Update on Non-pharmacological Management of Canine Osteoarthritis

SYSTEMATIC REVIEW

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SUMMARY. Introduction: Osteoarthritis is characterized by being a common chronic disease in both dogs and cats. It is a slow and progressive inflammatory disease, characterized by degeneration of the articular cartilage, hypertrophy of the bone at the margins and changes in the synovial membrane, resulting in joint pain and stiffness. Joint damage generates the release of pro-inflammatory cytokines, causing damage to type II collagen and proteoglycans, resulting in a perpetual destructive cycle. Among the predisposing factors are genetics, overweight and excessive exercise that can lead to traumatic injuries. The use of carprofen, firocoxib, meloxicam and many other analgesics used in the moderation of the clinical signs of osteoarthritis is recognized, however, the presence of side effects limits its use to all patients for long periods of time. **Aims:** to evaluate the vision of new non-pharmacological alternatives that allow a more effective pain management and help in the improvement of joint mobility. **Conclusions:** there are multiple options for the treatment of joint pain in canines, from conventional medicine to homeopathy and even moxibustion and massage, which added to each other only provide benefits in the control of joint pain.

Keywords: alternative therapy, dogs, joint disease, osteoarthritis

Actualización en el manejo no farmacológico de la Osteoartritis Canina

RESUMEN. Introducción: La osteoartritis se caracteriza por ser una enfermad crónica común tanto en perros como en gatos. Es una enfermedad inflamatoria lenta y progresiva, que se caracteriza por degeneración del cartílago articular, hipertrofia del hueso en los márgenes y cambios en la membrana sinovial, resultante en dolor y rigidez articular. El daño articular genera la liberación de citoquinas pro inflamatorias, generando daño sobre el colágeno tipo II y sobre los proteoglicanos, lo que resulta en un ciclo destructivo perpetuo. Dentro de los factores predisponentes están la genética, el sobrepeso y el ejercicio excesivo que pueden generar lesiones traumáticas. Es reconocido el uso de carprofeno, firocoxib,

meloxicam y muchos otros analgésicos usados en la moderación de los signos clínicos de la osteoartritis, no obstante, la presencia de efectos secundarios hace limitado su uso a todos los pacientes por tiempos prolongados. **Objetivos:** evaluar la visión sobre nuevas alternativas no farmacológicas que permitan hacer un manejo más efectivo del dolor y ayuden en la mejoría de la movilidad articular. **Conclusiones:** existen múltiples opciones para el tratamiento del dolor articular en caninos, desde la medicina convencional hasta la homeopatía e incluso la moxibiustion y el masaje, que sumadas unas con otras solo aportan beneficios en el control del dolor articular.

Palabras clave: enfermedad articular, terapia alternativa, osteoartritis, perros

Introduction

Osteoarthritis (OA), also known as degenerative joint disease or osteoarthrosis, is a chronic disease characterized by pain and limping associated with pathological changes in the synovial tissues and joints, as well as cartilage loss. In 1997, Johnston suggested that 20% of dogs over 1 year of age are affected by the progressive changes associated with osteoarthritis. Nowadays, there is no known effective cure to this disease and only palliative care is available to ensure a better quality of life for patients. Joints undergo mechanical stress, which activates mechanisms leading to cartilage degradation that causes matrix fractures. This causes the cartilage to lose elasticity and its protective layer due to the enzymatic degradation of proteoglycans. This continuous damage causes bone friction, which leads to inflammation, soft tissue thickening, and loss of joint mobility (Renberg, 2015). Before the onset of any radiological signs, the dog's pain may be very intense even in the absence of significant symptoms such as limping. In this case, alternative therapies may prove to be very effective in reducing the progress of the disease and, if dietary and exercise habits are regulated, the patient's condition can improve immensely. The evaluation and detection of joint pain as a widely used clinical tool would be a great clinical advance because many adult and elderly patients could easily spend years without proper handling or diagnosis for their joint pathology. Creating an ethical and humanitarian attitude toward pain should always be a priority.

Review of the disease

In almost all forms of arthritis, there is bone or cartilage loss that results in changes in the shape of the joints. Morphologically, the different types of joints are classified in various categories according to the tissue that unites them: fibrous, cartilaginous, and synovial. Physiologically, the joints are classified as synarthrosis (not movable), amphiarthrosis (very limited movement), and diarthrosis (wider range of movement) (Holland, 2014). Cartilaginous joints consist of fibrous tissues or hyaline cartilage that allow little to no movement. Synovial joints are formed by synovial liquid and irregular and dense connective tissue that creates a synovial joint capsule that allows joints to move freely. These joints are

more commonly affected and the areas of greater incidence in dogs are hips, knees, and elbows (Pasquini, 2007).

