JZAR JOURNAL OF ZOO AND AQUARIUM RESEARCH
www.jzar.org

Evidence-based practice

Dietary management of an obese kinkajou (*Potos flavus*) with congestive heart failure secondary to hypertrophic cardiomyopathy

David Eshar

Department of Clinical Studies–Philadelphia, University of Pennsylvania School of Veterinary Medicine, Philadelphia, PA, USA
Correspondence: David Eshar, Avian and Exotics Service, Ontario Veterinary College, University of Guelph, Guelph, Ontario N1G2W1, Canada; deshar@uoguelph.ca

Keywords:

kinkajou, obesity, diet review

Article history:

Received: 6 December 2012
Accepted: 28 February 2013
Published online: 31 October 2013

Abstract

An adult castrated male pet kinkajou (*Potos flavus*) with a history of bilateral stifle osteoarthritis was diagnosed and successfully treated for congestive heart failure secondary to hypertrophic cardiomyopathy. The animal was markedly obese and with a presenting body weight of 8.8 kg. The kinkajou's home diet was not balanced and there was no energy restriction. Dietary modification was directed as part of the patient's clinical management, and owners were given guidance on content and proportions of the recommended diet. Dietary changes were implemented over several months with some adaptations based on the kinkajou's food preferences and clinical improvement. The maintenance diet was calculated to about 1047 KJ/day and mainly consisted of an assortment of fruit and sugar-free juice. The kinkajou responded well to its new diet, and over a 6-month period its weight decreased by almost 40%. Obesity is considered a major risk factor for developing cardiac disease in many mammalian species and may contribute to the high prevalence of cardiomyopathy in this particular species. Proper diet composition, adhering to what is known about diets in the wild, along with controlled energy intake, can reduce the health risks commonly related to obesity, increase longevity, and offer better care for captive kinkajous.

Background

Kinkajous (*Potos flavus*), medium-sized mammals, belong to the family Procyonidae, related to raccoons, coatis, ringtails and olingos (Ford and Hoffmann 1988). Kinkajous inhabit the canopies of neotropical primary rainforests throughout Central America and northern South America (Ford and Hoffmann 1988). Kinkajous are often found in zoological collections and also as privately -owned pets (Wright and Edwards 2009).

In this case, a 14.5-yr-old castrated male kinkajou was presented for severe respiratory distress. Prior history included castration at 3 years of age, bilateral stifle osteoarthritis, and intermittent bronchitis for the past 5 years treated with unreported antimicrobials. The animal was diagnosed with congestive heart failure (CHF) secondary to hypertrophic cardiomyopathy (HCM) and suspected pulmonary arterial hypertension (Eshar et al. 2010). Diagnosis was based on history, clinical signs, clinical pathology, radiographs, abdominal ultrasonography, abdominal fluid analysis, electrocardiography, and echocardiogram (Eshar et al. 2010). An undetermined hepatopathy was also found at presentation and resolved following metronidazole antimicrobial treatment.

Figure 1. Picture of the kinkajou taken at the initial presentation. The animal appears markedly obese, the abdomen is severely distended and with no ability to move. There is loss of body line curvatures and the animal has a BCS of 5. The abdomen was shaved for the sonographic evaluation.

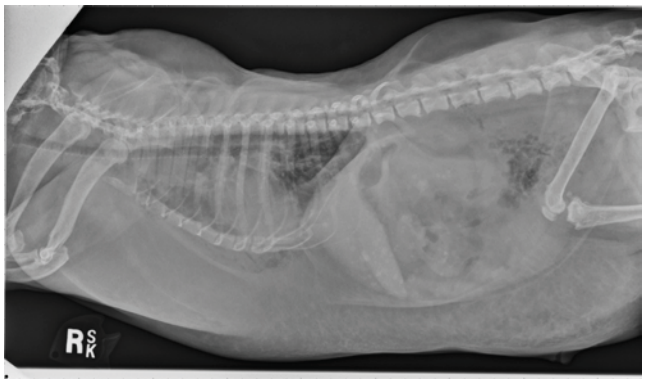

Figure 2. Right lateral radiograph of the kinkajou on presentation. There is bi-cavitary and subcutaneous effusion, cardiomegaly, hepatomegaly with multiple foci of mineralisation and stifle osteoarthritis. There is a marked subcutaneous adipose layer over the thoracic and abdominal regions.

Cardiopulmonary medical treatment, including a loop diuretic, an ACE-inhibitor, a beta-adrenergic receptor blocker and a bronchodilator provided improvement of the clinical signs (Eshar et al. 2010).

