Ultrasound of the Adrenal Glands

Wendy Blount, DVM
Signs of hyperadrenocorticism:
• Endocrine alopecia, PU-PD, polyphagia, panting, calcinosis cutis, COPD-like lung dz, hypertension, pseudomyotonia
• Elevated liver enzymes, hypercalcemia, hyperlipidemia, proteinuria

Signs of pheochromocytoma:
• Hypertension, panting, bleeding diathesis, hemoabdomen

Ascites without right heart failure (portal hypertension)
• Pure transudate
Calcified mass cranial to the kidney on abdominal radiographs

As ultrasound technology has improved, the adrenal glands have become easier to visualize.
**Patient Preparation**

*Fast for 12 hours*

Place in dorsal recumbency

Lateral recumbency for:

- Compromised or deep chested patients
- Left lateral recumbency for the right adrenal gland
- Right lateral recumbency for left limb of the pancreas

Standing/sternal may be necessary for patients with large abdominal masses
**Transition Adjustments**

*Depth* — usually no changes from the pancreas

*Frequency* — varies 5-7.5 MHz
- May need higher frequency for smaller pets
- For the best detail, the highest frequency that will penetrate to the adrenals should be used

*Gain and Contrast* — usually no change from liver & spleen

*TGC* — adjust as needed
**Landmarks for Adrenals**

**Right Adrenal Gland** – boomerang shaped
- Cranial & medial to the right kidney
  - Find the cranial pole of the right kidney and fan medially
- Ventral to the caudal vena cava

**Left Adrenal Gland** – peanut shaped
- Cranial & medial to the left kidney
  - Find the cranial pole of the left kidney and fan medially
- Just cranial to the left renal artery
- Just Lateral to the aorta
Landmarks for Adrenals

**Right Adrenal Gland** - Left lateral recumbency
Transducer caudal to the costal arch, just ventral to the sublumbar muscles
Point toward the caudal vena cava (midline)

**Left Adrenal Gland** - Right lateral recumbency
Transducer caudal to the costal arch, just ventral to the sublumbar muscles
Point beam toward the right knee – 30° to long axis

You may have to rotate the probe to elongate the adrenal
Right Adrenal Gland (2)
1. Long Axis (sagittal)
2. Short Axis (transverse) – evaluate the cranial comma shaped turn

Left Adrenal Gland (1-2)
1. Long Axis (sagittal)
2. Short Axis (transverse) if enlarged
Ultrasound of the Left Adrenal Gland

Daniel Rodriguez Arroyo, DACVR

Video
Goals – Adrenal Ultrasound

Identify enlarged adrenal glands
Identify masses in the adrenal glands
Identify calcification of the adrenal glands
High resolution ultrasound may allow distinguishing adrenal cortex from medulla
The cranial pole of the kidney tells you where to start, but the vascular landmarks truly locate the adrenals. The right adrenal gland will be more difficult to find:

- Gas in the cecum
- More cranial & deeper – under the costal arch
- Right adrenal is smaller than the left

Use firm pressure to better visualize deep structures:

- Especially in larger dogs
Normal adrenal glands hypoechoic to mesenteric fat

• <7-8mm width at the caudal pole in the dog
• <4-5mm in width in the cat
• There is some overlap with pituitary hyperadrenocorticism
• Bilateral adrenals >7-8mm in the dog – 77% specific, 80-90% sensitive for PDH

Measure at the thickest long axis width

• At the caudal pole in normal adrenals (some also like to do cranial pole)
• At center in plump adrenals, at thickest part of the mass
Cat adrenals are more oval than dogs

- Left peanut shaped and right comma shaped in the dog

Sometimes normal adrenal glands are not found, most often due to gas and ingesta in the GI tract

- Obesity and deep chest dogs also difficult

- Left adrenal found 70% of the time in a 1990 study and 100% of the time in a later study.
- Right adrenal found 50% of the time in a 1990 study and 83% of the time in a later study

Tips – Adrenal Ultrasound
DDx for plump, rounded adrenal glands in dogs
  • Hyperadrenocorticism
  • Chronic stress, including SARDs
Adrenal masses can be primary or metastatic; malignant or benign; functional or non-functional
  • Benign, non-functional adrenal tumors can be an incidental finding
  • Look at the other adrenal for clues of function (atrophy)
  • Bilateral functional tumors are possible, as is simultaneous PDH and ADH
Sonographic appearance of all adrenal tumors is similar:

- Adenoma, adenocarcinoma, pheochromocytoma
- Hyperechoic, isoechoic or mixed echopattern

**Caveats:**

- Invasion of the cava indicates malignancy
- Metastasis to liver/spleen indicates malignancy (FNA)
- Mineralization indicates tumor in the dog, but not necessarily malignancy
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Clinical signs of adrenal tumors invading the caudal vena cava

• Ascites – pure transudate in abdomen, but not thorax
• TL spinal cord symptoms, due to invasion of the spinal cord
  • Normal cranial nerves and thoracic limbs
  • UMN to the rear limbs
• Retroperitoneal or abdominal bleeding
• Symptoms of metastasis to lungs or CNS
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Tips – Adrenal Ultrasound

Adrenal mass invading the cava

Thrombus
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Adrenal glands are probably most easily confused with nearby great vessels.

