

Application of hyperbaric oxygen in bone tissue engineering- -effect of hyperbaric oxygen treatment on bone marrow stem cells

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Despite the benefit of hyperbaric oxygen (HBO) treatment for delayed bone healing and non-union of bony fractures has been proposed since 1966, little has been known about the effect of HBOT on bone marrow stem cells (BMSC). The aim of this study is to investigate the effect of HBO treatment on osteogenetic differentiation of BMSC and potential application in bone tissue engineering.

Adhesive stromal cells harvested from bone marrow were characterized by mesenchymal differentiation potential, cell surface markers and their proliferation capacity. Mesenchymal stem cells, which demonstrated osteogenic, chondrogenic and adipogenic differentiation potential and expressed positively for CD 29, CD 44, CD 73, CD 90, CD 105, CD 166 and negatively for CD34 and CD 45, were selected and treated in a laboratory-scale HBO chamber using different oxygen pressures and exposure times. No obvious effect of HBO treatment on BMSC proliferation was noticed. However, cytotoxic effects of HBO were considerably less pronounced when cells were cultured in medium supplemented with 10% FBS in comparison to medium supplemented with 2% FCS, as was evaluated by WST-1 assay. Under HBO treatment, bone nodules were formed in three days, which was clearly revealed by Von Kossa staining. In contrasts, without HBO treatment, bone nodules were not detected until 9-12 days using the same inducing culture media. Calcium deposition was also significantly increased after three days of HBO treatments compared to no HBO treatment. In addition it was also found that oxygen played a direct role in the enhancement of BMSC osteogenic differentiation, which was independent of the effect of air pressure.

HBO treatment stimulates BMSC differentiation to osteogenic lineage which implies a potential application of HBO in bone tissue engineering.