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Feline Ultrasound Mini Series

Session One: Abdominal Ultrasound 1

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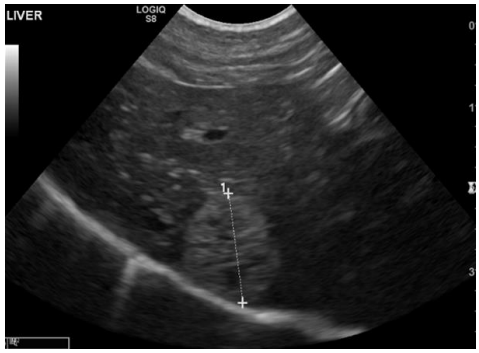

Feline Abdominal Ultrasound Mini Series: Session 1

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Basic Physics of Ultrasound

Sound is a mechanical longitudinal wave. It relies on particle motion and hence it requires a medium through which it can travel. Therefore, sound cannot travel in a vacuum. As a sound wave passes through a given medium, it causes particles in that medium to vibrate back and forth in the same direction (i.e. parallel) as that of the travelling sound wave. This occurs because sound is actually a travelling variation in pressure comprising alternating regions of high and low pressure.

Ultrasound is sound with a frequency >20kHz. This is above the audible range for humans. Diagnostic ultrasound generally uses a frequency range of around 4 to 15MHz although some transducers allow higher frequencies to be used, particularly for ocular ultrasound.

One of the simplest ways of understanding ultrasound and image generation is by looking at the pulse-echo principle. The transducer sends out an ultrasound pulse into the body. Echoes are generated at organ boundaries and within organs and then return to the transducer. At any given interface, an echo is produced but usually some of the ultrasound pulse is transmitted and echoes continue to be produced from deeper tissues. The echoes from ultrasound pulse are then used to create a scan line. The scan line is composed of multiple dots, each dot representing an echo. The location and brightness of the dot represent the location and strength of the echo. The location of each echo can be worked out if the direction of the initial ultrasound pulse is known and the time for the pulse to return is also known (distance = speed x time). The ultrasound machine makes two important assumptions. Firstly, the machine assumes an echo returns straight back to the transducer along the same direction the ultrasound pulse was emitted and secondly, it assumes a constant speed of 1540m/s. When these assumptions are incorrect, artefacts occur. Once all echoes have been received, the next ultrasound pulse is sent out by the transducer from either a slightly different origin and parallel to the first (i.e. linear image) or a different direction (sector image). By adding many (hundreds) of these scan lines together, a 2-D image is created and this is what we see on the screen of our ultrasound machine.

So how does the transducer create ultrasound pulses? The transducer is contains a specific type of crystal called a piezoelectric crystal. When an electrical voltage is applied to the crystal it results in deformation of the crystal shape and creation of an ultrasound pulse that is sent into the tissues of the body. When the pulse encounters an interface, an echo is created which travels back to the transducer and causes another alteration in shape of the crystal, which generates a voltage. The size of the voltage corresponds with the strength of the echo. This information is then used to create the image.

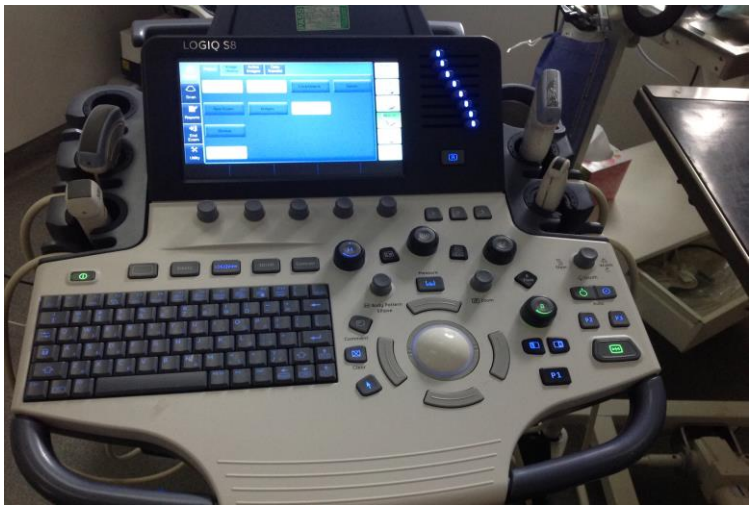
Interaction of Ultrasound with Matter:

An ultrasound pulse can interact with a tissue boundary in several different ways. When the ultrasound beam encounters an acoustic boundary, in most instances, part of the beam is reflected and part of the beam is transmitted across the boundary. Reflection can be categorised into two types – specular and non-specular reflections.

