

Kidney Failure in Dogs and Cats: Where to Begin

Wendy Brooks, DVM, DABVP

Date Published: 01/01/2001

Date Reviewed/Revised: 09/23/2020

Whether the pet is brought in sick or the condition is discovered incidentally on routine lab work, the diagnosis of kidney failure can come as a shock. It does not help that the term "kidney failure" sounds dramatic and evokes images of on-going sickness, expensive hospitalization, and doom. In fact, kidney failure simply means that the kidneys are not able to do at least some of the tasks they are supposed to do as well as they are supposed to do them. Many clinicians prefer the term renal insufficiency or insufficient kidneys so as not to conjure up disturbing images when the patient is in a treatable state. Renal insufficiency is one of those conditions where early intervention can make a big difference and normal life quality can be maintained for months or even years.

From a practical standpoint, the terms chronic renal failure, renal insufficiency, chronic kidney failure, and kidney insufficiency all mean the same thing.

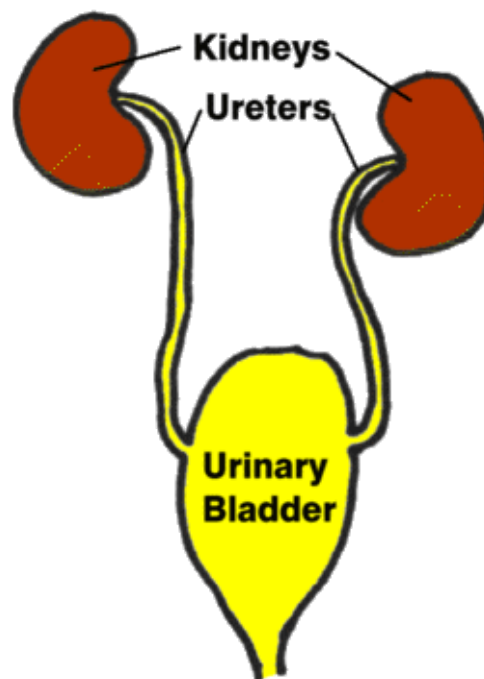
Our purpose is to review the terminology of chronic renal failure so that you will understand what your veterinarian is monitoring and why. We will also review the stages of kidney failure as defined by the International Renal Interest Society (IRIS) so that you can know where your pet stands and how fast or slow your pet's condition is progressing. Obviously, the goal is to keep the pet feeling completely normal and slow or arrest the disease progression.

What our Kidneys Do/What Insufficient Kidneys Cannot Do

First, it is important to know what normal kidneys do. Kidney function goes far beyond simply making urine. Kidneys are made of millions of processing units

Additional Resources

- [Fluid Therapy in Pets](#)
- [Renal Failure Dietary Therapy](#)
- [Kidney Dialysis: Is it for your Pet?](#)
- [Kidney Transplants for Cats and Dogs](#)
- [Kidney Failure \(Chronic\) Links](#)
- [Calcium Phosphorus Balance in Dogs and Cats](#)
- [Renal Anemia, or Inadequate Red Blood Cells](#)
- [Glomerulonephritis in Dogs and Cats](#)
- [High Blood Pressure in our Pets](#)



Graphic by MarVistaVet

called nephrons. These tiny little units are responsible for separating the chemicals you want to keep in your body from the chemicals you need to dispose of. The chemicals to remove are dissolved in water and make up the fluid we all know as urine. So here is what your kidneys do for you and for your pet, what they become unable to do in renal insufficiency, and some of the parameters your veterinarian will want to track.

Water Conservation

Hydration of the body depends not only on water consumed but on water removed. In times of dehydration, the kidney must respond by conserving water. This means that all the materials that the body needs to get rid still need to be removed but the kidney needs to do so using the smallest amount of water possible. Similarly, if you drink too much water, the kidney needs to efficiently remove it to prevent dilution of the blood stream. A pet with insufficient kidney function will not be able to make a concentrated urine and will need to drink extra water to process the body's waste chemicals. For this reason, excessive water consumption is an important early warning sign and should always be investigated.

When we analyze a urine sample, one of the most important parameters is the specific gravity. It is a measure of how concentrated a urine sample is. Water has a specific gravity of 1.000. A dilute urine sample has a specific gravity less than that at 1.020 (often less than 1.010). A concentrated urine sample would have a specific gravity over 1.030 or 1.040. A failing kidney, by definition, cannot make a concentrated urine and the patient must drink excessively to get enough water to get rid of the day's toxic load.

Toxin Removal

The kidneys remove our metabolic wastes for us. If there is inadequate circulation going through the kidneys or if there are not enough functioning nephrons to handle the waste load, toxins will build up. When the toxins build up and exceed the normal range, a condition called azotemia occurs. If the toxins build up to a level where the patient actually feels sick, they have a condition called uremia. If we can keep our azotemic patient below the uremia level, they will feel pretty normal and have good life quality.

