The role of nutrition in the management of cats and dogs with renal disease

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ABSTRACT: Renal disease is a common condition seen in veterinary practice, which affects both cats and dogs. Nutrition plays an important role in helping to support these patients, and is proven to increase longevity when a specifically formulated renal diet is fed. Restriction of phosphorus, moderation of protein and calcium, and supplementation with antioxidants are all important factors to consider when selecting an appropriate diet. Palatability is another key element, particularly as these patients may be inappetant due to underlying metabolic processes associated with renal disease, and when and how the diet is introduced may affect acceptance.

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Introduction

Renal disease is a common yet serious condition seen in both cats and dogs in first-opinion veterinary practice. Some patients may be presented as emergencies and require immediate treatment (for example, in acute renal failure due to ethylene glycol ingestion), whereas others may not be presented until the disease is in a later stage (for example, an older patient with chronic renal failure when the owner had not picked up on the subtle clinical signs). Either way, the veterinary nurse plays an important role in the diagnosis, treatment and management of patients with renal disease and this article will look more in depth at the nutritional aspect of patient management.

Aetiology

The two most common renal conditions to affect cats and dogs are acute renal failure (ARF) and chronic renal failure (CRF). The International Renal Interest Society (IRIS) has developed staging systems for both ARF and CRF based on plasma creatinine levels, but this will not be covered here. Further information can be found at iris-kidney.com.

Differentiation between ARF and CRF can be made by considering the clinical history (recent surgery, exposure to toxins or administration of nephrotoxic drugs may suggest ARF), onset of clinical signs, laboratory analyses and size of the kidneys (small, irregular kidneys suggest CRF) (Allen, Polzi, & Adams, 2000).

Acute renal failure

In ARF there is a sudden and rapid deterioration of the ability of the kidneys to regulate water balance. Causes include renal conditions such as ischaemia and nephrotoxic injury and post-renal causes such as urinary obstruction or rupture, and may be either reversible or irreversible (Allen et al., 2000). Clinical signs include sudden-onset anorexia, vomiting, diarrhoea and oliguria/anuria.

Chronic renal failure

In CRF, there is a progressive and irreversible loss of kidney function, with functional nephrons being replaced by non-functional scar tissue. CRF may be congenital/familial or secondary to acquired disease, insult or injury (Elliott & Lefebvre, 2006). Clinical signs include polydipsia/polyuria, vomiting and anorexia.

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According to IDEXX (2015), 75% of kidney function is lost before blood creatinine levels show changes, but a new test is now available which measures SDMA (symmetric dimethylarginine), a methylated form of arginine which is excreted almost exclusively by the kidneys; this has been shown to indicate CRF much earlier (Yerramilli, Obare, Jewell, & Hall, 2014). CRF may also be referred to as chronic kidney disease (CKD), chronic renal insufficiency (CRI) or chronic renal disease (CRD). A study by Lulich, Osborne, O'Brien, and Polzin (1992) found that around 33% of cats over 12 years have some form of renal insufficiency and the propensity to develop the disease increases as the cat ages. However, a study of around 107,000 dogs found that the incidence of CRF is fairly rare, with less than 4% of dogs succumbing to it (O'Neill et al., 2013).

Disease pathology

Diseased kidneys have a mixture of functioning and non-functioning nephrons, with renal function being influenced by the number of functional nephrons remaining (Elliott & Lefebvre, 2006). Loss of functional nephrons leads to a decreased glomerular filtration rate (GFR), which in turn reduces the ability of the kidneys to filter and excrete waste products efficiently. Accumulation of nitrogenous waste products such as urea, creatinine and ammonia leads to azotaemia and uraemia, which can affect the gastrointestinal tract, cardiopulmonary, metabolic and endocrine systems as well as fluid, electrolyte and acid–base balance (Elliott & Lefebvre, 2006). Reduced renal function also effects the production of calcitriol and the kidney's ability to degrade parathyroid hormone. The resulting changes to calcium and phosphorus metabolism may lead to hyperphosphatemia, osteodystrophy and deposition of calcium in soft tissues (Case, Daristotle, Hayek, & Raasch, 2011).

