Abdominal Radiography: General Techniques & Interpretations

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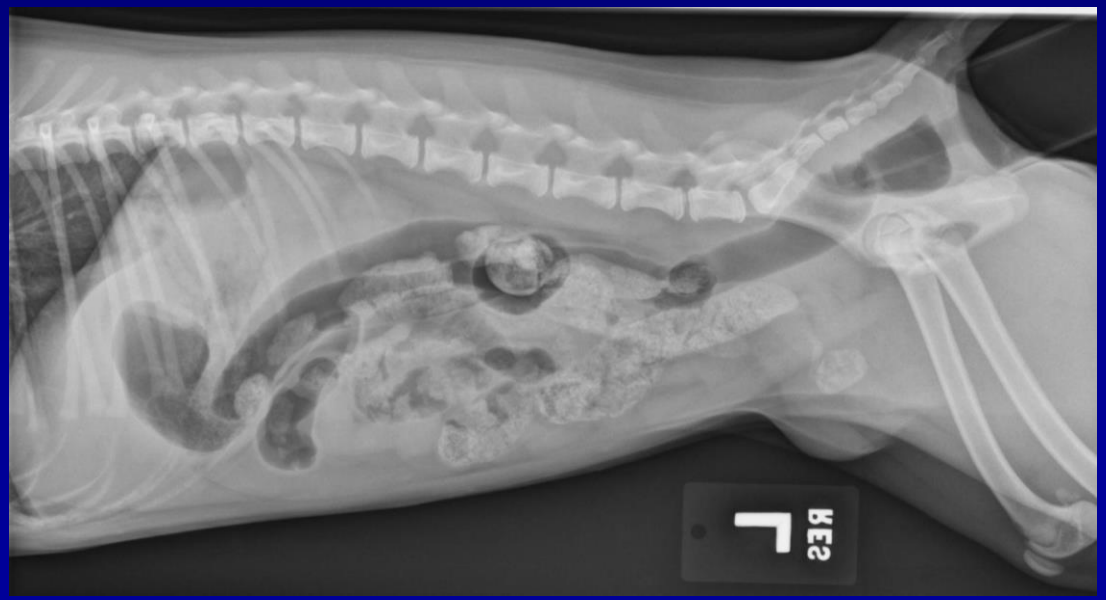
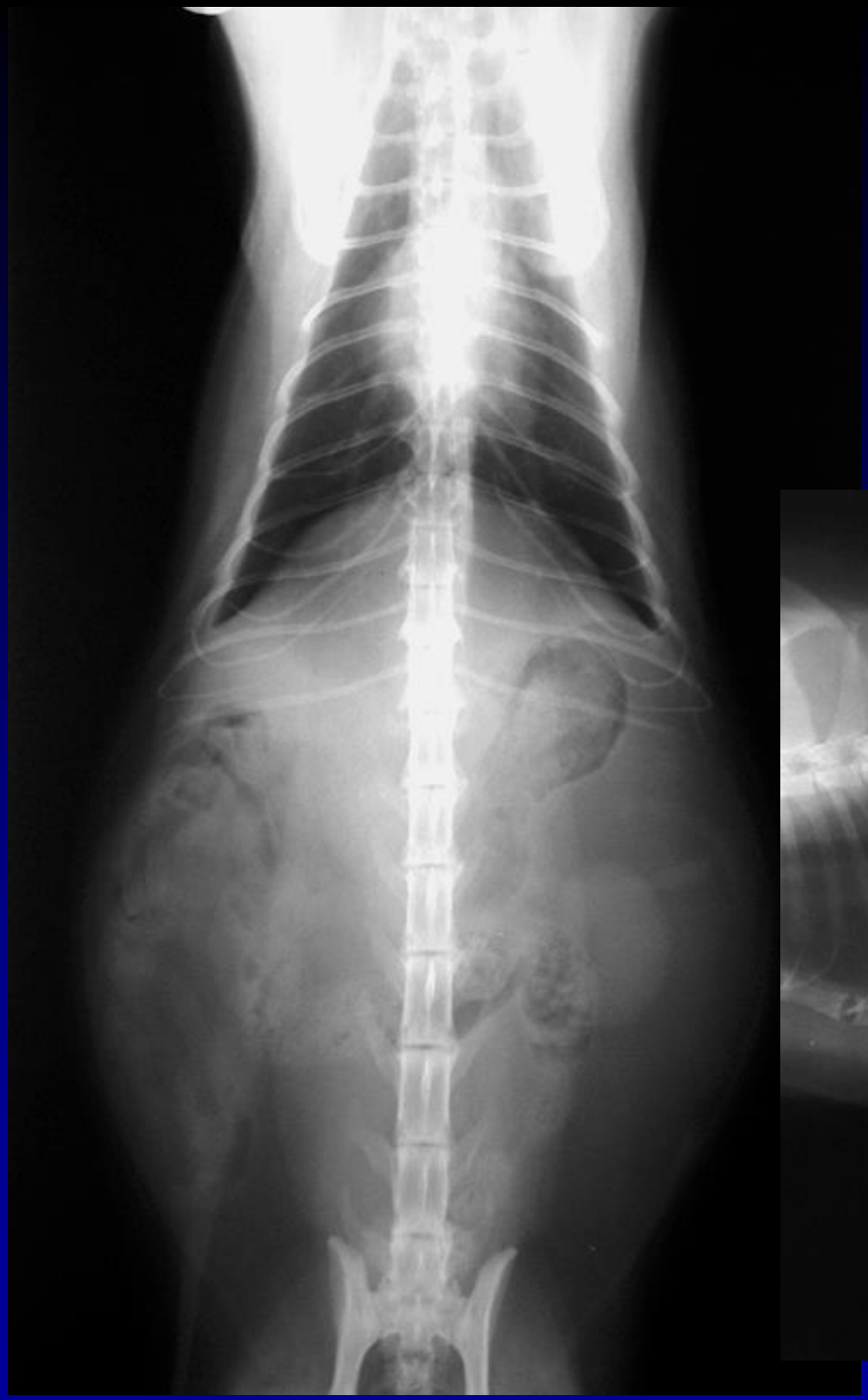
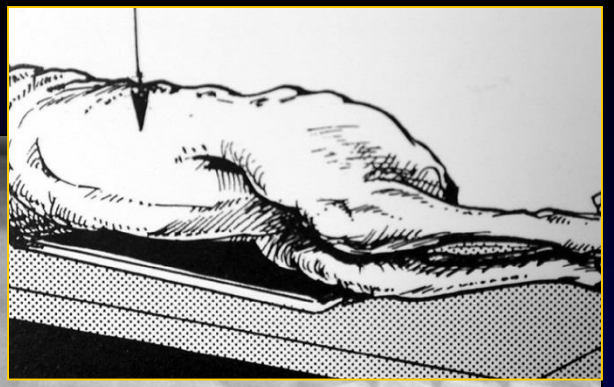


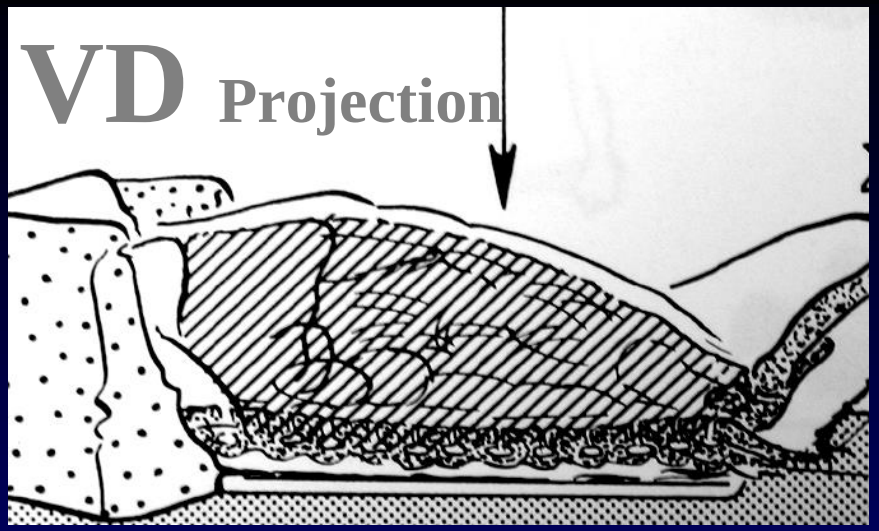
~ Breed
~ Age
~ Body condition
~ Hair coat
~ Film Quality

