PAPER

Feline osteoarthritis: a prospective study of 28 cases

OBJECTIVES: To identify a cohort of cats with clinical osteoarthritis and to report on the clinical signs, the frequency of joints affected and the possible aetiopathogenesis within this population.

METHODS: Inclusion criteria for this prospective study were presence of historical evidence and/or clinical signs of osteoarthritis, together with radiographic evidence of osteoarthritis. Patients showed clinical improvement within four weeks of analgesic administration and were free from other disease processes, which might explain the clinical signs and/or their response to analgesia.

RESULTS: Twenty-eight cases were included in the cohort. The elbow (45 per cent) and the hip (38 per cent) were the most frequently affected joints. Seventy-one per cent of cases had primary/idiopathic aetiology. Alterations in both the ability to jump (71 per cent) and the height (67 per cent) of jump (lifestyle changes) were the most frequent signs of disease. Sixty-one per cent of owners felt that their pet had made a marked improvement following administration of an analgesic/anti-inflammatory drug. There were statistically significant improvements in the ability to jump ($P<0.001$), the height of jump ($P<0.001$), lameness ($P=0.03$), stiff gait ($P=0.04$) and the activity level ($P=0.02$) when compared with the start and the end of the study period.

CLINICAL SIGNIFICANCE: Osteoarthritis is a clinical problem in cats, but overt lameness is not the most common clinical feature.

S. P. CLARKE* AND D. BENNETT

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Division of Companion Animal Sciences, Institute of Comparative Medicine, University of Glasgow Veterinary Faculty, Bearsden, Glasgow, Scotland G61 1QH

*Current address for S. P. Clarke is: East Neuk Veterinary Clinic, Station Road, Netherton Estate, St Monans, Fife

INTRODUCTION

Osteoarthritis (OA) is a pathological change of a diarthrodial synovial articulation, characterised by the deterioration of articular cartilage, osteophyte formation, bone remodelling, soft tissue changes and a low-grade non-purulent inflammation.

Despite the fact that radiographic features of feline OA have been well described (Allan 2000, Hardie and others 2002, Godfrey 2005, Clarke and others 2005), clinical signs of feline OA are poorly documented. The obvious difficulty in assessing lameness in cats results from their small size and natural agility, which allows them to apparently cope with many severe orthopaedic diseases. This, coupled with the difficulty of determining pain on clinical examination, likely contributes to the poor documentation of clinical signs of OA in this species. It is generally believed that clinical signs of feline OA include weight loss, anorexia, depression, abnormal elimination habits, poor grooming habits, aggressive behaviour, reduction in the ability to jump and overt lameness (Hardie 1997, Patsikas and others 1998, Godfrey 2002, 2003). Some of the clinical signs assumed to be associated with clinical feline OA have been extrapolated from other species without justification (Godfrey 2005).

Studies by Hardie and others (2002), Clarke and others (2005) and Godfrey (2005) reported that only 4, 16·7 and 17·5 per cent of cases, respectively, affected by radiographic OA had clinically detectable lameness noted in their hospital records. These studies raised the question as to whether this represented a poor correlation between clinical OA and radiographic OA, as reported in other species (Lane and Buckwalter 1993, Gordon and others 2003), or whether clinical OA in cats may be associated with other clinical signs besides lameness.

Previous radiographic studies on feline OA identified the need for a suitable prospective study of clinical cases of feline OA in order to fully elucidate clinical signs, radiographic features and possible aetiopathogenesis (Godfrey 2005, Clarke and others 2005). The purpose of this prospective study was twofold. First, to identify a cohort of cats with clinical OA (that is, OA causing pain), and secondly, to use this cohort to report on the clinical signs, the frequency of joints affected and the possible aetiopathogenesis. Their response to and tolerance of metacam are also reported. To the authors' knowledge, this is the first peer-reviewed publication reporting a series of cats clinically affected with OA.

MATERIALS AND METHODS

Establishment of cohort of cats with clinical OA

Two meetings were held with primary care practitioners who regularly refer cases to the University of Glasgow Veterinary School, Small Animal Hospital. Feline OA and details of a prospective clinical study on feline OA were discussed. A request for the referral of possible clinical cases of OA was made. Cases were recruited from January 2003 to December 2004. Because of the unique way in which this study was set up, coupled with the fact that owners were not charged, meant that these cases represented a first opinion, rather than a referral, population.