If the boundary is flat and smooth and larger than the wavelength of the incoming beam, then specular (mirror-like) reflection occurs. If on the other hand, the reflecting object is a rough surface and/or is the same size as or less than the wavelength of the ultrasound pulse, scatter occurs. Scatter is the redirection of the ultrasound pulse in many directions. This is a bit like when light from a car headlight passes through fog (i.e. suspended water droplets). The light from the beam is scattered and it is difficult to see through the fog. Scatter is beneficial in ultrasound imaging however, because it allows us to see echotexture of organ parenchyma.

Ultrasound knobology:

Generally, for a cat abdomen, I will use a linear probe for the whole abdomen however, if you only have access to a microconvex probe, it is fine to use this except some of the finer detail such as wall layering will be less clear.



There are a handful of knobs on the ultrasound machine that you should familiarise yourself with. Depth controls the depth of anatomy displayed on the screen. Depth should be adjusted such that an organ fills around two-thirds to three quarters of the depth of the image. Depth is often altered in conjunction with frequency. Frequency refers to the frequency of the ultrasound beam emitted from the transducer. Nowadays, most transducers allow a range of frequencies to be selected and we are no longer confined to a single frequency per transducer. Using a high frequency is desirable since this improves image resolution (and hence our image looks much nicer and more detailed). There is, as with all things however, a trade-off. As we increase frequency, ultrasound beam wavelength decreases and the ultrasound beam is attenuated (weakened – due to reflection, scattering and absorption i.e. conversion to heat) much more rapidly as it travels through body tissues. In practical terms, this means that with a high frequency, we can only image relatively superficial structures. If we decrease the frequency, wavelength increases and the depth of penetration of the beam into the tissues is much greater. However, because we are now using a lower frequency, image resolution is poorer so we see less detail. Fortunately, cat abdomens are typically quite narrow and hence it is usually possible to perform the entire abdomen using a high frequency. Sometimes I will also use a slightly lower frequency for the liver to ensure I have seen everything. It is common (more so in dogs than cats) to alter the frequency multiple times throughout a single abdominal ultrasound as you change from imaging superficial structures (high frequency, high resolution, low wavelength, low depth) to much deeper structures (low frequency, poorer resolution, long wavelength, greater depth of ultrasound penetration).

So to summarise, as a general rule of thumb, use the probe with the highest frequency that will still permit you to image to the depth that you require.

Altering gain has the effect of either increasing or decreasing amplification of the voltage created as a result of echoes returning to the transducer. Increasing overall gain increases the amplification of these voltages by the same amount and vice versa. Time gain compensation follows the same principle however it allows you to selectively amplify weaker voltages created from echoes returning from deep within the tissues.

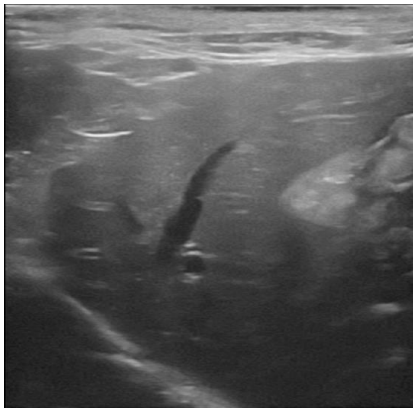
Power has a similar effect on the image as gain (i.e. increasing power or gain make the image whiter/brighter and vice versa) however increasing power works by increasing the initial voltage applied to the piezoelectric crystal to create a larger ultrasound pulse and hence more energy is driven into the patient.

To the right of the image, there is usually a small marker (exact appearance varies from machine to machine – usually an arrowhead or something similar) that identifies the level of the focal zone on a given image. The focal zone represents the depth of the best lateral resolution within the image. The focal zone should be constantly altered throughout the ultrasound examination so that it is always at the level of most interest within an image.

