasma showed similar effects as HA in the suppression of inflammatory mediator concentration and expression of their genes in synoviocytes and cartilage.

Clinical Relevance: The antiinflammatory and anti-inflammatory activities of PRP support its use in OA joints to reduce pain and modulate the disease process. This study supports further clinical investigations of IA PRP for the treatment of OA.

Keywords: knee articular cartilage biology of cartilage growth factors/healing enhancement platelet-rich plasma regenerative medicine synovium

Footnotes

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