Clinical Impact of obesity on osteoarthritis in canines

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Osteoarthritis (OA) is estimated to affect around 20% of dogs aged one year or older (Johnson et al, 1994) and approximately half of all pet dogs are either overweight (?10% ideal bodyweight) or obese (?20% ideal bodyweight; German, 2006).

Both conditions adversely affect quality of life and form a “vicious cycle” of clinical impairments. This article discusses the interaction of these diseases and challenges faced in their simultaneous management, as well as offering practical suggestions.

Obesity and development and progression of OA

A series of papers report the results of a study that examined the effects of overweight Labrador retrievers genotypically predisposed to hip dysplasia.

In a paired-control study, 48 dogs were assigned to a “control-fed” group (fed ad lib for three years, then controlled) or a “restricted” group (fed 25% less than paired-control). The prevalence of hip OA, and the severity of elbow and shoulder OA, was greater in the control-fed group than the restricted group, and the development of OA occurred earlier in the control-fed group (Smith et al, 2006).

Obesity is recognised as a risk factor for knee and hand OA in people. The mechanisms by which excess bodyweight influences OA progression appear to be mechanical and biological. The most obvious effect of obesity on joint function is increased load. In a normal trotting dog, the peak vertical force is approximately 105% of bodyweight in the forelimbs and 65% of bodyweight in the pelvic limbs (Rumph et al, 1994), so any increase in body mass undoubtedly increases joint loading.

Tilly, focus of the case study at the base of the article.

Furthermore, ground reaction forces alone do not reflect the entire compressive joint loads also resulting from muscle contraction, nor do they demonstrate the torsional and tensile forces that act on the joint capsule and articular ligaments. Overall, the mechanical effects of excess bodyweight on joint loading are likely to be significant and complex.

These mechanical effects may vary between animals according to their conformation. Longer limbs have greater momentum acting on each joint, so the effect of obesity on joint loading may be exacerbated in larger breeds.

Animals with angular or torsional limb abnormalities, or with joint laxity or instability, may be more susceptible to the effects of increased joint loading. In the human knee, the positive link between body mass index (BMI) and radiographic OA severity is greater in patients with a varus knee conformation (increased medial compartment loading) than those with a valgus conformation – where joint forces are more evenly distributed (Sharma et al, 2000).

Cranial cruciate ligament (CCL) failure is invariably associated with subsequent OA. A retrospective case-controlled study of signalment factors for the risk of CCL failure in a UK first opinion practice identified obesity quadrupled this risk (Adams et al, 2011).

The association between BMI and hand OA in people is not easily explained by mechanical factors. Adipokines are hormones and mediators secreted by adipocytes. Leptin and adiponectin are adipokines detected in synovial fluid, and leptin is upregulated in osteoarthritic joint tissues. Both have been demonstrated in vitro to have detrimental effects on mediated chondrocytes, at least in

part, by other proinflammatory cytokines, such as matrix metalloproteinases -6, -9 and -13. The roles and mechanisms of adipokines in the progression of OA are yet to be fully elucidated.

Obesity impact on clinical effects of OA

Many of the factors linking obesity and the development and progression of OA are also relevant when considering the clinical manifestations of orthopaedic disease.

Increased and altered distribution of articular loads, and the adipokine-mediated effects of obesity, are likely to contribute to mobility impairment and quality of life issues in arthritic animals. This is evidenced by clinical improvements observed in people and animals with OA when body mass is reduced.

The most obvious effects are observed during locomotion: body mass increase has been demonstrated to exacerbate lameness as measured using a force platform (Moreau et al, 2010) and weight loss has been demonstrated to improve lameness (Moreau et al, 2010; Marshall et al, 2010).

The amount of weight loss reported to improve clinical signs varies between studies from approximately 6% (Marshall et al, 2010) to 11% to 18% (Impellizeri et al, 2000).

Obese humans are known to exhibit higher levels of inflammatory markers, such as interleukin 6, tumour necrosis factor alpha and C-reactive protein (CRP), and a large body of literature supports the association between proinflammatory cytokines and hyperalgesia. It should be noted, however, little evidence exists to directly link obesity with pain through cytokine production. Also, in people, there is a complex reciprocal relationship between pain, obesity and depression – though this is difficult to extrapolate to veterinary species.

