

RADIOGRAPHIC SPECIAL PROCEDURES: IS ULTRASOUND ALWAYS NECESSARY?

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RADIOGRAPHIC SPECIAL PROCEDURES. WHY NOT USED?

- Ultrasound
- CT
- MRI
- The alternate imaging modalities have replaced most special procedures
- But what if you do not have access to US, CT or MRI?
- What if your owners cannot afford these options?

COMMONLY PERFORMED SPECIAL PROCEDURES

- Esophagram
- Upper GI series
- Positive, negative and double contrast cystogram
- Intravenous Pyelogram (IVP)
- Pneumocolon

WHAT DO THESE SPECIAL PROCEDURES HAVE IN COMMON?

- Needed to answer a specific diagnostic question that plain x-rays cannot answer
- All require additional images to be taken
- All require some type of contrast material to be administered

CONTRAST MATERIAL

- Increases the conspicuity of a particular organ or viscous
 - In other words, you can see it better on the radiograph
- Types of contrast material
 - Positive contrast material
 - Shows up "white" or "radiopaque" on radiographs
 - Barium contrast
 - Iodinated contrast
 - Negative contrast material
 - Shows up "black" or "radiolucent" on radiographs
 - Room air
 - CO₂ (carbon dioxide)

POSITIVE CONTRAST MATERIAL

- Barium
 - An inert metal (but looks like a white powder) that has a metallic radiopacity on radiographs (bright white)
- Only used in the gastrointestinal tract
- 3 different forms
 - Powder
 - Solution
 - Paste

BARIUM POWDER

- Cheapest form of barium
- Comes in a plastic container
- Must mix the powder with water
 - No matter how much you mix, the powder will still settle out to the bottom over time
- Tends to lead to poor contrast studies due to settling of barium powder in solution
- Results in "floculation"
 - Barium powder comes out of solution and clings to the gastrointestinal wall
- Not recommended



BARIUM SOLUTION

- Pre-mixed barium in solution
- Usually comes in 1 gallon jugs
- Recommend diluting this $\frac{1}{2}$ and $\frac{1}{2}$ with tap water
- Consistency of thin pancake batter
- Does not settle out
- The ideal contrast for routine upper GI studies
- Often has a therapeutic effect as well as being diagnostic



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BARIUM PASTE

- Comes in a tube similar to tooth paste
- Thick, with the consistency of tooth paste
- Used to evaluate the esophagus and swallowing disorders
- NOT used for upper GI studies



BARIUM PROBLEMS

- Aspiration of a small amount of barium usually causes no problems
- Aspiration of a large amount of barium usually leads to death
- Barium leakage into the peritoneal space causes severe peritonitis



IODINATED CONTRAST MATERIAL

- Typically comes in a glass container
- Many brand names and concentrations
 - Conray
 - Renografin
 - Gastrografin
 - Iohexol
 - Omnipaque



IODINATED CONTRAST MATERIAL CONCENTRATION

- Refers to how many mg of iodine / ml of solution
- Will say on the bottle what the concentration is
- Recommend purchasing Omnipaque 240 or 300
- What concentration is this bottle?



USES FOR IODINATED CONTRAST MATERIAL

- Intravenous pyelogram (IVP)
- Cystogram
- CT procedures
- Rarely for upper GI procedures
- Safe to give IV or per os
- Omnipaque safe to give intrathecal (myelogram)
 - The other types of iodinated contrast are NOT safe to use for a myelogram – only Omnipaque (iohexol)



IODINATED CONTRAST MATERIAL

- Gastrograffin, iohexol, omnipaque, renograffin, etc.
- Bitter taste, oily substance, which is easily aspirated
- Very hyperosmolar (2600mOsmol/liter)



PROBLEMS WITH IODINATED CONTRAST

- Very hyperosmolar (2600 mOsmol)
- Very bitter tasting and oily/slimy
- Worse than Barium if aspirated, will draw water into lungs, resulting in severe, fulminate pulmonary edema and death
- If leaked into peritoneal space, usually causes no problems



WHY NOT USE IODINATED CONTRAST FOR ROUTINE UPPER GI SERIES

- Does not coat and soothe the GI tract well
- Dilution of contrast column as it passes through the GI tract
- Poor evaluation of mucosal surface of bowel
- Moves through GI to quickly



UPPER GI SERIES

- Indications
 - Evaluate for GI obstruction
 - Foreign body
 - Intussusception
 - Mural disease
 - Evaluate for GI rupture
 - Evaluate for GI motility



CHOICE OF CONTRAST MATERIAL

- Barium
 - Use for routine GI procedures unless there is a suspicion for a tear/rupture
- Iodinated contrast
 - Only use if worried about a tear/rupture
- BIPS – barium impregnated spheres
 - Dissolving capsules that contain plastic bubbles of various sizes with barium in them
 - Not diagnostic. Waste of money.