Whole Body Radiographs



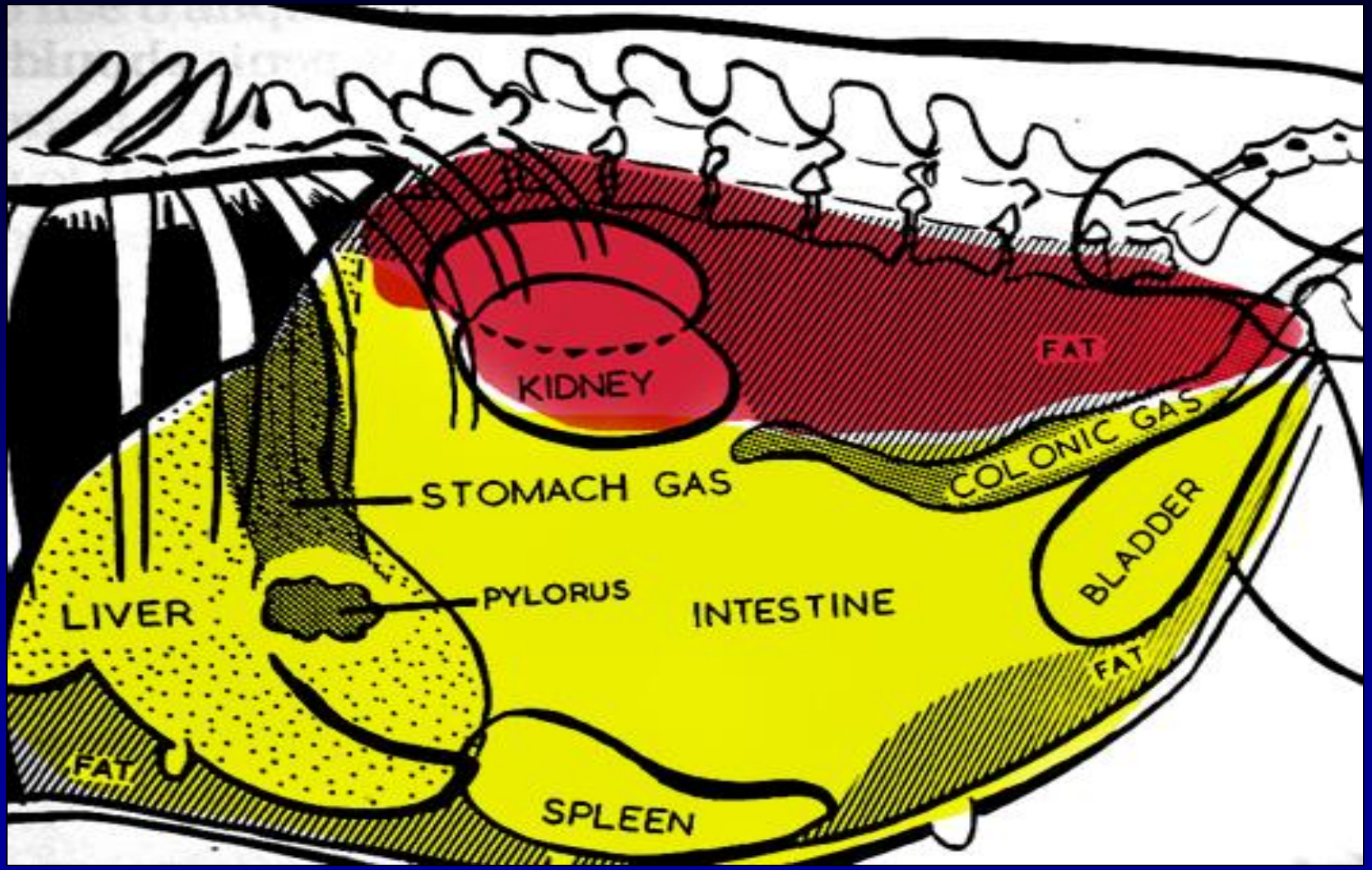
Lateral Abdominal Radiography

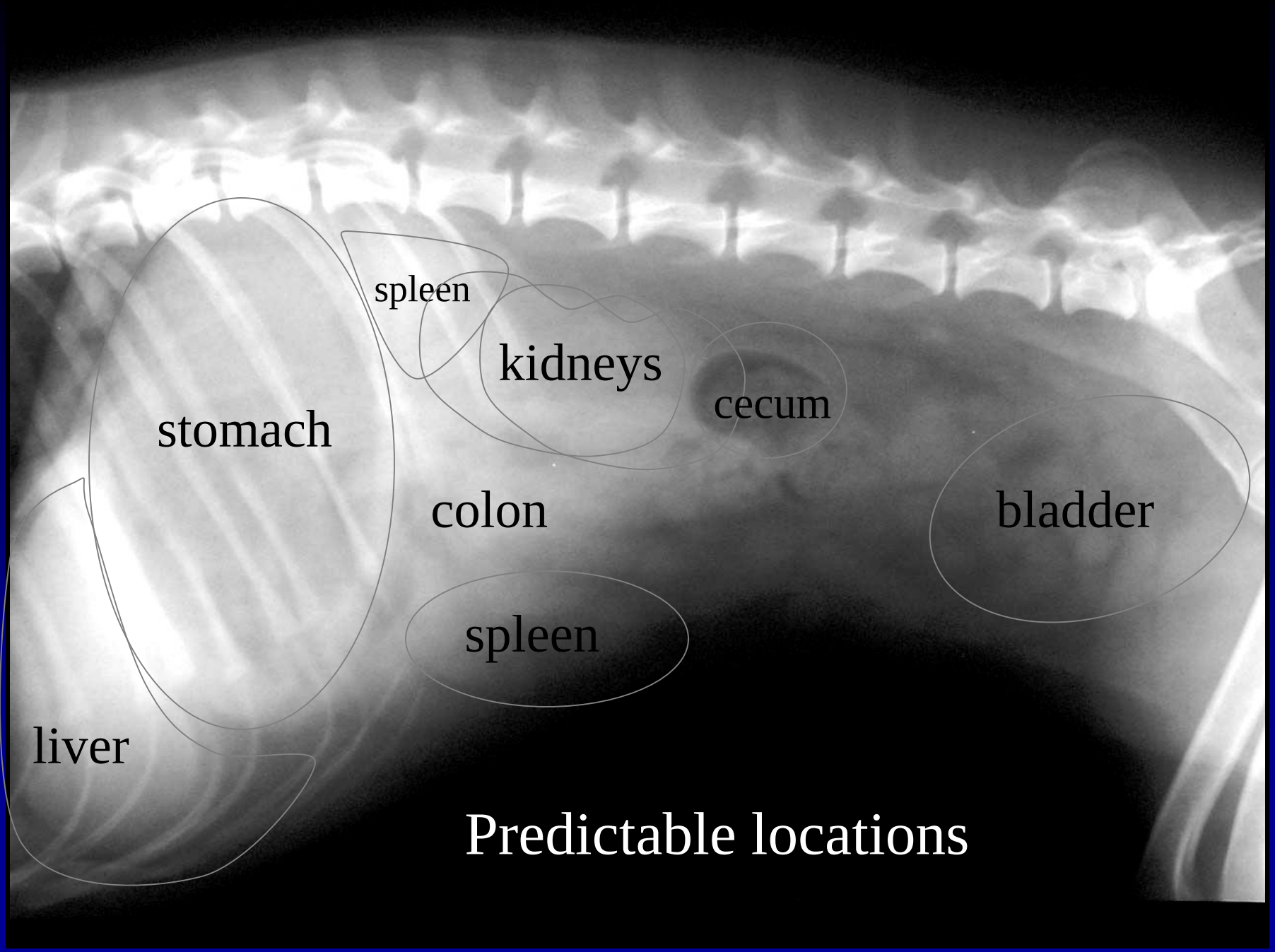


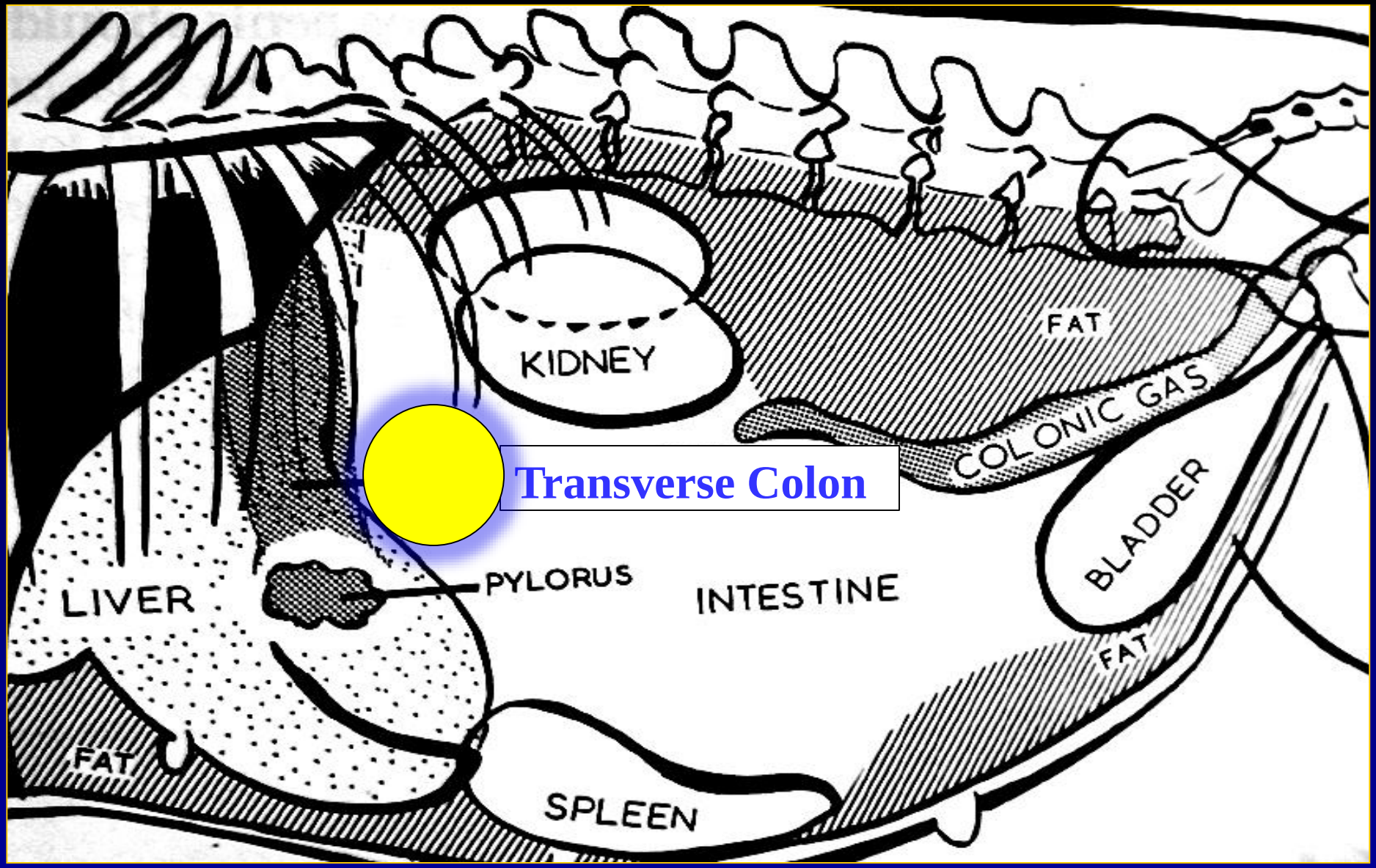


- Diaphragm to pelvis
- Rear limbs extended
- Positioning devices
- Expiratory phase
