

Abdominal Ultrasonography of Normal and Colicky Adult Horses

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Introduction

Ultrasonography is a valuable imaging modality for the diagnosis of acute and chronic gastrointestinal disorders and diseases involving the abdominal organs and urogenital tract. This lecture describes the technique of transcutaneous and transrectal ultrasonography, normal ultrasonographic findings, and features of common abdominal conditions associated with colic in adult horses.

Equipment and Patient Preparation

For better image quality, the hair of the patient should be clipped using a #40 surgical blade from the xiphoid process of the sternum to the pubis ventrally and bilaterally from the paralumbar fossa to the elbow, ventral to the lung fields.¹ The skin should be thoroughly cleaned. Alcohol and warm ultrasound coupling gel applied to improve contact. Proper preparation for transrectal ultrasound include adequate restraint of the patient, administration of sedation as needed, and use of obstetrical lubricant.² For transcutaneous evaluation, sector scanner transducers with frequencies of 2.5-5 MHz and 5-10 MHz microconvex linear array transducers are required. Transrectal ultrasonography can be performed with linear or microconvex linear array transducers with a frequency of 5-10 MHz.

Normal Gastrointestinal Tract

The stomach is normally visualized between the left 8th to 13th intercostal spaces.³ The stomach appears as a large semi-circular structure with a hyperechoic shadowing gas echo originating from the gastric mucosa. The wall thickness varies with the degree of gastric distention, but is usually less than 0.75 cm.²

The small intestine appears as small tubular and circular loops. The contents of the small intestine vary from a hyperechoic shadowing gas echo to hypoechoic or hyperechoic fluid, mucus or ingesta. The small intestine lacks sacculations and has frequent peristaltic contractions (6-15 contractions/min).² The duodenum is imaged around the caudal pole of the right kidney and medial to the right liver lobe.³ The jejunum is not normally seen ventrally owing to the interposed gas filled large colon. From the left side, the jejunum is usually visualized between the spleen and the stomach.³ The ileum is inconsistently imaged in the ventral abdomen in adult horses. The wall thickness of the duodenum and jejunum should be less than 0.3 cm, whereas the ileal wall can measure up to 0.4 to 0.5 cm.^{3,4}

The cecum is visualized in the right caudodorsal quadrant and the large intestine from the ventral and lateral aspects of the abdomen. The small colon can be imaged from the ventral abdomen only through a distended urinary bladder which is used as an acoustic window.³ The cecal and colons contents consist of gas or thick ingesta, which produce a semi-curved hyperechoic line casting an acoustic shadow from the mucosal surface. Sacculations are present except for the left dorsal colon. Peristaltic activity is normally subtle (2-6 contractions/min.).²

A small volume of anechoic peritoneal fluid is normally visualized between the abdominal organs and gastrointestinal tract, mainly along the ventral abdomen. Transrectal evaluation of the right caudal abdomen allows visualization of the base of the cecum dorsally and right dorsal colon ventrally. The duodenum is normally seen caudal to the right kidney. The mesenteric root and small intestine are imaged in the center of abdomen. The small colon can be visualized in the left caudodorsal quadrant dorsal to pelvic flexur.^{3,5}

Normal Abdominal Organs

The liver is normally imaged in the right 6th to 15th intercostal spaces and from the left 6th to 9th intercostal spaces.³ Atrophy of the right lobe of the liver is common in older horses.⁶ The liver has sharp, well-demarcated margins and a homogenous parenchyma of medium echogenicity containing a branching vascular pattern. The biliary system is not normally visualized unless distended.⁶

The spleen is visualized adjacent to the body wall from the left 8th intercostal spaces to the paralumbar fossa, extending in the ventral abdomen.³ The splenic parenchyma has a granular homogenous appearance and contains a few blood vessels. The spleen is the most echogenic abdominal organ.³

The right kidney is located between the 14th and 17th intercostal spaces adjacent to the abdominal wall.³ The left kidney can be imaged from the 17th intercostal spaces to the paralumbar fossa medial to the spleen.³ The right kidney is 13-15 cm long, 5-18 cm wide, and 5 cm thick. The left kidney is longer measuring 15-18 cm with a width of 11-15 cm, and is 5-6 cm thick.² The kidneys are the least echogenic abdominal organs.³

The urinary bladder is not imaged from the ventral window, unless distended, due to the gas present within the large intestine. The ureters and urethra cannot be visualized unless abnormally distended; except for the proximal portion of the right ureter.³

