



PATIENT PRESENTING CLINICAL SIGNS

Harley Brower

History: Bladder stones (CAox) removed 4/2021. Harley's owner is not good at giving him rx diet, and he often gets gi upset. He has had elevated calcium, alp, and cpl (lipase amylase as well). Increasing values from 3/22 to 5/22. New systolic murmur IV/V noted, mild left atrial enlargement seen on radiographs today with no signs of CHF. Recurrent stones in bladder noted as well.

SPECIES

Canine

Abnormal PE/Chem/CBC/UA Results: Calcium 12.6, SDMA 26, BUN 36,ALP 531, AMYL 1979, LIP 5636, cpL abnormal, These are all approx 10-15% higher than 3/3022. Normal CBC, and T4=1.8. UA reveals 1.037 with 1+ protein, 2+ blood (9/HPF, <1WBC/HPF) no casts, 1-2 non-squamous, <1/HPF unspecified crystal but no struvite, ox, bilirubin or biurate noted. No bacteria noted. No evidence of anal sac mass on palpation, or enlarged lymph nodes.

BREED

Yorkshire Terrier

ULTRASONOGRAPHIC EXAMINATION OF THE ABDOMEN

SEX

Urinary System

Neutered male

The **urinary bladder** wall was mildly thickened. Slight calculi were noted and measured up to 0.4 cm. Smaller calculi were noted. No evidence of inflammatory or neoplastic changes was noted. Ureteral papillae were normal.

AGE

12 years

The **kidneys** presented a relatively uniform cortical hyperechogenicity when compared to the renal medulla, spleen and liver. No overt masses were noted. Corticomedullary definition was nebulous and the ratio favored the cortex slightly. The ureters were not visible and assumed to be normal. These changes are most consistent with chronic interstitial nephritis yet infiltrative disease could not be entirely ruled out without biopsy though neoplasia is not suspected. The right kidney measured 4.9 cm. The left kidney revealed minor pyelectasia and corticomedullary mineralization. The left kidney measured 4.0 cm with moderate degenerative changes. Blood flow to the kidneys appeared to be adequate on power Doppler assessment.

WEIGHT

15.4 lbs

INTERPRETED BY

Eric Lindquist, DMV
DABVP, Cert. IVUSS

Adrenal Glands

IMAGING PERFORMED BY

Susan Lincoski

Both **adrenal glands** were visualized and recognized as having normal shape, size, position and echogenicity for this breed. The phrenic vasculature, glandular echogenicity and detail were unremarkable. Capsule, cortex, and medullary definition were normal for this age patient. The right adrenal gland measured 1.39 x 0.59 cm. The left adrenal gland measured 1.0 x 0.3 cm.

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Spleen

REFERRING VET

Dr. Lincoski

The **spleen** presented a smooth homogeneous parenchyma hyperechoic to liver and renal cortical parenchyma. The capsule was smooth without noticeable expansion or deviation from within the spleen or adjacent pathology. The splenic vasculature demonstrated normal volume without signs of congestion or thrombosis. No sonographic evidence of acute or chronic inflammatory, neoplastic, or infarctual changes was noted.

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Liver

DATE

6/13/22

The **liver** images from right and left intercostal as well as subcostal views revealed subjectively normal liver size, contour, and structure. Some age-related parenchymal remodeling was noted but likely not



PATIENT

Harley Brower

clinically significant at this time. Vascular and biliary tracts were of normal volume and no evidence of congestion was noted. The gallbladder was mildly over distended with suspended debris.

SPECIES

Canine

Gastrointestinal

Examination of the **gastrointestinal tract** revealed a stomach and intestine free of stasis, of normal wall thickness, acceptable curvilinear mural detail, and peristaltic activity. Small and large intestine demonstrated normal luminal chyme and stool consistency respectively. No obstructive or overt infiltrative disease was noted. No associated abnormal lymphatic activity was noted.

BREED

Yorkshire Terrier

Pancreas

SEX

Neutered male

The base and limbs of the **pancreas** were observed to be largely isoechoic to surrounding omental fat. Some parenchymal remodeling, however, with mild deviation from curvilinear normalcy was observed. Pancreatic duct and capsular irregularities were present consistent with age related changes. If pain upon imaging (+ Murphy sign) was present or if the patient is focally painful in subxiphoid palpation then low-grade smoldering chronic pancreatitis should be suspected.

