

# Hypercalcemia

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## FOR MORE

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- ▶ Basophilia
- ▶ Decreased Total Thyroxine
- ▶ Eosinophilia
- ▶ Epistaxis
- ▶ Hypercholesterolemia
- ▶ Hyperkalemia
- ▶ Hypoalbuminemia
- ▶ Hypcholesterolemia
- ▶ Hypoglycemia
- ▶ Hypokalemia
- ▶ Hypophosphatemia
- ▶ Increased & Decreased Blood Urea Nitrogen
- ▶ Increased & Decreased Creatinine
- ▶ Increased Total Thyroxine
- ▶ Neutropenia
- ▶ Panting
- ▶ Regurgitation
- ▶ Tremors

See page 71 for references.

Most (≈99%) calcium in the body is stored in the bones. The remaining calcium is stored in extracellular fluid and is composed of 3 parts: protein-bound, complexed, and unbound/ionized (active form) calcium. As a result, protein concentrations can affect total calcium; however, formulas to correct for albumin concentration should not be used, as they are often inaccurate. Any increase in total calcium should be rechecked and an ionized calcium test performed if calcium is still increased. Some conditions can cause hypercalcemia via multiple mechanisms.

Following are differential diagnoses for patients presented with hypercalcemia.\*

- ▶ Artifactual hypercalcemia
  - Severe lipemia or icterus
- ▶ Physiologic hypercalcemia (mild hypercalcemia due to bone growth in young animals)
- ▶ Increased protein binding
  - Hemoconcentration (ie, hyperalbuminemia)
  - Hyperproteinemia (ie, paraproteinemia)
- ▶ Malignant hypercalcemia (most common cause in dogs)
  - Lymphoma
  - Anal sac apocrine gland adenocarcinoma
  - Other carcinomas (eg, mammary, thyroid, lung, clitoral), particularly if metastatic to bone
  - Thymoma
  - Multiple myeloma
  - Osteosarcoma or other primary bone tumor
  - Melanoma
- ▶ Hypoadrenocorticism
- ▶ Idiopathic hypercalcemia (most common cause in cats)
- ▶ Primary hyperparathyroidism
- ▶ Chronic kidney disease (less commonly, acute kidney injury)
- ▶ Raisin/grape toxicity
- ▶ Hypervitaminosis D
  - Cholecalciferol toxicity
  - Calcipotriene/calcipotriol (eg, antipsoriasis creams) ingestion
  - Calcitriol or vitamin D overdose (eg, due to inappropriate dietary supplementation)
  - Plant (eg, day-blooming jessamine) ingestion
- ▶ Drug-induced effect
  - Thiazide diuretics
  - Excessive calcium (eg, calcium carbonate) supplementation
  - Aluminum-based phosphate binders
  - Dimethyl sulfoxide when used extra-label in the treatment of calcinosis cutis
- ▶ Localized osteolysis
- ▶ Osteomyelitis
- ▶ Hypertrophic osteodystrophy
- ▶ Disuse osteoporosis
- ▶ Granulomatous disease
  - Blastomycosis
  - Histoplasmosis
  - Hepatozoonosis
  - Schistosomiasis
  - Pythiosis
  - *Angiostrongylus vasorum* infection
  - *Heterobilharzia americana* infection
  - Secondary to biologic implants
- ▶ Benign humoral hypercalcemia
  - Benign mixed mammary tumors
  - Benign renal angiomyxoma
  - Benign esophageal/vaginal leiomyoma
- ▶ Hypervitaminosis A
- ▶ Retained fetus (dogs) ■■■

\*Differential diagnoses for hypercalcemia do not have a determined order of likelihood and are listed in no particular order.

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## References

- Bischoff K, Rumbeisha WK. Pet food recalls and pet food contaminants in small animals: an update. *Vet Clin North Am Small Anim Pract.* 2018;48(6):917-931.
- Ferguson DC, Hoenig M. Endocrine system. In: Latimer KS, ed. *Duncan and Prasse's Veterinary Laboratory Medicine: Clinical Pathology*. 5th ed. Ames, IA: Wiley-Blackwell; 2011:299-301.
- Finch NC. Hypercalcemia in cats: the complexities of calcium regulation and associated clinical challenges. *J Feline Med Surg.* 2016;18(5):387-399.
- Koch SN, Torres SMF, Plumb DC. Dimethyl sulfoxide. In: Koch SN, Torres SMF, Plumb DC. *Canine and Feline Dermatology Drug Handbook*. Ames, IA: Wiley-Blackwell; 2012:365-367.
- LeBlanc CJ, Echandi RL, Moore RR, Souza C, Grooters AM. Hypercalcemia associated with gastric pythiosis in a dog. *Vet Clin Pathol.* 2008;37(1):115-120.
- Linde KJ, Kelleher TR, Perry JA. Biological implant-associated granulomatous inflammation resulting in secondary hypercalcemia and azotemia in a dog. *Clin Case Rep.* 2018;6(9):1801-1806.
- Messinger JS, Windham WR, Ward CR. Ionized hypercalcemia in dogs: a retrospective study of 109 cases (1998-2003). *J Vet Intern Med.* 2009;23(3):514-519.
- Schenck PA, Chew DJ, Nagode LA, Rosol TJ. Disorders of calcium: hypercalcemia and hypocalcemia. In: DiBartola SP, ed. *Fluid, Electrolyte, and Acid-Base Disorders in Small Animal Practice*. 4th ed. St Louis, MO: Elsevier Saunders; 2012:136-156.
- Stern JA, Chew DJ, Schissler JR, Green EM. Cutaneous and systemic blastomycosis, hypercalcemia, and excess synthesis of calcitriol in a domestic shorthair cat. *J Am Anim Hosp Assoc.* 2011;47(6):e116-e120.
- Stiver S, Laukkonen C, Luong R. Suspected hypercalcemia of benignity associated with canine vaginal leiomyoma. *J Am Anim Hosp Assoc.* 2019;55(2):e55205.
- Stockham SL, Scott MA. Calcium, phosphorus, magnesium, and their regulatory hormones. In: Stockham SL, Scott MA, eds. *Fundamentals of Veterinary Clinical Pathology*. 2nd ed. Ames, IA: Blackwell Publishing; 2008:598-602.
- Van den broek DH, Chang YM, Elliott J, Jepson RE. Chronic kidney disease in cats and the risk of total hypercalcemia. *J Vet Intern Med.* 2017;31(2):465-475.
- Verin R, Cian F, Stewart J, et al. Canine clitoral carcinoma: a clinical, cytologic, histopathologic, immunohistochemical, and ultrastructural study. *Vet Pathol.* 2018;55(4):501-509.
- Yuki M, Nitta M, Omachi T. Parathyroid hormone-related protein-induced hypercalcemia due to osteosarcoma in a cat. *Vet Clin Pathol.* 2015;44(1):141-144.

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