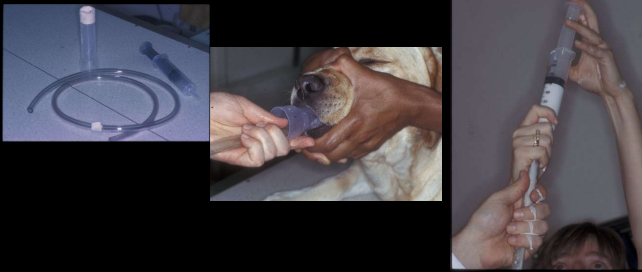
PROPER UPPER GI SERIES

- GI tract should be free of ANY food
 - Usually requires period of fasting and an enema or two
- 6-10 mls/lb body weight
- Administer into stomach via a stomach tube
- Imaging sequence (lateral and VD view)
 - Plain films before contrast administration
 - 5, 10, 15 min
 - Every 15 min for first hour
 - Every 30 min for first 4 hours
 - Every hour until barium fills colon

UPPER GI COMMON MISTAKES

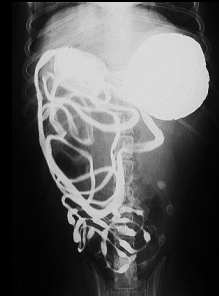
- Not administer enough contrast to distend the stomach fully
- Do not administer it via stomach tube but rather give it in the dogs mouth. Leads to ingestion of more air than contrast. Also, leads to more cases of aspiration.
- Do not administer barium with food and just let the dog eat it. The food causes filling defects that you can't differentiate from foreign objects and you can't evaluate the bowel wall well.
- Do not follow correct time intervals

UPPER GI SUPPLIES AND ADMINISTRATION



GI TRANSIT TIMES

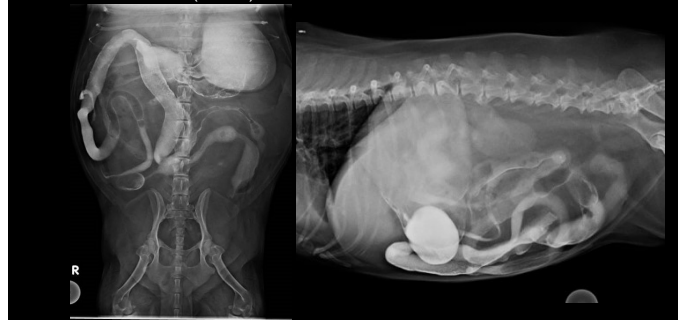
- Dogs – extremely variable
 - Stomach empty – 30 min to 2 hours
 - Small bowel – 1 hour to 6 hours
 - If food is present, GI transit times will be much slower
- Cats – usually all done in about 1 hour



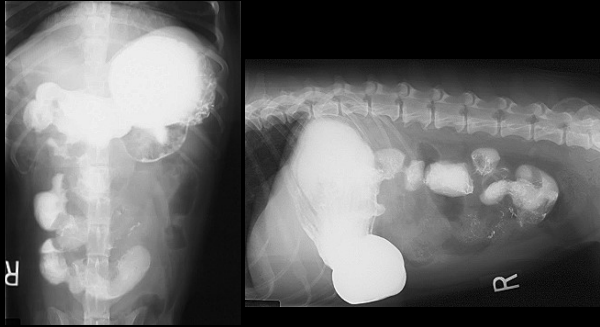
SMALL BOWEL FB (DAY 1)



SMALL BOWEL FB (DAY 2)



LINEAR FOREIGN BODY



BART – 2 YR., MC DSH. VOMITING FOR 2 DAYS. CAN'T KEEP ANYTHING DOWN.



