

Basic Abdominal Ultrasound Hints

Probe Marker: point cranial or right

Video Clips: transverse videos - Cr to Cd. Sagittal videos - R to L for single structures or Med to Lat for paired structures.

For Each Area: Adjust gain, TGC and Map to optimize image. Adjust frequency up for shallow and down for deep organs.

Lesions: take still images and videos of each abnormality, in sagittal and transverse. Measure length, width and/or height.

Gain: brightness. Adjust to see borders of structures clearly. Start at 50-60% for abdomen.

Map: shades of gray, and distribution of dark grays and light grays. Increase for more whites, decrease for more blacks.

TGC – Time Gain Compensation Levers: fine adjustment of gain by zones of depth on the screen.

Focused Exam – Liver & Gall Bladder (GB)

Probe: Curvilinear probe is most often used. Sometimes linear probe can be used for small animals and will give better detail.

Harmonics: off for liver, on for gall bladder.

Depth: so diaphragm is $\frac{3}{4}$ down to the bottom of the screen.

Evaluate: Note if interrogation is incomplete and why (air in the stomach/gut, food in the stomach, uncooperative patient, etc.).

Liver shape, margins (smooth with dull points is normal).

GB wall thickness, contents (sludge \pm organized, stones, mass), size and tortuosity of common bile duct.

Measure GB size if enlarged, GB wall if thickened, common bile duct if enlarged, and masses/nodules if present.

Hepatic Vein size, Caudal Vena Cava size as it passes through diaphragm (fat, normal or flat).

Portal Vein wall prominence (increased=hypoechoic liver, normal or decreased=hyperechoic liver).

Ascites - presence of fluid in the abdomen – free fluid or localized.

Relative Echogenicity: Liver should be hypoechoic to fat and spleen, and hyperechoic to renal cortex.

Echotexture of liver is less coarse than fat and more coarse than spleen.

Normal Measurements: GB wall <2-3mm in the dog; <1mm in the cat. Common bile duct <4mm.

DDx hyperechoic liver: steroid, lipidosis, fibrosis, neoplasia.

DDx hypoechoic liver: passive congestion, acute inflammation/necrosis, neoplasia.

DDx mottled echotexture: chronic necrosis/toxicosis/inflammation, diffuse abscess/granuloma, neoplasia, nodular hyperplasia.

Hints: elongate GB as much as possible on sagittal video; if deep chest dog or full stomach, try intercostal approaches; hold probe like an ice cream scoop, not a pencil.

Location: Liver caudal to diaphragm, cranial to stomach/kidneys/spleen. GB in right liver lobe, lateral to porta hepatis.

Focused Exam – Spleen

Probe: linear. **Harmonics:** off.

Depth: head of spleen extends to but does not run off the bottom of the screen

Evaluate: margins (normally smooth and hyperechoic), note if markedly enlarged, look for masses and infarcts (triangular), evaluate blood flow at splenic vein with color Doppler.

Measure nodules of present.

Relative Echogenicity: Spleen should be hypoechoic to fat, and hyperechoic to liver and renal cortex.

Echotexture of spleen is finer than liver and fat.

DDx focal lesions: Cyst, abscess, granuloma, necrotic tumor, neoplasia, hematoma, extramedullary hematopoiesis, nodular hyperplasia, lymphoid hyperplasia, infarct (wedge shaped). Any of these can be hypoechoic and/or hyperechoic to spleen, depending on the case.

Hints: landmark for hilus is “whale tail” splenic vein; risk of hemorrhage if FNA on cavitated lesion or has flow on color Doppler; splenomegaly in the cat is usually pathologic (>1cm in width); if can’t find the cat spleen, check under the costal arch (intercostal approach).

Location: caudal to left liver lobe, caudal to fundus of stomach, ventral to left kidney.

Focused Exam – Urinary – Kidneys and Urinary Bladder

Probe: linear for bladder; linear for kidney on small dogs and cats; curvilinear for kidney on larger dogs.

Harmonics: on for bladder; off for kidneys.

Depth: bladder extends to $\frac{3}{4}$ the depth of the screen – use light pressure to avoid flattening the bladder; kidney extends to $\frac{1}{2}$ + depth.

