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### Urinalysis

Examination of the urine can give almost as much useful information about the health of your Beardie as the CBC and Biochemistry profile, and should be part of each wellness visit to the vet as well as when your dog has problems relating to urination. These can include an increase or decrease in urination, difficulty urinating, blood in the urine, a foul or unusual smell to the urine or an odd coloration. If you suspect a urinary tract infection it is best if the vet collects urine directly from the bladder via a needle inserted through the abdominal wall near the belly button. This is called cystocentesis. Urine that passes from the body via the normal route or via catheter is likely to pick up the bacteria normally present on the dog's hair or in the prepuce or vulva, or which have been introduced into the bladder via the catheter. However, if the vet accidentally punctures a blood vessel during cystocentesis there may be blood in the sample which wasn't present in the urine. Urine should be analyzed within 20 to 30 minutes after it leaves the body, or the composition will start to change. For this reason it is better if the urine can be collected at your vet's office.

#### Physical Characteristics

Color Normally the urine is yellow to amber becoming darker as the urine is more concentrated. Red urine indicates the presence of blood (hematuria). In this case, the urine is usually cloudy and clears when spun in a centrifuge. If the discoloration occurs mostly at the start of urination it indicates a problem in the urethra or the genital tract, if it occurs mostly at the end of urination the source is probably the bladder.

Other abnormal colorants would include bilirubin – the pigment from bile - that makes urine dark yellow to brown with a yellow foam. Steroids, some antibiotics and other drugs can increase levels of bilirubin, while ascorbic acid (vitamin C) can reduce it. Bilirubin levels in urine may precede the increase in blood causing jaundice. Hemoglobin (blood pigment) and myoglobin (muscle pigment) will turn urine a reddish brown. Porphyrins – substances that help form various substances in the body but especially hemoglobin – give acid urine a pink fluorescence in ultraviolet light. Drugs and vitamins can also alter the color of the urine.

Transparency Urine is usually clear when voided, but becomes cloudy if left to stand, as the salts precipitate and form crystals. Cloudy urine doesn't necessarily indicate pathology, but should be examined microscopically. Besides crystals, cells, blood, mucus, bacteria, casts and sperm may cause urine to appear cloudy.

Odor Bacterial enzymes called ureases cause ammonia to form in urine, and the longer it has been retained or allowed to sit the stronger the smell will be. If urine smells of acetone (nail polish remover) it suggests ketosis – where the body uses fat rather than glucose for energy. Certain drugs also impart characteristic odors to urine.

Volume Volume is usually not measured as part of the urinalysis. The 24-hour production may be measured if the rare condition of diabetes insipidus (where the dog cannot concentrate its urine) or psychogenic polydipsia (in which the dog continues to drink in excess of its body's needs) are suspected. If your Beardie seems to pee a lot make note of how much he is drinking and vice versa. This is useful information for your vet. Possible causes of increased urine volume in addition to those mentioned are acute or chronic kidney disease, diabetes mellitus (pancreas doesn't produce enough insulin), liver failure, Cushing's disease, increased blood calcium, or



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pyometra. Reduced urine volume is also associated with acute kidney disease, dehydration, shock, terminal chronic kidney disease or urinary tract obstruction.

Urine Concentration This is usually measured as specific gravity. However, this can vary greatly in normal animals depending on their hydration status. A dog with a specific gravity greater than 1.030 is presumed to be able to concentrate urine adequately. If there is a concern about how well the dog can concentrate urine, the first urine of the day after being deprived of water overnight is most informative.

