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Ultrasonographic Imaging of the Adult Equine Acute Abdomen

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Take Home Message

This paper will describe a rapid, systematic examination protocol for ultrasound evaluation of the adult colic patient. Once the clinician is comfortable with the normal ultrasonographic anatomy and alterations commonly seen in the wide spectrum of colic disorders, they should be able to quickly categorize the condition into gastric, small, or large intestinal disorders in order to add important information to the total colic examination procedure. The overall objective is to provide the horse owner with a more rapid and accurate diagnosis and recommended treatment for their horse.

Introduction

Besides the physical examination, ultrasound is the author’s next step in the evaluation of the critical colic patient. Rectal examination remains useful, but is limited to structures that are within of the examiner in the caudal abdomen. The abdominal cavity reaches cranially to the diaphragm just caudal to the heart. A systematic approach to the ultrasonographic evaluation of the abdomen allows for rapid assessment of location, characterization, and content of multiple intra-abdominal structures.

Understanding Ultrasound Equipment

A variety of options are available in the offerings of ultrasound equipment. Newer, more portable devices are coming on the market each year – both digital and in laptop configurations. Some understanding of the physics of ultrasound is necessary – mainly in understanding the principles of frequency. The higher frequency wavelengths provide more detailed images, but less (more shallow) tissue penetration. An example being a 12- mHz probe is usually used for tendon imaging… providing excellent image quality with fine detail, but unable to visualize anatomic structures more than a few centimeters deep to the skin. Alternatively, a 1.9-mHz probe provides adequate depth of penetration to image the entire equine heart, but does not produce the fine detail image of the high frequency probe. The type of probe used should be appropriate to the body region being evaluated. The smaller, microconvex probes are good for accessing small body parts, especially in tight confined areas such as the inguinal region. The curvilinear 3.5 mHz probe is probably the best all-around probe for general abdominal imaging of the colic patient. Various other probes may be used for additional evaluation (higher frequency, higher detail probes for more detail of the serosal surfaces, or lower frequency probes to penetrate large volume effusions or to evaluate the pregnant uterus).
Patient Preparation

Preparation of the area to be imaged is also an issue. Some coupling material is required for the sound waves to penetrate the hair and skin. For most situations, isopropyl alcohol alone is used to wet down the hair coat without clipping. This may degrade the surface material of the probe over time. On some occasions, clipping the hair and application of a contact gel will be required to achieve the best detail in the image.

The Ultrasound Exam

The practical part of the ultrasound examination is that it can be quickly performed immediately following the physical examination. In some situations, it can be performed prior to the rectal examination. For the abdomen, a systematic approach is helpful as with the physical examination. The author prefers a system starting cranially on one side – just caudal to the elbow, progressing caudally, imaging all appropriate structures on that side, and then repeating the process on the contralateral side. This way, a complete examination of the body cavity is performed in an effort to determine the nature of the disease process. On the left side, one would start near the elbow – scanning dorsal-to-ventral in each intercostal space to include the ventral lung margin and diaphragm. Most cranially - observing the liver, moving caudally to observe the stomach and its contents (mainly looking for excessive fluid volume as would occur with intestinal obstruction), and the spleen. The spleen-stomach relationship is important to identify on the left side (Fig. 1). Evaluation of the stomach content and size can be determined. The typical adult gastric profile is visible over 3-4 intercostal spaces. Colonic displacements or epiploic foramen entrapments can obscure the normal stomach-spleen image. Small intestinal segments are usually observed in the caudal-ventral abdomen just medial to the ventral margin of the spleen. Normal small intestine rarely contains luminal fluid, and will often be seen as variably motile structures between the medial surface of the spleen and the colon.

Figure 1. Spleen-stomach relationship on the left side.
In the recently postpartum mare, imaging just beneath the flank fold and caudally into the inguinal region can be helpful in evaluating the broad ligament for the presence of hematomas. In the dorsal-caudal abdomen, the left kidney and nephrosplenic space should be visible (Fig. 2). Moving to the right side, beginning again at the elbow, the colon wall will be seen just caudal to the diaphragm. In some patients, some segments of small intestine can be present. Moving caudally, beneath the diaphragm the liver can be identified, and eventually, the duodenum will be present between the ventral-medial surface of the liver and the right dorsal colon (Fig. 3). Its course can be traced caudally to its turn medially just beneath the right kidney. This is important to be able to identify for evaluation of distension from small intestinal obstructive diseases or thickening as would occur with primary diseases of the duodenum such as the gastroduodenal ulcer syndrome. In older horses (teens and upward), the right lobe of the liver will often have atrophied and may not be visible beneath the right lung margin. Ventrally and caudally, the colonic and cecal surfaces can be seen. In the mid-ventral abdomen, some segments of small intestine may be visible. When evaluating for colonic displacements, identification of the vasculature of the medial mesocolon can be useful. The presence of the vasculature of the large colon against the body wall implies either a displacement or at least a partial torsion of the colon.

Figure 2. Spleen, left kidney, and nephrosplenic space on caudodorsal left abdomen.

Figure 3. Normal duodenum, between ventral-medial aspect of liver and right dorsal colon.

