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STRATEGIES FOR IMPROVING PERIPHERAL NERVE REGENERATION AFTER SEVERE LESIONS: THE POTENTIAL ROLE OF LOW-LEVEL LASER THERAPY

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- Laboratory research

Why?

- Nerve fibers are subject to trauma
- CNS injuries 11,000; peripheral nerve injuries greater than 50,000
- Peripheral nerves (PNS) regenerate (can) spontaneously
- White matter fascicles (CNS) do not regenerate spontaneously
- His thesis
    - PNS regenerate more but almost never completely
    - CNS regenerate less, but almost never nothing at all
    - Because of this, both situations warrant rehabilitation

Peripheral Nerves

- Mild lesions do not require surgical repair
- Severe lesions require surgical repair

Surgical repair to re-establish nerve continuity

- No substance loss: suture, quite good but not lined up
- Substance loss: more complex,
    - Nerve graft (usually sacrifice a totally sensory nerve, like the sural nerve)
    - Stabilization: biological tube which allows the fibers to grow
    - Most severe: no more cell bodies, still have the distal nerve, or have the nerve cell but no distal nerve: can graft onto another nerve

Postsurgical rehabilitation

- Drugs
    - Hormones
    - Immunosuppresants
    - Gangliosides
    - Ca channel blockers
    - Neurotrophins
- PT
    - Exercise
    - US
    - Electrostim
    - Magnetic fields
    - Hyperbaric oxygen
    - Laser
- Others: stem cell transplants

Critical analysis of the literature on experimental studies for post-traumatic or other peripheral nerve injuries:

- Ten studies
- Rabbit studies more similar to humans, rats regenerate better than both: 80% rat, 20% rabbit, 70% mild nerve lesion
- Laser: more recently using semiconductors, 83l8-904 nm, -.31 to 162 J/cm, 90% continuous, 10% pulsed
- Treatment protocol: begin on first posttraumatic/operative day, 5-28 daily applications transcutaneously
- Outcome measures: functional evaluation, electro physiology, morphology
- RESULTS
    - 90% laser increased nerve repair process
    - 10% no detectable effect, but study limitations
    - 7 labs around the world

His study: worst lesion: transection requiring surgery, then laser after surgery, used rats, complete transection of left median nerve, repair by end-to side neurrorhaphy on the ulnar nerve, measured by grasping (only nerve that does)

- 3 times a week for 3 wks
- Continuous emission InGa(Ai)As laser 80 nm, 29 J cm/w
- Pulsed emission 905 nm, 40 J/cm2 Incas laser
- 4 groups: sham, continuous laser-TX, pulsed laser-TX, continuous pulsed combined laser TX
- The best results were with the combination of continuous and pulsed laser, next best with continuous, only a little improvement with pulsed, took 16 weeks—functional results combined gave 50% of normal function
- Muscle weight with the combined treatment was the same as control, as normal, the untreated lost 50% of mass
- The nerve fiber was 50% of normal size in the combo treated group
- SUMMARY:
    - Faster myelinization
    - Faster recovery of muscle trophism
    - Faster recovery of lesioned function
- What does LLLT do?
    - Stimulation of CA++ release and ATP synthesis
    - Neuroprotection, up regulation of TGF-beta 1, CGRP
    - Promotion of Schwann cell proliferation
    - Activation of the sprouting program distributed along the axon length (usually repressed)
- Early post-operative laser therapy should be regarded as a very promising rehabilitation tool for improving nerve regeneration after surgically repaired severe nerve lesions in patients.