



Ultrasonography of the Gastrointestinal Tract and Pancreas of the Dog and Cat

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Ultrasonographic examination of the gastrointestinal (GI) tract is often challenged by the presence of gas and/ or faeces in the stomach and intestine. Despite this interference, ultrasonographic examination of the gastrointestinal tract is commonly performed^{1,2}.

Examination Technique

A sector or curvilinear transducer is preferred with frequencies 7.5-10 MHz in small dogs and cats and 3.5-5MHz in medium to large and in giant breeds of dogs. Higher frequency transducer allows better resolution for the evaluation of the gastrointestinal wall layers. Before the examination, if clinically possible, fasting for 6-12 hours to minimize interference by gas and ingesta is recommended. Some examiners recommend fluid administration through a stomach tube (approximately 15ml/ kg of body weight) for better examination of intraluminal and wall lesions of the proximal gastrointestinal tract. The stomach and duodenum that follows from the pylorus, and the colon that can be followed from dorsal to the bladder can be evaluated individually. For the remainder of the gastrointestinal tract a "castle"-scanning scanning pattern is recommended from both sides of the animal. Due to the fact that the gastrointestinal tract cannot be followed continuously from beginning to end ultrasonographic examination of the complete gastrointestinal tract cannot be guaranteed.

Normal ultrasonographic appearance

The stomach is easily identifiable caudal to the liver by its size, regular peristaltic activity (5 peristaltic waves a minute) and presence of rugae. In the stomach we can identify the

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rugae and the 4 wall layers: hypoechoic mucosa, hyperechoic submucosa, hypoechoic muscularis and hyperechoic serosa. A wide range of distension of the stomach may be observed during ultrasonographic examination. In dogs the gastric wall thickness can be up to 5mm when measured by ultrasound. In cats the stomach wall has been reported to measure between 2mm (inter-rugal thickness) and 4.4 mm (rugal fold thickness)³. The intestinal wall layers are also visible having the same echogenicity as for the stomach. Duodenal wall can be up to 5-6mm thick in dogs. The duodenal papilla can be identified with high-resolution equipment. In the descending duodenum, mucosal indentation may be seen along the antimesenteric border and most likely they represent Payer's patches. These indentations may be easily confused with duodenal ulcers, The difference lies with the fact that these indentations are not associated with wall thickening which is expected to occur with ulcerative lesions. Normal intestinal wall in the dog averages 4-5mm⁴. In the cat it has been reported to be 2.1mm for the small intestine and 1.7 mm for the colon³.

Abnormal Ultrasonographic Appearance

In the lumen of the GI tract we can normally see gas, chyme, faeces, mucous, ingesta and water. We should assess the peristalsis. For this it is recommended to keep the transducer still for 3 minutes to assess the motility of the stomach and upper GI tract. The wall layers should be assessed carefully. Sometimes a hyperechoic layer may be seen next to the luminal margin of the mucosa and this reflects the mucosal surface.

The abnormal intestinal wall may have a simple or multiple ring target-like appearance. Simple target appearance may be seen with inflammation, haemorrhage and neoplasia. Multiple ring target pattern is typical of intussusception. Hypermotility or ileus can be identified with ultrasound. The lumen should also be evaluated carefully for the presence of foreign bodies.

Hypertrophic thickening of the pyloric sphincter is the main ultrasonographic appearance of hypertrophic pyloric stenosis in the dog. It appears to affect mainly the muscular layer. Chronic hypertrophic gastropathy may appear as enlarged fluid filled stomach with reduced gastric motility. This finding is not specific and it mainly indicates severe gastric outflow obstruction.

Gastric ulcers appear as thickened gastric wall with a crater⁵. The crater appears as a distinct disruption of the mucosal layer. Gas bubbles and blood clots often accumulate at the ulcer site and appear hyperechoic.

Enteric duplication cysts may occur at any level. Ultrasonographically they appear as cystic structures intimately adherent to a gastrointestinal segment with a common or separated muscular layer between cyst and bowel.

Intussusception is characterised ultrasonographically by a multilayered series of concentric rings (multiple rings sign) representing the wall layers of the intussusceptum and the intussusceptiens^{6,7}.

The appearance of inflammatory diseases of the GI tract varies depending on the type and duration of the process. Commonly a thickened GI tract wall is identified with visible wall layers.

Incidence of GI tract tumours is low with adenocarcinomas being the most common malignant GI tract tumours in the dog and lymphomas in the cat⁸. The ultrasonographic

appearance of tumours varies and commonly they appear as focally thickened wall with loss of the layered appearance. Lymphomas in the dog and cat are characterised by uniform hypoechoic thickening of the wall. Regional or general lymphadenopathy can also be identified in the cases of GI tract neoplasia.

