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Topical Review

Acupuncture for Analgesia in Veterinary Medicine

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Acupuncture for analgesia is growing rapidly in popularity with veterinarians and pet owners. This article summarizes the mechanisms of analgesia derived from acupuncture and reviews current literature on the topic. Areas covered include the local effects at area of needle insertion, systemic effects secondary to circulating neurotransmitters and changes in cell signaling, central nervous system effects including the brain and spinal cord, and myofascial trigger point and pathology treatment. Clinical applications are discussed and suggested in each section. When used by appropriately trained professionals, acupuncture offers a compelling and safe method for pain management in our veterinary patients and should be strongly considered as a part of multimodal pain management plans.

Introduction

Acupuncture is commonly used in modern veterinary medicine to treat pain, both acute and chronic, as well as a host of specific painful conditions. Although acupuncture began in primitive China using stone needles to let small or large volumes of blood, the underlying scientific mechanisms and its place in modern medicine have progressed tremendously. Acupuncture has evolved over centuries, in both Eastern and Western cultures, to become a scientifically driven, medically appropriate therapy for human and veterinary patients.[1] In modern acupuncture, a thin, sterile acupuncture needle is inserted into a series of acupuncture points to create a comprehensive treatment that will address discomfort and disease via multiple pathways and mechanisms.

Acupuncture points are associated with specific anatomic locations based on gross and histologic features. Usually acupuncture points are near major nerves, blood vessels, or lymphatic vessels. Richly innervated locations and regions that have autonomic nervous association are commonly acupuncture points. Such locations include nerve penetration of fascia, exits through bony foramina, neurovascular bundles, and sites of nerve branching.[2] Additionally, many acupuncture point locations are closely associated with regions that generate muscular dysfunction and pain, such as myofascial trigger points, musculotendinous junctions, and muscle motor points. In fact, solely targeting myofascial trigger points with acupuncture needles is a common practice by human physical therapists and veterinarians and is sometimes referred to as “dry needling.” Histologic features of acupuncture points include infiltration of afferent receptors such as Meissner corpuscles and nociceptors,[3] Golgi tendon organs, nervi vasorum, and neuromuscular junctions.[2] Because of the diversity in types of acupuncture points, a combination of these points can lead to a broad treatment using multiple mechanisms to target any individual patient and their pain condition.

Electroacupuncture is a common adjunct to acupuncture treatments to enhance the treatment outcome and prolong the benefit of the treatment. A gentle electrical current is applied to several acupuncture points to gain more vigorous and prolonged stimulation to the needles. Electrical current can be applied to acupuncture needles at either a high or low frequency, each having a different effect on systemic neuromodulation.

Acupuncture has become well accepted in veterinary medicine because of its minimally invasive nature, pleasurable experience for patient and client, and minimal risk of adverse effects. Painful conditions are a common reason for clients to seek acupuncture, and because acupuncture plays nicely into the treatment paradigm of a multimodal approach to acute and chronic pain management, it is a logical choice for most animals that have pain and prolonged discomfort.

It should be noted that acupuncture has shown varied research results over the years for pain and other conditions.[4] Though there is accumulating data in both veterinary and human medicine strongly indicating beneficial results, there continue to be some challenges with acupuncture research.[5] Because the mechanism for acupuncture is complex and continues to be elucidated, defining an acupuncture study that is closely placebo controlled and blinded is very challenging. Point selection, method of acupuncture administration, and type of placebo administered can each greatly affect the outcome of a trial. Because acupuncture works through such complex endogenous mechanisms, individual patient response, anatomic and physiological individuality, and overlap of neurologic input and output can confound data and make interpretation challenging. Despite these challenges, there are continuing studies in the field that continue to contribute to our knowledge base.

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The goal of this article is to highlight some of the mechanisms of acupuncture for pain management that have evidence to back them, drawing on literature from the basic science, human, and veterinary fields. At the conclusion of each section of the article are some clinical applications for the mechanism of acupuncture discussed.