All cats were examined by the same veterinary surgeon (D. B.). During the initial consultation, general information regarding diet and lifestyle was recorded. Subsequently, a questionnaire was completed during the discussion with the owner. Information regarding food intake, general demeanour and lameness was recorded using a discontinuous scoring system, involving a simple descriptive scale (SDS), with an ordinal score recorded for each parameter (Table 1). Behavioural characteristics such as seeking seclusion, resentment/vocalisation/aggressiveness on handling and abnormal elimination habits, and lifestyle alterations like unwillingness to jump and/or reduced height of jump and any abnormal gait were recorded as dichotomous variables with a nominal scale.

Table 1. Simple descriptive scale scoring system used for assessing food intake, lameness and general demeanour

	Score	Description
General demeanour (activity level)	1	Normal
	2	Slightly subdued
	3	Moderately subdued
	4	Very subdued
	5	Totally disinterested
Food intake	1	Unchanged
	2	Slightly decreased
	3	Moderately decreased
	4	Severely decreased
	5	Increased
Lameness (limp)	1	None
	2	Slight lameness
	3	Moderate lameness
	4	Severe lameness
	5	Non-weightbearing lameness

Each patient was subjected to a full general and orthopaedic examination, followed by blood collection and analysis. Complete blood cell counts and serum biochemistry (including T4 levels) were performed. Fructosamine levels were measured if the blood glucose level was elevated. Screening for feline leukaemia antigen (FeLV) and antibodies to feline corona virus (FCOV) and feline immunodeficiency virus (FIV) was also performed.

Survey appendicular and axial skeletal radiography was performed under general anaesthesia. Additional radiographs were taken as indicated by clinical findings and survey radiographs. Appendicular joint radiographic features consistent with OA were recorded in a manner previously described (Clarke and others 2005).

Where appropriate, a four-week course of meloxicam oral suspension (Metacam; Boehringer-Ingelheim) was dispensed. Each case received the same dose: 0·3 mg/kg once a day for one day, 0·1 mg/kg once a day for four days, followed by 0·05 mg/cat once daily for 23 days. Dosage was based on information provided by Boehringer-Ingelheim. Meloxicam is recognised as being an effective analgesic in cats for single-dose pre-emptive analgesia (Slingsby and Waterman-Pearson 2000, 2002) and for five-day therapy (Lascelles and others 2001). No non-steroidal anti-inflammatory drug is licensed for long-term use in cats; however, the authors had previous experience of using 0·05 mg meloxicam once a day to treat painful locomotor problems in cats, with apparent success and without complications. A previous report (Robertson and Taylor 2004) also suggests successful use of long-term meloxicam therapy. The reason for administering meloxicam was not primarily to evaluate its efficacy as an analgesic but to assess whether any clinical improvement occurred in the test population, thus giving credence to the diagnosis of clinical OA.

Re-examination was performed as close to four weeks after the initial consultation as was possible. Meloxicam administration was continued in all cases until the re-examination had been carried out. At re-examination, the questionnaire, the general and orthopaedic examinations, and the blood analyses were repeated. Owners were asked to give an overall subjective summation as to the degree of improvement their pet had shown during the four weeks. Patient tolerance to and acceptance of meloxicam were also recorded.

For inclusion into the cohort, the cases had to meet the following criteria:

(1) historical evidence and/or clinical signs of OA together with radiographic evidence of OA;
(2) clinical improvement within four weeks of analgesic administration; and
(3) the absence of another disease process, which might explain the clinical signs and/or response to analgesic therapy.

Data analysis

The results of data analysis of this cohort of cats with clinical OA are presented in the form of descriptive and inferential statistics. Inferential statistical analysis was performed using the McNemar test and Wilcoxon signed rank test for comparison of dichotomous variables and ordinal data at the beginning and end of the study period. Statistical analysis was performed using the online software Simple Interactive Statistical Analysis (http://home.clara.net/sisa/index.htm) and Minitab version 12 (Minitab Inc., 3081 Enterprise Drive, State College, PA 16801, USA). Statistical significance was set at $P<0·05$.

