TRANSCRANIAL LOW-LEVEL LASER (LIGHT) THERAPY IN MICE: TRAMAUTIC BRAIN INJURY AND BEYOND

Michael Hamblin, Weijun Xuan, Liyi Huang,
Shih-Fong Huang
Wellman Center for Photomedicine, Massachusetts General
Hospital, Boston, MA

Background: Traumatic brain injury (TBI) has no good treatment at present. Transcranial low-level laser (light) therapy at near-infrared wavelengths (810 nm) penetrates the scalp and skull and provides many beneficial effects to the brain. These include neuroprotection, anti-apoptosis, anti-inflammation, angiogenesis, neurogenesis and synaptogenesis. These effects could also be beneficial in numerous brain disorders.

Study: Mice were subjected to two different types of TBI (closed head and controlled cortical impact (CCI)) and treated with LLLT to the head starting at 4 hour post-injury. The wavelength, fluence, power density, pulse structure and treatment repetition were varied. Mice were followed with neurological severity score, wire grip test, forced swim test, tail suspension test, Morris water maze, and numerous immunofluorescence studies on brain sections removed at sacrifice.

Results: In the closed head model a single treatment 4-hours post-TBI with CW lasers at 660nm and 810nm were effective, while 730nm and 980nm were not. In the CCI model 810-nm laser pulsed at 10Hz was superior to 810nm laser at CW or pulsed at 100 Hz. In another study we compared a single treatment 4 hours post TBI with three daily treatments and with fourteen daily treatments. Three daily treatments gave best results while 14 treatments gave no benefit. This result was explained by the lack of neurogenesis after 14 treatments that was apparent after 3 treatments. Upregulation of a neurotrophin (BDNF) and markers for synaptogenesis was also seen.

Conclusion: The beneficial effects in stimulating neurogenesis, synaptogenesis and BDNF after transcranial LLLT suggest it may have wider applications beyond TBI to neurodegenerative diseases such as Alzheimer's and psychiatric diseases such as major depression.