METHODS IN MOLECULAR BIOLOGY

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Glycosaminoglycans

Chemistry and Biology

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Preface

Glycosaminoglycans are structurally the most complex biopolymers among the many naturally occurring polysaccharides. Complexity arises from the variation in the sugar residue-type, interglycosidic linkage, chain length, sulfation level, and sulfation position. There are six types of glycosaminoglycans including heparan sulfate, heparin, chondroitin sulfate, dermatan sulfate, keratan sulfate, and hyaluronic acid. With the exception of hyaluronic acid, all glycosaminoglycans are covalently attached to proteins. Glycosaminoglycans have been shown to play significant roles in many model organisms starting from early growth period, through development and beyond. These complex carbohydrate polymeric chains regulate numerous biological and pathological processes such as angiogenesis, morphogenesis, organogenesis, neurogenesis, stem cell differentiation, cell proliferation, cell migration, left-right axis induction, synaptic plasticity, synapse formation, neuronal guidance and growth, hemostasis, infection, and many others. Naturally, there is a considerable interest in understanding the structural basis for their numerous biological actions and in identifying protein ligands that orchestrate these functions through direct interaction with glycosaminoglycan chains. There has been a steady growth in the appreciation for the roles of glycosaminoglycan in many scientific disciplines ranging from developmental biology, chemical biology, organic synthesis, structural biology, biochemistry, cell signaling, drug discovery, stem cell biology, tissue engineering, bioinformatics, and computational glycobiology as seen by the large number of glycosaminoglycan-related papers published in the last 10 years.

In this volume of *Methods in Molecular Biology*, we provide robust methods for studying chemistry and biology of glycosaminoglycans. The volume emphasizes several areas of glycosaminoglycan research including structural analysis of GAGs using a variety of approaches, chemical and enzymatic synthesis of GAGs for therapeutic purposes; biophysical and biochemical methods for studying GAG–protein interactions; molecular approaches for modulating and defining GAG biosynthesis; informatics approaches for deciphering GAG code; computational approaches for establishing specific and/or nonspecific interactions; and genetic and biochemical tools for manipulating/visualizing glycosaminoglycan expression and studying their functions in a variety of model organisms. This volume has a primary goal of providing practical guidance for the chemist to carry out biological experiments, for the biologist to perform chemical/biochemical studies, and for the applied scientist to harness therapeutic application possibilities using chemical, biochemical, genetic, and computational tools. Overall, it is our expectation that this volume will serve as a valuable manual for cutting-edge methodologies and practical (hard to find from the primary literature) tips to overcome any obstacles with experimentation pertaining to chemistry and biology of glycosaminoglycans.

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