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# Abdominal Radiology Mini Series

## Session 3: Evaluating the Gastro-Intestinal Tract

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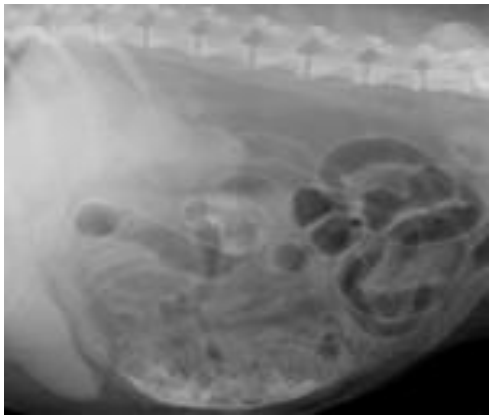

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**The Gastro-Intestinal Tract**

**The Stomach**

**Normal Anatomy**

- Located immediately caudal to the liver and cranial to the transverse colon within the cranial abdomen.

- The oesophagus passes through the diaphragm to enter the cardia of the stomach in the cranio-dorsal abdomen.

- The largest part of the stomach consists of the fundus and the body and lies to the left of the midline
    - The fundus of the stomach is a blind sac, located dorsal to the cardia
    - The body of the stomach extends from the cardia to the ventral angle of the stomach
    - When the animal is in right lateral recumbency, gas typically rises to the highest point and will be seen in the fundus and body
    - When the animal is in sternal recumbency, gas rises into the fundus

- The pylorus (consisting of the pyloric antrum and pyloric canal) of the stomach is located ventrally, usually just cranial to the body, and to the right (dogs) or approximately midline (cats)
    - Typically contains a gas bubble when the animal is in dorsal or left lateral recumbency
    - Typically fluid filled when the animal is in right lateral recumbency, appearing as a round soft tissue opacity which is easily misdiagnosed as a mass or a gastric foreign body
    - The pylorus will move further to the right when the stomach is full, especially in the cat

- The gastric axis, an imaginary line through the pylorus & body of the stomach, should be approximately parallel to the ribs on the lateral view and perpendicular to the spine on the VD view.

- Variable amounts of fluid, ingesta and gas within the stomach lumen result in a variable size and shape to the normal stomach
    - Rugal folds are often seen as approximately parallel soft tissue opacities, highlighted by intraluminal gas
    - Occasionally it may not be possible to identify a completely empty stomach

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**Radiographic Abnormalities**

**Gastric Displacement**

- **Cranial displacement**
  - As the pylorus moves further cranially, the gastric axis appears more upright, or even angled from cranio-ventral to caudo-dorsal on the lateral view
  - Causes include:
    - Small liver, diaphragmatic rupture, PPDH, hiatal hernia, pressure from increased abdominal volume (eg advanced pregnancy, severe ascites)
  - Remember that an apparently small liver and upright gastric axis can be a normal variation

- **Caudal displacement**
  - The gastric axis is increasingly angled from caudo-ventral to cranio-dorsal on the lateral view, with caudal and dorsal displacement of the pylorus
  - The stomach may project beyond the last rib and be seen extending caudal to the level of the 13$^{th}$ rib on the VD view
  - Causes include hepatomegaly, increased thoracic volume

- **Lateral displacement**
  - To the left by right sided hepatomegaly, pancreatic enlargement
  - To the right by left sided hepatomegaly, splenic enlargement

**Gastric enlargement**

- Normal in position, normal or increasingly rounded in shape, mild-moderate distension (typically heterogenous, mainly soft tissue opacity due to fluid & ingesta)
  - Recent meal
  - Pyloric outflow obstruction
    - Eg due to foreign body, pyloric spasm, muscular hypertrophy, pyloric/duodenal ulceration, neoplasia
    - Chronic obstruction often characterised by the accumulation of mineralised ingesta proximal to the obstruction (gravel sign)