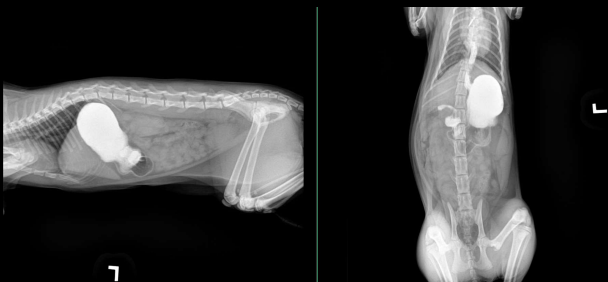
VD



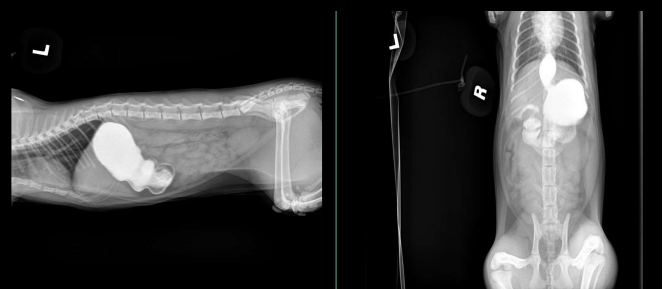
5 MIN

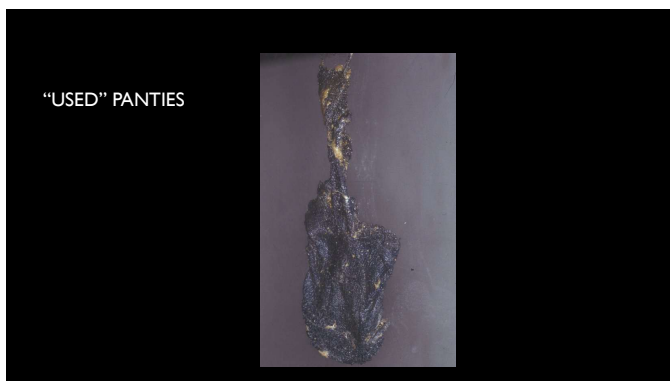
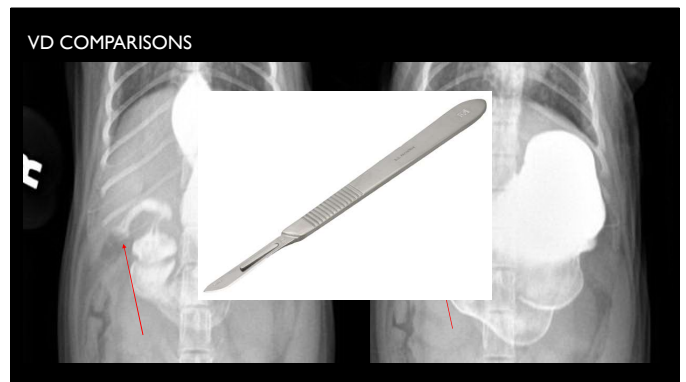
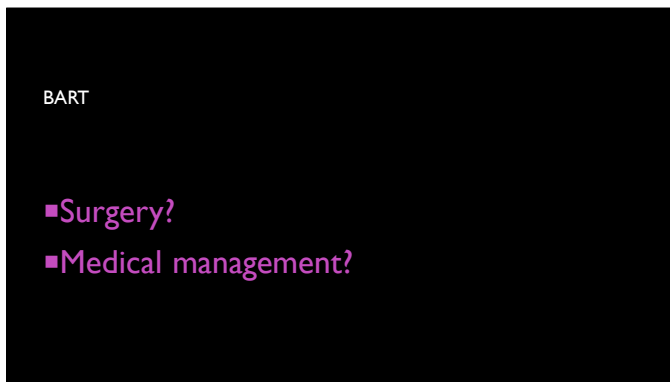
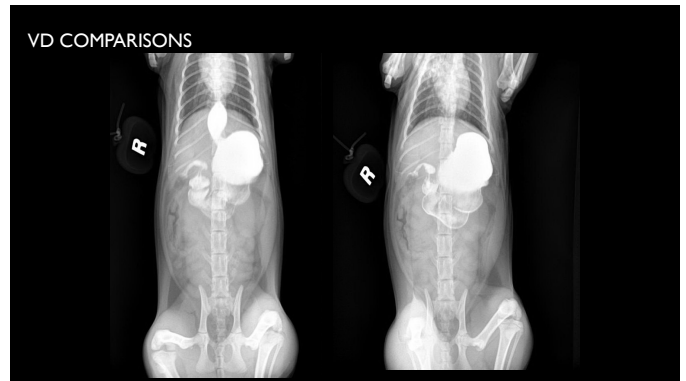


