OSTEOARTHRITIS PATHOGENESIS

Introduction

Osteoarthritis is the most common chronic musculoskeletal disorder. It is the leading cause of activity limitation and absenteeism among working-age adults and is associated with a significant decline in function among older individuals. Understanding of changes early in the development of osteoarthritis is important.

Initially, osteoarthritis has been considered to be a disease of articular cartilage, but recent research has indicated that the condition involves the entire joint. The loss of articular cartilage has been thought to be the primary change, but a combination of cellular changes and biomechanical stresses causes several secondary changes, including subchondral bone remodeling, the formation of osteophytes, the development of bone marrow lesions, change in the synovium, joint capsule, ligaments and periarticular muscles, and meniscal tears and extrusion.

Articular Cartilage

Normal adult articular cartilage is made up of extracellular matrix (water, collagen, proteoglycans and a very small component of calcium salt) and chondrocytes. The normal turnover of this matrix components is mediated by the chondrocytes, which synthetize these components and the proteolytic enzymes responsible for their breakdown. Chondrocytes are, in turn, influenced by a number of factors, including polypeptide growth factors and cytokines, structural and physical stimuli and even the components of the matrix itself.

Osteoarthritis result from failure of chondrocytes to maintain homeostasis between synthesis and degradation of these extracellular matrix components. Trauma causing a microfracture or inflammation causing a slight increase in enzymatic activity may allow the formation of ”wear” particles, which could be then engulfed by resident macrophages. At some point in time, the production of these ”wear” particles overwhelms the ability of the system to eliminate them and they become mediators of inflammation, stimulating the chondrocyte to release degradative enzymes. Molecules from breakdown of collagen and proteoglycan cause release of proinflammatory cytokines, like TNFα, IL-1 and IL-6. These cytokines can bind to chondrocyte receptors leading to further release of metalloproteinases and inhibition of type II collagen production, thus increasing cartilage degradation.

Subchondral Bone

Subchondral bone consists of the subchondral bone plate and the underlying trabecular bone and bone marrow space. The subchondral bone plate consists of cortical bone and is separated from the articular cartilage by the zone of calcified cartilage.

Changes in the bone include sclerotic changes and the development of bone cysts in the subchondral compartment. There is a progressive increase in the subchondral bone plate thickness, a modification in the architecture of subchondral trabecular bone, formation of new bone at the joint margins – osteophytes.

In osteoarthritic subchondral bone, type I of collagen is elevated, but this collagen content is abnormal and this leads to abnormal mineralization. Osteoarthritic subchondral bone has an increased osteoid collagen matrix and an abnormal mineralization resulting in a hypomineralization of this tissue. Although the subchondral bone tissue is hypomineralized in osteoarthritis, the increase in trabecular number and volume compensates for this situation, thus providing an apparent stiffer structure. With alteration in its properties, subchondral bone may be less able to absorb and dissipate energy, thereby increasing forces transmitted through the joint and predisposing the articular surface to deformation.

Synovial Membrane

Histologically, the synovial membrane of osteoarthritic joints commonly exhibits hyperplasia of the lining cell layer occasionally accompanied by focal infiltration of lymphocytes and monocytes in sublining layers.

The synovium produces some of the chemokines and metalloproteinases that degrade cartilage, even though the cartilage itself produces most of these destructive molecules. In turn, cartilage breakdown products, resulting from mechanical or enzymatic destruction, can provoke the release of collagenase and other hydrolytic enzymes from synovial cells and lead to vascular hyperplasia in osteoarthritic synovial membranes.

Menisci

Meniscal degeneration is commonly seen in osteoarthritis, where menisci appear torn, fissured, fragmented, macerated or completely destroyed. Intrameniscal changes correlated with perimeniscal synovitis, calcification not limited to the outer, peripheral portion of the menisci contribute to meniscal degeneration and reduced meniscal tensile strength. The meniscus is less able to withstand loading and force

transmission during normal movements of the joint, further leading to degenerative tears.

Conclusion

Osteoarthritis is a multifactorial disease of whole joint, with a complex pathomechanism involving interaction between the multiple joint tissue. Knowing of this complex process of producing osteoarthritis is essential for development of new methods of diagnostic and treatment.