Ultrasonography of the Pancreas of the Dog and Cat

Ultrasonographic examination of the pancreas can be helpful in the determination of the presence, extent and severity of pancreatic lesion(s) and the identification of complications associated with pancreatic disorders. While pancreatic abnormalities are common in practice, definitive diagnosis is difficult due to the absence of pathognomonic clinical features of pancreatic disease.

A complete and optimal evaluation of the pancreas can be difficult because it is a small organ with indistinct ultrasonographic margins and similar echogenicity to the surrounding mesenteric fat¹. Consequently, anatomic landmarks must be used as reference points for identification of the organ and subsequent evaluation. Evaluation is further complicated by the proximity of the pancreas to gas containing structures, excessive breathing motion, obesity and inability to position the transducer in the best position due to abdominal distension and abdominal pain^{9,10}.

Indications for ultrasonographic examination of the pancreas include: evaluation of the pancreas in animals with suspected pancreatic disease including those with vomiting, signs of abdominal pain, palpable cranial abdominal mass, peritoneal effusion and persistent hypoglycaemia and aspiration or biopsy of the pancreatic lesions.

Examination Technique

Ultrasonographic examinations of the pancreas can be performed with the animal in lateral, dorsal or ventral recumbency. Usually a transducer 5-8.5 MHz, depending on the animal's size, will be adequate for the evaluation of the canine and feline pancreas. Small contact surface of the transducer is desirable due to easier positioning.

The pancreas is divided to right and left lobes and body. Anatomic references used for identification of the pancreas vary for the right lobe, the left lobe and the body. The right kidney, descending duodenum and pancreaticoduodenal vein can be used as landmarks for the right lobe. The pyloric antrum, right pancreatic lobe and portal vein can be used for the identification of the body of the pancreas. The stomach, spleen, transverse colon, splenic vein and portal vein can all be used potentially for the identification of the left limb of the pancreas⁹⁻¹².

Normal Appearance

The normal pancreas is a thin structure with homogeneous echogenicity and echotexture. It is normally hyperechoic to isoechoic compared to the hepatic parenchyma in the dog and cat^{9,10}. In cats it may also be slightly hyperechoic to the adjacent liver lobes. The pancreaticoduodenal vein, which appears as an anechoic longitudinal channel, can be used to confirm the identification of the right pancreatic lobe. The pancreatic duct is sometimes seen ventral to this vessel. The pancreatic body is hypoechoic to the

surrounding mesenteric fat. The left lobe of the pancreas, that has a triangular appearance, is hypoechoic to the spleen and may extend up to the level of the left kidney. The pancreatic duct may be seen as an anechoic structure running through the left lobe, more consistently in cats¹³. It can be recognised by the lack of a Doppler flow signal^{9,13}. In cats, it is more difficult to visualise the right lobe of the pancreas because it is relatively smaller while it is easier to visualise the left lobe, which is relatively wider¹³.

The Abnormal Pancreas

Pancreatitis may appear as multifocal hypoechoic, hyperechoic or mixed echogenicity areas in the pancreas with or without cavitory lesions. However, a large hypoechoic pancreas is the image most commonly expected in cases of pancreatitis. Other signs seen with pancreatitis are localised peritoneal fluid, thickening of the gastric or duodenal wall, displacement of the duodenum, biliary obstruction and focal lymphadenomegaly^{9,14-19}. The adjacent mesenteric fat may appear hyperechoic due to fat enhancement through an oedematous gland or fat saponification^{9,15,16}. In chronic diseases, areas of scarring or calcification may be identified¹¹.

Pancreatic neoplasia is less common than pancreatitis¹². It is difficult to distinguish pancreatitis from pancreatic neoplasia based solely on ultrasonographic findings. Insulinomas usually appear as distinct spherical or lobular hypoechoic nodules. Carcinomas are usually apparent as a mass that distorts the appearance of the gland.

Pancreatic abscess and pseudocyst are both cavitory lesions and may be hypoechoic or anechoic with a thick and irregular wall. The abscesses may appear like masses containing hypoechoic areas. An ultrasound-guided aspirate can differentiate abscess from pseudocyst. Abscesses contain an exudate composed mainly of degenerative neutrophils whereas pseudocysts contain viscous fluid with high trypsin-like immunoreactivity that confirms the pancreatic origin¹⁹.

Pancreatic oedema has been reported as a feature of experimental pancreatitis in dogs induced by cholecystikinin-8 or caerulein^{14, 20-23}. Pancreatic oedema can also occur in parallel with peritoneal effusion in dogs with hypoproteinaemia or abnormal portal haemodynamics. The pancreas contains anechoic fissures and there is evidence of extensive peritoneal fluid. Naturally occurring pancreatic oedema is probably an incidental finding and should not be confused with pancreatitis²⁴.

It has to be noted that normal appearance of the pancreas does not exclude pancreatic disease²⁵.

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