Review

The role of chondroitin sulfate proteoglycans in regeneration and plasticity in the central nervous system

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ABSTRACT

Chondroitin sulfate proteoglycans (CSPGs) consist of a core protein and glycosaminoglycan (GAG) chains. There is enormous structural diversity among CSPGs due to variation in the core protein, the number of GAG chains and the extent and position of sulfation. Most CSPGs are secreted from cells and participate in the formation of the extracellular matrix (ECM). CSPGs are able to interact with various growth-active molecules and this may be important in their mechanism of action.

In the normal central nervous system (CNS), CSPGs have a role in development and plasticity during postnatal development and in the adult. Plasticity is greatest in the young, especially during critical periods. CSPGs are crucial components of perineuronal nets (PNNs). PNNs have a role in closure of the critical period and digestion of PNNs allows their re-opening. In the adult, CSPGs play a part in learning and memory and the hypothalamo-neurohypophysial system.

CSPGs have an important role in CNS injuries and diseases. After CNS injury, CSPGs are the major inhibitory component of the glial scar. Removal of CSPGs improves axonal regeneration and functional recovery. CSPGs may also be involved in the pathological processes in diseases such as epilepsy, stroke and Alzheimer's disease.

Several possible methods of manipulating CSPGs in the CNS have recently been identified. The development of methods to remove CSPGs has considerable therapeutic potential in a number of CNS disorders.

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Abbreviations: BRAL1, brain link protein 1; BRAL2, brain link protein 2; ChABC, chondroitinase ABC; C1R1L1, cartilage link protein 1; CS-GAG, chondroitin sulfate glycosaminoglycans; CSPG, chondroitin sulfate proteoglycan; ECM, extracellular matrix; GalNAc, N-acetyl galactosamine; GlcA, glucuronic acid; PNNs, perineuronal nets; RHAMM, receptor for hyaluronic-acid-mediated motility; RPTPζ, phosphacan/receptor-type protein-tyrosine phosphatase ζ; WFA, Wisteria floribunda agglutinin

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