RESULTS

From the 36 cases examined, a cohort of 28 cases were selected for the study. Of the eight cases excluded, five had another disease processes – fibrosarcoma, hyperthyroidism, type III Achilles tendonopathy (Meutstege 1993), diabetes mellitus and abdominal neoplasia – which were considered to be the primary reason for their clinical signs. Four of these cases did have radiographic OA, while the remaining three did not return for follow-up examination. Two cases had a concurrent disease process in combination with their clinical OA. Both had diabetes mellitus and one also had hypertrophic cardiomyopathy. Both the patients were receiving appropriate therapy for these problems

Table 2. Results of breed, sex, age, weight, lifestyle and diet in study population

Parameter	Result
Breed	82% (23) DSH, 7% (two) DLH, 11% (three) oriental
Sex	54% (15) MN, 43% (12) FN, 3% (one) M
Median age	11 years (range 3·2-16 years)
Median weight	4·9 kg (range 3·1-8·7 kg)*
Lifestyle	89% (25) inside and outside, 11% (three) indoor only†
Diet	71% (20) dry and wet food, 4% (one) dry food, 25% (seven) wet food

DSH Domestic shorthair, DLH Domestic longhair, M Male, MN Male neutered, FN Female neutered
*Three cats were considered to be obese based on body condition score
†Information on urination and defecation is available for the three indoor cats only. No abnormality was reported

Table 3. Numbers of cases with a specific clinical sign at the beginning and end of the study period*

Clinical parameter	Number of cases affected at first presentation	Number of cases showing improvement	McNemar test result
Seeks seclusion	9	2	P=0·48
Vocalises if handled	10	2	P=0·48
Resents handling	9	2	P=0·48
Aggressive if handled	6	2	P=0·48
Unwilling to jump	20	19	P<0·001
Reduced height of jump	19	18	P<0·001
Stiff gait	9	6	P<0·04

*Results of statistical analysis are included and P<0·05 indicates statistical significance

and were considered stable at the time of entry into the study.

Thirteen cases originated from one practice. Four practices each supplied two cases and the remaining 11 cats were from individual practices. Information on breed, sex, weight, age, diet and lifestyle of the study population is shown in Table 2.

Two cases were FeLV positive and one was FIV positive. One case had an initial FCOV titre greater than 1280, which reduced to 320 after four weeks. It was felt that this patient was likely to be a chronic carrier, which had had reactivation of infection. Serum biochemistry results were considered unremarkable in all cases. Significant haematological abnormalities were present in five cases. Four cases had mild non-regenerative anaemia when they were first sampled. In two cases, this had resolved at the time of repeat sampling. One case showed a leucopenia (neutropenia) when re-sampled.

Data regarding demeanour, lameness, food intake, behaviour, lifestyle and other orthopaedic parameters before and after analgesic administration and results of statistical analyses of each variable between both time points are summarised in Tables 3 and 4. There were statistically significant improvements in unwillingness to jump, height of jump, stiff gait, lameness and activity level.

Sixty-one per cent (17) of the owners felt that their cat had made a marked improvement during the four weeks, 14 per cent (four) felt that their cat had made a moderate improvement and 25 per cent (seven) felt that their cat had made a slight improvement.

During the study period, 18 per cent (five) of cats showed intermittent signs of gastrointestinal disease. Three cats vomited, two of which only vomited during the first five days of meloxicam administration; one had vomiting and diarrhoea and the other had diarrhoea only. In no case did the signs persist or were considered severe enough to necessitate withdrawal of medication. Ninety-six per cent (27) of cats accepted medication without any problem. The remaining cat occasionally refused its food when containing meloxicam.

A total of 86 appendicular joints in 25 cats were felt to be painful on orthopaedic examination, in that, manipulation of their joints elicited varying degrees of patient reaction. The data on these 25 cases are summarised in Table 5. The table shows the number of joints assumed to be painful and those actually affected with clinical OA, based on radiographic confirmation. The number of joints assumed painful but which were radiographically normal and the number of joints with radiographic OA but without clinical signs are also included. The number of clinical cases, which had unilateral and bilateral joint involvement, is also recorded, as are the percentages of joints with periarticular thickening and/or reduced range of motion. Clinically, 22 cases had bilateral joint involvement. Seven of these cases had bilateral involvement of multiple joints.

Six of these 25 cats had radiographic OA affecting the articular facets of the thoracolumbar region of the axial skeleton. In only one cat, pain was present on examination of this area and the OA considered to be clinically significant.

If the hip and the shoulder joints, where periarticular thickening cannot be easily assessed, are excluded from the 72 clinically affected joints, 67 per cent of the remaining joints had periarticular thickening. Only 6 per cent of all appendicular joints had a demonstrable reduced range of motion. Crepitus was not detected on manipulation of any joint.

