Thoracic and abdominal ultrasound in horses and foals:
Picture worth a thousand words
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Ultrasoundography is a widely used non-invasive diagnostic technique for the evaluation of abdominal and thoracic organs in horses and foals. Ultrasound findings often help guide treatment planning, including the need for medical therapy or surgical intervention. Thoracic and abdominal ultrasound not only allows us to assess the structure of the internal organs; ultrasound-guided biopsy and aspirate can be used to determine the underlying etiology and prognosis.

Indications
In the thorax, the most common applications of ultrasonography are management of pneumonia, pleuropneumonia, and fluid within the pleural cavity, whether this is blood or an effusion. Ultrasonography of the abdominal organs including the kidney, liver, spleen, gastro-intestinal track, bladder, and umbilical structures has become a valuable diagnostic procedure in the acute and non-acute abdomen in horses and foals.

Technique
Alcohol saturation and clipping the hair might be necessary to obtain diagnostic images of the thorax and abdomen. In the thoracic ultrasound, the curvilinear or linear transducer is positioned intercostally and pivoted from cranial to caudal and dorsal to ventral. Each ICS is thoroughly evaluated in systematic fashion.

Techniques for abdominal ultrasound can be divided in to three categories:

- Limited examination (caudoventral abdomen and left caudal intercostal spaces)
- FLASH technique (fast localized abdominal sonography of horses). This technique divides the horse’s abdomen into 7 topographic locations:
  1. Ventral abdomen
  2. Gastric window (the 10\textsuperscript{th} left intercostal space (ICS) in the middle third of the abdomen)
  3. Spleno-renal window (left 17\textsuperscript{th} ICS)
  4. Left middle third of the abdomen
  5. Duodenal window (14\textsuperscript{th}-15\textsuperscript{th} right ICS, the dorsal part of the abdomen)
  6. Right middle third of the abdomen
  7. Cranial ventral thorax
- Full examination (it includes three general regions):
  1. Paralumbar fossa/flank region
  2. ICS (5-17\textsuperscript{th}) from the ventral lung margins to costochondral junctions
3. Ventrum from sternal to inquinal region and costochondral junctions to midline

**Normal Structures of the thorax:**
Ultrasound waves are reflected by air or gas. Therefore, if the lung is inflated, the ultrasound image only shows the pleural surface of the lung. The hyperechoic line representing the pleural surface should be continuous with no aberrations (“comet tails”). Movements of the pleura surface synchronous with respiration (“the gliding sign”) should be observed in normal patients.

**Abnormal structures of the thorax**
Pleuropneumonia, superficial pulmonary abscesses, pulmonary consolidation, pneumothorax and fractured ribs are the most common pathologic conditions diagnosed by ultrasound exam. Pleural fluid generally appears anechoic and is located between the lung and the thoracic wall. Consolidation of the lung refers to the filling of alveolar tissue with fluid instead of air. Consolidated pulmonary parenchyma is often wedge shaped with areas of mixed echogenicity (anechoic to hyperechoic). B-lines (“Comet tails”) represent the accumulation of small amounts of exudate or cellular debris at the lung surface. Pulmonary abscess appears as a cavitated lesion with an anechoic center and a well-defined or irregular wall.

**Normal Ultrasonographic Anatomy of the Equine Abdomen**
Ultrasound examination of the abdomen include the spleen, the stomach, the small and large intestine, the liver, the urinary bladder, and kidneys. When imaging is started on the left cranial side of the abdomen internal organs can be found in the following locations:

- Stomach (9th-13th ICS)
- Spleen (the left ventral 8th ICS to the paralumbar fossa)
- Left Kidney (16th-17th ICS, between the level of the tuber coxae and the tuber ischii)
- Left ventral colon – ventromedial to the spleen
- Small intestine (hard to visualize in the healthy horse) – the left inguinal area

Ultrasonographic anatomy of the right side of the abdomen:

- Liver (6th-14th ICS)
- Right dorsal colon (immediately caudal to the liver)
- Duodenum (between the liver and the right dorsal colon)
- Right kidney (rostral right paralumbar fossa-16th ICS)
- Cecum (the right paralumbar fossa to the ventral midline)
Pathologies involving the gastrointestinal track and abdominal organs

Horses and foals with abdominal pain can have a variety of conditions. These conditions may include gas distension of the large colon secondary to an impaction, large colon displacement or torsion; gastric distention, small intestinal fluid distension with small intestinal volvulus, or intussusception, or occasionally enteritis; and increased peritoneal fluid with either uroperitoneum, hemoperitoneum and peritonitis. The most common ultrasonographic abnormalities observed in horses with colic include:

- Decreased or absent intestinal motility
- Gastric dilatation
- Thickening of the intestinal and gastric wall
- Distended small intestine loops (>3 cm) filled with anechoic fluid
- Inability to image the left kidney and ventral displacement of the spleen (neproplenic entrapment)
- Increased volume and echogenicity of the peritoneal fluid
- Intussusception (multiple concentric rings-target lesions)

Ultrasonographic abnormalities in the liver include hepatomegaly, rounded margins, increased echogenicity, hepatoliths, biliary distension, abscesses or neoplasia. Renal pathological conditions are characterized by enlarged or small (chronic renal failure) kidneys, hypo or hyperechoic parenchyma, loss of normal architecture, renal pelvis distention and uroliths. Similarly, to the liver, renal and splenic abscesses, hematomas and neoplasia have variable ultrasonographic appearances.

In neonatal foals, ultrasonographic exam has become the primary modality for assessment of the umbilicus. The umbilicus consists of paired umbilical arteries, an umbilical vein and the urachus and can be divided into external and internal parts. The normal size of the umbilical structures are:

- Umbilical vein: <1 cm
- Umbilical artery: < 1.3 cm
- Combined umbilical arteries and urachus at apex of the bladder: <2.5 cm

In foals, transabdominal ultrasonography can be used to detect the ruptured bladder with increased hypoechoic peritoneal fluid, patent urachus and infection/inflammation of the umbilical structures.