



# Long-Term (Chronic) Kidney Disease and Kidney Failure

## Basics

### OVERVIEW

- Long-term kidney disease is known as “chronic kidney disease” or CKD; it is defined as kidney disease that has been present for more than 3 months
- Kidney disease encompasses functional or structural abnormalities in one or both kidneys
- Kidney disease is recognized by decreased kidney function (defined as the pet having an excess level of urea and other nitrogenous waste products in the blood [known as “uremia” or “azotemia”]) or evidence of kidney damage as detected by blood or urine tests, imaging studies (such as abdominal x-rays [radiographs] or ultrasound examination), or kidney biopsy
- “Chronic kidney disease” is a broad term that includes less advanced forms of kidney disease and cases previously described as “renal insufficiency” (where the kidney’s function was inadequate) and as “renal failure” (where kidney function is no longer able to remove waste products from the body and maintain the normal water and salt content of the body) ‘renal’ refers to the kidneys
- Pets with CKD are categorized into stages based on progression of disease
- The kidney filters the blood and removes various waste products from the body as it produces urine; the kidney is involved in maintaining the normal fluid volume of the body; each kidney is composed of thousands of nephrons (the functional units of the kidney, each consisting of the glomerulus [a tuft of blood capillaries—the “blood filter”] and a series of tubes and ducts, through which the filtered fluid flows, as urine is produced)

### GENETICS

- Inherited in the following breeds (mode of inheritance, known or suspected, indicated in parentheses):
  - ♦ Abyssinian cats (autosomal dominant with incomplete penetrance)
  - ♦ Persian cats (autosomal dominant)
  - ♦ Bull terrier (autosomal dominant)
  - ♦ Cairn terrier (autosomal recessive)
  - ♦ German shepherd dog (autosomal dominant)
  - ♦ Samoyed (X-linked dominant)
  - ♦ English cocker spaniel (autosomal recessive)
- Abnormal development of the kidneys (known as “renal dysplasia”)—mode of inheritance not determined; breeds include the shih tzu, Lhasa apso, golden retriever, Norwegian elkhound, chow chow, standard poodle, soft-coated Wheaten terrier, Alaskan malamute, miniature schnauzer, Dutch kooiker; also seen sporadically in many other breeds

## **SIGNALMENT/DESCRIPTION OF PET**

### **Species**

- Dogs
- Cats

### **Breed Predilections**

- All breeds of dogs and cats are affected

### **Mean Age and Range**

- Pets of any age can be affected; likelihood of chronic kidney disease is higher with increasing age
- Mean age at diagnosis is approximately 7 years in dogs and 9 years in cats

## **SIGNS/OBSERVED CHANGES IN THE PET**

- Clinical signs are related to the stage of chronic kidney disease and the presence or absence of complications (such as protein in the urine [known as proteinuria] or high blood pressure [known as “hypertension”])
- Dogs and cats with Stage 1 or 2 CKD may not have any clinical signs
- Clinical signs typically become apparent when the dog or cat is in Stage 3 or 4
- A pet with stable CKD may no longer be able to offset the decreased kidney function, resulting in a medical crisis (so-called “uremic crisis”)
- Increased urination (known as “polyuria”) and increased thirst (known as “polydipsia”)—less frequent in cats than dogs; increased urination may be detected by less color to the urine (that is, the urine appears more clear) and the litter box may be more wet or have more urine clumps than previously observed
- Lack of appetite (known as “anorexia”)
- Sluggishness (lethargy)
- Weakness
- Vomiting
- Weight loss
- Urinating at night (known as “nocturia”)
- Constipation
- Diarrhea
- Degeneration of the retina (back part of the eye) due to high blood pressure (known as “hypertensive retinopathy”) and resulting sudden (acute) blindness
- Seizures or coma—late
- Cats may have excessive drooling (known as “ptyalism”) and muscle weakness with abnormal position of the head and neck, in which the chin is located near the chest (known as “neck ventroflexion”), because of a muscle disorder caused by low levels of potassium in the blood (known as “hypokalemic myopathy”)
- Small, irregular kidneys or enlarged kidneys secondary to polycystic kidney disease (disease characterized by multiple fluid-filled sacs or cysts in the kidney) or lymphoma (a type of cancer that develops from lymphoid tissue, including lymphocytes, a type of white blood cell formed in lymphatic tissues throughout the body)
- Dehydration
- Extreme weight loss with muscle wasting (known as “cachexia”)
- Pale gums and moist tissues of the body
- Ulceration of the mouth
- Abnormal odor to the mouth/breath due to excessive levels of urea and other nitrogenous waste products in the blood (uremia or azotemia; abnormal odor known as “uremic breath odor”)
- Constipation
- Bone disorder caused by long-term (chronic) kidney failure leading to abnormal levels of calcium and phosphorus in the blood and resulting loss of mineralization of the bones (known as “renal osteodystrophy”); signs include bone pain, especially involving the bones of the skull
- Reduced body temperature