Table 4. Lameness, food intake and general demeanour scores at the beginning and end of the study period*

	SDS scores at first presentation SDS category					SDS scores at re-examination SDS category					Wilcoxon signed rank test results
	1	2	3	4	5	1	2	3	4	5	
General demeanour (activity level)	11	7	8	2	0	18	6	3	1	0	P=0·02
Food intake	22	1	0	0	5	24	1	5	0	0	P=0·27
Lameness (limp)	15	3	10	0	0	21	4	3	0	0	P=0·03

SDS Simple descriptive scale
*Results of statistical analysis are included and P<0·05 indicates statistical significance

Table 5. Summary of joint involvement in the study population

Joint affected	Number of joints with radiographic OA only	Number of joints with equivocal radiographic OA	Number of joints detected as painful on clinical examination	Number of joints assumed painful on orthopaedic examination but with no radiographic OA	Number of joints with clinical OA based on orthopaedic and radiographic examination	Number of clinical cases with bilateral joint involvement	Number of clinical cases with unilateral joint involvement	Percentage of joints with clinical OA, with joint thickening	Percentage of joints with clinical OA, with reduced range of motion (%)
Elbow	3	4	35	2	33	15	3	70	6
Shoulder	14	8	3	0	3	1	1	0	0
Carpus	6	0	0	0	0	0	0	0	0
Hip	11	2	32	5	27	12	3	0	4
Stifle	5	0	10	5	4	1	2	25	0
Hock	2	4	6	1	5	1	3	80	20

OA Osteoarthritis

In three cats, the presence of joint pain on manipulation was considered equivocal; however, an overall improvement was seen at the end of the study period. Radiography revealed OA affecting several joints in these cats – five elbows, four shoulders and two hips.

Twenty cases (71 per cent) had no apparent historical evidence or radiographic explanation for the cause of OA and were considered to have primary/idiopathic OA. Based on radiographic and clinical information of the remaining eight cases, two (7 per cent) had secondary OA and six (22 per cent) had a combination of primary/idiopathic OA and secondary OA. Table 6 summarises the aetiology of OA and the joints affected in these eight cases.

The mean Norberg Angle (NA) for dysplastic hips with secondary OA, normal hips and non-dysplatic hips were 87·5°, 99·2° and 96·6°, respectively.

DISCUSSION

The elbow (Fig 1a, b) and the hip joints were most frequently affected with clinical OA. Radiographic reviews of feline OA have similarly identified the elbow (Hardie and others 2002, Godfrey 2005, Clarke and others 2005) and the hip (Clarke and others 2005) to be the most frequently affected joints. Hardie (1997) also suggested that the shoulder was frequently clinically affected, a finding not substantiated in the present study. In the present study, the frequency with which the hip joint was clinically affected is interesting since it is recorded in other studies as being infrequently affected (Godfrey 2002, 2003).

The inclusion criteria allowed the establishment of a cohort of cats with clinical OA, which then enabled an accurate assessment and documentation of the clinical signs. In addition to analysing the clinical features at the beginning and end of the study period, we also asked the owners to give a subjective assessment of how they felt their cat had improved with analgesic therapy, with the majority of owners reporting a marked overall improvement.

This study identified clinical OA in older cats (median age 11 years), which was in common with other clinical (Godfrey 2003) and radiographic studies of feline degenerative joint disease (Godfrey 2005, Clarke and others 2005). The domestic shorthair was the most common breed represented within the current study population and most likely reflects the fact that they are the most common breed within the general feline population. Males and females were represented in almost equal numbers in this study.

As in previous reports (Hardie 1997, Godfrey 2002, 2003), periarticular thickening was identified as a common finding on physical examination, although it was generally not marked. The presence of clinically detectable periarticular thickening in 64 per cent of appendicular joints was, as might be expected, associated with more advanced radiographic OA. An interesting feature of clinically affected

Table 6. Number of cases with primary/idiopathic OA and secondary OA and number of cases with secondary OA only*

Number of cases	Primary/idiopathic OA (joints affected)	Secondary OA (joints affected and aetiology)
1	Bilateral elbows	Left hip: PTOA, previous femoral neck fracture
3	Bilateral elbows	Bilateral hips: hip dysplasia
1	Right elbow	Left hock: PTOA previous distal tibial fracture; bilateral hips: hip dysplasia
1	N/A	Bilateral hips: hip dysplasia
1	Bilateral elbow, right hip	Left hip: hip dysplasia
1	N/A	Right carpus, right stifle, left hip: PTOA, previous radial and ulnar and femoral fractures

OA Osteoarthritis, PTOA Post-traumatic osteoarthritis, N/A Not applicable
*The joints affected are also included as is the cause of the secondary OA. All other cases were thought to have primary/idiopathic OA only