AGE

12 years

ULTRASONOGRAPHIC FINDINGS

WEIGHT

15.4 lbs

Moderate, degenerative renal changes.

Mild pancreatic remodeling.

INTERPRETED BY

Eric Lindquist, DMV
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Benign hepatopathy with minor, excessive gallbladder debris.

Bladder calculi.

IMAGING PERFORMED BY

Susan Lincoski

INTERPRETATION OF THE FINDINGS & FURTHER RECOMMENDATIONS

A hypercalcemia panel is recommended in this patient to assess for primary versus secondary hyperparathyroidism. Repeat cystotomy, stone analysis and culture is indicated. Diet change may be appropriate to address the bladder calculi that are likely oxalate as well as the chronic active pancreatic inflammation.

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For an additional charge an internal medicine consult can be utilized through [Sonopath.com](http://sonopath.com). You can select the internal medicine drop down at <http://spa.sonopath.com/>.

REFERRING VET

Dr. Lincoski

One of the world's top internists & SonoPath associate Dr. Remo Lobetti BVSc, MMedVet, PhD, DECVIM can evaluate your case through SonoPath. <https://sonopath.com/resources/sonopath-services/internal-medicine-teleconsultation-services>

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SPECIES

Canine

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Yorkshire Terrier

SEX

Neutered male

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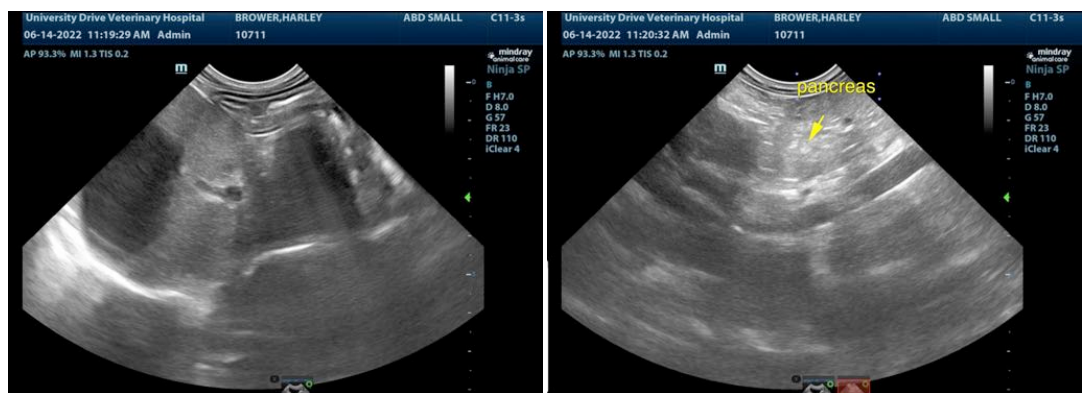
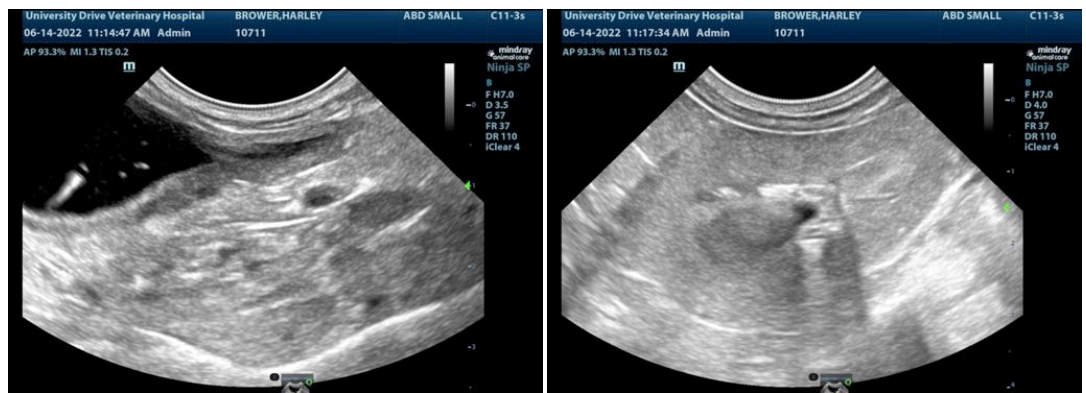
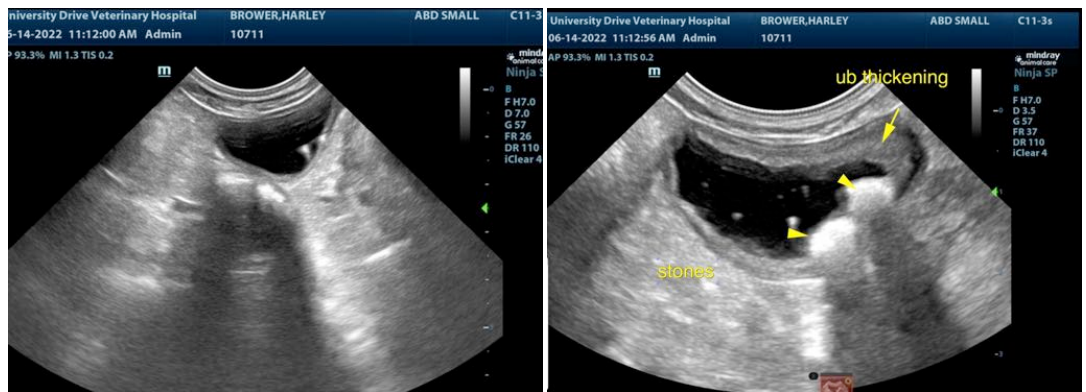
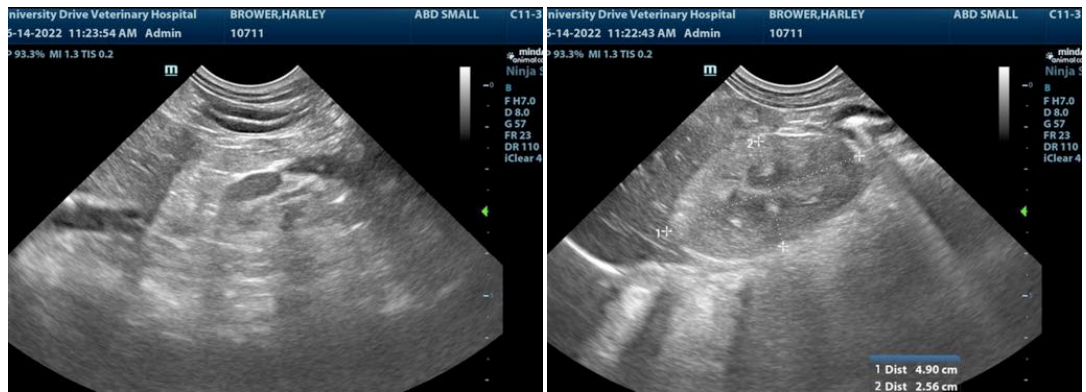
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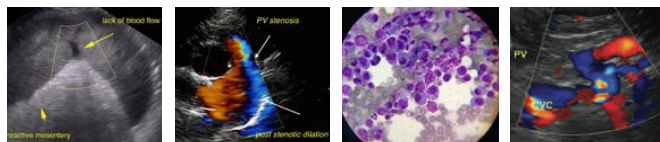
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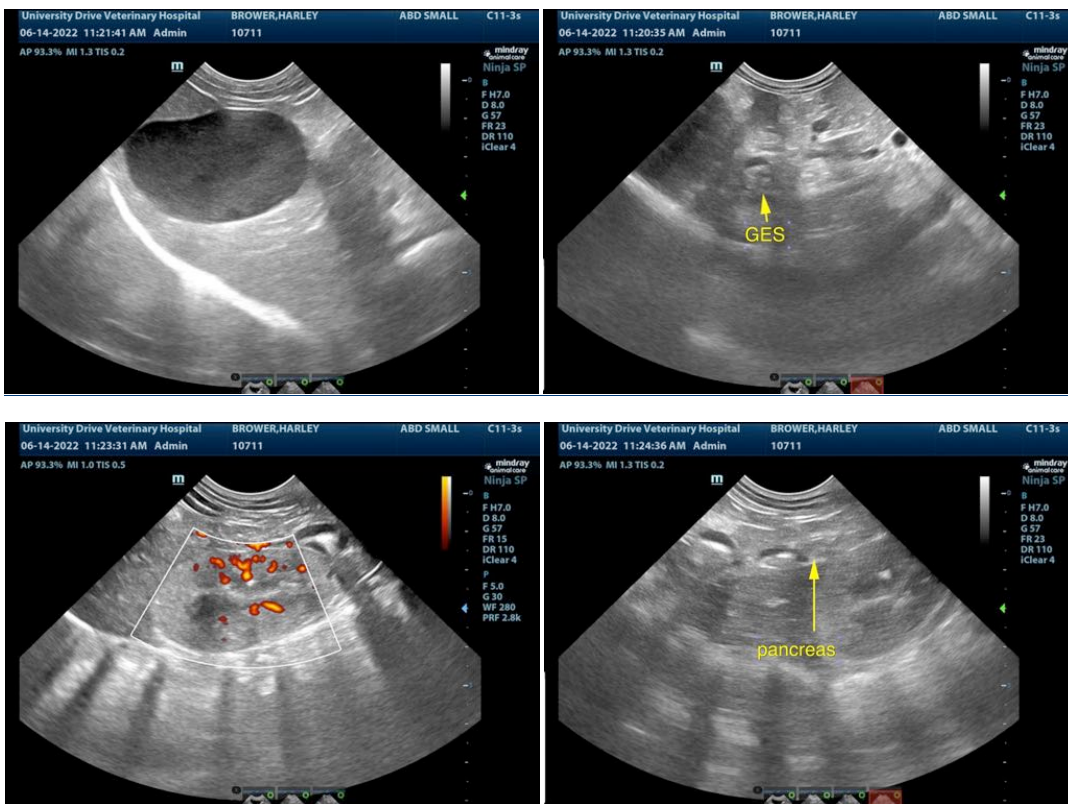
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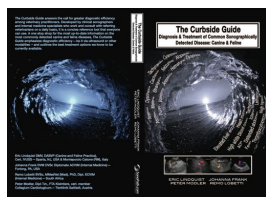
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The information and recommendations provided are based on the images presented by the referring veterinarian/sonographer. No evaluation can be communicated regarding pathology that was not visible in the image/video clips provided.

