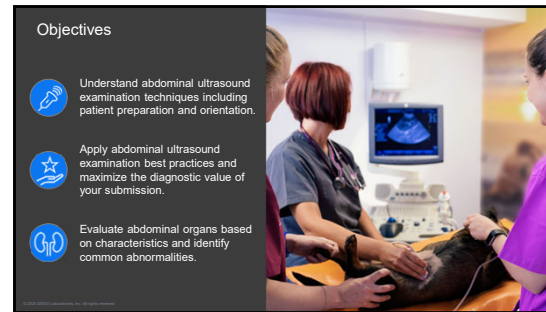
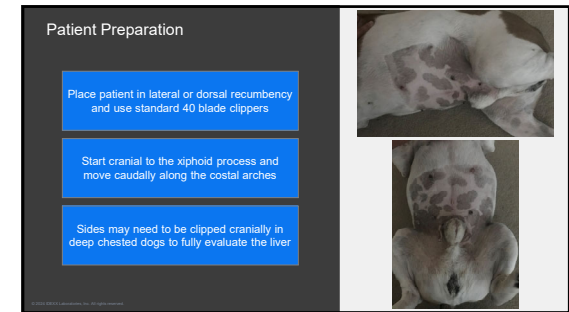


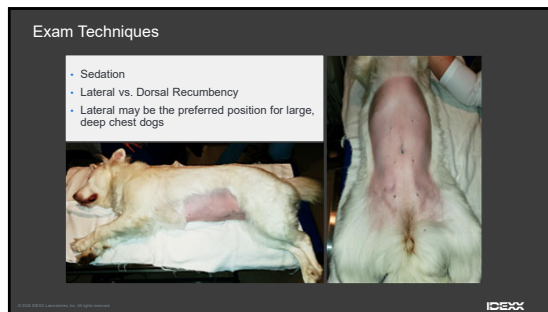
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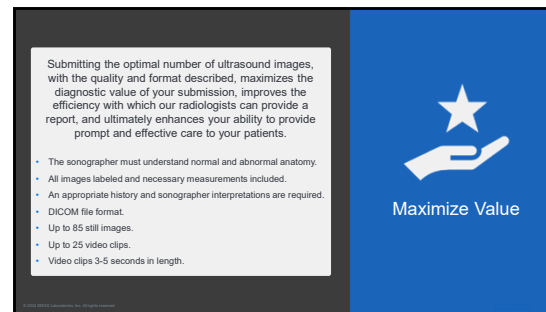
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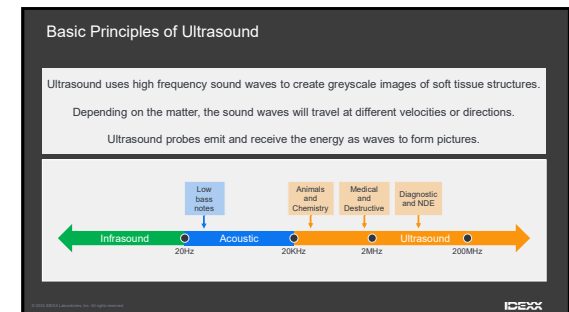
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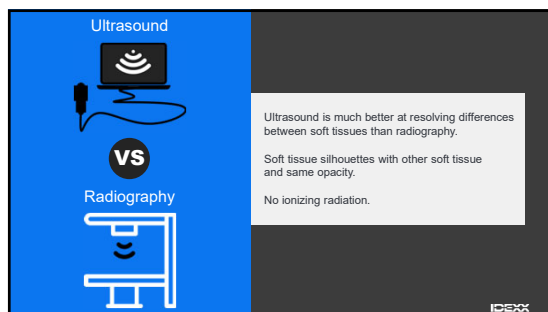
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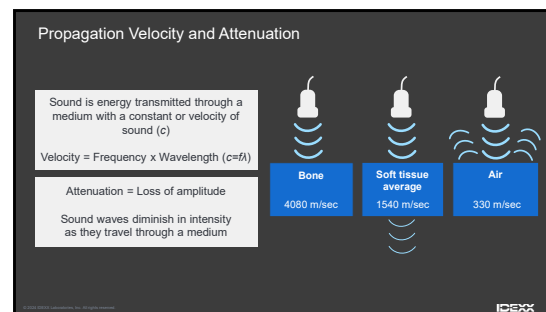
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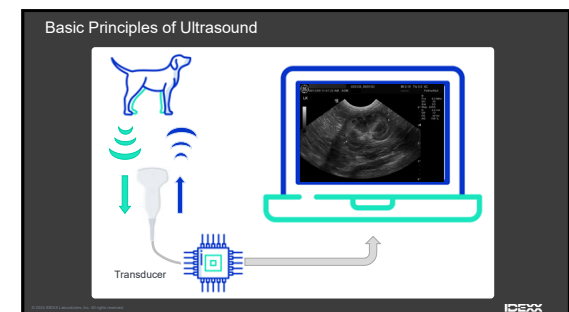
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8



