Calcium Disorders

Clinical Signs

Hypercalcemia	Hypocalcemia
PU/PD Decreased appetite Lethargy, weakness Muscle tremors or twitching Urolithiasis	Muscle tremors, twitching, fasciculations Seizures Facial itch/rubbing/biting paws Behavioral changes Prolapsed third eye or ptyalism (cats) Rubber jaw / Rickets

Hypercalcemia

Causes "HARD IONS" Dogs Cats

- Primary hyperparathyroidism
- Addison's disease
- Renal failure (especially acute)
- Hypervitaminosis D – cholecalciferol rodenticides!
- Idiopathic (especially cats)
- Osteoclastic disease (granulomatous disease)
- Neoplasia
- Spurious

Hypercalcemia of Malignancy

Lab Findings: High total Ca, High iCa, low/normal PTH, Low Phos

Mechanism

- In some malignancies, cancer mets to bone and stimulates bone resorption
- In other malignancies, humoral factors that are produced can stimulate osteoblastic bone resorption and renal tubular calcium resorption
    - Mainly PTH-rP
    - Osteoclast growth factors (multiple myeloma)
    - Prostaglandins, some Cytokines (IL-1, IL-4, TNF-a, TNF-b)
- Tumors associated with hypercalcemia
    - Lymphoma/leukemia – T cell mainly
    - Anal Sac Adenocarcinoma
    - Multiple myeloma
    - Thymoma

    - Also reported but less common: mammary gland adenocarcinoma, prostatic adenocarcinoma, squamous cell carcinoma, metastatic or primary bone tumor, OSA, melanoma

Primary Hyperparathyroid

Lab Findings: High total Ca, High iCa, high/normal PTH, low/normal Phos

- Reminder, if iCa is high, PTH should be ZERO!
    - 70% of dogs with primary hyperparathyroidism should have PTH within reference range but with a high Ca
- Low Phos seen ~30% the rest are WNL

Causes

- Parathyroid adenoma – solitary, benign 75-90%
- Hyperplasia – autonomously secreting parathyroid gland 5-25%
- Carcinoma (typically does not met) ~5%
- Keeshond – genetically predisposed
    - Autosomal dominant in 26-40% of cases and responsible breeding has greatly decreased this

Presentation

- Most commonly present for lower urinary tract signs (stone or UTI)
- Can see low BUN/low creat. (due to pu/pd)
- Can be asymptomatic

Treatment

- Surgical removal: parathyridectomy
    - Good prognosis / chance for a cure
    - "hungry bone syndrome" – severe postoperative hypocalcemia due to low PTH levels after surgery and residual high bone turnover – rapid/profound/prolonged decreases in Ca due to influx into the bone, P and Mg
- Other options
    - Ethanol ablation
        - Significant learning curve, want to have someone experienced do this
        - Good prognosis (~75% cured, 10% complication rate)
    - Heat ablation 80-90% success
    - Sensipar (Cinacalcet) – medical tx in human med

Renal Secondary Hyperparathyroidsim

Lab Findings: High (or low/normal) total Ca, low/normal iCa, high/normal PTH, high Phos

- 3-14% of dogs are hypercalcemic, 11-30% of cats are hypercalcemic
    - Degree of hypercalcemia is usually minimal but most have hyperphosphatemia
- Hypercalcemia is due to the low GFR leading to an increase in phosphorous, decreasing renal PTH degradation
- Decreased FGF23 in CKD – contributes to increasing PTH, calcitriol

Idiopathic Feline Hypercalcemia

Lab Findings: High total Ca, High iCa, low/normal PTH, normal/high Phos

- Recognized within the last 20 years; most common cause of hypercalcemia in cats
    - Unknown etiology; cats only
- Clinical signs
    - Subclinical
    - Weight loss (20%), vomiting, constipation, calcium oxalate urolithiasis
- Diagnosis of exclusion

Diagnosis of Hypercalcemia

- Verify!
    - Repeat total Ca
    - Measure iCa
- Detailed history
    - Complete PE
- Min database
    - CBC, chem, UA (USG), thoracic rads, +/- abdo rads
    - Advanced database
        - AUS, baseline cortisol, total t4, FeLV/FIV, neck ultrasound, MSU parathyroid panel

Treatment Options

Indications

- Severe range
- Acute/rapid increase
- Ca*P >60-70
- Clinical Signs

ER

- IVF
- Furosemide

- +/- bisphosphonate
- Others

Chronic

- Diet + soluble fiber
- Chia Seeds (cats and small dogs)
- SQ fluids
- Steroids
- IV/PO bisphosphonates
- Cinacalcet

Hypocalcemia

- Spurious/artifact
    - Hypoalbuminemia
        - Corrected calcium
    - EDTA
    - Dilution
- Causes you should be suspicious for based on hx
    - Eclampsia
    - Phosphate enema
    - Ethylene glycol toxicity
    - Nutritional secondary hyperparathyroidism
    - Tumor lysis syndrome
    - Blood transfusion using citrate anticoagulant
    - Post-op parathyroidectomy
- Causes that may require additional workup
    - AKI vs CKD
    - SIRS or Sepsis
    - Pancreatitis
    - Malabsorptive GI disease
    - Soft tissue trauma or rhabdomyolysis
    - Hypomagnesemia
- Causes of *unexplained* hypocalcemia
    - Primary hypoparathyroidism
        - Post-op vs idiopathic in dogs
        - Dx: low PTH with low iCa

<u>Treatment Options</u>

ER

- Ca gluconate IV
    - Monitor ECG for bradycardia
- Start PO tx

Chronic

- Vitamin D: Calcitriol
- Calcium: calcium carbonate (Tums)