NUTRITION STRATEGY
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NUTRITION

Feeding Dogs with Chronic Kidney Disease: What the Evidence Can and Can't Tell Us

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Nutrition is arguably the most important aspect of chronic kidney disease (CKD) management. Manipulating the composition of a patient's diet can slow the progression of CKD, minimize uremic symptoms, and improve quality of life.

A seminal study in dietary management of CKD demonstrated that dogs with spontaneous CKD lived an average of 13 months longer when fed a diet designed for renal disease compared with a maintenance diet.[1] In addition, dogs eating the renal diet had a 3-fold reduction in relative risk of uremic crises compared with dogs eating the maintenance control diet. At the end of the 2-year study, only 33% of dogs receiving the renal diet died from renal-related causes, compared with 65% of dogs receiving the maintenance diet.

Most therapeutic diets designed for CKD use a combination of moderately restricted protein, phosphorus, and sodium, with moderately elevated concentrations of omega-3 fatty acids and potassium (**TABLE 1**). This article explores the evidence behind these nutrient alterations.

PROTEIN

The goals behind lowering dietary protein concentration for dogs with CKD are to (1) lower the amount of nitrogenous waste produced during protein metabolism while (2) minimizing the amount of protein entering the glomerular filtrate of the kidneys.

Protein restriction as a dietary management strategy for CKD has become increasingly controversial. Some argue that, in an effort to retain muscle mass and increase diet palatability, dogs with kidney disease should not be placed on a low-protein diet, while others cite research suggesting that lower-protein diets, in combination with other nutrient modifications, reduce morbidity and prolong lifespan.[1-3]

Azotemia and Uremia

Creatinine and blood urea nitrogen are waste products of protein and muscle metabolism cleared through the kidneys. Elevated levels of these substances, along with other by-products of protein metabolism not routinely measured in blood samples, result in azotemia and clinical signs associated with uremia (e.g., nausea, inappetence, malaise). Nitrogenous wastes can also contribute to gastric ulceration, reduce red blood cell lifespan,[4] and exacerbate polyuria and polydipsia through creating excess solute load in the kidneys. Reduction of dietary protein intake may lower the concentration of these uremic toxins in dogs.

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TABLE 1 Nutrient Profile of Typical Therapeutic Diets Designed for CKD Management

NUTRIENT (G/1000 KCAL)	THERAPEUTIC CKD DIETS	AAFCO*	NRC RECOMMENDED ALLOWANCE FOR ADULT DOGS[9]
Protein	31–41	45	25
Fat	40–62	14	14
Phosphorus	0.5–0.8	1.0	0.75
Potassium	1.1–2.3	1.5	1.0
Sodium	0.4–1.2	0.2	0.2
EPA + DHA	0.4–1.2	n/a	0.1

**2017 American Association of Feed Control Officials (AAFCO) adult maintenance minimum.*
DHA, docosahexaenoic acid; EPA, eicosapentaenoic acid; n/a, not available; NRC, National Research Council.

Most studies evaluating protein restriction in dogs with CKD are based on the remnant kidney model, which induces renal failure through removal of large amounts of renal tissue or ligation of the renal blood supply instead of naturally occurring disease.[2,3] Moderate protein and phosphorus restriction (35 g and 750 mg per 1000 kcal, respectively) reduced morbidity and mortality in beagles with induced CKD while high protein intake (110 g/1000 kcal) worsened clinical signs and increased death rates. Low-protein diets containing 17 g protein/1000 kcal lowered plasma protein and albumin concentrations.[2,3] Unfortunately, it is difficult to determine the true impact of dietary protein in these studies, as the diets varied in caloric density, phosphorus and sodium content, and protein digestibility.

Proteinuria

The intact nephron hypothesis states that once a critically low mass of nephrons is reached, the remaining nephrons hypertrophy and signal the need for increased blood flow, glomerular filtration rate, and pressure. The chemical and electrical selective barriers of the glomeruli are then impaired, and increased levels of protein pass into the filtrate. Eventually the tubular reabsorption of protein is overwhelmed, and tubular cells begin to secrete inflammatory mediators that further damage the kidneys.[5]

Protein-restricted diets have been shown to reduce glomerular damage and urinary protein concentrations in dogs with hereditary nephritis.[6,7] The amount of protein restriction needed to mitigate renal damage secondary to proteinuria in dogs is unclear. For example, when dogs with nephritis ate diets containing 72 or 33 g of protein per 1000 kcal, mean urine protein:creatinine ratios were 4.7 and 1.8, respectively. However, dogs on the lower-protein diet also had reductions in albumin and body weight.[7] A more recent study evaluated a renal diet in combination with angiotensin-converting enzyme inhibitors in proteinuric dogs with CKD and saw no change in albumin or body condition score over a 5-month period.[8]

Careful consideration of dietary protein intake, including current protein intake, is required in dogs with proteinuria. For example, a proteinuric dog on a high-protein diet may have substantial improvement if dietary protein intake is reduced by 25% to 50%. Careful monitoring and assessment of other clinical signs are needed to balance protein losses and renal damage in these patients.

