Cell adhesion molecules in the development of the nervous system (review)

by

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Introduction.

The developing nervous system is one of the most complex examples of morphogenesis, involving both the formation of intricate tissue structures and their precise interconnections. To accomplish this, the cells must migrate to the proper place where they aggregate, differentiate and form stable connections. Path finding, active migration and formation of stable adhesions during the formation of tissue patterns and formation of synapses in the nervous system are major aspects of its morphogenesis. In these processes cell surface molecules play an important role. These processes depend not only upon cell- cell adhesion molecules (CAMs), but also upon cell-substrate adhesion molecules (SAMs). The growing axons of retinal ganglion cells, for instance, move toward the tectum by recognizing cell adhesion molecules along their pathways (Silver and Rutihauer, 1985). During migration of neural crest cells, cell migration is promoted by extracellular matrix molecules in the pathway of cells moving to sites of differentiation (Thiery, et al., 1986).

Similarly, several types of cell adhesion molecules

developing retina in organ cultures. By culturing a piece of retinal tissue from a 6 day chick embryo for three days in medium containing N-CAM antibodies, they observed several alterations which reduce the resemblance to normal retina. The ganglion cells which normally are arranged in an even layer were less organized and scattered through the inner plexiform layer. It seems that the presence of N-CAM antibodies inhibits recognition of neurons for each other. However, further studies using antibodies to different classes of N-CAMs or together with antibody to R-cognin, could give more information about the involvement of cell adhesion molecules in retinal development.

IV. Discussion.

From studies of N-CAM it can be seen that the immunocytochemical method is used in both in vitro and in vivo experiments to detect cell adhesion molecules or substrate adhesion molecules. By using a specific antibody to a molecule, one can study the involvement of the molecule in developmental mechanisms. However, this method also has limitations. Many of the CAMs' involvement in development for instance, the involvement of N-CAMs in axonal elongation cannot be studied in vivo. In this case, the assumption of what happens in vivo is

References

Antonicek, H., E.Persohn, and M.Schachner, 1987. Biochemical and Functional Characterization of a novel Neuron-Glia Adhesion molecule that is involved in neuronal migration. J.Cell Biology, 104 : 1587 - 1595

Bixby, J.L., R.S. Praat, J. Lilien, and L.F. Reichardt, 1987. Neurite outgrowth on muscle cell surfaces involves extracellular matrix receptors as well as Ca2+ -dependent and -independent cell adhesion molecules. Proc. Natl. Acad. Sci. USA, 87 : 2555 - 2559

Bock, E., C.R-Landsberg, A.Faissner and M.Schachner, 1985. Demonstration of immunochemical identity between the nerve growth factor-inducible large external (NILE) glycoprotein and adhesion molecule L1. The Embo journal, 4 : 2265 - 2768

Bray, D., and Chapman, K., 1985. Analysis of Microspike Movements on the neuronal Growth Cone. J. Neurosci., 5 : 3204 - 3213

Bray, D., 1987. Growth cones: do they pull or are they pushed. Trend In Neurosci., 10 : 1431 - 1434

Bray, D., and J.G. White, 1988. Cortical flow in animal cells. Science, 239 : 883 - 888

Breen, K.C., P.G.Kelly, and C.M. Regan, 1987. Postnatal D2-CAM/N-CAM Sialylation State is Controlled by a Developmentally Regulated Golgi Sialyltransferase. J. Neurochemistry, 48 : 1486 - 1493

Buskirk, D.R., J-P. Thiery, U. Rutishauser, and G.M. Edelman, 1980. Antibodies to a neural cell adhesion molecule disrupt histogenesis in cultured chick retinae. Nature, 285 : 488 - 489

Chuong, C., D.A. McClzin, P. Streit, and G.M. Edelman, 1982. Neural cell adhesion molecules in rodent brains isolated by monoclonal antibodies with cross-species reactively. Proc. Natl. Acad Sci., 79 : 4234 - 4238