The transrectal approach is useful for the evaluation of the caudal edge of the spleen and left kidney adjacent to the left dorsal and lateral abdominal wall. The bladder appears as an oval or round structure with a hypoechoic wall cranial to the pelvic brim. The bladder contains anechoic to hyperechoic fluid depending on the degree of urine, mucus and crystals present.⁵ The size, location and wall thickness of the

bladder vary upon the degree of urine distention. Normal wall thickness should measure between 0.3-0.6 cm.³ The entry of both ureters can usually be imaged in the dorsolateral aspects of the bladder wall. The pelvic urethra can often be followed caudally, mainly in male.⁵

Pathologies Involving the Abdominal Cavity and Gastrointestinal Tract

Gastric dilatation and impaction are characterized by an enlarged stomach distended by anechoic to hypoechoic fluid secretion or hyperechoic shadowing material. Thickening of the gastric wall occurs with neoplasia, gastritis and gastric ulceration. Gastric squamous cell carcinoma usually appears as a mural mass of complex echogenicity.³

In the presence of simple mechanical obstruction, the small intestine diameter is usually markedly increased in the pre-stenotic and affected segments, while the post-stenotic segment appears empty. The wall thickness is normal but may increase with time. The peristalsis is maintained unless distention is persistent preventing resolution of the problem.² Functional ileus is characterized by little to no motility of the affected segment. The diameter and wall thickness may be normal or increased.³ The diameter of the pre-stenotic and affected segments involved in a strangulation lesion is usually greater than 3 cm. The wall thickness is often increased and the motility absent.² The affected loops appear turgid and sedimentation is seen in absence of motility (Figure 1).



Figure 1. Sonogram of a small intestinal volvulus with distended small intestine loops filled with anechoic fluid.

With enteritis, the small intestinal distension can be mild, moderate or severe. The wall thickness of the affected segment is increased with presence of mucosal irregularity. The peristaltic contractions are increased, normal or reduced.³ With any small intestinal lesions, the distended loops and sometimes the stomach, contain anechoic to hypoechoic fluid secretion.

Ultrasonography has limited value in the diagnosis of tympany, spasmodic colic, displacement and torsions of the cecum or colons.^{2,3} Changes in the location, motility and contents of the affected segment and secondary enlargement or atrophy of other abdominal structures can be indicative of gas distention or primary malposition of the cecum or colon. Characteristics of nephrosplenic entrapment include inability to image the left kidney and ventral displacement of the spleen. The dorsal aspect of the spleen appears as a straight border due to the dorsal displacement of the large colon over the nephrosplenic ligament⁷ (Figure 2).

Impactions are characterized by round distended viscus lacking visible sacculations. The peristalsis is absent and the wall thickness is usually normal to slightly increased. Fecal impaction appears as a hyperechoic line casting an acoustic shadow from the mucosal surface, whereas small hyperechoic particles causing reverberation artifacts are consistent with sand impaction⁸ (Figure 3).

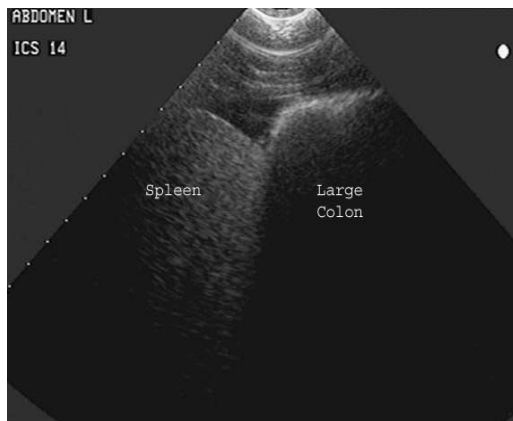


Figure 2. Sonogram of entrapment of the large colon in the nephrosplenic space.

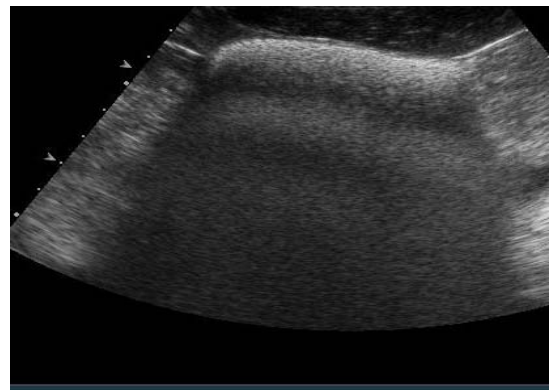


Figure 3. Sonogram of a sand impaction involving the large colon.

