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Review Article

The pathophysiology of osteoarthritis

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ABSTRACT

Osteoarthritis is a chronic, inflammatory joint disease in the world. In India more than 20% of total population is suffering from arthritis, although the main cause of disease is unknown, morphological changes observed in OA include cartilage erosion as well as inflammation. Complex network of risk factors and biochemical parameters, including cytokines, proteolytic enzymes trigger the disease, by knowing the exact mechanism of progressive of disease, it may help in finding the new drug for reducing pain and curing of the joint disease. In the present review, we described the most important risk factors and morphological changes in the cartilage and bone during the development of OA.

1. Introduction

Osteoarthritis (OA) is degenerative joint disease, which affects millions of people in the world. It is a complex disease whose pathogenesis, changes the tissue homeostasis of articular cartilage and subchondral bone, determine the predominance of destructive processes. A key role in the pathophysiology of articular cartilage is played by cell/extra-cellular matrix (ECM) interactions.

2. Signs and symptoms

Findings from studies indicate that age, gender, joint impairment, reduced range of motion (ROM), joint stiffness, and pain, contribute to increased disability.[1,2]

2.1. Pain

The most common symptom is a chronic pain,[3] during development of knee joint inflammation the concentration of Excitatory amino acids (EAA) especially Glutamate is increased which is released from sensory neurons in the spinal cord contribute to hyperalgesia and pain in the affected area.[4] Several studies have found that there is no correlation between radiological images and pain parameters, but the medial side of the knee showed most sensitization in patients with strong/severe knee OA, the degree of pain can be measured with temporal summation of pressure pain instrument.[5]

2.2. Joint stiffness

The concept of joint stiffness in arthritis and related pathology diseases was introduced in the early 1960s.[6,7] It is revealed that surface-active phospholipid (SAPL) (synovial surfactant) capable of reducing friction to the very low levels and provide lubricant in normal joint moreover, this lining is deficient in osteoarthritis and lead to stiffness of joint.[8,9]

2.3. Muscle weakness

Quadriceps muscle strengthening is an important protective function at knee joints. Cross-sectional studies suggest that strength is correlate with physical function and that

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increasing quadriceps strength reduces pain and improves function. Evidence suggests that thigh muscle strength may protect against knee joint damage and progression of existing OA.[10,11] Arthrogenic muscle inhibition (AMI) is a presynaptic, constant reflex inhibition of musculature surrounding a joint after damage to joint as it restricts full muscle activity and prevent the quadriceps strengthening, weaker quadriceps have been associated with an increased rate of loading at the knee joint.[12] AMI is caused by activity in multiple inhibitory pathways, its severity may vary according to the degree of joint damage.[13]

2.4. *Bone enlargement and swelling*

Due to pathological changes of articular cartilage in knee joint resulted from many causes leads to blockage and edema of soft tissues, disturbance of blood circulation, erosion and injury of chondrocyte, and even increase of bony density and formation of cystic changes, resulting in swelling and pain.[14]

3. Risk factors of knee osteoarthritis

OA has a multifactorial etiology, can be considered the product of interaction between systemic and local factors.

4. Systemic risk factors for OA

4.1. *Age*

It is most important factor for development of osteoarthritis; with increasing age the tensile property of cartilage in articular cartilage is decreased results in accumulation of glycation which causes mechanical failure.[15]

4.2. *Gender*

Women have a higher level of pain and disability than men.[16] A hospital-based study revealed rates of osteoarthritis is as high as 68% in women and 58% of men aged 65 and older.[17]

4.3. *Genetics hormones*

Classic study of monozygotic (MZ) twins aged 48 to 70 years, having identical genes showed 65% influence of genetic factors in developing of osteoarthritis.[18] Between 39% and 65% of osteoarthritis in the general population can be attributed to genetic factors, women after menopause are more susceptible to knee arthritis because of increasing level of osteocalcin and bone resorption.[19] Levels of osteocalcin, a marker of bone turnover, were lower in women with knee osteoarthritis.[20]

4.4. *Diet*

Rapid changes in diet and lifestyle by consumption of unrefined carbohydrates and Junk foods increased the rate of chronic diseases.[21]

Furthermore, chondrocytes are powerful sources of reactive oxygen species, which may damage cartilage collagen and synovial fluid hyaluronate, since micronutrient antioxidants provide defense against tissue injury, high dietary intake of these micronutrients could be helpful to protect against osteoarthritis.[20]

5. Local risk factors

5.1. *Joint injury and trauma*

Articular cartilage tolerates loading from daily physical activities, in joints injuries and trauma the cartilage loses its flexibility, kills the cells and decrease the loading of the subchondral bone.[22]

5.2. *Obesity*

People with an elevated body mass index (BMI) as a measure of relative weight for obesity, has a positive association between obesity and knee OA results in substantial overloading and damage to the knee joint.[23]

5.3. *Occupation*

The lifting of heavy loads was found mainly in farmers, fishermen, construction site workers, and general laborers. Walking up stairs was experienced mainly by general laborers; all of these stress activities causes the strong association between knee injury and osteoarthritis.[24]

5.4. *Physical activity/Sports*

In china women practicing gymnastic or kung fu (traditional Chinese martial arts) regularly were at the risk of Knee injury.[25] Schematic diagram of risk factors in osteoarthritis is shown in Fig. 1.

6. General changes in bone and cartilage in OA

OA is a complex disorder, its initiation, progression and severity may be influenced by multiple factors. The concept of subchondral bone stiffening and increasing bone density in OA is date back to 1970 to suggestion of first investigators Radin and Paul.[26] There is a correlation between subchondral bone changes and articular cartilage degeneration, the bone volume and trabecular thickness significantly increase with the higher stage of cartilage degeneration.[27] In OA the bone becomes stiffer; it may be less able to absorb impact loads, which may lead to more stresses in the cartilage.[28] The common features of osteoarthritis are loss of cartilage, joint space narrowing, hypertrophic bone changes, osteophye formation, osteophytes were defined as outgrowth of the bone and cartilage occurring at the joint margins, the previous study shows that direction of osteophyte at all sites except the lateral tibia and medial patella alters with size; similarly strong association was observed between osteophyte size and local cartilage narrowing, especially in the medial TFJ and lateral PFJ. Biomechanical factors support the osteophyte development.[29]