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Editor's Note

Dear colleagues,

South Africa doesn't do anything halfway! When it's cold, it's cold enough to snow in Joburg. If there's a storm in Durban, it's not just any storm – it's a tornado. When we loadshed, we do it stage 6 style. And when we ask South African veterinary professionals to share their knowledge with us, we get nothing short of world-class contributions.

This edition of Vet360 is a proudly South African, featuring articles on clinical pathology, surgery, physiotherapy, opthalmology and even AI in veterinary medicine, all written by local key opinion leaders. This month's magazine features articles by Fred Reyers, Izak Venter, Tanya Grantham, Jaqqui Posthumus and Neels du Plessis. My sincere thanks to our authors for giving us their time, and for the team at Vetlink publications for putting the magazine together in an easy-to-read format that we can enjoy over coffee – even if sometimes it has to be by candlelight!

As always, the CPD quiz is available online to subscribers, and if you are reading our magazine online and would like a printed copy, do let the Vetlink team know and they will add you to the mailing list.

Stay warm and informed,

Marianne

vet360

VET360 aims to be a leader in the field of continuing veterinary development in Southern Africa by providing veterinary professionals from diverse disciplines with tools to help them meet the challenges of private practice. The magazine aims to make information accessible, both paper and electronic, and provide clinical, business and other veterinary information in a concise form to enable the practitioner to rapidly acquire nuggets of essential knowledge

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AI Applications in Veterinary Medicine: Revolutionizing Animal Healthcare in South Africa

AI and Jaqqui Posthumus
Country Head of Digitail South Africa

Artificial Intelligence (AI) has emerged as a transformative technology, revolutionizing various industries worldwide. South African veterinarians are also embracing the potential of AI to enhance animal healthcare and improve veterinary practice management. AI has become accessible to "the man on the street" and veterinarians need to consider the applications of AI in veterinary medicine, its ethical considerations, and its future prospects specifically in the context of South Africa.

Understanding AI and Its Relevance

AI refers to the simulation of human intelligence in machines that are programmed to think, learn, and problem-solve like humans. Its applications in veterinary medicine have the potential to streamline diagnostic processes, provide accurate predictions, and improve overall animal care. Its applications in the daily running of your business are endless.

AI's Current Uses in General

Here's some simple examples of how "everyday businesses" can use AI to simplify their lives.

1. ***Content Generation Assistance:*** Utilize Chat GPT to assist in generating content ideas or creating social media captions. You can provide prompts or questions, and the Chat GPT model can offer suggestions and inspiration for your content creation efforts.
2. ***Social Media Listening:*** Utilize AI tools to monitor social media platforms for mentions of your brand or industry-related keywords. This helps you stay updated on customer opinions, industry trends, and potential opportunities for engagement or marketing campaigns.
3. ***Intelligent Data Analysis:*** Apply AI techniques to analyze sales data, customer demographics, and market trends to gain valuable insights. This can help identify patterns, preferences, and target audiences, allowing you to make informed decisions and tailor your marketing strategies accordingly.
4. ***Automated Email Responses:*** Set up AI-powered email responses to automatically address common customer inquiries or provide basic information. This saves time for your team and ensures prompt and consistent responses to customer queries.

As an example, a veterinary clinic can ask Chat GPT the following:

"Write an email marketing campaign using the 'Four C's' framework to create clear, concise, compelling, and credible copy for millennial and Gen Z pet owners who live in Pretoria. Use this checklist to ensure that our message is effectively communicated and persuades the reader to take action. Include talking points such as [unique selling point] and [desired action]."

OR

"Using the 'Star-Story-Solution' framework, please write an email marketing campaign that introduces the main character of a [story]

related to our [product/service] and keeps the reader hooked. End the story with an explanation of how the star wins in the end with the help of our product.

How About

"*Write a firm but friendly email to Mrs. Smith convincing her to settle her outstanding account.*"

OR

"Write a personalized educational piece about the dangers of overfeeding your pets for Fluffy's owner, Mrs. Smith. Include the long-term effects of obesity in pugs as well as a recommended nutrition and exercise program."

Chat GPT, Bard, Co-Pilot, and Midjourney are examples of AI-powered tools that have found relevance across industries and are readily available in South Africa. Veterinarians can leverage these tools to access valuable information, collaborate with peers, and improve decision-making processes.

Ethical Considerations of AI in Veterinary Medicine

As AI becomes more prevalent in veterinary medicine, it is crucial to address ethical considerations. Two primary concerns are data privacy and security. South African veterinarians must ensure that patient data is protected and comply with relevant data protection regulations like POPIA.

Additionally, accountability and AI decision-making are essential. Veterinarians should be aware of the limitations of AI and carefully evaluate the outputs to ensure accurate diagnoses and appropriate treatment plans.

The Future of AI in Veterinary Medicine is Already Here!

AI Applications in Veterinary Medicine can range from diagnostic imaging through automating the interpretation of imaging and assisting in detecting abnormalities, through to predictive analtyics used to forecast disease outbreaks as well as predicting patient outcomes based on factors such as breed, age, lifestyle and other trends.

This information helps veterinarians implement preventive measures, offer personalized treatment plans, and improve overall patient care.

In South Africa, AI-based platforms like Digitail are already revolutionizing veterinary practice management. Digitail provides an AI tool called TAILS for appointment scheduling, medical record management, inventory tracking, and client communication. By automating administrative tasks, South African veterinarians can focus more on patient care, improving efficiency and client satisfaction.

Benefits and Challenges in the Adoption of AI

The adoption of AI in South African veterinary practices offers numerous benefits, including improved diagnostic accuracy, efficient patient care, and enhanced practice management. However, challenges such as initial costs, staff buy-in, and confidence in AI's decision-making capabilities need to be addressed.

Some clinics are still working on server-based software or keeping records on paper, it will be **essential to get conquer change hesitancy**. Proper training and education will be crucial to ensure that veterinarians and support staff can effectively utilize AI technologies.

Artificial Intelligence has already started to transform veterinary medicine in South Africa, enabling veterinarians to provide better care and manage their practices more efficiently. By embracing AI applications such as diagnostic imaging, computational pathology, predictive analytics, and veterinary practice management tools, South African veterinarians can stay at the forefront of technological advancements, ultimately benefiting the health and well-being of animals across the country. Don't get left behind!

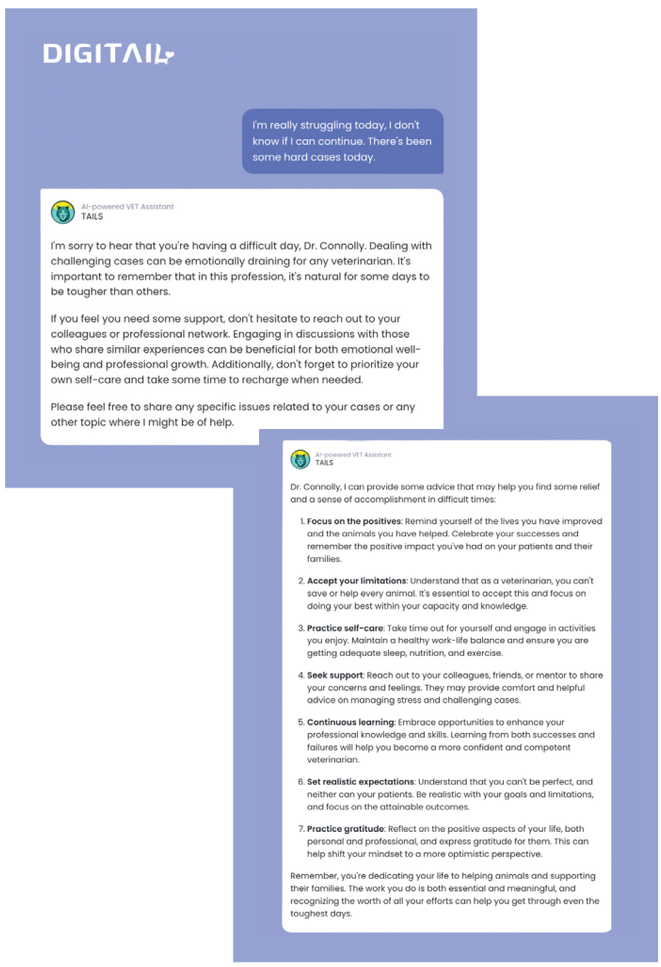

Image: *Could this be an unforeseen use case for AI in Vet Med?* 🤔

Obviously, I'm not implying that AI should be used specifically for therapy. But AI-powered chatbots and virtual assistants may offer a promising way to improve access to mental health resources and support for veterinary professionals. By providing quick and easy access to confidential support, such as crisis hotlines or counseling services, could AI help to reduce the stigma around mental illness and empower veterinary professionals to seek help when they need it? 🤍

Would you find this advice helpful?

