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Nutritional Secondary Hyperparathyroidism in Cats under Six-Month-Old of Ahvaz

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Abstract

Objective- To determine the prevalence of nutritional secondary hyperparathyroidism (NSH) in companion and stray cats of Ahvaz.
Design- Clinical study.
Animals- 80 cats (companion=40 and stray=40)
Procedures- This survey was accomplished during a two-year period and based on clinical, radiographic and laboratory findings between 2005 and 2007. The studied cats were divided into two general group (companion and stray) and based on age into groups ≤ 3 months and 3-6 months. Status of nutrition was studied from using of milk and other dairy products (as a source of calcium). In our survey nutritional secondary hyperparathyroidism was diagnosed in seven cases. The measured biochemical parameters included calcium, phosphorus and alkaline phosphatase (ALP).
Results- The most radiographic findings were thin cortex, pathological fractures, constipation, decreased bone density and pelvic and column vertebral deformity. Level of ALP was high in some affected and healthy cats, but difference was not significant (P> 0.05). Calcium and phosphorus were in normal range both groups. Also, on statistical analysis (ANOVA), there was no significant differences between different sexes and companion and stray cats (P>0.05). Nevertheless, prevalence was significantly higher in some companion cats that were fed with high phosphorus and low calcium, as well as in cat's ≤ 3 months (P< 0.05).
Conclusion and Clinical Relevance- Nutritional secondary hyperparathyroidism is common partly in Iran, where many cats are fed mainly meat diets. This study showed importance of balanced nutrition special calcium and phosphorus in cats ≤ 3 months.
Key Words- Nutritional Secondary Hyperparathyroidism, Cat, Osteoporosis, Ahvaz.

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Introduction

Nutritional secondary hyperparathyroidism (NSH) is a metabolic disorder in which bone production is normal but osteopenia results from excessive bone resorption. It is caused by diets providing excess phosphate, insufficient calcium, or both. Affected animals have usually been fed mainly meat, organ tissue, or both. This provides adequate phosphate but insufficient calcium, and Ca: P ratios of about 1:16 to 1:35 which contrast with the recommended 1: 1 for cats. Added cow's milk provides insufficient calcium to correct the imbalance. The imbalance induces hypocalcemia, which increases secretion of PTH. Increased parathyroid activity tends to normalize blood calcium and inorganic phosphate concentrations by promoting mineral resorption from bone, enhancing intestinal calcium absorption, and facilitating renal phosphate excretion and calcium retention. However, continued ingestion of the defective diet sustains the hyperparathyroid state and causes progressive skeletal demineralization and consequent clinical signs.[1]

Nutritional secondary hyperparathyroidism causes clinical disease in kittens, but it also occurs occasionally in adults. Signs in young animals are lameness, reluctance to stand or walk, and skeletal pain. Costochondral junctions and metaphyses may appear swollen, and pyrexia is sometimes present. Bone fractures can follow relatively mild trauma. Limb deformity may be evident. Paresis or paralysis may result from vertebral compression, and constipation may follow pelvic collapse. Effects are less dramatic in adults, but generalized osteopenia and skeletal pain are sometimes seen, and resorption of alveolar bone may cause loosening and loss of teeth.[1]

Radiographically, decreased bone density and thin cortices are seen, with or without fracturing. Growth plates are normal, but metaphyses may be mushroom shaped. An area of relative radio-opacity occurs in the metaphyses adjacent to growth plates, representing the area of primary mineralization, and may be best appreciated in the distal radius and ulna.[2,3]

The purpose of this study was to determine the prevalence of nutritional secondary hyperparathyroidism in companion and stray cats of Ahvaz area. Changes of calcium, phosphorus and ALP were measurement and radiographic features were characterized of the long bone and spine of cats too.

