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Commentary

Bone Angiogenesis and Important Strategies in the Prevention of Osteoporosis

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DESCRIPTION

Osteoporosis can be controlled in its tracks by physical activity or the right kind of exercise. Although it is generally recognized that exercise or mechanical loading regulates hormones, cytokines, signalling pathways, and noncoding RNAs in bone. Research has revealed that bone is a highly vascularized tissue and that vasculature dysregulation is linked to numerous bone disorders, including osteoporosis and osteoarthritis. In addition, angiogenic mediators are essential for preserving skeletal health, which is modulated by exercise or mechanical loading, which controls bone vascularization in the bone microenvironment. The effects of exercise, its underlying mechanisms for preventing osteoporosis, and an angiogenic-osteogenic coupling in response to exercise. Low bone mass or Bone Mineral Density (BMD), degeneration of bone micro-architecture, and increased fracture risk are the characteristics of the skeletal disease osteoporosis. Osteoporosis has been identified as one of the major public health issues in the ageing population, particularly for individuals over the age of 50, and has been linked to the worldwide rapid growth of the ageing population in many aspects of human health.

In order to prevent and treat osteoporosis without the use of drugs, exercise has been suggested by the WHO. It is well known that the changes mediated by exercise are helpful for bone health from many various aspects, such as force stimuli, hormones, cytokines, and cell signaling pathways, as well as noncoding RNAs, even though the exact mechanism of the beneficial effects of exercise on skeletal health is still far from being fully understood. Another important process in bone metabolism and remodelling may be the regulation of hormones in the body by exercises, such as oestrogen, parathyroid hormone, and glucocorticoids. Physical activity may stimulate the release of oestrogen (estradiol) in premenopausal women and somewhat duplicate the effects of hormone replacement therapy for osteoporosis. Exercise may raise serum Estradiol (E2) levels, similar to the increase in bone mass and strength in ovariectomized rats. Resistance training also demonstrated that, in older men, exercise could raise serum testosterone levels, which was associated with a reduction in bone loss.

Bone is a highly vascularized tissue with a large network of blood vessels and capillaries bone delivers oxygen and nutrients for bone growth and development, which are regulated by the control of many signaling pathways between endothelial cells and bone cells. Additionally, blood vessels are produced through two different biological processes and are essential in the development of osteoporosis. Hemangioblasts, which develop from mesodermal cells in the early stages of embryogenesis, move to a specific location and gather to create the primary vessels in the process of vasculogenesis. Endochondral ossification and intramembranous ossification are the two separate processes through which bones are formed. In order to generate endochondral bone, osteoblasts must be present, and the growing bone must be accompanied by increasing neovascularization. Angiogenesis-osteogenesis coupling describes the overall spatial and temporal link between bone development and the vascularization of the ossifying tissue. During the angiogenesis process, endothelial cells proliferate, migrate, form tubes, and eventually form conduits where blood flows and supplies the bone cells with the essential nutrients, oxygen, growth factors, and hormones. Hematopoietic precursors of osteoclasts are also transported by blood vessels to the sites of cartilage and bone resorption in order to remove the byproducts of the damaged extracellular matrix. Pericytes, which seem to play a significant role in the linkage between osteogenesis and angiogenesis, are also found in the subendothelial walls of blood vessels. Angiogenesis in the bone microenvironment is necessary for bone growth and development, postfracture repair, and maintenance of normal bone health.

As a non-drug preventive measure, exercise or physical training can help older individuals to avoid developing osteoporosis. In order to maintain a healthy skeleton, the interaction of mechanical loads, hormones or cytokines, and signalling pathways triggered by exercise increased bone production and decreased bone resorption. Numerous bone disorders, including osteoporosis, are characterised by dysregulation of bone angiogenesis, and exercise enhances angiogenesis in bone *via* regulating important angiogenic mediators. The foundation for preventing osteoporosis in the older population will be built on a deeper understanding of the mechanics of angiogenesis, signalling pathways, and important regulators generated by exercise.

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