The articular cartilage is avascular, aneural, and aliphatic. It possesses a viscoelastic connective tissue that works autonomously to support weight. Its primary function is to transmit a force between the extremes of the bones through a wide contact surface, thereby avoiding the existence of eventual loads that could injure the joint. Its histomorphology is composed of an extracellular matrix (ECM) that consists mainly of an intricate collagenous network (collagens II, IX, and XI) and proteoglycans (mainly aggrecans). The damage on the articular cartilage is due to the mechanical tension imposed on the joints, as well as the enzymatic activity of matrix metalloproteinases (MMPs, mainly MMP-2,-3, and -13) and aggrecanases (a disintegrin and metalloprotease with thrombospondin motifs (ADAMT)-4 and -5), which degrade the structural components of the ECM (Lavalle, 210).

There are four main zones of articular cartilage: superficial, transitional (mid), deep (radial), and calcified. The superficial or tangential zone (40 µm) possesses very little metabolic activity and presents an elevated concentration of collagen fibers arranged perpendicularly among themselves and parallel to the surface. It can withstand shearing forces. The middle or transitional zone (500 µm) possesses an elevated metabolic activity and has a higher proteoglycans and less collagen content. It is arranged obliquely; it supports compression forces, and the existing chondrocytes are rounder. The deep or radial zone (1000 µm) is rich in proteoglycans (PGs) and collagen fibers. It is arranged radially and forms arches and supports compression forces. The calcified zone (300 µm) is the layer that anchors the cartilage to the bone. It does not contain PGs and the collagen present in it is arranged radially. It contains hydroxyapatite crystals and is adjacent to the subchondral bone. Its cellularity is low (Aicher, 2014).

Osteoarthritis is a progressive disease that develops in four stages. The first stage begins with the thickening and breaking down of the cartilage matrix due to the chondrocyte's affected metabolism, as well as the increased damage to the matrix by MMPs. The severity of cartilage injuries can be correlated to the levels of existing collagenase (MMP-1). This alters the function of the cartilage, increasing friction and inflammation that leads to pain (Rajat, 2012). The second stage begins with bone erosion due to previous cartilage injuries. The development of osteophytes begins, compromising joint mobility. During this stage, it is possible that PGs and collagen fragments are released inside the synovial membrane. In an adult dog, PGs are replaced faster (300 days) than collagen, estimated in 120 years. The marked reduction of proteoglycans from the articular cartilage is irreversible and causes joint degeneration (Renberg, 2015). The third stage is considered as moderated arthrosis, where bone thinning and joint space narrowing are present due to friction and wear of the subchondral bones. At this stage, synovial macrophages and cytokines such as interleukin |tissues by spreading back into the cartilage and can stimulate chondrocytes (Renberg, 2015). The fourth stage is considered the most severe because it shows a significant reduction of joint space and a nearly total disappearance of the cartilage. At this point, clinical handling is vital to avoid further joint damage and to alleviate symptoms (Renberg, 2015).

From the third stage onward, there is a significant reduction in mobility, causing musculoskeletal pain and disability. We must bear in mind that muscle pain is not always

associated with a joint or its SOMA. For example, it is common to observe cervicalgia in elbow limping. This chronic response may cause innocuous stimuli such as cold or heat become painful for the patient due to a change in receptors caused by peripheral and central nervous system sensitization (Freye, 1999). The mechanisms involved take place at different levels according to increased sensitivity of nociceptors and activation of "sleeping" nociceptors. In the spinal cord, chronic pain results in central sensitization and neuroplasticity with cellular death of inhibitory neurons, synaptic remodeling to intensify transmission, increase in pain-transmitting neurons sensitization, and increase in connections to second order neurons. All these chronic responses can only reduce the quality of life of our patient and increase the additional risk of morbimortality.

It has been observed that it is unlikely for pharmacological intervention alone to be effective in alleviating chronic pain once the musculoskeletal function is altered, whether as compensation for positioning or derived from disease as such. So, we propose a variety of options, according to each medication's own characteristics and advantages of a specific alternative procedure.

