THE FLASH TECHNIQUE FOR EQUINE ACUTE COLIC

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Now that normal ultrasonography of the abdomen has been reviewed, let's put it into practice. There are many indications for performing transabdominal ultrasonography in the horse, including acute or chronic abdominal pain, weight loss, inappetance, and fever of unknown origin, to name a few. You may be using transabdominal ultrasonography because there are specific clinical signs or physical findings that are directing your attention to a particular organ or area (i.e. stomach, liver, or kidney) that you would like more information on, or it may be that the signs are nonspecific, and the entire abdomen is being scanned. Reviewing all abnormalities of the equine abdomen is beyond the scope of this review. However, since "colic" is a frequent clinical complaint of the horse, this review will focus on use of transabdominal ultrasonography as a guide to the diagnosis of equine abdominal pain. It is important to note, the transabdominal ultrasonography only occasionally leads to a definitive cause for the painful equine abdomen. In other words, transabdominal ultrasonography of the equine abdomen is an ancillary diagnostic aide that must always be interpreted in conjunction with the signalment, history, clinical signs, and other diagnostic findings. With an acute abdomen patient though, time is an essential factor and thus the FLASH[11] technique will be reviewed. FLASH is the acronym for Fast Localized Abdominal Sonography of the Horse and basically involves sonography of seven to eight key regions of the abdomen. Each of those regions will be reviewed below. With a little training, the FLASH method should be able to be completed in less than 10 minutes.

AREA 1 LEFT: THE STOMACH

In general, the ultrasonographic view of the stomach is limited, and thus diagnostically, the information gained is also somewhat limiting. **Gastric distension,** as evidenced by gas or excessive fluid reflux when a nasogastric tube is passed, is a sign of delayed gastric emptying or proximal obstruction or inflammation. Gastric distension can be verified by transabdominal ultrasonography simply by the size or position of the stomach.[1] Normally, the stomach wall does not extend beyond the 13th intercostal space. If the stomach is distended with fluid, in addition to the stomach wall being visualized beyond the 13th rib, a gas/fluid interface may be present. **Gastric impactions** are very rare and may also result in gastric distension, depending on the size of the ingesta bolus. However, because gas is usually also present in the stomach when a gastric impaction is present, the impaction per se may be obstructed by gas. Because **gastric ulceration** in horses commonly occurs along the margo plicatus, especially at the lesser curvature of the stomach, an area difficult to capture ultrasonographically, gastric ulceration is difficult to document by ultrasonography in the mature horse. However, thickening, edema (distinct hypoechoic layer in the wall), or "pitting" of the wall are findings suggestive of gastric ulceration.[2] In general, gastric impactions and ulceration are less reliably detected on transabdominal ultrasonography and 3-meter endoscopy is recommended to secure these diagnoses. Also examine this area for small intestine. When the stomach is empty, rarely you can see small intestine between the stomach and the spleen; however, distended or thickened small intestine should not be visible.

AREA 2 LEFT: THE LEFT KIDNEY AND SPLEEN

The left kidney and spleen should be adjacent to each other. If the **left colon is dorsally displaced** and entrapped in the nephrosplenic ligament, gas within bowel will be seen dorsal to spleen, between spleen and left kidney, which usually obliterates the left kidney from view or lateral to the spleen.[7] Displacements and impactions of the colon should be palpable per rectum. Note that gas distension of the left colon can obscure ultrasonographic visualization of the left kidney without the colon being displaced. The left kidney should have good cortiomedullary distinction. Hydronephrosis and hydroureter may be present with nephroliths or ureteroliths.

AREA 3 LEFT: THE LEFT COLON

Many disorders of the large colon may be palpable by rectal examination, and thus transabdominal ultrasonography is an ancillary tool. Remember that the left dorsal colon has no sacculations. In areas in which the colon is not reachable rectally or with some more obscure diseases of the colon, ultrasonography may be the essential tool that secures the diagnosis. For example, sometimes a horse presenting in the early stages of colitis, before diarrhea develops, is quite colicky and little is palpably abnormal on a rectal examination. On ultrasonography, the colon wall will be thickened and edematous in some cases of colitis. Fluid contents to the colon is another helpful finding with colitis. Motility will be variable. Diagnosis of a left colon impaction can be secured via rectal examination but sonography of left colon impactions may reveal loss of sacculations. Sand and gravel may cast small acoustic shadows.

