GLYCOPROTEINS AND LONG LASTING PLASTICITY IN FISH CNS

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In several systems, short term plasticity (e.g., homosynaptic facilitation and habituation) is mediated by second messengers, in particular by modulation of intracellular calcium concentrations. The decreasing extracellular calcium concentration induced by synchronous activity may provide a further signal for heterosynaptic mechanisms involved in long term plasticity during regeneration and associative learning, i.e., in plastic changes which also require protein biosynthesis.

Ependymins are homologous, acidic glycoproteins, first observed in the ependymal zone of goldfish brain. They are preferentially synthesized and secreted into the extracellular matrix (5, 6) when the fish learn an operant or classical task. Furthermore, anti-ependymin antibodies prevent memory consolidation after a vestibulomotoric training (5, 8) and after associative learning of an active avoidance response (2) when injected into brain ventricles during a critical time period following acquisition. They also interfere with activity-dependent sharpening of the multiunit receptive fields during regeneration of retinotectal projections after optic nerve crush (3). - Analysis of positive clones derived from goldfish brain c-DNA libraries revealed the presence of a cleavable N-terminal signal sequence in the ependymin precursor-molecule, typical of secretory proteins (1). Furthermore, two N-glycosylation sites were found, in accordance with the detection of 3-sulfoglucuronic acid in N-linked sugar moieties of mature ependymin molecules (9). This epitope is recognized by the HNK-1 antibody, which also reacts with neural cell adhesion molecules (N-CAM, MAG). Isolated ependymins are responsive to their ionic environment: They bind radioactive calcium (4) and polymerize in its absence (7).

It is suggested that synchronous neuronal activity decreases the calcium concentration in the synaptic cleft, thereby triggering polymerization of secreted ependymin molecules. The induced conformational change may ultimately lead towards ultrastructural modifications of functional significance. Behavioural plasticity may thus become comprehensible as a micro-event in synaptic differentiation.

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