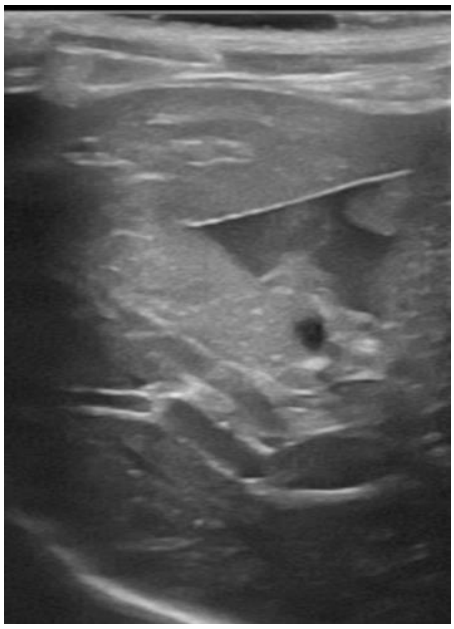
Ultrasonography of the Feline Liver

The diaphragm borders the liver cranially. The diaphragm is recognised on ultrasound as a highly echogenic, smooth curvilinear structure. Mirror image artefact is a normal finding at the diaphragm and can cause various structures including the liver and gall bladder to appear as if they are cranial to the diaphragm. The caudal margin of the liver is bordered by the stomach and/or spleen on the left and right kidney on the right, which sit in the renal fossa of the caudate liver lobe. It is important to evaluate the liver systematically to ensure all lobes have been interrogated. Individual lobes lie adjacent to one another and cannot usually be identified unless peritoneal effusion is present which causes separation of the lobes. I prefer the animal to be in right lateral recumbency at the start of the examination. Begin with the probe placed on the midline at the xiphoid sternum. The marker on the probe should be directed cranially. Begin by fanning cranially and then caudally to the starting position and then fan to the left and finally to the right. Rotate the probe through 90 degrees and repeat the first part of the process, now examining the liver in the transverse plane. Sliding the probe from one side of the costal arch to the other can also aid visualisation of the entire liver. Unlike deep-chested dogs, it is not always necessary to use an intercostal approach however, I have found that it can be helpful to examine the liver of obese cats using the same method but with the cat in dorsal recumbency.

Vessels are visible throughout the liver and these represent either portal veins or hepatic veins and may be distinguished based on appearance. Portal veins have echogenic walls whereas the walls of hepatic veins are not visible unless the vessel is directly perpendicular to the ultrasound beam (when the wall may appear as a thin hyperechoic line). Hepatic arteries and intra-hepatic and extra-hepatic bile ducts are not normally visible. Bile ducts may become visible if biliary obstruction and secondary intra-hepatic biliary dilation occurs. The common bile duct is located ventral to the portal vein at the porta hepatis and is often seen in normal cats.



Hepatic vein in the liver of a cat.



Portal veins in the liver of a cat.

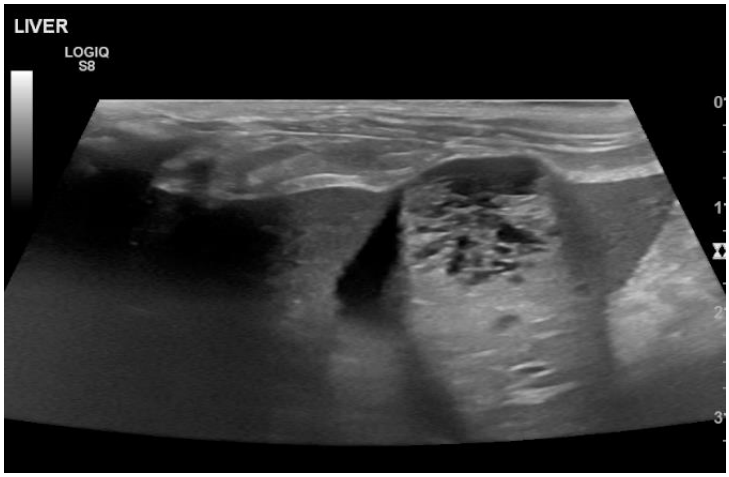
Ultrasonography of the liver should include an assessment of liver size, contour and echogenicity. Assessment of liver size on ultrasound is subjective and more difficult than assessing liver size radiographically. Liver lobes should be sharply pointed and smoothly marginated. Rounding of the lobes suggests enlargement. A liver that extends beyond the right kidney and/or to the level of the left kidney is also suggestive of enlargement. Take care not to confuse the falciform ligament with the liver as this can create a false impression of hepatomegaly. The falciform ligament lies ventral to the liver and contains a variable amount of fat. It may be distinguished from the liver due to its more coarse echotexture. It may be hyperechoic to the liver although is sometimes isoechoic and thus differentiation can be more challenging to the novice ultrasonographer. Obese cats may have a liver that is hyperechoic to the falciform fat.

