DIETARY MANAGEMENT OF KIDNEY DISEASES

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Chronic kidney disease (CKD) is a common disease both in dogs and cats, with an estimated overall prevalence of 0.5-7% in dogs and 1.6-20% in cats in the United States, which increases with age (1). The International Renal Interest Society (IRIS, www.iris-kidney.com) has developed a staging method of the disease (from stage I to stage IV) based on fasting plasma creatinine. The patient is then substaged based on proteinuria and systemic blood pressure.

Nutrient modifications in kidney disease: what is the evidence?

There are clinical studies showing that commercial diets formulated for kidney disease (so-called "kidney diets") prolong survival time and improve laboratory values in both dogs (2, 3) and cats (4, 5, 6) with naturally-occurring disease (independent of aetiology). Most commercial diets include the same modifications, but they are all different in their level of restriction/supplementation of nutrients, and the choice of diet should be made for the individual patient.

Energy: A decrease in appetite is common in these patients (1). Kidney diets tend to be high in energy density and high in carbohydrates and fat. Fat not only provides energy, but also is important for palatability.

Protein: Protein restriction minimizes azotaemia and decreases clinical signs of uraemia in later stages of CKD, but excessive restriction should be avoided since it can result in protein malnutrition and subsequent muscle wasting (7). The use of high quality protein sources with a correct balance of amino acids is critical (such as animal proteins and egg). There is not a consensus on when to institute protein restriction. There does not seem to be an effect of protein restriction in progression of CKD in companion animals, but this is still a very controversial topic (8, 9). Protein loss through the glomeruli is considered to be damaging to the tubules (and result in progression of the disease), and, in these patients, protein restriction may help prevent further damage (10, 11). Protein cannot be excessively restricted in cats due to their elevated protein requirements.

Phosphorus: Phosphorus excretion is impaired in CKD, resulting in increased serum phosphorus concentrations and renal secondary hyperparathyroidism. There is evidence that dietary phosphorus restriction slows down progression of the disease in both cats and dogs with experimentally induced disease (12, 13). Phosphorus restriction results in a decrease in serum PTH in cats with CKD (14). Since phosphorus is abundant in meat sources, phosphorus restriction without some degree of protein restriction is challenging.

Sodium: There is no clinical evidence showing that sodium restriction or limitation is beneficial for patients with CKD. However, therapeutic diets have a decreased concentration of sodium due to the presence of systemic and glomerular hypertension in many of these patients. Sodium restriction can also have downfalls such as loss of palatability and activation of the renin-angiotensin-aldosterone system (9). Renal diets provide less sodium than maintenance diets but are still well above minimum requirements (15).

Omega 3 fatty acids: Two studies by Brown and collaborators (16, 17) have shown the beneficial effect of marine fish oil on progression of experimentally induced kidney disease in dogs. The addition of menhaden oil in these studies resulted in decreased proteinuria; decreased serum concentrations of triglycerides, cholesterol and inflammatory mediators; improved glomerular filtration; and less severe histological lesions. There is no such strong evidence in cats at this time. The doses of fish oil in these studies were very high, and not practical to include in commercial diets. There are no studies regarding the efficacy of alpha-linolenic acid, a shorter

chain omega 3 (present in flaxseed or canola oil) or gamma-linolenic acid (present in borage oil) in helping manage CKD in cats or dogs.

B vitamins: Therapeutic diets have boosted levels of water-soluble vitamins. The rationale behind it is that polyuric animals lose higher amounts of these vitamins.

Fibre: Most commercial diets kidney diets include fermentable fibre. The theory behind this is that this type of fibre promotes the growth of beneficial bacteria in the gut, which will use dietary nitrogen and blood urea as a nitrogen source, and thus can help reduce azotaemia. At this point, clinical trials in cats and dogs showing the efficacy of this strategy are lacking.

Antioxidants: In a recent review (18), Brown discussed the role of oxidative stress in kidney disease. At this time, antioxidant therapy for these species has not been studied in the clinical setting, and it should be approached with caution due to the risks of over-supplementation. In any case, if omega 3 fatty acids are added, antioxidant supplementation is very important to prevent diet rancidity and in vivo oxidation of this fatty acids. Acid base balance: these diets are also alkalinizing (both by being low in protein and by addition of alkalinizing agents) due to the tendency of cats and dogs with CKD towards acidosis.

Nutrition for stage of disease

The clinical studies with kidney diets are with cats and dogs in CKD stages II-IV. There are no clinical studies on the efficacy of dietary modification on patients with stage I kidney disease, so no dietary recommendations or changes are recommended at this time, except if the patient is proteinuric, where protein restriction is indicated. In Stage II animals, diet change to a therapeutic kidney diet is indicated. Severe protein restriction is not required but phosphorus restriction should be instituted as soon as possible. In this stage, dietary phosphorus restriction is usually enough to keep serum phosphorus at acceptable levels (see www.IRIS-kidney.com).

In Stage III-IV patients, protein restriction to control uraemia is important. As azotaemia increases, the severity of protein restriction should increase as well. Regarding phosphorus, if dietary restriction does not control serum phosphorus concentrations, phosphate binders might be necessary (almost always needed for stage IV). In Stage IV patients, nutritional support (tube feeding) will be necessary to prevent malnutrition. Protein deficiency can occur if the patient is not eating adequate amounts of the diet to maintain body weight. Patients in this stage rarely eat enough amounts of an adequate diet. This might be necessary long-term, although some animals might start eating by themselves once they feel better.

