



**PATIENT PRESENTING CLINICAL SIGNS**

Bo Young  
 History: Follow up on previous ultrasound for parathyroid tumor and adrenal tumors.  
 Abnormal PE/Chem/CBC/UA Results: No labwork provided. Reportedly calcium is in high normal range.

**SPECIES**

Canine

**ULTRASONOGRAPHIC EXAMINATION OF THE ABDOMEN**

**BREED**

**Urinary System**

Shih Tzu

The **urinary bladder**, trigone, and pelvic urethra presented normal thicknesses and normal tone. The ureters were not visible which is normal. No uroliths or sediment were visualized and anechoic urine was present. No evidence of inflammatory or neoplastic changes was noted. Ureteral papillae were normal.

**SEX**

Neutered male

The residual prostate measured 0.5 cm.

**AGE**

10 years

The **kidneys** revealed largely normal size and structure, corticomedullary definition and ratio (cortex 1/3 of medulla) were essentially maintained with some age-related loss of curvilinear patterns regarding the capsule and C/M junction. The cortices presented largely uniform texture with some increased echogenicity expected for this age patient. Medullary structure differed distinctly from that of the cortex and no evidence of pelvic dilation was present. Occasional cortical cyst was noted in the kidneys. The right kidney measured 4.82 cm.

**WEIGHT**

20 lbs

**Adrenal Glands**

**INTERPRETED BY**

Both **adrenal glands** were nodular and expansive. A cavitated portion of the left adrenal gland was noted. The left adrenal gland was persistently enlarged and measured 2.36 x 1.94 cm. The right adrenal gland was persistently enlarged and measured 1.46 x 1.32 cm. Neither adrenal was very vascular, which would suggest a low-grade process.

Eric Lindquist, DMV  
DABVP, Cert. IVUSS

**IMAGING PERFORMED BY**

**Spleen**

Potomac Mobile  
Veterinary Ultrasound

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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Leesburg VH

**REFERRING VET**

Dr. Jarrett

**Liver**

**INVOICE**

The **liver** was uniformly swollen. The liver presented coarse architecture with mildly increased portal markings and subtle, mixed echogenic changes. A hyperechoic, mid cranial liver nodule was noted. The nodule is non-disruptive and consistent with lipogranuloma measuring 1.5 x 1.3 cm. Occasional parenchymal cyst was noted in the liver. This is consistent with vacuolar hepatopathy and some level of remodeling and history of inflammatory component. There was no overt suspicion of neoplasia. The gallbladder lumen is moderately distended. The wall of the gallbladder is not thickened and has a smooth mucosal surface. There is a moderate amount of non-organized echogenic debris. The cystic and common bile ducts are normal/not visible.

**DATE**

9/29/21



**PATIENT**

Bo Young

**Gastrointestinal**

**SPECIES**

Canine

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**

Shih Tzu

**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**

10 years

**Thyroid**

**WEIGHT**

20 lbs

The right and left thyroid lobes were noted. A hypoechoic nodule measuring 0.23 x 0.17 cm was noted on the left lobe. The right thyroid gland revealed a hypoechoic 0.18 cm nodule at the mid body. These would essentially be normal for parathyroids. Other smaller, hypoechoic nodules were noted. This is consistent with normal parathyroids or parathyroid hyperplasia. The salivary glands were normal as well as the esophagus and trachea.

**INTERPRETED BY**

Eric Lindquist, DMV  
DABVP, Cert. IVUSS

**ULTRASONOGRAPHIC FINDINGS**

Persistent nodular adrenal glands, expansive. Adenoma, adenocarcinoma, pheochromocytoma, hyperplasia are all possible in either gland.

**IMAGING PERFORMED BY**

Potomac Mobile  
Veterinary Ultrasound

Essentially normal thyroid and parathyroid glandular presentation. The largest measured 0.23 cm on the left lobe. This could technically represent an early parathyroid adenoma; however, no obvious parathyroid adenomatous type lesions were noted.

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**INTERPRETATION OF THE FINDINGS & FURTHER RECOMMENDATIONS**

Full adrenal work-up is warranted. I recommend rescanning the parathyroid if hypercalcemia panel suggests primary hyperparathyroidism; however, if parathyroid adenoma is present it would necessitate time to grow to an adequate size to suggest resection. However, these may be normal parathyroids for this patient. Blood pressure measurements are recommended regarding the adrenal presentation. If hypertension is present then urine catecholamine is indicated to assess for pheochromocytoma of either gland. The left adrenal gland concerns me more than the right. Left adrenalectomy and right adrenal gland biopsy can also be considered if any clinical signs are associated with the adrenal glands. Ultrasound-guided FNA can also be considered if the sonographer is comfortable with the procedure.