9

Transducer Selection



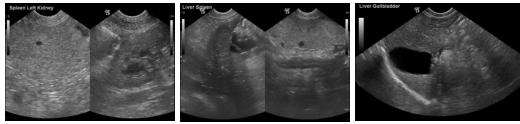
Low frequency (3 - 5 MHz) Deeper penetration with less detail Abdomen, thorax, pelvis, coxofemoral joints, sacroiliac joints, thoracic or lumbar facet joints
Mid-range frequency (5 - 11 MHz) Moderate penetration with moderate detail Cervical facet joints, thorax, pharyngeal structures, distal musculoskeletal structures
High frequency (11 - 18 MHz) Little penetration with high detail Distal musculoskeletal structures

ICEXX

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Ultrasound Terms

HYPERechoic Brighter than it should be, or brighter than surrounding tissue	HYPOechoic Darker than it should be, or darker than surrounding tissue	ANechoic No echoes, or black
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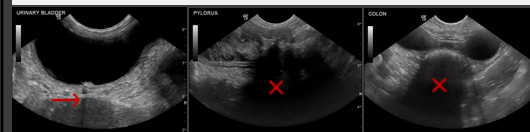
ICEXX

11

Ultrasound Artifact

Shadowing

Prevents echoes from progressing beyond it, such as gas, mineral, and metal.



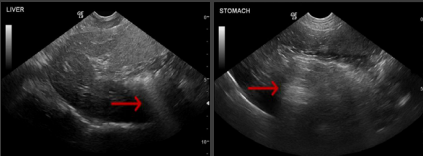
ICEXX

12

Ultrasound Artifact

Reverberation

Sound waves bounce back and forth between two surfaces, such as gas or metal, creating multiple echoes.



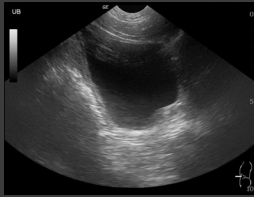
ICEXX

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Ultrasound Artifact

Distal Enhancement

Sound waves progress through the structure more than surrounding tissues, such as fluid.




ICEXX

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Considerations


- Ultrasound waves cannot travel through,
 - Air (cloudy shadow)
 - Bone or metal (clean shadow)
- Sonographer dependent
- Significant learning curve in performing scans



ICEXX

15

Maintaining a consistent approach is key to a complete study!
Start caudally and begin scanning cranially.

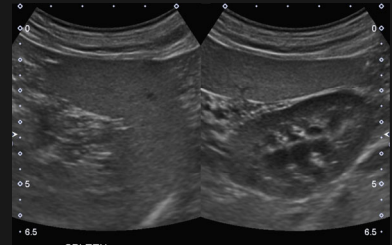


Urinary Bladder Long/Trans, Trigone	Prostate/Testicles Ovaries/Uterus (if present)	Great Vessels with Lymph Nodes
Left Kidney Long/Trans	Left Adrenal Gland Long	Right Kidney Long/Trans
Right Adrenal Gland Long	Spleen Head/Body/Tail	Liver and Gallbladder Long/Trans Left, right, and mid-liver
Duodenum Stomach, Pylorus Contents, wall thickness, motility	Pancreas Left, Right, Body	Small Intestine Content, wall thickness, motility
Colon Contents, wall thickness	Mesenteric Lymph Nodes	Mesenteric Free Fluid

ICEXX

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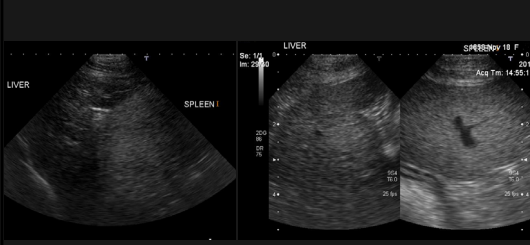
Comparison Views: Spleen and Left Kidney (L abdomen)



