

Working Together to Repair the Cord: A Multifaceted Challenge

The American Paralysis Association (APA) is a national nonprofit organization whose mission is to encourage and support research to find a cure for paralysis caused by spinal cord injury (SCI) and other central nervous system disorders. Since its inception in 1982, the APA has invested millions of dollars in the research of nearly 350 scientists around the world who are exploring ways to repair the damaged spinal cord and promote recovery of function.

Repairing the injured spinal cord is no longer in the realm of science fiction. In the last decade, researchers have made dramatic progress toward limiting and reversing the paralysis and loss of function caused by spinal cord trauma. But we now know there will be no single wonder drug. Treatment will involve a precisely orchestrated series of therapies, starting immediately following an injury and extending through rehabilitation.

For that reason, the American Paralysis Association supports a wide variety of promising research—including the work of the Association's Research Consortium on Spinal Cord Injury. Comprised of seven world-class laboratories, the Consortium brings together a variety of technologies and talents to address the many challenges spinal injuries pose.

The problems researchers must solve are many. The first relates to the hours and days immediately following a spinal cord injury and the others deal with the chronic phase of injury:

CONTROLLING INFLAMMATION. The body's immune system launches a full-scale response to the injury, causing inflammation that worsens nerve cell damage within the spinal cord. Methylprednisolone is now used to control this immune system response, but other drugs are being developed, including some resembling ones that suppress rejection in organ transplants.

MAINTAINING THE BLOOD SUPPLY. A trauma to the spinal cord also ravages blood vessels, sharply reducing blood flow in the area. Circulation must be restored to keep surviving neurons alive and to nourish any new neurons that, with effective treatments, will grow to replace lost ones.

PREVENTING A SECOND ROUND OF NEURONAL DEATH. A spinal cord injury unleashes a disastrous second wave of nerve cell death that may continue for up to a year. Two mechanisms are at work:



Photography courtesy of American Paralysis Association

As Chairman of the American Paralysis Association, Christopher Reeve and his wife Dana present the annual Reeve Research Medal to Martin E. Schwab, Phd, of the Brain Research Institute in Zurich, for his discovery of a protein in the spinal cord that inhibits nerve cell growth and his development of an antibody to block the inhibition.

HELPING NEW AXONS TO REACH THEIR TARGETS.

Axons, the long arms of neurons that extend to other nerve cells, link with them, and transmit electrical impulses, need support and guidance to reach their target connections. Transplanted glial cells, which nourish, protect, and support neurons, could provide a weblike framework for growing axons.

REPLACING LOST NEURONS AND CIRCUITS. By the time regenerated axons reach their destination, target nerves may be damaged or missing. New motor neurons, the nerve cells that control movement, may have to be transplanted to restore nerve pathways.

PRESERVING MUSCLES. Muscles die if they are not activated. They must be kept alive long enough for new nerves to reach them, which could take two years or longer.

necrosis and apoptosis. Necrosis occurs when a cell is damaged and its energy sources fail, causing it to die, decompose, and spew substances that injure other cells. Apoptosis, or programmed cell death, is a tidier process that begins when a healthy cell near the injury site senses something is amiss. Certain genes are activated within the cell, triggering it to methodically shut down.

STIMULATING NERVE REGROWTH. New nerve cells are needed to replace dead and injured neurons. Nerve-growth stimulants known as neurotrophic factors have to be delivered to the site of the injury along with agents to disarm naturally occurring growth inhibitors.

Some of the most important recent developments in spinal cord research have occurred in these areas:

AXON RETRACTION. When spinal axons are severed, the two ends retract, increasing the gap that must be bridged to restore nerve connections. Researchers found that neurotrophic factors, proteins that promote nerve cell growth and survival, also prevent axon retraction.

STEM CELLS IN THE SPINAL CORD. Researchers have discovered primitive cells in the adult rat spinal cord that can divide and become different kinds of cells. When a combination of neurotrophic factors was administered, these so-called stem cells proliferated and migrated to an injury site, where they ensheathed regenerating axons with myelin, an insulation needed to transmit nerve impulses. This is a hopeful sign that once transplanted cells "turn on" the regeneration process, host cells will rise to the occasion and help with the repair.

REHABILITATION. Provocative evidence points to the possibility that rehabilitation may do more than maintain strength and flexibility. Certain types of training may actually activate spinal stem cells to divide and differentiate. One day doctors may combine chemical treatments with rehabilitation to encourage the spinal cord to heal.

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