Nerve Growth Factor Encyclopedia Article

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Contents

Nerve Growth Factor Encyclopedia Article.....1

Contents.....2

Nerve Growth Factor.....3

Nerve Growth Factor

Nerve growth factor (NGF) is a hormone-like protein produced by target cells throughout the body that controls growth of axons (fibers) that connect embryonic nerve cells and is also required for their survival. NGF, discovered in the 1950s by the Italian-American biochemist Rita Levi-Montalcini, was the first of a number of growth factors that control cell development.

When NGF binds with receptors on the nerve cell and moves into the nucleus, the cell responds by growing an axon (a fiber for transmitting signals) toward the target cell and forms a synapse (connection) with it, building the body's nervous system network. When NGF is blocked by antibodies, the nerve cells die.

Levi-Montalcini first observed rapid nerve growth in chick embryos that were in direct or indirect contact with mouse tumors. Believing that a chemical was the cause, she used the then-new technique of tissue culture--combining tumor material with embryo tissue and blood--to produce nerve growth in the laboratory. The chemical, which she named nerve growth factor, was purified and its protein structure determined by Levi-Montalcini's colleague Stanley Cohen in 1953. The two scientists received the 1986 Nobel prize in physiology or medicine for this work. NGF's complete amino acid sequence was accomplished in 1971 by the American biochemists Ruth Hogue Angeletti and Ralph Bradshaw using a technique developed by the Italian biochemists Vincenzo Bocchini and Pietro Angeletti. Several groups of scientists in the United States have since sequenced the gene that codes for the molecule.

Scientists know that production of axons and development of NGF receptors are two separate functions, but many mysteries about the receptors must still be solved. For example, sympathetic nervous system cells in very early embryos do not need NGF and will not even respond to it. But more mature sympathetic neurons and some sensory neurons must have NGF to survive. Scientists are trying to discover how and when the cells begin expressing NGF receptors and responding to it. Many believe that electrical activity may be involved. Also, the composition of the receptor molecule is not yet known, but a protein produced by an oncogene (cancer-causing gene) called trk appears to be a component. NGF produced by genetic engineering is being studied for possible use in treating nerve cells damaged by Alzheimer's disease, Huntington's chorea, and AIDS-related peripheral neuropathy.