AREA 4 LEFT: THE JEJUNUM IN THE LEFT LOWER FLANK

There are several differential diagnoses for thickened wall or distended small intestine. Ultrasonographically, thickened or distended small intestine often looks the same, despite the etiology. However, using a combination of clinical signs and some distinguishing ultrasonographic features can be helpful in securing a diagnosis, especially if the affected portion of small intestine cannot be felt by transrectal palpation. The wall of the small intestine can be **thicker** than normal (i.e. > 4 mm) from inflammation, edema, hypertrophy, or neoplasia. Some causes of inflammation and edema are acute in nature, i.e. "**proximal or anterior enteritis,"** and some causes are chronic or insidious in nature, such as the **inflammatory bowel syndromes (i.e. granulomatous enteritis, eosinophilic enteritis)** or idiopathic intestinal hypertrophy**.** In addition to the clinical signs of proximal enteritis (low grade fever, gastric reflux, inflammatory leukogram, pain followed by depression after gastric decompression), the mucosa wall of the small intestine may appear corrugated or wavy,[2] like the edge of a lasagna noodle. The proximal portions of the small intestine, especially the duodenum) and the stomach will be distended symmetrically with fluid. The motility of these loops may vary from low to apparently no movement, to hypermotile. If hyperechoic gas sounds are seen within the wall of the small intestine, it is indicative of either necrosis or anaerobic infection (clostridium) and is a poor prognostic sign. If the signs of abdominal pain are more insidious and/or weight loss is a component, symmetrically and diffusely or regionally thickened small intestine may be a sign of infiltrative or hypertrophic disease, such as the inflammatory bowel diseases, neoplasia, especially lymphosarcoma, or idiopathic ileal hypertrophy.[3] In these circumstances, the thickened wall often appears uniformly hyperechoic with a narrow lumen, which when viewed across the small axis, appears like a "bagel." Cases of inflammatory bowel disease may also have hypoproteinemia. Definitive diagnosis of inflammatory bowel disease or idiopathic hypertrophy requires histopathologic evaluation.

Obstructive or strangulating lesions of the small intestine may also result in edema and inflammation, and thus thickening of the bowel wall. Here the combination of clinical signs (persistent pain, perhaps sanguineous peritoneal fluid) will be helpful signs. However, clearly distinguishing acute severe enteritis from strangulating obstructions can be difficult. With obstructive or strangulating lesions, the thickened small intestinal wall tends to be focal (i.e. at the local of the obstruction), with relatively uniformly thickened walls. The intestine proximal to the obstruction will be distended with either gas for fluid. With complete obstructions, the distended proximal loops will often be seen to have a "hair-pin" appearance, as distended loops of bowel stack upon each other. The motility should be poor to absent with obstructive lesions. Thus, with regionally, uniformly thickened small intestine, with other evidence of obstruction on ultrasonography (hypomotile, U-turn stacks of turgidly round and distended loops of small intestine), an obstruction should be the top consideration. In one study, focally thickening and distended small intestine with no motility was 100% sensitive and specific for strangulation.[4] Also bear in mind that most obstructive and strangulating lesions of the equine small intestine involve the distal jejunum and ileum, thus if the affected segments are most readily visualized in the lower left flank or adjacent to the spleen and stomach on the left or next to the cecum, these locations are areas in which gastro-splenic, epiploic, and inguinal incarcerations are readily found. Rarely, with intraluminal obstructions (ileal impaction, ascarids in foals) the obstructing contents of the small intestine may be visualized in the lumen.

Finally, **intussusceptions** of the small intestine are most common in foals and young horses and have a characteristic "bulls-eye" or target lesion appearance when imaged across the short axis of the small intestine.[5] The intussuscepted intestine tends to fall toward the dependent portion of the abdomen. Like other obstructive diseases, the proximal small intestine will be distended, with reduced motility and hairpin turns, depending on the degree of obstruction and the patient may present with either chronic intermittent signs (incomplete obstruction) or acute intense signs (complete obstruction).

AREA 5 RIGHT: THE LIVER, RIGHT DORSAL COLON, DUODENUM

The caudal edge of the liver is normally distinctly sharp and may appear rounded with hepatomegaly. Obstructing choleliths may rarely be a cause of colic in the horse and appear as variable sized hyperechoic foci with an anechoic acoustic shadow within dilated bile ducts.[10] Most obstructive choleliths that cause colic in the horse are located in the common bile duct, which cannot be imaged ultrasonographically by the transabdominal approach in the horse.

The mesoduodenum keeps the duodenum in a fixed location on the right, descending between to liver and right dorsal colon to the area ventral to the right kidney. The wall, degree of distension, and motility of the duodenum should be carefully studied. As mentioned above under jejunum, horses with **enteritis** will have reduced motility of the duodenum, distension with fluid, and as severity of disease increased, thickened, irregular walls. Only a signal loop of duodenum should be visible between the liver and right dorsal colon. If additional loops of small intestine area in this area, especially if they are thickened, consider an epiploic foramen entrapment.