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GCS JOINT CARE ADVANCED

Calcareous Degeneration of the Canine Cornea

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Introduction

There are three main groups of corneal lesions that appear as crystalline corneal opacities namely: corneal dystrophies, lipid keratopathy, and corneal degeneration. In this article the emphasis will be on calcareous corneal degeneration [CCD] but differentiating features between these three conditions will be discussed.

Corneal calcification in the dog is regarded as an uncommon problem in younger dogs but is seen more often in geriatric patients. Corneal mineralization may occur as a part of primary corneal dystrophy or as a secondary feature to corneal degeneration and/or systemic disease. Chronic ocular inflammatory conditions leading to degenerative changes include keratoconjunctivitis sicca, uveitis, glaucoma, or phthisis bulbi. Precipitation of calcium can occur with even minor alterations in the corneal microenvironment for example tear osmolality and pH. In dry eye patients the tear calcium levels are further concentrated.

Systemic diseases resulting in hypercalcemia, hyperphosphatemia, uraemia, hypervitaminosis D, and hyperadrenocorticism have also been associated with corneal calcification. The concentration of calcium and phosphate in serum may be reflected in the tears and interstitial fluids. It has also been found that long term use of topical corticosteroids may exacerbate this condition by increasing phosphate concentrations in tears.

Most of these calcium deposits occur in the horizontal interpalpebral fissure and is referred to as band keratopathy. One theory for this anatomic location is an interaction between tear evaporation and pH, with the pH of the interpalpebral fissure higher than that of the rest of the ocular surface. This may be due to carbon dioxide release from the interpalpebral exposure zone.

Sansom J et al. reported an age and sex predilection with an average age of 13.5 years and the majority cases were neutered females. Most cases in their report were small dogs.

The exact mechanism of calcium deposition in the cornea of older dogs, defined as calcareous corneal degeneration however remain unknown.

Clinical signs

Clinically, corneal degeneration has a highly variable appearance but have a crystalline white or grey appearance. These deposits are usually located superficially in the axial or paraxial cornea but may

Figure 1: *Typical appearance of CCD. Paraxial cornea affected with a crystalline white appearance of the lesion.*

Figure 2: *Corneal degeneration with secondary stromal ulcer. Note the two eyelid neoplasms most likely tarsal adenomas contributing to the underlying keratitis.*

occur anywhere in the cornea. [Figure 1]. They have an irregular appearance on magnification and feel gritty when touched with a cotton bud or instrument. Lesions may be unilateral or bilateral but are usually not symmetrical. Other signs of keratitis for example corneal vascularization and pigmentation may be present. There is a predisposition to secondary corneal erosions in the affected areas. [Figure 2]. In some cases, this ulceration may progress resulting in the formation of a descemetocele or corneal perforation. These secondary corneal ulcers typically are very slow to heal and require more than the standard corneal ulcer treatment.

Differential diagnosis

Calcareous degeneration of the canine cornea must be differentiated from true corneal dystrophy and lipid keratopathy.

Crystalline corneal dystrophies are usually inherited, bilateral, and of varying density. Unlike CCD they are often first diagnosed when the animal is a young adult; however, this varies by breed. The lesions are also located in the anterior stroma but in these cases the corneal epithelium remains intact. There is no inflammation, vascularization, or pigmentation associated with these lesions. [Figure 3].

Corneal dystrophy usually has a very typical appearance in specific breeds for example, in the adult Golden Retriever, the opacity usually affects the peripheral cornea, the lesion is oval or elliptical in shape with a lucent interval between the lesion and the limbus. In the Beagle the opacities are located at the junction of the middle

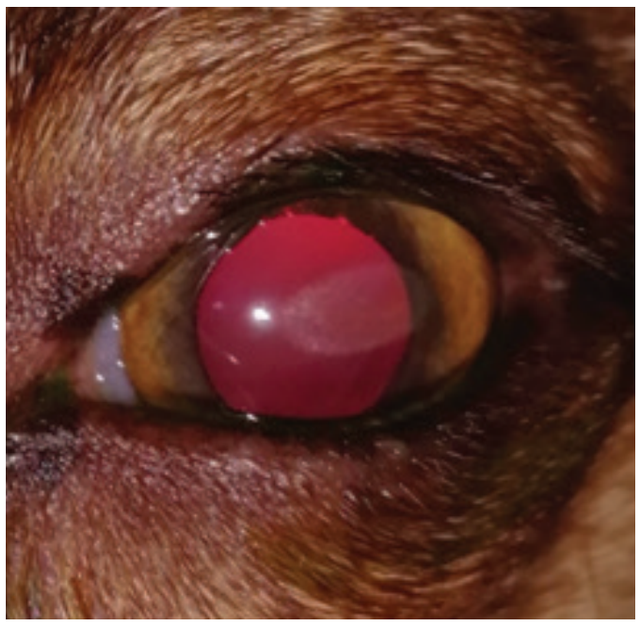

Figure 3: *Classic appearance of corneal dystrophy Note the absence of any signs of corneal inflammation.*

and ventral one-third of the cornea. The lesions are horizontally oval and average 3 by 5mm in size.

Lipid keratopathy in the dog has been associated with systemic lipid abnormalities, for example hypothyroidism, pancreatitis, diabetes mellitus and spontaneous hyperlipoproteinemia.

It is characterized by peripheral and central corneal crystalline opacities. Clinically, lipid keratopathy can be unilateral or bilateral but in bilateral cases the lesions are asymmetrical. The corneas are non-vascularized in the early stages however, chronic cases are associated with vascularization. [Figure 4].

Figure 4: *Dog with perilimbal lipid keratopathy. [Ledbetter EC, Gilger BC. Diseases and Surgery of the Canine Cornea and Sclera]*

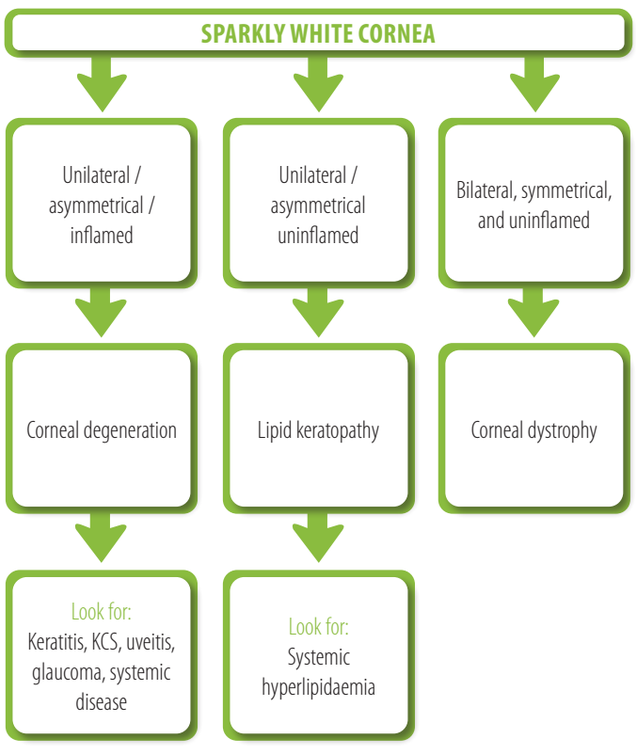

Figure 5: *The differentiating features of corneal degeneration, dystrophy and lipidosis.*

Treatment

Resolution of a calcific band keratopathy may occur with normalization of serum calcium levels and therefore a diagnosis and correction of a possible underlying cause is important.

The primary goals of treatment for CCD are:

- Removal of calcium deposits.
- Restoring a smooth ocular surface.
- Resolving discomfort.

Various modalities have been used in the treatment of CCD in dogs including corneal diamond burr keratotomy (DBK), superficial lamellar keratectomy, topical administration of EDTA (1%–4%) in artificial tears, or a combination.