The normal liver should have a coarse but uniform echotexture. Hepatic parenchymal lesions can be grouped into one of three categories: diffuse, focal or multifocal. Diffuse alterations in liver echogenicity can be difficult to detect and are subjective and the sonographer usually has to rely on either comparison with another organ such as the spleen or on experience. One of the easiest ways to assess liver echogenicity is to compare the left liver with the spleen. In cats, the spleen and liver are usually similar in echogenicity to each other.

It is important to compare the two organs at the same depth and frequency and preferably in the same image. In a liver that is diffusely hypoechoic, the portal vein walls, which are hyperechoic, will appear more prominent than usual and they may be seen extending right to the periphery of the liver. There are relatively few differentials for a diffusely hypoechoic liver which include acute hepatitis/cholangiohepatitis, congestion, lymphoma and amyloidosis. Whilst acute cholangiohepatitis in cats is most commonly associated with a hypoechoic or normal-appearing liver, it may also cause the liver to become mixed in echogenicity or even hyperechoic, particularly as the condition becomes chronic. Cholangiohepatitis is also frequently associated with thickening of the gall bladder and/or bile duct wall, gall bladder sludge, cholelithiasis and pancreatitis. Amyloidosis is a rare condition that affects young Abyssinian and Siamese cats although the condition has also been reported in Domestic Short Hair cats and a Devon Rex. In affected cats, large amounts of the amyloid protein is deposited in the liver resulting in hepatomegaly and disruption of normal hepatic function. It most commonly presents as a diffusely heterogenous liver containing both hyper- and hypoechoic foci. In severe cases, spontaneous liver rupture and fatal haemoabdomen can occur. Amyloid may also accumulate in the kidney leading to chronic renal failure.

Differentials for a diffusely hyperechoic liver include hepatic lipidosis, chronic hepatitis, cirrhosis, fibrosis, mast cell neoplasia and lymphoma. Hepatic lipidosis is more commonly seen in overweight cats that stop eating suddenly causing fat to accumulate within hepatocytes. The liver appears diffusely hyperechoic, enlarged and becomes hyperattenuating such that liver in the far field appears to become more hypoechoic than liver nearer the transducer. Therefore, the gain must be increased for the far field using time gain compensation. The liver can also appear diffusely mixed in echogenicity. Differentials for this include hepatitis, lymphoma, primary or metastatic disease, amyloidosis and a combination of conditions such as lipidosis and concurrent nodular hyperplasia. Cirrhosis typically results in a small hyperechoic liver, with hypoechoic nodules deforming the contour associated with peritoneal effusion. The irregular, heterogenous appearance could be confused with neoplastic infiltration however this would normally result in hepatomegaly.

Solitary hepatic and biliary cysts are occasionally identified in cats and appear as well-circumscribed, thin walled cavitated structures with anechoic contents and acoustic enhancement. The surrounding liver tissue is usually normal. Hepatic and pancreatic cysts may be seen in cats with polycystic kidney disease. Biliary cystadenomas are benign liver tumours of older cats that present as focal or multilocular cystic lesions within the liver. They are usually associated with distal acoustic enhancement due to fluid within the cysts which is hypoattenuating compared with adjacent soft tissue. They can grow to become very large and displace nearby organs such as the stomach and in such cases may be associated with abdominal discomfort and/or vomiting. Biliary cystadenocarcinoma, the malignant version of biliary cystadenoma, cannot be differentiated from the latter based on ultrasound appearance alone and biopsy is required.



Cystadenoma within the liver of an elderly cat.

Hepatic abscesses a rare in cats. They have a variable appearance but can appear as thick-walled, poorly defined and irregular, cavitated lesions with hypo- or hyperechoic contents that may show evidence of sedimentation. It gas is present within the abscess, echogenic foci associated with reverberation artefact will be visible. Surrounding fat may be echogenic due to inflammation and free peritoneal fluid and hepatic lymphadenopathy may also be present.

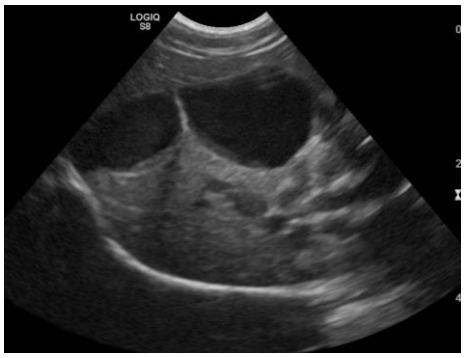
Hepatic granulomas and pyogranulomas tend to have an inhomogenous, hyperechoic appearance and vary in size. Whilst relatively uncommon, they may be present in certain conditions such as feline infectious peritonitis and feline eosinophilic fibroplasia.

