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Proteoglycans and its Function in the Extracellular Matrix

Kalita Martineau*

Department of Pathology, University of Utah, Salt Lake City, United States

***Corresponding author:** Kalita Martineau, Department of Pathology, University of Utah, Salt Lake City, United States, E-mail: KMartineau@gmail.com

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Description

Proteoglycans are highly glycosylated proteins. The basic proteoglycan unit is composed of a "core protein" in which one or more Glycosaminoglycan (GAG) chains are covalently linked. The binding point is a serine residue to which glycosaminoglycans bind *via* a tetrasaccharide bridge. Ser residues are generally located in the sequence of Ser-Gly-X-Gly (X is any amino acid residue other than proline), but not all proteins with this sequence have glycosaminoglycans bound to them. Chains are long, linear carbohydrate polymers that are negatively charged under physiological conditions due to the appearance of sulfate and uronic acid groups. Proteoglycans are found in connective tissue. Proteoglycans are the main components of the extracellular matrix of animals and are "filler" substances that exist between the cells of living organisms. Here, they form large complexes with other proteoglycans, hyaluronic acid, and fibrous matrix proteins such as collagen. The combination of proteoglycans and collagen forms cartilage. Cartilage is usually highly hydrated mainly due to the negatively charged sulfates of the glycosaminoglycan chains of proteoglycans. They are also involved in the binding of cations (sodium, potassium, calcium, etc.) to water and regulate the movement of molecules through the matrix. There is also evidence that they can affect the activity and stability of proteins and signaling molecules in the matrix.

The individual functions of proteoglycans can be assigned to either the protein core or the bound GAG chain. It also functions as a lubricant by making a moisturizing gel that can withstand high pressure. The protein component of proteoglycans is synthesized by the ribosome and migrates to the lumen of rough vesicles. Glycosylation of proteoglycans takes place in several enzymatic steps in the Golgi apparatus. First, a special link tetrasaccharide binds to the serine side chain of the core protein and functions as a primer for polysaccharide growth. The sugars are then added one at a time by the glycosyltransferase. The finished proteoglycan is transported by secretory vesicles to the extracellular matrix of the tissue. Proteoglycans are glycosylated proteins with strong covalently bound anionic glycosaminoglycans. Many forms of proteoglycans are present in virtually every extracellular matrix of connective tissue.

The main biological function of proteoglycans derives from the physicochemical properties of the glycosaminoglycan component of the molecule. This gives the tissue moisture and swelling pressure and can withstand the compressive forces. This function is best demonstrated by aggrecan, the most abundant proteoglycan found in cartilage tissue. Over the last decade, different types of proteoglycans have been identified in many connective tissues, cell surfaces, and intracellular compartments. These proteoglycans have a variety of biological functions in addition to hydrodynamic functions and have been demonstrated to be involved in many aspects of cell and tissue activity. For example, decorin, which is widely used in many connective tissues, may have the ability to regulate collagen fibril formation and alter the activity of transforming growth factor beta. Parlecan, a major heparan sulfate proteoglycan in the glomerular basement membrane, may play an important role as a major anion site involved in charge selectivity in glomerular filtration. Specific interactions between proteoglycans (*via* glycosaminoglycans and core protein components) and extracellular matrix macromolecules are important components of proteoglycan function. The stimulating biological functions of proteoglycans are now gradually emerging.