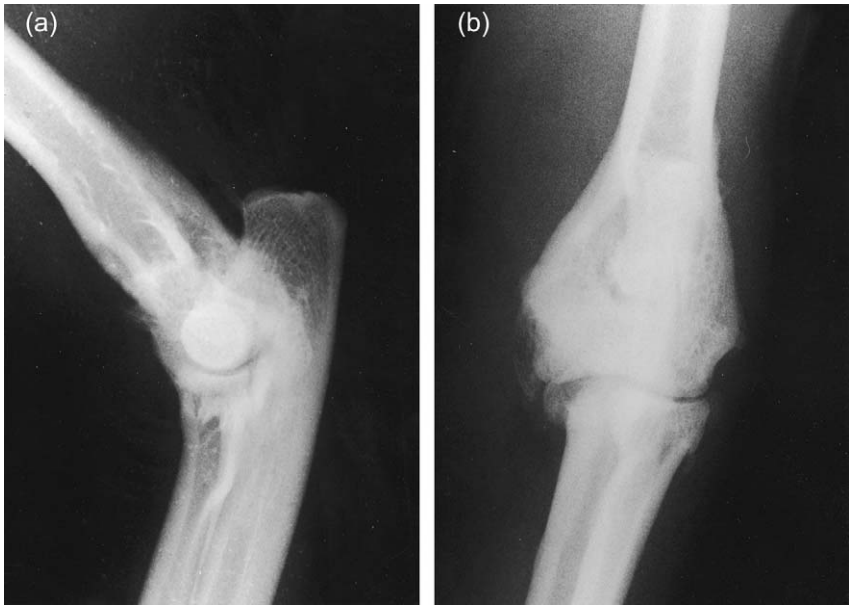

FIG 1. (a) Mediolateral radiograph of an elbow showing osteophyte deposition and subchondral sclerosis of the semilunar notch. (b) Craniocaudal radiograph of an elbow showing osteophyte deposition and remodelling of the joint surface

joints in this study was that despite periarticular thickening, only 4 per cent had a reduction in the range of motion. Crepitus was not detected in any joint. Synovial effusions were seldom obvious.

Hardie and others (2002) postulated that most cases of OA were likely to occur secondarily to undetermined factors such as elbow dysplasia, chronic low-grade trauma or subtle malarticulation, as opposed to primary degeneration, despite having no evidence to support this. Examples of secondary OA were identified in the present population. They could be divided into two distinct groups, posttraumatic OA and OA secondary to hip dysplasia (HD), both of which are recognised causes of OA in cats (Holt 1978, Langenbach and others 1998, Patsikas and others 1998, Keller and others 1999, Clarke and others 2005).

In human beings, when there is no obvious aetiology for OA, it is classified as being primary/idiopathic (Moskowitz and others 2004). In the current study, 71 per cent of cases had no apparent historical evidence or radiographic explanation for their OA; the authors thus feel justified in categorising this as potentially primary/idiopathic OA. Primary/idiopathic aetiology for feline OA has been previously proposed in radiographic studies (Godfrey 2005, Clarke and others 2005) on feline OA.

HD was diagnosed if less than 50 per cent of the femoral head was contained within the acetabulum or where there was subluxation and/or a misshapen femoral head in combination with incongruity between the femoral head and the acetabulum, as assessed on a ventrodorsal pelvic radiograph (Figs 2 and 3). These radiographic features of feline HD have been previously reported (Keller and others 1999). OA secondary to HD was diagnosed in six cases; however, in only three cases was it of clinical significance. This is not unexpected since there is a poor correlation between HD and clinical signs in cats (Patsikas and others 1998). The mean NA for dysplastic hips with secondary OA in our study was 87·5°, only slightly higher than the mean of 84° reported by Langenbach and others (1998). The mean NA for normal hips has been reported to be 92·4° (Langenbach and others 1998). The mean NA for normal hips and non-dysplastic hips with OA in the present study was 99·2° and 96·6°, respectively, which would support the opinion that the latter may represent idiopathic/primary OA (Fig 4).

SDS consist of four or five expressions, which are used as descriptors of varying degrees of pain, or other variables, which are thought to alter in response to pain (Bellamy 1988, Welsh and others 1993, Holton and others 1998, Cambridge and others 2000, Lascelles and others 2001). Lascelles and others (2001) used SDS to gather data relating to both general clinical and locomotor parameters, when assessing analgesic efficacy in cats with painful musculoskeletal disorders, and their study most likely included some cats with clinical OA. The SDS used in the current study differed only slightly from that used in the study by Lascelles and others (2001), by the addition of another expression, in an attempt to increase the sensitivity of the scale.