### Chemical Characteristics

Protein The amount of protein present in urine should be evaluated with regard to the specific gravity. The less concentrated the urine the more significant the presence of protein – proteinuria. If there is significant protein in the urine then the source must be determined. Blood can indicate hemorrhage into the urinary tract, while white cells alone indicate inflammation of the urinary tract, although not the location of the problem. Very high values of protein - in the absence of blood or cellular sediment with or without casts - is typically found in kidney disease primarily affecting the glomeruli – the parts of the kidney where blood filtration takes place . If the kidney disease affects the tubules where active and passive exchange of water and electrolytes occurs protein levels will be low to moderate. Most kidney disease affects both glomeruli and tubules though, and protein levels will be relatively high. Transitory mild increases in proteinuria associated with temporary changes in glomerular permeability can occur in fever, heart disease, seizures, shock or muscular exertion. Non transient proteinuria is usually divided into prerenal - hemoglobin, myoglobin and other low molecular weight proteins can be excreted if their concentration in the blood is high; renal or postrenal - due to urinary tract infections or hemorrhage. Recently, urinalysis has begun to include measurement of microalbumin in the urine. This is considered elevated if the level is greater than 2.5 mg/dl. This test is used as an early detection tool for detecting kidney disease before significant damage to the kidneys has already occurred as it will have when levels of albumin in the urine are detectable by standard tests.

Glucose If blood levels of glucose exceed the capacity of the tubules to resorb it, then glucose appears in the urine. This usually happens when blood glucose is greater than 180 mg/dl. Problems with the renal tubules themselves rarely cause a problem, certainly in Beardies. Diabetes mellitus is the primary rule-out for glucosuria.

Ketones Ketonuria is present before ketones are detectable in the blood. It indicates the excessive breakdown of fat and/or deficient carbohydrate metabolism. It can result from diabetes mellitus, starvation or low carbohydrate high fat diets.

Bilirubin If bile flow is obstructed bilirubin is released into the blood, and from there into the urine. In dogs it will be detected in urine prior to detection in the blood. This is important as it will allow earlier detection of gall bladder and/or liver disease. However, it is non specific, and a positive result may also be due to the breakdown of red cells in the blood vessels or from hemoglobin in the urine.

Occult Blood Positive tests indicate blood, hemoglobin or myoglobin in the urine. If it is blood, red cells will be found in the sediment, and some of these will have broken releasing hemoglobin into the urine. It usually



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indicates a problem in the lower urinary or genital tract unless blood is collected by cystocentesis in which case it is probably an artifact. If hemoglobin is present in the urine it will not clear on centrifugation, erythrocytes will usually not be present, and plasma will also be reddish in color. It usually indicates an intravascular hemolytic anemia. Myoglobin produces brown rather than red urine, that doesn't clear on centrifugation, but plasma will be clear. There will be no evidence of anemia. Its presence indicates muscle disease.

Urobilinogen can only be measured in fresh urine as it degenerates quickly. It is formed in the gut from bilirubin so that it can be resorbed and used to make more bile acids. Its presence in the urine indicates that the bile duct is not completely blocked. Levels vary dramatically though and absence does not prove the bile duct is blocked. Levels increase in hemolytic diseases and also if there is reduced functional liver mass.

pH pH is a measure of the acidity or alkalinity of the urine. The healthy kidneys maintain optimal blood pH by secreting hydrogen or bicarbonate ions into the urine as necessary. It can only be measured in absolutely fresh urine as urine loses carbon dioxide if left to stand making it more alkaline. High protein diets make urine more acid. Cystitis and other causes of urine retention make urine more alkaline as urea is converted to ammonia. The pH of the urine determines which types of crystals and uroliths (stones) may form. Certain drugs can affect urine pH, while urine pH can affect the efficacy of certain drugs to treat urinary tract disease.

### **Sediment Examination**

The quantity of sediment in urine depends on how concentrated it is, so values must be evaluated taking the urine's specific gravity into consideration. The method of collection will also influence the type and amount of sediment present due to contamination outside the urinary system, or bleeding during cystocentesis.

Epithelial cells are of three types. Squamous epithelial cells slough off from the urethra, vagina and prepuce and are of no diagnostic significance. Transitional epithelial cells come from the upper urethra, bladder, ureters and the pelvis of the kidney – the part where the filtered urine collects before passing via the ureters to the bladder. They are only of diagnostic significance in cases of transitional cell cancers. Renal epithelial cells come from the kidney tubules and are often hard to distinguish from the slightly smaller white cells.