The most important marker of uremia is called creatinine. Creatinine is a by-product of muscle break-down and is always in small amounts in the bloodstream. The kidney removes it continuously unless there is a kidney function problem. A newer parameter called SDMA (symmetrical dimethylarginine) becomes abnormal much earlier than creatinine does and is becoming more commonly tracked. We are able to stage a patient's kidney disease based on creatinine blood level and SDMA level (see the staging section below). Another marker is the BUN, which stands for blood urea nitrogen. This parameter is similar to creatinine but is influenced by dietary protein as well as kidney function. These three markers are central to determining the severity of a kidney problem.

Calcium/Phosphorus Balance

The balance between calcium and phosphorus in the blood is really important. Too much of one or the other will lead to crystals forming in body tissues and the bones to the extent they may actually become rubbery. The kidney plays an important role in this balance and when kidney function is lost, phosphorus levels begin to rise. Therapy for insufficient kidney function requires monitoring of phosphorus levels and the use of diet and medications to keep phosphorus levels in a reasonable range.

Sodium/Potassium Balance

The kidney plays a major role in controlling electrolyte balance as well. In particular, conserving potassium is an important aspect. Insufficient kidneys lose their ability to conserve potassium and potassium levels begin to drop, leading to weakness. Potassium supplements are commonly needed in treatment of kidney failure.

Blood Pressure Regulation

Blood pressure sensors in the kidney help regulate blood pressure in the body. When these are damaged, [hypertension](#) (high blood pressure) can result and can damage the kidney even more. Blood pressure is commonly measured in kidney failure patients.

Protein Conservation

There are a lot of important proteins circulating in the bloodstream and it is crucial that they are not lost in urine. The nephron possesses a filtration system that keeps protein in while removing harmful wastes. If this filtration system is damaged ([glomerular disease](#)) then a much more severe form of kidney failure results. Screening for this damage is an important aspect of staging kidney failure and test called a urine protein:creatinine ratio is often included in the testing profile to assess this condition.

Red Blood Cell Production

The kidney produces a hormone called erythropoietin. This hormone tells the bone marrow to make more red blood cells. In the absence of this hormone, a non-responsive anemia occurs and can get so bad that a transfusion is necessary. Erythropoietin can be given by injection to treat this problem but there are some potential pitfalls in doing this as will be discussed in a later article. Hematocrit and packed cell volume (PCV) are measures of red blood cell volume commonly monitored in kidney patients.

pH Balance

Metabolic processes require a narrow pH range for efficiency. The kidney also regulates this balance and if it cannot, intervention, usually in the form of fluid therapy, is necessary.

We are born with two kidneys and a huge excess of nephrons. As we live our lives, nephrons die off either as a consequence of disease or simply through wear and tear. When we are down to less than 1/3 of one kidney's worth of nephrons (in other words we have lost 5/6 of our total nephrons), test results become notably abnormal and it becomes important to make lifestyle changes. How big these changes are depends on how far things have gone out of whack when the problem is discovered. Early detection of poor kidney function is one of the main reasons laboratory screening tests are recommended.

Urine Specific Gravity

One of the kidney's most important jobs is to conserve the body's water. The kidney must get rid of the toxic by-products created by the body's metabolism, but it will want to do so in the least amount of water possible. A healthy kidney can make a concentrated urine. When we analyze a urine sample, one of the most important parameters is the specific gravity. This parameter is a measure of how concentrated a urine sample is. Water has a specific gravity of 1.000. A dilute urine sample has a specific gravity less than 1.020 (often less than 1.010). A concentrated urine sample would have a specific gravity over 1.030 or 1.040. A failing kidney by definition cannot make a concentrated urine and the patient must drink excessively to get enough water to excrete the day's toxic load.

Blood Urea Nitrogen (BUN)

This is a protein metabolite excreted by the kidney (it is one of the toxins we are concerned about, though it may be more of a marker for other toxins that are less easily measured). In a normal animal, the BUN is 25 mg/dl or so. Often at the time of diagnosis, BUN is well over 150, 200, or even 300. We'd like to keep the BUN no more than 60-80 mg/dl. BUN is influenced by dietary protein (including the patient's own blood that has bled into the intestine), something which becomes important in certain situations.

Creatinine

This is another protein metabolite (though this one is less dependent on dietary protein intake than is BUN). A normal creatinine is less than 1.4 mg/dl, certainly less than 2.0. Patients begin to feel sick when values meet or exceed 5.0 so we try to keep the value at 4.5 or less. BUN and creatinine will be tracked (as will several other parameters) over time and in response to different treatments.

Phosphorus

The calcium/phosphorus balance becomes deranged in kidney failure due to hormone changes as well as the inability of the failing kidney to remove phosphorus. If calcium and phosphorus levels become too high, the body's soft tissues will develop mineralized deposits, which are inflammatory, uncomfortable, and often cause intestinal bleeding. The bones will weaken as well, in some cases becoming rubbery. Keeping phosphorus levels in the low normal range has been associated with improved survival.

Potassium

The failing kidney is unable to conserve potassium efficiently and the pet may need supplementation. Signs of hypokalemia (the scientific name for low blood potassium) include weakness, especially drooping of the head and neck.