- Large dogs = 2 films
  - to cover entire abdomen

Normal Abdominal Anatomy

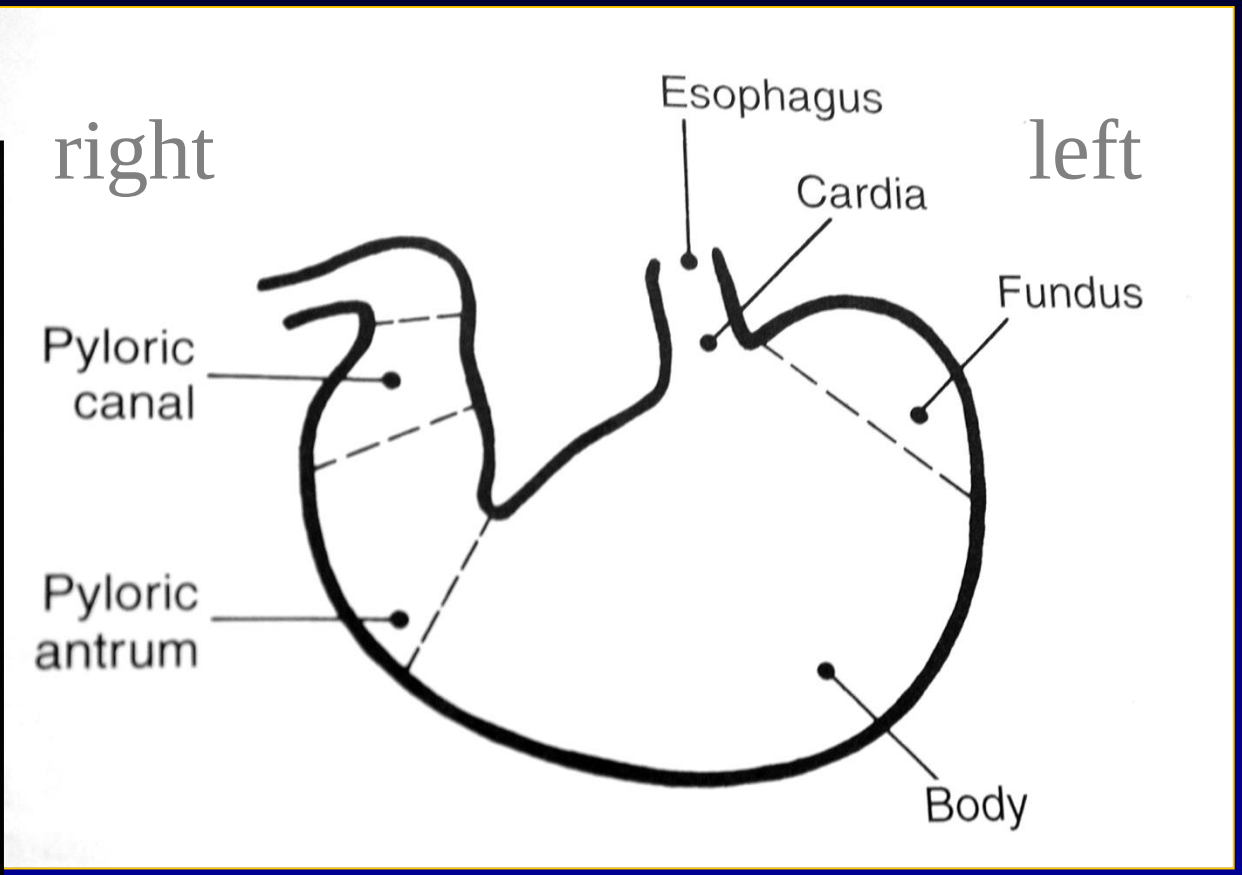



spleen
kidneys
cecum
stomach
colon
bladder
spleen
liver
Predictable locations



Radiographic Abdominal Anatomy: Colon = Landmark

Stomach Regions



Stomach VD view:

Cat stomach

antrum & pylorus

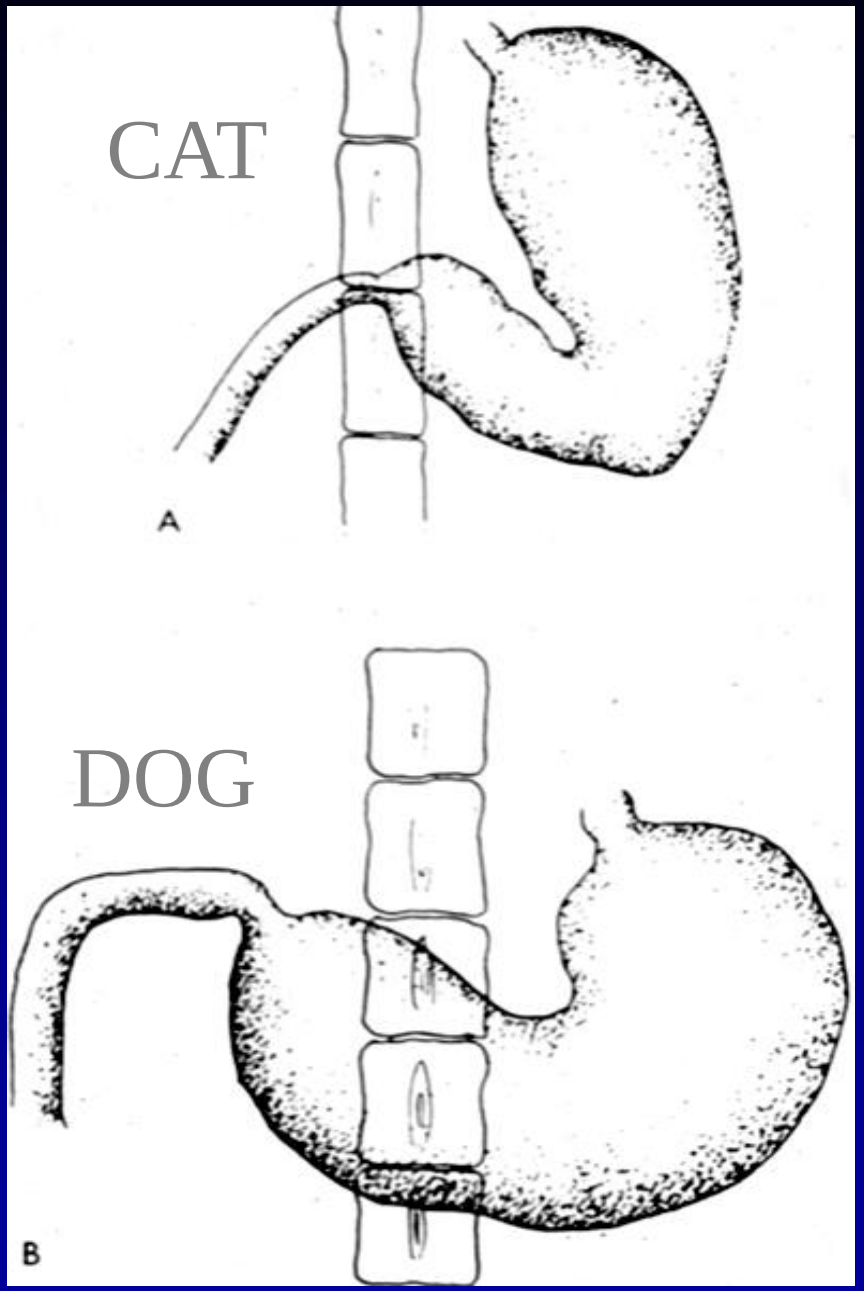
on midline

-vs-

Dog stomach

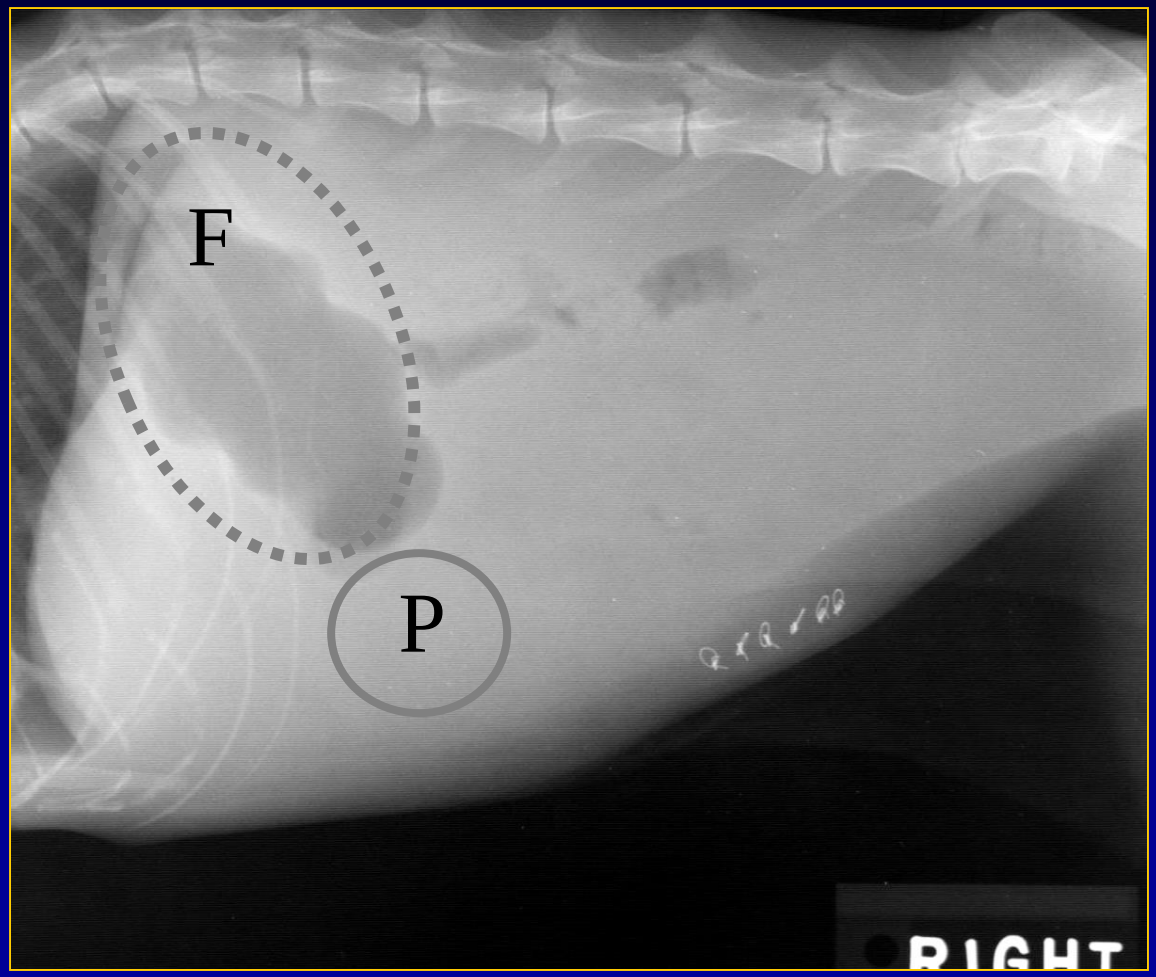
antrum & pylorus

right of midline