Local Effects of Acupuncture for Pain and Tissue Healing

The pain-relieving actions of acupuncture start at the site of insertion of the needle into the skin and underlying tissues. There is an intimate connection between tissues at the needling sites and the nervous system that plays a crucial role in the analgesic effects of acupuncture. As previously mentioned, there are a plethora of structures located at acupuncture points. These include blood vessels; specialized afferent nerve endings that respond to pain, touch, pressure, and chemical changes; immunomodulatory cells like mast cells; glands; and soft tissue structures like muscle spindles; collagen; and other connective tissues. The grouping of structures at acupuncture sites has recently been called a neural acupuncture unit (NAU).[6] The NAU includes the activated neural and neuroactive components in the surrounding skin, muscle, and connective tissue. The acupuncture needle interacts with these structures to have effects on tissues near the insertion site and commence its interaction with the nervous system and more distant sites.

Early acupuncture research revealed that if an area of the skin was blocked with local anesthetic, the pain-relieving effects of acupuncture were also blocked.[7] It is clear there is a strong connection between needle insertion and neuronal signaling that continues to be explored. Once the needle is inserted and manipulated (primarily twisted), collagen and elastin fibers wind around the needle. This leads to a coupling between the needle and connective tissues in the immediate area. There is a subsequent deformation of the local collagen matrix. The grab of the tissues on to the needles creates a “pull-out force” needed to remove the needle from the tissue. This tug and pull effect acts on local cells like fibroblasts, as well as the local vasculature and nerve endings. This coupling and interaction between needles and connective tissue has been explored extensively.[8,78]

The stimulation of local nerve endings after the deformation of local tissues leads to a response known as the local axon reflex. It is most likely the combination of this local neurologic reflex arc along with the pull on local collagen that creates the sensation of “de qi” in patients undergoing acupuncture treatments. “De qi” is described in people as a delayed sensation after needle insertion that is dull and achy and can travel from the site of initial insertion. The sensation has traditionally been held as a strong indicator of effectiveness of treatment.[9] The axon reflex leads to a cascade of substance releases in the area leading to blood vessel dilation and mast cell activation. This is clearly evident in non-haired species when the skin around the needle insertion site quickly flushes red with increased blood flow, mast cell degranulation, and vasodilation. When mast cells were destroyed, the analgesic response to needle insertion was not same.[10] The deeper the needle insertion, the more dramatic the effects on both skin and muscle blood flow.[11,12] In this same study, the more manipulation there was of the needle, the greater the change in blood flow.

In response to the stimulation of the nerve endings in the local area, a variety of neuropeptides are released including calcitonin gene–related peptide (CGRP), nerve growth factor, substance P, vasointestinal active peptide, and many more. These changes in the local blood flow and milieu of cytokines and neurotransmitters contribute to both local pain relief and improved local healing after acupuncture treatment.[13] In a study on deep second-degree burns on rat skin, acupuncture treatment accelerated healing when compared with conventional wound management dressing treatment.[14] Acupuncture offers an adjunct treatment for conditions that are painful locally and may also promote local healing. These local effects initiate the cascade of systemic effects that ultimately provide the comprehensive, systemic analgesia that greatly benefits patients.

Clinical conditions that may benefit from the local mechanisms for acupuncture analgesia include the following: acute and chronic wounds, surgical incisions, burns and abrasions, lick granulomas, local dermatitis, and local injuries to joints, muscles, and other soft tissues.

Modulation of Pain Signaling in the Periphery

Human acupuncture patients often report a general sense of well-being or pain relief at a site distant from the location of the acupuncture needle. This phenomenon is also appreciated anecdotally in veterinary patients. These findings are likely owing to the modulation of neurotransmitters and other neuromodulatory substances via placement of the needle. These substances are key players in pain pathways, and alteration in their concentrations explains the analgesic mechanisms of acupuncture. Some of the most groundbreaking early research in this area includes a study where the cerebrospinal fluid (CSF) from rabbits treated with acupuncture was given to recipient rabbits that received no treatment. The rabbits that received the CSF showed an increased pain threshold during subsequent painful procedures.[15] In this early work, the specific transmitters were not identified, but this and similar studies sparked a quest to understand the neurotransmitters and cytokines responsible for the analgesic effect. As our knowledge and understanding of pain pathways and mechanisms continues to expand, it becomes evident that pain is complex, involving numerous transmitters, modulators, and receptors.