- Normal, rounded or abnormally folded in shape, mild-severe distension (typically gas)
  - Aerophagia
    - Secondary to eg dyspnoea, mega-oesophagus, struggling
  - Motility disorder, gastro-intestinal ileus
  - Gastric dilation +/- volvulus

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**Gastric foreign bodies**

- Mineralised / metallic foreign bodies are easily identified.
- Take a minimum of 2 orthogonal views to confirm the foreign body is in the stomach lumen.
- Radiolucent foreign bodies are harder to identify.
- Taking all 4 views (RLR, LLR, VD and DV) can be useful in redistributing gas and ingesta, and may help to outline a suspected foreign body.
- Although an obstructive foreign body may result in gastric distension, the stomach may appear empty in an acutely vomiting patient.
- Look for evidence of a gravel sign (accumulation of mineralised ingesta, typically at the pylorus) in patients with possible partial obstruction.
- Contrast studies, ultrasonography and endoscopy are also useful in identifying gastric foreign bodies.
- Remember that many foreign bodies are incidental findings and unrelated to the clinical presentation.

**Gastric Dilation and Volvulus**

- Characterised by marked distension of the stomach with gas +/- ingesta.
- Compartmentalisation of the stomach by a soft tissue band is very suggestive of volvulus.
- With volvulus, the pylorus is often rotated dorsally and to the left, while the fundus is rotated ventrally and towards the right
    - Taking both RLR and LLR views can help to decide the position of the pylorus, but in an emergency situation, stabilisation of the patient should be the priority.
- Concurrent splenic torsion may be recognised as splenic enlargement +/- abnormal location and shape.
- Linear gas lucencies within the stomach wall are suggestive of gastric necrosis (grave prognosis).
- Small intestinal ileus is commonly seen in conjunction with GDV.
- Oesophageal dilation and evidence of hypovolaemia due to shock may be seen in the caudal thorax.

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**Changes in stomach wall**

- Gastric wall thickness can only be accurately assessed where the stomach is moderately distended and the wall highlighted by gas or positive contrast
    - Fluid within the stomach lumen can merge with the soft tissue opacity of the wall to give a false impression of wall thickening
    - Ultrasound is very useful in evaluating both the thickness and structure of the stomach wall

- Thickening of the stomach wall may be seen due to:
    - Muscular hypertrophy
    - Chronic gastritis
    - Eosinophilic infiltration
    - Neoplasia
    - Haemorrhage (eg due to coagulopathy)

- Gas in the stomach wall is occasionally seen with ulceration and with necrosis (eg secondary to GDV)

- Mineralisation of the gastric folds may be seen with chronic renal failure

**Gastric neoplasia**

- Diagnosis often challenging on plain radiographs
    - Contrast (ideally double contrast) studies may be useful
    - Ultrasound very useful, may also allow guided aspirates / biopsy

- Radiographic abnormalities may include:
    - Localised or diffuse wall thickening
    - Distortion of rugal folds
    - Intraluminal mass

- Most frequently located in pyloric antrum +/- lesser curvature

- Adenocarcinoma most common in the dog
    - Typically focal mass

- Lymphoma most common in the cat
    - Can be diffuse

- Less commonly leiomyoma/leiomyosarcoma / fibroscarcoma / mast cell tumour

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**Gastric Contrast Studies**