Gastric Disorders

Gastric distension usually implies a more distal obstructive process as opposed to primary gastric obstruction (Fig. 4). Most often ultrasound cannot differentiate gastric distension from intestinal obstruction from that caused by ileus. Profound distension of the stomach with free-floating omentum may imply impending gastric rupture. The earlier the gastric distension is detected during the examination process, the sooner relief of pain can be provided by passage of a nasogastric tube. In fact, ultrasound can be useful in evaluating the success of gastric decompression. If the patient’s heart rate remains high, or it remains painful, and a distended stomach is still observed during ultrasound examination, then the decompression may not have been successful and should be repeated.
Gastric impaction is difficult to diagnose on ultrasound alone, but can be inferred by observing the presence of an expanded gastric profile over a larger than normal area on the left side (5-7+ intercostal spaces). Additional evaluation, including gastroscopy, may be necessary to be confident of the diagnosis. Serial evaluation using ultrasound can be performed to evaluate response to management.

Small Intestinal Disorders

Often, the challenge is to identify the presence of small intestinal distention before it is palpable per rectum, or to differentiate between a strangulating obstruction of the small intestine and non-strangulating disorders such as ileus or enteritis. The presence of fluid or gas filled small intestine should be considered abnormal. Strangulating obstructions (volvulus or entrapment by strangulating lipomas) can result in profoundly distended, non-motile segments of small intestine with tendency toward sedimentation of luminal contents to the ventral aspect of the abdomen (Fig. 5). In the Gulf Coast and southern US, the incidence of ileal impactions is much higher, and this lesion can appear very similar to strangulating obstruction of the small intestine (Fig. 6). Clinical experience and evaluation of the patient’s history and clinical course must be taken into account when observing fluid-distended, poorly motile small intestine in geographic regions where this entity is common. Additional clinical diagnostic measures (such as abdominocentesis) may be needed to differentiate ileal impaction from strangulating lesions of the small intestine. Enteritis is generally viewed as fluid distension of the lumen, with variable motility and variable thickening of the intestinal walls (Fig. 7). Ileus often appears similar to (and can occur concurrently with) enteritis with variably motility and variable thickening of the intestinal wall, and with molding of the intestinal segments against each other. Strangulating obstructions of the small intestine tend to have more profound luminal distension with minimal motility and tendency toward sedimentation of particulate material to the ventral aspect. There is a time course involved with changing appearance over time following strangulation. Early in the course,
the intestinal wall thickness may be thin with some persisting motility present, and with progression of strangulation and vascular congestion, the wall thickness increases with devitalized small intestinal having a markedly thickened wall and a less distinct serosal surface. Clinical information such as concurrent fever and leukopenia and neutropenia will be supportive of the diagnosis of enteritis. Some specific small intestinal lesions include epiploic foramen entrapment – suggested by multiple segments of poorly motile small intestine in the left cranial abdomen, and ileocecal intussusception – sometimes the small intestinal segment can be observed within the cecal lumen if surrounded by fluid. Scrotal and inguinal herniation of small intestine is generally self-evident, and the contents of the hernia can be rapidly confirmed using ultrasound (Fig. 8).

Large Intestinal Disorders

Ultrasound can be used to evaluate the position and contents of the large intestine.
Cecal Disorders

As just mentioned, ileocecal intussusceptions can be occasionally identified on ultrasound. Cecocolic and cecocecal intussusceptions can also be identified, generally with the thicker multiple edematous layers of the intussuscepted portion being visible within the liquid contents of the colon (Figs. 9 and 10). Cecal impaction is generally not easily identifiable by ultrasound alone.

![Figure 9. Longitudinal view of trilayer appearance of edematous cecal wall within lumen of right ventral colon consistent with cecocolic intussusception.](image1)

![Figure 10. Transverse view of trilayer appearance of edematous cecal wall consistent with cecocecal intussusception.](image2)

Large Colon Disorders

Ultrasound has become a tool to aid in identification of colonic displacements with the nephrosplenic entrapment being most commonly and easily identified. Generally, the presence of colon along the dorsal aspect of the left peritoneal cavity with some evidence of medial displacement of the lateral splenic capsule is confirmation of this lesion (Fig. 11). Right dorsal displacements and colon torsions can result in observation of the medial colonic vasculature against the body wall (Fig. 12). Rectal examination is still useful in further characterization of colon position within the abdomen, and to further evaluate colonic contents. Colon impaction still requires rectal palpation for detection and confirmation, as it is difficult to differentiate the character of solid colonic contents on ultrasound alone. Large colon volvulus often presents with characteristic clinical signs of acute onset of profound abdominal pain and abundant gas distended colon palpable on rectal examination. In some situations where abdominal ultrasound is performed on these patients, the operator may observe edema of the wall of the large colon (Fig. 13).

Other Abdominal Disorders

Ultrasound can be useful in identifying various disorders within the abdominal cavity that do not have a primary intestinal lesion. Postpartum disorders like uterine artery rupture with hemoperitoneum or peritonitis secondary to a uterine tear are common scenarios where
ultrasound provides critical diagnostic information. It is also helpful in characterizing peritonitis secondary to gastrointestinal rupture. An uncommon disorder that can be identified using ultrasound is a diaphragmatic hernia. In some cases, the muscular portion of the diaphragm will be absent with intestinal or other abdominal structures being observed directly adjacent to the heart or lungs.

Figure 11. Nephrosplenic entrapment with large colon present in the nephrosplenic space, obscuring observation of the left kidney and displacing the spleen medially.

Figure 12. Vessels of medial mesocolon of the large colon positioned laterally against right body wall with right dorsal displacement.

Figure 13. Thickening of the wall of the large colon with edema secondary to large colon volvulus.