ICEXX

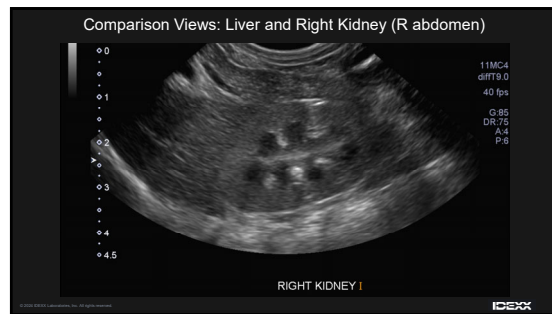
17

Comparison Views: Liver and Spleen (L abdomen)



ICEXX

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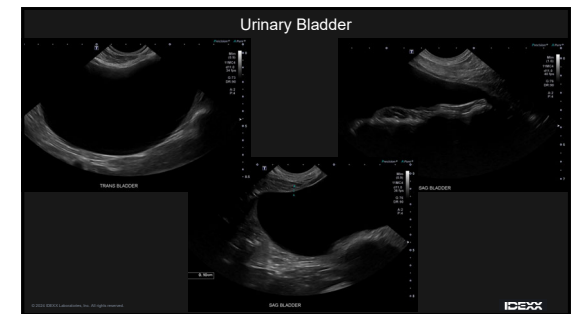


19

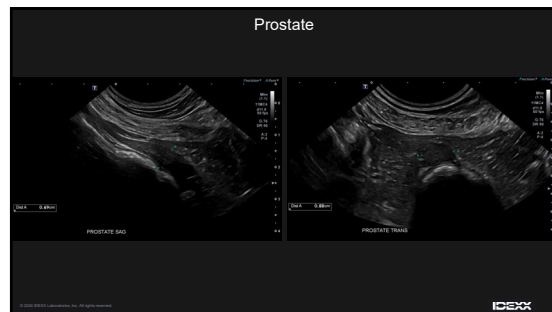
Urinary Bladder: Scanned in two planes

<p>Bladder wall</p> <p>Outer hyperechoic serosa</p> <p>3 smooth muscle layers that are hypoechoic with a hyperechoic lamina propria submucosa that parallels the inner hypoechoic mucosa</p> <p>Thickness averages approximately,</p> <table border="1"> <tr> <td>Felines</td> <td>Canines</td> </tr> <tr> <td>1.5mm</td> <td>2.5mm</td> </tr> </table> <p>Less if distended, more if not</p> <p>Mean bladder wall thickness increases with body weight</p>	Felines	Canines	1.5mm	2.5mm	<p>Ureterovesicular junctions visible in dorsocaudal trigone region and should not be mistaken for an abnormality.</p> <p>Cervix and uterine body lie immediately dorsal to bladder in females whereas descending colon occupies this space in males.</p>
Felines	Canines				
1.5mm	2.5mm				

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Urinary Bladder Wall: Common Abnormalities

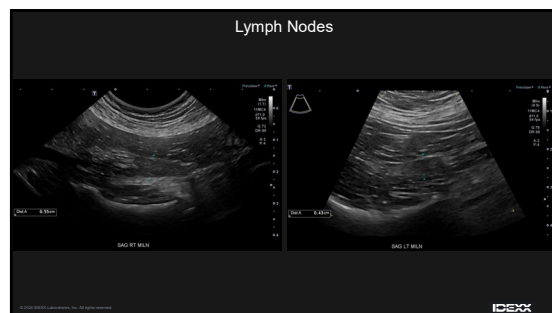
Ectopic Ureters	Calculi	<ul style="list-style-type: none"> Radiopaque or radiolucent Hyperechoic, varying degrees of distal shadowing Can adhere, often in dependent portion of bladder
Foreign Bodies	Cystitis	<ul style="list-style-type: none"> Entire bladder wall Usually more pronounced cranioventrally
Polyps	Blood Clots	<ul style="list-style-type: none"> Hyperechoic, non-shadowing, irregular shape No color Doppler blood flow Trauma, bleeding disorder, infection, neoplasia
Sediment	Hematoma	<ul style="list-style-type: none"> Hypoechoic mass associated with thickened wall Trauma, cystocentesis
Ureterocele	Neoplasia	<ul style="list-style-type: none"> Transitional Cell Carcinoma is most common Sessile mass extending into lumen Focal irregular wall thickening

