Photobiomodulation

There are numerous examples of light induced photochemical reactions in biological systems. Our vision is based upon light interacting with photosensitive cells in our retinas called photoreceptors. When light is absorbed by these cells, a photochemical reaction occurs converting light energy into electrical signals that are transmitted to the visual processing centers of the brain. Vitamin D synthesis in our skin is another example of a photochemical reaction. When the ultraviolet B (UVB) wavelength in sunlight strikes our skin, it converts a universally present form of cholesterol, 7-dehydrocholesterol to vitamin D3. The negative effects of the absence of light on the human body are also well known. Two examples include seasonal affective disorder (SAD) and lack of vitamin D production leading to rickets.

Photobiomodulation (PBM) is the term used to describe the mechanistic/scientific basis for this photonic specialty and photobiomodulation therapy (PBMT) as the term for its therapeutic application. PBMT was first developed in the 1960s. During the early years, this emerging photonic application was plagued by a number of problems including inconsistent terminology. A number of terms were introduced such as Biostimulation, Cold/Cool Laser, Low Level laser therapy, Soft Laser and Low Power Laser Therapy. Based on recent consensus in the field, PBM and PBMT are now considered the terms of choice. In 2015 thanks to the efforts of Dr. Praveen Arany, PBMT was added to the National Library of Medicine MeSH database as an entry term to the existing record of laser therapy, low-level. In summary, PBM and PBMT are accurate and specific terms for this effective and important therapeutic application of light.

What devices are used to treat these conditions?

A suggested definition for PBMT is a form of light therapy that utilizes non-ionizing forms of light sources including LASERS, LEDs, and broadband light, in the visible and near infrared spectrum. It is a non-thermal process involving endogenous chromophores eliciting photophysical and photochemical events at various biological scales. PBM devices have been cleared for marketing by FDA through the Premarket Notification/510(k) process as adjunctive devices for the temporary relief of pain. These clearances were based on the presentation of clinical data to support such claims.

Description of treatment

In this therapy, a light source is placed near or in contact with the skin, allowing the light energy (photons) to penetrate tissue where it interacts with chromophores located in cells resulting in photophysical and photochemical changes that lead to alterations at the molecular, cellular and tissue levels of the body. Light induces a complex chain of physiological reactions in diseased and damaged tissues to accelerate wound healing and tissue regeneration, increase circulation, reduce acute inflammation, reduce acute and chronic pain and help restore normal cellular function. Interestingly, recent research indicates that light can enhance performance in normal tissues and cells.

When should PBMT be used?

The potential applications of PBMT are numerous and are being explored experimentally at the basic science, pre-clinical and clinical level. The current clinical uses are for the relief of pain and inflammation and the treatment of sports injuries. PBMT devices have been approved by the FDA to stimulate hair growth and decrease fat deposits.

Pain Relief

Before using PBMT treatment to treat acute or chronic pain, a provider must diagnose the condition to confirm that the pain is from a neuromusculoskeletal condition caused by aging or injury and that there is no disqualifying condition or contraindication for laser use. For example, if there are visible lesions on the skin, it must first be confirmed that they are not cancerous before the patient can undergo PBMT. Pregnant women also are not good candidates for PBMT since the effects on the fetus are unknown. The treatment parameters and number of sessions needed for PBMT are dependent upon location and cause. PBMT usually requires more than one treatment for optimal pain relief. It may take several treatments for the results to become evident. Spine-Health.com reports that it can take anywhere from eight to 30 sessions for a treatment to be fully effective, and some patients find it necessary to undergo treatment two to four times per week. The total number of treatments needed depends on the condition being treated, the severity of the condition, and each patient's individual response.

Targeting Inflammation

For inflammation, PBMT causes the smaller arteries and lymph vessels of the body to increase in size, which is called vasodilation. Vasodilation allows inflammation, swelling, and edema to be cleared away from injury sites more effectively. Vasodilation in lymph nodes promotes lymphatic drainage, which also aids in the healing process. Basic research has demonstrated that PBMT can decrease the pro-inflammatory cellular response factors and increase the anti-inflammatory response.

Sports Injuries

PBMT has been adopted as an essential pain management tool by athletic trainers in most major league sports franchises in the United States, as well as by many Olympic teams. Trainers claim that elite athletes make comebacks faster after being injured when PBMT is part of the treatment plan. Major league pitchers, for example, use lasers as part of a normal warm-up routine, and many athletes use them as part of rehabilitation. PBMT is also used to treat the weekend athlete with common sports injuries such as plantar fasciitis, hamstring pulls, and various muscular sprains.

Success rates/Potential complications

Treatment parameters for PBMT were originally established using cells *in vitro* and in small animal models. These treatment parameters generally had a low irradiance and fluence and worked well for cutaneous applications. However when clinicians began to use PBMT to treat structures that were located deeper in the body, they used these parameters with negative results. A number of negative studies were published and it was concluded that there was inadequate evidence to recommend PBMT for clinical use. We now understand that these negative studies were due to incorrect device and treatment parameters for transcutaneous treatment of deeper structures. Recent advances in laser therapy devices and more research into the appropriate dosages have dramatically improved the results of PBMT. For treating deep tissues, the wavelength of light used determines the depth of penetration into a tissue. In general near-infrared light penetrates more deeply than shorter wavelengths of light such as red light. Therefore, it is important that a clinician uses the appropriate wavelength of light and parameters to treat a condition. One wavelength and one set of treatment parameters will not be effective for all conditions. Negative side effects have not been reported from the use of PBMT.

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For more information on research using Photobiomodulation, visit the LED Therapy Studies (/for-the-public/general-information/devices---led's/led-therapy-studies) page.