Assessment of pain in cats is difficult since they appear less demonstrative than dogs in indicating that they are in pain, with aggression, resentment to handling and lack of responsiveness to human attention being proposed as manifestations of both acute and chronic pain in this species (Lascelles and Waterman 1997).

Resentment to joint palpation and manipulation has been reported as a common

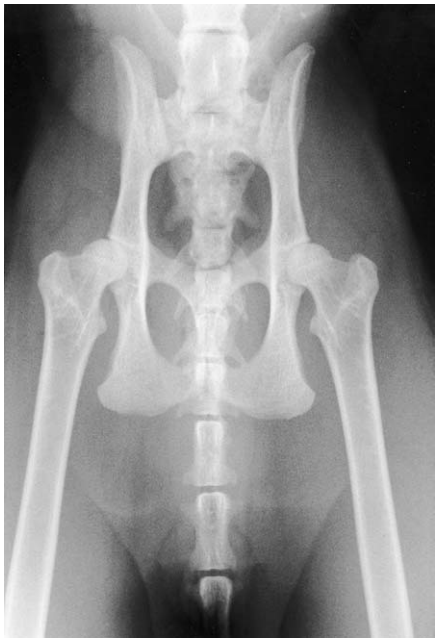

FIG 2. Ventrodorsal pelvic radiograph showing feline hip dysplasia with secondary osteoarthritis. Less than 50 per cent of the femoral heads are contained within the acetabulum. There is mild osteophyte deposition on both femoral necks

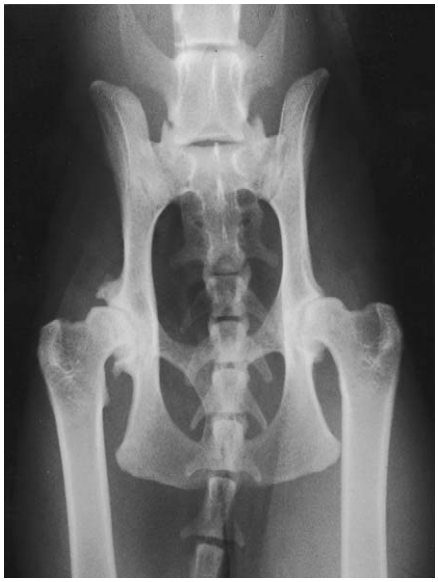

FIG 3. Ventrodorsal pelvic radiograph showing feline hip dysplasia with secondary osteoarthritis. Both femoral heads are misshapen. There is osteophyte deposition at both acetabuli, which is severe in the right side, which also has extensive osteophyte deposition and remodelling of the cranial effective acetabular edge

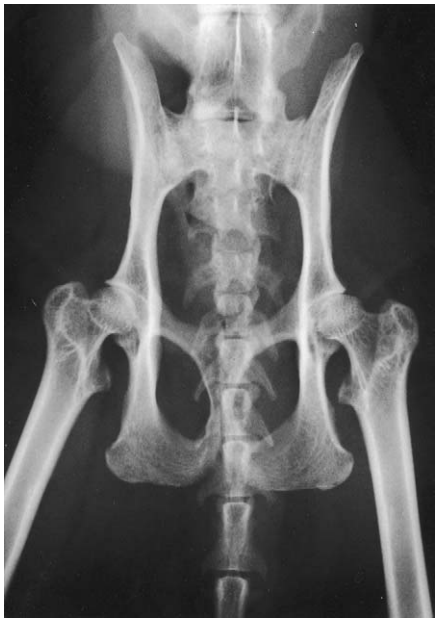

FIG 4. Ventrodorsal radiograph showing primary/idiopathic osteoarthritis of both hips. There is osteophyte deposition on both left and right cranial effective acetabular edges and on both femoral necks

finding in feline clinical OA (Godfrey 2003). The present results suggest that, based purely on detection of a patient's reaction in response to joint manipulation, there was an overestimation of the number of joints assumed to be clinically affected. This is explained merely by the fact that many cats will not tolerate palpation and manipulation of their limbs during a clinical examination. The converse is also likely to be true in that an apparent painful reaction on manipulation of an osteoarthritic joint may not be a true reflection as to whether or not the joint is painful. Arthrocentesis was not performed in the joints assumed to be painful on orthopaedic examination but which were radiographically normal. Therefore, the presence of other forms of joint disease, for example, immune-mediated disease, cannot be completely excluded. Three patients demonstrated no pain response to joint manipulation but had historical evidence and other clinical features felt to be consistent with OA, the presence of which was confirmed radiographically. All three patients showed clinical improvement at the end of the study period.