15 MIN



30 MIN





GASTRIC COKE-A-GRAM

- Administer ½ can or so of a carbonated beverage per os
- Shoot both lateral views and a VD view as quick as you can
- Helpful in placing negative contrast into the stomach to see a lucent gastric foreign body



COKE-A-GRAM PYLORIC FOREIGN BODY



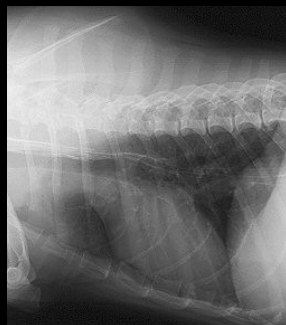
ESOPHAGRAM

- Used to diagnose megaesophagus, esophageal mass, esophageal foreign body, esophageal tear
- Difficult to do without fluoroscopy
- Administer "mouthful" of barium with dog in lateral recumbency and shoot film within 3-10 seconds

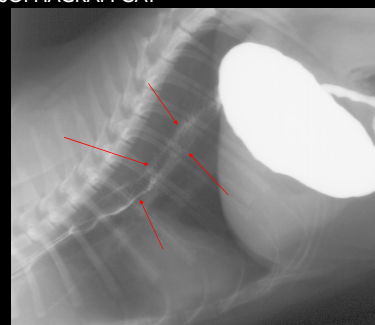
NORMAL

- Barium will tend to slow/accumulate at three places normally
 - Just cranial to the thoracic inlet
 - Just cranial to the heart
 - Just cranial to the diaphragm
- Dogs have normal longitudinal striping
- Cats have longitudinal stripes in cranial ½, then a herringbone pattern in the caudal ½
- Should not see any barium retention after a minute or so

NORMAL ESOPHAGRAM DOG



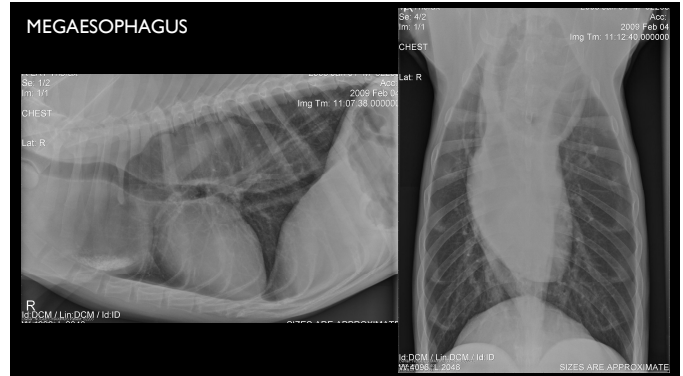
NORMAL ESOPHAGRAM CAT



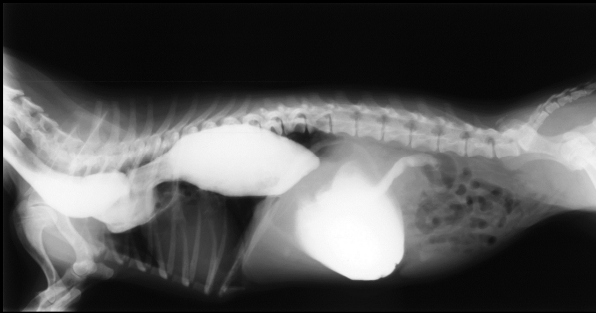
MEGAESOPHAGUS

- Idiopathic megaesophagus
 - Diffusely dilated esophagus with loss of motility
- Ring Anomaly (persistent 4th right aortic arch)
 - Esophagus is dilated cranial to heart base, but normal caudal to this
- Leads to aspiration pneumonia and emaciation

■ Put normal chest film here



MEGAESOPHAGUS



CAUSES OF MEGAESOPHAGUS

- Hypothyroid – not proven to cause ME, however, many dogs that have ME are also hypothyroid or euthyroid sick
- Myasthenia gravis – will cause ME in some cases
- Mediastinal mass – will cause ME in some cases
- **Most remain idiopathic**

SEQUELAE OF MEGAESOPHAGUS

- Aspiration pneumonia
 - Right middle lung lobe > caudal subsegment of left cranial lung lobe > right cranial lung lobe
- Chronic wasting and weight loss
- Treatment – none effective, feed from elevated platform, antibiotics for the pneumonia

