

# HOLISTIC HEALTH CARE FOR CAVALIERS

## Part XIII

### *The Kidney – Function, Failure and Therapy Part One*

By: Larry A. Bernstein, VMD  
©2014 Larry A. Bernstein, VMD



Last chapter, we examined the liver, one of the most intricate organs in the body, besides of course, the brain.

#### The Kidney

We see many cases of renal disease (“renal” is a medical term for the kidney) in veterinary practice, and in this chapter, we will be discussing:

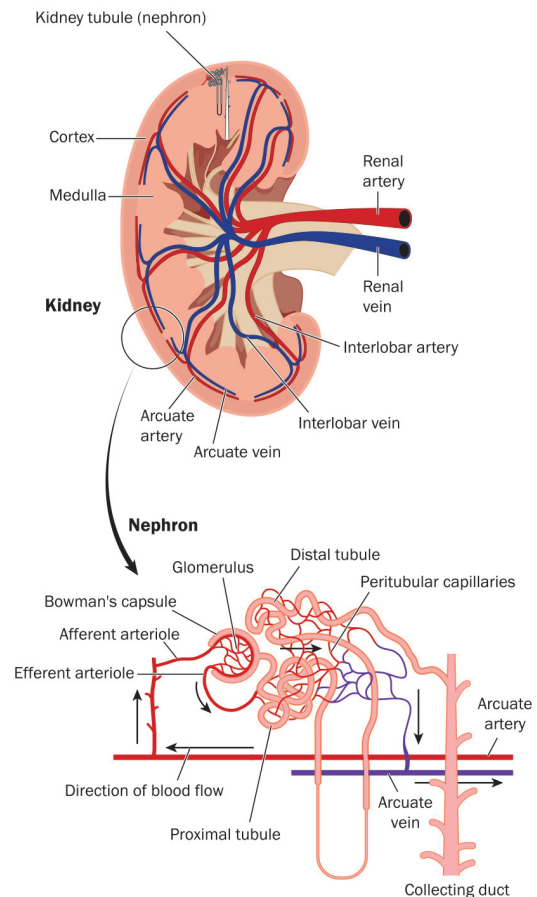
1. The anatomical structure of the kidney
2. The functions of the kidney both on macroscopic and microscopic (physiologic) scales
3. Things that can go wrong with the kidney(s) from an acute and chronic standpoint
4. Things that can be done to AVOID kidney issues
5. Things we can do to treat kidney issues

Most everyone is aware that most mammals have two kidneys and they are the main organs responsible for excreting by-products of protein metabolism, especially nitrogen based compounds like creatinine and urea. They do this through the production of urine which is stored in the bladder and then voided. What many people do not realize is that these valuable organs are the water reclamation plants of the body. To understand this in more detail, we need to understand renal physiology, such as what urine is, how it is produced, and how many things can affect it.

The mammalian kidney is composed of an outer and inner portion, the renal pelvis and the renal cortex. And, while that’s great to know, it really does not come into play that much except when we are dealing with kidney stones or “uroliths.” Kidney stones are relatively rare in dogs and cats, whereas bladder stones can be very common. The renal pelvis, the outer meaty portion of the kidney, is composed of millions of individual process units called nephrons. So, to understand kidney function as it pertains to most aspects of kidney disease, we need to understand the nephron.

I like to think of the nephron as a microscopic water treatment plant. Dirty water (or plasma with toxic products whether administered or part of the normal components of metabolism) enters the nephron at the glomerulus, traverses multiple tubules and then empties into the collecting duct as urine. The urine is collected, flows down the ureter to the bladder and out

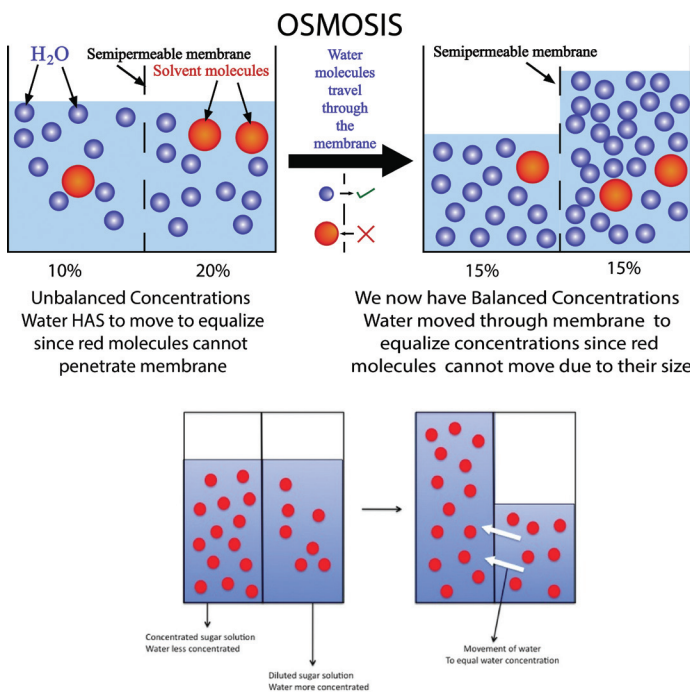
the bladder via the urethra. There are many, many factors that come into play during the journey from the glomerulus to the collecting ducts and that will be our initial focus to better understand the physiology and importance of the nephron as the fundamental building block of the kidney.