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Lymph Nodes

<p>Location</p> <p>Primarily lies along vessels</p> <p>Occasionally visible adjacent to diseased organ (pancreas)</p>	<p>Measurement</p> <p>Lymph node thickness (width) is the most common measurement taken</p> <p>Length and width may be considered when monitoring response to chemotherapy</p>			
<p>Appearance</p> <p>When considering size of lymph node, also take appearance into account</p> <p>Normally a soft grey echogenicity</p>	<table border="1"> <tr> <td>Felines & Small Canines < 5mm</td> <td>Medium Canines < 8mm</td> <td>Large Canines < 10mm</td> </tr> </table>	Felines & Small Canines < 5mm	Medium Canines < 8mm	Large Canines < 10mm
Felines & Small Canines < 5mm	Medium Canines < 8mm	Large Canines < 10mm		

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Lymphadenopathy Differentials


<p>Inflammatory, Infectious</p> <p>Typically, only mildly increased size and possible heterogeneity</p>
<p>Neoplastic</p> <p>Typically, larger and more hypoechoic than lymph nodes +/- surrounding hyperechoic mesentery = lymphosarcoma</p>

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Kidneys

Scanned in two planes, sagittal and transverse.

Transverse is best to appreciate renal pelvic dilation.



Three distinct regions of a kidney are appreciated.

Hyperechoic central peripelvic fat. The renal pelvis itself is often hypo to anechoic as it contains a small volume of fluid.

Hypoechoic medulla separated in sections by diverticula and interlobar vessels.

Outer slightly more hyperechoic cortex.

Adequate corticomedullary distinction should be present.

Normal size

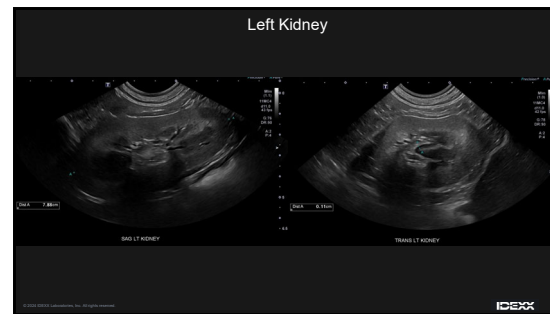
- Felines 3.0cm - 4.5cm
- Canines is subjective, renal length to aortic diameter ratios have been reported.

Cranial pole of left kidney contacts dorsomedial aspect of the spleen laterally.

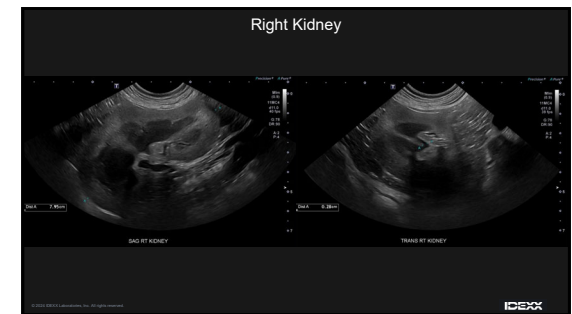
Cranial pole of right kidney is noted in the renal fossa of the caudate liver lobe.

IDEXX

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Kidneys: Common Abnormalities

Small Kidneys	<ul style="list-style-type: none"> Congenital Renal Hypoplasia or Dysplasia Chronic End Stage Renal Disease
Focal Renal Enlargement	<ul style="list-style-type: none"> Granulomas Abscesses Cysts Polycystic Renal Disease Primary or Metastatic Neoplasia
Diffuse Renal Enlargement	<ul style="list-style-type: none"> Compensatory Hypertrophy Acute Renal Failure Ethylene Glycol Toxicity Hydronephrosis Acute Nephritis Early Amyloidosis Shunts Diffuse Infiltrative Disease

IDEXX


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Adrenal Glands

Bilobed organs craniomedial to the kidneys

Left Ventrolateral to the aorta between the origin of the cranial mesenteric and left renal arteries.	Right Between the medial aspect of the cranial pole to the right kidney and the caudal vena cava.
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
Usually uniformly hypoechoic although can sometimes see normal corticomedullary distinction of the organ.



Canines

Adrenal glands shaped like peanuts.