While mechanical removal of the calcium deposits is the primary treatment for CCD in the veterinary literature, EDTA chelation is widely utilized in the human literature and reported as a safe, reliable method resulting in improvements in visual acuity and ocular comfort. Topical EDTA has many therapeutic properties and is utilized as an antioxidant, preservative, chelating agent, and anti-collagenolytic. Disodium EDTA forms stable water-soluble complexes with metal ions, thus decreasing tear film levels of calcium and limiting progression of calcium deposition.

In a study by Anastassiadis Z et al. administration of ongoing post operative topical EDTA following DBK had a recurrence of 13.7% (7/51 eyes) and a probability of recurrence at 12 months of 15.6%. This is considerably lower than other reports using DBK alone for CCD in dogs with a probability of recurrence at 12 months of 58%.

Summary

It is important to differentiate CCD from corneal dystrophy and lipid keratopathy and every effort should be made to determine and treat possible underlying causes.

Superficial keratectomies are very effective in removing these lesions, but this surgery falls outside the scope of most general small animal practices. DBK is an easy and safe procedure to perform and can be done just with topical anaesthesia in most patients. Topical 4 % EDTA in oil is an effective treatment following DBK and may also be used as the sole treatment for CCD if DBK is not possible. It is important to sill treat the secondary corneal ulcers as per the usual ulcer treatment protocol using topical antibiotics.

4 % EDTA in oil is available in South Africa as a compounded product through VetScripts.

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CRP as a Test for Assessing and Monitoring Systemic Inflammation

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Abstract

Inflammation caused by a number of disparate mechanisms, cause the release of Interleukins by leukocytes and some of these (such as IL-6) promote the release of Acute-phase proteins by the liver. One of these is C-reactive proteins (CRP). The use of CRP in the detection and monitoring of inflammatory disease, in human medicine has been well established for over 30 years and many specific applications have been published.

For many years validate methods were not available for the assay of CRP in veterinary medicine (such as for dogs) and in-house developed methods were used in the earlier publications on CRP in dogs. More recently some methods designed for use in humans were validated for canine serum CRP and very recently a number of immunologically-based methods, specific for canine serum CRP were developed. This has led to the publication of numerous articles demonstrating its clinical usefulness in certain settings.

In order to derive maximum utility of the now widely-available test, the author has suggested four clinical scenarios to be used as templates to guide the clinician in using this test.

Scenario 1: Vague clinical presentation (such as anorexia) where the test is used to determine if significant inflammatory pathology is present.

Scenario 2: Differentiating between inflammatory and non-inflammatory causes of clinically evident abnormal signs (such as differentiating inflammatory from non-inflammatory causes of lameness)

Scenario 3: In the presence of diagnostically established inflammatory disease (such as burns), determining the degree of inflammation and setting a prognosis.

Scenario 4: In the presence of diagnostically established inflammatory disease (such as pneumonia), determining the response to treatment.

Introduction

Inflammation can be produced by a number of tissue insults, including trauma, heat, infections, immune-reactions and various types of neoplasia. During inflammation, T-lymphocytes and monocytes/macrophages (principally) produce a number of "communication molecules" called Interleukins and, in particular, Interleukin-6 (IL-6). In turn, IL-6 induces the production of a range of compounds by the hepatocytes, which are called "Acute Phase Reactants", most of which are proteins and hence the name "Acute Phase Proteins" (APP) is generally used. Different APPs respond to differing degrees (in terms of their blood serum concentration) in different species. For instance, in humans and dogs C-reactive protein (CRP) has a profound response (up to a 1000-fold increase over resting levels), whereas in horses and cats it does not. In those species Serum Amyloid A (SAA) and Alpha-1 Acid Glycoprotein (AGP), respectively show a greater increase. APPs are produced as part of the innate immune response and play different roles in this response. CRP, for instance, *inter-alia* promotes the binding of Complement to bacteria, enhancing phagocytosis, induces the production of other cytokines, and inhibits neutrophil chemotaxis.

CRP tends to rise rapidly in serum after the onset of inflammation and can peak in 24-48 hours. It has a relatively short half life and therefore, when the inflammation abates (or is successfully treated) CRP levels decline rapidly.

Use of serum CRP in human medicine

A test for CRP has been available in human medicine for well over 30 years and it has been shown to be a useful aid in the diagnosis of various forms of inflammatory joint disease, rheumatic fever, pancreatitis, sepsis, pneumonia, appendicitis, bacterial endocarditis, post-operative infection, Crohn's disease, cystitis, differentiating between inflammatory and non-inflammatory thyrotoxicosis, post-operative monitoring of metritis, risk of death in chronic dialysis patients, identifying neonatal infections, urinary tract infections, differential diagnosis of brain abscesses and many more. Sequential CRP levels have been used to assess response to treatment in a number of conditions and it is a standard practice in the treatment of pneumonia.

It is important to note that the determination of CRP, in human medicine, is not, in itself diagnostic of any one particular disease – just the presence of inflammation. However, it has been shown that the magnitude of the rise in CRP can be used as a rough guide to the cause of inflammation with viral infections eliciting a smaller response than bacterial infections and certain immune-mediated diseases, with the highest levels seen in sepsis and burns. In some disease situations CRP has been used to distinguish between two or more potential causes. For instance, in inflammatory bowel disease CRP is either not increased or only minimally increased in ulcerative colitis but Crohn's disease shows a strong CRP response. Against expectations, CRP is not usually elevated in Systemic Lupus (possibly due to high IFN-alpha in SLE inhibiting CRP production) but if an SLE patient has a significant increase in CRP, then it may point to secondary infection.

CRP has also entered the field of prognosis in human cancer. A study showed that CRP was useful in determining prognosis in non-Hodgkins lymphoma. Elevated CRP levels are identified with poor prognosis in patients with solid cancers. Raised CRP has been shown to be associated with poor outcome/prognosis in small-cell lung cancer.

Recently, a new, more sensitive CRP test has been developed for use in human medicine, namely "High-sensitivity CRP". This test is rapidly gaining acceptance in the field of cardiovascular disease investigation in that persistent production of low levels of CRP appear to be responsible for angiopathy.

Use of serum CRP in veterinary medicine)

In general, CRP in canine serum (based on immunological tests) does not cross-react with most methods designed for humans until quite recently when a few validation studies, using a human method, were published.

Reports of the use of CRP in veterinary medicine have been around since the 1980s but very sporadic until recently. The earlier literature refers to studies that were conducted with in-house/research-linked/developed methods. This situation has now changed quite profoundly recently.

First of all, it was established that some methods for human CRP cross-reacted sufficiently well with canine CRP to be validated as clinically useful and, very recently, several canine-specific CRP methods have been published and put into practice – one of which will now become available to users of the Idexx Catalyst biochemistry analyser.

So, more recently (2013-2016 literature), a number of publications have appeared that show the utility of determining serum CRP in dogs, mostly using canine-validated/specific tests. Cystitis in dogs – although full urinalysis will reveal the same information, a single serum test, in suspected cystitis can be very useful.

CRP has been shown to be a much more sensitive marker of inflammation than leukocyte count in canine babesiosis. CRP has been shown to be associated with treatment success in canine leishmaniosis. Differentiating between suppurative and non-suppurative arthritis has been shown to be facilitated by serum CRP measurement.

In suspected pyometra in bitches, serum CRP was found to be a more reliable indicator than leukocyte count. Elevated CRP was found to be a useful test to confirm the diagnosis and monitor response to treatment in dogs with various forms of cancer. In

fracture healing of dogs it was found that low CRP levels were associated with cases stabilized with closed reduction. Post-surgical inflammatory complications, in dogs, was shown to be identified by raised serum CRP.

Measurement of CRP was found to be a useful parameter to assess the post-treatment complications in adulticide treatment of heartworm in dogs.

Also, serum CRP can be used as a marker of endothelial arteritis and hypertension in dogs with heartworm. Major increases in CRP were found to be a marker of disease severity in canine parvoviral diarrhoea. In pancreatitis, disease severity was positively correlated with serum CRP levels in dogs.

In canine spirocercosis, serum CRP levels were associated with the presence of secondary neoplasia. Plasma CRP was found to be a useful marker for the presence of Immune-Mediated Polyarthropathy in dogs. Dogs with bacterial pneumonia were found to have higher CRP levels compared with dogs with other respiratory diseases. In canine babesiosis serum CRP levels were high before treatment and remained high for three days after initiation of treatment.