Materials and Methods

This survey was performed based on clinical, radiographic and laboratory findings between 2005 and 2007. A total of 80 (40 companion and 40 stray) cats aged less than 6 months were selected. The studied cats were divided into two general group (companion and stray) and based on age into groups ≤ 3 months and 3-6 months (Table 1). Status of nutrition was studied from using of milk and other dairy products (as a source of calcium). The measured biochemical parameters included calcium, phosphorus and alkaline phosphates. Inorganic phosphate, calcium and ALP were measured using biochemical analyzer and routine laboratory techniques. In history, the affected cats were fed beef without supplementation of calcium and vitamins after weaning. Upon physical examination they had ataxia, constipation and skeletal pain on digital palpation. In addition, reluctance to move and depressed withdrawal reflex were noted at the neurological examination. Based on the results of examinations, nutritional secondary hyperparathyroidism was diagnosed.

Table1. Characteristic of cats based on age, sex and number of affected animals in two groups: Group I, companion cats; Group II, stray cats

		Companion cats (n = 40)		Stray cats (n = 40)	
Age		≤ 3 months (n = 20)	> 3 months (n = 20)	≤ 3 months (n = 20)	> 3 months (n = 20)
Sex	Male	8	13	12	10
	Female	9	8	11	9
Number of affected cats		4	1	2	0

Table2. Concentrations of phosphorus, calcium and ALP (mean ± SD) in two groups of cats: Group I, healthy cats; Group II, affected cats

Group	Phosphorus (mg/dl)	Calcium (mg/dl)	ALP (IU/l)
I	6.7 ± 0.3	9.5 ± 0.4	224 ± 0.8
II	5.1 ± 0.1	8.1 ± 0.2	176.9 ± 0.1

Results

Statistical analysis was performed by using the computer package SPSS for Windows 10.1 SPSS. One-way repeated measures analysis of variance (ANOVA) was used to assess: (a) the differences between groups for the calcium, phosphorus and ALP, and (b) the intragroup differences for the variables under study. A value of $P \leq 0.05$ was considered as significant.

In the present study, nutritional secondary hyperparathyroidism was diagnosed in seven cases (2 cases = sever, 3 cases = moderate and 2 other cases = mild). The most radiographic findings were decreased bone density, thin cortices, constipation, pathological fractures, pelvic and column vertebral deformity (Fig.s 1 and 2). The overall changes of the skeleton were observed on the lateral and ventrodorsal view of radiographic examination. Level of ALP (Table 1 and 2) was high in some affected and healthy cats, but difference was not significant ($P > 0.05$). Changes of calcium and phosphorus were not significant.

Also, on statistical analysis (ANOVA), there was no significant differences between different sexes and groups (companion and stray) of cats ($P>0.05$). Nevertheless, prevalence was significantly higher in cats that were feed with high phosphorus and low calcium, as well as in cat's ≤ 3 months ($P< 0.05$). The ratio of Ca: P was in normal range (1/6) in the affected cats. They were confined for the first few weeks of treatment to reduce the risk of fractures and deformity. For all the affected cases, calcium syrup was added to hold a normal range of Ca: P ratio.

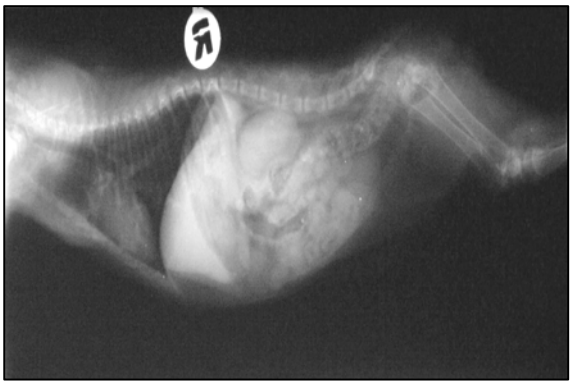

Figure 1. Overall bone opacity of the femur is decreased, and cortices are thin. Constipation and deformity of pelvis and vertebral column is seen in the affected cat.

