# *SPINAL CORD INJURY*

The horseback-riding accident of actor Christopher Reeve focused the attention of the world on the devastating severity which can result from spinal cord injury. Although he played Superman on the silver screen, Reeve was powerless to heal himself in real life. In fact, for years he had to be strapped into his wheelchair just to sit upright. Even the life-giving act of breathing, which occurs automatically and without consideration for most of us, was far from routine for Mr. Reeve. Following the accident, each and every breath required the assistance of a mechanical device. Although he improved somewhat, Christopher Reeve was never able to walk or perform most of life's day-to-day activities which most of us take for granted.

■ ***Omental Transposition*****.** In real life there are medical supermen who may have been able to help Mr. Reeve. During the 1960s, Dr. Harry S. Goldsmith of the University of Nevada School of Medicine developed a surgical technique known as *omental transposition*. The omentum is a large, fatty membrane that is attached to the stomach and intestines in the lower abdomen. This apron-like structure is rich in nutrients and growth factors (angiogenic and neurotrophic factors) that promote vascular development (increase blood vessel growth and blood supply) and stimulate healing. Omental transposition consists of freeing the biochemically-rich omentum from the abdominal cavity and, with its blood supply remaining attached and intact, transposing it over the injured area(s) of the brain or spinal cord.[1]

Although the technique has been largely ignored in the U.S., surgeons in many other countries including Brazil, Cuba, Germany, India, Italy, Japan and Singapore have used omental transposition effectively to treat a range of either age-related or traumatically-induced neuropathic conditions including Alzheimer's disease, cerebral palsy, Parkinson's disease, spinal cord injury, and stroke. In China alone over 5,000 omental transpositions have been performed.[2]

One success story is the case of gymnast Darren Renna who sustained a fractured neck at the age of 17, leaving him a quadriplegic who had to be strapped into his wheelchair much the same as Chris Reeve. Renna underwent omental transposition a year-and-a-half following his injury, and today has regained almost total use of both his arms—including the ability to power his own wheelchair.[3] In another dramatic case, a nun regained her ability to read within several weeks after receiving omental trasposition. She underwent the operation two-and-a-half years after having suffered a stroke.

Hundreds of journal articles have been published on the technique of omental transposition, including nearly 100 by Dr. Goldsmith himself. To learn more about the technique, do a key word search for "omental transposition." Dr. Goldsmith still performs the operation, and can be contacted at P.O. Box 493, Glenbrook, NV 89413; fax (702)749-5861.

■ ***Laser Light***. A group of researchers at the Uniformed Services University in Maryland have performed groundbreaking research using laser light. For the first time ever, the severed spinal cords of mammals have been fused together using the coherent, low-intensity light of a laser at the 810 nanometer (nm) wavelength. A group of 10 rats with severed spinal cords received laser treatment over a two week period for about 50 minutes per day. When tested nine weeks after the treatments began, all of the animals had regained their mobility. A control group of ten animals not receiving light treatment showed no signs of improvement.[4]

Although the researchers do not fully understand the mechanism(s) behind the remarkable spine-mending results, they believe the light alters the behavior of cells, allowing the neurons of the spinal cord to "regroup," which in turn allows the spinal cord to refuse.

Lead researcher Professor Juanita Anders stated that advances in light therapy are being made which are "almost too incredible to believe." Christopher Reeve, the researchers believe, might have recovered had he been lasered in the days following his injury. The researchers believe it also might be possible to treat long-term, non-recent injuries. In addition to spinal cord injuries, they intend to focus their technology on stroke victims as well.

■ See also ***Light***, under **Topical Pain Relievers**.

■ ***Dimethyl Sulfoxide (DMSO)***. According to the co-discoverer of its therapeutic properties, Dr. Stanley Jacob of the University of Oregon Medical School believes the substance (solvent) DMSO operates on an entirely new therapeutic principle. According to the medical and pharmaceutical literature, DMSO "is declared to have the widest range and greatest number of therapeutic actions ever shown for any other single chemical."[5]

As such, it benefits a wide range of ailments and performs a variety of functions. It is an anti-inflammatory, bactericide, diuretic, free radical scavenger, fungicide, immune booster, pain blocker, vasodilator, and virocide. In addition, DMSO is able to transport a variety of pharmaceuticals across cell membranes; reduce the incidence of blood platelet thrombi (clots); act as a tranquilizer when rubbed into the skin; promote interferon formation; stimulate wound healing; and a host of other benefits.

One of the most striking areas of benefit of DMSO is in the treatment of brain and spinal cord injuries. When administered intravenously (IV) within 90 minutes of the injury, the substance can produce near miraculous results, including prevention of paralysis.[6] The sooner a patient is given DMSO, the more pronounced the beneficial results are likely to be. Dramatic results have accompanied DMSO administration even when given several hours after the initial trauma. There appear to be at least three factors responsible for this benefit. DMSO is an anti-inflammatory, a free radical scavenger, and the substance reduces the cellular requirement for oxygen.