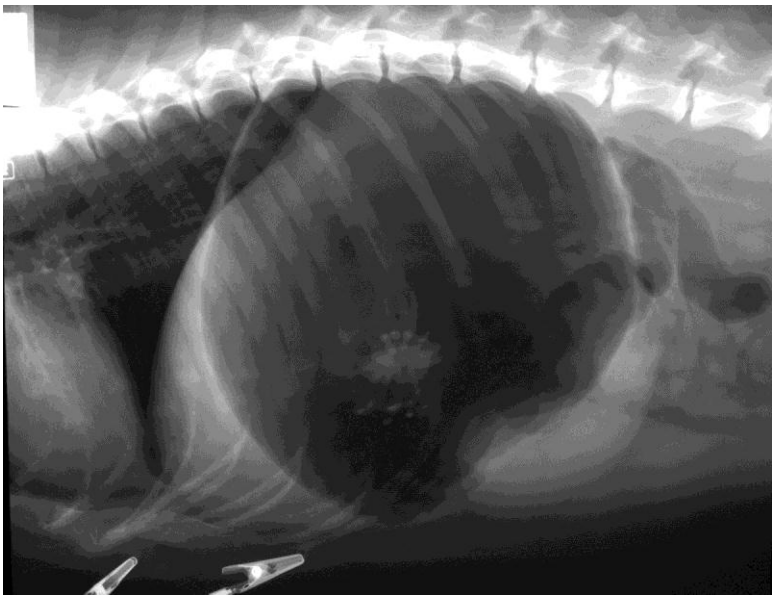
**Do not use barium if there is any suspicion of stomach perforation!!!**

**Indications**

- Chronic vomiting
- Haematemesis
- Evaluation for intraluminal radiolucent foreign bodies or masses
- Evaluation of gastric emptying

**Pneumogastrogram**

- 12 hour fast if elective procedure
- Sedation / GA
- Take plain lateral and VD radiographs first
- Administer 10ml/kg of room air via stomach tube
- Allows
  - Determination of gastric location, size and shape
  - Assessment of stomach wall thickness
  - May highlight suspected foreign bodies or mass lesions



**Pneumogastrogram demonstrating a gastric foreign body**

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**Double Contrast Gastrogram**

- 12 hour fast if elective procedure
- Sedation / GA
- Take plain lateral and VD radiographs first
- 1ml/kg 100% w/v barium administered via stomach tube
- Stomach then distended with air
- Roll the patient to distribute the contrast
- Take a minimum of 2 (lateral and VD) and ideally 4 (both laterals, VD and DV) views
- Demonstrates
    - excellent mucosal detail
    - stomach wall thickness
    - radiolucent foreign bodies

**Positive contrast gastrogram**

- Animal usually conscious to allow assessment of motility
- Take plain lateral and VD radiographs first
- 7-12 ml/kg 30% w/v liquid barium administered via stomach tube (if conscious patient will allow, syringe feed WITH CARE otherwise, some dogs may drink it!)
- Provides less information about stomach lumen and mucosal surface than double contrast study
- Minimum of lateral and VD views
- Demonstrates
    - Stomach location, size and shape
    - May highlight filling defects
    - Sequential radiographs in the conscious patient allow an assessment of contractility
- Most commonly performed as part of a barium follow through (see later)

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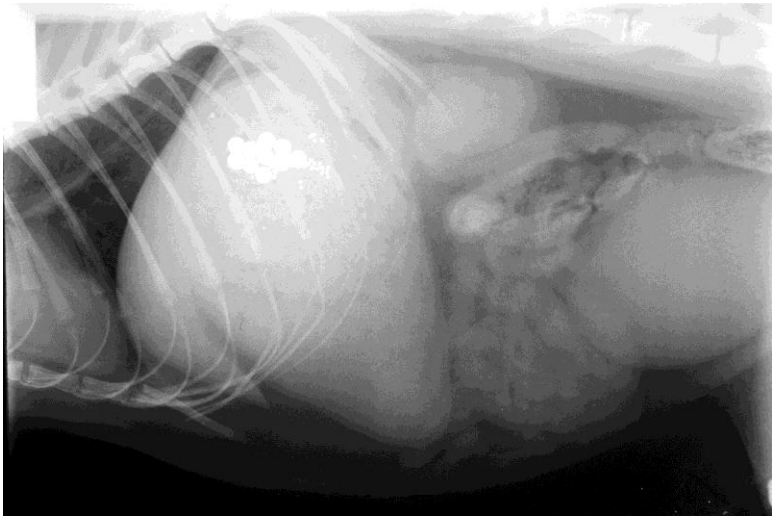
**Barium Impregnated PolySpheres (BIPS)**

