

Role of the HNK-1 carbohydrate in the neural plasticity

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The HNK-1 carbohydrate is characteristically expressed on a series of cell adhesion molecules and the expression is spatially and temporally regulated during the development of the nervous system, suggesting that the HNK-1 carbohydrate has important roles in the formation of neural network. The HNK-1 carbohydrate has a unique structure comprising a sulfated trisaccharide (HSO₃-3GlcAβ1-3Galβ1-4GlcNAc-) and is sequentially biosynthesized by one of two glucuronyltransferases (GlcAT-P or GlcAT-S) and a sulfotransferase (HNK-1ST). To reveal the function of the HNK-1 carbohydrate, we generated gene-deficient mice of GlcAT-P, which is a major glucuronyltransferase compared with GlcAT-S in the nervous system. The GlcAT-P gene deficient mice exhibited reduced long-term potentiation (LTP) at the Schaffer collateral-CA1 synapses and defects in spatial memory formation. Therefore, the HNK-1 carbohydrate plays crucial roles in synaptic plasticity. However little is known about the molecular mechanisms how the HNK-1 carbohydrate controls synaptic plasticity. In this study, we produced the evidence that the HNK-1 carbohydrate is expressed on one of glutamate receptors involved in the synaptic plasticity. Using cultured hippocampal neurons, it was revealed that lacking of the HNK-1 carbohydrate affected the localization of the glutamate receptor. These results suggest that the HNK-1 carbohydrate on the glutamate receptor could be involved in the regulation of synaptic plasticity.