Unfortunately, no ultrasonongraphic changes are pathognomic for one condition over another and there is much overlap between conditions such that different conditions can present with a very similar appearance on ultrasound and conversely, the same condition (such as lymphoma) can have several different ultrasonographic appearances. Therefore sampling is always necessary to achieve a definitive diagnosis. Fine needle aspiration can be performed under sedation whereas general anaesthesia is advisable for tru-cut biopsies. It is also advisable to check clotting function and in particular, platelet count, certainly prior to biopsy and potentially prior to fine needle aspiration also. A diagnosis can usually be reached by FNA in cases of hepatic lipidosis, hepatic lymphoma and mast cell neoplasia, cholestasis hepatitis and cholangiohepatitis. Ultrasound-guided tru-cut biopsy has the advantage of obtaining a larger sample of cells and hence a better chance of obtaining a diagnosis however it also carries a higher risk of complications, especially haemorrhage. It is always advisable to check for haemorrhage after the procedure. The use of an automated tru-cut biopsy gun has been linked a severe fatal reaction in 5 cats. This is thought to be due to the result of a pressure wave created by the device resulting in intense vagotonia and shock due to the strong spring mechanism of the gun. Thus, the use of an automated device is contra-indicated in cats. There have been no reports of fatalities associated with semi-automated devices. In a report on the accuracy of fine needle aspiration of the liver, there was agreement between the histological diagnosis and cytological diagnosis in around 50% of cats.

The Biliary Tree

The gall bladder is located just to the right of midline between the two parts of the right medial liver lobe in the cat and is usually encountered whilst fanning through the liver. In some normal cats, the gall bladder is bilobed creating a valentine-shaped gall bladder. Gall bladder size varies markedly depending on when a cat last ate.

Normal gall bladder wall thickness is <1mm. The cystic bile duct leaves the gall bladder and receives bile from extrahepatic hepatic ducts. Once the last extrahepatic duct has joined the cystic duct, it becomes the common bile duct. It is not uncommon for the proximal bile duct to be tortuous especially near the gall bladder neck in cats. The diameter of the normal bile duct lumen should not exceed 4mm in cats (3mm in dogs) and the wall should be <1mm thickness. In cats the common bile duct joins with the major pancreatic duct before enter the duodenum at the major duodenal papilla.



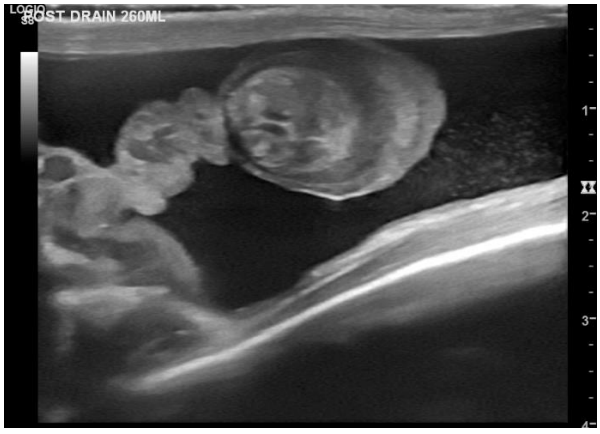
Bilobed gall bladder in a cat.