- Can be used to provide some information about stomach emptying
- A pack of BIPS (10 large and 30 small) are mixed in with food and fed normally
- As a minimum, follow up radiographs should be taken at 24 hrs

**Interpreting the Gastrogram**

- The stomach wall should be of fairly uniform thickness, with a smooth mucosal surface.
- Parallel curving bands of barium are seen collecting between the rugal folds.
- Peristaltic waves should create smooth, symmetrical indentations in the lumen
  - Transiently seen as thickening of the wall, but should change on sequential radiographs
- If the stomach was empty at the beginning of the study, following administration of 7-12ml/kg liquid barium, emptying should begin within 15-30 minutes and the stomach should be empty by 4 hours
  - Barium mixed with food will take up to 12 hours to empty
- If a mixture of BIPS and food is fed
  - Half of the BIPS should leave the stomach within 6-9 hours
  - ¾ of the BIPS should leave within 8-11 hours



**An accumulation of BIPS in the stomach of a cat with outflow obstruction. This radiograph was taken 24 hours after feeding the BIPS.**

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**Radiographic Abnormalities**

- Stomach wall thickening
    - Muscular hypertrophy, chronic gastritis, eosinophilic infiltration, neoplasia, haemorrhage

- Intraluminal filling defects
    - Neoplasia, foreign body, blood clot, retained food

- Mucosal irregularities and persistence of barium after the stomach has emptied
    - Ulceration, secondary to gastritis or neoplasia

- Delayed gastric emptying
    - Sedation / GA
    - Pyloric obstruction / stenosis
        - Foreign body, muscular hypertrophy, ulceration, neoplasia
    - Pancreatitis
    - Peritonitis

- Accelerated gastric emptying
    - Cats
    - Gastritis

**Pitfalls**

- Inadequate distension of the stomach
    - Can give a false impression of wall thickening and gastric masses
    - Can delay gastric emptying

- Inadequate number of images
    - Suspected abnormalities should be consistently seen on multiple radiographs to avoid over interpretation of transient changes

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**The Small Intestine**

**Normal Anatomy**

- Consists of the duodenum, jejunum and ileum

- Should be fairly evenly distributed, occupying most of the mid-ventral abdomen, lying caudal to the stomach and cranial to the bladder on a lateral radiograph

- Appears as smoothly curving 'tubes' in long axis and circular or ring-shaped opacities in cross section.

- The descending duodenum runs from the pylorus along the right body wall before curving medially at the caudal duodenal flexure

- The ascending duodenum, jejunum and the proximal ileum are radiographically indistinguishable

- The terminal ileum may be recognised at the ileocaecocolic junction
    - Identified from the normally gas filled (in the dog) caecum located to the right of midline around the level of L3-4

- In a fasted animal, the small intestine contains a mixture of fluid and gas
    - In the dog, the contents are typically 30-60% gas
    - In the cat, there is usually very little gas

- Loops of intestine should be approximately equal in size
    - In the dog:
        - Less than twice the width of the 12$^{th}$ rib
        - Less than the depth of the endplate of a lumbar vertebral body
    - In the cat, less than 12mm
    - Peristaltic waves may be recognised on plain radiographs as transient segmental narrowing

- Sufficient abdominal fat is required to visualise the serosal surfaces of the intestine

- Small intestinal wall thickness **cannot** be assessed on plain radiographs as the soft tissue opacity of the wall cannot be distinguished from fluid in the lumen

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**Radiographic Abnormalities**

**Small intestinal serosal surface**

- Reduced visibility in the presence of free fluid, inflammation or diffuse neoplasia of the mesentery, lack of abdominal fat

- Increased visibility in obese animals and in the presence of free abdominal gas

- Corrugation of the serosal surface may be seen due to enteritis, plication caused by a linear foreign body, peritonitis, neoplasia