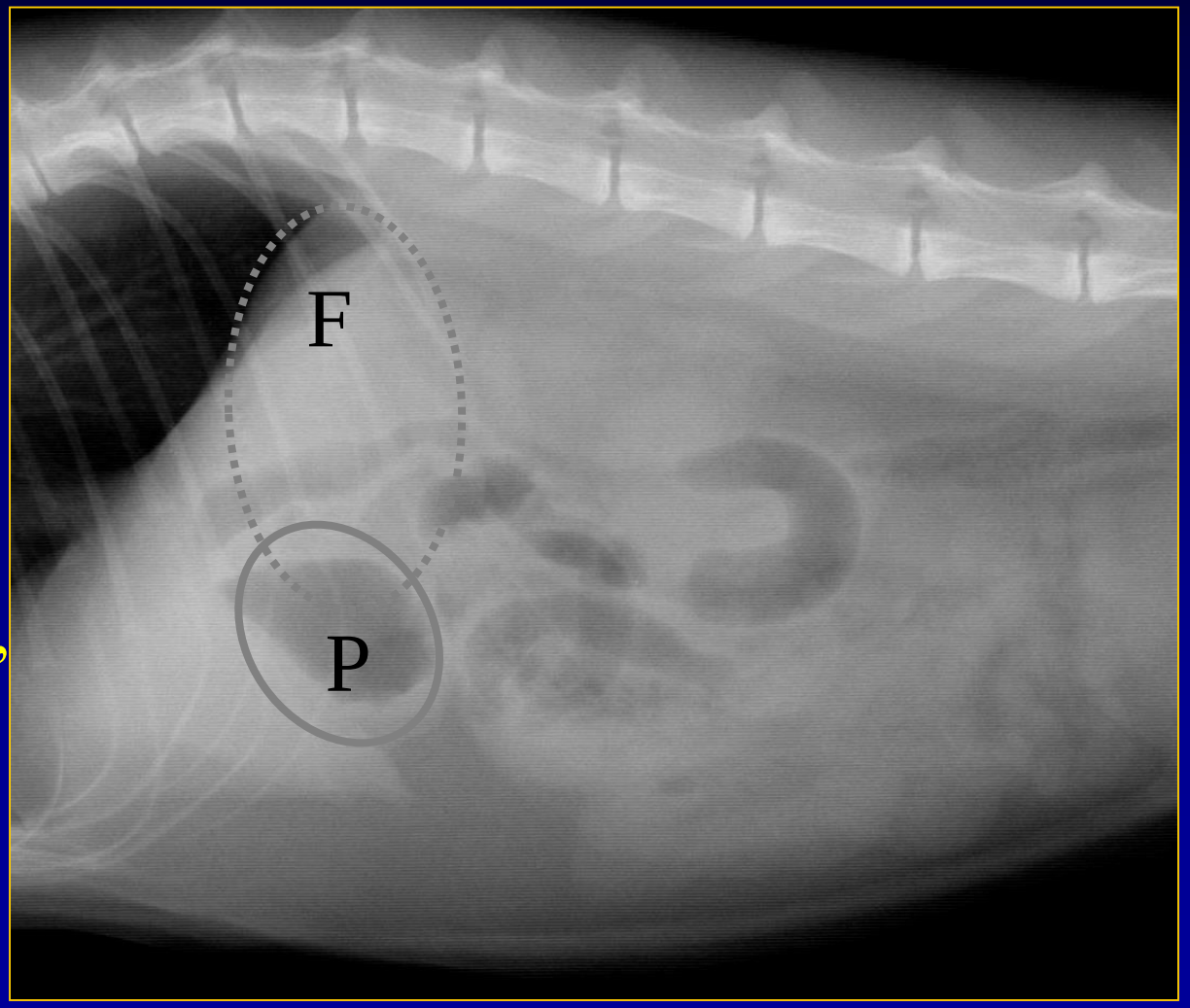
Right Lateral Recumbent

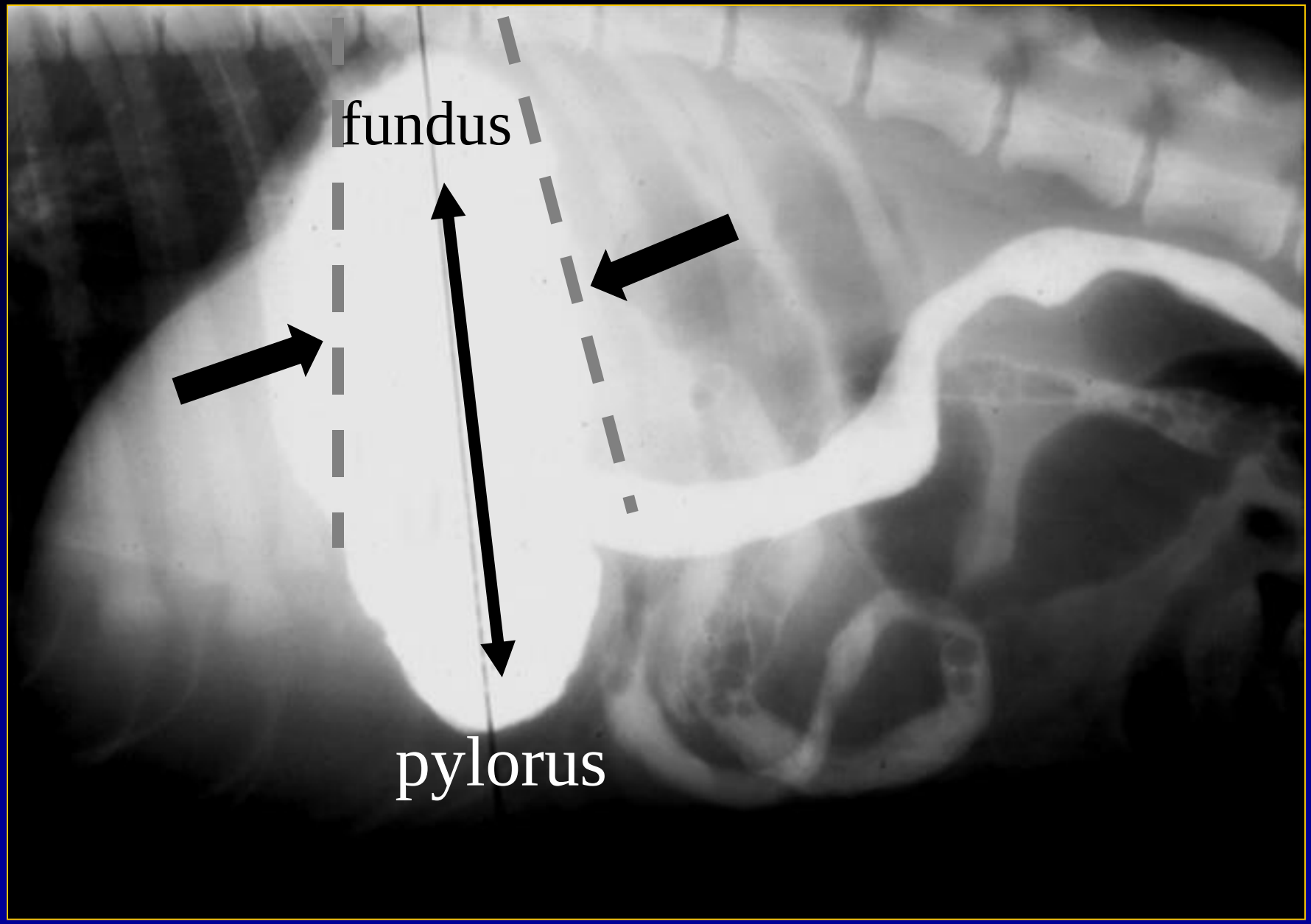
- Fundus up
  - "non-dependent"
  - air filled
- Pylorus down
  - "dependent"
  - fluid filled