Before we can go any further, we also need to understand a process called osmosis. Osmosis is the tendency of two solutions, separated by a porous or permeable membrane, to want to equalize its concentration or specific gravity on either side of that barrier. The concept of specific gravity and osmosis is of critical importance to our discussion, if renal physiology and its

real life implications are to make any sense whatsoever.

Osmosis is the physical need for two solutions of different concentrations on opposite sides of a water permeable membrane to equalize their concentrations. This is why, if you put a potato in a bowl of salt or sugar water, it will start to shrivel up over time, because the salt or sugar concentration outside the potato is higher than the concentration inside the potato so some of the water leaves the potato to try to equalize the concentration because the salt (or sugar if a sugar solution is used) cannot penetrate that membrane.



Remember concentration is relative – it is a percentage and there is now less water in the potato because the salt concentration has increased in the potato. Since some of the water has moved out of the potato to the bowl, the salt concentration in the bowl is lower (same amount of salt but more water equals less concentration). This does not only have to be salt it can be anything that creates a differential in the concentration or specific gravity on the two sides of the membrane. This is a natural physical force, like gravity and is the basis of how the kidney functions. Really try to think of it as two sides with different pressure or volume or concentration trying to equalize. Two bodies of water that are connected try to reach the same level via water moving from one side to the other. Two rooms with different pressure try to equalize if you open the door between them. The same thing happens in nature within two tissues or two solutions with different concentrations that try to equalize. This same force (osmotic attraction or pressure) is why fluid stays in the blood. The proteins (albumin and globulin) in the blood have to create an osmotic pressure to “hold” liquid in the blood.

Fluid passes into the nephron at the glomerulus or the placenta like connection to the bloodstream at a concentration or specific gravity of 1.015 (for reference the specific gravity of pure water is 1.000). Since normal urine has a concentration

of 1.020-1.060, you can see that something happens to pull water out of the tubules so it can be recycled into the body and at the same time, raise the concentration or specific gravity of the urine. Essentially, this is the main function of the nephron. There are many other functions related to electrolytes and blood pressure and acid base balance but for our purposes, this water recycling is the main issue. It takes fluid at the normal specific gravity of the body (1.015 or “filtration level”) and does its best to reclaim as much water as possible. Since this is against the osmotic pressure, the nephron has to have energetic “pumps” to achieve this goal. It is active not passive.

When the nephron is not functioning properly, the urine does not get concentrated and passes out of the nephron at the filtration level (specific gravity 1.015) or close to it. There are even situations, such as diabetes, where there is so much sugar in the bloodstream (a blood glucose over 155) that some of that sugar spills into the nephron and acts as a water “magnet” to hold water in the tubule and this osmotic pull can be strong enough to draw from the body into the urine. In this kind of situation, even though the animal is drinking a lot and urinating a lot, it’s actually dehydrating itself and that is why animals and people with highly elevated blood sugar often end up in the hospital from dehydration because the sugar in the renal tubules is actually pulling extra water through this process therefore dehydrating the patient. Since the tendency to balance fluid concentration through osmosis is the natural order of things, the nephron requires a complex energetic mechanism to overcome this tendency and concentrate the urine.

Now consider the fact that there are millions of nephrons in each kidney, like little water treatment and recycling plants, and you should be able to see why they play such an important role in the body. Not only are they reclaiming water but the water that is finally excreted as urine contains many toxins and metabolic by-products. They also serve to help maintain blood pressure and balance electrolytes like sodium, potassium, phosphorus, and chloride.

On a side note, and as an example, the white matter on top of bird droppings is actually composed of urine crystals. The bird’s kidneys are so efficient that they pull almost all the water out of the nephron and the remaining urine is excreted as dry matter.

When an animal goes into “kidney failure” or “kidney compromise” a number of things can happen that interfere with this recycling process. The blood pressure may be too low because of heart disease, medication, dehydration from vomiting, or other reasons. This low blood pressure decreases the amount of fluid flowing into the nephron so kidney output is diminished. Let us say the blood pressure is fine and the inflow is normal but there is often a problem in the kidney itself. Nephritis (inflammation or infection of the kidney), cystic kidneys, renal amyloidosis (starch like deposits replacing kidney tissue), underdeveloped kidneys, fibrosis, medications, toxins, repeated incidents or insults, and even actual injuries can affect the number of functional nephrons and create a problem. We could spend an entire chapter reviewing any one of these issues, but the goal here is to give you an overview of how the kidneys work and how they fail.

Our second goal is to address some of the specific

## HOLISTIC HEALTH CARE *continued*

problems, discuss some of the things we can do to avoid those problems, and introduce some of the things we can do to treat the kidney if issues do arise.