Packed Cell Volume / Hematocrit

The PCV or hematocrit is a measure of red blood cell amount. More literally, it is the percentage of the blood made up by red blood cells. The hormone that stimulates the production of red blood cells is made by the kidney. The failing kidney does not make this hormone in normal amounts, leading to reduced red blood cells, which in turn lead to weakness, poor appetite, and overall poor life quality.

Blood Pressure

Blood pressure is not something measured off a laboratory result sheet but it is important to monitor it in kidney patients as hypertension (high blood pressure) tends to develop in kidney failure. Specific medications may be needed to manage this problem should it arise.

Urinary Protein

One function of the kidney is to prevent loss of the body's proteins, in particular the blood proteins. The kidney's filtering mechanism that enables it to remove toxins is designed to leave larger molecules (such as proteins) inside the body where they belong. But if holes develop in the filter, protein can be lost. If this complication cannot be controlled, survival time is dramatically shortened.

If you are a hands-on kind of pet owner, you can request copies of monitoring lab work so you can make a chart of these parameters. In this way you can see how the disease is progressing or improving and what the problem areas are.

IRIS Staging

The [International Renal Interest Society \(IRIS\)](#) has posed the following staging criteria for pets with Stage I being pets with evidence of kidney disease but no evidence of a change in actual kidney function all the way up to Stage IV where pets actually begin to feel sick from their disease. These stages are based on measured blood creatinine levels. It is worth noting that MANY patients are well past IRIS Stage IV at the time of diagnosis with creatinine of 8, 9, 12 mg/dl or even higher. IRIS does not have criteria beyond the relatively low creatinine value of 5.0 so it is best to think of the IRIS system as a way to intervene in the earlier stages of renal insufficiency. For patients in more dire initial states, the goal is to drive their toxin levels down to where the IRIS system becomes relevant.

Table 1: Creatinine Values for Each IRIS Stage, listed in US, International and SDMA Units

	Units	Stage I (pre-failure)	Stage II (mild failure)	Stage III (moderate failure)	Stage IV (severe failure)
Dog	mg/dl	<1.4	<1.4-2.8	<2.9-5.0	>5.0
	µmol/l	<125	<125-250	<251-440	>440
	SDMA µg/dl	<18	<18-35	<36-54	>54
Cat	mg/dl	<1.6	<1.6-2.8	<2.9-5.0	>5.0
	µmol/l	<140	<140-250	<251-440	>440
	SDMA µg/dl	<18	<18-25	<26-38	>38

Sub-staging of kidney disease involves screening for urine protein loss and measuring blood pressure. A urine protein:creatinine ratio is performed on a urine sample and the protein amount is classified as either non-proteinuric, borderline proteinuric, or proteinuric. Blood pressure is checked and the patient is classified as normotensive (normal), borderline hypertensive, hypertensive, or severely hypertensive. The ultimate classification for the patient will reflect all of these things ("Stage 3, non-proteinuria, normotensive" would be an example). Further testing and monitoring is determined based on what the actual parameters are. For more details on these substages, see the articles on glomerular disease, and hypertension.

A Note on Pyelonephritis

Pyelonephritis is another name for kidney inflammation and usually means kidney infection. Patients get kidney infections when a bladder infection goes unnoticed or incompletely treated long enough and the bacteria go up the ureters into the kidney where they set up shop and cause damage and pain. This form of kidney failure has the most potential for to reverse or partially reverse, so it is important to culture the urine for it early. Urinalysis is frequently unable to detect infection in this situation as the patient drinks so much water that the visible markers of infection are diluted out and cannot be found. The infection also will produce a significant amount of urinary protein so the patient will be sub-staged incorrectly if infection is not ruled out.

The bottom line is that there is a wide range of what is involved when a patient has kidney failure or insufficient kidneys. Each patient will have a different stage and a different constellation of issues to contend with. Some will need only a diet change and some will need on-going fluid therapy at home or hospitalization. Prognosis depends on all the factors involved. Your veterinarian will let you know what your particular pet needs and will be watching many different lab tests to keep control of your pet's condition.

Related resources

- [Renal Anemia, or Inadequate Red Blood Cells, in Dogs and Cats - February 4, 2021](#) 
- [Kidney Failure \(Chronic\) Links for Additional Information - October 7, 2020](#) 
- [Fluid Therapy in Pets - June 16, 2020](#) 
- [Glomerulonephritis in Dogs and Cats - October 29, 2019](#) 
- [Calcium Phosphorus Balance in Dogs and Cats - June 5, 2019](#) 
- [Kidney Transplants for Cats and Dogs - June 1, 2019](#) 
- [Renal Failure Dietary Therapy - May 29, 2019](#) 
- [Kidney Dialysis: Is it for your Pet? - August 1, 2018](#) 
- [High Blood Pressure in our Pets - July 19, 2018](#) 

URL: <https://veterinarypartner.vin.com/doc/?id=4951452&pid=19239>

The content of this site is owned by Veterinary Information Network (VIN®), and its reproduction and distribution may only be done with VIN®'s express permission.

The information contained here is for general purposes only and is not a substitute for advice from your veterinarian. Any reliance you place on such information is strictly at your own risk.

Links to non-VIN websites do not imply a recommendation or endorsement by VIN® of the views or content contained within those sites.