Dietary Protein Requirements

When assessing the protein content of a diet, it is important to remember that animals require amino acids rather than protein. Feeding high-quality protein sources with well-balanced ratios of essential amino acids can lower overall dietary protein content while preventing protein malnutrition. It is also important to note that all diets currently marketed for management of CKD in dogs exceed the amounts of protein recommended by the National Research Council (TABLE 1).[9]

More studies are needed to determine whether lowering dietary protein to the level of most renal diets is critical for managing CKD, or if alterations in phosphorus or omega-3 fatty acids are providing most of the improvement seen in research studies to date. Based on the evidence currently available, diets providing approximately 35 g/1000 kcal of high-quality protein, combined with other dietary modifications, improve and prolong the life of dogs with CKD[1,2]

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while providing adequate protein to support albumin production[1,3] and maintain body weight.[3]

Phosphorus

While there is still much to learn regarding the need and extent of protein restriction that is optimal for dogs with CKD, the need for phosphorus restriction is less controversial. As the kidneys retain phosphorus, the parathyroid gland is stimulated to release parathyroid hormone (PTH) to increase renal phosphorus excretion. However, PTH also stimulates the release of phosphorus from bone, which exacerbates hyperphosphatemia. In addition, calcitriol deficiency occurs secondary to decreased renal production of 1-α-hydroxylase and hyperphosphatemia. This ultimately leads to calcium deficiency and increased PTH production.

Studies have shown that reducing phosphorus in the diet reduces hyperphosphatemia and the sequela of renal secondary hyperparathyroidism.[10,11] The importance of phosphorus restriction was demonstrated in a study in which 24 dogs with induced kidney disease were fed a diet with 32% protein dry matter with and without phosphorus restriction over 2 years. Dogs on the high-phosphorus diet had a lower survival rate (33%) than the restricted-phosphorus group (75%).[11]

OTHER NUTRIENTS

Other nutrients to consider in dogs with renal disease are sodium, potassium, and omega-3 fatty acids. Sodium restriction has been recommended as a method to combat hypertension associated with CKD. However, studies demonstrating that sodium reduction improves hypertension are lacking in dogs.

Hypokalemia is a well-recognized consequence of renal disease in dogs, and most prescription renal diets have moderately high levels of potassium. Although it is more common in cases of acute kidney injury, some dogs with CKD can become hyperkalemic and may need a potassium-restricted homemade kidney diet formulated by a board-certified veterinary nutritionist.

Omega-3 fatty acids—notably eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)—competitively inhibit the formation of proinflammatory leukotrienes and prostaglandins by omega-6 fatty acids. Diets high in omega-3 fatty acids have been shown to reduce glomerular capillary pressure and proteinuria and to abate the decline of glomerular filtration rate in dogs with experimentally induced CKD.[12] A dosage of 40 mg/kg EPA combined with 25 mg/kg of DHA q24h has been recommended for dogs with CKD.[13] This equates to approximately 1 g of EPA and DHA per 1000 kcal of diet when fed at 1.4 times resting energy requirements for adult maintenance.

Some foods are supplemented with high concentrations of the omega-3 fatty acid alpha-linolenic acid (ALA). While this is an essential fatty acid for dogs, the conversion of ALA to EPA and DHA is poor and consideration of omega-3 fatty acid doses should not be based on ALA concentrations.

ADDITIONAL CONSIDERATIONS

Most veterinarians know that renal diets are a critical part of managing CKD; however, several factors can limit the use of these diets. Although renal diets are often highly palatable, as renal failure progresses, animals tend to become hyporexic. It is important to minimize food aversion as much as possible by avoiding renal diets when patients are nauseous or stressed in the hospital setting.

As a dog becomes more averse to eating, it may be necessary to try different flavors or brands or to have a homemade diet formulated by a nutritionist. If a patient is unable to meet its energy requirements, a feeding tube may be useful for supplying calories, medications, and/or fluids. Homemade diets can also be used for clients opposed to feeding conventional pet foods or if a patient has multiple diseases that cannot be managed with a commercial renal diet (e.g., a dog with CKD and pancreatitis requiring a low-fat diet). While homemade diets can be used for managing CKD in dogs, a board-certified veterinary nutritionist should formulate them.

SUMMARY

There is still much to learn about the nutritional needs of dogs with CKD. While the combination of moderately low protein, low phosphorus, moderate sodium, and moderately high potassium and EPA/DHA is proven to reduce uremia and extend the lifespan of dogs with CKD, controversy remains regarding the optimal dietary protein concentration for dogs with this disease. Dogs with early stages of CKD will likely tolerate less protein restriction than dogs with severe azotemia. In addition, hyporexia

induced by CKD may play a more important role in muscle wasting seen in patients eating a therapeutic renal diet. Until further evidence is available, dogs with azotemic or proteinuric CKD will benefit from a therapeutic diet designed for renal disease and every effort, including use of feeding tubes, should be made to maintain adequate caloric intake. TVP

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