Gall bladder wall thickening (>1mm) can occur due to inflammation (cholecystitis, cholangitis, cholangiohepatitis) or oedema (biliary obstruction, portal hypertension, hypoalbuminaemia). Neoplasia of the gall bladder wall is very rare. Cholecystitis (inflammation of the gall bladder) and cholangiohepatitis may also be associated with the presence of sludge and or choleliths/sludge balls. A common indication for ultrasound of the icteric cat is to rule out common bile duct obstruction. Duct luminal diameter equal to or greater than 5mm is consistent with dilation and suggestive of extrahepatic biliary obstruction. The degree of distension is not helpful in terms of differentiating the cause of obstruction. Following complete obstruction of the common bile duct, the duct becomes dilated relatively quickly (24-48hrs). The gall bladder may also dilate however, in a study of cats with extrahepatic biliary obstruction, the gall bladder was dilated in less than 50% of cats. This may be due to low gall bladder wall compliance and/or reduced elasticity of the surrounding liver parenchyma. Therefore, lack of gall bladder distension is not sufficient to exclude the possibility of biliary obstruction. Within 5-7 days of obstruction, intra-hepatic biliary dilation occurs. Intrahepatic bile ducts closely follow portal veins. Dilated intrahepatic bile ducts may be differentiated from blood vessels because they appear tortuous (blood vessels are normally relatively straight) and by their lack of flow when Colour Doppler is applied. The appearance of dilated bile ducts is sometimes referred to as the ‘too many tubes’ sign. Extrahepatic biliary obstruction is most commonly due to obstruction of the distal common bile duct. In cats, the most common causes of obstruction include choledocholithiasis, and inflammation or neoplasia of the common bile duct, pancreas and duodenum. Pancreatitis can cause obstruction of the duct due to the close association of the right limb with the duodenal papilla/distal common bile duct. Chronic cholecystitis and cholangitis may be associated with obstruction due to the presence of inflammatory tissue and wall thickening. Inflammation of the biliary tree can also be associated with cholelithiasis and amorphous plugs blocking the common bile duct. Choleliths may be mineralised or non-mineralised. The former have an echogenic interface and depending on the size, may be associated with distal acoustic shadowing. This feature is normally absent in amorphous plugs. Neoplasia arising in the common bile duct, pancreas or proximal duodenum, is a less common cause of obstruction. The most common neoplasm of the biliary tree is carcinoma. Inflammatory and neoplastic causes of obstruction are usually associated with a longer duration of clinical signs than cholelithiasis, which tends to present more acutely although this is not an absolute rule.

It is also important to be aware that dilation of the biliary tree can persist after the obstruction has cleared. Dilation of intrahepatic and/or extrahepatic ducts is not pathognomonic of the presence of an extrahepatic biliary obstruction and may instead be due to non-obstructive hepatobiliary diseases.

The Peritoneal Cavity

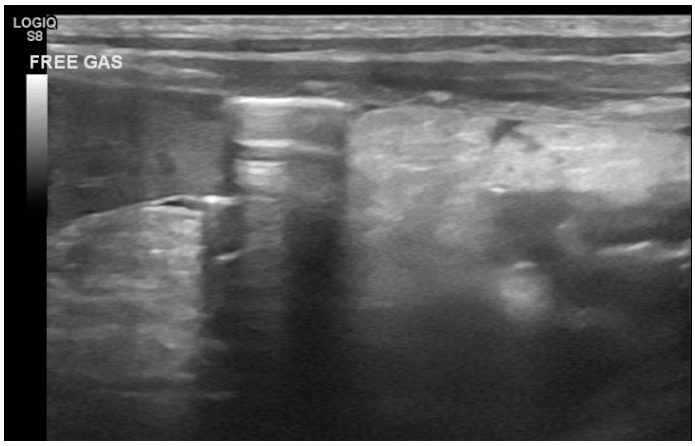
Ultrasound is more sensitive than radiography for the detection of small volumes of free fluid. Free fluid can accumulate anywhere in the abdomen but is often easiest to identify between the liver lobes cranially, around the bladder caudally and in the dependent portion of the abdomen. Attenuation of the ultrasound beam is much less as it passes through fluid compared with other tissues and hence organs deep to fluid will often appear unusually bright. This is due to the presence of fluid and should not be misinterpreted as organ pathology. Once peritoneal fluid has been identified in the feline abdomen, it is useful to assess the echogenicity of the fluid as this can provide a clue as to what the fluid might be. There are a large number of differentials for abdominal fluid including transudate, modified transudate, exudate, urine, bile and haemorrhage. Assessing echogenicity helps the sonographer to prioritise this differential list. Anechoic fluid is more likely to be a transudate or modified transudate or urine. At the most basic level, highly echogenic fluid usually indicates the presence of cells in the fluid. Broadly-speaking therefore, echogenic fluid most likely represents either haemoabdomen (red blood cells) or septic exudate (inflammatory cells) although there are other differentials such as chyle to consider. The most common cause of septic exudate is bowel rupture and a definitive diagnosis can be obtained by abdominocentesis. This is best performed under ultrasound-guidance to avoid inadvertently aspirating the spleen giving a false diagnosis of haemoabdomen.



Free fluid in a cat with FIP.