When the brain and spinal cord (central nervous system, CNS) are traumatized by injury, there is compression of the nerves and tissues which produces swelling. As the swelling takes place within the skull in head injuries and the spinal column in spinal cord injuries, blood vessels constrict and blood and oxygen are cut off from the damaged areas, causing the injury or death of cells and tissues. With the timely infusion of IV DMSO, the swelling is prevented and there is an increased amount of blood flow to the damaged area.[7]

During head injuries, water and blood accumulate within the cranium causing a buildup of pressure that eventually compresses vital brain centers, resulting in permanent injury or death. Immediate treatment with DMSO significantly reduces intercranial pressure, helping the victim to avoid lasting injury or possible death. DMSO binds to the water and blood, takes it to the surrounding blood vessels, and carries it away from the brain. In effect, it dries out the brain from potentially-damaging water and blood.[8]

The production of hydroxy free radicals accompanies head and spinal cord trauma, which extends the damage by killing surrounding cells. DMSO is such a powerful antioxidant that it interrupts the ensuing free radical cascade, thus protecting neuronal tissues. Although it is not known why, DMSO reduces the amount of oxygen required by the cells for healthy functioning. This is particularly important in brain and spinal cord injury where oxygen deprivation is a major contributing factor to cell damage and death.[9]

In animal CNS injuries, when the animal is brought to a point of near death—as indicated by a flat electroencephalogram (EEG)—the IV infusion of DMSO restores the normal EEG in about 10 minutes. A normal respiratory pattern is also restored, with breathing becoming deeper and faster, a desirable effect in CNS-injured victims. Also, the elevated blood pressure that accompanies CNS injury in animals and man is stabilized.[10]

In one dramatic study, the blood supply to the midsection of the spinal cord was blocked for 30 minutes in 24 mongrel dogs. The 12 animals in the control group received a saline injection, while the experimental group of 12 received an injection of DMSO. Eleven of the 12 animals receiving the saline solution experienced total paralysis of the lower extremities. Eleven of the 12 DMSO-injected animals, on the other hand, had a complete recovery and were able to walk and run normally. The twelfth animal in the DMSO group had only a slight weakness. Microscopic studies of the tissues of both groups showed ischemic (oxygen deficient) changes and cellular damage in the control group but none in the DMSO-treated group.[11]

Administering DMSO to humans has had similar dramatic results. In one quadriplegic patient who had no sensation or muscle activity from the neck down, the immediate administration of DMSO led to the patient moving his toes within two hours, and an eventual total recovery with full function.[12]

DMSO's co-discoverer Dr. Jacob reported two cases at his Oregon medical school in which DMSO was given within one hour for CNS accidents which would have resulted in immediate, complete quadriplegia. In both instances the patients walked out of the hospital after having made a complete recovery.[13] Dr. Jacob reported three additional cases where DMSO was administered five, six and nine hours following CNS trauma, where the likelihood of paraplegia was near 100%. Even though the 90 minute window of opportunity had passed significantly, two of the three patients were able to walk after receiving intravenous administration of DMSO.[14]

There have been other similar cases, yet the technique is virtually unknown within the halls of emergency medicine. Those who understand its therapeutic efficacy believe DMSO should be carried in ambulances for rapid administration, and should be a standard emergency medical tool readily available in all emergency room settings.

To learn more about DMSO, see **Topical Pain Relievers**, read Dr. Morton Walker's book *DMSO: Nature's Healer*, or do a key word search for "dmso."

■ ***Rolipram*.**[15] Inhibition of nerve cell growth in the spinal cord is a major contributing factor in preventing recovery in spinal cord injuries. Various chemicals have been identified which inhibit the regrowth of damaged spinal cord neurons, including *NOGO*, *myelin-associated glycoprotein*, and *oligodendrocyte myelin glycoprotein*. In 2001 it was discovered all three inhibitory chemicals function by binding to the same receptor site on the surface of nerve cells, which raised the possibility that blocking this receptor site could prevent growth inhibition.

Researchers at the City University of New York recently discovered a drug that overcomes the effect of the growth-inhibiting chemicals. It does this by raising the level of the common signaling molecule *cyclic AMP*, or cAMP. The drug, rolipram, was once licensed for use as an antidepressant, but was removed from the market for causing nausea and vomiting in the oral form—which shouldn't be a problem when used in an injectable form in treating spinal cord injuries.