In the current study, behavioural variables including seeking seclusion, vocalisation on handling, aggression and/or resentment to handling were present in only a small number of cats and when present, the cats did not show a statistically significant improvement at the end of the study period, suggesting that these behavioural characteristics may be a 'normal' response in some cats. It is not disputed that such behavioural characteristics may be a manifestation of acute pain or indeed osteoarthritic pain, but using them in isolation as indicators of clinical OA may not be reliable.

An overall change in general demeanour was seen in 46 per cent of the cases, a clinical feature also reported by Godfrey (2003). A statistically significant improvement was seen in general demeanour scores, a finding also demonstrated by Lascelles and others (2001) when assessing analgesic efficacy in cats with painful locomotor disorders. This latter study also demonstrated a statistically significant improvement in the patients' food intake over the duration of their therapy. These findings were not demonstrated in our study.

Assessment of lameness in feline patients is also difficult (Hardie 1997, Lascelles and others 2001). A stiff gait was present in 32 per cent of patients in the current study, a finding similar to that of Godfrey (2002). In the current study, limping was identified in only 43 per cent of patients compared with 71 per cent those who were unwilling to jump and 67 per cent of those who had a reduced height of jump (lifestyle alterations). Most studies to date have relied on subjective lameness assessment, which is particularly difficult in cats, and if a more objective assessment of limb function, for example, pressure platform analysis (Conzemius and others 2003) was used, non-observable alterations in limb function may be appreciated. Statistically significant improvements were seen in lameness scores, lifestyle alterations and stiff gait between the start and end of the study period.

Eighteen per cent of patients in the current study developed intermittent gastrointestinal signs, which may have been associated with meloxicam administration. Two of the three patients who vomited only did so during the initial five days of therapy. In no case was the severity of gastrointestinal signs such that withdrawal of medication was required. Lascelles and others (2001) reported only a 2 per cent prevalence of vomiting with meloxicam administration. The palatability of meloxicam was excellent, a finding in common with a previous report (Lascelles and others 2001). The liquid formulation mixed with food was easy to administer and facilitated accurate dosing by the owners.

In the absence of other obvious aetiologies, the non-regenerative anaemia in four cases may represent anaemia associated with a chronic inflammatory disease, in this case OA. This is the most common type of anaemia seen in small animals, with therapy aimed at amelioration of the underlying disorder (Feldman 2005). The anaemia in two cases resolved after anti-inflammatory therapy. Neutropenia was identified at the end of the study period in one case; however, it is uncertain as to whether meloxicam administration was responsible for this.

Only a small number of primary care practices contributed cases to the study, with one practice contributing 46 per cent of all cases in the final study population. Given this finding, it may be that the

overall prevalence of clinical OA in the general cat population is greater than one might believe.

Conclusions

OA is an important clinical disease in cats. Lifestyle alterations were the most frequently identified signs of disease, as opposed to limping and stiff gait, which were present in less than half of the cases. Periarticular thickening is often minimal and affected joints often show a normal range of motion. Synovial effusions are seldom obvious and crepitus on movement is not a feature. A significant improvement in orthopaedic and lifestyle parameters but not in behavioural parameters was identified at the end of the study period, which might suggest that the latter features are less reliable indicators of clinical OA. This study, in common with previous reports (Godfrey 2003, 2005, Clarke and others 2005) provides further evidence that a primary/idiopathic aetiology, as currently defined, may explain most cases of feline OA.

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References

Allan, G. S. (2000) Radiographic features of feline joint disease. *Veterinary Clinics of North America: Small Animal Practice* **30**, 281-302

Bellamy, N. (1988) Methods of clinical assessment of anti-rheumatic drugs. *Clinical Rheumatology* **2**, 339-362

Cambridge, A. J., Tobias, K. M., Newberry, R. C. & Sarkar, D. K. (2000) Subjective and objective measurements of postoperative pain in cats. *Journal of the American Veterinary Medical Association* **217**, 685-690

Clarke, S. P., Mellor, D., Clements, D. N., Gemmill, T., Farrell, M., Carmichael, S. & Bennett, D. (2005) Radiographic prevalence of degenerative joint disease in a hospital population of cats. *Veterinary Record* **157**, 793-799

Conzemius, M., Horstman, C., Gordon, W. & Evans, R. (2003) Non-invasive, objective determination of limb function in cats using pressure platform gait analysis. Proceedings of 30th Annual Conference of Veterinary Orthopaedic Society. Steamboat Springs, CO, February 23 to 28, 2003. p 84