Evaluate:

Bladder: retroperitoneal fluid, ascites local or generalized, intact wall, wall thickness, wall masses, stones, clots. Bounce to check for snowglobe sign. May see ureteral jet(s) at trigone.

Kidneys: margins (normally smooth), relative echogenicity, masses/cysts in cortex, retroperitoneal fluid, subcapsular fluid, ascites, stones, pelvic mineralization, medullary rim sign, infarcts (triangular).

Measure thickness of cortex (C) and medulla (M) and calculate ratio. Measure length of each kidney. Measure each renal pelvis.

Relative Echogenicity: renal cortex should be hypoechoic to fat, spleen and liver; renal cortex should be hyperechoic to medulla.

DDx Wall thickening or masses: cystitis, neoplasia.

Normal length 30-44mm (cat) & 2.5-3.5xL2 (dog); normal C:M 1:1; normal pelvis <3mm (cat) & <4mm (dog); normal ureters <2mm.

Fosgate Formula for bladder volume: length (cm) x width (cm) x height (cm) x 0.63 = urine volume (ml)

Hints: If snow globe sign seen, take UA. Change position to evaluate gravity effect on soft tissue densities to distinguish intraluminal clots from wall masses. Look for acoustic shadow to tell stones from soft tissue masses. Ease pressure to tell stones from colon.

Location: bladder in caudal most abdomen; both kidneys where costal arch meets paralumbar muscles; right kidney caudal to caudate liver lobe; left kidney ventral and medial to head of spleen, and caudal to left liver lobe and stomach fundus. . If can’t find bladder, check caudally underneath pelvis or re-check in 2 hours after hydration. If can’t find kidney, try lateral paralumbar approach.

Advanced Abdominal Ultrasound Hints

Focused Exam - Gastrointestinal: Stomach, Duodenum, Small Bowel, Feline Ileum, Colon

Probe: Linear. **Harmonics:** On.

Depth: *stomach* – ventral wall ½+ screen depth; *duodenum*- 4-6 cm; *small bowel* – dorsal body wall ¾ down screen depth.

Evaluate: colon only if abnormal; feline ileum only if seen (prominent submucosa)

Note: --lumen diameter and measure if >1cm

--variations in wall thickness

--submucosal short axis striping can indicate lymphangiectasia

--obliteration of normal layering means infiltrative disease: phycomycosis, neoplasia, etc.

Measure: stomach wall thickness, duodenum mucosa/muscularis/wall thicknesses, small bowel mucosa/muscularis/wall thicknesses

Count: motility for 3 minutes in stomach, duodenum and small bowel. Divide by 3 to get peristaltic waves per minute.

Normals:

Small Bowel Layers: *white* – lumen; *black* – mucosa; *white* – submucosa; *black* – muscularis; *white* – serosa.

Motility: *stomach* 3-6 peristaltic waves per minute; *small bowel* 1-3 peristaltic waves per minute.

Dog Wall thickness: *stomach* 3-5mm; *duodenum* 2-6mm; *jejunum* 2-5mm; *colon* 2-4mm.

Cat Wall thickness: *stomach* 1-3mm; *pylorus* 2-4mm; *duodenum* 1.5-3.5mm; *jejunum* 1.5-3.5mm; *colon* 1-2.5mm.

Mucosa:Muscularis Ratio: >1.6:1.

Small bowel luminal diameter <1.5cm.

Obstruction Indicators:

1) segmental fluid distension;

2) non-uniform peristalsis;

3) hyper- & hypo-motility in the same animal;

4) hypermotility without content progression.

Caveat: 2&4 can be seen with non-obstructive motility disorders.

Hints: use plenty of gel for videos to avoid black acoustic shadow artifacts; do measurements on long axis still images; avoid rugal folds for stomach wall thickness measurements; try standing, sternal or lateral for dorsal stomach wall masses.

Landmarks:

Stomach – caudal to liver, cranial to L limb of pancreas and transverse colon.

Pylorus near gallbladder and orad to the duodenum; *Body* between pylorus and fundus; *Fundus* near head of spleen & L kidney.

Duodenum- medial and parallel to R abdominal wall, ventral to R kidney, lateral to ascending colon.

Small Bowel – throughout abdomen.

Ascending colon- medial to duodenum and R limb of pancreas;

Transverse colon- caudal to stomach and L limb of pancreas;

Descending colon – dorsal to bladder, ventral to L kidney.