**Displacement of Intestinal Loops**

- Displacement of the small intestine outside the abdominal cavity may occur due to defects in the body wall or diaphragm. Depending on the number of loops displaced, the abdominal cavity may appear abnormally empty.
    - Cranial displacement into the thoracic cavity
        - Diaphragmatic rupture or peritoneal-pericardial diaphragmatic hernia
    - Displacement of the intestinal loops outside the body wall
        - Body wall rupture, umbilical and inguinal hernia

- Within the abdominal cavity
    - Central bunching of the small intestinal loops
        - In obese patients, especially cats the small intestinal loops may be "gathered" centrally in the middle of the abdomen.
        - Pathological causes include a linear foreign body & adhesions
    - Ventral displacement is usually due to retroperitoneal disease
        - Eg renomegaly, adrenomegaly, retroperitoneal effusion
    - Caudal (and often dorsal) displacement
        - Hepatomegaly, stomach distension, splenomegaly
        - An empty, ruptured or retroflexed bladder may result in caudal displacement of SI loops into the area normally occupied by the bladder
    - Cranial displacement
        - Cranial location of intestinal loops against the diaphragm may be normal in some deep chested dogs
        - A distended bladder, gravid uterus, pyometra, marked prostatomegaly & paraprostatic cysts will displace intestinal loops cranially
        - A small liver, or herniation of the liver cranially through a diaphragmatic defect may result in cranial displacement of the stomach & SI loops

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- Peripherally
    - Mesenteric mass
    - Pancreatitis, with displacement of the desc duodenum further to the right

**Small intestinal distension**

**Ileus** is an abnormal increase in the diameter of the small intestine.

- Distension is diagnosed
    - If any loop is greater than twice the height of L5
    - If any loop is more than twice the diameter of any other loop
    - If any loop is > 4 x the width of the last rib

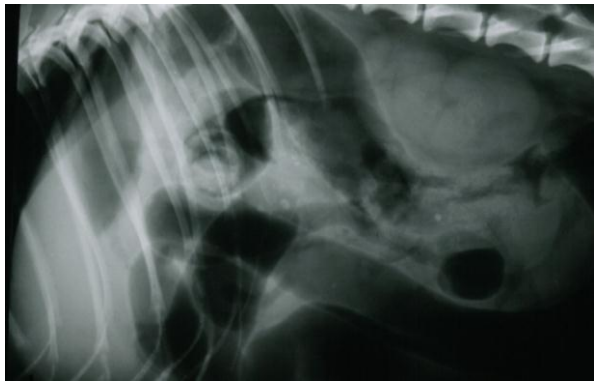
- Obstructive (or mechanical) ileus is seen secondary to foreign bodies, intestinal masses, intussusceptions, entrapment through a hernia or adhesions
    - In obstructive disease the severity of the luminal distension is related to the completeness of the obstruction.

- Functional (or paralytic) ileus may be seen secondary to hypokalemia, peritonitis (chemical or inflammatory), inflammation (enteritis), aerophagia

- Dilated loops may contain fluid, gas or a mixture
    - In obstructive disease, the dilated loops are often gas filled in the early stage, but become increasingly fluid filled with time

- A “sentinel” loop is a loop of bowel which consistently appears abnormally dilated and is suggestive localised disease or obstruction

- The number of dilated loops should be assessed
    - A few dilated loops suggest a relatively proximal obstruction or a localised functional ileus (eg secondary to localised peritonitis, pancreatitis , recent surgery)
    - Generalised dilation of the intestinal loops is seen with
        - Generalised functional ileus
        - A distal intestinal obstruction
        - Mesenteric torsion



**Dilated SI loops in a dog**

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**Intestinal Obstruction**

The appearance of obstructive small intestinal disease will depend on the location and duration of obstruction and whether the obstruction is partial or complete. Variable amounts of gas and/or fluid intestinal dilation may be present proximal to the site of obstruction.