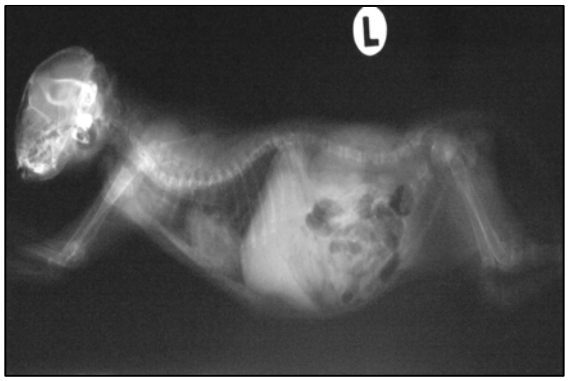

Figure 2. Decreased opacity of the femur, thin bone cortices, and pathologic fracture can be seen in distal femur. Deformity of pelvis and vertebral column is also seen.

Table 3. Plasma concentrations of phosphorus, calcium and ALP in the affected cats

Number of affected cats	Phosphorus (mg/dl)	Calcium (mg/dl)	ALP (IU/l)
1	3.1	8.1	258
2	6.8	6.9	48
3	7.2	6.8	284
4	4.6	9.8	56
5	3.9	7.5	238
6	4.8	10.1	60
7	5.2	7.4	294

Discussion

NSH is still an important clinical entity, and should be considered in all of growing cats presenting with spontaneous fractures or seizures. Many cases of metaphyseal disturbance are reported in kittens.[3] We suggest that radiography would be accomplished in all the cats that have been fed meat without milk or supplemented with calcium. Our study showed when the cats fed a high phosphorus diet rapidly developed severe osteoporosis. It emphasized the importance of balanced nutrition specially calcium and phosphorus in cat's ≤ 3 months old. It was showed that blood biochemical tests (concentrations of calcium, phosphorus and ALP) were of little value between the healthy and affected cats. The calcium and phosphorus concentration were within the reference range. Concentration of ALP was high in some healthy and affected cats, but it is common in growing animals, so it should be interpreted carefully.

Tomsa, et al (1999) diagnosed nutritional secondary hyperparathyroidism in 6 cats. Clinical signs were attributable to severe osteopenia (n = 5) and hypocalcaemia (n = 4), which resulted in spontaneous fractures of long bones, scapulae, pelvis, nasal bones, or spine, and in excitation, muscle twitching or seizures, respectively. Serum parathormone levels were markedly elevated, and 1, 25(OH)-2-vitamin D3 mildly elevated, whereas 25(OH)-vitamin D3 was mildly decreased compared to age-matched healthy cats.[4] In our study, we couldn't measure vitamin D3 and PTH, because we didn't access to laboratory techniques.

Gnudi, et.al (2001) reported an unusual hyperparathyroidism in a cat. He was presented with anorexia and vomiting. The cat was depressed and reluctant to move. He had difficulties in keeping the standing position and grossly deformed thighs. Lytic changes and disruption of normal architecture of the bone were observed, involving mainly the femoral diaphyses. An inverse Ca/P ratio and kidney failure were diagnosed.[5] In the present study Ca/P ratio was normal (1/6) and differences were not significant ($P>0.05$). The probable reason is compensatory mechanism in kidneys.

Rensburg and Lowry (1998) notified nutritional secondary hyperparathyroidism in a lion cub. She was a cub about five months old from a litter raised artificially in a lion park, was euthanized and necropsied. The history was poor growth, lameness, reluctance to move and skeletal malformations with disproportionately large head and feet.[6]

Herz and Kirberger (2004) reported nutritional secondary hyperparathyroidism in a white lion cub (Panthera Leo), with concomitant radiographic double cortical line. In their report a white lion cub was presented with hindquarter pain, lameness and reluctance to move.[7]