Analgesia is known to involve opioid peptides, adrenergic receptors, serotonin, and dopamine receptors,[16] but as the body of evidence continues to grow, it is likely the mechanism for acupuncture analgesia will be further elucidated.

Opioid Peptides

Research in the area of opioid peptides provided a breakthrough for acupuncture in the scientific community. There are higher concentrations of opioid peptides after an acupuncture treatment in both the CSF and plasma, and the analgesic effects of acupuncture can be reversed with opioid antagonists. The initial research started in the 1970s soon after the discovery of endogenous opioid peptides by Hughs et al. in 1975. The pain-relieving phenomenon of acupuncture was found to be reversible with naloxone in patients with induced tooth pulp pain. This initially pointed to opioid peptides as a key player in acupuncture analgesia,[17] and was corroborated by similar findings in additional animal models.[18] Following on the heels of these reversal studies, it was found that there was a higher concentration of beta-endorphins in the CSF of human patients after acupuncture treatment with electrical stimulation when compared with pretreatment levels.[19] Studies continue to show that increased concentrations of opioid peptides play an important role in the analgesic effects of acupuncture.

Electrostimulation of acupuncture points can enhance an acupuncture treatment by altering opioid peptides release and the profile of peptides resulting from a given acupuncture session.

Low-frequency stimulation (2-4 Hz) leads to a release of beta-endorphin, enkephalin, and orphanin, whereas higher frequencies (80-100 Hz) lead to serotonin and norepinephrine release.[20,21] Han also noted that the analgesic effect after using lower frequencies was longer lasting and more cumulative in analgesia provided. A pilot study comparing opiate analgesia with electroacupuncture analgesia using a canine model found that dogs that were treated with electroacupuncture after ovariohysterectomy (OHE) had elevated beta-endorphin levels postoperatively and had prolonged analgesia over at least 24 hours.[22] A similar study in horses found that after electroacupuncture, spinal fluid beta-endorphins were increased from baseline and the animals had increased tolerance to cutaneous noxious stimuli. The changes in nociception were found with acupuncture alone (no electric stimulation), but the same change was not seen in CSF levels of beta-endorphins.[23] Induction of endogenous opioids is perhaps the most accepted mechanism of acupuncture (especially electroacupuncture) analgesia.

5HT3 Receptors and Norepinephrine

Acupuncture also has an analgesic effect via induction of the endogenous descending pain control pathways that modulate nociceptive signals at the level of the brain and spinal cord.[24,79] Serotonin and norepinephrine are the 2 key neuromodulators in these pathways. There are several types of serotonin receptors that have been implicated in electroacupuncture analgesia.[25] With both acupuncture and electroacupuncture, the spinal and brain concentrations of serotonin, as well as serotonin receptor activation, are increased in rat models, indicating central descending pathway activation.[26] In humans with fibromyalgia, acupuncture treatment induced an increase in serotonin levels in the plasma as well as pain relief and a decrease in specific sensitive spots.[27] When serotonin receptors were blocked with receptor antagonists, acupuncture-induced analgesia was dramatically reduced.[28] Serotonin and its receptors play a prominent role in acupuncture analgesia.

Norepinephrine also plays a role in the inhibition of pain at the level of the spinal cord. With chronic pain states, there is modification of the adrenergic system that may respond to acupuncture treatment. Alongside serotonin, norepinephrine was implicated in the inhibition of inflammatory pain in rats after electroacupuncture.[29] There is also a possible synergistic effect of amitriptyline (serotonin and norepinephrine reuptake inhibitor) and electroacupuncture for incisional pain in rats.[30] Inhibitory pathways originating in the periaqueductal gray (PAG) area of the brain may play a role in the analgesic effects of acupuncture via these descending mediators.