Pneumoperitoneum refers to the presence of air in the abdomen. Free peritoneal gas may be recognised as a focal hyperechoic line associated with reverberation artefact just deep to the non-dependent abdominal wall usually at or close to the highest point in the abdomen. Care should be taken not to confuse gas in the descending colon, which lies close to the left lateral abdominal wall, as free gas. The distinction can be made since colonic gas is separated from the abdominal wall by the thin wall of the colon. Causes of pneumoperitoneum include recent surgery, rupture of the gastrointestinal tract, penetrating trauma and abdominocentesis. The most common of these are recent surgery and rupture of the gastrointestinal tract. Free air can remain in the peritoneal cavity for several weeks following abdominal surgery. For this reason, the presence of free gas cannot reliably be used to assess for the occurrence of wound dehiscence in a patient that has recently had intestinal surgery involving an enterotomy or enterectomy.

In the absence of a history of recent surgery, the primary differential for pneumoperitoneum should be rupture of the gastrointestinal tract until proven otherwise. This is less common in cats compared with dogs but can be seen in cases of perforation following chronic linear foreign body, non-steroidal-induced ulceration and rupture of an intestinal mass. Free gas secondary to gastrointestinal rupture is almost always accompanied by echogenic free fluid and hyperechoic mesenteric and mental fat due to inflammation. Abdominocentesis usually involves the introduction of a small volume of gas into the peritoneal cavity and care should be taken not to over interpret this. It also follows therefore, that any assessment of free gas should be carried out prior to abdominocentesis to avoid false positive diagnoses. Penetrating trauma is a less common cause of pneumoperitoneum but should be considered where there is a known history of trauma such as a gun shot injury.



Pneumoperitoneum.

Ultrasonography of the Feline Spleen

In dogs the spleen is commonly visible on both orthogonal radiographic views of the abdomen. In cats however, it is not uncommon for the spleen to be poorly visible or not seen at all on abdominal radiographs. This is particularly true of the lateral view when the presence of the splenic tail is considered suggestive of splenomegaly.

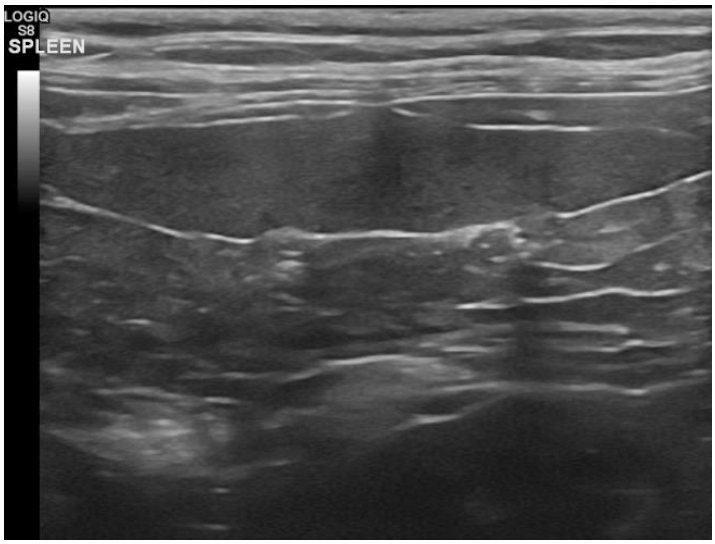
Normal anatomy

The head of the spleen is consistently located adjacent to the left lateral abdominal wall and just caudal to the gastric fundus to which it is attached by the gastrosplenic ligament. In cats, the body and the tail of the spleen are usually found superficially along the left body wall. To find the spleen, start with the animal in right lateral recumbency. Place the probe on the xiphoid sternum and then slide the probe dorsally and slightly caudally along the left flank, such that you are effectively following the costal arch/last rib. The spleen will appear as a boat-shaped organ in the near field of your image. If you are struggling to locate the spleen, it may be helpful to try moving the probe even more dorsally and be prepared to widen your clip. With the probe in the dorsal plane, examine the spleen by sliding the probe caudally and back again. Then rotate the probe by 90 degrees and repeat thus examining the spleen in two orthogonal planes.

Normal appearance of the spleen

The spleen is a strap-like organ in longitudinal section and triangular in cross-section. It typically has a fine, uniform echotexture (i.e. lots of small echogenic dots close together) compared with the coarser echotexture of the liver.

