Most abdominal organs have distinctive ultrasonographic characteristics in dogs and cats, including size, shape, echogenicity, echotexture, and localization specific to the normal anatomy in the given species. **TABLE 1** describes the expected normal measurements of canine and feline abdominal organs.\(^1\)\(^{-10}\) For greater detail on each organ, please refer to the relevant previous Imaging Essentials articles on todaysveterinarypractice.com.

**LIVER**

The liver is composed of the right lateral, right medial, left lateral, left medial, quadrate, and caudate lobes; the caudate lobe is made of the caudate and papillary processes. Ultrasonographically, the lobes cannot be differentiated. Instead, the liver appears as a contiguous structure containing normally branching hepatic portal veins. A normal-appearing liver does not exclude infiltrative disease in dogs or cats.\(^11\)
TABLE 1 Normal Abdominal Organ Measurements in Dogs and Cats

<table>
<thead>
<tr>
<th>ORGAN</th>
<th>DOG</th>
<th>CAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallbladder wall thickness</td>
<td>1 mm&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1 mm&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Common bile duct diameter</td>
<td>Not visualized&lt;sup&gt;1&lt;/sup&gt;</td>
<td>&lt;4 mm&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Spleen thickness</td>
<td>Not reported</td>
<td>Up to 10 mm&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Kidney length</td>
<td>Reduced if LK:Ao &lt; 5.5&lt;sup&gt;2&lt;/sup&gt;</td>
<td>3.66 ± 0.46 cm&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Increased if LK:Ao &gt; 9.&lt;sup&gt;1,2&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Renal length to vertebral length (measured as a straight line from ventral or lateral aspect of L5 or L6) ratios 1.3–2.73</td>
<td>3.5–4.4 cm&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Renal pelvis width</td>
<td>Normally not dilated; if 1–3 mm, diuresis is likely; other causes of pyelectasia are possible; if ≥ 13 mm, obstruction is possible&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Normally not dilated, but can be 1–3 mm</td>
</tr>
<tr>
<td>Urinary bladder wall thickness</td>
<td>Minimally distended: mean 2.3 mm&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Minimally distended: mean 2.3 mm&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Mildly distended: mean 1.6 mm&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Mildly distended: mean 1.6 mm&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Moderately distended: mean 1.4 mm&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Moderately distended: mean 1.4 mm&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Fully distended: 1–2 mm&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Fully distended: 1–2 mm&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
<tr>
<td>Adrenal gland caudal pole height</td>
<td>Mean: &lt;0.74 cm&lt;sup&gt;1&lt;/sup&gt; 10–30 kg: &lt;0.80 cm&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.4–0.46 cm&lt;sup&gt;1&lt;/sup&gt;; 0.8 cm in length</td>
</tr>
<tr>
<td></td>
<td>10–30 kg: &lt;0.74 cm&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;30 kg: &lt;0.80 cm&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Pancreas thickness (mean)*</td>
<td>Left: 4.8–8.2 mm&lt;sup&gt;7&lt;/sup&gt; Body: 4.7–7.9 mm&lt;sup&gt;7&lt;/sup&gt; Right: 6.3–9.9 mm&lt;sup&gt;7&lt;/sup&gt;</td>
<td>Left: 3.4–9.0 mm&lt;sup&gt;1,8&lt;/sup&gt; Body: 2.5–9.5 mm&lt;sup&gt;1,8&lt;/sup&gt; Right: 2.8–6.0 mm&lt;sup&gt;1,8&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pancreatic duct diameter*</td>
<td>Mean: &lt;1 mm</td>
<td>Mean: &lt;2.5 mm&lt;sup&gt;9&lt;/sup&gt; Age ≥ 10 years: 0.5–1.3 mm&lt;sup&gt;8&lt;/sup&gt; Age ≥ 10 years: 0.6–2.4 mm&lt;sup&gt;10&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ovary size (in estrus)&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Length: 1.5 cm Thickness: 0.5 cm Width: 0.7 cm</td>
<td>0.5 × 0.5 × 0.5 cm</td>
</tr>
</tbody>
</table>

LK:Ao, ratio of left kidney length to aortic luminal diameter.