Serum CRP was found to be a reliable indicator of the degree of surgical trauma in soft tissue surgery. Serum CRP was found to be high in SRMA in a dog. In ovariohysterectomy by experienced and inexperienced surgeons, serum CRP was an indicator of the level of inexperience. In GDV, serum CRP concentrations were frequently increased.

There is, therefore, sufficient recent evidence that serum CRP has a place in the laboratory workup of canine clinical cases. However, CRP is NOT specific for any one disease and it is important to grasp the role that CRP should play in diagnostics. To this end, there are four scenarios described, below, which are not exhaustive but can be used as a model to suit the needs of the veterinary diagnostician.

Scenarios for optimizing the use of CRP in the clinical setting

Scenario 1

a) Problem: The dog "is not him/herself"/ is lethargic / is anorexic / has unexplained weight loss, without any overt clinical signs.

b) Role of CRP assay: To determine if there is a significant inflammatory process/pathology present somewhere in the body.

The sensitivity of CRP in this scenario is not very high as there are many diseases that can present with the above vague findings that do not have inflammatory disease. However, the specificity (for detecting significant inflammation/ pathology) is quite substantial and if CRP is abnormally high, it suggests that other diagnostic approaches and procedures are warranted.

Scenario 2

a) Problem: There is a clinical finding that can have more than one cause, one (or more) of which is/are inflammatory. For example: lameness, abdominal effusion, coughing.

b) Role of CRP assay: To determine if the abnormal clinical finding has an inflammatory or non-inflammatory cause.

Again, sensitivity is not very high but specificity is good. If CRP is raised, in the presence of the clinical abnormality, then the diagnostic options are a very small focus group.

Scenario 3

a) Problem: There is an established diagnosis of inflammatory disease. For instance: Trauma (fight or HBC), snake bite, burns.

b) Role of CRP assay: To determine the severity of the pathology and possibly set a prognosis.

Scenario 4

a) Problem: Largely an extension of Scenario 3. There is an established inflammatory disease present and treatment has been initiated. For instance: canine babesiosis, pneumonia, post operative (as in pyometra), trauma.

b) Role of CRP assay: To determine whether the treatment is/has been effective. This may require several sequential determinations.

Suggested reading

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1. Which of the following scenarios involves using CRP to set a prognosis in an established inflammatory disease?

a) Scenario 1
b) Scenario 2
c) Scenario 3
d) Scenario 4

2. How long does it typically take for CRP levels to peak in serum after the onset of inflammation?

a) 1-2 hours
b) 6-12 hours
c) 24-48 hours
d) 3-5 days
e) 1 week or more

3. Which of the following statements is true about the use of CRP in human medicine?

a) CRP is a diagnostic marker for specific diseases.
b) CRP levels are higher in viral infections than bacterial infections.
c) CRP has no role in prognosis assessment for cancer patients.
d) Sequential CRP levels can be used to monitor treatment response.
e) None of the above

4. What is the role of CRP in the innate immune response?

a) Enhancing phagocytosis
b) Inducing the production of other cytokines
c) Inhibiting neutrophil chemotaxis
d) All of the above
e) None of the above

5. What is one of the limitations of using CRP as a diagnostic marker in veterinary medicine?

a) It is not specific for any one disease.
b) It is not sensitive enough to detect inflammation.
c) It cannot be measured accurately in dogs.
d) It does not cross-react with human methods.
e) It has a long half-life in serum.

6. Which of the following conditions has shown an association with elevated CRP levels in dogs?

a) Canine babesiosis
b) Canine leishmaniosis
c) Bacterial pneumonia
d) All of the above
e) None of the above

7. What is the suggested role of CRP in Scenario 2 of the clinical setting?

a) Determining the severity of inflammatory pathology
b) Assessing the response to treatment
c) Distinguishing between inflammatory and non-inflammatory causes of clinical findings
d) Setting a prognosis for the disease
e) None of the above

8 In dogs with bacterial pneumonia, how do CRP levels compare to dogs with other respiratory diseases?

a) CRP levels are lower in dogs with bacterial pneumonia.
b) CRP levels are higher in dogs with bacterial pneumonia.
c) CRP levels remain unchanged in dogs with bacterial pneumonia.
d) CRP levels depend on the severity of the respiratory disease.

9. What is the role of CRP assay in Scenario 1 of optimizing CRP use in the clinical setting?

a) To determine the severity of the pathology
b) To assess the post-treatment complications
c) To differentiate between inflammatory and non-inflammatory causes
d) To identify the presence of significant inflammatory pathology
e) None of the above

10. What is the significance of CRP levels declining rapidly after the inflammation abates?

a) It indicates the presence of a secondary infection.
b) It suggests the need for additional diagnostic approaches.
c) It confirms the diagnosis of inflammatory joint disease.
d) It indicates the effectiveness of treatment.

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Abstract

Thoracolumbar disc herniation is likely the most common neurological disease presented to the small animal practitioner. It is important to exclude other orthopeadic conditions that may mimic spinal conditions. A proper neurological examination is invaluable. A grading system is in place to help determine management of these cases.

The grading system is not an indication of disc herniation or not, nor is it an indication of the amount / volume of herniated material present. Medical management has a high recurrence rate and a moderate success rate.

The use of corticosteroids in management of these patients is to be discouraged. Surgical management consists of decompressive surgery with a success rate of 90% +, with return to function often within days vs weeks for conservative management. It is important that clients should ALWAYS be given the option of referral and surgical intervention.

Keywords: thoracolumbar disc herniation, medical management, surgical management.

Introduction

The incidence of thoracolumbar intervertebral disc herniation in the Dachshund have not been determined. It is likely the most common neurological disease presented to the small animal practitioner.

Clinical symptoms of these dogs with spinal disease are often recognized from the owner history as well as typical clinical signs. These vary from non-distinct pain, abdominal tensing, arching of the back, unwillingness to jump up, screaming for no apparent reason, ataxia and paresis of paralysis.

The severity of these signs are dependent on the dynamic force of the compression (a "punch" vs a "push"), the size of the protrusion (a small volume high velocity extrusion can have devastating consequences) , and the location of the lesion.

The effects of spinal cord compression are most readily seen in the thoracolumbar area because of the relatively small ratio of spinal canal to cord diameter. Cervical disc herniation in the small breed usually presents as pain only because the spinal canal diameter is larger, allowing more room for the spinal cord to compensate for mechanical displacement. A "root signature" may sometimes present in the form of a front limb (often unilateral) lameness. On occasion will neurological fallout be present in the back legs as well.

Physical Examination

A proper history and full clinical examination should always be done as routine, and neurological status should be recorded for future reference. It is important to exclude other orthopeadic conditions that may mimic spinal conditions.

Examples are: cranial cruciate ligament injury (especially bilateral), osteoarthritis, patellar luxation, Achilles tendon rupture, tibial crest avulsion, and fractures. A screening neurological examination should be done when suspicious.

Diagnostic Imaging

The role of survey radiographs is debatable and should be mainly considered to ensure normal anatomy and exclude obvious spinal column pathology. Accurate positioning is vital if a diagnosis is to be made.

A narrowed disc space may be seen in approximately 60% of cases by the experienced clinician, if positioning and radiographic quality is optimal, and may therefore identify the exact location, though spatial orientation of the lesion (left, right, ventral lateral) cannot be ascertained. The presence of calcified discs in the Dachshund can be seen as an incidental finding, and is not diagnostic for a prolapsed disc.

Myelography is usually very sensitive and specific for diagnosis and localizing the compressive lesion but carries the risk of iatrogenic spinal cord damage and can be technically challenging. The utility can be enhanced by combining it with a CT.

Magnetic resonance imageing (MRI) is a non invasive and safe way of diagnosing and localizing (both anatomically and spatially) the site of compression. Overall, MRI shows excellent anatomical detail with a reasonably high sensitivity. Sensitivity is enhanced with the use of contrast enhancement. Accurate interpretation of images does require a high level of skill and experience.

The Intervertebral Disc (IVD)

The IVD consists of two anatomically distinct regions: an outer layer of fibrocartilaginous material arranged in concentric layers like an onion (the annulus fibrosus) and an ovoid central region of gelatinous material (the nucleus pulposus).

The annulus fibrosus is approximately two times thicker ventrally than dorsally, and its laminar structure is most prominent ventrally and least prominent dorsally.