• Rotate the probe to elongate the structure to find out if you have a peanut/round shaped structure or a long vessel.
• Put some color on it.
Adrenal glands are probably most easily confused with nearby great vessels.

- Rotate the probe to elongate the structure to find out if you have a peanut/round shaped structure or a long vessel.
- Put some color on it to identify the phrenicobdominal vein.

30% of geriatric cats have mineralized adrenal glands.

- Mineralization of feline adrenals does not equal neoplasia.
- Mineralized canine adrenals are generally neoplastic (but not necessarily malignant).
US more sensitive than rads for free fluid in abdomen

- As little as 2 ml/lb detected by US

It matters where localized fluid lives

- Around the gall bladder – look for signs of cholecystitis
- Around the pancreas – look for signs of pancreatitis
- Retroperitoneal – check for urinary tumors or rupture
- Midabdomen – look for walled of GI perforation
- Anywhere/Everywhere – look for signs of infection, CHF, or lesion that may have bled

Waving fibrin tags suggests fluid chronicity
Tips – Abdominal Fluid

When in dorsal recumbency, the smallest amount of ascites collects between the liver and the diaphragm. Also look between the liver lobes & kidneys.
Tips – Abdominal Fluid

When in dorsal recumbency, the smallest amount of ascites collects between the liver and the diaphragm.
Also look between the liver lobes & kidneys
And dorsal to the bladder
Pneumoperitoneum

Expected for a few days after surgery – can hinder post-op sonograms
If no previous surgery, considered to be a surgical emergency
Ruptured hollow abdominal viscus is the most likely cause
Costophrenic angle most sensitive for small amts of gas
Peritonitis

Septic fluid can range from hypoechoic, to flocculent, to swirling peritonitis due to pancreatitis often suppurative. Also bile peritonitis, uroabdomen, chyle, FIP.

- Fluid analysis chart

Failure to find free gas does not rule out GI perforation.

Serial accumulation of fluid should prompt collection for fluid analysis.
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Omental lymphosarcoma
Peritonitis

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Fluid analysis chart:

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Peritonitis due to pancreatitis often suppurative.
Also bile peritonitis, uroabdomen, chyle, FIP.

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Local peritonitis
Peritonitis

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Cat – duodenal perforation
Peritonitis

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- Fluid analysis chart
- Failure to find free gas does not rule out GI perforation
- Serial accumulation of fluid should prompt collection for fluid analysis.
Normal puppies and kittens can have a small amount of abdominal fluid.

55% of dogs with traumatic pneumothorax also have hemoabdomen:
- Wrapping a hemoabdomen can make pneumothorax worse.

40% of dogs with pelvic fractures have hemoabdomen.

HBC patients (Lisciandro, 2014):
- ALT >1000 U/L has 90% specificity for hemoabdomen.
- ALT <100 U/L has 90% sensitivity for no hemoabdomen.
DH and CC are the most commonly positive for fluid.
SR is least sensitive for abdominal fluid.
Free abdominal fluid in cats surviving HBC is more likely to be urine than blood.

- Cats with spontaneous non-traumatic hemoabdomen have a poor prognosis.

95% of free abdominal fluid in HBC dogs is blood.
- <2-3% uroabdomen.
A small amount of subcapsular renal fluid can be seen with acute renal failure

- Confirm by looking at the other kidney

**SR position** - be careful not to push so hard on the probe you push the L kidney out of view
- Push just hard enough to bring the left kidney into view

**SR view** is most sensitive for pneumoperitoneum

Retroperitoneal fluid can be seen with urinary obstruction, & will resolve w/ resolution of obstruction
Don’t sweat tiny triangles of fluid
• Recheck with the next serial AFAST³
• Every 4 hours, or sooner if patient condition worsen

Don’t sweat it if you can’t find the urinary bladder on the first serial AFAST³
• Recheck at 4-hour AFAST³ – *slide ventrally* to avoid colon
• No bladder after 4 hrs of fluids means either oliguric/anuric renal failure, or ruptured urinary tract
• Look for retroperitoneal and/or free abdominal fluid to confirm
Keep dogs for 4 hours after liver/spleen FNA for AFAST\(^3\) prior to release

AFAST\(^3\) makes diagnostic peritoneal lavage mostly obsolete

AFS 3-4 after surgery (confirmed to be hemorrhage) should generally be explored
When there is a large amount of ascites, all organs appear more hyperechoic.