- Very proximal, for example duodenal, obstruction may not result in any intestinal dilation
- Proximal jejunal obstruction typically results in a few dilated intestinal loops
- Distal jejunal obstruction typically results in many dilated intestinal loops
- Acute obstruction typically results in markedly distended gas filled loops, which may become increasingly fluid filled with time
- A gravel sign may be recognised in cases of chronic partial obstruction
- The descending colon may appear empty

- **Foreign bodies**
    - May be mineralised / metallic and easily recognized
    - More often of soft tissue opacity
        - Difficult to identify
        - Look for evidence of intestinal dilation and odd gas patterns at the site of the suspected foreign body
        - Look for evidence of a gravel sign to identify chronic foreign bodies causing partial obstruction
        - Use positional radiography to alter the distribution of gas & fluid
    - Linear foreign bodies often cause intestinal plication (‘concertina’ appearance)
    - If the diagnosis cannot be made on plain radiographs
        - With an experienced operator, ultrasound is a very sensitive
        - Contrast studies may help to outline a foreign body
            - **Exploratory laparotomy, not a contrast study, is indicated in cases where obstructive ileus is strongly suspected**
            - Never use barium if there is a suspicion of intestinal perforation

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- **Intussusception**
    - Most commonly seen in young patients, often at the ileo-caeco-colic junction
    - Occasionally in older animals, usually secondary to intestinal pathology
    - Dilation of the proximal intestine, often with a crescent shaped gas opacity lying between the intussuscipiens and intussusceptum
    - Ultrasound / contrast study may be needed to confirm the diagnosis
- **Neoplasia**
    - Most commonly seen in older patients
    - May be recognised radiographically as partial or complete intestinal obstruction
    - Non-obstructive lesions often cannot be diagnosed from plain radiographs
        - Ultrasound / contrast study
    - Dystrophic calcification of some intestinal tumours may be apparent
    - Differential diagnoses include:
        - Lymphoma
        - Adenocarcinoma
        - Leiomyoma / leiomyosarcoma
- Adhesions / strictures / strangulated hernias / mesenteric volvulus may also cause intestinal obstruction

**Intestinal perforation**

- May be caused by a dehiscence following intestinal surgery, perforating foreign body, ulceration (especially duodenum), bowel infarction
- Radiographically identified by:
    - Localised or generalized loss of serosal detail due to peritoneal inflammation +/- free fluid
    - May be corrugation of SI loops at site of perforation
    - Intestinal ileus
    - Free abdominal gas
        - Large amounts will be recognised highlighting the serosal surfaces of the abdominal organs
        - A left lateral decubitus view may be useful in identifying smaller amounts collecting under the uppermost part of the right rib cage
    - The use of barium is contra-indicated where there is a suspicion of intestinal perforation: use iodine based contrast instead

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## Intestinal Contrast Studies

### Barium follow-through

- Less commonly used as access to and experience of ultrasound increases

### Indications

- Acute and persistent or recurrent vomiting
- Suspected gastro-intestinal foreign body
- Haematamesis / malaena
- To locate the GI tract in cases with suspected diaphragmatic rupture

### Technique

- 24 hour fast and enema 2 hours before the study if elective procedure
- Sedation theoretically avoided for this study due to its effect on GI motility
    - ACP/pethidine?
- 7-12 ml/kg 30% w/v liquid barium as for positive contrast gastrogram
- Take a minimum of 2 (ideally 4) radiographs centred on the stomach immediately
- Repeat these radiographs at 5-10 minutes, and at 10-15 minutes
- Lateral and VD views of the abdomen should be taken at (approximately) 30, 45, 60, 120 and 240 minutes to demonstrate the passage of contrast through the small intestine into the colon
- Follow up lateral and VD views should be taken at 24 hours

### Interpretation

- Stomach as previously described
- Barium should begin to enter the duodenum within 15-30 mins and the majority should be in the large intestine by 4 hours (1 hour in cats)
- The small intestine should be seen as a mass of curving tubes
- Some variation in opacity will be seen where the barium mixes with intestinal gas & fluid
- The diameter of the loops will vary with peristalsis