N-Methyl-D-Aspartate Receptor Modulation

In chronic and pathologic pain states, the N-methyl-D-aspartate receptor (NMDAR) is activated as a part of spinal cord sensitization and hyperalgesia. Activation of the NMDAR alters the threshold to nerve firing, leading to a greater (more painful) response to stimulation. This is a major part of hyperalgesia and allodynia. There is some research exploring how acupuncture may help treat chronic pain by affecting the NMDAR and in turn reduce the intensity of hyperalgesic states.[31] Low-level electrostimulation provided similar analgesia to that provided by an intrathecal injection of an NMDAR antagonist.[32,33] Electroacupuncture has also been shown to work synergistically when given with a NMDAR antagonist (dizocilpine). When given together, there was an increased tolerance for inflammatory pain, and phosphorylation of the NMDAR was inhibited.[34] This is an ongoing area of research but offers promise for our understanding of acupuncture mechanisms for chronic pain conditions.

Other Players

Many other neuropeptides, mediators, and receptors are possible candidates for acupuncture analgesia and are the subject of further research. Oxytocin, which is a known player in pain modulation, plays a role in acupuncture analgesia. Nonnoxious sensory stimuli can have an antinociceptive effect (electroacupuncture, massage, and thermal stimulation), and with these stimuli, there is an increase in the concentration of oxytocin in the periphery, as well as in the central nervous system (CNS). The antinociceptive effects can also be reversed with an oxytocin antagonist given before treatment.[80] Oxytocin had altered concentrations in the CNS, but not in the periphery, of rats treated with acupuncture in another study, suggesting its role in the central effects of acupuncture analgesia is probably important.[35]

CGRP is produced by neurons in the CNS, as well as in the periphery, and acts as a potent vasodilator and plays an important role in pain signaling pathways. Local levels of CGRP increase with acupuncture treatment, causing alteration in local blood flow, mediation of inflammation, and promotion of healing.[36-38] Acupuncture may also augment other inflammatory mediators to modulate inflammation and the subsequent pain associated with inflammation.[39] Inflammatory mediators including lipopolysaccharide, IL-1β, IL-6, and tumor necrosis factor-α were measured in human patients with chronic headache. Levels of all these substances were elevated in these patients and returned to healthy control levels after acupuncture treatments.[40] Inflammatory mediators associated with arthritis were decreased in rats treated with electroacupuncture.[41]

Numerous other cytokines and receptors, including nitric oxide, alpha-2 adrenoceptors, vasoactive intestinal protein, sodium channels, and TrpV-1 receptors, are amongst the numerous other substances that are being explored as potential players in acupuncture analgesia. It is clear even from the very early studies that neuroactive compounds play a role in the translation of the mechanical signal of needle insertion to chemical nervous system signaling. These compounds are critical to this translation, and our understanding of this signaling makes the mechanisms of acupuncture more clear.

Clinical conditions that may benefit from the systemic modulation of pain signaling that results from acupuncture and electroacupuncture include the following: intraoperative and postoperative surgical pain, traumatic injury, dental procedure pain, intervertebral disk disease (IVDD), and chronic pain states, including osteoarthritis, prolonged postoperative pain, chronic back pain, neuropathy, and others.

Spinal and Segmental Effects of Acupuncture for Analgesia

The development of the embryologic spinal cord segments and vertebral column is closely related, which accounts for the manner in which the roots and spinal nerves of each segment are distributed among the vertebrae. As the somatic dermatome expands and contributes to the surface of the body, it maintains its original segmental innervation. Studies in the dog have shown that each dermatome of the neck and trunk extends from the dorsal to ventral midline, and there is craniocaudal overlap of up to 3 dorsal roots in the lumbosacral region.[42] There is considerable overlap of the cutaneous areas of adjacent peripheral nerves. Owing to the connectivity via shared innervations, every part of a segment is able to modulate all other parts of the same segment.

