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Editorial

Osteoimmunology: Interface between the Skeletal System and the Immune System

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EDITORIAL NOTE

Osteoimmunology is an interdisciplinary topic of study that focuses on the molecular knowledge of the immune and skeletal systems' interactions. Although osteoimmunology began with the study of osteoclast immune modulation, it has now expanded to include a variety of molecular and cellular interactions, such as those between osteoblasts and osteoclasts, lymphocytes and osteoclasts, and osteoblasts and haematopoietic cells. As a result, the two systems should be viewed as integrated and operating within the context of the 'osteoimmune' system, a heuristic concept that provides not only a framework for gaining new insights through basic research, but also a scientific foundation for the discovery of novel treatments for diseases involving both systems. Osteoimmunology is a 40-year-old field that examines the interface between the skeletal system and the immune system, which is referred to as the "osteo-immune system." In vertebrates, osteoimmunology also looks at the components and mechanisms that are common across the two systems, such as ligands, receptors, signalling molecules, and transcription factors. Osteoimmunology has been studied therapeutically for the treatment of bone metastases, rheumatoid arthritis, osteoporosis, osteopetrosis, and periodontitis over the last ten years. Osteoimmunology research reveals links between blood cell molecular communication and structural diseases in the body. The RANKL-RANK-OPG axis is an example of a crucial signalling pathway that is involved in both bone and immune cell communication. RANKL is found on osteoblasts and activated T cells, while RANK is found on osteoclasts and dendritic cells, which can both be formed from myeloid progenitor cells. Surface RANKL on osteoblasts and secreted RANKL signal osteoclast precursors to develop into osteoclasts. Through binding to RANK expressed on DCs, RANKL expression on activated T cells causes DC activation. OPG is a soluble decoy receptor for RANKL that inhibits RANKL binding to RANK. It is generated by DCs.

The immune system requires the normal growth of the bone marrow cavity, which also harbours crucial stem cells for immune system maintenance. Immune cells create cytokines, which have critical impacts on bone homeostasis both inside and outside of this region. The immune system's production of cytokines such RANKL, M-CSF, TNFa, ILs, and IFNs affects osteoclast development and activity, as well as bone resorption. Ex vivo primary cultures of cells from inflamed synovial fluid of patients with disease flare of the autoimmune illness rheumatoid arthritis show inflammatory osteoclastogenesis and osteoclast activation. Clinical osteoimmunology is a branch of medicine that focuses on the treatment and prevention of bone illnesses caused by immune system malfunctions. Bone modelling and remodelling are disrupted as a result of abnormal and/or extended immune system activation. Osteoporosis and bone deterioration are common illnesses caused by disorders of the osteoimmune system, which are often accompanied by RA, which is characterised by a significant infiltration of CD4+ T lymphocytes in the rheumatic joints and involves two mechanisms: Synovial cells have osteoclast precursors and osteoclast supporting cells, and synovial macrophages are highly differentiated into osteoclasts with the help of RANKL released from osteoclast supporting cells, resulting in an indirect effect on osteoclastogenesis from rheumatoid synovial cells in joints. The second consequence is an indirect influence on osteoclast development and activity caused by the release of inflammatory cytokines such as IL-1, IL-6, and TNFa in the synovium of RA patients, which increases RANKL signalling and, ultimately, bone degradation. OPG and RANKL therapy in arthritis is a therapeutic method to preventing bone-related illnesses caused by RA. Infections (e.g., respiratory virus infection) have been shown to diminish the amount of osteoblasts in bone, which are the primary cells involved in bone production.

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