A guarded prognosis is given for full recovery in more case, as changes to the thoracolumbar vertebral are considered potentially irreversible. In all of these diagnoses, the use of routine radiographic studies has been extremely helpful, first in detecting that a bone abnormality is present, and then in the differential diagnosis of the etiology of this abnormality.[1]

Won, et al (2004) described a case of nutritional secondary hyperparathyroidism in a Siberian tiger cub. She was a three months Siberian tiger cub that was referred with hind limb ataxia.[8] Our cases emphasize that nutritional secondary hyperparathyroidism can be occurred in all of companion and stray cats raised on a meat diet containing imbalanced calcium and phosphate particular in age's $\leq$ 3 months old.

In conclusion, we emphasize that nutritional secondary hyperparathyroidism is quite common in cats of Iran, where many cats are fed mainly meat diets. Advanced cases with severe skeletal deformities and multiple fractures can be difficult to restore, but cases presenting mainly with pain, lameness and minor fractures respond well to dietary therapy when properly applied.[9]

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چکیده

هیپرپاراتیروئیدیسم ثانویه تغذیه ای در گربه های شهرستان اهواز

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هدف- تعیین میزان شیوع هیپرپاراتیروئیدیسم ثانویه تغذیه ای (NSH) در گربه های خانگی و بومی اهواز.

طرح مطالعه- مطالعه درمانگاهی.

حیوانات- ۸۰ قلاده گربه (۴۰ تا خانگی و ۴۰ تا بومی)

روش کار- این تحقیق در طی یک دوره ۲ ساله و بر اساس یافته های بالینی، رادیوگرافی و آزمایشگاهی در طول سال ۸۶ – ۱۳۸۴ انجام شده بود. گربه های تحت مطالعه به ۲ گروه کلی (خانگی و بومی) و بر اساس سن (کمتر از ۳ ماه و بین ۳ تا ۶ ماه) تقسیم بندی شده بودند. وضعیت جیره غذایی از نظر استفاده از شیر و دیگر فراورده های لبنی (به عنوان منبع کلسیم) در گربه های خانگی بررسی شده بود. در تحقیق اخیر، در ۷ مورد هیپرپاراتیروئیدیسم ثانویه تغذیه ای تایید شد. پارامترهای بیوشیمیایی اندازه گیری شده، شامل کلسیم، فسفر و آلکالین فسفاتاز بودند.

نتایج- مهمترین یافته های رادیوگرافی شامل کورتکس کاغذی، شکستگی های پاتولوژیک، یبوست، کاهش وضوح زوائد شوکی ستون مهره ها و و دفرمیتی در لگن و ستون مهره ها بود. میزان آلکالین فسفاتاز در تعدادی از گربه های مبتلا و سالم بالا بود و تفاوت معنی داری از نظر آماری دیده نشد ($P>0.05$). میزان کلسیم و فسفر نیز هر دو در محدوده نرمال بودند. همچنین بر اساس آزمون ANOVA تفاوت معنی داری بین جنس و نیز از نظر خانگی و بومی بودن بدست نیامد. با این وجود آن دسته از گربه های خانگی که در جیره غذایی آنها بیشتر از منابع فسفر و کمتر از منابع کلسیم استفاده شده بود و نیز در سنین کمتر از ۳ ماه، شیوع بیماری بالاتر و از نظر آماری معنی دار بود ($P<0.05$).

نتیجه گیری و کاربرد بالینی- هیپرپاراتیروئیدیسم ثانویه ای تغذیه ای در گربه های ایران نسبتا معمول است و دلیل آن استفاده بیشتر از گوشت در جیره غذایی است. این مطالعه اهمیت بالانس جیره غذایی بویژه از نظر کلسیم و فسفر را در جیره غذایی گربه های کمتر از ۳ ماه نشان می دهد.

کلید واژگان- هیپرپاراتیروئیدیسم ثانویه تغذیه ای، گربه، استئوپروز، اهواز.