Principles of nutritional management

The aim when treating renal disease is to stabilise the patient, alleviate clinical signs and limit further deterioration. When presented with an animal with renal disease, the priority is to administer any necessary emergency treatments and rectify any fluid and electrolyte imbalances (**Figure 1**). Once the patient is stable, medical and nutritional treatment can be instigated. Any complicating factors will need to be resolved; for example, by treating concurrent conditions such as urinary tract infections.

Nutrition is an important factor to consider in renal disease. Several studies have shown that patients fed a "renal" diet live longer than those who remain on a "standard" diet (Bartges, 2012; Elliott, Rawlings, Markwell, & Barber, 2000; Plantinga, Everts, Kastelein, & Beynen, 2005).

There are several key factors to consider when formulating a diet for cats and dogs with renal disease.

Phosphorus

During the progression of renal disease, GFR deteriorates, which leads to a decreased ability to excrete phosphorus. The resulting hyperphosphataemia stimulates the release of parathyroid hormone (PTH) in order for the body to maintain a calcium to phosphorus ratio of 1:1. As a result, bone demineralisation causes bones to become weak and pliable.

Hyperphosphataemia can be managed by limiting dietary phosphorus intake to help normalise serum phosphorus levels and help prevent secondary hyperparathyroidism (Elliott & Lefebvre, 2006). A study by Elliott et al. (2000) of cats with naturally occurring renal failure concluded that severe restriction of phosphorus can double life expectancy after diagnosis of CRF. Phosphate binders, such as calcium carbonate, can be used in addition to further reduce phosphorus uptake, although these are only effective if the patient is

Figure 1. A dog receiving treatment to rectify fluid and electrolyte imbalances © Sarah Collins

eating, because they bind with phosphate in the food. The current consensus is that restriction of phosphorus is a key factor in slowing the progression of renal disease.

The recommendations for phosphorus levels in diets for patients with renal disease are: 0.3–0.6% dry matter basis (DMB) for cats and 0.2–0.5% DMB for dogs (Forrester, Adams, & Allen, 2010).

Protein

Dietary protein is an important macronutrient, as it provides the body with amino acids, the building blocks for many structural components of the body, as well as enzymes, antibodies and hormones. Some amino acids are essential and must be provided in the diet as the body cannot synthesise them, these include arginine, methionine and taurine (the latter in cats only). It is therefore important to provide enough protein to prevent deficiency. Protein also enhances palatability, as well as providing energy.

In patients with renal disease, damage to the glomeruli, tubules and/or interstitium causes protein to be lost via the urine, resulting in proteinuria and hypoproteinaemia. Azotaemia and uraemia occur due to the accumulation of metabolites derived from dietary protein, with high levels exacerbating azotaemia (Elliott & Lefebvre, 2006).

Protein moderation can improve the clinical status of a uraemic dog; however, protein restriction has not been shown to slow the rate of disease progression in either dogs (Elliott & Lefebvre, 2006) or cats (Queau, 2013). In dogs with renal disease, protein intake should be adjusted to minimise azotaemia while at the same time ensuring sufficient protein intake to prevent protein malnutrition (Elliott & Lefebvre, 2006).

Unlike in dogs, high urine protein creatinine (UPC) ratios are an uncommon finding in cats with CRF; however, proteinuria does worsen as the number of functioning nephrons decreases (Elliott & Elliott, 2008). It is unclear whether protein restriction in the diet of cats with CRF stages II and III will limit proteinuria; however, it is suggested that there may be some potential renal haemodynamic modifying effects in cases with a UPC > 1.0 (Elliott & Elliott, 2008).

For patients with renal disease, a moderately restricted yet high-quality protein diet is recommended to help limit the amount of nitrogenous waste products produced and therefore the workload on the kidneys.

Fat

Fat increases the energy density of the diet, allowing the patient to obtain its nutritional requirements from a smaller volume of food, which minimises gastric distention, thereby reducing the risk of nausea and vomiting (Elliott & Elliott, 2008). Providing energy in this form also spares protein from being used for energy. Fat also improves palatability, which is another important factor in managing patients with renal disease whose appetite may be affected by the underlying disease processes.

Elliott and Lefebvre (2006) suggest that long-chain omega-3 fatty acids (such as EPA and DHA found in fish oil) reduce inflammation and preserve renal function, and so diets rich in these may help to slow the progression of the disease. However, omega-6 fatty acids cause a detrimental increase in GFR.