Feldman, B. F. (2005) Nonregenerative anemia. In: Textbook on Veterinary Internal Medicine. Vol. 2. 6th edn. Eds S. J. Ettinger and E. C. Feldman. W. B. Saunders, Philadelphia, PA, USA. pp 1908-1917

Godfrey, D. R. (2002) Osteoarthritis (OA) in cats: a retrospective series of 31 cases. *Journal of Small Animal Practice* **43**, 260

Godfrey, D. R. (2003) Osteoarthritis in cats: a prospective series of 40 cases. *Journal of Small Animal Practice* **44**, 418

Godfrey, D. R. (2005) Osteoarthritis in cats: a retrospective radiological study. *Journal of Small Animal Practice* **46**, 425-429

Gordon, W. J., Conzemius, M. G., Besancon, M. F., Evans, R., Wilkie, V. & Ritter, M. J. (2003) The relationship between limb function and radiographic osteoarthrosis in dogs with stifle osteoarthrosis. *Veterinary Surgery* **32**, 451-454

Hardie, E. M. (1997) Management of osteoarthritis in cats. *Veterinary Clinics of North America: Small Animal Practice* **27**, 945-953

Hardie, E. M., Roe, S. C. & Martin, F. R. (2002) Radiographic evidence of degenerative joint disease in geriatric cats: 100 cases (1994-1997). *Journal of the American Veterinary Medical Association* **220**, 628-632

Holt, P. E. (1978) Hip dysplasia in a cat. *Journal of Small Animal Practice* **19**, 273-276

Holton, L. L., Scott, E. M., Nolan, A. M., Reid, J., Welsh, E. & Flaherty, D. (1998) Comparison of three methods used for assessment of pain in dogs. *Journal of the American Veterinary Medical Association* **212**, 61-66

Keller, G. G., Reed, A. L., Lattimer, J. C. & Corley, E. A. (1999) Hip dysplasia: a feline population study. *Veterinary Radiology & Ultrasound* **40**, 460-464

Lane, N. E. & Buckwalter, J. A. (1993) Exercise: a cause of osteoarthritis? *Rheumatic Disease Clinics of North America* **19**, 617-629

Langenbach, A., Giger, U., Green, P., Rhodes, H., Gregor, T. P., Lafond, E. & Smith, G. (1998) Relationship between degenerative joint disease and hip joint laxity by use of distraction index and Norberg angle measurement in a group of cats. *Journal of the American Veterinary Medical Association* **213**, 1439-1443

Lascelles, B. D. X., Henderson, A. J. & Hackett, I. J. (2001) Evaluation of the clinical efficacy of meloxicam in cats with painful locomotor disorders. *Journal of Small Animal Practice* **42**, 587-593

Lascelles, B. D. X. & Waterman, A. E. (1997) Analgesia in the cat. *In Practice* **19**, 203-213

Meutstege, F. J. (1993) The classification of canine Achilles tendon lesions. *Veterinary and Comparative Orthopaedics and Traumatology* **6**, 53-55

Moskowitz, R. W., Kelly, M. A. & Lewallen, D. G. (2004) Understanding osteoarthritis of the knee – causes and effects. *American Journal of Orthopaedics* **33** (Suppl 2), 5-9

Patsikas, M. N., Papazoglou, L. G., Komninou, A., Dessiris, A. K. & Tsimopoulos, G. (1998) Hip dysplasia in the cat: a report of three cases. *Journal of Small Animal Practice* **39**, 290-294

Robertson, S. A. & Taylor, P. M. (2004) Pain management in cats – past, present and future. Part 2. Treatment of pain – clinical pharmacology. *Journal of Feline Medicine and Surgery* **6**, 321-333

Slingsby, L. & Waterman-Pearson, A. E. (2000) Postoperative analgesia in the cat after ovariohysterectomy by use of carprofen, ketoprofen, meloxicam or tolfenamic acid. *Journal of Small Animal Practice* **41**, 447-450

Slingsby, L. & Waterman-Pearson, A. E. (2002) Comparison between meloxicam and carprofen for postoperative analgesia after feline ovariohysterectomy. *Journal of Small Animal Practice* **43**, 286-289

Welsh, E. M., Gettinby, G. & Nolan, A. M. (1993) Comparison of a visual analogue scale and a numerical rating scale for assessing lameness, using sheep as a model. *American Journal of Veterinary Research* **54**, 976-983