The nucleus pulposus is eccentrically located in the dorsal one third of the IVD. The proteoglycan content decreases and the collagen content increases with age in both the nucleus and the annulus. This leads to reduced water retention, decreased shock absorbing ability and increased friability.

By two years of age, the majority of Dachshund discs have undergone chondroid metamorphosis, and many nuclei have mineralized, changing from a jellylike consistency to a dry gritty substance. These often lead to a Hansen type I extrusion at a peak incidence of 3 – 6 years of age.

Neurological Examination

Starts in the waiting room. Observe the dog as it walks in, if carried in, ask for it to be put down on the floor. Ask yourself the following questions:

- Can it walk? Yes or no.
- If yes, normal or ataxic – check conscious proprioception.
- If no, check superficial pain.
- If present, do not check deep pain as it will be there.
- If not present, check deep pain (dog must show a conscious response to stimulus, NOT JUST A WITHDRAWEL!)
- Check for and record a '"hyperpathic" spot (repeatable, "tender" spot on back with progressive spinous process pressure, starting from mid thoracic and progressing caudally).
- Cutaneous trunci reflex.
- Subtle lesions will benefit from hopping and wheelbarrow test.
- Local spinal reflexes tested – hypo vs hyper reflexia.
- Localize the lesion (C1–C5, C6–T2, T3-L3 L4-S3)
- Decide on surgical vs conservative management.
- RECORD FINDINGS to allow serial evaluation over time.

In the spinal cord loss of function develops in the following sequence:

- loss of proprioception
- loss of voluntary motor function
- loss of superficial pain sensation
- loss of deep pain sensation.

Loss of deep pain sensation usually goes with a poor prognosis for functional recovery.

Function usually returns in the reverse sequence. Urination usually returns with voluntary motor function (trying to walk / crawl) starts returning.

Conservative Management

Grading system:

- 1 – pain only.
- 2 – paresis and walking.
- 3 – paresis and not walking.
- 4 – paraplegia.
- 5 – no deep pain.

Medical management relies on variations of 3 strategies and should mainly be considered in group 1 and 2 patients. Group 5 patients should not be considered:

- Enforced cage rest for at least 4 weeks, theorized to allow healing of the bulging or torn annulus. If successful, a gradual increase in exercise can be allowed between weeks 6 – 8, with jumping and impact exercise restricted for 4 – 6 months.
- Use of analgesics, muscle relaxants and NSIADS to reduce pain and inflammation. Anti-ulcerogenics like proton pump inhibitors should be considered routine as up to 70% of affected dogs will have some form of gastro intestinal ulceration present.
- Physical rehabilitation to maintain muscle tone, strength and range of motion.

Recent studies evaluating success for medical management reports success rates of 55% - 81% for ambulatory patients, 43% - 51% for non ambulatory patients, with a recurrence rate of 30% – 40%.

The use of corticosteroids in management of these patients is to be discouraged as there is a strong body of evidence showing no positive effects on short term neurological outcome with its use, with dexamethasone showing the highest complication rate.

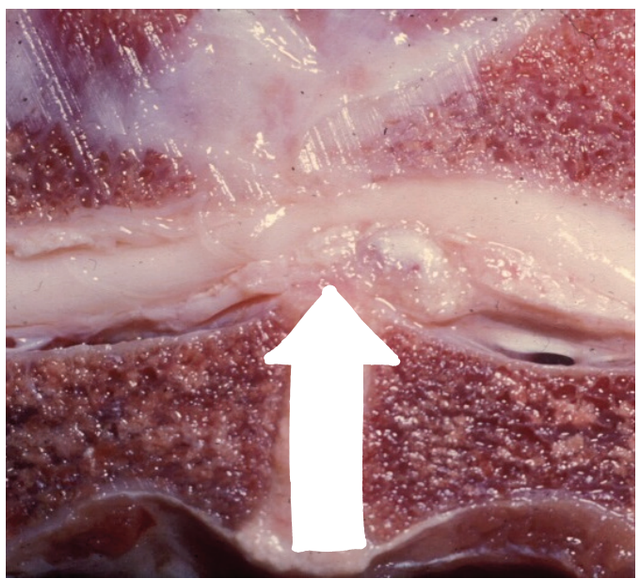
A very small percentage of cases may progress to a progressive ascending-descending myelomalacia, characterized by progressive and complete sensorimotor loss in both hind and front legs (absent withdrawal reflexes in the legs, and loss of spinal reflexes) with eventual bilateral Horner's syndrome and respiratory distress and death, usually due to humane euthanasia. It is an irreversible complication. Risk factors are poorly understood and the condition is almost invariably fatal. It can present within 2 to 7 days of initial incident. Surgical intervention does not preclude it.

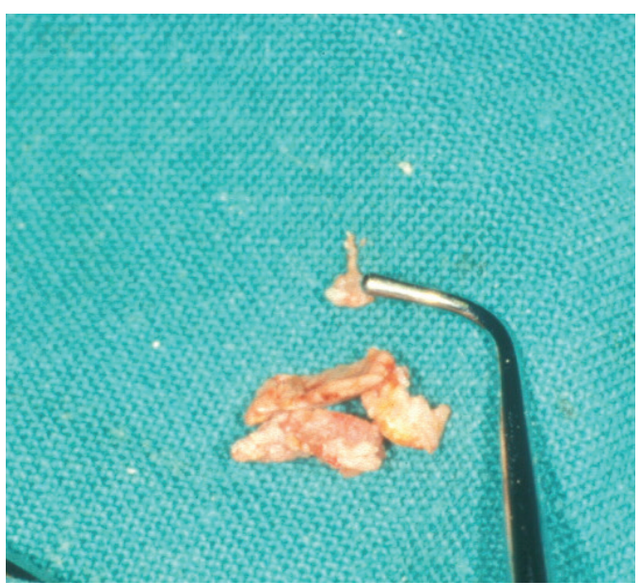
Serial neurological examinations are vital when managing these cases conservatively, as regression in neurological status should be picked up early and referral for surgery encouraged with owners.

Always remember that conservative management will most likely convert and acute disc herniation into a chronic disc herniation as the extruded material does not disappear as a rule. This will complicate future decompressive surgery. The grading system is not an indication of disc herniation or not, nor is it an indication of the amount / volume of herniated material present.

Dogs presenting with pain only, will, in the author's experience, almost invariably have a considerable amount of herniated disc material putting pressure in the spinal cord. The spinal cord recovers easier from acute pressure relief compared to chronic pressure which causes permanent demyelination.

Surgical Management

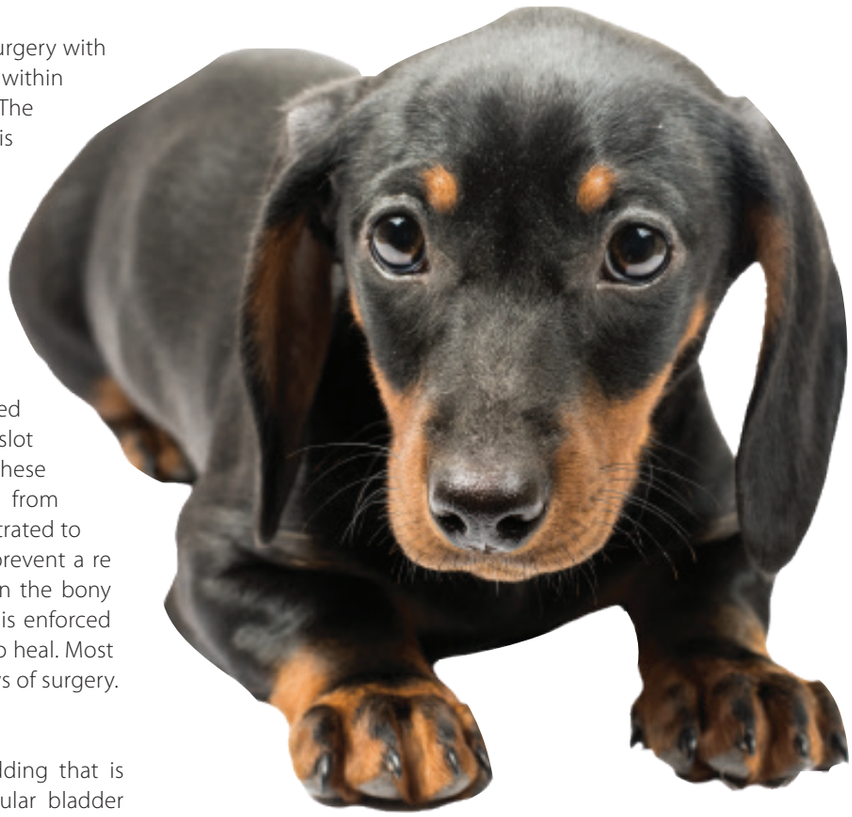




Herniated disc material compressing spinal cord. Material removed.