It is possible obesity affects quality of life in OA patients in a broader manner than merely mobility. German et al (2012) demonstrated significant improvements in vitality, emotional disturbance and pain in 30 dogs that successfully completed a weight loss programme.

Obese dogs tend to be more sedentary: this reduces their interaction with their owners and other pets in the household, and limits their opportunities to engage in play or environment exploration. Also, more tangible risks exist, such as the increased risk of pressure sores.

Management of OA and obesity

Much is written on the management of OA. Suffice it to say all of the usual strategies for OA management apply to obese animals, and optimisation of these strategies is especially important, given the adverse clinical effects of the obesity itself. In this article, emphasis will be given to aspects of care that require particular consideration in the obese patient.

Clearly, a treatment priority for obese, arthritic patients is a programme of weight reduction. Two medications with reported efficacy for canine weight reduction were previously available. However, the commercial performance of these drugs did not reflect their experimental success and both were subsequently withdrawn from the market.

Physical exercise is an important part of OA management and this is especially true in obese animals. However, exercise is not as important as diet in bodyweight reduction. Mobility impairment due to OA should not preclude successful weight loss and should not be accepted as an excuse for failure. Lame, obese dogs might require a greater degree of calorie restriction to lose weight than non-lame dogs (German et al, 2014).

Successful weight-loss programmes rely on the correct choice of diet, accurate administration and strict adherence by the owner to the feeding protocol. Again, other resources on weight-loss strategies exist, and this article aims to outline some specific considerations.

For successful weight loss, dogs may need to be fed around 60% of their maintenance energy requirement at their target weight (German et al, 2007). Considering this level of restriction, purpose-formulated weight-loss diets should be used to ensure delivery of other essential nutrients. When recommending proprietary diets for weight management, the clinician should consider their relative formulations and evidence base.

Table 1. Dry dog foods marketed for joint disease and/or weight management

Manufacturer	Diet	Kcal/ 100g	Omega-3 content (% dry matter)	EPA content (% dry matter)	EPA content (mg/100g dry matter)
Hill's	r/d	313	0.25	Not stated	Not stated
	w/d	299	0.48	Not stated	Not stated
	metabolic	313	0.77	Not stated	Not stated
	j/d original	363	3.6	0.42	107
	j/d reduced calorie	341	3.41	0.37	101
	metabolic and mobility	319	3.52	Not stated	Not stated
Royal Canin	satiety support	288	Not stated	Not stated	Not stated
	mobility support	379	Not stated	0.3	Not stated
Purina	overweight management formula	262	Not stated	Not stated	Not stated
	joint mobility formula	384	0.85	Not stated	Not stated

This table is intended as a reference guide only and is not exhaustive. EPA: eicosapentaenoic acid.

Table 1. Dry dog foods marketed for joint disease and/or weight management.

Table 1 offers a brief comparison of some popular diets, based on information gathered from manufacturers' websites. Portions should be weighed using scales to ensure accuracy. Strategies to optimise treatment adherence should be considered, including regular check-ups, a diet that improves pet satiety and engaging the owner in clinical decision-making.

Exercise is important for many aspects of musculoskeletal health, including homeostasis of cartilage and conditioning of periarticular ligaments, and muscles and tendons. The correct level of exercise will vary from dog to dog, but a reasonable rule of thumb is to provide regular exercise to the highest level possible that does not induce prolonged exacerbation of clinical signs.

The type of exercise is probably at least as important as duration. In most cases, activities requiring repetitive acceleration, braking or sudden changes of direction should be avoided. Regular walks are important for physical conditioning and for healthy pet-owner interaction. Application of lead restriction should be made on a case basis, depending on the dog's behaviour and environmental factors, such as terrain and the presence of other dogs.

Hydrotherapy offers a means of exercise with no or reduced weight bearing and can be a source of enjoyment for some patients. Barriers to a meaningful hydrotherapy regime include cost, time commitment and geographical availability. Owner-administered physical therapy regimes may be beneficial in some cases, with the added advantage of increased pet-owner interaction.

The medical management of OA is not significantly different in obese animals than in non-obese animals, other than, to reiterate, for any given morphological degree of OA, it is likely the clinical manifestations will be worse in the obese animal, necessitating a higher plain of management.

Also, obese animals may be more likely to have concomitant disease (German et al, 2010) that might influence the choice of pharmaceutical agents. For example, patients with poorly controlled hyperadrenocorticism may be at increased risk of gastrointestinal ulceration if administered NSAIDs.