Classification and diagnosis of OA

Diagnosis of OA is common in big and heavy breeds or in those that have been subjected to extreme exercises. The breeds that are most affected by OA are: German shepherd, Labrador, Siberian husky, and Rottweiler. OA appears more frequently in dogs of adult or old age and usually presents as the inability to move from a sitting or lying down position, joint sounds, rigidity, muscle atrophy, and visible pain.

Currently, there are multiple radiological scales that allow us to detect early stages of OA. Among them is the Bioarth scale, which organizes four main key points: presence of osteophytes in joint margins, presence of subchondral sclerosis highlighting an underlying bone response because of a reactive response of the bone, joint collapse understood as reduction of the space situated between joints (it is necessary to evaluate this under loading conditions), and finally, evaluate the presence of subchondral cysts that appear during a state of chronical osteoarthrosis. Specific anatomic areas are delimited for each joint, and each area is rated according to radiographic signs. This rating allows for detection of OA among those with no radiological signs of arthrosis, mild arthrosis, moderate arthrosis, and severe arthrosis (Carmona, 2006).

Measurement of joint mobility uses a goniometer to measure the degree of joint mobility in the flexion and extension of anterior and posterior extremities in dogs. This allows to evaluate ligaments, tendons, and muscles and is a useful way to assess the progression of the disease (Ates, 2011).
Blood tests are available to determine the degree of joint inflammation. These tests include those for globular sedimentation rate, C-reactive protein, antinuclear antibody, and rheumatoid factor.

Alternative disease management

The use of alternative therapies in OA in dogs and cats is meant to control pain with minimum side effects. It is highly important to educate the owner about the disease and get the pets to exercise moderately and regularly and to lose weight. These are the foundational elements to build a basic treatment for canine OA (alongside pharmacological treatment) that yield better results than the use of analgesics alone (NICE, 2008).

Weight control

A 6%–8% weight loss in dogs with OA has been shown to reduce pain scores (Marshall et al., 2010). Dietary management, lifestyle changes, and therapeutic exercise can reduce weight in clinical cases of dogs (German et al., 2007). Currently, there are many commercial brands that can be used to reduce weight faster, and some products are focused on helping to improve the joints. Obesity damages joints, not only because of the mechanical stress it causes but also because of an important group of fat-derived cytokines, known as adipocytes, which promote joint inflammation. Other cytokines derived from adipose tissue are TNF-α and IL-1. Both are hyperactive in arthritis and cause inflammation and, as a result, joint damage (Arthritis Foundation, 2016).

Therapeutic massage

Manipulation of soft tissue is used to reduce pain and alter the mechanical stress caused by tissue disorders. In humans, there is evidence supporting that massage can increase the joint mobility range (Sefton, 2011) and decrease pain scores (Cherkin, 2001). Physiological effects include tissue repair and pain modulation (Wright & Sluka, 2001), mediated through a better local blood flow and lymphatic drainage, segmental inhibitors mechanisms, and activation of descending pain inhibitory system (Furlan et al., 2002; Sutton, 2004).

Myofascial release of trigger points

Physical trauma results in areas of myofascial tension that cause loss of normal flexibility, leading to more trauma and pain in areas distant from the original injury (Sutton, 2004; Barnes, 2009).

Diagnosis criteria for myofascial trigger points have been described in dogs (Frank, 1999), including the discreet identification of painful nodes of 0.5–4 cm in diameter inside the muscle knots (Janssens, 1991). Pain from palpation can be experienced locally or at a distance and treatment is directed in the region where pain occurs. However, it is possible for that area to not be the solution to the initial pain point (Janssens, 1991).

Passive stretching and passive range of motion

Patients affected by OA have a restricted joint movement, which is the result of a combination of postural protection and reduced levels of activity, causing soft tissue shortening and fibrosis. Regular movement is important to maintain a complete range of

motion and for the health of articular and periarticular structures (Johnston, 1997; Millis, 1997).

Passive stretching and passive range of motion are particularly useful exercises that improve the extensibility of the muscles and soft tissues (such as the joint range of motion), avoid adherences, promote production of synovial liquid and improve cartilage lubrication (Millis & Levine 1997; Allen & Koshi, 2005).
Therapeutic exercise

A wide range of exercise programs related to hydrotherapy have been described and are associated with lower pain points. Moreover, proper rest in a soft bed is important for patients with chronic pain. However, excessive rest will lead to the exacerbation of musculoskeletal disorders and pain (Gibbs & Klinger, 2011). For this reason, it is essential to plan a daily exercise routine to keep joints in good shape.

