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
  - 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

**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
  o Determined by refractometry
  o 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
  o Canine: >1.030
  o Feline: >1.035
  o 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
  o 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
  o 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


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