Phosphorus

Interpretive Summary

Description: Phosphorus is essential for energy production, protein synthesis, and acid/base balance in the body. Phosphorus is also a major component of bone.

Decreased Phosphorus

Common Causes

- Increased urinary excretion
  - Diabetes mellitus with ketoacidosis
  - Diuretics
  - Hyperparathyroidism
  - Hypercalcemia of malignancy
- Translocation from extracellular fluid (ECF) to intracellular fluid (ICF)
  - Bicarbonate administration
  - Insulin therapy
  - Insulinoma
- Defective mobilization from bone
  - Eclampsia (dogs)
- Artifact
  - Icterus may lower measured phosphorus, depending on method used

Uncommon Causes

- Decreased intestinal absorption
  - Diet imbalance
    - Dietary insufficiency
    - Prolonged anorexia
  - Intestinal malabsorption
  - Phosphate binding agents
  - Vitamin D deficiency
- Renal tubular defects
  - Fanconi syndrome (dogs)
  - Other renal tubular defects
- Translocation from extracellular fluid (ECF) to intracellular fluid (ICF)
  - Intravenous glucose administration
  - Metabolic or Respiratory Alkalosis
- Unknown mechanism
  - Renal failure (horses)
  - Halothane anesthesia (horses)

Related Findings

- Diabetes mellitus with ketoacidosis
  - Increased glucose, ALP, ALT, BUN, creatinine, cholesterol, anion gap
  - Decreased TCO2, sodium, potassium (can also be normal or increased)
  - Increased fructosamine
  - Glucosuria and ketonuria, variable bacteriuria and pyuria
  - Increased Spec fPL® or Spec cPL® (with concurrent pancreatitis)
- Hyperparathyroidism
  - High normal to increased PTH
  - Increased total and ionized calcium
- Hypercalcemia of malignancy

    - Increased total and ionized calcium
    - Decreased PTH
    - Increased PTHrp
    - Cytology and/or histopathology consistent with neoplasia
- Eclampsia (dogs)
    - Decreased total and ionized calcium

Increased Phosphorus

Common Causes

- Decreased urinary excretion
    - Decreased glomerular filtration rate (GFR)
        - Renal failure
        - Prerenal azotemia
        - Postrenal azotemia
    - Growing animals (2X increase common)
    - Hypoparathyroidism
- Artifact
    - Caused by hemolysis in vitro

Uncommon Causes

- Increased intestinal absorption
    - Increased intake
        - Phosphate enema
        - Phosphate-containing urinary acidifier ingestion
    - Increased vitamin D or vitamin D analogue
        - Cholecalciferol rodenticide
        - Jessamine/wild jasmine (*Cestrum diurnum*)
    - Dietary excess (low Ca/PO_4 ratio)
    - Intestinal ischemia
- Shift from ICF to ECF
    - Acute tumor lysis syndrome
    - Myopathies
        - Exertional rhabdomyolysis
        - Malignant hyperthermia
        - Endurance rides (horses)
- Other or unknown mechanisms
    - Lactic acidosis
    - Neoplasia with osteolytic bone lesions
    - Hyperthyroidism (cats)
    - Acromegaly

Related Findings

- Renal failure
    - Increased BUN and creatinine
    - Isosthenuria (urine specific gravity 1.008-1.012)
    - Mild to moderate nonregenerative anemia with chronic disease (decreased erythropoietin)
    - Increased parathyroid hormone (PTH) due to renal secondary hyperparathyroidism
    - Positive PCR or serology for leptospirosis, Lyme or other infections
    - Urinary casts, pyuria, hematuria, proteinuria, glucosuria, and bacteria
    - Positive urine culture with pyelonephritis
    - Increased blood pressure
    - Abdominal ultrasound shows abnormal renal size and structure
    - With protein losing nephropathy (PLN) due to glomerulonephritis or amyloidosis
        - Decreased albumin
        - Increased urine protein:creatinine ratio

- Prerenal azotemia (severe)
  - Increased BUN and creatinine
  - Increased urine specific gravity (hypersthenuria; >1.030 dogs, >1.040 cats, >1.025 horses)
  - Increased serum protein and hematocrit
- Postrenal azotemia
  - Increased BUN and creatinine
  - Increased potassium (severe cases)
  - Urine sediment can show crystals, blood, and white blood cells with obstructive disease or just blood with rupture
  - Uroabdomen
    - Abdominal fluid has higher creatinine concentrations than serum
    - Contrast radiographs for urinary tract rupture or obstruction
  - Abdominal ultrasound for masses, stones, other causes of obstruction in the urinary tract
- Growing animals
  - Often also have increased ALP (especially dogs and horses)
- Hypoparathyroidism
  - Decreased total and ionized calcium
  - Decreased PTH

Additional Information

Physiology

- Most phosphorus occurs free; smaller amounts are complexed to nonprotein cations and cationic proteins.
- Inorganic phosphorus is predominantly HPO_4^{2-} at neutral pH of 7.4; chemical forms vary with pH.
- Balance between parathyroid hormone (PTH) and Vitamin D metabolism is critical for phosphorus homeostasis.
- Phosphorus is an important component of adenosine triphosphate (ATP) and depletion may significantly affect brain, RBC, and skeletal muscle cells.

References

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