DISEASES OF CALCIUM METABOLISM

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Calcium Phosphorus homeostasis and formation of bones are closely related to two other regulatory hormones *viz* The Parathyroid hormone (PTH) and Calcitonin. Vitamin D acts more like a hormone than a vitamin in calcium regulation.

Regulating Hormones

The normal calcium level in the blood is maintained mainly by the three hormones despite the levels of calcium uptake and excretion. Calcium ions an essential structural component of the skeleton plays important role in muscle contraction, blood coagulation, enzyme activity, neural excitability, membrane permeability etc. corticosteroids, estrogen, thyroxine, somatotropins, glucagon etc also contribute to Calcium homeostasis.

The Parathyroid Hormones

PTH synthesized and stored in the chief cells of parathyroid gland controls calcium concentrations in the extra cellular fluid. This is performed by affecting the rate of transfer of calcium in and out of bone, re-absorption in kidneys and absorption from the GI tract. Synthesis and release of PTH is regulated by feed back mechanism involving the level of blood calcium Bio amines, peptides and steroids can influence PTH secretion. PTH does not directly affect the absorption of calcium from the gut; instead it is mediated through the regulation of synthesis of active metabolite of Vit. D.

Vitamin D

Second major hormone involved in the regulation of calcium metabolism and skeletal remodeling. Vit. D may be of animal origin (Cholecalciferrol D3) or of plant origin (Ergocalciferol D2). In several species Vit. D can be synthesized in the skin from a cholesterol metabolite on exposure to UV light. But dogs and cats are not able to synthesize Vit. D3 and are mainly dietary dependant.

Calcitonin

Secreted from the C- cells (parafollicular cells) of thyroid glands. It exerts its effects by interacting with the target cells of the bones, kidney. The action of PTH and calcitonin are antagonistic on bone resorption and synergistic on decreasing the renal tubular reabsorption of phosphorus. Calcitonin causes decreased entry of calcium from skeleton to the plasma resulting from temporary inhibition of PTH stimulated bone re-absorption and thus it causes hypocalcaemia.

HYPERCALCAEMIA IN DOGS

Development of clinical signs of hypercalcaemia depends on the magnitude of calcium elevation, its duration and how quickly it develops. Total serum calcium levels less than or equal to 15 mg/dL may be associated with clinical signs. Serum concentrations above 18 mg/dL are often associated with life threatening signs.

In dogs the condition is commonly associated with malignancies, Addison's disease and renal diseases. Less common causes are primary hyperparathyroidism, Vit. D toxicosis, granulomatous diseases and miscellaneous causes.

Hypercalcaemia in Malignancies

In malignancies hypercalcaemia is a common feature due to osteoclastic activity. Increased renal re-absorption and increased intestinal absorption also contribute to the fact. Most commonly found in lymphoma, adenocarcinoma of apocrine anal gland and multiple myeloma. Other tumors like thymoma, squamous cell carcinoma, nasal carcinoma, haemangiosarcoma and undifferentiated adenocarcinoma have also been associated with hypercalcaemia.

Lymphoma/ Lymphosarcoma

Most common tumor associated with hypercalcaemia in dogs and cats. This causes hyercalcaemia by local release of osteolytic factors which causes bone resorption and mobilization of calcium when marrow is infiltrated with tumor cells. Usually hypercalcaemia is the first sign noticed. But for confirmatory diagnosis thorough examination among

with chest radiographs, abdominal ultrasonography, multiple lymph node aspiration biopsies and bone marrow biopsies may be necessary. Treatment with steroids like Prednisolone will help in lowering the serum calcium levels.

Adenocarcinoma of apocrine glands of anal sac

Condition is common in old female dogs and 90 % cases shows hypercalcaemia. The condition is usually malignant. Despite of total surgical resection and other treatment protocols like radiation and chemotherapy, the condition can recur in months and the prognosis is guarded to poor. Total surgical resection will usually lower the calcium levels.

Multiple Myeloma

Myeloma cells are known to produce osteoclastic activity factors in human patients. Extensive bone lysis also contributes to hypercalcaemia. Treatment with suitable chemotherapeutic agent has been associated with long term survival.

Hypercalcaemia associated with Hypoadrenocorticism

Mild hypercalcaemia is a common feature in Addison's disease. The reason is multi factorial like increased complexed calcium hemoconcentration, increased renal re-absorption of calcium and increased affinity of proteins for serum calcium. The hypercalcaemia resolves quickly with successful treatment with condition.

Primary hyperparathyroidism

Primary hyperparathyroidism is rare in dogs and cats and results from excessive secretion of PTH by one or more parathyroid gland which are neoplastic. Persistent hypercalcaemia is a feature of this condition.

Most common cause is adenoma of the external or internal parathyroid gland. Polydyspsia, polyuria, anorexia lethargy and depression are the most common signs. But many animals with hypercalcaemia are asymptomatic. Constipation, weakness, shivering, twitching, vomiting, stiff gait and facial swelling are reported but rare.

Hypercalcaemia, normal to low serum phosphorus, low specific gravity of urine are common findings. Azotemia usually develops. In hypercalcaemic animals with normal renal functions estimation of serum PTH levels will be useful. High normal to normal serum PTH levels in hypercalcaemic animals with normal renal function is consistent with hyperparathyroidism. Low serum PTH levels are usually consistent with malignancies. Exploratory surgery of the cervical region is a diagnostic alternative if no other cause for hypercalcaemia can be determined.

Treatment of primary hyperparathyroidism is often surgical excision of parathyroid adenoma. A less commonly advocated treatment is injection of Ethanol to parathyroid glands under ultra sound guidance. Utmost care should be taken while injecting ethanol since leakage may lead to serious problems including vocal code paralysis. Injection of fluids and furosemide prior to surgery will be beneficial to lower the serum calcium levels.

Hypervitaminosis D

Toxicity of Vit. D refers to the effects of excessive intake of bio active metabolites of Vit.D. usually caused as a result of excessive supplementation for treatment of primary hypoparathyroidism. Treatment is directed at discontinuing the supplementation or decreasing the dose rate of Vit.D.

Principles of Treatment of Hypercalcaemia.

Definitive treatment is treating or removing the underlying cause of hypercalcaemia. Since exact cause is mostly obscure, supportive measures must be taken to reduce the serum calcium levels.

Fluid Therapy

Blood volume expansion with normal saline decreases the haemoconcentration and increases the renal calcium loss by improving glomerular filtration rate and sodium excretion. Usually 100 – 125 ml/Kg? day of normal saline is advocated.

Diuretics

Loop diuretics like furosemide @ 2 to 4 mg/Kg every 8 to 12 hours increases calcium excretion by the kidneys. If dehydration is present fluid therapy should be performed first. Thiazide diuretics are contraindicated because these agents decrease calcium excretion by the kidneys.

Sodium bicarbonate

Bicarbonates when given as intravenous bolus or continuous infusion will reduce the serum calcium levels. Bicarbonate therapy is more beneficial when combined with other treatments.

Glucocorticoids

Glucocorticoids like Prednisolone (@1 – 2 mg/Kg twice daily) when administered decreases bone resorption of calcium and intestinal calcium absorption and increases excretion of calcium ions.

HYPOCALCAEMIA IN DOGS

Principles of Treatment

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