Available commercial diets: which one to choose

There are several different commercially available therapeutic diets in Europe, and might vary from country to country. Examples are (but are not limited to): Hill's Prescription Diet k/d canine and feline canned and dry, Royal Canin Veterinary Diet Renal canine and feline canned and dry, Purina Veterinary Diet NF canine and feline canned and dry, and Advance Veterinary Diet Renal Failure canine and feline canned and dry. These diets vary in protein, fat, phosphorus, sodium, and potassium contents, and the best option will vary for the individual patient. Not all of them include fish oil (or EPA and DHA) so supplementation with fish oil capsules is recommended in those cases. Commercial diets are reformulated, so contacting the company at regular intervals to obtain the most accurate information is very important.

When home cooked diets are the best option

In the author's experience, despite the high number of commercial options, sometimes a complete and balanced home cooked diet is indicated. One of the most common reasons to try a home cooked diet is their lack of palatability for certain patients. Home cooked diets can be formulated with specific ingredients palatable to the specific patient, and tend to be more appealing in general.

The presence of co-morbidities with different dietary strategies is also common. Kidney diets are contraindicated in fat-sensitive diseases such as pancreatitis, lymphangiectasia, and hyperlipidaemia, since they are generally high fat. Another example where home cooking might be the best option would be inflammatory bowel disease or adverse reactions to foods.

Finally, hypokalaemia in CKD is common, especially in cats, which can result from increased renal losses, acidosis, and decreased food intake (7). Supplementation (on top of the commercial diet) might be necessary. However, hyperkalaemia can also be seen in these patients (19). Some medications, like enalapril (commonly used in proteinuric kidney disease), are potassium sparing and can contribute to hyperkalaemia. In these cases, if the lowest potassium commercial diet is still inadequate, a home cooked diet restricted in potassium might be necessary to control serum potassium levels. However, providing all essential amino acids in protein-restricted home cooked diets can be challenging. Also, home cooked diets cannot be tested for adequacy and a more rigorous veterinary control is indicated in patients eating these types of diets.

REFERENCES

1 Polzin DJ, Osborne CA, Ross SJ. Chronic kidney disease. In: Ettinger SJ and Feldman EC, editors. Textbook of Veterinary Internal Medicine. 6th ed. St Louis (MO): Elsevier Saunders; 2005. p. 1756.
2 Leibetseder JL, Neufeld KW. Effects of medium protein diets in dogs with chronic renal failure. J Nutr 1991; 121:Suppl: 145-9.
3 Jacob F, Polzin DJ, Osborne CA, Allen TA, Kirk CA, Neaton JD et al. Clinical evaluation of dietary modification for treatment of spontaneous chronic renal failure in dogs. J Am Vet Med Assoc 2002; 220:1163-70.
4 Harte JG, Markwell PJ, Moraillon RM, Gettinby GG, Smith BH, Wills JM. Dietary management of naturally occurring chronic renal failure in cats. J Nutr 1994; 124:2660S-2662S.
5 Plantinga EA, Everts H, Kastelein AMC, Beynen AC. Retrospective study of the survival of cats with acquired chronic renal insufficiency offered different commercial diets. Vet Rec 2005; 157:185-187.
6 Ross SJ, Osborne CA, Kirk CA, Lowry SR, Koehler LA, Polzin DJ . Clinical evaluation of dietary modification for treatment of spontaneous chronic kidney disease in cats. J Am Vet Med Assoc 2006; 229:949-957.
7 Elliott DA. Nutritional management of chronic renal disease in dogs and cats. Vet Clin North Am Small Anim Pract 2006; 36:1377-84.
8 Adams LG, Polzin DJ, Osborne CA, O'Brien TD. Effects of dietary protein and calorie restriction in clinically normal cats and in cats with surgically induced chronic renal failure. Am J Vet Res 1993; 54:1653-1662.
9 Finco DR, Brown SA, Brown CA, Crowell WA, Sunvold G, Cooper TL. Protein and calorie effects on progression of induced chronic renal failure in cats. Am J Vet Res 1998; 59:575-582.
10 Adams LG, Polzin DJ, Osborne CA, O'Brien TD, Hostetter TH. Effects of reduced dietary protein in cats with induced chronic renal failure. J Vet Intern Med 1990; 4:125.
11 Burkholder WJ, Lees GE, LeBlank AK, Slater MR, Bauer JE, Kashtan CE et al. Diet modulates proteinuria in heterozygous female dogs with X-linked hereditary nephropathy. J Vet Intern Med 2004;18:165-75.
12 Ross LA, Finco DR, Crowell WA. Effect of dietary phosphorus restriction on the kidneys of cats with reduced renal mass. Am J Vet Res 1982; 43:1023-1026.
13 Brown SA, Crowell WA, Barsanti JA, White JV, Finco DR. Beneficial effects of dietary mineral restriction in dogs with marked reduction of functional renal mass. J Am Soc Nephrol 1991;1:1169-79.
14 J. Elliott, J. M. Rawlings, P. J. Markwell, P. J. Barber. Survival of cats with naturally occurring chronic renal failure: effect of dietary management. J Small Anim Pract 41: 235-42.
15 National Research Council. Nutrient Requirements of Dogs and Cats. Washington, D.C.: National Academy Press; 2006.
16 Brown SA, Brown CA, Crowell WA, Barsanti JA, Allen T, Cowell C, et al. Beneficial effects of chronic administration of dietary omega-3 polyunsaturated fatty acids in dogs with renal insufficiency. J Lab Clin Med 1998; 131: 447-455
17 Brown SA, Brown CA, Crowell WA, Barsanti JA, Kang CW, Allen T, et al. Effects of dietary polyunsaturated fatty acid supplementation in early renal insufficiency in dogs. J Lab Clin Med 2000;135:275-86.