Mineralization in enlarged adrenal glands is concerning for neoplasia.



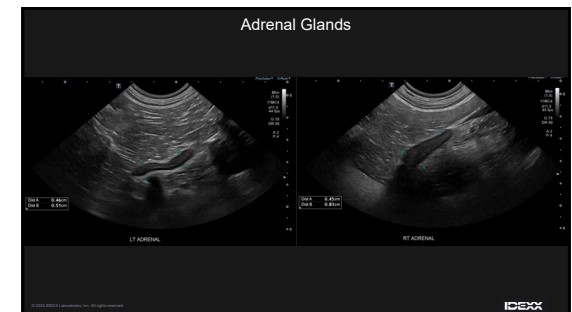
Felines

Adrenal glands more ovoid in shape.

Mineralization is often incidental in older felines.

IDEXX

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Adrenal Glands: Common Abnormalities

Normal Adrenal Size	Maximum diameter of the poles is most useful, the length is not useful. <ul style="list-style-type: none"> Up to 7.4mm width in canines Up to 5mm width in felines
Adrenal Enlargement	<ul style="list-style-type: none"> Pituitary-dependent Hyperadrenocorticism (PDH) Adrenal Tumors
Reduced Adrenal Size	<ul style="list-style-type: none"> Hypoadrenocorticism Exogenous corticosteroid administration

IDEXX

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Spleen

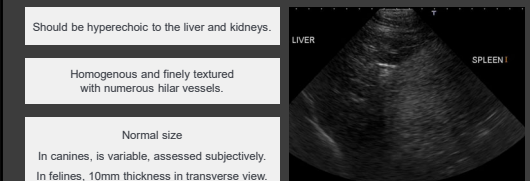
Should be hyperechoic to the liver and kidneys.

Homogenous and finely textured with numerous hilar vessels.

Normal size

In canines, is variable, assessed subjectively.

In felines, 10mm thickness in transverse view.



IDEXX

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Spleen: Common Abnormalities

Increase in size without parenchymal abnormalities	<ul style="list-style-type: none"> Anesthesia Breed Variant Chronic Anemias Extramedullary Hematopoiesis 	<ul style="list-style-type: none"> Hematopoietic Neoplasia's Hemolytic Anemias Lymphoid Hyperplasia
Diffuse nodular disease	<ul style="list-style-type: none"> Amyloidosis Granulomatous Disease Hemangioma Hemangiosarcoma 	<ul style="list-style-type: none"> Hematopoietic Neoplasia's Histoplasmosis Lymphoid Hyperplasia
Focal or multifocal pathology	<ul style="list-style-type: none"> Extramedullary Hematopoiesis Granuloma Abscess Hematoma 	<ul style="list-style-type: none"> Metastatic Tumor Nodular Hyperplasia Primary Tumor

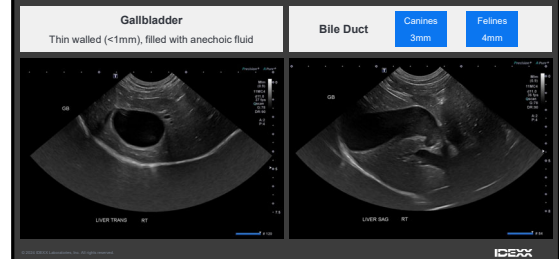
37

Liver

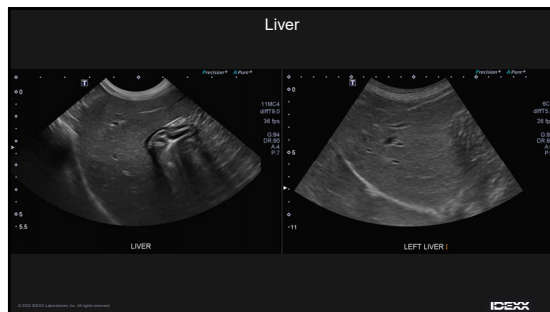
Preparation	Appearance
<p>Patient must be fasted.</p> <p>Sedation will limit aerophagia giving a better study.</p>	<p>Normal Echogenicity</p> <p>In canines, liver is hypoechoic to spleen and equal to mildly hyperechoic to kidney.</p> <p>In felines, isoechoic to the faciform fat. Look for portal markings and Doppler blood flow.</p> <p>More coarsely echo textured than the spleen.</p> <p>Portal vascular markings visible.</p> <p>Can we tell exact liver lobes sonographically?</p>
Location	
<p>Place transducer in subxiphoid position and angle beam craniodorsally in transverse plane.</p> <p>Scan left and right.</p> <p>Repeat in a long plane.</p> <p>Intercostal evaluation is often necessary.</p>	

