

Notes by Joan B. Martin MD

Please contact me with any corrections

drjoanbmartin@yahoo.com or joan.b.martin@kp.org

810 NM LIGHT THERAPY IMPROVES AXONAL REGENERATION AND FUNCTIONAL RECOVERY FOLLOWING ACUTE SPINAL CORD INJURY

Kimberly Byrnes, Georgetown University, USA

- 11,000 new cases year
- 55% between 16-20 y/o
- 46% in the thoracic or lumbar region
- Her interest is in the secondary injury
 - Demyelination
 - Axonal degeneration
 - Neuronal death
 - Cavitation
 - Glial scarring
 - Inflammation
 - Cytokines
 - Cell invasion: neutrophils, macrophages and activated microglia
 - All of which exceed the injured area

Treatments

- Current
 - Anti-inflammatories: methylprednisolone
 - Removal of inhibitory factors
 - Growth factors
 - Transplantation
- Light therapy in low doses can have stimulatory effects
 - Increases DNA < RNA and protein synthesis
 - Improves axonal
- High dose > 10 J/cm² can have the reverse, negative effect

Hypothesis: transcutaneous application of light promotes axonal regeneration and functional reinnervation of spinal cord neurons following transection in rats

- Can light penetrate the spinal cord?
 - 810 nm, 150 mW laser, measure penetration: got 50% transmission through tissues, except higher in blood
 - Got 9 mw to spinal cord
 - In vivo measurements showed a peak of wavelength for deep penetration at 800-810 nm
 - Conclusion 810 nm light optimal to penetrate to spinal cord
- Transected rat spinal cords
- 810 nm 150 mW, 29 minutes, 57 seconds, 14 days = 1589 J/cm² per day
- Through a fiberoptic fiber that gave a homogeneous beam
- Found increased axons distal to the lesion 5 wks post injury
- Laser treated had 9 mm of growth past the lesion, control had 3 mm???

- 10% actual axonal regeneration in laser treated group

Spinal cord injury and function

- Laser treated were able to cross a ladder faster, but had the same number of “foot falls”
- Conclusion: laser improved some locomotor abilities

Most recent work: determine optimal parameters for light therapy:

- Number of days: no difference between 14 and 2
- Improved if did 7 days of TX after the injury over the injury and then moved it distally
- 24 hour delay in TX after injury does not seem to make a difference
- Laser affects over 200 genes involved in spinal regeneration

Summary

- 6 hours post injury: neutrophils invade, cytokines?
- 48 hr-14 days: macrophages and activated microglia invade + astrocytic activation leading to scar
- Light alters gene expression after injury
 - Cytokines decrease
 - No decrease in neutrophil invasions
 - But significant decrease in macrophage and microglia invasion
 - Decreased inflammation and scarring
 - So improved axonal regeneration and functional recovery