Obviously, if the blood pressure is too low (dehydration, loss of blood, shock, or low cardiac output), then there may not be enough fluid at the input end of the nephron. When this happens the kidney produces hormones that tell the heart to work harder or the capillaries to contract to try to raise the blood pressure, all in an effort to compensate and to increase production. In some cases, this can cause high blood pressure or blood pressure spikes.

For our purposes, the two primary by-products of protein metabolism are creatinine and blood urea nitrogen (BUN) and these are excreted, almost completely, in the urine. If the blood pressure is too low or the kidneys themselves are damaged or inefficient or there is too much being produced in the body for the kidney to handle, the level of these by-products rises in the blood and is often the main indication of renal compromise. This does not necessarily mean that the animal is in chronic kidney failure because this can happen in a dehydrated animal, perhaps a dog that has been vomiting and had diarrhea for the last day or two.

We have often seen animals that started out having a gastrointestinal “bug” develop severe kidney disease because they became dehydrated and developed what was, initially, a prerenal Azotemia. Azotemia is an old medical term for an increase in the creatinine and BUN and prerenal means the problem started because of an issue outside the kidney (like dehydration) rather than an immediate kidney issue. If left untreated the kidney gets damaged and can go into failure (or often recovers but has lost some of its reserve nephrons).

Another potential problem might be an overproduction of creatinine or nitrogen that makes up the BUN so that the kidneys cannot handle the load placed upon them. This is the rationale behind treating kidney issues with a low protein diet in chronic kidney animals so that, theoretically, the kidneys have to process less by-products. We will discuss this in more detail later but there is an entire group of veterinarians and nephrologists that think the damage done by too low of a protein diet can be more costly than a higher but complete or well-balanced protein diet.

Before we tackle problems of the kidney itself, there is also the possibility that there is some sort of blockage either via a tumor or a kidney stone or stone in the ureter that creates a back flow of urine and a back pressure forcing the shutdown of the kidney. This can be seen with bladder stones or urethral stones in a dog, but is much more common in a “blocked” cat with the inability to urinate because of sand or a plug at the penis so the bladder just fills up until the kidney shuts down. We do see this in male dogs also, but it is not as common.

There are many diseases of the kidney itself, as we previously alluded to which include, chronic strain through subclinical dehydration, infection (pyelonephritis), inflammation, cysts, scarring, poisoning, effects of renal toxic drugs, and trauma.


Many drugs can be toxic to the kidneys and one must be especially careful with Ibuprofen (Advil) as I have seen

complete kidney failure with a single dose. Ethylene glycol (antifreeze) is also very dangerous, as it sometimes leaks or is spilled and tastes sweet to an animal.

There are also a number of antibiotics (often the aminoglycosides like gentamicin) that can be extremely renal toxic so it is important to have a good idea of renal function and to maintain excellent hydration while on these types of antibiotics. Anesthesia can be hard on the kidneys because of the drug load plus the low blood pressure that usually comes with anesthesia, and we always recommend fluid therapy during and after any prolonged anesthesia, even with dentistry.

Unfortunately, (or fortunately depending on how you look at it) one does not see elevated creatinine or blood urea nitrogen (BUN) until over three quarters of kidney function is lost in the chronic case. That means that the kidney has a tremendous reserve and, by the time we are physically starting to see symptoms of chronic renal compromise, we are often in a very advanced state of pathology. I am not talking about a dog who has been throwing up for forty-eight hours and has not been on fluids, because that is more of an acute pre-renal situation that often responds quickly to fluid therapy or even appears to resolve on its own, although invisible damage can occur as we stated earlier. The acute situation can be absolutely life-threatening in its own right, but I am referring to an older dog whose appetite has been diminished, who is drinking loads of water, urinating large amounts frequently, and can even start having bad breath with a “urine like” smell. Once we reach that stage, we have already lost the functional value of at least one and a half of the kidneys.

Unlike the liver, kidneys do not regenerate. Kidneys can heal to some degree, they can become more efficient, and mildly damaged processing units (nephrons) can come online but the kidney does not generate new replacement nephrons. In humans, there are kidney transplants (done in animals but on a very limited basis) and there is dialysis. IV dialysis has not yet been effective in dogs and cats – there is a fragility to the red blood cells that makes them much more liable to rupture if taken out of the blood stream and run through tubes and a machine, plus there is the cost factor even if physically possible.

All of which brings us to the point of the first half of this chapter – what do we do to maintain kidney health and how do we treat when things go wrong? I may have used this quote before, but it is worth repeating. In ancient China, a famous general, Sun Tzu, wrote a book called the *Art of War* and it is still the definitive work on battle tactics thousands of years later. To paraphrase, he said that the BEST way to win a battle was to NOT BE THERE. It makes sense and I use it in my medical practice. So the BEST way to treat kidney failure is to NOT GET IT. There are many things we can do to help treat these patients but there are also many things we can and should do to help keep the kidneys stay strong and functional and less vulnerable. This will be the subject of our next chapter. 

Larry A. Bernstein, VMD, CVA, CVH, PHom.  
Natural Holistic Health Care  
[www.naturalholistic.com](http://www.naturalholistic.com)  
[www.facebook.com/Naturalholistic](https://www.facebook.com/Naturalholistic)