Thank you for this referral. If the clinical or image interpretation does not parallel your findings or if I can be of any further assistance please contact me.

Eric Lindquist, DMV, DABVP, Cert. IVUSS, CEO of SonoPath.com
info@SonoPath.com



The following is an applicable excerpt from the *Curbside Guide to Diagnosis & Treatment of Sonographic Disease* offered by [SonoPath.com](http://sonopath.com) Lindquist, Frank, Lobetti, and Modler.

An essential quick guide for every general practitioner and sonographer.

<https://sonopath.com/products/curbside-guide-editing-due-release-12012015>

CANINE HYPERCALCEMIA

<http://www.sonopath.com/CanineHypercalcemia>



PATIENT

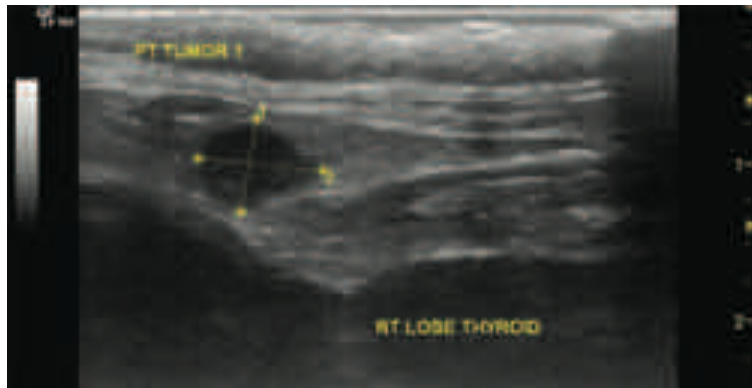
Harley Brower

SPECIES

Canine

BREED

Yorkshire Terrier



Long axis of the right thyroid lobe in a dog with a parathyroid adenoma. The right internal parathyroid gland (between calipers) shows severe uniform enlargement of more than 7mm.

