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Abdominal Ultrasound

Mini Series

Session 1:

Liver Spleen & Peritoneum

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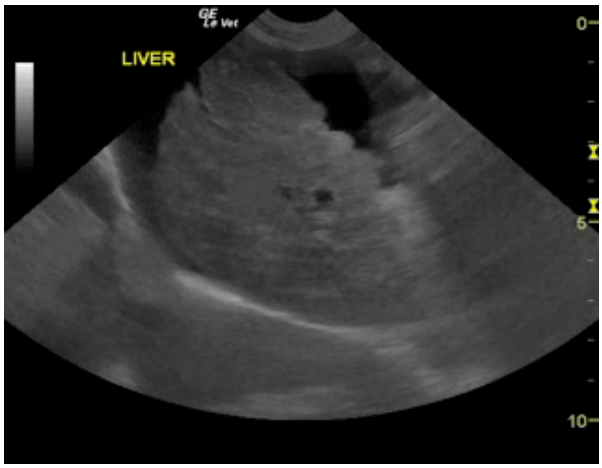

Abdominal Ultrasound Part 1

Liver, spleen and peritoneum

Scanning Technique

Patient preparation

For abdominal ultrasonography, the animal should be starved overnight. For abdominal ultrasound, panting and tense abdominal muscles can limit an ultrasound scan even in a co-operative patient, so sedation or even general anaesthesia is preferred, especially if sampling is planned. Hair clipping and the application of surgical spirit and or ultrasound gel is necessary to provide good contact between the ultrasound probe and skin as the ultrasound beam will not pass through air.

My routine protocol is to scan animals in right lateral recumbency, usually under heavy sedation or general anaesthesia, depending on the conformation of the animal, it is sometimes necessary to move the animal into dorsal or left lateral recumbency for a thorough scan. Probe choice will clearly vary with animal size and organ of specific interest. Proper positioning of the patient, ultrasound machine and sonographer is important, as it means that it is easier to concentrate on the scan and means that a more effective scan will be carried out and there is less risk of shoulder or back injuries to the sonographer. For a right handed person, position the ultrasound machine in front of you, with the patient comfortably on a table to your right, so that you can scan with your right hand and work the machine controls with your left, while comfortably looking at the machine and interpreting the images.

Liver

A general abdominal ultrasound usually starts with the liver. The probe is placed just caudal to the xiphisternum with the marker pointing cranially, producing a longitudinal midline view of the liver. Deep-chested animals or animals with a distended stomach may require that the probe is aimed cranially, and some pressure may need to be applied to the probe to attain an adequate image. Normal liver parenchyma is echogenic and homogeneous. Portal and hepatic veins are seen as anechoic round or tubular structures; portal veins can be distinguished because they have more echogenic walls than hepatic veins. The stomach is immediately caudal to the liver and can occasionally be confused with a mass; closer inspection will reveal its typically layered walls. The lung-diaphragm interface can be seen at the cranial aspect of the liver. Both the parenchyma and hepatic margins should be assessed. The probe is slid or angled slowly across to the left, still in the longitudinal plane to image the left lobes of the liver, and then back to midline to scan the entire left portion of the liver. Sometimes in large dogs, it is necessary to also rock the probe cranially and caudally because the entire liver may not fit in the field of view. As the probe continues to the right of midline, the gallbladder will be identified. The gallbladder may contain echogenic, dependent ‘sludge’ or even calculi, which are usually incidental findings unless the calculi migrate along the bile duct and cause obstruction. The portal vein enters the liver near midline, at the porta hepatis, which is an important area to evaluate in consideration of liver disease. This region includes the portal vein, hepatic lymph nodes, common bile duct, body of pancreas and gastric antrum. This area can be difficult to evaluate in conscious dogs as it is deep within the abdomen and may be obscured by bowel gas; a sub-costal or right intercostal approach can be used. After the longitudinal view, the liver should be examined in a transverse plane, by placing the transducer caudal to the xiphisternum again, but with the marker pointing to the right and then the ultrasound beam is swept

cranially and ventrally, through the midline and then to the left and right, so that the lateral margins of the liver can be assessed

Ultrasound evaluation of the liver parenchyma is unfortunately non-specific, alterations in parenchymal echogenicity can be easily identified as areas of increased, decreased or mixed echogenicity, but focal parenchymal changes have a wide variety of differential diagnoses; primary tumour, metastatic tumour, lymphoma, nodular hyperplasia, abscess, granuloma, necrosis, infarction, hepatocutaneous syndrome. Diffuse changes are similarly non-specific, and so sampling is almost always necessary for a diagnosis in these cases.

Irregular hepatic margination can be multiple hepatic nodules distorting the capsule, or chronic fibrosis. Rounding of the ends suggests caudal bulging and enlargement, although assessment of liver size using ultrasound is subjective and not as accurate as radiography.

The common bile duct is not normally visible in dogs, but when distended, it can be identified ventral to the portal vein. In cats, the normal common bile duct may be visualised, but should be less than 4mm in diameter. The extra hepatic ducts are found near the gallbladder neck, and may be traced to the common duct; again, these are not usually visible unless dilated. Intra hepatic duct dilation is known as the 'too many tubes' sign, as dilated intra hepatic ducts become visible clustered around portal vessels. Findings consistent with biliary tract obstruction should prompt thorough evaluation of the liver, biliary tract, pancreas, GI tract and lymph nodes at the porta hepatis, to try to determine the cause.

