Hope for accident victims

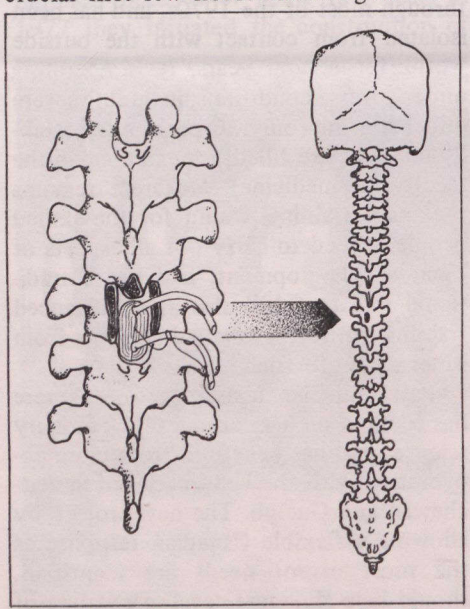
After more than ten years of research, the National Research Council (NRC) and the Montreal Neurological Institute have developed a practical method for preventing some of the crippling consequences of spinal cord injuries, reports Michel Brochu in *Science Dimension* 1979/5.

Each year in Canada, some 500 people suffer devastating spinal cord injuries in automobile, skiing and diving accidents, too often resulting in a permanent loss of sensation and muscular control in much of their bodies. Modern medicine has been relatively helpless in many such cases, the only recourse being palliative care and words of sympathy.

Now, however, a Canadian research team has developed a promising method for treatment of these injuries to the spine, a surgical "cold finger" which has already been dramatically demonstrated as effective on an injured Montreal man.

Cooling injured cord

The researchers, neurosurgeon Dr. Robert Hansebout of the Montreal Neurological Institute, Dr. Alan Tanner, Head of NRC's Control Systems and Human Engineering Laboratory, and neuroanatomist Dr. Cesar Romerro-Sierra of Queen's University, Kingston, Ontario, have spent the last ten years developing the technique, which involves local cooling of the injured section of the spinal cord during the crucial first few hours following an accident. The cooling unit was developed at NRC and tested for several years on hundreds of experimental animals.



This schematic view of a human backbone shows the site of implantation of a cooling pad used to treat spinal injuries.

Explains Dr. Hansebout: "The spinal cord is a vital pathway for nerve impulses to and from the brain; as such, it is very well protected: located in a canal inside the backbone, it is surrounded by a tough membrane called the dura and floats in a cushioning layer of fluid. If the vertebrae are displaced or fractured, however – in other words, if you break your back – the cord can get pinched and its blood supply hindered, causing swelling. At first, it might look intact, but within minutes little hemorrhages begin in the center of the cord and spread slowly. Within a few hours, large portions of the cord can suffer irreversible damage. Several other destructive processes involving the release of harmful enzymes and disruption of the nerve cell membranes can also occur."

Heat exchanger developed

In 1968, medical researchers became interested in the possibility of slowing down, perhaps even preventing some of those harmful processes by cooling the patient's body. They soon found out that when the whole body is cooled below 28°C, the heart goes into ventricular fibrillation, which can lead to death. Some surgeons tried to cool the spinal cord locally by irrigating it with cold water, but there were a number of undesirable side effects. It was in light of these background events that Dr. Hansebout sought out the help of NRC's Alan Tanner to produce a compact heat exchanger that could be placed directly on the injured section of the spinal cord to cool it at a controlled rate for a few hours.

The final design, arrived at after testing many variations, was a small pad of silastic rubber through which a cooling liquid flows. The liquid, a mixture of alcohol and water, is circulated by a "peristaltic pump", a common device in hospitals for pumping blood without the risk of contamination.

Several years of testing the system on animals followed, and by 1977 Dr. Hansebout was ready to try the new technique on selected human patients. His first candidate was Paul Rheault, a young Montreal architect who suffered a severe spinal cord injury in a three-storey accidental fall. A quick examination at the Montreal Neurological Institute showed that Rheault was totally paralyzed from the waist down, with no sensation of muscular control in the lower half of his body because of a fractured vertebra in the middle of his backbone. This kind of injury usually results in paralysis for life.

Treatment overcomes paralysis

Although his recovery took months he has now recovered to a remarkable degree. He now walks, occasionally using walking sticks to help himself, and his body functions and sensations have returned to normal.

Since that first operation, three more patients have been treated with an improved portable version of the NRC spinal cord cooling machine, with encouraging results.

The treatment's effectiveness, clearly established with experiments on hundreds of animals, involves administering cortisone to the patient and opening the injured section of the spinal column to expose the *dura,* the envelope of the spinal cord. The cooling pad is then gently deposited onto the unopened *dura* and maintained at 6°C for four hours. By not opening the *dura,* the risk of exposing the central nervous system to infection is avoided. Also, because the spinal cord is very delicate and soft it can literally be squeezed out like toothpaste from a punctured tube if this envelope is opened.

After the treatment is completed, the surgeon fuses the injured vertebrae and closes the wound to await recovery.

Time essential

Concludes Dr. Hansebout: "Last summer, we treated more patients. One of the crucial factors we recognize in these injuries is time. We have found, from our experiments with animals, that it is absolutely essential to cool the spinal cord as early as possible after an injury. If delayed for more than about four hours, the treatment loses a great deal of effectiveness. We cannot perform miracles and the whole point of the technique is to save what is left of the spinal cord and prevent swelling and other harmful reactions from irreversibly crippling the patient. This must be done in the crucial first few hours after an accident, as the technique cannot be used to treat old injuries after a period of days, months or years.

The technique, which is still at an early clinical stage, is currently being subjected to extensive clinical trials taking place in Canada and the United States.