Left Lateral Recumbent

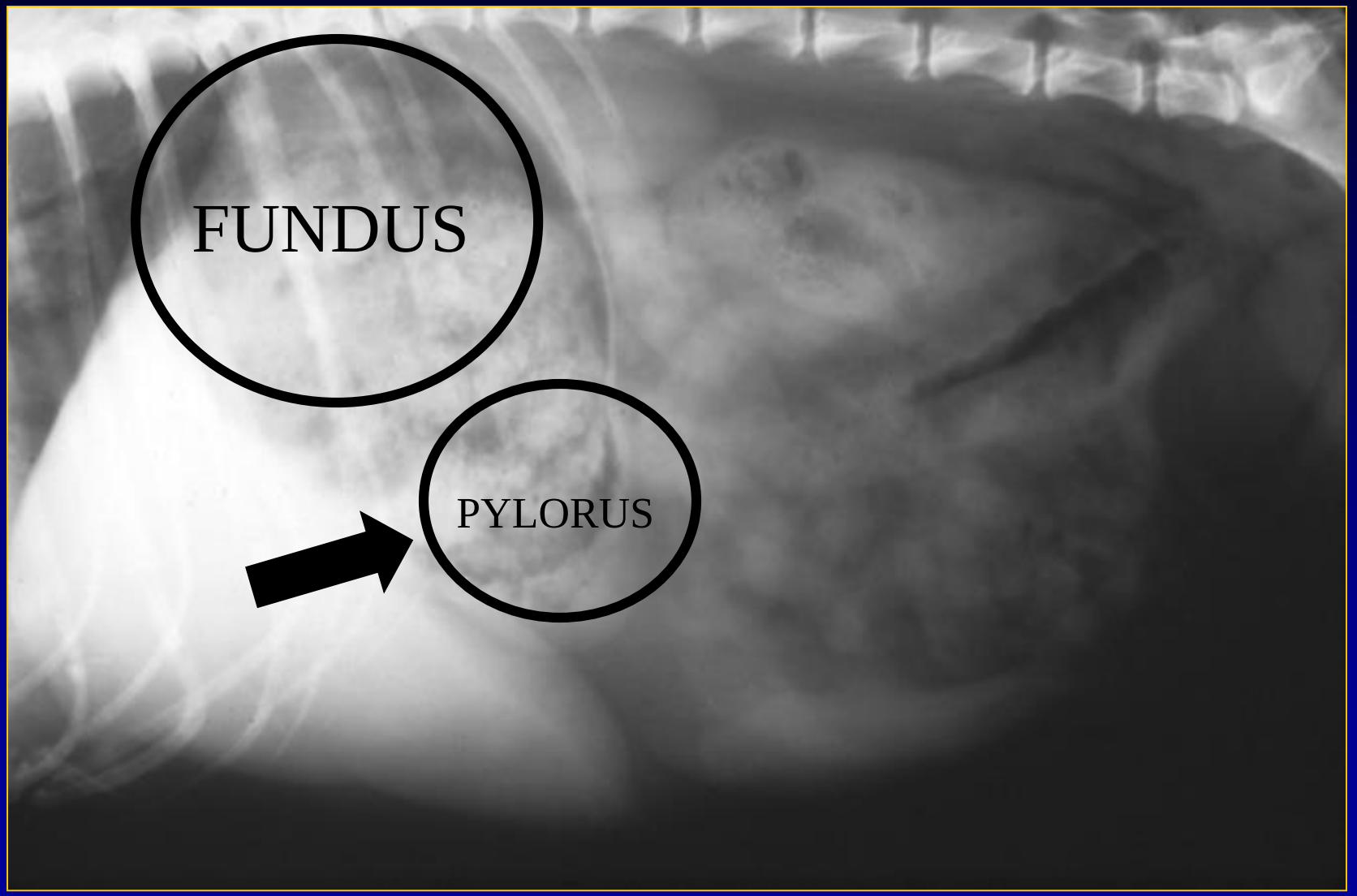
- Fundus down
  - "dependent"
  - fluid filled
- Pylorus up
  - "non-dependent"
  - air filled



