Therapeutic Laser in Veterinary Medicine

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KEYWORDS

• Laser therapy • Therapeutic laser • Photobiomodulation • Veterinary laser treatment

KEY POINTS

- Laser therapy is an increasingly studied modality that can be a valuable tool for veterinary practitioners to successfully treat conditions whether in a rehabilitation clinic or in a general practice.
- Understanding the basics of light penetration into tissue allows evaluation of the correct dosage to deliver for the appropriate condition, as well as for a particular patient, based on physical properties.
- Photobiomodulation has several potential benefits and using this technology in a systematic way may allow for the discovery of other applications.
- New applications are currently being studied for some of the most challenging health conditions and this field will continue to grow as we learn more.
- Additional clinical studies are still needed and collaboration is highly encouraged for all practitioners using this technology.

Laser therapy is rapidly becoming a modality that is used in a variety of conditions in veterinary medicine. It is estimated that close to 20% of veterinary hospitals in North America are using a therapeutic laser in their practice. Although lasers have been used for many years, it has been only in the past 5 or 6 years that use of laser therapy has become so widespread. The main reasons for this recent change are as follows: an increased awareness and deployment of veterinary rehabilitation services, availability of educational resources on therapy lasers, and the development of products and protocols that have resulted in more consistent clinical outcomes. Because laser therapy is a noninvasive, drug-free treatment option, many clients are happy with a nonpharmacologic treatment option.

Research in the area of photobiomodulation is continuing to increase. Many studies are now focused on particular conditions with translational studies from the laboratory to the clinic. Understanding the basics will allow the therapist to

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accurately prescribe this modality for appropriate conditions in the practice whether it be the main treatment option or as an important adjunctive to other treatments.

THE BASICS

When laser light is absorbed by a chromophore, a biochemical change can occur. There are several examples in nature where this happens, including photosynthesis or the production of vitamin D via conversion by sunlight. Laser therapy or photobiomodulation, the scientific term for this phenomenon is an example of a photochemical process in which light from a laser, or other light source, interacts with cells and causes stimulation or other biochemical change. The term photobiomodulation is most appropriate, as some biochemical events are upregulated and others can be downregulated. Other terms that have been used are cold laser therapy (not accurate, as there is often heat produced during clinical treatments), low-level laser therapy, low light therapy, or nonablative laser therapy, which separates this treatment from more invasive laser surgical procedures. There are many published studies regarding photobiomodulation. A large number of these studies have been performed on cells in vitro. There are excellent published studies on light's effects on various types of cells. Increases in angiogenesis,[1,2] neurite extension,[3] normalization of ion channels,[4] stabilization of the cellular membrane,[5] and a host of other cellular changes have been investigated and published.

The mechanism of action associated with photobiomodulation is often still questioned among scientists in the field. There are most likely several mechanisms of action depending on the target and the type of cell being modulated. The most published and recognized mechanism is that of the cytochrome c system, which is found in the inner cell membrane in the mitochondria and acts as a photoreceptor. Cytochrome c absorbs light from 500 to 1100 nm due to specific properties of this large molecule.[6] After laser light is absorbed by cytochrome c, it is excited and breaks bonds with nitric oxide (NO). This action allows bonding with oxygen to become more prevalent and cytochrome c oxidase to be produced at an optimal rate. Cytochrome c oxidase is critical to the formation of ATP. ATP is essential for energy production in the cell and results in many favorable biologic responses or secondary mechanisms, including reduction of pain and inflammation, and tissue healing.

REDUCING PAIN

There have been extensive studies evaluating various mechanisms of photobiomodulation that may result in pain relief.[7,8] On laser interaction with cells, the following processes may occur:

- Increase in serotonin (5-HT) levels[9–11]
- Increase in beta endorphins,[12–14] whose reception reduces the sensation of pain.
- Increase in NO,[15] which has an effect on vasodilatation and may enhance oxygen delivery.
- Decreases bradykinins[16]; bradykinins normally induce pain sensation by stimulating nociceptive afferent nerves
- Normalization of ion channels[4,17]
- Block depolarization of C-fiber afferent nerves[18]
- Increase nerve cell action potential[19]
- Improve axonal sprouting and nerve cell regeneration[3,20–22]