Surgical management consists of decompressive surgery with a success rate of 90% +, with return to function often within days vs weeks for conservative management. The presence or absence of deep pain in these patients is an important prognostic indicator. Overall recovery rates for patients with loss of deep pain vary from 25% to 76%, with a chance of recovery of less than 5% if deep pain is absent for longer than 48 hrs. Recovery can take up to 6 months in these patients and is usually only functional, not normal. The skill level of the surgeon may however affect outcome.

A pediculectomy or a hemilaminectomy is performed for thoracolumbar disc herniation, and a ventral slot decompression used for cervical herniation. During these procedures the compressive material is removed from around the spinal cord, and the affected disc fenestrated to remove as much residual material as possible to prevent a re herniation at the same site. A fat graft is placed in the bony defect to prevent scar tissue formation. Cage rest is enforced for 6 weeks post surgery to allow the surgical site to heal. Most dogs are discharged as ambulatory within 5 – 7 days of surgery.



Hospital Care

Nursing care should include: soft, absorbent bedding that is changed regularly to avoid decubital ulcers, regular bladder expression to avoid overstretching and retention cystitis, frequent turning if patient incapable of doing so, monitoring hygiene to prevent urine and fecal scald, physiotherapy and hydrotherapy to improve balance and prevent muscle atrophy. Walking aids like carts can be considered in permanently paralysed patients though management is challenging.

Client Communication

It is important that clients should ALWAYS be given the option of referral and surgical intervention, regardless of the clinician's perception of whether the client will pursue this treatment as surgery is currently the gold standard for managing these cases. Where possible the clinical problem, the diagnostic steps and management should be explained to the client in simple non scientific terms.

As accurate prognosis as possible should be given based on clinical presentation and recent literature, both for the recovery and estimated time required. The risks of conservative vs surgical management should be explained in no uncertain terms. The future possibility of a second (20%), a third (10%) and even a fourth disc herniation should be discussed with owners.

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The Role of Physiotherapy in the Management of Canine Osteoarthritis

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Introduction

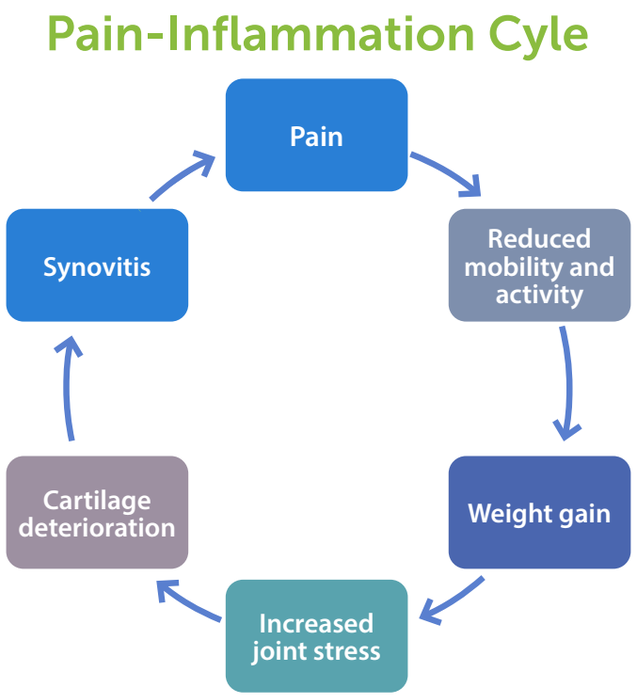
Osteoarthritis (OA) in dogs is a chronic progressive disease. The condition is painful, which impacts mobility and quality of life. OA is the most commonly diagnosed joint disease in veterinary and human medicine. [1] Figures for the prevalence of OA in dogs is conflicting. Reports range from 6.6% (primary care data) to 80% in dogs older than eight years (radiographic and clinical data from referral settings)[1]. OA can develop at any age, but it is considered a disease of older dogs. The joints most commonly affected in the appendicular skeleton are the hips, stifles and elbows. Diagnosis is frequently made only when the OA is causing significant mobility issues.

Non-steroidal anti-inflammatory drugs remain the mainstay of treatment for osteoarthritic pain. Veterinarians are well-versed in using multimodal drug therapy for the management of pain. Intra-articular (IA) injections (specifically corticosteroids) have been used and are still used to reduce joint inflammation. Different substances are now being used for IA treatments. These include hyaluronic acid, mesenchymal stem cells and platelet rich plasma.[2] Research in the use of regenerative medicine for managing osteoarthritis is ongoing. Adding physiotherapeutic modalities and principles to managing canine patients with OA will enable veterinarians to develop a truly multi-modal approach to managing this debilitating disease.[3]

Why Physiotherapy?

The main reasons to choose physiotherapy for OA dogs is to alleviate pain and improve mobility. Impacting these two factors will greatly enhance the patient's quality of life (QOL) and increase longevity. This will positively influence the caregiver's state of mind. The impact of animal companions on their human guardians is well-researched and outside of the scope of this article. Suffice it to say that a positive result will reflect favourably on the veterinary practice and further enhance the relationship between client and practice.

The main goals of physiotherapy for OA are to reduce pain, increase muscle strength and preserve joint function. A further consideration would be achieving or managing the dog's ideal weight. Achieving these goals will result in improved QOL, thereby also increasing longevity. OA creates a pain-inflammation cycle. If left unattended the process continues in a downward spiral. Physiotherapeutic interventions can aid in reversing the trend by assisting with pain control, minimising inflammation, increasing joint range of motion and muscular strengthening.



Pain Reduction

Physiotherapy can and should be used in conjunction with medical management of pain. The use of NSAIDs and analgesics allow for the therapist to create a suitable and sustainable exercise program for the dog. To ask a dog to move when it is in pain is not indicated. However, medically treating the pain and then instituting a program that builds and maintains muscle, which supports the diseased joints, is definitely indicated.

Veterinary physiotherapists employ numerous techniques and use different modalities to reduce pain. These modalities include the use of hot and cold packs (thermotherapy), massage and other manual therapies, electrostimulation, extracorporeal shockwave therapy and photobiomodulation.

Furthermore, home environments and the patient's lifestyle are adapted to facilitate functions of daily living. Including the client in the process empowers them. Many clients remark on how much better they feel because they can participate in a program that helps their companion. Physiotherapy is often considered a last resort with the goal of pain relief and improved quality of life. Maintaining muscle mass is easier to achieve than rebuilding muscle following atrophy. Thus, the goal would be to engage a veterinary physiotherapist sooner, rather than later, in the course of the disease.