Sensory inputs from small unmyelinated C fibers synapse through substantia gelatinosa (SG) cells whereas the fast myelinated Aδ fibers synapse directly in the dorsal horn. The Aδ fibers also make collateral connections to intermediate cells, which inhibit the activity of the SG cells. These intermediate cells enkephalinergically inhibit the nociceptive pathway in the SG cells. Enkephalin suppresses activity of the spinal nociceptive neurons[43] known as segmental analgesia, which can continue well past the initial acupuncture treatment.

The axons from the transmission cells ascend the spinothalamic tract of the spinal cord where they activate higher pain control centers. In animals, much of the ascending pain information is bilateral, although a major portion still travels up the spinal cord on the contralateral side. Further control of segmental pain transmission occurs from descending fibers in the dorsolateral tracts, which are largely serotonergic and noradrenergic neurons that inhibit segmental pain transmission.

Segmental dysfunction has been defined as impaired or altered function of related components of the somatic system: skeletal, arthroidal, and myofascial structures, and related vascular, lymphatic and neural elements.[44] It is not defined as a pain syndrome or a disease, although most state pain as their primary complaint. Clinical features of segmental dysfunction include tenderness in contrast to pain, which is not always present, asymmetry of the musculoskeletal system, decreased or asymmetric range of movement of joints, and tissue texture abnormality of the skin, fascia, muscles, or ligaments.[81] Obscure relations between symptoms and most acupuncture effects can often be explained via segmental interactions.

Pain relief treatment is fundamental in dealing with osteoarthritis owing to its association with increased pain and loss of mobility. Segmental analgesia in addition to pain relief may reverse any pathologic muscle tone, encouraging mobilization, which in turn improves blood flow and healing. With stifle pain, the noxious stimuli from the pain-sensitive area travel in the small unmyelinated C fibers into the dorsal horn mainly at the levels L4, L5, and L6.[42] The spinal segment that supplies a joint also supplies the muscles that act on it, and needling those muscles suppresses pain in the joint.

Acupuncture significantly improved weightbearing behavior and inhibited neural responses of articular afferents to noxious stimulation in an animal model of arthritic knee pain.[45] Acupuncture also provided significantly better relief from stifle or knee osteoarthritis pain and a greater improvement in function than sham acupuncture, standard care treatment, or waiting for further treatment that included nearly 4000 human patients in a meta-analysis.[46]

Electroacupuncture combined with standard Western medical treatment was effective and resulted in shorter time to recover ambulation and deep pain perception than did the use of Western treatment alone in dogs with signs of thoracolumbar IVDD.[82]

Acupuncture can be an important supplement of conservative orthopedic treatment in the management of chronic low back pain,[47] and improvement can last for at least 6 months after acupuncture treatment.[48]

Segmentally, there is a convergence of somatic and visceral afferent information at the dorsal horn. "Referred pain" from an abdominal organ is perceived as arising in the abdominal wall muscles that have the same segmental innervations. By reversing the process, visceral pain may be suppressed by stimulating appropriate somatic receptors at the same segmental level. This becomes most useful when local acupuncture points cannot be used. There is a dermatomal distribution of referred visceral nociception, and the surface of the body can be mapped to represent the areas of pain of the various visceral organs. Although pain referral zones are not generally recognized and specifically defined in animals as they are in humans, clinical examination of animal patients with known visceral pain often reveal consistent areas of cutaneous sensitivity similar to those recognized in people.

Acupuncture not only provides pain relief but also alters organ blood flow and activity of the autonomic nervous system regulating visceral function. Visceral pain associated with irritable bowel syndrome in a rat model can effectively be treated by electroacupuncture.[49] Acupuncture has also been shown to alter acid secretion, gastrointestinal motility, and visceral pain in functional gastrointestinal disorders.[50] Acupuncturing abdominal points (e.g., CV12) causes muscle relaxation and may inhibit gastric acid secretion via the somatosympathetic pathway, whereas lower leg acupoints (e.g., ST36) causes muscle contractions via the somatoparasympathetic pathway.[51] Using acupuncture at the level of autonomic innervation of the viscera involved can reduce pain and normalize the autonomic output.

Clinical conditions that may benefit from segmental acupuncture analgesia are as follows: IVDD, neuropathies, joint dysfunction particularly due to osteoarthritis, and painful visceral conditions.