On presentation the kinkajou's weight was 8.8 kg (Figs 1–2), almost 200% of the reported upper range for captive male kinkajous (1.9–4.75 kg) (Wright and Edwards 2009). Using a body condition score (BCS) of 1 to 5, with 1 representing an emaciated kinkajou, 3 being a healthy weight, and 5 being an obese animal, a healthy kinkajou should appear sleek from all sides, similar to the domestic cat (Wright and Edwards 2009). As a result of its medical condition the animal was almost completely sedentary with no ability to freely lift itself or move around. The owner obtained the animal as a weaned baby at 4 months of age, and since then, the home diet had no calorie limits and comprised table scraps, rice porridge baby formula, high calorie sports drinks, candy and select fruits.

An adequate kinkajou diet is a matter of debate in the literature. Some resources describe kinkajous as omnivorous, feeding on insects, small reptiles, rodents and a diverse range of wild fruits (Nowak and Paradiso 1991) with recommendations for keepers to provide animals with up to 50% live protein in their diet (Pernalete 1997). Scientific observations from the field suggest that although within the order Carnivora, and without having obvious anatomic–physiological adaption, kinkajous are primarily frugivorous, feeding almost exclusively on fruits (90%) supplemented with nectar, pollen and leaves (Charles-Dominique et al. 1981; Bisbal 1986; Julien-Laferriere 1999; Kays 1999).

Action

Once the cardiac disease was under control, and since weight loss can have a positive impact on longevity and ability to cope with the cardiac and joints diseases, a long-term weight loss plan was part of the clinical management of this patient. The weight loss strategy aimed to address two key points: first, to normalise animal–owner food interaction, where the owner needed to recognise the problem and be willing to take corrective steps, and second, to supplement an adequate (i.e. balanced and energy restricted) and palatable diet.

The weight loss protocol was designed to put the kinkajou in a 'negative energy balance'. The resting energy requirement (RER) was calculated using the following formula for animals weighing 3–25 kg: RER = (30 x current body weight in kg) + 70 = 334 kcal/day (Chan and Freeman 2006). Kinkajous are thought to have a basal metabolic rate of approximately 0.316 mL O_2/g/h, which is only 65% of the predicted mammalian metabolic rate calculated by the Kleiber (1961) formula: M (kcal/h) = $3W^{0.75}$. Therefore, a kinkajou's diet should contain 209 KJ/day less than the one of an equivalent size placental mammal, and in this case the kinkajou's RER was calculated to be 1189 kJ/day. Due to its obesity and decreased ability to exercise, the daily energy requirement (DER) was calculated as DER = 0.8 x 1189 = 963 kJ/day.

Nutrient requirements of kinkajous have not been studied clearly or defined under controlled conditions (Wright and Edwards 2009). As a result, practical diets are extrapolated from the nutrient requirements of domestic dogs, and a detailed description of such diets and their nutritional contents can be found in the literature (Wright and Edwards 2009). However, in this author's experience not all kinkajous can accept the composition of the canine diet; some animals either eat too much of the dog kibble or completely ignore it for the lack of palatability. In this case, the kinkajou was given a diet based on its favoured items with a combination of commercial fruits and vegetables. Bananas, apples, oranges, kiwi, melons, pears and berries were given in moderation to prevent sugar overload. Favoured vegetables included cucumbers, corn, snow peas and sweet potatoes, which have a nutrient content similar to many wild fruits. The initial amounts to be given were calculated to be about 3 cups (921 kJ) per day. Dried fruits (raisins, dates, prunes, papaya, pineapple, apricots) were given as single treats to maintain the owner–pet relationship.

Fruit consumed by wild kinkajous has lower sugar, starch and moisture content, higher protein and fibre content, and more concentrated minerals and vitamins than domestically available fruits (Edwards 2006; Wright and Edwards 2009). Dietary protein was provided by offering beans, peas and low-fat non-dairy peanut butter (10 g), which was also another positive reinforcement treat. The undetermined liver disease of this kinkajou was taken into consideration, and protein requirements were adjusted based on those recommended for dogs with hepatic disease that need 2–3g/419 kJ/day (Chan and Freeman 2006). Dietary fibre was included by giving cooked pumpkin and sweet potatoes. Multivitamin (5 drops/day: Enfamil Poly-Vi-Sol: multivitamin drops, manufactured by Mead Johnson & Company, Glenview, IL, USA) was given because of the concern about hypovitaminosis from offering an incomplete diet. Although some dried figs (relatively high calcium content) were given as treats, the kinkajou was also given a calcium supplement (1 ml/day: Calcionate: Ca-glubionate syrup, manufactured by Rugby Laboratories, Inc. Duluth, Georgia, USA).

Consequences

The kinkajou was checked on a monthly basis. After one month the kinkajou lost 1.3 kg from its presenting body weight (15%). It is also possible that the diuretic drugs had an initial weight loss effect as internal body effusions and subcutaneous oedema started to resolve. Clinically, the kinkajou started to move around, and water with natural sweetener (SteviaPlus Fiber™: artificial sweetener, manufactured by Wisdom Natural Brands, Gilbert, AZ 85233, USA) was provided. Since fluids are important for weight reduction diets because of the low calorie:volume ratio, water-based fruit shakes (with flax seeds and natural sweetener) were also given.