Thermotherapy

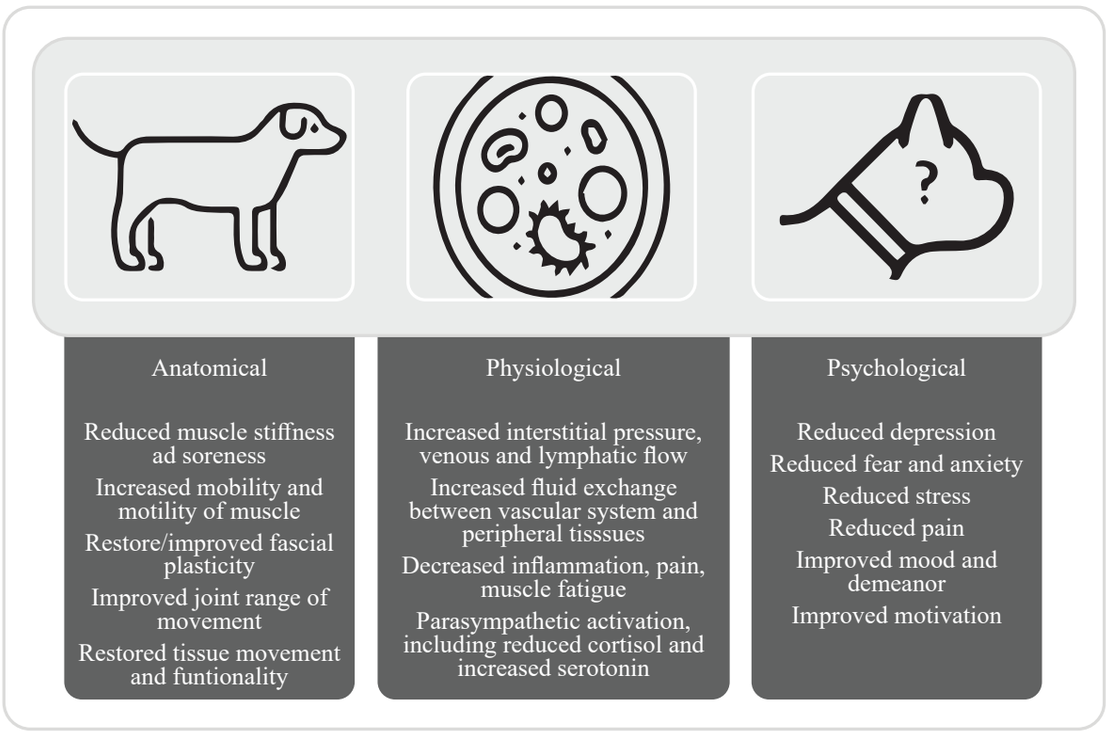
Applying cold packs or ice to an acutely inflamed joint reduces pain. Osteoarthritic patients do experience flare-ups of the condition by virtue of the very nature of dogs. It is difficult to resist the neighbour's cat that is balancing on the wall, seemingly teasing the dog. Cold therapy slows down nerve conduction and causes vasoconstriction.

The application of heat to osteoarthritic joints may make more sense in terms of the chronicity of the condition. Superficial heat is applied using infra-red lamps, heat packs, or warm water. Pain is relieved because of stimulation of inter-neurons in the pain pathway (Gate Theory of pain control) and muscle relaxation. Therapeutic ultrasound produces thermal (by friction) and non-thermal (micro massage) effects. Compensatory muscular tension can be treated using therapeutic ultrasound which is able to heat tissues to a depth of 4 centimetres. The duration of heating is short. This modality is used before stretching dogs with OA.

Massage

Chronic pain caused by osteoarthritis will result in compensatory patterns of movement and adjusted posture, depending on the affected joints. The result can be seen as one or more of the following changes: adaptations in gait, muscle weakness, myalgia, and localised tremors.[4] Certain areas of the body will become overworked resulting in muscular tension and the development of myofascial trigger points.

Massage relieves the pain-tension-pain cycle. The local temperature is increased during a massage session (refer to application of heat). This facilitates release of the muscular tension. The therapeutic effects of massage are far reaching and include positive anatomical, physiological, and behavioural responses.



Potential therapeutic massage benefits in dogs (after corti, 2014)

Please note that massage therapy should not be viewed as a stand-alone practice. It is important that it forms part of a holistic physiotherapeutic plan. Simple release of muscular tension will have no effect on the support of the diseased joints. Massage treats compensatory pain and should be used as an adjunct to the strengthening components of the overall plan. Massage releases endogenous endorphins which are a natural pain reliever.

Transcutaneous Electrical Nerve Stimulation (TENS)

TENS requires an intact sensory nerve to be effective. Analgesia is created by directly inhibiting hyper-excited sensory nerves. TENS also produces relaxation. For acute pain, a high frequency with low intensity is most effective, thought to assist by the Gate control theory of Pain. For chronic pain the intensity of the electrical current is high while the frequency is low.

This releases endogenous opioids. Both acute and chronic settings may be necessary to assist with pain management in a dog diagnosed with OA. The effects are temporary. The therapy can be repeated 2 – 3 times per day. It is possible to teach the client to use this device which is another way of including the animal guardian in the management process.

Extra-Corporeal Shock Wave Therapy (ESWT)

The exact manner in which ESWT affects tissue is unknown. Mechanical waves create a very steep and rapid pressure that is followed by a negative pressure period (cavitation). Analgesia is one of the documented benefits of ESWT. The pain relief is attributed to hyperstimulation of nociceptors which leads to an increase in the pain threshold. Longer lasting analgesia may be as a result of descending inhibition and modulation of sensory stimulus through the spinal cord.[6] A few studies in dogs (elbow osteoarthritis[7] and stifle OA[8]) indicate that ESWT improves peak vertical force of the affected limb/s. Further research is required in this modality.

Photobiomodulation Therapy (PBMT)

Photobiomodulation therapy refers to the application of light and the non-thermal effects of specific wavelengths on tissues and cells. During PBMT photons of energy are absorbed by chromophores with resultant chemical, thermal and mechanical effects. Benefits include (but are not limited to) alleviation of pain and inflammation, immunomodulation, and promotion of wound healing and tissue repair. Therefore, PBMT is indicated for use during the management of OA in dogs. The goals of therapy[9] when applying PBM would be to:

- decrease inflammatory mediators released by the cells of the synovium.
- decrease joint effusion and in so doing, increase nutrition to the chondrocytes. The intention is to slow the progression of OA by stimulating cartilage repair.
- decrease inflammation, oxidative stress, and discomfort in the joint.
- increase blood flow by stimulating vasodilation.

By reducing pain and inflammation the dog's desire to move is increased. Movement combats muscle atrophy and enhances joint health.

Improve Mobility

A common belief is that exercise will adversely impact OA. It is important that activity is modified but not stopped. The role of cartilage in the disease process of OA is undisputed. Articular cartilage receives its nutrients, and the removal of waste products

occurs, via diffusion through the synovial fluid. Maintaining healthy cartilage is dependent on the mechanism of the synovial pump, which is activated with movement. The key to managing exercise in osteoarthritic dogs is regular, controlled, low impact exercise. Regular exercise for dogs with OA means daily exercise.

Controlled exercise is slow and deliberate, encouraging the dog to use each of its four limbs individually. When the dog is taken for a walk, it is always on a leash and walked as opposed to allowed to trot or run. Low impact exercise excludes jumping, running, and turning at speed. Physiological movement is essential to maintain the optimal condition of the locomotor system.

Body weight which is higher than the ideal is a risk factor in the development of OA. Weight reduction results in a reduction of symptoms, particularly lameness. The reduction in mechanical stress placed on the joints is an important reason to maintain a lean body weight. The effect of pro-inflammatory cytokines in obese dogs has not been confirmed.

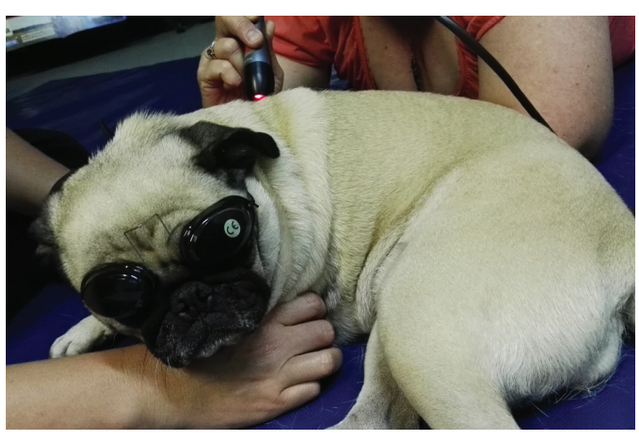
Exercise can be seen as passive or active. Passive range of motion (PROM) exercises are frequently recommended post-operatively to stimulate movement of synovial fluid in the affected joint. PROM exercises can be applied to osteoarthritic joints however, active exercises are preferable if the dog can perform them. The activation of supporting musculature, stimulation of the nervous system, and proprioceptive feedback, with the dog in a normal posture, are important aspects of active exercise.

Active exercise can be therapeutic exercises, functional movements, and hydrotherapy. It is the role of the physiotherapist to evaluate the osteoarthritic patient and create a program suited to the dog's level of dysfunction (or not). The program may include exercises in each of these areas. Exercises can be done in the physiotherapy facility, as well as at home.

A home exercise program forms a fundamental part of the management plan. Furthermore, veterinary physiotherapists regularly re-evaluate patients and adjust the programs according to patient progress.