<sup>1</sup>Superscript numbers are reference citations.

<sup>2</sup>In dogs, pancreatic thickness and pancreatic duct diameter significantly increase with body weight.

Dog

The canine liver (FIGURE 1A) is hypoechoic relative to the adjacent spleen. The falciform fat in dogs is not necessarily a good indicator of overall liver echogenicity, as it may appear hypo-, iso-, or hyperechoic relative to the liver in a normal dog. Canine portal veins have distinct hyperechoic walls.<sup>12</sup>

Cat

Unlike in dogs, the feline liver (FIGURE 1B) is typically isoechoic to the falciform fat, which is thicker than in dogs. However, the liver becomes hyperechoic in clinically obese cats secondary to lipid-rich liver or feline hepatic lipidosis or hypoechoic as with active hepatitis or lymphoma (FIGURE 2). The hepatic portal veins in cats are less distinct than in dogs.

GALLBLADDER

The gallbladder is a thin-walled (<1 mm), fluid-filled, anechoic structure (FIGURE 3). Its degree of distention in both species varies, depending on when the last meal was eaten and the fat content of that meal.<sup>13</sup>
Dog

The neck of the gallbladder should taper normally; consequently, the cystic and bile ducts are not visualized to the level of the major duodenal papilla in dogs (FIGURE 4). Echogenic material within the canine gallbladder is considered normal but has been seen in a higher incidence in dogs with Cushing’s disease. Typically, echogenic material in the gallbladder is more gravity dependent (in the far field).

Cat

The gallbladder can be bilobed in the cat as a normal anatomic variant (FIGURE 3B). In normal cats, the cystic and bile ducts can be followed to the level of the major duodenal papilla and can measure up to 2 to 3 mm in diameter (FIGURE 5). If echogenic material is seen in the feline gallbladder in conjunction with wall thickening, consider cholecystitis or cholangiohepatitis as a diagnostic differential; the normal feline gallbladder usually does not contain echogenic material.

SPLEEN

In both species, the spleen can have a fine, heterogeneous echotexture when using a high-resolution linear transducer when compared with the microconvex transducer. The splenic arteries are not apparent without color Doppler evaluation.

Dog

In the dog, the craniodorsal extremity (sometimes called the head) of the spleen is located immediately to the left of the gastric fundus and may change its location based on the degree of gastric distention (FIGURE 6A). The splenic size in dogs is also variable, and in some breeds it can be quite large.

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**Figure 3.** (A) Short-axis view of the canine liver. Note the round, thin-walled, anechoic gallbladder located within the right side of the liver. The bile within the gallbladder is anechoic. Its fluid nature causes distal acoustic enhancement, noted in the far field of the image (white arrow). (B) Long-axis view of the feline liver. Note the thin-walled, bilobed gallbladder (*) with mirror-image artifact on the opposing side of the diaphragm.

**Figure 4.** Short-axis view of the canine major duodenal papilla (white arrowhead) at the level of the oral descending duodenum. Note the normal focal thickening of the hyperechoic submucosal layer of the duodenum at the level of the insertion of the major duodenal papilla.

**Figure 5.** Short-axis view of the feline cystic duct at the level of the gallbladder. Note the gradual tapering and relative distention of the feline cystic duct; this is considered normal in a cat with a measurement of <3 mm. A small amount of echogenic sludge is in the lumen of the gallbladder.
greyhound, German shepherd). The canine spleen is easy to find but difficult to trace in its entirety due to its size. A left-sided intercostal approach may be necessary to visualize the entire dorsal aspect (head) of the spleen. The splenic portal veins are seen along the visceral (mesenteric) surface of the spleen.

Cat

The feline spleen is positioned along the left body wall, lateral to the stomach, and is more consistent in size and location than in dogs; it should not be >1 cm in thickness, which is measured on the left lateral aspect of the abdomen in the near field of the image.¹ The feline spleen is usually no longer than 3 to 5 cm.¹ The feline spleen has a coarser echotexture than the canine spleen (FIGURE 6B). In cats, the spleen can be difficult to visualize as it is often isoechoic to slightly hypoechoic relative to the surrounding mesenteric fat and is located in the near field (within the first centimeter). The splenic portal veins are less apparent in cats but can still be found, particularly with color Doppler.