With a **right dorsal colon displacement,** ultrasonography is rarely helpful as a sole diagnostic tool. With a right dorsal displacement or colon torsion, nonsacculated (LEFT dorsal colon) may be visualized in the right abdomen, or distended vessels in colonic mesentery with reduced blood flow may be seen. If NSAID toxicity is suspected, the right dorsal colon wall will be particularly affected and will appear thickened.[6]

AREA 6 RIGHT: THE RIGHT KIDENY, CECUM, DUODENUM

The descending duodenum can be seen immediately ventral to the right kidney and is again a good place to look for distension or thickening of the duodenum that may indicate proximal obstruction of the jejunum or enteritis. The right kidney should be reviewed for size and echogenicity.

Continuing to scan ventral to the right kidney, the cecum should be visible. Most diseases affecting the cecum can be sufficiently identified by transrectal palpation. However, ultrasonography can be helpful in validating some of the diseases. With **typhylitis**, or acute inflammatory disease of the cecum, the wall will be thickened and hypermotile**.** Often gas normally present in the body or base of the cecum precludes visualization of its contents. With typhylitis, the cecum is sometimes distended with fluid that is readily seen swirling inside of the hypermotile cecum. The presence of fluid cecal contents also enables discrete visualization of cecal haustral folds in the lumen that sometimes appear as "finger-like" projections from the cecal wall. Like the stomach, gas contents or gas surrounding ingesta often interferes with the diagnosis of an impaction. The size of the cecum and loss of sacculations may be signals that the cecum is distended. Unlike the stomach, cecal distension or impaction could be readily identified by transrectal palpation. **Cecocecal or cecocolic intussusceptions** are often palpable on transrectal evaluation as indistinct large masses in the right or mid caudal abdomen. Like small intestinal intussusceptions, the characteristic "target lesion" of the cecal apex moving into the cecal body or if it continues, the cecal wall in the right ventral colon can be seen. In long standing intussusceptions, the walls are very thick and may appear abscessed or "mass-like."

Be mindful that small intestine is typically not seen in the right flank, thus if it is present there is a problem involving jejunum or the ileum and both nonstrangulating and strangulating causes should be considered, using the criteria provided above.

AREA 7 VENTRAL: THE LARGE INTESTINE

The proximal ventral abdomen can be scanned at the **abdominocentesis site** to assure that the spleen or distended or impacted colon in not in the location. Peritoneal fluid can only occasionally be seen in most horses, thus lack of ability to see peritoneal fluid does not mean that you will not be successful in obtaining it with an abdominocentesis. Peritonitis should be suspected if there is increased volume or echogenicity of peritoneal fluid. In some cases, free floating or adherent fibrin or fibrous tags may be visible. An abdominocentesis would be an integral set to further characterize peritoneal disease.

Use of ventral transabdominal ultrasonography was helpful in the diagnosis of 75% of horses with **colon volvulus** when the colon was reached at least 9 mm thickness.[8] As with any colon displacement or torsion, the finding of colon wall thickening (edema) warrants a guarded prognosis. In some cases of colon torsion, nonsacculated colon replaces sacculated colon in the left ventral abdomen.[9]

AREA 8 RIGHT or LEFT: THORAX

A quick peek at the ventral thorax, especially on the right, can be used to rule out pleural effusion and diaphragmatic hernia.

ADDITIONAL COMMENTS:

The contents of the small colon are often hard to image transabdominally in full sized horses. The same general principles for impactions and colitis discussed for the large colon also apply to the small colon. Transrectal imaging may facilitate visualization of distal sections of the small colon or the urinary bladder can be helpful as a sonographic window to the small colon with a transabdominal technique. Due to their location in the transverse and small colon, enteroliths can rarely be imaged by transabdominal ultrasonography.

Abscesses and neoplasia would be two differential diagnoses for intra-abdominal masses and they can be just about anywhere in the peritoneal cavity, in or attached to bowel or other intra-abdominal viscera (i.e. spleen, kidney, liver). The basic concept is that there are soft tissue densities of variable shapes and acoustic properties that distort normal sonographic architecture. Although a definitive etiology of an intra-abdominal mass is often not discernable ultrasonographically, a "classic" abscess appears loculated with mixed echogenicity and a cobweb-like appearance. A hematoma may appear similar to an abscess. An abscess or hematoma more commonly is isolated to a single location, whereas metastatic neoplasia should be considered if variable masses are present in multiple locations. Although the ultrasonographic appearance of a mass may not be distinguishing to etiology, ultrasonography may be a helpful guide to biopsy or aspiration of an intra-abdominal mass.

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