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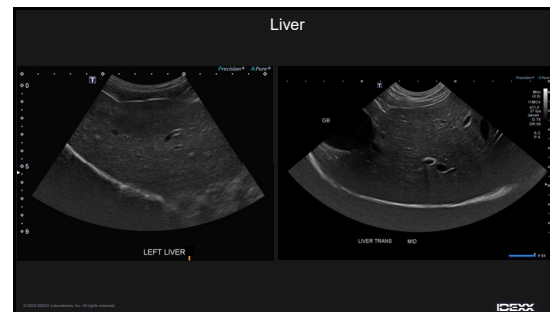
Gallbladder and Bile Duct



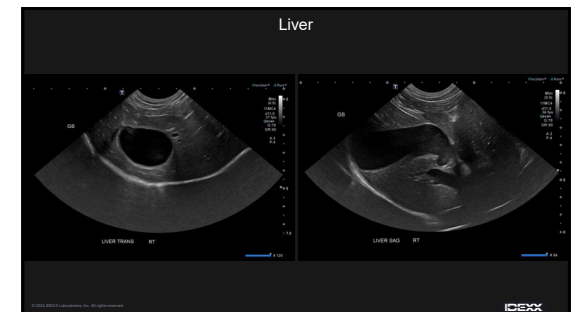
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Liver: Common Abnormalities

Hepatomegaly	Microhepata
<p>Rounding of the liver margins.</p> <p>Extension of the liver caudal to the stomach or pushing the right kidney caudally with extension around the right kidney.</p>	<p>Poor visualization of the liver even without excessive stomach gas.</p> <p>Poor visualization of liver cranial to the right kidney.</p> <p>Evidence of irregular liver margins or nodules.</p>

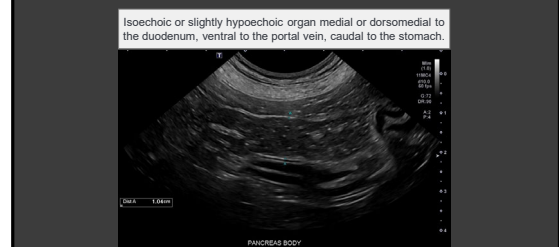
43

Liver: Common Abnormalities

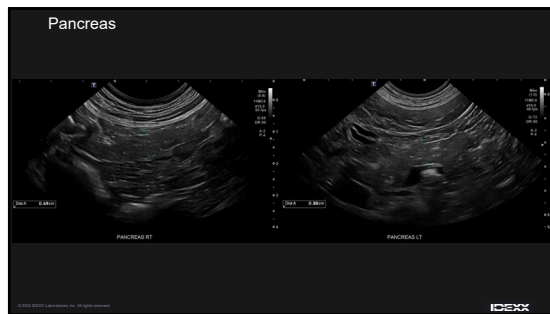
Focal Hepatic Lesions	Diffuse Hepatic Lesions
<p>Cysts Thin and well defined, anechoic fluid with mostly a lack of internal echoes, sharp distal borders, strong distal acoustic enhancement.</p> <p>Hematoma Acute is echogenic. Later appears anechoic or hypoechoic until organized than hyperechoic.</p> <p>Abscess E. coli is most common, any echogenicity.</p> <p>Necrosis Hypo or anechoic with cavitory appearance.</p> <p>Nodular Hyperplasia - variable.</p> <p>Neoplasia Variable. Metastatic or primary including hepatocellular adenoma and carcinoma, cholangiocellular adenoma and carcinoma, and those of mesenchymal origin.</p>	<p>Normal Normal, acute hepatitis, neoplasia (e.g., mast cell).</p> <p>Mixed Echogenicity Neoplasia, hepatocutaneous syndrome, heterochromasia (flake), cirrhosis, regeneration, steroid or vacuolar hepatopathy.</p> <p>Increased Echogenicity Loss of portal vascular wall prominence. Hepatic lipidosis, steroid or vacuolar hepatopathy, chronic hepatitis, cirrhosis, lymphoma.</p> <p>Decreased Echogenicity Portal walls appear more prominent. Lymphoma, leukemia, amyloidosis, passive congestion, acute hepatitis.</p>