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Canine

**BREED**

Shih Tzu

**SEX**

Neutered male

**AGE**

10 years

**WEIGHT**

20 lbs

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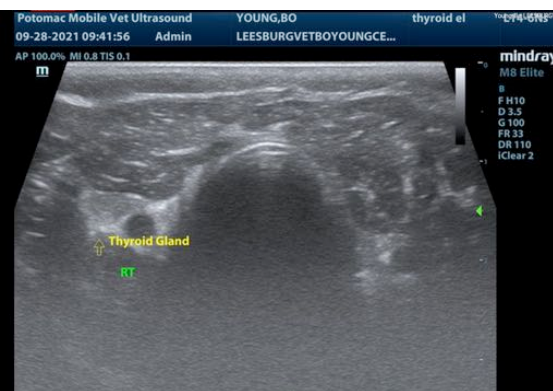
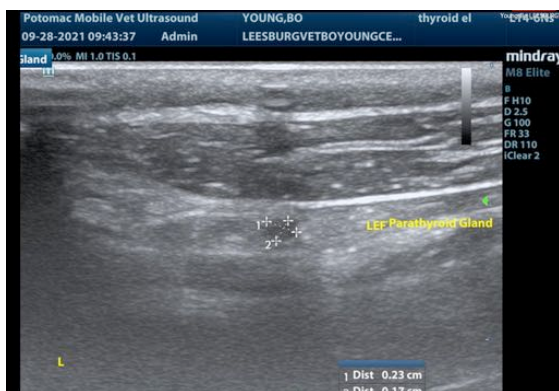
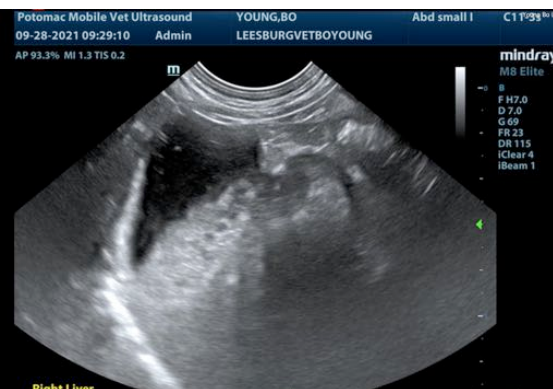
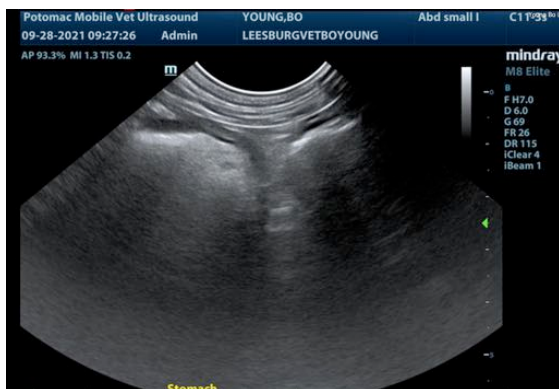
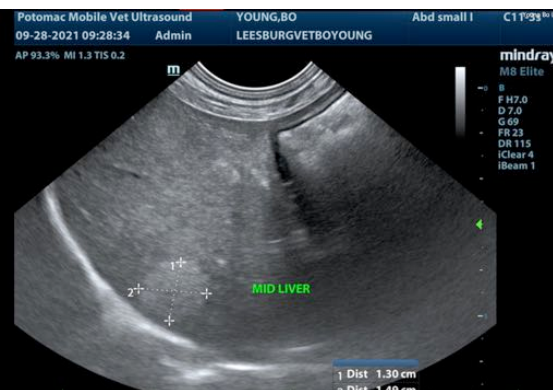
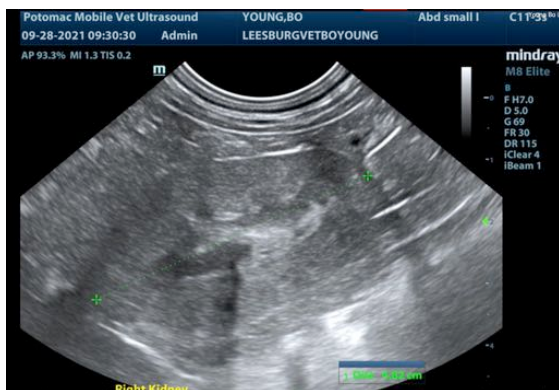
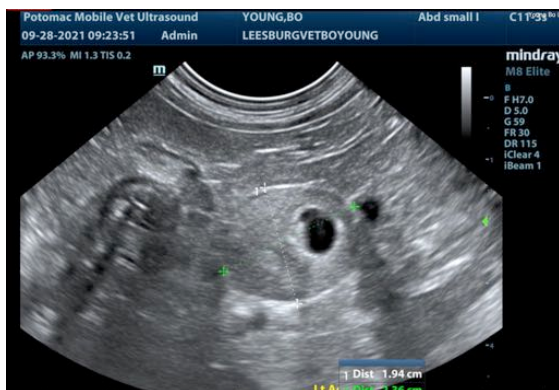
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Bo Young