CNS Effects of Acupuncture for Analgesia

The analgesic effects of acupuncture also derive from changes in the CNS. The challenge with this area is our fairly superficial understanding for all the processes in the brain that relate to pain perception in endogenous pain management. The arcuate nucleus, hypothalamus, and lymbic system are stimulated and affected by acupuncture. Afferent pain fiber pathways (Ad) terminate in the arcuate nucleus of the hypothalamus, and C fibers terminate in the limbic system. The hypothalamus releases beta-endorphins, which directly activates the PAG in the midbrain; the PAG is also activated via input from the limbic system, which encompasses the emotional aspect of pain and the reason pain is often an unpleasant experience rather than merely a simple sensation. Current research documents the PAG, albeit acting in concert with other midbrain sections, to be the primary CNS structure responsible for descending pain inhibition. Imaging studies have documented concurrent analgesia with increased activity in the PAG with electroacupuncture.[52] Other image studies (positron emission tomography scans and computed tomography) documented acupuncture-induced activation of specific brain sites known to be involved in acute and chronic pain states[53,54]; this theoretically indicates that acupuncture relieves pain by disrupting the equilibrium generated by pain-related central networks thereby interrupting the perpetuation of pain.

There is good evidence from other imaging studies documenting considerable analgesic effect via the limbic system using acupuncture[55-57] along with demonstrating dissimilar brain activation, and therefore, different effects between sham and real acupuncture.[58] Other imaging studies (magnetic resonance imaging) confirm that different acupuncture points, even those in the same spinal segment, have distinct response patterns in the brain.[59] Further yet, a magnetic resonance imaging study documented similar but greater central brain signal increases with electroacupuncture than manual acupuncture, which was, in turn, greater than the placebolike tactile control stimulation all at the same acupuncture points (ST36).[60]

Previously, we have addressed descending inhibition of analgesia from the CNS focused on transmitters, modulators, and receptors; although the PAG and other pain pathways in the CNS are yet to be fully explained, we do know it works via serotonin and noradrenaline release at all dorsal horn segments, therefore, overlapping with the effects of segmental analgesia of acupuncture. Put simply, central effects reinforce segmental and local analgesia. However, there is an intrinsic functional difference between acupuncture's effect on the affective component of pain (the limbic system) and that which it has on the sensory component of pain.

Although there is growing evidence for central mediated analgesia of acupuncture, it continues to be limited by our understanding of central regulatory events of analgesia. For interpretation of this evidence and implementation into practice, we must consider that the limbic system is likely stimulated by nonspecific acupuncture points. Treatment points are less specific to the CNS, and these CNS effects should be considered complementary to local and segmental treatments.

Clinical conditions that may benefit from the central mechanisms for acupuncture analgesia may include the following: anxiety, stress, licking obsession, and chronically painful conditions, especially neurologic and orthopedic.

Treatment of Myofascial Trigger Points With Acupuncture

A myofascial trigger points is defined as "a hyperirritable spot usually within a taut band of skeletal muscle or in the muscle's fascia, that is painful on compression and that can give rise to characteristic referred pain, tenderness, motor dysfunction and autonomic phenomena," which was stated by Dr Janet Travell in the 1940s.[83] Trigger points are now widely accepted to be an important source of pain in many human pain syndromes and have recently been recognized as a clinical phenomenon in veterinary medicine. These trigger points develop because of altered posture, chronic muscular overuse, acute overload, traumatic injury, and metabolic disease. On a physiological level, a trigger point is a region of muscle tissue that is pathologically tight, stuck in a shortened configuration that leads to secondary pathology. Reduced local circulation, poor oxygen tension, and a reduced pH all contribute to local pain and release of inflammatory mediators in and around the affected region.[61]

There are both active and latent trigger points, which reflect different levels of dysfunction and pain within the affected muscle and rest of the body. Both are capable of causing increased pain signaling to the CNS, specifically the sensory region of the dorsal horn of the spinal cord. This can make conditions that are already painful more painful, even when the primary cause of the pain is resolved. Active trigger points cause spontaneous referred pain in surrounding muscles, skin, and fascia leading to the recognized radiating pain sensation at these and distant locations.[77]

Acupuncture of myofascial trigger points, with both local injection and "dry needling," has shown to be equally successful in reducing pain and muscular dysfunction in patients affected by myofascial pain syndrome and myofascial trigger points.[62,63] Acupuncture needles inserted directly into trigger points are known to reduce pain immediately and improve some of the underlying pathophysiological changes that accompany latent and active trigger points and myofascial pain syndromes.