Red Blood Cells More than 4 or 5 RBCs (erythrocytes) per high power field indicates hemorrhage due either to trauma or inflammation of the urinary tract. In concentrated urine they can have an irregular outline, and in dilute urine they may lyse. Certain yeasts can also resemble RBCs.

White Blood Cells More than 5 to 8 WBCs (leukocytes) per high power field indicates pus in the urine that may or may not be septic. They are usually seen with bacteria in the urine, but bacteria can occur without pus. WBCs break down as urine is left to stand, and also in dilute and alkaline urine.

Casts These elongated structures form on a skeleton of mucoprotein produced in the distal tubules of the kidneys when the urine is acidic – alkaline urine tends to dissolve them. Anything present in the distal tubules at the time of formation will be embedded in the cast. While they indicate changes in the tubules, they can be seen in healthy individuals, and do not measure the severity of kidney disease. They are discharged intermittently, so their absence also does not rule out kidney disease. Hyaline casts are hard to detect, and are



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composed solely of mucoprotein. Granular casts are the most common type and contain plasma proteins and any tubular debris. They are similar to epithelial casts, although these also contain epithelial cells sloughed from the lining of the tubules. Waxy casts lack granular content and are wide and often have broken ends. They are degenerating cellular or granular casts and indicate chronic tubular damage. Fatty casts contain globules of fat from degenerating tubular epithelial cells. Erythrocyte casts indicate hemorrhage or inflammation in the kidneys and leukocyte casts kidney inflammation.

Mucus indicates irritation of the urethra, or genital secretion. Fat may be seen and is of no pathological significance. Sperm may also be present.

Bacteria These can be divided into rods (longer in one dimension) or cocci (basically round) and can occur singly or in chains. They are best identified using stains. As a general rule, there must be 30,000 bacteria/ml present before they can be visualized microscopically. Urine is sterile only until mid urethra, so bacteria seen on free catch or catheterized urine specimens are of questionable diagnostic significance. While it may be acceptable veterinary medicine to prescribe antibiotics which are generally efficacious to dogs with a first or rare urinary tract infection, culture and sensitivity to antibiotics in vitro must be determined for dogs with recurrent or persistent infections and the urine must be obtained via cystocentesis to avoid contamination.

Parasites Those parasitic structures that may be seen in urine include *Dioctophyma renale* – the giant kidney worm, which dogs can get from ingesting infected raw fish or frogs; *Capillaria plica* eggs – dog bladder worm, dogs become infected by eating infected earthworms; microfilaria of *Dirofilaria immitis*, the dog heartworm. While budding yeasts and segmented hyphae may be seen in urine, fungi are purely contaminant artifacts.

Crystals Precipitation will depend upon the pH of the urine and the solubility and concentration of the crystalloid. Crystals are identified by their shape, color and whether they dissolve in acids or alkaline solutions. Only when crystals become large enough to form stones or uroliths do they usually have clinical significance. The following crystals may indicate potential pathology.

Ammonium biurate can occur with portal venous systemic shunts and other liver diseases.

Tyrosine may be associated with liver disease.

Cystine is caused by altered protein metabolism, usually congenital cystinuria - seen most often in Chihuahua, Dalmatians, Dachshunds, Tibetan spaniels, Landseer Newfoundlands, bulldogs, and basset hounds.

Sulfonamide These crystals are seen in dogs that have been treated excessively with sulfa antibiotics.

Oxalates These may be normal, but are also seen in dogs with ethylene glycol (antifreeze) and certain plant toxicities.

Hippuric acid These may also occur with ethylene glycol ingestion.

Struvite or triple phosphate These crystals form in alkaline urine. While struvite calculi are the most common type of urinary stone, crystals are usually present without stones.

### Uroliths

The formation of stones in the urinary tract is not usually diagnosed by urinalysis. However, they usually present with straining to urinate, blood in the urine prompting the owner to bring the dog for urinalysis, others may be found on routine health check having no presenting signs.