## **CAUSES**

- Usually, the origin of chronic kidney disease remains unknown due to late diagnosis
- Causes include familial (runs in certain families or lines of animals) and congenital (present at birth) kidney

disease; exposure to products that are toxic to the kidneys; increased levels of calcium in the blood (known as “hypercalcemia”); low levels of potassium in the blood (known as “hypokalemia,” condition known as “hypokalemic nephropathy”); diseases of the glomeruli (plural of glomerulus) of the kidney (known as “glomerulopathies”); amyloidosis (a group of conditions in which insoluble proteins [known as “amyloid”] are deposited outside the cells in the kidney, compromising normal function); infection/inflammation of the kidney (known as “pyelonephritis”); polycystic kidney disease (multiple fluid-filled sacs or cysts in the kidney); kidney stones (known as “nephroliths”); long-term (chronic) urinary blockage or obstruction; drugs; cancer that develops from lymphoid tissue, including lymphocytes, a type of white blood cell formed in lymphatic tissues throughout the body (lymphoma); leptospirosis (following sudden [acute] kidney failure), and feline infectious peritonitis (FIP) in cats

## RISK FACTORS

- Age, protein in the urine (proteinuria), increased levels of calcium in the blood (hypercalcemia), low levels of potassium in the blood (hypokalemia) in cats, high blood pressure (known as “hypertension”), urinary tract infection, diabetes mellitus (“sugar diabetes”)

## Treatment

### HEALTH CARE

- Pets with chronic kidney disease that are able to offset the loss of function of the kidneys may be managed as outpatients
- Pets in uremic crisis (vomiting, dehydrated, “sick”) should be managed as inpatients—correct fluid and electrolyte deficits with intravenous fluid therapy (such as administration of lactated Ringer's solution); correct dehydration over 8 hours to prevent additional kidney injury from poor or diminished blood flow (known as “ischemia”)
- Subcutaneous fluid therapy (daily or every other day) may benefit pets (especially cats) with moderate-to-severe CKD
- Hemodialysis (procedure to remove waste products from the blood) and kidney transplantation are available at selected veterinary referral hospitals

### ACTIVITY

- Unrestricted

### DIET

- Food designed for dogs and cats with chronic kidney disease, such as Hill's Prescription Diet k/d, have been shown to delay the onset of uremic crisis (signs of vomiting, dehydration, being “sick”) and extend survival for pets with Stage 2–4 disease
- Foods containing reduced protein with n-3 fatty acids may be beneficial for pets in Stage 1 CKD with protein in their urine (proteinuria)
- Important components of foods for pets with CKD include: reduced protein, phosphorus, sodium and net acid content and supplementation of n-3 fatty acids and antioxidants
- Free access to fresh water at all times

### SURGERY

- Avoid low blood pressure (known as “hypotension”) during anesthesia, to prevent additional kidney injury
- Kidney transplants have been performed successfully in cats with advanced kidney disease

## Medications

- Medications presented in this section are intended to provide general information about possible treatment. The treatment for a particular condition may evolve as medical advances are made; therefore, the medications should not be considered as all inclusive

### UREMIC CRISIS

- Signs of vomiting, dehydration, and being “sick”
- Famotidine to minimize nausea and vomiting