After two months the kinkajou's weight dropped by 2.8 kg (32%) to 6.0 kg. The animal was now moving more and behaving as if hungry because of the increased energy requirements, and the daily rations were increased by another 0.5 cup/day (approximately 150 kJ) mixed fruits. Environmental enrichment was needed to increase physical activity, and food was offered in

a covered bucket with holes in it. After six months the kinkajou's weight was 5.7 kg (35% less). The owner reported that the animal was now able to climb up and down stairs, run around the house and jump from ground level up to table height. Exercise is the best and practical means of increasing energy expenditure, and it also benefits obese patients by lessening the loss of lean body mass and maintaining or improving resting energy rate (RER); therefore, further physical enrichment was provided by placing dried fruit in a Wiffle Ball (hollow toy ball, manufactured by The Wiffle Ball, inc., Shelton, CT, USA) and ferret Kong toys (Kong Ferret Treasure: rubber toy, manufactured by Kong Company, Golden, CO, USA).

After 11 months the kinkajou's weight was 5.3 kg, a drop of 3.5 kg (39%) from the initial presentation. Clinical evaluation, including blood tests, abdominal ultrasonography, radiology and cardiography showed marked improvement of the cardiac and hepatic disease.

This case emphasises the need for weight management and diet considerations to be part of the clinical management of every medical case. It also demonstrates the challenges in clinical management of a severe chronic disease parallel to dietary management of an exotic species with our limited knowledge of its nutritional requirements.

Kinkajous are commonly kept in small cages, not allowing for enough energy expenditure, and food is usually offered with no caloric restriction and few foraging opportunities (Wright and Edwards 2009). Neutering can be another contributing factor to obesity, with the absence of the catabolic effect of testosterone. Captive kinkajous are often obese and commonly present with associated medical conditions such as diabetes mellitus, pancreatitis, arthritis and cardiovascular diseases (Wright and Edwards 2009). Since prevention is the best way to fight obesity, it is our hope that kinkajous in captivity receive better nutrition and thus evade many of their common dietary-related illnesses.

Acknowledgements

Gordon D. Peddle, VMD, Jeleen A. Briscoe, VMD, Dipl. ABVP (Avian), Kathryn E. Michel, DVM, MS, DACVN from the Department of Clinical Studies–Philadelphia, University of Pennsylvania School of Veterinary Medicine, Philadelphia, PA, USA.

References

Bisbal F.J. (1986) Food habits of some neotropical carnivores in Venezuela (Mammalia, Carnivora). *Mammalia* 50: 329–340.

Chan D.L., Freeman L.M. (2006) Nutrition in critical illness. *Veterinary Clinics of North America: Small Animal Practice* 36: 1225–1241.

Charles-Dominique P., Atramentowicz M., Charles-Dominique M., Gérard H., Hladik A., Hladik C.M., Prévost M.F. (1981) Les mammiferes frugivores aboricoles noctunes d'une foret gutanaise: interrelations plantes–animaux. *Revue d'Ecologie (La Terre et la Vie)* 35: 341–435.

Edwards MS. (2006) Feeding the non-human primate. Presented at *The North American Veterinary Conference*. Orlando, FL.

Eshar D., Peddle G.D., Briscoe J.A. (2010) Diagnosis and treatment of congestive heart failure secondary to hypertrophic cardiomyopathy in a kinkajou (*Potos flavus*). *Journal of Zoo and Wildlife Medicine* 41: 342–345.

Ford L.S., Hoffmann R.S. (1988) *Potos flavus. Mammalian Species* 321: 1–9.

Julien-Laferrière D. (1999) Foraging strategies and food partitioning in the Neotropical frugivorous mammals *Caluromys philander* and *Potos flavus*. *Journal of Zoology* 247: 71–80.

Kays R.W. (1999) Food preferences of kinkajous (*Potos flavus*): a frugivorous carnivore. *Journal of Mammalogy* 80: 589–599.

Kleiber M. (1961) *The Fire of Life: An Introduction to Animal Energetics.* New York: John Wiley & Sons.

Müller E.F., Kulzer E. (1977) Body temperature and oxygen uptake in the kinkajou (*Potos flavus*), a nocturnal tropical carnivore. *Archives Internationales de Physiologie, de Biochimie et de Biophysique* 86: 153–163.

Nowak R.M., Paradiso J.L. (1991) Kinkajou. In: Nowak R.M. (ed.) *Walker's Mammals of the World,* 5th edn. Baltimore: The Johns Hopkins University Press, 1103–1104.

Pernalete J.M. (1997) Management and reproduction of the kinkajou *Potos flavus* at the Barquisimeto Zoo. *International Zoo Yearbook* 35: 287–289.

Wright K., Edwards M.S. (2009) Considerations for kinkajou captive diets. *Veterinary Clinics of North America: Exotic Animal Practice* 12: 171–185.