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Calcium Oxalate These are found most often in miniature schnauzers, Lhasa apsos and Yorkshire terriers. Risk factors include excessive dietary calcium, protein, sodium and vitamin D all of which produce increased calcium in the urine. Dietary oxalates (found in chocolate and peanuts) as well as ascorbic acid increase oxalate secretion. High concentrations of glucocorticoids whether natural or given as drugs and the diuretic furosemide also increase calcium excretion. Crystals of calcium oxalate may be seen in the urine sediment. Special diets do not dissolve these stones. They can either be flushed back into the bladder and removed surgically or broken up with shock wave lithotripsy. Even if blood calcium remains normal, most affected dogs form new stones within three years.

Calcium Phosphate These are also called apatite stones. They form more often in the kidneys than in the bladder. Pure apatite stones are usually associated with primary hyperparathyroidism kidney tubular acidosis or excessive dietary calcium and phosphorus. However, some apatite is usually found in both struvite and calcium oxalate stones. Crystals of some forms of calcium phosphate may be seen on urinalysis. Primary diseases must be treated, but surgery or lithotripsy may be needed to remove obstructive stones. Canned diets that reduce calcium excretion and restrict phosphorus are used to prevent further stones forming too.

Cystine Cystine, a non-essential amino acid, is normally present in low concentrations in plasma and having been filtered out by the glomeruli is resorbed by the proximal tubules of the kidneys. In dogs with cystinuria not only is the cystine not resorbed it may be actively secreted. Cystine dissolves in alkaline urine but forms crystals and stones in acid urine. Not all dogs with cystinuria form stones. Stones can be dissolved by adding 2-mercaptopyrionyl glycine (2-MPG) which compounds with cystine in a more soluble form. Urine alkalinizers and diets which reduce urinary excretion of cystine while diluting urine concentration are used to manage these uroliths.

Struvite These uroliths are composed of magnesium ammonium phosphate hexahydrate (MAP) aka struvite. The formation of these stones requires supersaturation of the urine with MAP and it is usually associated with urinary tract infections caused by urease producing bacteria – especially *Staphylococcus*, *Proteus* and *Ureaplasma*. Urine has to be alkaline. Elevated urea in the urine from high protein diets or the breakdown of amino acids for other reasons also contributes to MAP formation. Anatomic and metabolic abnormalities that predispose dogs to urinary tract infections are another risk factor. While any breed may be affected miniature schnauzers, dachshunds, poodles, Scottish terriers, beagles, Pekingese, and corgis are at particular risk. Struvite stones can be dissolved using a special calculolytic diet. This is to be used only for the time it takes to dissolve the stones and should not be used long term. It must also not be used in a dog that requires more protein than is present in the diet. Any UTI should be treated with appropriate antibiotics. Urinary acidifiers and diligence in early detection and treatment of urinary tract infections will help prevent recurrence.

Urate Uric acid, sodium urate or ammonium urate uroliths occur in dogs with impaired metabolism or uric acid and ammonia, they are frequently seen in dogs with portosystemic shunts. Dalmatians, bulldogs, miniature schnauzers and Yorkshire terriers are at the greatest risk. Urine is acid and urate crystals will be seen. Crystals can be dissolved by feeding a low purine, urine alkalinizing diet. Initially, urinalysis should be repeated every one to two months to detect recurrence as early as possible. If urate crystals are not detected this can increase to every 2-4 months if the dog is clear for 6 months.



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Xanthine These uroliths occur if the dog is receiving allopurinol (used to treat uric acid uroliths as well as Leishmania and trypanosomiasis) and fails to convert xanthine to uric acid. Some cases are congenital. Xanthine crystals are distinctive and can be seen in urine sediment. Stones must be removed surgically. Allopurinol should be discontinued and the dog put on a low purine diet.

For a substance that we consider a waste product and rather unpleasant urine can certainly give us a lot of information about the health of our dogs. With luck everything will be normal on your Beardie's urinalysis, if not I hope the above overview will help you understand any problems there may be so that you can better discuss your Beardie's health with your veterinarian.

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