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- Spiculated margination of the contrast against the mucosal surface is a normal finding in some animals
    - Extension of barium between the intestinal villi = ‘Fimbriation’

Pseudoulcers’ may be seen as small outpouchings of barium along the antimesenteric border of the duodenum in some normal dogs

- ‘Beading’, especially of the duodenum, giving a ‘string of pearls’ appearance is a normal finding due to peristalsis in cats

**Duodenal ‘beading’ in a cat**

**Radiographic Abnormalities**

- Increased wall thickness +/- mucosal irregularities
    - enteritis, infiltrative / inflammatory intestinal disease, neoplasia, lymphangiectasia

- Luminal filling defects
    - retained food, foreign bodies, intussusception (‘watch spring’ appearance to contrast), neoplasia

- Variations in luminal diameter
    - normal peristalsis, ‘beading’ in normal cats, pseudoulcers in normal dogs
    - neoplasia, linear foreign body, ulceration

- Delayed intestinal transit time
    - sedation / GA
    - partial obstruction
    - paralytic ileus

- Faster intestinal transit time
    - enteritis with hypermotility

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**The Pancreas**

**Normal anatomy**

- Consists of right and left pancreatic limbs connected by the pancreatic body
    - Right limb lies to the right of the midline between the duodenum and right kidney
    - Left limb lies caudal to the stomach

- Not normally radiographically apparent

**Radiographic abnormalities**

- Pancreatitis
    - Often radiographically unremarkable
    - An increase in pancreatic size may cause lateral displacement of the descending duodenum and caudal displacement of the transverse colon
    - Local inflammation may cause increased soft tissue opacity and a loss of serosal detail in the right cranial abdomen
    - The duodenum may appear dilated due to localised ileus

- Pancreatic neoplasia
    - Large tumours may be identified as a mass lesion in the right cranial abdomen, displacing the duodenum laterally, or in the mid-abdomen caudal to the stomach, displacing the transverse colon caudally
        - A large pancreatic tumour is most likely to be a pancreatic adenocarcinoma

    - Smaller tumours not seen
        - Insulinomas rarely >1cm across and difficult to identify even on ultrasound

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**The Large Intestine**

**Normal anatomy**

- Comprised of caecum, ascending, transverse and descending colon, rectum and anus

- Caecum is located to the right of the midline at the level of L3-4
    - Usually gas filled in the dog
    - Small in the cat and usually not seen

- Ascending colon runs cranially from the ileo-caeco-colic junction, to the right of the midline and medial to the duodenum

- Transverse colon crosses from right to left immediately caudal to the stomach

- Descending colon runs caudally on the left side to the pelvic inlet
    - 'Redundant' colon, characterised by extra bends in the descending colon can be a normal finding in large breed dogs

- As the colon passes into the pelvic inlet it becomes the rectum

- The colon and rectum are normally filled with varying amounts of heterogenous faecal material and gas
    - Normal colonic diameter should be <1.5 x the length of L7

**Radiographic Abnormalities**

**Visibility of large intestinal serosal surface**

- As for small intestine

**Large Intestinal Displacement**

- Caudal displacement of transverse colon away from the stomach
    - Enlargement of left limb of pancreas

- Displacement of ascending colon towards the midline
    - Enlargement of right kidney, right limb of pancreas, dilation of the duodenum, right sided hepatomegaly

- Displacement of descending colon
    - Towards the midline / right
        - May be normal in large breed dogs/following R lateral recumbency
        - Redundant colon

    - Splenomegaly, left sided hepatomegaly

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- Ventrally
    - Enlargement of left kidney (proximal descending colon)
    - Enlargement of the medial iliac lymph nodes (distal descending colon)
    - Retroperitoneal haemorrhage / urine leakage / abscessation etc

- Dorsally
    - Prostatomegaly
    - Uterine enlargement (pyometra, pregnancy)

- Caudally
    - Perineal hernia / rupture

- Displacement of the rectum
    - Dorsally
        - Distended bladder
        - Prostatomegaly
        - Vaginal mass, urethral mass, other pelvic mass

    - Ventrally
        - Vertebral or dorsal pelvic mass

**Intussusception**

The ileo-colic junction is the most common site for an intussusception. Occasionally caeco-colic (caecal inversion), ileo-caecal and colo-colonic intussusceptions are possible.

