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FACT SHEET

Photobiomodulation and Thermal Therapies

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Photobiomodulation (PBM) and thermal therapies are commonly used in clinical practice for pain relief. The purpose of this text is to describe these interventions, mechanisms of action, and clinical evidence. In addition, we mention the practitioners who use them, and how these interventions can be integrated into an integrated care approach.

Photobiomodulation (PBM)

The term photobiomodulation therapy is defined as "A form of light therapy that utilizes non-ionizing forms of light sources, including lasers, LEDs, and broadband light, in the visible and infrared spectrum". It is a nonthermal process involving endogenous chromophores that are photosensitive molecules within the membranes of cells and organelles sensitive to specific wavelengths of light. This process results in photochemical events. The photons are absorbed by mitochondrial chromophores, and consequently, there is an increase in respiratory chain activity, enhanced adenosine triphosphate (ATP) synthesis, reactive oxygen species, and the release of nitric oxide [8].

The mechanism of action involved in the analgesic efficacy of low-level laser PBM is not fully understood; however, it seems to have a relation with the anti-inflammatory effect produced by the decline in inflammatory markers such as prostaglandin E_2, interleukin 1β and tumor necrosis factor α (TNF-α:) [5], decreasing oxidative stress [5]; increasing serotonin levels [12], and a selective inhibition in the Aδ and C fibers responsible for transmitting nociceptive information [5].

Some systematic reviews have observed the analgesic efficacy of PBM therapy in several painful conditions, such as acute and chronic neck pain [5], temporomandibular joint disorders [1], shoulder tendinopathy [11], and knee osteoarthritis [3].

Thermal Therapies

The terms "heat" or "cold" refer to the greater or lesser magnitude of kinetic energy of matter (molecular movement), which is perceived by the skin through thermoreceptors (Ruffini corpuscles and Krausse bulbs) and triggers different physiological responses to maintain homeostasis in the human body [4]. Thermotherapy is defined as the application of thermal agents on the skin for therapeutic purposes, favoring superficial or deep heating of the tissues, while cryotherapy is the term for different cold resources applied to the skin, with superficial or deep effects depending on the application time, thickness of subcutaneous fat tissue, and cold modality [2,4]. Depending on the modality, different thermal agents exchange energy with the human body via conduction, convection, or radiation mechanisms [4].

The physiological effects of heat include vasodilation, increased metabolism, increased tissue viscoelasticity, and increased nerve conduction velocity, which is therapeutically useful in promoting tissue repair, increasing range of motion, muscle relaxation, and pain relief. Cold, on the other hand, has antagonistic physiological effects, highlighting vasoconstriction, decreased metabolism and nerve conduction velocity, which is described therapeutically for the control of inflammation, pain reduction, and muscle spasm [2,4].

The mechanism of action involved analgesic efficacy of heat is supported by the removal inflammatory mediators by increasing blood flow and lowering the activity of nociceptors [4]. In addition, analgesia induced by desensitization of TRPV-1 receptors, which participate in nociceptive transmission, has been described [6]. Moreover, intermittent heat pulses with peaks of 45 °C have reported greater analgesic benefits than continuous heat (37 °C), an effect equivalent to that of non-steroidal anti-inflammatory drugs and opioids [6]. Also, continuous, low-level heat provides pain relief, improves muscular strength, and increases flexibility [6]. On the other hand, cold analgesia is supported by decreased activation of peripheral nociceptors and decreased discharge from primary afferent fibers, especially when a 4°C drop is achieved in the skin, reducing inputs to the central nervous system [4,10].

Although heat and cold modalities are widely used in clinical practice, their evidence is limited. Currently, moderate evidence supports the use of superficial thermotherapy for the management of low back pain and neck/shoulder pain and heat or cold as palliative therapies in rheumatoid arthritis [6,10]. The evidence suggests that the application of cold in osteoarthritis (OA) can favor the reduction of edema and increase the range of motion, although its analgesic effects are not so clear [2,14]. Moreover, there is little evidence for deep thermotherapy that recommends the use of pulsed shortwave diathermy to reduce pain and improve muscle performance in knee osteoarthritis and therapeutic ultrasound for morning stiffness and pain in rheumatoid arthritis [7,15].

Practitioners Who Use Photobiomodulation and Thermal Therapies

In general, the use of PBM therapy, and thermal modalities (heat or cold) has become widespread in the areas of physical therapy, physical medicine, chiropractic, athletic trainers, and sports therapy; however, it is physical therapists who are trained in the application of these resources [2,4,8].

How These Interventions Can Be Integrated Into An Integrated Care Approach

The use of these resources can be integrated into a plan to reduce pain, inflammation, and edema in acute or chronic painful conditions. Mainly, in chronic painful conditions the addition of PBM to exercises can promote additional improvements of pain and functional capacity [9,11,13]. In general, the PBM application is performed in clinics by physical therapists. Nevertheless, there are PBM devices over the counter. Then, patients instructed on how to use the PBM equipment, may acquire it and apply PBM themselves. Many cold treatments are applied at the end of a session when inflammation occurs with exercise or training [1]. On the other hand, heat can be used as an analgesic agent to improve range of motion and muscle flexibility associated with manual therapy or therapeutic exercises [2,4,10]. Moreover, hot and cold application methods may be used as self-care strategies for pain management in patients who have been instructed in their use by a physical therapist [16].

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