Acupuncture, or dry needling, of a myofascial trigger point is easy and rewarding for trained veterinary practitioners, though it can cause some mild discomfort at the time of needle insertion. Numerous established acupuncture points are located near motor endplates, a frequent location for trigger points to form. There are additional trigger points that are specific to the individual or condition, which may not necessarily align with a named point. These additional trigger points can be localized by careful palpation of the veterinary patient, to determine tight bands of muscle that are associated with increased pain intensity and may have an associated twitch response when directly palpated. Achieving a local twitch response with needle insertion is important in accomplishing immediate pain relief for the patient. Rapid redirection and twisting of the needle may be helpful to achieve the local twitch response needed for release[64] and is usually tolerated by the patient.

The mechanism for release of trigger points is not well defined; however, it has been shown to reduce regional pain immediately, likely through a series of alterations in dorsal horn modulation of the pain signal generated by the trigger point.[65] In addition, spontaneous motor endplate noise is also inhibited by acupuncture at local and distal sites.[64]

Treatment of myofascial trigger points can be beneficial for patients with any primary musculoskeletal injuries or conditions that alter muscular mechanics or tension, such as neurologic injury. Examples of conditions that may benefit from trigger point acupuncture include the following: orthopedic surgery and injury, peripheral nerve injury, spinal cord injury, head tilt or torticollis, and osteoarthritis, especially in patients with altered gait or posture.

Acupuncture Safety

When executed appropriately by a trained professional, the safety risks of acupuncture are very low. A prospective study of more than 34,000 acupuncture treatments aimed to determine the type and frequency of adverse events related to acupuncture treatments in humans.[66] There were no serious adverse events that lead to hospitalization or death (by definition), with only 43 minor events. The most common minor events were nausea after treatment and light-headedness or fainting. The less common and mild events included a worsening of symptoms, pain or hematoma or bruising, and a strong emotional response. Some of the minor events were practitioner error and could have been avoided—a forgotten needle or burns from moxibustion over needle sites (3 total patients). Similar prospective studies have found a low incidence of adverse events, with moderate and serious events being exceptionally rare and a higher frequency of mild effects.[67,68] It is critical that the practitioner performing the acupuncture treatment be adequately trained to avoid reported but extremely rare events like pneumothorax and spinal cord damage.[69] It is clear that risks of acupuncture are very low, and it offers a very safe pain management modality.

Discussion

Medical explanations for the effects of acupuncture, particularly in the field of pain management and healing, continue to emerge as our understanding of this ancient art grows. The physiological, anatomic, and neurologic basis of acupuncture grows with our better understanding of pain signaling mechanisms and the profound effect of acute and chronic pain on the peripheral and central nervous system. From basic science research and laboratory animal studies, this information needs to continue to be translated into clinical trials and finally to the clinic floor, to allow our veterinary patients to reap the benefits of acupuncture analgesia. Clinical trials provide certain challenges, as designing a valid study that will yield objective, useful data is challenging in the field of acupuncture and in pain management. Because pain is such an individual experience, and its measurement provides significant challenges in the laboratory and clinical setting, pain studies are inherently challenging. In addition to this, the complexity of mechanism for analgesia provided by acupuncture and developing effective studies with appropriate control groups, minimal individual variation, and acceptable placebo treatments are examples of just a few of the challenges that exist.