In a study of 20 rats which had their spinal cords severed in the neck region, half were administered rolipram two weeks after injury for an additional two weeks. Following treatment, 70% of the treated group regained significant function compared to 20% of the placebo group. Although still in the initial stages of research, the use of rolipram may eventually offer one aspect of a multi-pronged approach to treatment.

■ ***Fusion Technology***. Yet another technique offering hope to those with nerve injuries has been pioneered by researchers at the University of Texas at Austin. As reported in the *Journal of Neuroscience*,[16] researchers first apply a sticky solution of polyethelene glycol (PEG) to the cut, crushed, or otherwise damaged nerve axons for a period of only one or two minutes. Thereafter, the PEG solution is washed off and the nerve endings are then soaked in calcium salt solutions resembling natural body fluids. The PEG solution basically removes water from cell surface membranes, allowing the membranes to fuse together. Within seconds to minutes after the (central or peripheral) nerves are rejoined, the repaired cells once again begin to conduct electrical signals across the previously-damaged area. Between 5-60% of the nerve impulse level has been restored. Purdue University researchers have also demonstrated similar results.[17]

■ ***Constraint Induced Movement Therapy*** (CIMT, or CI Therapy). A technique offering much hope to stroke victims is being called an example of miracle medicine. Known as Constraint Induced Movement

Therapy (CI Therapy), the technique aims to assist brain-damaged individuals regain significant use of an affected limb when suffering from *hemiparesis*—total or partial paralysis of the limb or limbs of one side of the body which results from disease or injury to the motor centers of the brain. The method also appears to be effective in the treatment of **spinal cord injury**, fractured hip, children with cerebral palsy, and musicians with focal hand dystonia (incoordination of the fingers).[18]

During the initial period of limited mobility following an injury or other damage to the brain, a person learns not to attempt to use the affected limb(s), called "learned non-use." While efforts to use the affected limb are futile, painful and embarrassing, the motor area of the brain begins to atrophy as the result of non-use. This creates a cycle that results in the person's continued inability to move the limb.

CI therapists believe that learned non-use can be overcome and reversed. The technique consists of constraining the unaffected (good) limb such as an arm or leg, while the affected limb receives intensive physical training six to seven hours per day for two to three weeks—a technique that's referred to as "massed practice." The unaffected limb is immobilized either by bandages, a cast, a sling or a mitt, while the affected limb is exercised using routines such as drawing, playing chess or checkers, sweeping the floor, throwing a ball, or walking. The unaffected limb remains immobilized for 90% of the patient's waking hours.

The rationale for the treatment is that following brain injury, a certain number of brain cells die. However, many cells surrounding the area most severely affected are merely "stunned," but continue to live and have sufficient plasticity to recover. The goal of CI Therapy is to re-awaken these stunned or partially-injured cells so that they take over the task of the cells that are totally nonfunctional. In effect, CI aids the brain in rewiring itself by triggering new connections, resulting in massive cortical reorganization.[19]

Of the several hundred patients who have received CI Therapy to date, the best results have been achieved in patients with mild to moderately-severe stroke—representing the upper 50-75% of the most severely-impaired patients. Virtually all CI Therapy patients benefit substantially, with most regaining much of their lost limb movement, even if therapy is begun years after the stroke occurred. Following two weeks of therapy, most patients begin using their affected limbs much more normally. Those with an affected hand or arm begin to dress themselves, brush their teeth—in short, they once again reenter the world of the able bodied, and the beneficial results appear to be permanent.[20]

The routine of CI Therapy if fairly intensive. Those who most closely comply with the treatment guidelines receive the most benefit. Participants must have patience and a willingness to work hard, and must be continually encouraged that hard work will produce positive results.

Although several hundred patients have been treated with CI Therapy, the technique is still in its infancy. Until controlled, multicenter studies are done the technique will be considered experimental by some. One caveat to this approach is that there should be a span of several weeks between the initial injury/stroke and the initiation of therapy, as animal studied have shown that damage to the brain increases when the limb is used immediately following an experimentally-induced stroke.[21]

Most of the work with this technique has been done either at the University of Alabama in Birmingham, or in Germany. Dr. Edward Taub is one of the leading proponents of the technique, and administers CI Therapy at the Taub Training Clinic in Birmingham. The cost of treatment ranges from USD $6,000-13,000, and is not covered by Medicare or other insurers. The CI Therapy Research Laboratory, also in Birmingham, carries out various therapy research projects for which treatment is free. To research clinical trial availability, visit www.strokecenter.org/trials/. To speak to The University of Alabama Taub Training Clinic, call (205)975-9799. To learn more about CI Therapy, do a key word search for "constraint induced therapy."

■ See also ***Hyperbaric Oxygenation*** (HBO), discussed under **General Treatment Methods**.

## *ENDNOTES*

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