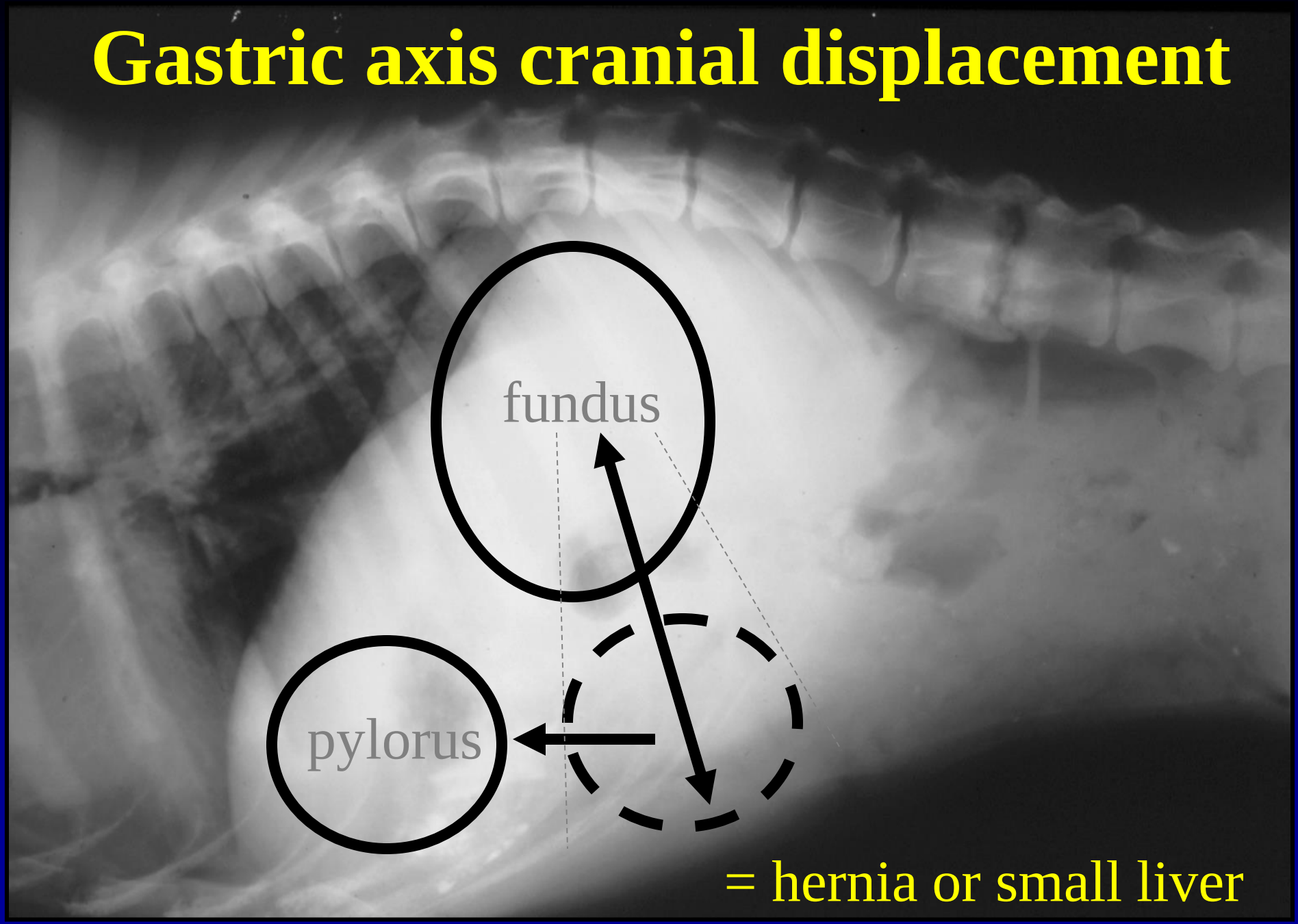


Normal “gastric axis” = parallels ribs to perpendicular to spine

Gastric axis caudal displacement = hepatomegaly

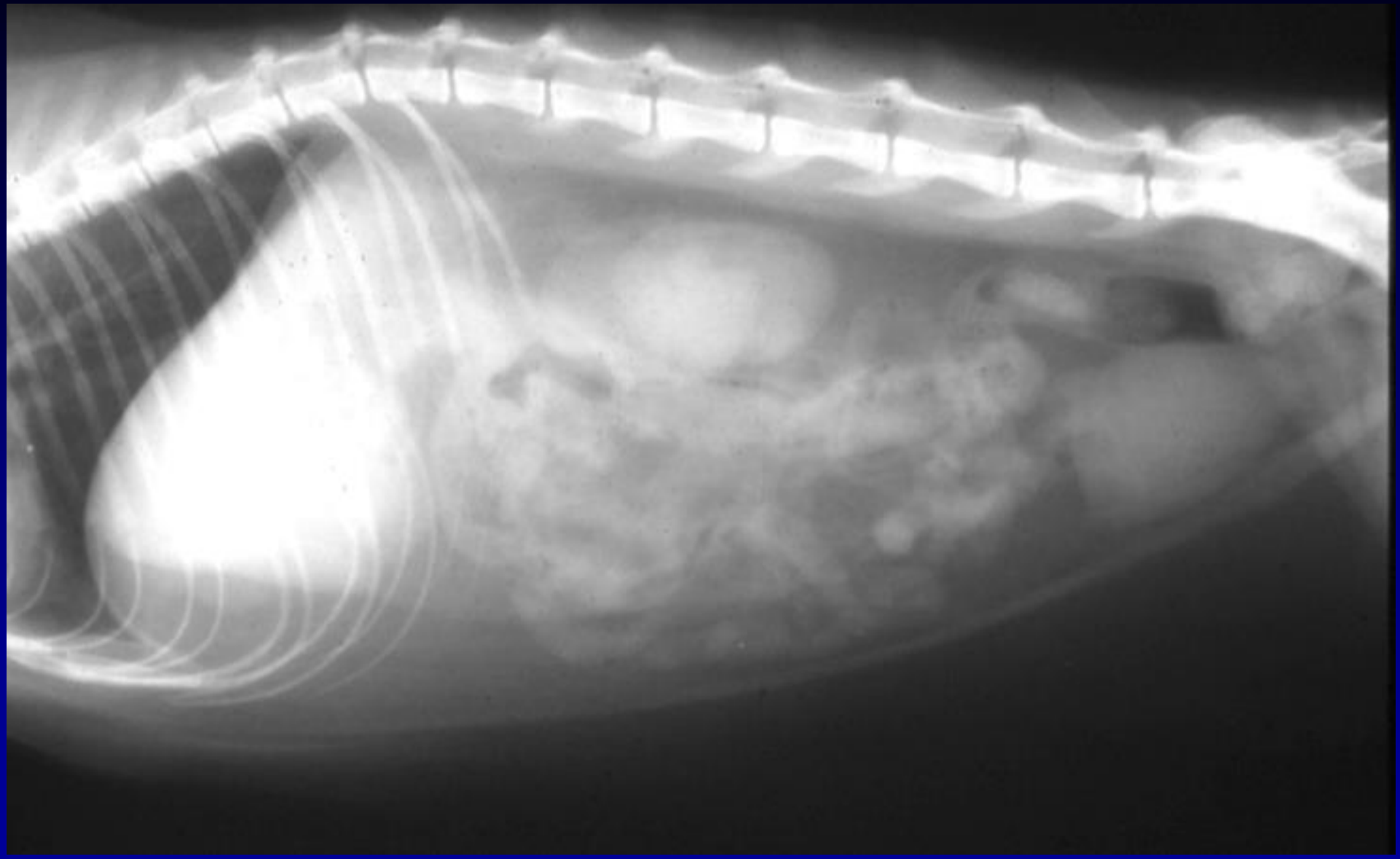


Gastric axis cranial displacement



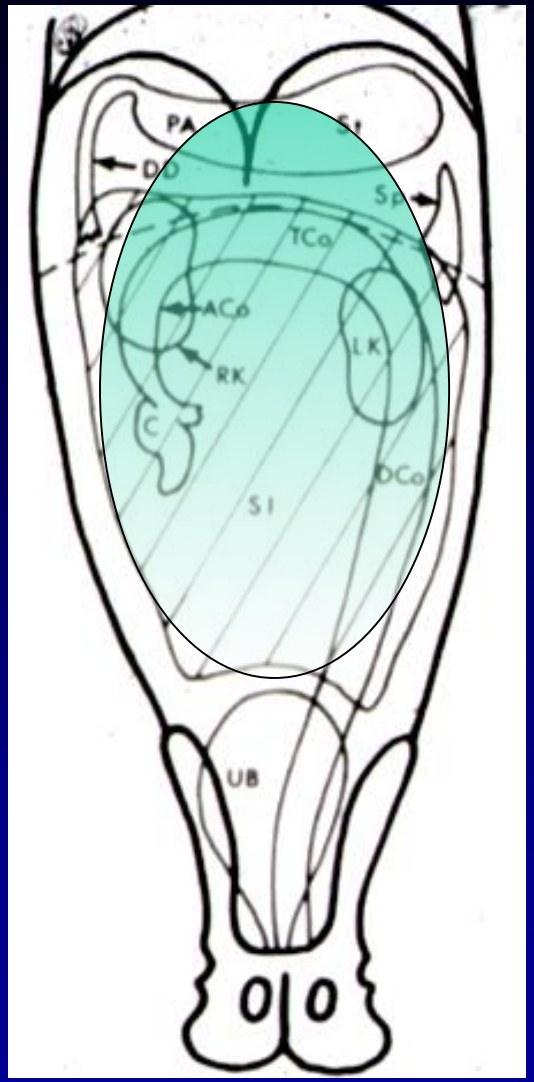