Ultrasound findings associated with colitis and typhlitis include increased wall thickness, fluid-filled lumen, variable degree of distention and change in the motility pattern. Intussusceptions have a characteristic target or bull's eye sign in a cross-section view which corresponds to the intussusceptum present within the intussusciptum.⁹ Infiltrative bowel diseases and neoplasia are characterized by localized or diffuse echogenic thickening of the gastrointestinal wall.

In the presence of an inguinal, abdominal wall or diaphragmatic hernia, ultrasonography is helpful in determining the size of the defect, contents of the hernia, integrity of incarcerated bowel, and the presence of adhesions (Figure 4).



Figure 4. Sonogram of a diaphragmatic hernia. Notice the spleen present within the thoracic cavity.

Strangulating lesions, inflammatory conditions, septic peritonitis, hemorrhage and neoplasia can result in an increase in volume and echogenicity of the peritoneal fluid due to the production of cellular material. With peritonitis, fibrin and adhesions of the viscera and/or peritoneum can be visualized. Particulate matter and free gas echoes are usually present if gastrointestinal rupture occurs.¹ The gastrointestinal tract is usually amotile or hypomotile, and has an increased wall thickness due to the surrounding inflammatory/infectious process. Hemoperitoneum appears as free swirling, homogenous, hypoechoic fluid. Hypoechoic to hyperechoic blood clots may subsequently develop.

Abdominal abscesses are variable in appearance being poorly margined or surrounded by a well-defined capsule. The abscesses contain anechoic to hypoechoic fluids or echoic material and are sometimes multiloculated.³ The presence of hyperechoic gas echoes within the abscesses is consistent with anaerobic bacterial infection.

Pathologies of the Abdominal Organs

Acute liver diseases are characterized by an enlarged liver with rounded margins and alteration of the echogenicity of the hepatic parenchyma.¹ Chronic conditions are associated with increased parenchymal echogenicity, decreased liver size with loss normal architecture and vascular markings.² Features of diseases affecting the biliary system include distension and thickening of the wall of the bile ducts. Hepatoliths and choleliths appear as hyperechoic structures casting strong acoustic shadows with secondary thickening and distention of the biliary tree.⁶ Focal lesions, such as abscesses and neoplasia, may be single or multiple and have a hypoechoic, hyperechoic or mixed echogenicity.² Generalized increase of the liver echogenicity occurs with diffuse neoplasia.

Splenic hematomas contain anechoic to hypoechoic fluid initially then become hyperechoic and loculated as fibrinous clots formation occurs and can lead to

hemoperitoneum.² Features of splenic abscesses and neoplasia are as described for the liver.

Acute renal conditions are characterized by enlarged kidneys, hypoechoic or hyperechoic parenchyma, poor definition of the cortico-medullary junction, and often perirenal edema.³ Chronic renal failure is associated with small irregular kidneys with increased echogenicity and loss of normal architecture.² Renal pelvis distention by hypoechoic fluid is usually associated with pyelonephritis. Uroliths appear as irregular, hyperechoic structures casting strong acoustic shadow and may affect the kidneys, ureters, urinary bladder and urethra (Figure 5).³

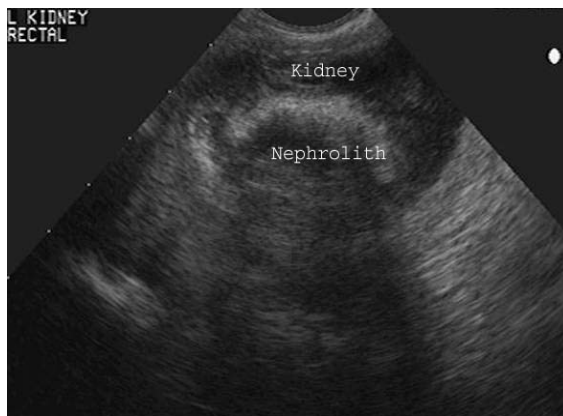


Figure 5. Transrectal ultrasonogram of a nephrolith.

Obstructive uroliths can result in marked distention of the proximal urinary tract. Such as for the liver and spleen, renal abscesses, hematoma, and neoplasia can have variable ultrasonographic appearances.

Cystitis is characterized by diffuse increased wall thickness whereas neoplasia usually appears as localized thickening or discrete masses projecting within the lumen.² Ruptured bladder leads to uroperitoneum. The affected bladder is usually collapsed and folded on itself and contains little or no urine.³

Conclusion

Ultrasonography is safe, noninvasive, reliable, and can be performed with readily available equipment. Diagnostic ultrasonography of the abdomen is a valuable adjunct to the evaluation of horses with signs of acute or chronic abdominal pain. The information obtained can lead to a prompt decision between medical management and surgical intervention which contributes to improved outcome.

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