KIDNEYS

The normal right and left kidneys of both dogs and cats should be symmetric, with a sharp zone of transition between the cortex and medulla; they are usually bean shaped at the hilum when imaged in dorsal plane (FIGURE 7). The cortex is relatively hyperechoic. In the renal diverticular regions, hyperechoic thin-walled vessels, called arcuate vessels, can be mistaken for renal diverticular mineralization; however, these vessels are normal in dogs and cats.
**TABLE 2 Localization of Canine and Feline Adrenal Glands**

<table>
<thead>
<tr>
<th></th>
<th><strong>DOG</strong></th>
<th><strong>CAT</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Left adrenal gland</td>
<td>Left renal artery is the caudal delimiter; “cat eyes” (celiac and cranial mesenteric arteries) are the cranial delimiters</td>
<td>Adjacent or caudal to celiac and cranial mesenteric artery; the left renal artery is often difficult to find</td>
</tr>
<tr>
<td>Right adrenal gland</td>
<td>Adjacent and medial to right kidney and immediately dorsolateral or lateral to the caudal vena cava</td>
<td>Cranial to right kidney and caudal to the caudate lobe of the liver; lateral to caudal vena cava</td>
</tr>
</tbody>
</table>

**Dog**
Renal size in dogs varies based on body conformation. Therefore, a normal ratio of left kidney length to aortic luminal diameter (L.K:Ao) has been established (TABLE 1). Kidney size is a nonspecific indicator of renal disease, as histopathologically abnormal kidneys may still be normal in size. In normal dogs, there can be an inner hyperechoic band associated with the renal cortex that has been shown to represent the outer renal medulla (not seen in cats).20

**Cat**
In cats, the kidneys are more consistent in size, with a normal length of 3.5 to 4.5 cm. Fat deposition in the renal sinus is greater in cats than in dogs. Castrated male cats tend to have more hyperechoic kidneys from increased fat deposition (FIGURE 8).21

**URINARY BLADDER, URETHRA, AND CANINE PROSTATE**
In dogs and cats, the layers of the urinary bladder are difficult to distinguish (FIGURE 9A AND 9B). In addition, the urinary bladder wall thickness and size can be variable, depending on the volume and size of the patient (TABLE 1).

**Dog**
The canine prostate is visualized caudal to the trigone (urinary bladder neck) and located surrounding the proximal aspect of the urethra. It is uniformly hypoechoic and fusiform in a neutered male dog but appears large, homogeneously hyperechoic, and rounded in an intact dog. Enlargement and heterogeneity (small anechoic cysts) are common in adult/older male intact dogs, likely representing benign prostatic cystic hyperplasia (FIGURE 10). In dogs, the trigone and proximal urethra can be in a pelvic position and thereby not evaluable from a transabdominal approach.

**Cat**
In cats, the urinary bladder can be smaller in volume, be more consistent in size, and contain suspended echogenic contents representing normal mucus or fat droplets. The feline prostate is not a discrete macroscopic structure, so it will not be ultrasonographically visualized, although it is present histologically. Although rare, prostatic carcinoma can occur in cats, so the proximal urethra should be evaluated in male cats. The proximal urethra is typically in an abdominal location and can be evaluated (FIGURE 9C).

**ADRENAL GLANDS**
TABLE 2 describes the ultrasonographic localization of the left and right adrenal glands in the dog and cat.

**Dog**
Canine adrenal glands appear as long, thin structures.
The left adrenal gland is often peanut-shaped in small-breed dogs (FIGURE 11A); it can appear pancake- or "lawn chair"-shaped in medium-sized and large dogs. The right adrenal gland is usually oval in small-breed dogs and pancake- or V-shaped in medium- and large-breed dogs. Normal adrenal gland sizes for dogs and cats have been reported. The commonly accepted normal height for the caudal pole of the canine adrenal glands is 0.5 to 0.741; however, recent studies have suggested taking the body weight of the patient into account for a more accurate size measurement. Clinical findings and results of additional diagnostic tests should be taken into account when adrenal gland measurements are obtained and interpreted.