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Pancreas



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Pancreas: Common Abnormalities

Pancreatic Abscess	Acute Pancreatitis	<ul style="list-style-type: none"> Normal pancreas so cannot rule out acute active pancreatitis!
Pancreatic Cysts	Chronic Pancreatitis	<ul style="list-style-type: none"> May appear like acute pancreatitis Maybe heterogenous
Pancreatic Neoplasia	Nodular Hyperplasia	<ul style="list-style-type: none"> Older animals Possible previous pancreatitis

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Gastrointestinal Tract: Stomach

Canines

Normal inter-rugal gastric wall thickness 3-5mm pending degree of distension

Rugal folds are prominent and should not be included in thickness measurements

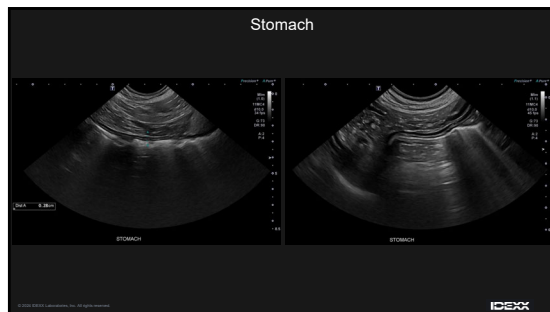
Felines

Normal inter-rugal gastric wall thickness approximately 2mm

Interpret thickness measurements considering the degree of distension

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Gastrointestinal Tract: Small Intestine and Colon

Normal Wall Layers

5 layered appearance with alternating hyperechoic and hypoechoic layers from the lumen outwards to the serosa.

- Mucosal surface
- Mucosa
- Submucosa
- Muscularis
- Serosa

M&M: Mucosal and muscularis layers are hypoechoic.
S&S: Submucosa and serosa are hyperechoic.

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Gastrointestinal Tract: Small Intestine and Colon

Duodenal Thickness

Canines	Felines
5mm	2-4mm

Peyer patches can be seen on the antimesenteric border of the descending duodenum.

Intestinal Wall Thickness

Canines and Felines
2-3mm

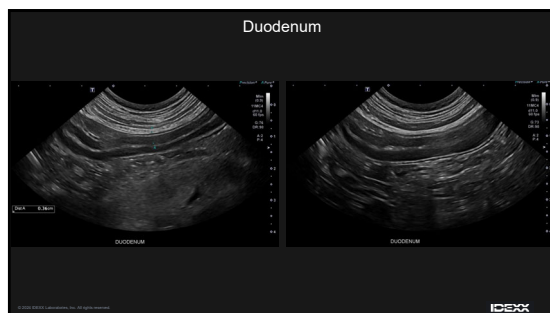
Measure near wall from mucosa to serosa. Measurement of each layer is not beneficial.

Colon Thickness

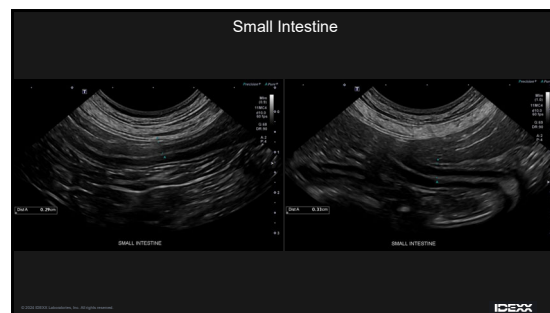
Canines	Felines
1-2mm	1.5-2mm

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Gastrointestinal Tract: Common Abnormalities

Foreign Bodies	<ul style="list-style-type: none"> • Distal Shadowing
Inflammation, Infiltrative Disease	<ul style="list-style-type: none"> • Wall Thickening • Focal versus Diffuse
Intussusception	<ul style="list-style-type: none"> • Multilayered structure in longitudinal view • Multiple concentric rings of bowel in transverse view

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Summary



Reviewed abdominal ultrasound examination techniques including patient preparation and orientation.



Discussed abdominal ultrasound examination best practices and maximize the diagnostic value of your submission.



Learned to evaluate abdominal organs based on characteristics and identify common abnormalities.



Full sonographic study can be performed using under 40 still images and reserve short video clips with color Doppler blood flow for pathology.



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