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Perspective

Structure, Biosynthesis and Functions of Keratan Sulfate

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DESCRIPTION

Keratan sulfate is a type of Glycosaminoglycan (GAG) that is found in various tissues of the body, including cartilage, bone, cornea, and brain. It is a linear polysaccharide consisting of repeating disaccharide units, which are composed of Galactose and N-Acetylglucosamine (GlcNAc) residues. The structure of keratan sulfate can vary depending on the tissue and species, and it can be either sulfated or unsulfated. In this perspective, we will discuss the biological functions, structure, biosynthesis, and clinical implications of keratan sulfate.

Biological functions of keratan sulfate

Keratan sulfate has various biological functions in different tissues of the body. In cartilage, it is a major component of the extracellular matrix and plays a crucial role in maintaining the mechanical properties of the tissue. Keratan sulfate is responsible for the compressive strength and elasticity of cartilage, which is important for joint function. In addition, it acts as a barrier against proteolytic enzymes and helps to maintain the structural integrity of cartilage.

In the cornea, keratan sulfate is a major component of the stroma, which is responsible for the transparency of the tissue. It forms a lattice structure with collagen fibrils, which helps to maintain the organization and stability of the cornea. In the brain, keratan sulfate is found in the extracellular matrix and is thought to play a role in neuronal development and plasticity.

Structure of keratan sulfate

Keratan sulfate is a linear polysaccharide consisting of repeating disaccharide units, which are composed of GlcNAc residues. The disaccharide unit can be either sulfated or unsulfated depending on the tissue and species. In cartilage, for example, most of the disaccharide units are sulfated, while in the cornea, most of the disaccharide units are unsulfated.

The structure of keratan sulfate can be further divided into two types: keratan sulfate I and keratan sulfate II. Keratan sulfate I contain sulfated disaccharide units and it is found in cartilage, while keratan sulfate II contains unsulfated disaccharide units and is found in the cornea.

Biosynthesis of keratan sulfate

The biosynthesis of keratan sulfate begins in the Golgi apparatus, where the initial steps of the synthesis occur. The first step is the transfer of a GlcNAc residue to a serine residue on a protein core, which is catalyzed by a specific enzyme called N-acetylglucosamine transferase. This step is followed by the addition of a galactose residue to the GlcNAc residue, which is catalyzed by galactosyltransferase. These two steps are repeated to form a linear chain of disaccharide units.

After the linear chain is formed, it can be further modified by sulfation and epimerization to form different types of keratan sulfate. Sulfation is catalyzed by specific sulfotransferases, while epimerization is catalyzed by specific epimerases. The final structure of keratan sulfate depends on the tissue and species.

CONCLUSION

In conclusion, clinical implications of keratan sulfate have been implicated in various clinical conditions, including osteoarthritis and corneal dystrophies. In osteoarthritis, the amount and quality of keratan sulfate in cartilage are decreased, which leads to a loss of mechanical properties and eventually to joint degeneration. In corneal dystrophies, mutations in genes encoding enzymes involved in the biosynthesis of keratan sulfate are also decreased.

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