Pain assessment is particularly challenging, when assessing the response of a clinical patient, or a laboratory animal, to any type of pain intervention. The use of pain scales and outcome assessment provides particular challenges in veterinary species and laboratory animals. In addition, personal experience of a pet owner or veterinary clinician has potential to affect pain evaluation of an animal patient. Overall, basic science research is removed from the placebo effect that compounds the challenges of pain evaluation, but designing a placebo-controlled clinical acupuncture study becomes complicated, as no totally ineffective placebo treatment exists that will keep patient and evaluator blinded to the treatment administered.[5] Sham acupuncture often involves insertion of needles near acupuncture point, placing just the insertion tube at a site, or using "fake needles."[70,71] Each of these placebos stimulates tissues near or at the treatment acupuncture points, which may lead to similar but less potent effects,[63] or lack of significant differences between placebo and treatment groups.[72] Because of this problem, acupuncture clinical trials need to be interpreted with caution, with close analysis of control group parameters, population size (to control for individual variation), and outcome measures.

A handful of veterinary studies that currently exist, examining the use of acupuncture for pain management, are fraught with these challenges. Most of the compelling evidence for acupuncture use in the field comes from laboratory animal and human studies, though the body of veterinary clinical evidence continues to grow. A systematic review completed in 2006 in the Journal of Veterinary Internal Medicine reviewed the use of acupuncture treatment for a wide variety of conditions.[4] The methodology and quality of these studies were reported by the reviewers to be overall low, so strong conclusions cannot be drawn. The supposition of the review was encouraging for cutaneous pain control, but there was not enough veterinary-specific evidence to accept or reject acupuncture as a treatment modality for any condition, in any species. Publication of veterinary studies continues as well as ongoing research in the basic science and human clinical realms.

Pain-related acupuncture research in veterinary medicine includes large- and small-animal patients, and a variety of pain types. A large number of studies examine the use of acupuncture for postoperative pain in dogs, after a variety of surgical procedures. This acute pain setting offers a more controlled, less variable situation when compared with management of chronic pain conditions, which is frequently complicated by comorbidities, variation in levels of pain tolerance, and large differences in levels of discomfort. Among the surgical studies, one concluded that acupuncture after OHE reduced postoperative opioid requirements in dogs.[22] Another study on OHE in dogs reveled that with acupuncture and electroacupuncture, pain scores and postoperative pain medication needs were less for the canine patients.[73] Finally, a study of elective mastectomies in dogs concluded that electroacupuncture provided better analgesia compared with preoperative morphine and sham acupuncture.[74] Another study looked at pain management after hemilaminectomy due to acute IVDD and found that for the initial 12 hours, dogs that received electroacupuncture did not require as much postoperative fentanyl and had lower pain scores at 36 hours.[75] At later time points, there were no significant differences between groups. An equine study using electroacupuncture to treat back pain in horses found that pressure-induced pain was significantly reduced in the treated horses.[76] With the growing understanding of the mechanisms of acupuncture analgesia and better clinical trial design, the future for further research in veterinary medicine is bright.

For many veterinary patients, pain management can be challenging, owing to difficulties recognizing and diagnosing pain, concurrent medical conditions that limit medical options, and pet owner compliance with recommendations, to name a few. Acupuncture offers a safe complimentary modality that works through a wide range of mechanisms to relieve pain. Acupuncture has a powerful role to play in any veterinary practice, and it enhances the well-accepted approach to multimodal pain management in acute and chronic pain patients enormously. The use of acupuncture is growing rapidly in veterinary medicine and when done safely, appropriately, and by a trained professional, may offer relief for patients who previously had few options for relief from pain. Despite the challenges, more data emerge monthly providing more evidence for analgesia provided by acupuncture, and the mechanisms that help achieve the comfort in treated animals. As aggressive and thorough pain management becomes best medicine for veterinary patients, client and clinician demand for this powerful and safe tool will only continue to grow.

Conclusion

Acupuncture analgesia offers an effective approach to pain management in our veterinary patients. There is compelling evidence in both basic science and clinical research that supports its safety and efficacy. Therefore, acupuncture should be accepted as part of a multimodal approach to the treatment of a wide variety of painful conditions when used by the well-trained practitioner.

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