Palatability

Circulating toxins and a reduction in olfaction in senior patients (**Figure 2**) can cause a disinterest in food and the risk of food aversion in animals with CRF. Highly palatable diets in a variety of textures and aromas therefore help to maintain appetite in these patients.

Sodium

Providing a low sodium chloride diet is thought to ease the workload on the kidneys; however, a study by Buranakarl, Mathur, and Brown (2004) indicated that too low sodium may result in hypokalaemic nephropathy and also reduce GFR. Most renal diets on the market have a moderately reduced sodium level.

Antioxidants

With oxidative stress more common in patients with CRF, the addition of antioxidants can help to neutralise free-radical damage, as well as helping support end-stage patients against secondary myocardial disease (Boaz et al., 2000). Examples of antioxidants include vitamin E, lutein, carotenoids and vitamin C.

Water

Water is often not mentioned when discussing nutrition as animals are provided with this separately to the diet. However, hydration is particularly important in patients with renal disease, as they have reduced urine-concentrating ability, which, combined with reduced water intake due to inappetance makes them more susceptible to dehydration. Patients with renal disease should be encouraged to take in more water, either by encouraging spontaneous water intake or including it in the diet. Methods include water fountains or slow dripping taps for cats, or adding water to the diet, whether that is wet or dry.

Wet or dry?

In terms of nutrient profile, there is little difference between wet and dry renal diets. Wet diets have the added benefit of a higher water content (± 80% versus ± 8% in dry diets), which, if the patient is eating well, means that their dietary water intake will be increased. Wet diets do have a lower energy content gram for gram compared with dry diets, as this extra water content dilutes the calories, meaning that the patient has to eat more volume to meet its nutritional needs compared to dry. The main factor will be patient (and possibly owner) preference, and as long as the patient consumes the recommended amount of food and has a good water intake, then there is no particular preference of one over the other.

Introducing a renal diet

It is important to remember *not* to start a patient on a renal diet in a hospital situation. Although it is tempting to get the patient eating the diet before it goes home, to help with owner compliance, it is actually more likely that once the patient gets home it will no longer eat the food. This is because the animal may associate the food either with the nausea and depression experienced during its hospitalisation, or with the stress of being in the hospital environment (or both).

Ideally, a highly palatable, highly digestible diet (such as a gastrointestinal diet) should be fed during hospitalisation. However, it is better that the patient eats something than nothing at all, so in the inappetant patient it is a case of trying different foods little and often.

If a patient has been anorexic for longer than 3 days (including the period before it was admitted), or has not eaten at least 80% of its resting energy requirement per day for the previous 3 days, then assisted feeding must be implemented. Naso-oesophageal tubes (**Figure 3**) are easy to place, do not require general anaesthesia,

Figure 2. Older patients may have a reduced sense of smell
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Figure 3. A cat with a naso-oesophageal feeding tube in place
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and can be left *in situ* for up to a week. A liquid diet should be used when feeding via a naso-oesophageal tube, with a specially formulated diet for patients with renal disease the diet of choice.

On discharge, the owner should be fully informed of the benefits of a renal diet and be given a selection of wet and dry products to take home and try. It is also important to tell the owner that the animal is likely to "go off" its food at some point, and for no particular reason. This is because the renal disease process affects the animal's sense of taste and smell, and they may suddenly refuse a diet they have been happily eating for several weeks/months. Encourage the owner to keep a selection of different varieties of the diet at home in case this should occur, remembering that because an animal refused a particular variety in the past does not necessarily mean that it will refuse it again.

Summary of the nutritional recommendations for cats and dogs with renal disease

- Feeding a specially formulated renal diet increases longevity
- Such diets contain restricted phosphorus, moderate protein and good levels of fat
- Additional nutrients which are beneficial to patients with renal disease include antioxidants and omega-3 fatty acids
- Actively encourage the patient to take in more water
- Never feed a renal diet in a hospital environment, as it is likely to cause a food aversion
- Feed whichever variant of renal diet the animal prefers
- Educate owners on the importance of feeding a renal diet and the likelihood that the animal will refuse it at some point in the future so that they can be prepared for this

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