SEX

Neutered male

AGE

12 years

WEIGHT

15.4 lbs

INTERPRETED BY

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DABVP, Cert. IVUSS

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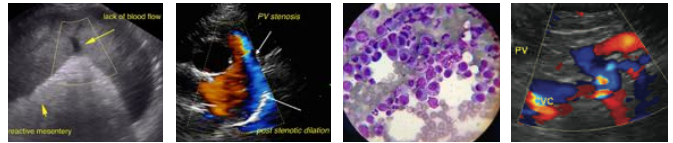
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Description: Hypercalcemia is defined as either a persistently elevated total calcium serum (> 12 mg/dl) or ionized calcium (> 1.45 mmol/l) concentration. Clinical signs are often absent with mild hypercalcemia (< 13 mg/dl). In fact, hypercalcemia is often only discovered when serum biochemistry is done for unrelated reasons. Clinical signs are usually mild when the serum calcium concentration is less than 14 mg/dl; however, signs become more readily apparent when the concentration exceeds 15 mg/dl. Life-threatening cardiac arrhythmias can develop when the serum calcium exceeds 18 mg/dl.

Common etiologies of hypercalcemia include humoral hypercalcemia of malignancy (HHM), hypoadrenocorticism, chronic kidney disease (CKD), hypervitaminosis D, and primary hyperparathyroidism. Less common etiologies include bone neoplasia, osteomyelitis, hypertrophic osteodystrophy, granulomatous disease, calcium supplementation, and oral phosphate binders.

Clinical Signs: Common clinical signs include polyuria, polydipsia, lethargy, inappetence, and weakness. With chronic hypercalcemia, calcium oxalate and calcium phosphate uroliths can form, resulting in clinical signs suggestive of lower urinary tract disease. Systemic signs of illness are suggestive of HHM.

Diagnostics: One important etiology of hypercalcemia is laboratory error; therefore, hypercalcemia should always be confirmed before embarking on any further diagnostic evaluation. Results of a CBC, serum biochemistry panel, and urinalysis, in conjunction with a patient history and findings from a physical examination, can often provide enough information to arrive at a diagnosis. The appendicular skeleton, peripheral lymph nodes, abdominal cavity, and rectum should all be carefully palpated for masses, lymphadenopathy, hepatomegaly, splenomegaly, and/or pain in the long bones. The following diagnostic tests are helpful for identifying an underlying malignancy: thoracic and abdominal radiographs; abdominal ultrasound; cytological evaluation of aspirates of the liver, spleen, lymph nodes, and bone marrow; determination of serum ionized calcium, parathyroid hormone (PTH), and parathyroid hormone-related protein concentration (PTHrP); and ultrasound of the neck. Ascertaining the concentrations of serum ionized calcium, PTH, and PTHrP helps differentiate primary hyperparathyroidism from HHM. The finding of one or more enlarged parathyroid glands upon conducting an ultrasound of the neck supports a diagnosis of primary hyperparathyroidism.



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Hypoadrenocorticism-induced hypercalcemia usually occurs in conjunction with hyponatremia, hyperkalemia, and prerenal azotemia. With HHM and primary hyperparathyroidism, serum phosphorus concentration is often in the low to low-normal reference range. If the serum phosphorus concentration is high but kidney function is normal, hypervitaminosis D or osteolysis should be suspected.

SPECIES

Canine

It can be difficult to determine whether kidney failure is primary or secondary to hypercalcemia when hyperphosphatemia and hypercalcemia coexist with azotemia. Serum ionized calcium concentrations are typically normal or decreased in cases of renal failure and increased in cases of hypercalcemia caused by other disorders.

BREED

Yorkshire Terrier

SEX

Neutered male

Sternal and hilar lymphadenopathy is common with lymphoma-induced hypercalcemia and can be readily identified on thoracic radiographs. In cases of multiple myeloma, discrete lytic lesions in the vertebrae or long bones, hyperproteinemia, proteinuria, and plasma cell infiltration in the bone marrow may be present. Cytological evaluation of the peripheral lymph nodes, bone marrow, and spleen can be helpful in identifying lymphoma.

AGE

12 years

Increased serum ionized calcium concentrations, detectable serum PTHrP concentrations, and non-detectable serum PTH concentrations are all diagnostic for HHM. Lymphoma is the most common etiology of HHM, but other tumors, such as apocrine gland adenocarcinoma and various carcinomas (e.g. mammary gland, squamous cell, bronchogenic), can all give rise to hypercalcemia. Increased serum ionized calcium, normal to increased serum PTH, and non-detectable PTHrP concentrations are diagnostic of primary hyperparathyroidism.