One aspect of medical management that deserves special consideration in obese patients is dietary supplementation with essential fatty acids (EFA). Evidence for the beneficial effects of EFA supplementation includes a study demonstrating increase in peak vertical force in more dogs with hip OA receiving a test diet than in those receiving a control diet (Roush et al, 2010).

However, EFAs are, obviously, fats and contribute to the calorific content of the diet. Fish oil contains approximately 10kcal per gram. The effects of EFAs are also dose-dependent and relatively high doses are probably required to have a significant clinical effect.

Table 1 briefly summarises EFAs and, specifically, eicosapentanoic acid concentrations, along with the calorific contents.

On balance, the body of evidence supporting the beneficial effects of weight loss in obese, osteoarthritic patients is greater than that supporting the effects of EFAs. Therefore, it is this author's opinion weight loss should be the overriding priority. If weight loss is, apparently, hindered by EFA supplementation then the latter should be abandoned until the target bodyweight is achieved.

While the ultimate goal is to “cure” obesity via a weight-loss programme and, therefore, ameliorate the OA-associated clinical signs, it should be accepted this process will take some time and, in some cases, fail. A secondary goal is to ensure the best possible quality of life for the patient in its present condition. To promote activity at home, the environment should be modified to eliminate obstructions to movement.

As examples, this may include providing floor coverings with adequate traction or secure ramps with steps. It is especially important drinking water and food is provided in an easily accessed position, as it is often located in kitchens or utility rooms with slippery floors. Bedding should be considered. Beds with raised, rigid sides may be more difficult to enter and exit than flat, open arrangements. Ample padding should be provided to minimise the risk of pressure sores and thick foam or memory foam mattresses are advisable.

Severe mobility impairment may manifest as inappropriate urination. In these cases, bedding that wicks moisture away from the dog may minimise the adverse effects of bed wetting and easily cleanable or disposable floor coverings, such as incontinence sheets, may reduce owner workload.

Summary

Arguably, it is perceived dogs, to variable extents, glean much of their quality of life from physical activity, interaction with their owners and other household pets, and, in some cases, through food. It is a sad fact for the obese, osteoarthritic patient all of these aspects of life are altered.

Successful management ultimately pivots on adherence to treatment protocols. Ensuring owners’ understanding of the issues discussed in this article, and of their role in optimising their pet’s quality of life, is an important start in maximising compliance. But owners must also see tangible results if they are not to become demotivated, so it is the clinician’s responsibility to formulate the best possible treatment regime for any individual.

CASE STUDY

Tilly, an obese eight-year-old Labrador retriever with bilateral stifle osteoarthritis.

- Signalment: eight-year-old neutered female Labrador retriever.
- Relevant clinical history: bilateral stifle osteoarthritis, subsequent to failure of both cranial cruciate ligament, one year apart (at two years of age and seven years of age), both managed with lateral fabellotibial sutures.
- Bodyweight: 43kg.
- Estimated ideal weight: 35kg.

- Current clinical status: copes reasonably well with a gently paced 45-minute lead walk each day, but is tired towards the end and is stiff after rest. Fairly active at home. Liverpool Osteoarthritis in Dogs (LOAD)* score = 20 (moderately affected). LOAD is a validated, owner-completed clinical outcomes questionnaire (Walton et al, 2013).

Suggested treatment:

- Diet: proprietary purpose-formulated weight management diet, consider essential fatty acid-supplemented:
    - Resting energy requirement (RER) at target weight (moderately active) = 70 × 0.75 (ideal bodyweight) = 70 × (35)0.75 = 1,007 kcal/day.
    - Starting energy provision = 75 per cent RER = 755kcal/day.
    - Examples of diet rations:
        - Hill's j/d – 222g/day
        - Hill's metabolic and mobility – 252g/day
        - Royal Canin satiety support – 280g/day
        - Royal Canin joint mobility support – 212g/day
        - Purina overweight management – 307g/day
        - Purina joint management – 210g/day
    - Review every two weeks and adjust ration to achieve one per cent to two per cent weight loss per week.
- Medication: NSAIDs to be used on an owner-determined "as-needed" basis.
- Exercise:
    - continue current walking regime
    - consider regular hydrotherapy
- Environment modification: minimise requirements to navigate slippery floor.

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