

Photobiomodulation (Laser Therapy) & Immune Function

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The coronavirus pandemic has affected the lives of millions, either through direct infection or unprecedented government-imposed quarantines and stay-at-home orders. Due to its deleterious effects, all science-based solutions should be explored and implemented if the benefits outweigh any potential risks.

Photobiomodulation (PBM, also known as laser therapy) uses a light source from lasers, light-emitting diodes or broadband light in the visible and near-infrared spectrum. Different methods to deliver PBM to target tissue include the following:¹

- Intravenous (IV), directly irradiating the bloodstream
- Transcutaneous, to target the bloodstream for systemic effects
- Transcutaneous, to directly target tissues deep in the body

Therapeutic Laser as an Immunomodulator

The human immune system acts a defense mechanism against potentially harmful invaders, such as bacteria and viruses. Photobiomodulation treatments can stimulate immune responses, and treatment targeting the lymph nodes or spleen can amplify the effect. Therapeutic laser is a safe, effective immunomodulator that can be applied to patients of all ages with a wide variety of clinical conditions.²

Intravenous PBM treatments are invasive, breaking the skin with a large-gauge needle. Systemic treatments use low-powered red lasers, which are held for 30 minutes or more on areas where the blood is near the skin surface, such as the wrist or popliteal fossa. Class 4 therapy lasers use infrared wavelengths that deliver adequate dosages to cells and tissues deep in the body.³

One paper concluded: "PBM has been shown to act on immune system cells in several ways, activating the irradiated cells to a higher level of activity. It has been shown to increase both the phagocytic and chemotactic activity of human leukocytes in vitro. PBM has also been shown to act directly and selectively on the autoimmune system, restoring immunocompetence to cells."⁴

Another study found pronounced improvement of the immunological indices in patients with positive clinical dynamics.⁵ PBM may be used as a supplemental therapy or even an alternative without side effects and drug interactions.⁶ Another source catalogs numerous studies on PBM and the immune system.⁷

A very recent paper reviewed the history of both disease pandemics and light-based therapies, and stated the following: "These early results suggest that red and near infrared light have the potential to reduce some of the critical complications of coronavirus infections, i.e., pulmonary

inflammation and lung fibrosis."⁸

Nitric Oxide Production With Photobiomodulation

According to the authors of a study published in *Experimental Biology and Medicine*, "Studies that have focused specifically on the mechanism of light therapy have shown increases in cellular metabolites and signaling molecules including ATP, reactive oxygen species (ROS) and nitric oxide (NO), leading to the currently accepted belief that the mitochondrial respiratory chain enzyme cytochrome c oxidase is the chromophore, receiving photostimulation."⁹

Nitric oxide mediates vasodilation by relaxing vascular smooth muscle and increasing vessel diameter, and has been implicated in a number of mechanisms mediating wound healing. It also modulates the inflammatory and immune response by "inhibiting T- and B-cell proliferation, antibody production by CD5 B-cells, T- and B-cell diversification and leukocyte recruitment."¹⁰

Potential Role of Laser in Viral Infection Defense

Evidence suggests some patients with COVID-19 might have a cytokine storm syndrome, and acute lung injury is a common consequence of this syndrome. The damage caused by the virus could be mitigated with an adjuvant therapy that reaches all organs, with a special interest in the respiratory system.¹¹

Effective COVID-19 management must include increased oxygenation and faster rehabilitation of the damaged tissue, antiviral effects, and finally, reduction or controlling of the cytokine storm by reducing inflammatory agents.¹² Treatments are focused on the antiviral and anti-inflammatory by stifling the cytokine storm and increasing tissue oxygenation.¹³

A paper in the *Journal of Virology* states that nitric oxide (NO) has an inhibitory effect on some virus infections, and that NO inhibits viral protein and RNA synthesis. It also states: "NO specifically inhibits the replication cycle of SARS CoV, most probably during the early steps of infection, suggesting that the production of NO results in an antiviral effect."¹⁴

A recent letter in *Photobiomodulation, Photomedicine, and Laser Surgery* opined, "Previous studies show that PBM improves the immune system. In consequence, we suggest taking special attention to the superoxide dismutase (SOD) synthesis increment as a result of this therapy and to evaluate if transdermal PBM could control the cytokine storm that may occur in patients with COVID-19."¹⁵

According to Praveen Arany, PhD, current president of the World Association for Photobiomodulation Therapy (WALT), "Many of us have clinical and, perhaps personal experiences with PBM treatment have clearly noted its ability to improve anti-viral response and host immunity showcasing the potential utility of this treatment in the current health crisis. Nonetheless, as far as we are aware there have been no direct, controlled studies to date on the COVID-19 specifically."¹⁶

Since nitric oxide is an established mediator in photobiomodulation mechanisms, and since nitric oxide is also proven to have antiviral effects, photobiomodulation is a potential viable treatment option for coronavirus patients.

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