WEIGHT

15.4 lbs

INTERPRETED BY

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Differentials for Hypercalcemia: "HARD IONS"

IMAGING PERFORMED BY

Susan Lincoski

Hyperparathyroid

Addison's

Renal

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D-toxicity

Idiopathic

REFERRING VET

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Osteolytic

Neoplastic

Spurious

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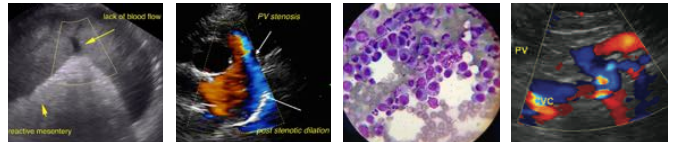
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PTH tumor: Elevated total and ionized Ca, low PTHrP, and normal/high PTH. Keeshonds, German Shepherds, and Golden Retrievers are all predisposed.

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Addison's disease: Elevated total and normal ionized Ca, elevated BUN, hypoalbuminemia and hyperkalemia.



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Renal failure: Elevated to normal total Ca, low ionized Ca, low PTHrP, elevated PTH, azotemia, and low urine specific gravity.

Vitamin D toxicity: Elevated total and ionized Ca, low PTHrP, and normal/low PTH.

SPECIES

Canine

Hypercalcemia of malignancy (HHM): Elevated total and ionized Ca, high PTHrP, and low PTH.

Granulomatous disease: Elevated total and ionized Ca, low PTHrP, and low PTH.

BREED

Yorkshire Terrier

Renal failure: Elevated to normal total Ca, low ionized Ca, low PTHrP, elevated PTH, azotemia, and low urine specific gravity.

SEX

Neutered male

Treatment: Therapies for hypercalcemia are aimed at correcting the underlying etiology; however, because prolonged hypercalcemia can result in kidney damage, the use of fluid therapy, furosemide, and possibly prednisone is indicated in all cases to reduce serum calcium levels. Suggested dosages include saline (0.9% 120-180 ml/kg day IV), furosemide (1-4 mg/kg PO TID), and prednisone (0.25 mg/kg PO Q24hr).

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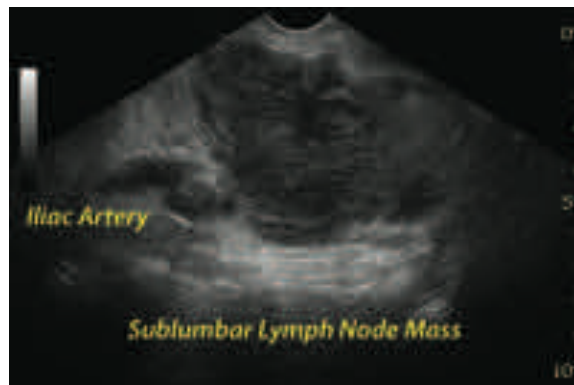
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IMAGING PERFORMED BY

Susan Lincoski

HOSPITAL NAME

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Long axis of the left hypogastric lymph node in a hypercalcemic dog with lymphoma and hypercalcemia of malignancy. The lymph node is severely enlarged and rounded with a short-to-long-axis ratio > 0.5 indicating malignant infiltration. The regular echoarchitecture is lost, the hilus is not recognized, lymph node parenchyma is hypochoic and heterogenous. Also note the mass effect on the external iliac artery. In light of hypercalcemia, lymphadenopathy in this region could also be owing to anal gland adenocarcinoma which can also be imaged sonographically.

References:

Chew DJ, Schenck PA, Jaeger JQ. Clinical disorders of hypercalcemia and hypocalcemia in dogs and cats. Proceedings from the American College of Veterinary Internal Medicine, Charlotte, NC, June 4-7, 2003.

Feldman EC. Disorders of the parathyroid glands. In: Ettinger SJ, Feldman EC, ed. *Textbook of Veterinary Internal Medicine, 7th ed.* St. Louis, MO: Saunders Elsevier; 2010:1722-50.

Peterson ME. Hypercalcemia in dogs & cats: differential diagnosis & treatment. Proceedings from the Western Veterinary Conference, Las Vegas, NV, February 19-23, 2012.

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Dr. Lincoski

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