- US beam is not attenuated by fluid as by soft tissue.

Loss of serosal detail on abdominal rads has poor sensitivity and specificity for hemoabdomen.
Great vessels can be confused with abdominal fluid, especially at the SR view

- Great vessels are tubular, and fluid is angular (often triangular)
- Rotate the probe – vessels will elongate from round to a tube
- Look for the pulse of the aorta & large arteries
- Put some color Doppler on it

Hydroureter can look like retroperitoneal fluid
- look for ureter walls
AFAST³ statistics are for emergency patients

- Abdominal fluid is most often blood (95%) or urine (2-3%) in emergency cases
- Abdominal fluid in the chronically ill patient is most often a modified transudate
  - CHF and neoplasia are most common

Always spin down fluid that appears to be blood

- PC<10% can look like blood, but is actually serosanguinious
Ultrasound of the Lymph Nodes

Wendy Blount, DVM
Historically, if lymph nodes were seen, they were thought to be enlarged.

Normal lymph nodes isoechoic relative to fat and are elongated.

Enlarged lymph nodes hypoechoic to fat and round.

All lymph nodes hyperechoic relative to ascites.

**Visceral abdominal lymph nodes** - mesenteric

**Parietal abdominal lymph nodes** – sublumbar & aortic

R or L Medial Iliac LN = R or L Sublumbar LN
Historically, if lymph nodes were seen, they were thought to be enlarged. Normal lymph nodes are isoechoic relative to fat and are elongated. Enlarged lymph nodes are often hypoechoic to fat and are rounded. Hyperechoic relative to ascites.

Visceral abdominal lymph nodes
- Mesenteric

Parietal abdominal lymph nodes
- Sublumbar & aortic
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Visceral abdominal lymph nodes:
- Mesenteric

Parietal abdominal lymph nodes:
- Sublumbar & aortic

Right Medial iliac lymph node
Tips – Lymph Node Ultrasound

Historically, if lymph nodes were seen, they were thought to be enlarged. Normal lymph nodes are isoechoic relative to fat and are elongated. Enlarged lymph nodes are often hypoechoic to fat and are rounded. Hyperechoic relative to ascites.

Visceral abdominal lymph nodes
- mesenteric

Parietal abdominal lymph nodes
- sublumbar & aortic

R & L Medial iliac lymph nodes
Markedly enlarged lymph nodes are most often neoplastic rather than reactive.

Enlarged lymph nodes can be nearly anechoic, and easily confused with cysts.

Normal lymph nodes <5mm in thickness

>1cm in thickness definitely enlarged
Landmarks for Abdominal Lymph Nodes

Mesenteric lymph nodes - seen in the mid-abdomen can
Landmarks for Abdominal Lymph Nodes

**Sublumbar & aortic lymph nodes** – seen between the branches of the aorta, most often dorsal to the bladder.

- Normal
- Markedly enlarged
Landmarks for Abdominal Lymph Nodes

Sublumbar & aortic lymph nodes
– seen between the branches of the aorta, most often dorsal to the bladder.
Ultrasound of the Great Vessels

Wendy Blount, DVM
Tips – Great Vessel Ultrasound

Normal contents anechoic
Thrombus will be echoic with decreased flow on Doppler

- **Red pattern** = flow toward the probe
- **Blue pattern** = flow away from the probe

DDx:
- Thromboembolic clot
- Tumor direct invasion or embolus
Landmarks for Great Vessels

Aorta, Caudal Vena Cava, Portal Vein - seen in the mid-abdomen scan

• Red – aorta (left)
• Blue – caudal vena cava
• Purple – portal vein (right)
Landmarks for Great Vessels

Aorta, Caudal Vena Cava - seen in the caudal abdomen scan, dorsal to the urinary bladder

• Aortic pulses differentiate the aorta
Summary

PowerPoint - Ultrasound of the Adrenals, Lymph Nodes & Vessels

pdf of PowerPoint - Ultrasound of the Adrenal Glands, Lymph Nodes & Vessels

Adrenal Ultrasound TIPs Sheet

Lymph Node Ultrasound TIPS Sheet

Animated PowerPoint - Scanning the Adrenal Glands

Video: Ultrasound of the Left Adrenal

Video: Ultrasound of the Right Adrenal
Acknowledgments

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