CYSTOGRAM AND URETHROGRAM

- Used to diagnose bladder rupture, urachal abnormalities, stones, transitional cell carcinoma, urethral stones, urethral tears, urethral strictures
- Used iodinated contrast material (Iohexol, Omnipaque, Conray or Renograffin) given via a pre-placed urinary catheter
- Urethrograms still commonly performed
- Cystograms rarely performed any more (ultrasound now)

TYPES OF CYSTOGRAMS

- Positive contrast
 - Used to diagnose ruptured bladder
 - Still performed
- Negative contrast
 - Used to evaluate bladder wall for areas of roughening and thickening
- Double contrast
 - Used to evaluate for small faint cystic calculi as well as wall abnormalities

CYSTOGRAM KEYS

- Must distend the bladder with enough contrast to distend the bladder
 - Bladder should feel taut when palpated
 - Don't overfill and rupture bladder, however

INTRAVENOUS PYELOGRAM (IVP)

- 1 ml/lb of 400mg/ml of Renograffin, Omnipaque, Iohexol or Conray, given IV
- Used to diagnose ureteral stricture, ureteral stones, ectopic ureters, pyelonephritis

SIDE EFFECTS AND CONTRAINDICATIONS OF IVP

- Vomiting shortly after administration
- Contrast induced renal failure
 - Rare as long as animal has some renal function and is not dehydrated
- Dehydration
 - Can lead to persistence of contrast in kidneys and contrast induced renal failure
- Extremely azotemic
 - Also leads to persistence of contrast in kidneys and contrast induced renal failure
 - Also yields a poor quality study

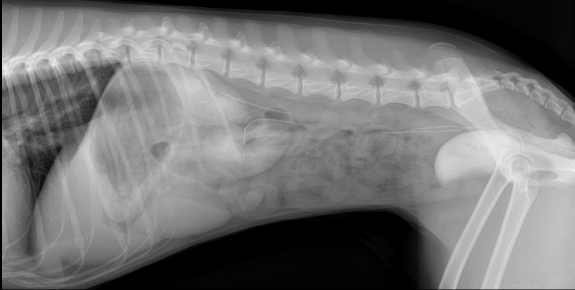
PYELOGRAPHIC PHASE

- Renal diverticuli and pelvis should be uniform in thickness and very thin (1-2mm)
- Ureters should be similar in diameter and very thin (1-2mm)
- Ureters have pulsatile flow, therefore filling of ureters is intermittent
- Usually finished in 20-40 mins

IVP PHASES

- Vascular phase
 - 1-2 minutes during and after IV administration
 - May miss it if you don't hurry!
 - Contrast seen in the renal and interlobar arteries
- Nephrogram phase
 - 2-6 minutes after administration
 - Blush of contrast seen in renal cortex, diminishes over a few minutes
- Pyelographic phase
 - 6-40 minutes after administration
 - Contrast seen collecting in renal diverticuli, renal pelvis and ureters
 - Should increase in intensity initially, then decrease over time

IVP LATERAL VIEW – NEPHROGRAM PHASE



PYELOGRAPHIC PHASE



IVP RENAL DIVERTICULA

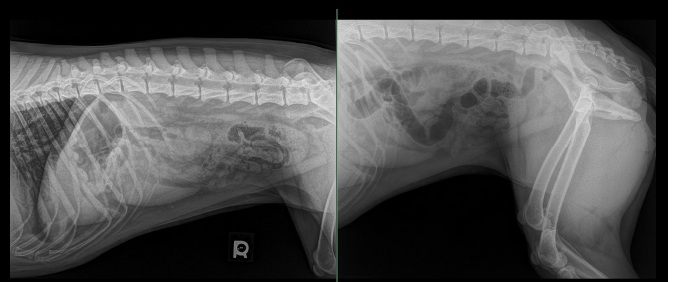


PNEUMOCOLON

- Used to diagnose foreign bodies in colon, colocolic intussusception, cecal abnormalities, ileocolic intussusception and differentiate a distended colon vs small bowel
- Place enough room air into colon to fully distend colon and cecum
- Take VD and lateral views



PRE AND POST PNEUMOCOLON. OBSTRUCTED?



OBSTRUCTED!



COLOCOLIC INTUSSUSCEPTION AND PNEUMOCOLON