Walking is an under-estimated exercise, which is easy for most pet parents to do. It requires no extra equipment. A walk is a 4-beat gait without a suspension phase. That means there is always at least one paw on the ground i.e. at no time is the body suspended in space. The stance phase duration is longer than the swing phase. This means the dog bears weight on the limb for a longer period than the limb is lifted off the ground. Each leg moves individually.

These are important facts for rehabilitation. The walk is often underutilised as an exercise. Simply slowing the dog down to a walk, makes the dog engage all four legs. A daily walk will increase strength and endurance, improve cardio-respiratory capacity, and relieve pain. As the dog improves, progressions can be added. A simple progression is to increase the distance. Another option is to add gentle inclines or to zig zag up and down a slope.



Therapeutic exercise uses voluntary movements to aid the recovery of physiological weight bearing.

An exercise program for a dog with OA should include strengthening exercises, exercises that enhance balance and activate core musculature, as well as exercises aimed at improving proprioceptive feedback.

Because it is not possible to tell a dog how to exercise or to go to the gym, functional movements form a large part of the exercise program. Functional movements are normal physiological activities that used for the purpose of rehabilitation. Examples of functional movements are:

- Sit to stand exercises to strengthen hind limbs.
- Mounting stairs to induce hip and knee extension.
- Voluntary flexion/extension of the neck by offering a ball or food from left to right or up and down.
- Walking in a circle or a figure of eight to stimulate the proprioceptive function and shift weight from one limb to another.

As seen in the pain-inflammation cycle, OA causes inactivity which leads to poor muscle activation and atrophy. The presence of OA frequently results in muscle weakness. It makes sense that an exercise program must include a strengthening component.

Strengthening is a core component in the management of humans with OA. Resistance training (making use of a resistance band or walking in water) can be added to an exercise program if indicated.

Before a dog can move properly stability is required. The main drive comes from the pelvic region but the pelvic and thoracic regions must be linked for movement to coordinate and follow through. This requires activation and strengthening of the core muscles. Core muscles include paraspinals, ventral and lateral abdominal muscles.

The compensatory adaptions found in dogs with OA often result in weak core musculature, and core muscles that do not activate properly or fire in the correct sequence. An exercise for an OA patient should include core strengthening exercises. In the early stages of a program this could be asking the dog to stand squarely on all four limbs, for 10 seconds. This is gradually increased to 30 seconds. Dogs can be taught to roll over or do planking exercises, all of which will strengthen the core.

No exercise program is complete without adding exercises to enhance balance and proprioception. Many balance exercises will also act as core strengthening exercises. Osteoarthritis has been shown to impair proprioceptive perception and postural stability in people.[3] Balance requires an intact sensorimotor system. This means that proprioceptive awareness and muscle function must be present to be able to balance.

Balance exercises could begin on a stable narrow platform and progress to balancing on an inflatable physioroll. During balancing exercises, correct posture is desired. When the dog learns to return to its correct posture, proprioception and body awareness are enhanced. Postural muscles that have weakened, because of compensatory patterns, are activated. This moves the patient into a positive position and decreases reliance on the legs. Less reliance on the legs is desirable because the legs may have one or more osteoarthritic joints.

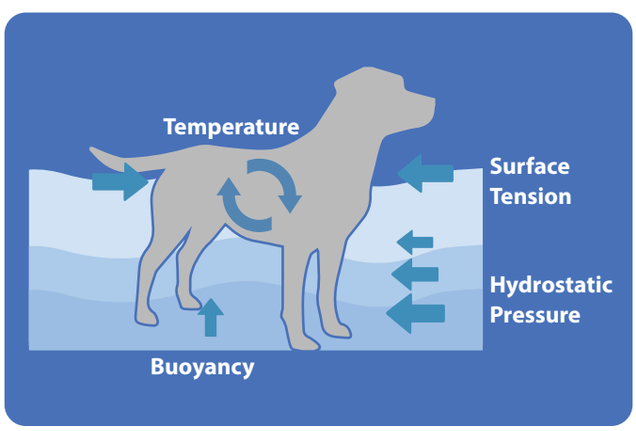
Proprioceptive exercises are also indicated for limb awareness. Stepping over cavaletti rails/poles stimulates proprioceptive pathways while simultaneously favouring joint range of motion. Walking backwards requires hind limb awareness and increases pelvic limb strength.

Human studies show a positive response in walking ability, pain, balance, stiffness and functionality when balance and proprioceptive training is added to the regimen.[3] Further research is required in OA dogs. It is recommended that these exercises remain in the exercise program for dogs with OA.

Hydrotherapy

It is proposed that hydrotherapy is a beneficial therapy for dogs with OA. The properties of water are utilised to create a therapeutic effect. The properties of buoyancy, hydrostatic pressure, viscosity and turbulence all contribute to a form of exercise that is low impact but high intensity. Moving in water reduces concussive forces on joints while simultaneously providing resistance, which facilitates muscle strengthening.

This form of exercise may assist overweight patients that are very painful. These dogs may be unable to perform land-based exercises for a length of time that is conducive to weight loss.



Swimming is non-weight bearing. The movement differs from walking in water. When dogs walk in water, the percentage of weight carried is dependent on the level of water. The higher the level, the less weight is placed on the joints.

After a thorough examination, including a detailed history, the veterinary physiotherapist will be in a position to decide whether hydrotherapy is appropriate. If it is appropriate, then a decision is made as to the type of aquatic therapy performed.

Again, this will be patient dependent. Joint kinematics and stride parameters differ depending on the activity (swimming or

walking in water) and on the level of water in the underwater treadmill.[10,11,12] Animal guardians may have access to lakes, oceans, home pools and rivers.

A program can include swimming and/or walking in these bodies of water if applicable to the patient. Long-term benefits of aquatic therapeutic interventions with regard to functionality, joint stiffness, comfort and ROM of osteoarthritic dogs have not been investigated yet.[3]

The key to successful management of OA dog is to start as early as possible. Clinical signs of the patient determine the type of exercise, the duration and the frequency. In the initial phases the sessions will be short. It may be preferable to exercise several times a day but only for a few minutes.

Progressions should be increased gradually. The advantages of improved mobility are increased strength and enhanced joint health. The negative spiral is reversed, and the dog can now exercise more. The result is improved quality of life!

Environmental Modifications

Lifestyle and household modifications should be discussed and included in the rehabilitation program.[3,13] These recommendations are made based on the individual patient, the human family, the signalment, the living and exercise environment.

Suggestions may include:

- Reduction of slipping. OA patients have weaker muscles and are prone to slipping. This will impact their confidence. Change the flooring that is prone to be slippery or introduce rubber mats. The use of booties or other products applied to the paws may be effective in increasing grip.
- Exercise in areas that provide a good grip for the dog. Grass as opposed to gravel. Softer, level surfaces are more appropriate than hard and uneven ones.
- Raise the height of the food and water bowls to facilitate easy access and reduce the need to over-exert while eating.
- Build ramps to facilitate movement up and down stairs. It may be necessary to lift the dog into and out of the vehicle, or to carry the dog up and down the stairs.
- Teach a dog basic commands that add to the dog's well-being and general health, especially in the long term. For example: to wait to be picked up onto the couch as opposed to jumping on and off the furniture.
- If the dog is overweight investigate the feeding schedule. There may be more than one person contributing to the calorie intake. Allocating a daily 'snack' allowance (per household or per person) allows for the client to manage calorie intake.

Many of these changes are easy to implement but are often overlooked. Through questioning and discussion, the client's awareness is raised. This is another way in which the guardian can play an active role in managing the condition. It is highly likely the person will feel supported and empowered.

Conclusion

This provides a summary of the role a physiotherapy program can play in the multi-modal management of dogs with osteoarthritis. Osteoarthritic dogs will benefit from early physiotherapeutic intervention. The veterinary physiotherapist can identify incorrect movement patterns, develop strategies to combat them, and involve the animal guardian. In early stages of the disease this may take the form of environmental and exercise modifications.

A home exercise program can be introduced, and the patient response monitored. The correct execution of exercises can be challenging. Teaching and explaining is time-consuming. The therapist will be in the best position to apply these principles to the dog and instruct the client on appropriate management.

As the disease progresses, the exercise program is adjusted to meet the needs of the dog.

The program may then progress to exercises at the rehabilitation facility and assistance with additional pain management. Each osteoarthritic patient deserves the best interventions to ensure a mobile, pain-free life for as long as possible.

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