- Medications to control vomiting (known as “antiemetics”)—maropitant or ondansetron to minimize nausea and vomiting
- Potassium chloride in intravenous fluids or potassium gluconate administered by mouth, as needed to correct low levels of potassium in the blood (hypokalemia)
- Sodium bicarbonate in intravenous fluids to correct metabolic acidosis (a condition in which levels of acid are increased in the blood)

## COMPENSATED CHRONIC KIDNEY DISEASE

- In which pet is able to offset loss of kidney function
- Famotidine to minimize inflammation of the stomach caused by excess levels of urea and other nitrogenous waste products in the blood (known as “uremia”; condition known as “uremic gastritis”) and possible nausea and lack of appetite
- Medications to control vomiting (antiemetics), such as maropitant, may be needed for vomiting and lack of appetite due to nausea
- Potassium gluconate administered by mouth, as needed to correct low levels of potassium in the blood (hypokalemia)
- Intestinal phosphate binders (such as aluminum carbonate, administered by mouth with meals), as needed to correct increased levels of phosphate in the blood (known as “hyperphosphatemia”)
- Calcitriol
- Darbepoietin (the hormone that stimulates the bone marrow to produce red blood cells) Anemia of Chronic Kidney Disease
- Amlodipine or angiotensin-converting enzyme (ACE) inhibitors (such as enalapril or benazepril), as needed to treat high blood pressure (hypertension); amlodipine is more effective than ACE inhibitors in cats with chronic kidney disease-induced hypertension; if pet does not respond to one drug, consider combination of amlodipine and ACE inhibitor with frequent monitoring of blood pressure
- Angiotensin-converting enzyme (ACE) inhibitors (such as enalapril or benazepril) to treat protein in the urine (proteinuria)

## OTHER DRUGS

- Metoclopramide can be used in addition to H<sub>2</sub>-blockers (such as famotidine) to treat vomiting caused by excessive level of urea and other nitrogenous waste products in the blood (uremia or azotemia)
- H<sub>2</sub>-blockers (ranitidine or cimetidine) may be used instead of famotidine for inflammation of the stomach caused by excess level of urea and other nitrogenous waste products in the blood (condition known as “uremic gastritis”)

## Follow-Up Care

### PATIENT MONITORING

- Dogs and cats with chronic kidney disease should be monitored at regular intervals, depending on therapy and severity of disease; initially weekly for pets receiving calcitriol or erythropoietin; re-evaluate pets with CKD Stages 3 and 4 every 1–3 months
- Monitor with bloodwork (serum chemistry profile and packed cell volume at minimum); “packed cell volume” or PCV is a means of measuring the percentage volume of red blood cells as compared to the fluid volume of blood
- Pets with protein in the urine (proteinuria) should be monitored with a serum creatinine concentration and urine protein:creatinine (U:PC) ratio (at minimum) every 3–4 months

### PREVENTIONS AND AVOIDANCE

- Do not breed pets with familial (runs in certain families or lines of animals) kidney disease
- Include urinalysis and serum creatinine testing in annual examinations for older dogs and cats to identify kidney disease as early as possible

### POSSIBLE COMPLICATIONS

- High blood pressure (hypertension) Excess levels of urea and other nitrogenous waste products in the blood (uremia or azotemia)

- Low red blood cell count (known as “anemia”)
- Secondary urinary tract infection
- Urinary tract stones in the kidneys (known as “nephrolithiasis”) or the ureters (known as “ureterolithiasis”); the ureters are the tubes from the kidneys to the bladder

### **EXPECTED COURSE AND PROGNOSIS**

- Short-term—depends on severity
- Long-term—guarded to poor prognosis in dogs (chronic kidney disease tends to progress over months to years in dogs); poor to good prognosis in cats (CKD does not progress in some cats)

### **Key Points**

- In dogs and many cats, chronic kidney disease typically progresses to terminal, CKD and kidney failure over months to years
- In some cats, CKD may not be progressive
- Higher levels of protein in the urine (proteinuria) have been associated with shorter survival times; treatment for proteinuria may increase survival time
- Carefully consider use of pets in breeding programs due to the genetic basis of familial (runs in certain families or lines of animals) kidney diseases; do not breed pets with familial kidney disease

# Notes

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