Effect of high hydrostatic pressure on biological properties of extracellular bone matrix proteins.

Abstract:
In orthopedic surgery, sterilization of bone used for reconstruction of osteoarticular defects caused by malignant tumors is carried out in various ways. At present, to devitalize tumor-bearing osteochondral segments, extracorporal irradiation or autoclaving is mainly used but both methods have substantial disadvantages, for instance, loss of biomechanical and biological integrity of the bone. In particular, after reimplantation, integration of the implant at the autograft-host junction is often impaired due to alteration of osteoinductivity as a result of its irradiation or autoclaving. As an alternative approach, high hydrostatic pressure (HHP) treatment of bone is suggested, a new technology which is in the preclinical testing stage, with the aim to inactivate tumor cells but leaving the biomechanical properties of bone, cartilage, and tendons intact. We investigated the influence of HHP on the major extracellular matrix (ECM) proteins, fibronectin (FN), vitronectin (VN), and type I collagen (Col-I), present in bone tissue, which are accountable for the biological properties within the bone. FN, VN, and Col-I were subjected to HHP ≤ 600 MPa prior to coating of cell culture plates with these matrix proteins. Thereafter, the capacity of HHP-pretreated FN, VN, and Col-I to affect cell proliferation, cell adherence, and spreading of human primary osteoblast-like cells and the human
osteosarcoma cell line Saos-2, was tested. Interestingly, even at HHP < or = 600 MPa, all three ECM proteins retained their biological properties because no significant changes were observed between HHP-treated and non-treated FN, VN, and Col-I regarding their biological properties to affect cell adherence, spreading, and proliferation. These data encourage further exploration of the potential of HHP to sterilize tumor-affected bone segments prior to reimplantation. While during this treatment eukaryotic cells including tumor cells will be irreversibly impaired, the bone's biomechanical properties and the biological properties of the ECM proteins FN, VN, and Col-I, respectively, are preserved.