Mineralization in canine adrenal glands is seen in adrenal neoplastic masses.

Cat
Feline adrenal glands are usually oval or bean-shaped, bilaterally symmetrical in size, and hypoechoic relative to the surrounding retroperitoneal fat. Two adrenal gland measurements have been proposed for cats: 4.0 to 4.6 mm in height and 5.3 mm in width. It is more difficult to see the distinction between the adrenal cortex and medulla in cats. Mineralization of the feline adrenal gland is considered an incidental finding (FIGURE 11B).

PANCREAS
The pancreas in the dog and cat can be isoechoic to the surrounding mesenteric fat and therefore not readily visualized. Decreasing the dynamic range of the image to create more contrast in the image can help in identifying the pancreas as it becomes more hypoechoic relative to the surrounding mesenteric fat.
Dog
In dogs, the right lobe of the pancreas (FIGURE 12A) is easier to identify based on its larger size relative to the left lobe and proximity to the descending duodenum. The canine pancreas generally varies in size depending on the size of the dog. The normal canine pancreatic duct is inconsistent in being identified. When present, the canine pancreatic duct appears as 2 hyperechoic parallel lines in the center of the pancreas.7

Cat
In cats, the left lobe of the pancreas (FIGURE 12B) is easier to identify because it is larger than the right lobe (the descending duodenum in cats is more difficult to identify because of its midline and dorsal position compared with the canine descending colon). The centrally located feline pancreatic duct can be routinely identified and is commonly used as a landmark to identify the pancreas. The feline pancreas duct diameter increases with age in normal cats (TABLE 1).8-10

GASTROINTESTINAL TRACT
The gastrointestinal tract of dogs (FIGURE 13) and cats (FIGURE 14) has 5 layers:

- Outer serosa (hyperechoic)
- Muscularis (hypoechoic)
- Submucosa (hyperechoic)
- Mucosa (hypoechoic)
- Inner mucosal-luminal interface (hyperechoic)
Each segment of the gastrointestinal tract (stomach, duodenum, jejunum, ileum, and colon) can be ultrasonographically distinguished based on wall layering and thickness. Ultrasonographic measurements of the individual wall layer thicknesses of the canine duodenum, jejunum, and colon have been proposed to assess gastrointestinal diseases that target specific wall layers or the entire intestinal wall segment. 

**TABLE 3** lists differences in overall wall thicknesses of the different intestinal segments as well as the appearance of the wall layering in dogs and cats. 

### Dog

The canine gastric submucosal layer is thin like that of the small intestine (**FIGURE 13A AND 13C**). Complete evaluation of the stomach can be limited by the presence of food material and/or gas, which is a common feature of the canine gastrointestinal tract.

The transition between the pyloroduodenal angle and proximal duodenum can be identified; the pyloroduodenal junction and cranial duodenal flexure are in a more lateral position in dogs than in cats. An intercostal right-sided approach may be necessary to identify the cranial duodenal flexure in a dog.

The canine duodenum is the thickest portion of the small intestine in the dog and normally has a thicker mucosal layer than the jejunum. The duodenal thickness in normal dogs varies according to weight.

The major duodenal papilla is located near the cranial duodenal flexure and appears as a hyperechoic, spindle-shaped structure located in the submucosa, with an area of eccentric thickening where the papilla is located (**FIGURE 4**).

### Cat

In cats, the rugal folds of the fundic portion of the stomach have a hyperechoic, prominent submucosal layer (**FIGURE 14A**) secondary to fat deposition. As in dogs, evaluation of the stomach can be limited by the presence of food material and/or gas; however, gas is less common in the feline gastrointestinal tract. The rugal folds in the region of the fundus become smaller at the transition to the gastric body and pyloric antrum (**FIGURE 13B**).

As in dogs, the transition between the pyloroduodenal angle and proximal duodenum can be identified; however, the pyloroduodenal angle is narrower and in a more midline and dorsal position in cats than in dogs.

