Laser Research

Clinical laser therapy and pain management

Various techniques are being studied as an option to conventional treatments for chronic pain: acupuncture, hypnosis, wholistic medicine concepts, etc.

Laser therapy is another alternative, and researchers are currently investigating this medium as a viable means of pain management.

In the following article, edited for publication from the *Journal of Clinical Laser Medicine and Surgery*, June, 1990, by John Lauerman and Robyn Rosenbaum, current research into lasers and pain control is reviewed.

A number of researchers are currently engaged in groundbreaking studies that may yield previously unknown applications for the laser in the area of pain control. Their research may even provide basic information about the nature of the nervous system as they hunt for information on the laser-neuron interaction.

Selective neuron distruction

Laser applications in the nervous system have been confined to cutting and vaporizing with the CO_2 laser and the coagulation of blood vessels with the Nd:YAG laser. These are considered high-temperature lasers, and are normally used for their ability to obliterate tissue and thus destroy malignancies and malformations.

Research is currently underway, however, to see how these and other lasers interact with neurons. These researchers hope that lasers can be used to selectively destroy pain-sensitive neurons, thereby combating certain intractable pain syndromes that have proven resistant to almost all conventional methods of treatment.

Conditions that can result in continuous pain are back pain, causalgia (pain due to nerve fibre injury), phantom limb pain that persist in nerves emanating from amputated limbs, stump neuromas, pain from tics, and from various types of cancer. Pain can also result from lesions of the somatosensory pathways in the spinal cord, brainstem, and thalamus.

Conventional methods

Several conventional methods are currently employed in treating these various pain syndromes. Rhizotomy, or the cutting of the spinal nerve roots to deactivate the troublesome nerve, is one such method. However, this procedure can result in loss of important and healthy functioning nerve tissue.

Other widely used methods include transcutaneous electrical nerve stimulation (TENS) - in which nerves are electrically stimulated - and the administration of analgesics. Both these methods are addictive, with TENS possibly even contributing to a patient's pain in the long run.

Selective photothermolysis

Because of the need for a more satisfactory method for treating chronic pain, researchers have directed their lasers at the problem. Originally, two medical researchers at the Harvard Medical School, Dr. John Parrish and Dr. Ron Anderson, developed the idea of destroying melanin-containing cells and micro-vessels using selective photothermolysis.

They discovered that the tunable-dye laser could be focused specifically on the red blood cells **inside** enlarged blood vessels. So focused was the laser that the tissue between the blood vessel and the surface of the skin was left intact.

It was the selectivity of the tunable-dye laser and the Anderson-Parrish research that inspired a professor of neurology at Harvard, Dr. Jeffrey Macklis, to apply their experimentation to pain neurons.

Dr. Macklis considered it an interesting idea to see if chromophores (molecules designed to absorb specific colour bands) could be put into selective populations of neurons by having certain kinds of nervous system cells actively store these molecules.

Dr. Macklin's inspiration was successful to the degree that he and associate, Dr. Roger Madison of Duke University, were able to induce brain and peripheral nervous system cells to selectively store chromophores in vitro.

Pain neurons labelled

Presently, Dr. Macklis is attempting to optimize the characteristics of both the tunable-dye laser and the chromophores he has been working with to selectively destroy only pain-sensitive neurons.

Using a recently developed delivery system that labels pain neurons with chlorin *e6*, he hopes to photothermalize only the selected pain cells.

Laser tissue interaction, selective neuron targeting and injury are being studied using live mice as the first experimental model. Chlorin *e6* and a fluorescent label will be injected into the mice, after which the rate, level and specificity of the uptake of chromophores into small-diameter pain neurons will be assessed biologically.

Impairing the synaptic function

Other experiments using the laser in pain control involve the effects of the Q-switched Nd:YAG laser on various nerve fibres. It appears that the laser can induce preferential impairment of synaptic function in small afferent fibres of dorsal horn cells in the spinal cord and slow-conducting nerves in dorsal roots and peripheral nerves.

Studies have shown that the laser impairs small neural conduction and molecular transport in small sensory nerve fibres, as opposed to fast-conducting fibres. The use of the laser on slow-conducting fibres could prove to have important clinical applications. For instance, pain management, according to Dr. William Rymer of the Chicago Institute of Neurosurgery and Neurological Research, is at its greatest just below the surface of the spinal cord. The laser must be able to affect only those pathways involved in pain transmission.

Patients with unrelenting pain from cancer or a tic normally would have to go through a surgical lesion of the spinal cord. Here, you run the risk of damaging pathways that might still be useful to the patient. However, Dr. Rymer says, "with the laser, you might be able to interrupt synaptic transmission without actually cutting the spinal cord."

This kind of pain control research may lead to a new means of laser therapy - a more focused, less invasive form of treatment for chronic, and in some cases acute, pain. Depending on the nature of the ailment and the status of the patient, laser therapy may be viable in a number of illnesses. With successful application of laser therapy, pain syndromes that have been labelled "intractable" may perhaps become labelled "temporary." ■

World's first stethoscope - a child's toy!

One of the most ubiquitous medical instruments is the stethoscope. Almost everyone can recognize one. But, would you recognize the first stethoscope in medical history? Probably not, unless you were in a Paris park on the afternoon of July 16, 1816.

Napoleon and his armies were playing their games around Europe, and so were a group of children in a Paris park the afternoon that Dr. Rene Laennec, Napoleon's personal physician, visited the park during lunch break and observed the children playing excitedly with a piece of hollowed-out wood.

In reply to his question about what was so impotant and exciting about the piece of wood, Laennec was told to sit down. One end of the hollow wood was put to his ear. At the other end, one of the boys made a slight scratching noise and the doctor suddenly heard a very loud noise in his ear.

Becoming deadly serious, he rushed back to the hospital which he operated, made a simple cardboard tube and shouted to his assistants that he had a device that would revolutionize medicine.

He headed for a patient with blue lips, diagnosed as having heart disease, pulled up his night shirt, placed the cardboard tube against the area of the heart and put his ear to the other end.

He seemed to become transfigured as he called his oldest assistant to him and asked him what he could hear. The answer defined that which was of essential importance for auscultation (listening).

"Quite strange, I hear heart beats. I can loudly hear heart beats through this silly thing! My God, what an invention!" And the stethoscope was born.