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BOOK REVIEW

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Renato V. Iozzo (ed): Proteoglycan protocols

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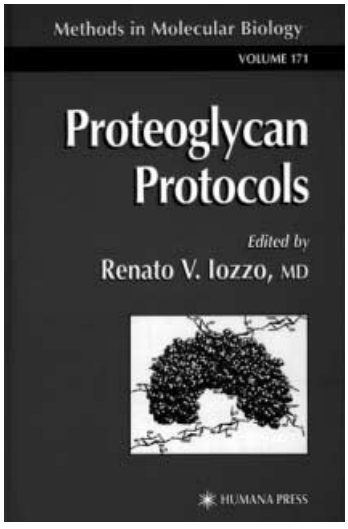
What is a proteoglycan? And how does it differ from a glycoprotein? Proteoglycans are usually easily distinguished from glycoproteins by the nature, quantity and arrangement of their sugar side chains. Glycoproteins usually contain from 1% to 60% carbohydrate by weight in the form of numerous, relatively short, branched oligosaccharide chains, generally of fewer than 15 sugar residues and variable composition, which often terminate with sialic acid. Proteoglycan can contain as much as 95% carbohydrate by weight, most of which takes the form of one to several hundred unbranched glycosaminoglycan chains and usually without sialic acid.

The in vivo roles of proteoglycans are not well-understood; however, functions have been ascribed to some. Of these, some functions are mediated by the core protein, and some by the glycosaminoglycans chain. *Proteoglycan Protocols* is part of the Humana Press *Methods in molecular biology* series and it offers a detailed collection of techniques and procedures needed by researches working in this field. The book comprises 51 chapters. All of the chapters are similarly structured and include a brief informative introduction, a list of material, and a detailed description of methods, followed by special notes that clarify some aspects of the methodology described, insight gained through the laboratory experience of the authors. Finally, there is also a full list of references.

Proteoglycans are proteins that are covalently linked to repeating linear polymers of specific disaccharides called glycosaminoglycans (GAGs). They are called glycosaminoglycans because one of the two sugar residues in the repeating disaccharide is always an amino sugar (*N*-acetylglucosamine or *N*-acetylgalactosamine) and the other is usually uronic acid (either D-glucuronicc acid or L-iduronic acid). One or both of the sugars contain one or two sulfate residues. Thus each GAG chain bears many negative charges. Four main groups of GAGs have been distinguished by their sugar residues, the type of linkage between these residues, and the number and location of sulfate groups: (1) hyaluronic acid, (2) chondroitin sulfate and dermatan sulfate, (3) heparan sulfate and heparin, and (4) keratan sulfate. GAGs are interesting examples of how sugar residues can be modified to provide polymers with a wide variety of properties and functions. Glycosaminoglycans are important constituents of all tissue matrices; they provide tissue hydration for fluid flow and molecular transport, charge repulsions or attractions for intermolecular spacing, and polyanionic domains for growth factor or integrin signaling, cell adhesion, and migration or proliferation. The proteoglycan complexes of connective tissue constitute one of the few examples in which the element silicon enters into biology. With few reported exceptions, proteoglycans are exclusively products of eukaryotic organisms, generally of mammalian origin. Although there is ample evidence that core-protein homologs exist throughout evolution in many members of the phylogenetic tree, the capacity to



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synthesize GAGs (chondroitin/dermatan, keratan, and heparin/heparan sulfates) appears to be exclusive to higher organisms.

Proteoglycan protocols is divided into three sections. Part I (Isolation and Purification) consists of listed protocols specifically detailing the isolation and purification of proteoglycans from different vertebrate tissues such as mineralized tissue (teeth), endothelial cells, connective and nervous cells, and invertebrate organisms (*Drosophila*) in 19 chapters. Protocols describe various approaches in cellulose acetate electrophoresis, utilization of cationic dyes –such as alcian blue– analysis of proteoglycans by electrophoresis and immunoblotting, anion exchange HPLC, etc. Part II (Headlined Expression, Detection, and Degradation) contains 20 chapters. This section focuses on the expression, detection and degradation of proteoglycans. Structural and functional studies of proteoglycan domains can be facilitated by the isolation and purification of native proteoglycan. Most current procedures for isolation of proteoglycan from tissue require the use of denaturing solvents. An alternative method is the use of recombinant expression systems. In different chapters, prokaryotic and mammalian cells that express proteoglycans are discussed. Theoretical and practical gene-targeting approaches, using both antisense technology and somatic-cell targeting, are also detailed. A variety of methods will enable the reader to inhibit glycosaminoglycan synthesis, to identify mutant cell lines in proteoglycan biosynthesis, and to study the degradation of various GAGs by using chemical and enzymatic approaches. Part III (Interactions) has 12 chapters. The described methods focus on the complex interaction between proteoglycan molecules – either the protein or the GAG– and lipoproteins, various extracellular matrix proteins, receptors, growth factors, etc.

This book is fully recommended to people that work in cell biology, and specifically in proteoglycans, but it may also be useful to clinical microbiologists, because many pathogenic microorganisms have learned to exploit eukaryotic cell-surface glycoconjugates, i.e. glycolipids, glycoproteins and proteoglycans, as receptor molecules for cell attachment to facilitate tissue colonization and invasion processes. Specific proteins, called adhesins, found on the surface of bacteria, viruses, fungi and parasites interact with carbohydrate chains of glycoconjugates, which enables microbes to colonize mucosal surfaces and tissue lesions. A large number of microbial pathogens, such as *Chlamydia trachomatis*, *Listeria monocytogenes*, and *Helicobacter pylori*, bind to sulfated GAGs such as heparan sulfate on eukaryotic cell surfaces, facilitating the adherence and/or cellular invasion of the pathogen. Heparan sulfate-like structures on macrophages may be key targets for GAG-binding lectins (located on the bacterial surface) to trigger cell binding and cell uptake. However, it cannot be excluded that also binding to other cell surface molecules is necessary to trigger cell uptake.

In the summer of 1881, Robert Koch went to London to attend the Seventh International Medical Congress. He made an important demonstration of the plate technique as well as other methods which he had developed. Louis Pasteur was present at the session and, taking Koch's hand, he exclaimed: "C'est un grand progrès, Monsieur!"

This was, indeed, a great triumph for Koch, as Pasteur could never forget that France had lost the Franco-German War of 1870. It is well-known that some methods lead to outstanding progress in a scientific discipline, and that Koch's greatest contribution to the development of bacteriology and microbiology as an independent science was his introduction of pure culture techniques using solid or semi-solid media. *Proteoglycan Protocols* offers a comprehensive and updated collection of preparative and analytical methods for the in-depth analysis of proteoglycan. It is mainly a practical book that may be modified or applied according to the reader's own circumstances.