Therapeutic exercise aims at improving muscular strength to support painful joints (including those of the spine), improving proprioception to provide dynamic stability and reducing the risk of injury, increasing joint mobility, cardiorespiratory improvement, and resistance to minimize anaerobic respiration (Hamilton et al., 2004).

Acupuncture and electroacupuncture

It is believed that the modulatory effects of pain are measured mainly at a segmentary level. The stimulation of afferent nerves through needles generates action potentials that reach the dorsal horn of the spinal cord. Descending pain inhibitory systems can also play a role in the analgesic effect of acupuncture (Wang et al., 2008).

The central regulatory effects mediated by the limbic system—which plays a central role in affective and cognitive dimensions of pain—can be responsible for general calming effects, as well as for a better sense of wellbeing in human patients (Wang, 2008; Fang, 2009).

Numerous articles conclude that acupuncture is efficient because it improves knee OA pain and improves joint function. Acupuncture and its derived therapies are fast and can last for a long time if the therapy is followed regularly.

Gold bead implantation in acupuncture areas has been used as long-term analgesia in dogs with hip dysplasia. Although this technique has yielded variable results, it always shows an important clinical significance when compared with acupuncture and conventional analgesia (Bolliger, 2002; Jaeger, 2007).

Transcutaneous electrical nerve stimulation

As in case of acupuncture, transcutaneous electrical nerve stimulation is based on depolarization by low frequency waves of the sensory nerve to suppress pain at the spinal cord level (Steiss & Levine, 2005). Its daily use allows reducing pain points and considerably improves muscle resistance. It is recommended to follow the program indicated by the

manufacturer of the equipment to achieve the necessary electrical stimuli according to the affected muscle group.

Palliative radiotherapy

Palliative radiotherapy is widely used for the treatment of pain associated with osteosarcoma in dogs, showing very few side effects (Ramirez, 1999). It has proven to be an effective treatment for OA in dogs (Ruppert et al., 2004). The mechanism by which radiotherapy improves pain in OA patients is still being studied in animals, but a reduction in inflammation seems to be the main cause (Calabrese, 2012). Radiotherapy has limited availability in veterinary patients and can be associated to severe acute diseases and late side effects (Arthur, 2008).

Moxibustion

Moxibustion is a very ancient technique derived from traditional Chinese medicine that involves combustion of the plant ***Artemisia***. Moxa is applied to acupuncture canals and points to warm and tone them. The main effect of moxibustion on the body is an increase in metabolism, causing blood vessels to dilate. This stimulates blood and lymphatic flow and increases the number of white blood cells in the area. According to traditional Chinese medicine, moxibustion helps disperse cold and humidity, opening the canals and allowing these factors to be eliminated. Regular treatment reduces joint pain and tends to improve joint elasticity.

Environmental Change

There is limited evidence that the type of bed used can affect the progression of OA in dogs. However, we can all agree that a warm and comfortable bed will allow the animal to experience less muscle contractures and joint pain associated with cold (Rogachefsky, 2004).

Homeosiniatry

Homeosiniatry or homeopuncture is the use of homeopathic products in specific acupuncture zones. This medical technique employs homeopathic medicines related to the joint pathology, wherein the patient is treated according to their clinical needs, whether it is for improving joint function or reducing local pain. Because it is applied at the acupuncture points, it enhances the action and benefit of the homeopathic medicine, providing relief from pain within a few days of starting the sessions and with no signs of adverse side effects along with being economically accessible.

Conclusions

Although there are currently multiple options for treating joint pain in dogs, very few of them have been studied or it is scientifically unknown if they have a therapeutic function. There are factors that influence the poor management of pain such as misdiagnosis, lack of cooperation from the owner, and medication and supplies costs, among other causes that need to be prioritized in order to effectively control joint pain.

Alternative therapies constitute an arsenal that allows the clinician to find therapeutic options that complement each other. We can use homeopathy for analgesia, acupuncture and moxibustion for local analgesia, massage to control muscle pain, among different options that when used together provide benefits in the management of OA. It is relevant to determine if the patient presents obesity so we can administer hypocaloric diets that allow gradual weight reduction, as well as evaluate if the animal overexercises because ligaments and muscles are a frequent source of pain in these cases.

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