In dogs, the spleen is usually hyperechoic to the liver and renal cortices when machine settings and depth are standardised. In cats however, the spleen may be isoechoic or mildly hyperechoic compared with the renal cortices. In my experience it is quite common for the normal spleen to appear slightly patchy with the linear probe. It is important to become acquainted with the typical appearance of the feline spleen with each probe using your own machine. A thin echogenic capsule surrounds the spleen, which is only visible when the ultrasound beam is directed at right angles to the capsule. Since the spleen is located superficially within the abdomen, a linear transducer can be used if available, image depth should be reduced and the frequency increased to maximum in order to achieve optimum resolution. The splenic artery supplies the spleen, which is a branch of the celiac artery. As in the liver, splenic arteries are generally not visible without colour Doppler ultrasound. Intraparenchymal splenic veins however, are easily visible as tubular anechoic structures with thin echogenic walls travelling towards the hilar region of the spleen.

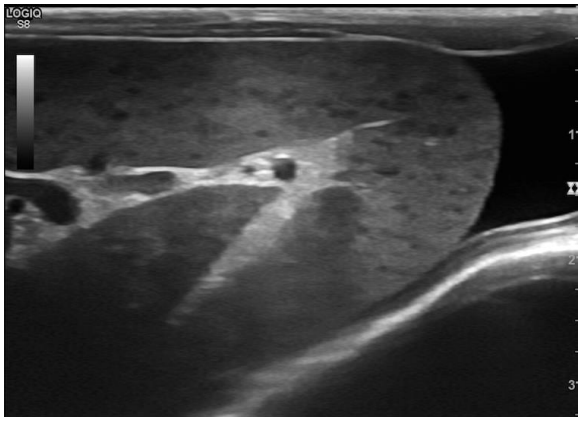


Normal appearance of the feline spleen.

Diseases of the spleen

Splenomegaly

Diffuse pathology of the feline spleen is much more common than focal nodules or masses. This is in contrast to the dog where splenic disease more frequently manifests as focal lesions. Assessment of splenic size in cats has traditionally been subjective however a recent study investigating the size of the feline spleen reported mean splenic width to be 26.7mm (SD 4.4mm) and thickness 8.2mm (SD 1.4mm). A feline spleen that is folded over on itself is generally considered to be enlarged. In dogs, acepromazine, thiopental, ketamine and diazepam but not propofol, have been shown to cause an increase in size of the spleen due to splenic congestion. It has been shown in cats that sevoflurane does not significantly alter the size or echogenicity of the spleen. In cats, the most common cause of splenomegaly is diffuse infiltrative disease particularly lymphoma and mast cell neoplasia, lymphoreticular hyperplasia, extramedullary haematopoesis, congestion and splenitis. Splenic echotexture and echogenicity may appear normal in cats with splenic lymphoma or mast cell neoplasia. Feline coronavirus has also been reported to cause splenomegaly in an otherwise unremarkable spleen.



Folded spleen in a cat with splenomegaly due to lymphoid hyperplasia and extramedullary haematopoesis.

Focal nodules/masses

Focal or multifocal splenic nodules and masses are not as common in cats as they are in dogs although the same differential diagnoses apply and include lymphoid hyperplasia, extramedullary haematopoesis (EMH), haematoma, neoplasia, abscess and granuloma. Haematomas, neoplasia and abscesses may appear cavitated. Haematomas typically reduce in size over time helping to differentiate them from tumours, which grow bigger. As in the liver, target nodules may be present in the spleen and whilst they can represent benign or malignant processes, are more commonly associated with the latter. In some cats, focal or multifocal, well defined strongly hyperechoic nodules are present in the spleen representing myelolipomas. They are often found surrounding splenic vessels in the hilar region and are usually small but can occasionally become very large. Myelolipomas are considered incidental findings and are also commonly present in the canine spleen. In a study investigating the ultrasonographic appearance of splenic disease in 101 cats, pathognomic changes were not recognised for any of the diseases. Even differentiating normal, benign and malignant changes is not possible. Therefore due to overlap in the appearance of different types of lesions, it is not possible to distinguish between them based on ultrasonographic appearance alone hence cytological sampling becomes essential for a definitive diagnosis.

Interventional Procedures

Fine needle aspiration of the spleen is a routine procedure. Non-aspiration techniques are preferable over aspiration techniques, which usually result in excessive haemodilution of the sample. Since aspirates of the spleen can be quite bloody, it is important to air-dry samples to avoid drying artefact of cells which can adversely affect interpretation of a smear.