**SPECIES**

Canine

**BREED**

Shih Tzu

**SEX**

Neutered male

**AGE**

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**WEIGHT**

20 lbs

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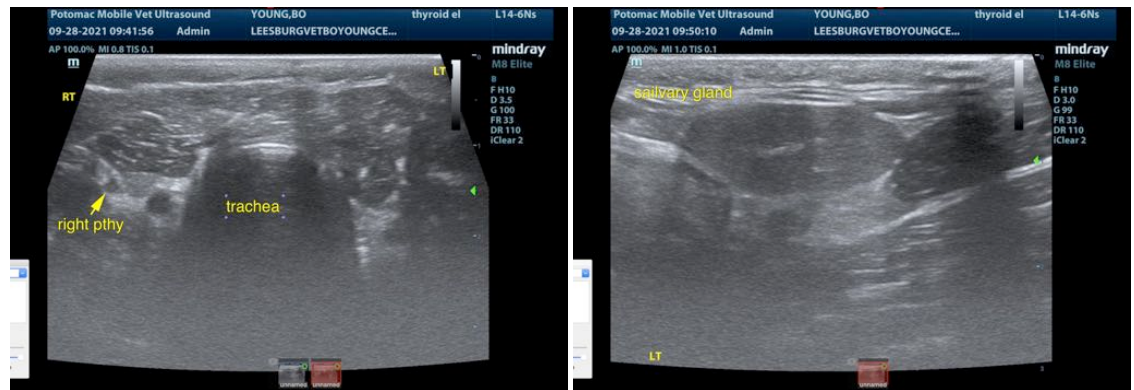
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**DATE**

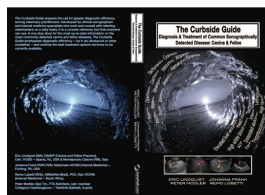
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The information and recommendations provided are based on the images presented by the referring veterinarian. No evaluation can be communicated regarding pathology that was not visible in the image/video clips provided.

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](mailto: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**

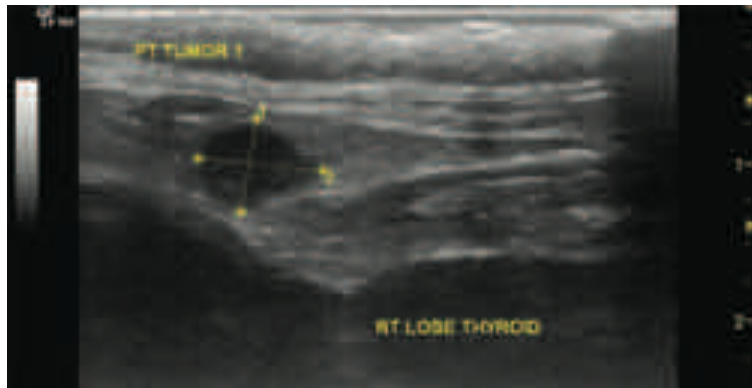
Bo Young

**SPECIES**

Canine

**BREED**

Shih Tzu



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**

10 years

**WEIGHT**

20 lbs

**INTERPRETED BY**

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DABVP, Cert. IVUSS

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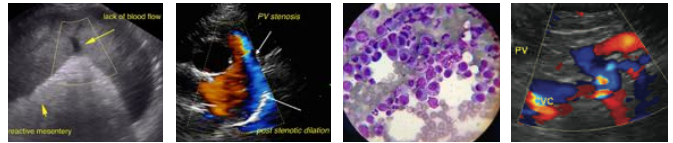
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**Description:** Hypercalcemia is defined as either a persistently elevated total calcium serum (> 12 mg/dl) or ionized calcium (> 1.45 mmol/l) concentration. Clinical signs are often absent with mild hypercalcemia (< 13 mg/dl). In fact, hypercalcemia 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.



**PATIENT**

Bo Young

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**

Shih Tzu

**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**

10 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**

20 lbs

**INTERPRETED BY**

Eric Lindquist, DMV  
DABVP, Cert. IVUSS

**Differentials for Hypercalcemia: "HARD IONS"**

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- Hyperparathyroid
- Addison's
- Renal
- D-toxicity
- Idiopathic
- Osteolytic
- Neoplastic
- Spurious

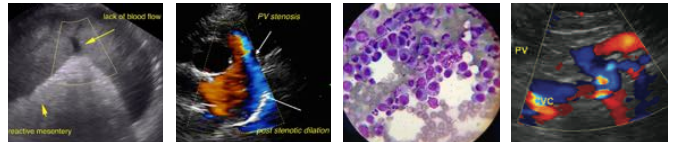
**INVOICE**

**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.



**PATIENT**

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

Bo Young

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

**SPECIES**

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

Canine

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

**BREED**

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

Shih Tzu

**SEX**

**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).

Neutered male

**AGE**

10 years

**WEIGHT**

20 lbs

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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 hypoechoic 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.