- Small intestinal dilation +/- a characteristic crescent shaped gas opacity between the intussuscipiens and the intussusceptum may be seen with ileo-colic intussusception

- Caecal inversion may be suspected from the presence of a soft tissue opacity in the right mid-abdomen, together with the loss of the normally air filled caecum

- Colo-colonic intussusceptions are variable in appearance and difficult to identify on plain radiographs.

- Following a barium enema (see later for technique)
    - The end of the intussuscipiens may be highlighted as a concave filing defect bulging into the lumen from proximally

    - Barium may track proximally between the intussusceptum and the intussuscipiens, appearing radiographically as a ‘coiled spring’

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**Large intestinal dilation**

The normal colon should be no greater than 3 x SI diameter, and not more than 1.5 x the length of the 7th lumbar vertebra. An increase in colonic diameter may be recognised with

- Constipation; faecal retention
    - Possible causes include pain on defaecation and neurological abnormalities,

- Obstipation; more severe faecal retention with a mechanical obstruction to defaecation
    - Possible causes include colonic stricture, narrowing of pelvic canal (eg due to an old fracture), prostatomegaly, neoplasia, perineal hernia

- Megacolon; hypomotility and dilation of the colon
    - Possible causes include constipation, metabolic disease (hypokalaemia, hypothyroidism), neurological disease (eg dysautonomia, sacro-coccygeal agenesis in Manx cats), idiopathic (especially in cats)

**Large Intestinal Contrast Studies**

Contrast studies can provide useful information about large intestinal pathology, but in many cases have been superceded by the use of endoscopy. Ultrasound can provide some information about the large intestinal wall, but in many cases complete evaluation is precluded by acoustic shadowing from faecal material or from the pelvis.

**Indications**

- Differentiation between large and small intestine
- Rectal bleeding
- Suspected large intestinal neoplasia
- Investigation of possible intussusception

**Pneumocolon**

- Fast for 24 hours and give a cleansing enema 2-4 hours before examination
- Sedation / GA
- Take survey lateral and VD radiographs
- Using a flexible catheter positioned in the rectum, administer 10ml/kg room air
- Take lateral and VD radiographs centred on the mid-caudal abdomen
- Quick study, but provides limited information
    - Differentiation between large and small intestine
    - May highlight strictures, intraluminal masses, ileo-caeco-colic intussusceptions

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**Barium enema**

- Fast for 24 hours
- Give a cleansing enema 2-4 hours before examination
- General anaesthesia
- Take survey lateral and VD radiographs
- Position a Foley catheter in the rectum and administer 7-14ml/kg 20% w/v liquid barium via gravity feed
- Take lateral and VD radiographs centred on the mid-caudal abdomen
- Contrast can be removed from the colon (place the enema bag on the floor) and replaced with air to give a double contrast study, which provides better mucosal detail
- A barium enema allows
    - Differentiation between large and small intestine
    - Demonstration of strictures, intraluminal masses, ileo-caeco-colic intussusceptions
    - Assessment of the mucosal surface

**Interpretation**

- The normal large intestinal mucosa in the dog and cat should be smooth and featureless
- Localised narrowing just cranial to the pelvic brim may be seen due to colonic spasm
- Beware filling defects caused by retention of faecal material

**Radiographic Abnormalities**

- Luminal filling defects
    - Retained faecal material
    - Mass lesion: polyp, leiomyoma/leiomyosarcoma, adenocarcinoma
    - Intussusception (see previously)
- Wall thickening +/- mucosal irregularity
    - Colitis
    - Diffuse neoplasia

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