Focused Exam – Pancreas

Probe: Linear. **Harmonics:** usually on.

Depth: pancreas in center screen depth.

Evaluate: relative echogenicity (should be isoechoic with fat); echotexture (should be more lobular than fat)

Note: hyperechoic halo can mean pancreatitis (saponification of fat)

hyper- or hypo-echoic foci

local fluid can indicate pancreatitis

mineralization.

Measure thickness if >1cm.

Normal thickness <1 cm.

Landmarks:

Right limb - dorsal to duodenum, ventral to right kidney, lateral to the ascending colon;

Body – medial to pylorus, near common bile duct;

Left limb – caudal to the greater curvature of the stomach, cranio-medial to the left kidney, caudo-medial to the head of the spleen, cranial to the transverse colon.

Focused Exam – Adrenal Glands

Probe: linear in small dogs and cats; curvilinear in larger dogs. **Harmonics:** off.

Depth: aorta and/or cava $\frac{3}{4}$ down the screen.

Evaluate: size, shape, masses, mineralization.

Measure: each adrenal length x width at the widest point (usually caudal pole in the dog and middle in the cat).

Normals: <4-5mm wide (cat), <7-8mm wide (dog).

Hints:

mineralized adrenals in the dog are often neoplastic (benign or malignant), but normal cat adrenals can be mineralized;

bilateral adrenals >7-8mm in the dog – 77% specific, 80-90% sensitive for PDH

if can't find adrenals, try lateral lumbar approach.

Use color Doppler to distinguish from vessels

If you see the medulla, you have likely found it

Landmarks:

Left Adrenal: start at cranial pole of the L kidney and fan medially. When you pass through the aorta, you have missed it, so fan back. The L adrenal gland usually sits just cranial to the L renal artery. L Phrenicoabdominal vein causes the peanut shape.

Right Adrenal: start at cranial pole of the R kidney and fan medially to pass through the cava. The R adrenal gland usually sits between the cava and the aorta. When you have passed through the aorta, you have missed it, so fan back.

Focused Exam – Iliac Lymph Nodes & Aortic Bifurcation

Probe: Linear. **Harmonics:** On.

Depth: aorta at center of screen depth.

Evaluate:

Doppler flow in terminal aorta and Caudal Vena Cava;

If iliac lymph nodes enlarged, measure the largest;

Look for retroperitoneal fluid.

Normals: lymph nodes <5mm in thickness; >1cm thick markedly enlarged; >2-3cm, usually neoplasia.

Hints: If can't find lymph nodes, try lateral paralumbar approach; normal lymph nodes are isoechoic to fat.

Landmarks: The bifurcation of the aorta is ventral to the neck of the urinary bladder. The medial iliac lymph nodes sit amongst the terminal aortic branches.

Focused Exam – Reproductive: Ovaries, Uterus, Pregnancy, Testicles, Prostate

Probe: either linear or curvilinear. **Harmonics:** off for all but early pregnancy.

Depth: organ of interest in center of screen depth.

Evaluate: presence of ovaries, uterus, testicles, pregnancy.

Size, shape, echotexture of prostate.

Note masses, fluid in uterus.

Normal prostate size: $\frac{1}{2}$ - $\frac{2}{3}$ the pelvic inlet (check this on x-rays).

Normal uterus <1cm in width. Post-partum uterus 3-5cm, involuted by 3-4 weeks.

Hints: Ovaries >3cm are likely neoplastic.

Pregnancy:

Gestational age < 40 days:

$$GA = (6 \times GSD) + 20$$

$$GA = (3 \times CRL) + 27.$$

GSD=gest sac diameter;

CRL=crown-rump length.

Fetal intestinal motility indicates imminent birth.

Fetal heart rate >190 – minimal stress;

160-180 – mild distress;

140-160 – moderate distress, risk of death if not delivered in 2-3 hours;

<140 – severe distress, death is imminent without c-section.

Landmarks

Ovaries sit up to 3 cm caudal to the caudal pole of the ipsilateral kidney, and are hypoechoic to fat

Uterine body found ventral to the neck of the urinary bladder, and each horn runs from there to the ipsilateral kidney.

Cryptorchid testicles can be found anywhere from the inguinal ring, to the caudal pole of the ipsilateral kidney.