Spleen

The canine spleen varies greatly in size and position, which makes a thorough ultrasonographic assessment more difficult than might be expected. It has a

homogeneous finely textured parenchyma and is normally slightly hyperechoic to liver. Branches of the splenic vein may be identified at the hilus and in the parenchyma. The spleen is a superficial organ. Its head runs along the left lateral body wall, caudal and lateral to the stomach, and it is imaged by placing the probe at the ventral aspect of the caudal ribs and aligning the probe so that the beam runs parallel with the left body wall and then the beam is fanned gently to image the entire thickness of the splenic head, an orthogonal view is also often used. The body and tail of the spleen can then be assessed, it is usually necessary to reduce the depth for this, due to the thin, superficial nature of the spleen. The beam is then swept caudally and ventrally along the body of the spleen, in planes both transverse and longitudinal to the spleen, to try to ensure that the entire splenic body and tail are imaged. The spleen has a smooth echogenic capsule when the ultrasound beam strikes it perpendicularly, and this can help distinguish if abdominal masses are of splenic origin.

The spleen has a highly variable size, and so assessment of splenic enlargement is subjective, it can also be due to a variety of causes, including many sedative or anaesthetic agents. Focal splenic abnormalities are easier to identify than diffuse changes, but as for the liver, they are usually non-specific. Focal lesions are most commonly hypoechoic nodules, but can be hyperechoic or of mixed echogenicity. Differentials for focal abnormalities include nodular hyperplasia, extramedullary haematopoiesis, primary or secondary neoplasia, haematoma, abscess, infarct and myelolipoma (usually hyperechoic). Diffuse splenic abnormalities may result from diffuse neoplasia or occasionally an infectious or inflammatory process.

Splenic torsion typically results in marked splenic enlargement with diffuse anechoic areas and multiple parallel lines (representing dilated vessels) throughout the parenchyma, producing a lacy or ‘starry sky’ appearance. The mesenteric fat at the splenic hilus is also often very hyperechoic (due to oedema).

The Peritoneal Cavity

Abdominal Fluid

This is seen as anechoic areas separating the abdominal structures. Ultrasound has been shown to be more sensitive than radiology in detecting free fluid; small amounts of fluid are often detected around the apex of the bladder, and between the liver lobes, fluid will usually be found in the dependant portion of the abdomen. With large quantities of fluid, small intestine often appears to 'float' and the pancreas and lymph nodes are often easier to detect. The abdominal organs appear more echoic than normal due to lack of attenuation of the ultrasound beam by the fluid. Usually fluid is generalised, but can occasionally be localised, e.g. around the pancreatic region with pancreatitis.

The echogenicity of the fluid can give some indication to its nature; transudate and modified transudate are usually anechoic. Haemorrhage and exudate can appear echogenic. Peritonitis may also cause inflammation of the mesenteric and omental fat, which becomes swollen and hyperechoic; often the small intestine takes on a corrugated appearance.

Whenever fluid is identified in the abdomen, a thorough search for a possible cause should be carried out. Occasionally masses or nodules are evident on peritoneal surfaces.

Lymph Nodes

Normal lymph nodes are not easily seen during abdominal ultrasound; many are small and surrounded by mesenteric fat, if seen, they are usually hypoechoic and homogeneous. The most commonly identified parietal nodes are the medial iliac lymph nodes, these are large (up to 5mm in depth) and usually lateral and ventral to the bifurcations of the aorta or caudal vena cava, and they are usually single but may

be double on one or both sides. They receive afferent vessels from most of the caudal abdomen and hindlimbs. These nodes are part of the Iliosacral lymph centre, which includes several other more caudally placed nodes. Cranially, the Lumbar aortic lymph centre consists of several small nodes which lie adjacent to the aorta and vena cava, up to the level of the diaphragm.

The largest and most commonly identified visceral nodes are the mesenteric lymph nodes, which are usually in the mid-abdomen, in the jejunal mesentery. Smaller visceral nodes include the hepatic, splenic, gastric, pancreaticoduodenal and colic nodes.

Lymphadenopathy is seen as enlarged lymph nodes which are homogenous, hypoechoic and smoothly marginated, they often become more rounded, rather than their normal elongated shape. They may occasionally show distal acoustic enhancement; as they become very large, they may become irregular and heterogeneous. They can be successfully aspirated when large enough.

Abdominal Vessels

Thrombus formation may occur in many abdominal vessels; they are usually seen as hyperechoic areas within the vessel lumen, but occasionally can be hypo- or anechoic, and in those cases, can only be identified with Doppler (see below). Many systemic diseases can lead to a hypercoagulable state (commonly cardiac disease, hyperadrenocorticism and lymphoma) and thrombi may be identified in these cases. Their significance depends on their location.

Masses

Other types of mass not specifically associated with an abdominal organ may occur; abscesses, granulomas, haematomas, lipomas etc. Classically, abscesses have a thick wall and echogenic contents. They may show distal acoustic enhancement and may contain gas. Sublumbar abscesses or granulomas may occur secondary to

grass awn migration. Haematomas are usually hypoechoic and may be heterogeneous, they can be demonstrated to be avascular using Doppler.