The mucosal layer of the feline duodenum is thinner when compared with the duodenum in the dog. This is similar to that of the feline jejunum. The location and appearance of the major duodenal papilla are similar to those in the dog.

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**TABLE 3 Normal Wall Thicknesses of the Gastrointestinal Tract of Dogs and Cats**

<table>
<thead>
<tr>
<th></th>
<th>Dog</th>
<th>Cat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach</td>
<td>3–5 mm$^{25}$</td>
<td>2 mm (inter-rugal)$^{26,27}$ and 4 mm (rugal fold thickness)$^{26}$</td>
</tr>
<tr>
<td>Duodenum</td>
<td>&lt;5 mm$^{28}$</td>
<td>2.0–2.5 mm$^{27}$</td>
</tr>
<tr>
<td>Jejunum</td>
<td>2–5 mm$^{29}$</td>
<td>2.5–3.2 mm$^{27}$; thickest segment in the cat</td>
</tr>
<tr>
<td>Ileum</td>
<td>2–4 mm$^1$</td>
<td>1.4–2.5 mm$^{27,30}$</td>
</tr>
<tr>
<td>Colon</td>
<td>2–3 mm$^{29}$</td>
<td></td>
</tr>
</tbody>
</table>

Superscript numbers are reference citations.
The ileum is the thickest portion of the small intestine in the cat. The feline ileum has thicker muscularis and submucosal layers compared to the mucosal layer.

The cat has a common opening to the ileum, cecum, and colon called the ileocecal junction, whereas the dog has separate ileocolic and cecocolic junctions. The feline cecum is usually not gas filled and is therefore small and identifiable as the ascending colon called the ileocecal adenopathy. The jejunal lymph nodes are fusiform and are found lateral to the caudal abdominal trifurcation into the external iliac arteries and continuation of the caudal abdominal aorta (Figure 15A). The jejunal lymph nodes are elongated, oval structures surrounding the caudal mesenteric artery and vein and are seen to the right of midline at the level of the umbilicus. These lymph nodes are much larger in puppies and can be lobulated and have hypoechoic peripheral areas (Figure 15C). The jejunal lymph nodes are hypoechoic relative to the surrounding mesenteric fat.

**Cat**

In cats, normal medial iliac lymph nodes (Figure 15B) are often not seen. The jejunal lymph nodes are found to the right of the umbilicus, medial to the ileocecal junction and adjacent to the cranial mesenteric portal veins. These lymph nodes are oval or bean shaped and hypoechoic to the surrounding mesentery. The ileocolic lymph nodes in the cat are seen adjacent to the ileocecal junction and typically measure <3 mm in width. These lymph nodes are often enlarged and infiltrated when round cell neoplasia is present.

**ABDOMINAL LYMPH NODES**

**Dog**

The jejunal and medial iliac lymph nodes can be routinely seen in dogs. The medial iliac lymph nodes are fusiform and are found lateral to the caudal abdominal trifurcation into the external iliac arteries and continuation of the caudal abdominal aorta (Figure 15A). The jejunal lymph nodes are elongated, oval structures surrounding the caudal mesenteric artery and vein and are seen to the right of midline at the level of the umbilicus. These lymph nodes are much larger in puppies and can be lobulated and have hypoechoic peripheral areas (Figure 15C). The jejunal lymph nodes are hypoechoic relative to the surrounding mesenteric fat.

**SUMMARY**

Ultrasound differences between the dog and cat are important to recognize. When performing a thorough abdominal exam in either the dog or cat, one must keep these normal anatomic variations in mind to ensure accurate descriptions of ultrasound abnormalities that might be present.

**References**


Figure 15. Long-axis views of the right medial iliac lymph node in a normal (A) dog and (B) cat. Note the normal fusiform shape and relative isoechogenicity of the lymph nodes relative to the adjacent mesenteric fat. These lymph nodes are considered normal. Ao = abdominal aorta. (C) Jejunal lymph node from a 10-month-old male neutered Boston terrier. Note the increased size, lobulated appearance, and peripheral oval to fusiform hypoechoic areas (white arrowhead).

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