

Specific Gravity

Interpretive Summary

Description: The specific gravity is a measure of the urine's concentration. Specific gravity varies in normal dogs and cats, and, when well hydrated, any specific gravity may be normal.

Hyposthenuria (SG<1.008)

Common Causes

- Resistance to ADH (nephrogenic diabetes insipidus)
 - Cushing's disease
 - Pyometra
 - Pyelonephritis
 - Hypercalcemia
- Increased water consumption (primary polydipsia)
 - Hyperthyroidism
 - Hypercalcemia
- Lack of medullary concentrating ability
 - Addison's disease
- Medications or fluid therapy

Uncommon Causes

- Primary or central diabetes insipidus (lack of ADH)
- Resistance to ADH (nephrogenic diabetes insipidus)
 - Hypokalemia
 - Liver failure
- Increased water consumption (primary polydipsia)
 - Hypokalemia
 - Liver failure
 - Psychogenic
- Lack of medullary concentrating ability
 - Liver failure

Related Findings

- Resistance to ADH (nephrogenic diabetes insipidus)
 - Cushing's disease
 - Increased ALP
 - Adrenal function tests consistent with Cushing's disease
 - Pyometra
 - Increased white blood cell count
 - Fluid-filled uterus on abdominal radiographs/ultrasound
 - Pyelonephritis
 - Pyuria, hematuria, bacteriuria, casts
 - Increased BUN and creatinine
 - Leukocytosis
 - Positive urine culture
 - Dilated renal pelvices on abdominal ultrasound
 - Hypercalcemia
 - Increased total and ionized calcium

- Alterations in PTH, PTHrp, BUN, creatinine depending on underlying cause (see Calcium Interpretive Summary)
- Increased water consumption (primary polydipsia)
 - Hyperthyroidism
 - Increased T4 and fT4
 - Increased ALT
 - Hypercalcemia
 - Increased total and ionized calcium
 - Alterations in PTH, PTHrp, BUN, creatinine depending on underlying cause (see Calcium Interpretive Summary)
- Lack of medullary concentrating ability
 - Addison's disease
 - Often have increased potassium and decreased sodium
 - Abnormal ACTH stimulation test
 - Decreased albumin, cholesterol, and glucose

Isosthenuria (SG 1.008-1.012)

Common Causes

- Renal disease
- Diabetes mellitus
- Resistance to ADH (nephrogenic diabetes insipidus)
 - Cushing's disease
 - Pyometra
 - Pyelonephritis
 - Hypercalcemia
- Increased water consumption (primary polydipsia)
 - Hyperthyroidism
 - Hypercalcemia
- Lack of medullary concentrating ability
 - Addison's disease
- Medications or fluid therapy

Uncommon Causes

- Lack of ADH (anti-diuretic hormone, primary or central diabetes insipidus)- complete or partial
- Resistance to ADH (nephrogenic diabetes insipidus)
 - Hypokalemia
 - Liver failure
- Increased water consumption (primary polydipsia)
 - Hypokalemia
 - Liver failure
 - Psychogenic
- Lack of medullary concentrating ability
 - Liver failure

Related Findings

- Renal disease
 - Increased BUN, creatinine, phosphorus (may be normal with early renal disease)
 - Increased or decreased potassium
 - Nonregenerative anemia
 - Increased blood pressure
 - Positive urine culture (pyelonephritis)
 - Increased urine protein/creatinine ratio (protein losing nephropathy)
 - Abnormal kidneys on abdominal ultrasound
 - Serology or PCR positive for Leptospirosis, Lyme disease, or rickettsial disease

- Diabetes mellitus
 - Increased blood glucose, glucosuria
 - Increased cholesterol
 - Ketonuria severe cases
 - Increased fructosamine
- Resistance to ADH (nephrogenic diabetes insipidus)
 - Cushing's disease
 - Increased ALP
 - Adrenal function tests consistent with Cushing's disease
 - Pyometra
 - Increased white blood cell count
 - Fluid-filled uterus on abdominal radiographs/ultrasound
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 - Alterations in PTH, PTHrp, BUN, creatinine depending on underlying cause (see Calcium Interpretive Summary)
- Lack of medullary concentrating ability
 - Addison's disease
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 - Decreased albumin, cholesterol, and glucose

Hypersthenuria

Common Causes

- Dehydration

Related Findings

- Dehydration
 - Elevated hematocrit and total protein
 - Elevated sodium and chloride

Additional Information

Diagnostic Methodology

- Specific gravity is the ratio of a solution's weight to the weight of an equal volume of water and is a reflection of solute concentration and osmolality.

- Refractive index is an estimate of urine specific gravity
 - Determined by refractometry
 - Highly dependent on three factors
 - Solute concentration
 - Chemical composition of solute
 - Temperature
- Use of dipsticks for measurement of urine specific gravity of veterinary species is not recommended (unreliable)
- Specific gravity of randomly collected urine may indicate adequate concentrating ability by the renal tubules
 - Canine: >1.030
 - Feline: >1.035
 - Neonates do not have efficient urine concentrating ability
- The amount of other substrates in the urine should be interpreted with consideration of the specific gravity and vice versa
 - Significant glucosuria and proteinuria can falsely increase the urine specific gravity
- Interpretation of specific gravity requires knowledge of the patient's hydration status, diet, and medications
 - Diuretics, glucocorticoids, anticonvulsants, excessive thyroid hormone supplementation, fluid therapy, low-protein diet, or administration of radiographic contrast media may lower the SG. Test SG prior to starting therapy.
- Specific gravity <1.020 is often associated with polyuria (usually > 50 ml/kg body weight/24 hours)
- A specific gravity above the interval for isosthenuria, but less than a specific gravity for adequate concentrating ability, with concurrent azotemia, indicates inadequate renal tubular function.
- Specific gravity indicative of adequate renal tubule concentrating ability does not rule out the presence of diseases associated with polyuria-polydipsia including hepatic insufficiency, Cushing's disease, hyperthyroidism, diabetes mellitus.

References

- Ettinger SJ, Feldman EC, eds. *Textbook of Veterinary Internal Medicine*, 6th ed. St. Louis, MO: Elsevier Saunders; 2005.
- Latimer KS, Mahaffey EA, Prasse KW, eds. *Duncan and Prasse's Veterinary Laboratory Medicine: Clinical Pathology*, 4th ed. Ames, IA: Blackwell; 2003.
- Osborne CA, Stevens JB *Urinalysis: A Clinical Guide to Compassionate Patient Care*. Shawnee Mission, KS: Bayer Corporation; 1999.
- Stockham SL, Scott MA. *Fundamentals of Veterinary Clinical Pathology*, 2nd ed. Ames, IA: Blackwell; 2008.
- Willard MD, Tvedten H, eds. *Small Animal Clinical Diagnosis by Laboratory Methods*, 4th ed. St. Louis, MO: Saunders; 2004.

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