Proceedings of the 34th World Small Animal Veterinary Congress
WSAVA 2009
São Paulo, Brazil - 2009

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HINTS TO HELP WITH GASTROINTESTINAL INTERPRETATION OF RADIOGRAPHS
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Stomach
The radiographic anatomy of the stomach is variable and dependent upon: species, breed confirmation, degree of gastric distention, volume and type of gastric contents, and position of the patient during exposure. The stomach is normally within the rib cage. On the lateral radiograph the vertical axis of the stomach should be approximately parallel to the 10th or 11th intercostal space. On the lateral view the pylorus should be superimposed over or slightly cranial to the body of the stomach. On the ventrodorsal radiograph in the dog the cardiafundus, and body are located to the left of the midline. The pyloric portions are located to the right of midline. In the cat the stomach is more acutely angled, with the pyloric antrum located to the left of midline and the pyloric canal on or near the midline (“J” shape).

Important to remember is that gas within the stomach will change position depending on the animal’s position. This is nice because if you want to evaluate the pylorus for a mass lesion or foreign body a left lateral would be indicated (gas will be located in the pylorus). If the animal is positioned in dorsoventral gas will be located in the cardia and fundus, when the animal is in ventrodorsal gas will be located in the pylorus and body, and in a right lateral recumbent film gas will be located in the fundus and body.

Gastric Foreign Bodies
Radiopaque foreign bodies of the stomach are usually easily identified. Radiolucent foreign bodies can be visible due to contrast of air that surrounds the foreign bodies. Cloth or porous foreign bodies frequently retain barium after the stomach is emptied (post gastrogram or upper gastrointestinal series). Less permeable foreign bodies will appear as filling defects within the barium filled stomach.

Gastric Volvulus/Dilation Complex
Gastric dilatation is defined as a moderately to severely distended stomach filled primarily with gas, gas and fluid, fluid, or ingesta. Most important this enlarged stomach retains its normal position.
Gastric volvulus is differentiated from gastric dilation by displacement (abnormal position) of the stomach due to its rotation. The stomach may be distended (these animals present in acute crisis, tympanic, and retching). The location of the pylorus and duodenum dorsocranial and near or to the left midline is the most common appearance to this malposition. With a low volume positive contrast gastrogram and a left lateral film the pylorus may be demonstrated. A standard right lateral radiograph (view of choice) should fill the pylorus with gas in an animal with GDV. Other radiographic changes that can be seen include compartmentalization (radiographic recognition of soft tissue bands that project into or across the gas filled lumen of the rotated stomach. These soft tissue bands are due to folding of the stomach on itself as the folded wall projects into the lumen and is outlined by gas within the lumen). Splenomegaly (and variations in the location of the body of the spleen) due to torsion may occur. The gastric wall may be thin. Gas may be seen within the gastric wall or liver (portal vessels) due to necrosis of the wall. Reduced size of the caudal vena cava and cardiac silhouette (due to reduction in preload) esophageal dilation, (megaeosophagus) and reflux paralytic ileus small intestine (which may be due to pain as well) may be present.

Small Intestine
There are several parameters of the small intestine that should be evaluated. These include: margination (defined as serosal surface definition). The margin of the small bowel should be smooth. It will normally be visible due to fat in the serosa except when the animal is young (less than 6 months of age, emaciated, an animal with fluid in the abdomen/peritonitis ascites,
hemorrhage, or carcinomatosis). The normal diameter of the small intestine in the dog is 2 - 3 rib widths or approximately 1.5 times the dorsal ventral dimension of the 2nd lumbar vertebral body (from the ventral vertebral canal to the ventral vertebral body on a lateral radiograph). The normal diameter of the small intestine in the cat may be 1-1.2 cm.

The small bowel should be uniformly distributed throughout the abdomen, occupying space not taken up by other organs. The jejunum and ileum have the greatest range of movement within the central abdomen. As organomegaly occurs whether normal (distended stomach or urinary bladder) or abnormal (mesenteric lymphadenopathy, pancreatic enlargement, splenic mass, etc.) the intestine will be displaced. The direction of displacement will help to determine the differentials for the mass effect causing the displacement. The small bowel should have a smooth, continuous, curved appearance.

It’s often necessary to have contrast studies (upper gastrointestinal series) to identify normal or abnormal shape or diameter of small bowel. The radiopacity of the bowel loop is dependent upon whether it is fluid filled, gas filled, or filled with a combination of fluid and gas. Fluid filled loops of bowel appear as white rope like structures. Gas filled loops appear as black, thin walled tubes. A small amount of gas above fluid appears as narrow radiolucent band with an apparent thickening of the bowel wall. A larger volume of gas reflects wall thickness more accurately and therefore bowel wall thickness should never be evaluated on survey films but only with use of contrast (whether negative or positive).

The Normal Appearance of the Small Intestine with Upper Gastrointestinal Evaluation of the Upper Gastrointestinal Contrast Series

1. Size of lumen.
2. Contour of mucosal surface.
3. Character of intraluminal shadow.
4. Thickness of bowel wall.
5. Flexibility and motility of bowel wall.
6. Position of small intestine.
7. Continuity of opaque column.
8. Transit time.

Ileus is defined as an obstructive condition of the intestine. There are two types of ileus: mechanical or functional. Mechanical ileus is also referred to as dynamic or obstructive ileus. It is usually simple and nonstrangulating. The radiographic signs may be influenced by the degree of obstruction, location of obstruction, and duration of obstruction. Dilation of small intestine secondary to mechanical obstruction occurs because of presence of swallowed air and saliva, and the accumulation of mucosal secretion into the digestive tract.

Functional ileus also referred to as paralytic or adynamic ileus can be localized or generalized and may be a sequelae to a mechanical ileus. The stages of development of functional ileus include muscle fatigue allowing stretching of the intestine, muscle ischemia secondary to stretching, and muscle necrosis. There are numerous causes of functional ileus including: 1) extrinsic (tend to be more generalized), the causes include spinal cord injury, reflex to pain, peritoneal trauma or irritation or vascular compromise. The 2nd type intrinsic (which is most often regional) may be caused by edema, amyloidosis, an acute inflammation or enteritis to name a few.

**Radiographic Signs of Ileus**

1. Excessive gas and fluid accumulation within bowel loops.
2. Hairpin curves to the folded bowel loops.
3. Stacking or layering to loops of bowel.
4. Squaring off of distended loops of bowel.
5. Degree of dilatation increases as obstruction is more aboral.
6. "Snake head".
7. Centennial loop/isolated segment of small intestine distended resulting from focal peritonitis.

**Linear Foreign Body Radiographic Signs:**
1. Accordion-like pleating of the small intestine.
2. Reduction in length of the affected bowel.
4. Increased number of eccentric gas bubbles (tear, crescent, or comma shaped).
5. Foreign body usually on mesenteric border.
6. Pleating on the mesenteric border.

**Abnormal Appearance to the Intestinal Tract with Contrast Radiographs**

Segmentation of contrast may be normal or abnormal. It is usually seen toward the end of a normal gastrointestinal series. It can result from factors other than small intestinal disease and include: loss of contrast medium fluidity, clumping of barium with mucous or food, inadequate volume of barium given, delayed gastric emptying because of fullness of ileum (gastroilial reflux). Abnormal segmentation of the contrast column may occur due to obstructive gastric disease, irritation of the gastrointestinal tract (severe gastritis or enteritis), or partial obstruction. Intraluminal disorders are usually demonstrated as radiolucent areas surrounded by positive contrast medium. They often delay intestinal transit time and cause ileus proximal to their location.