= hernia or small liver

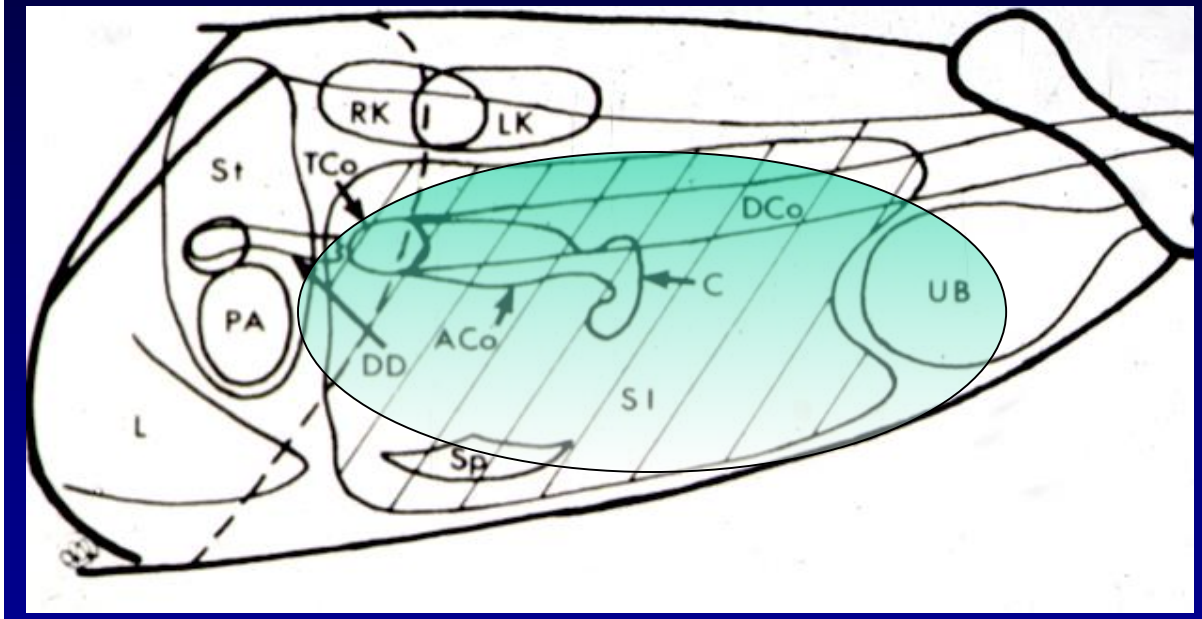
Small Intestines



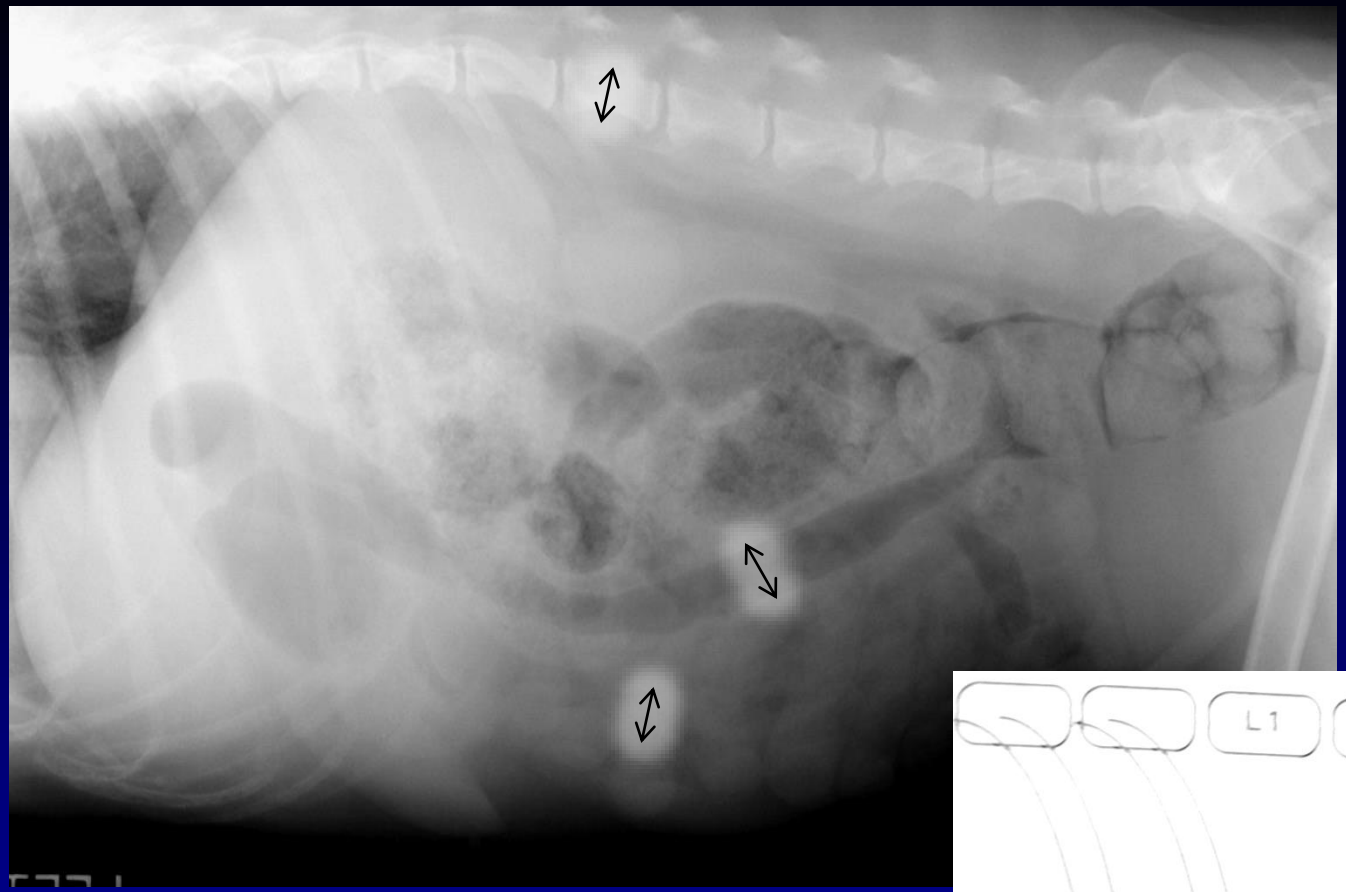
Variable position and contents

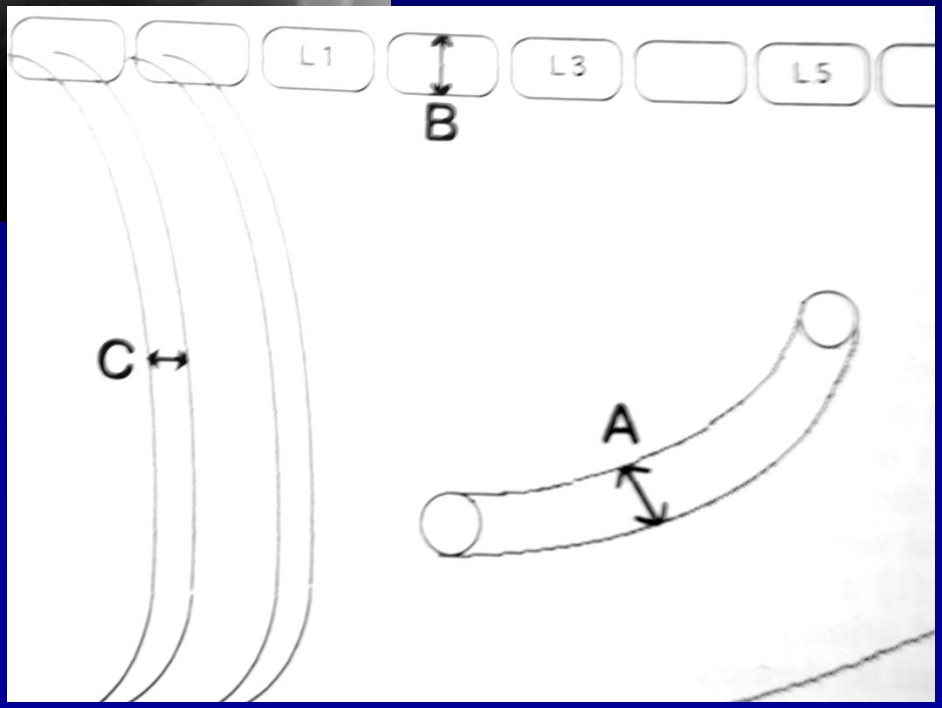
Small Intestines





Small Intestines size (diameter)





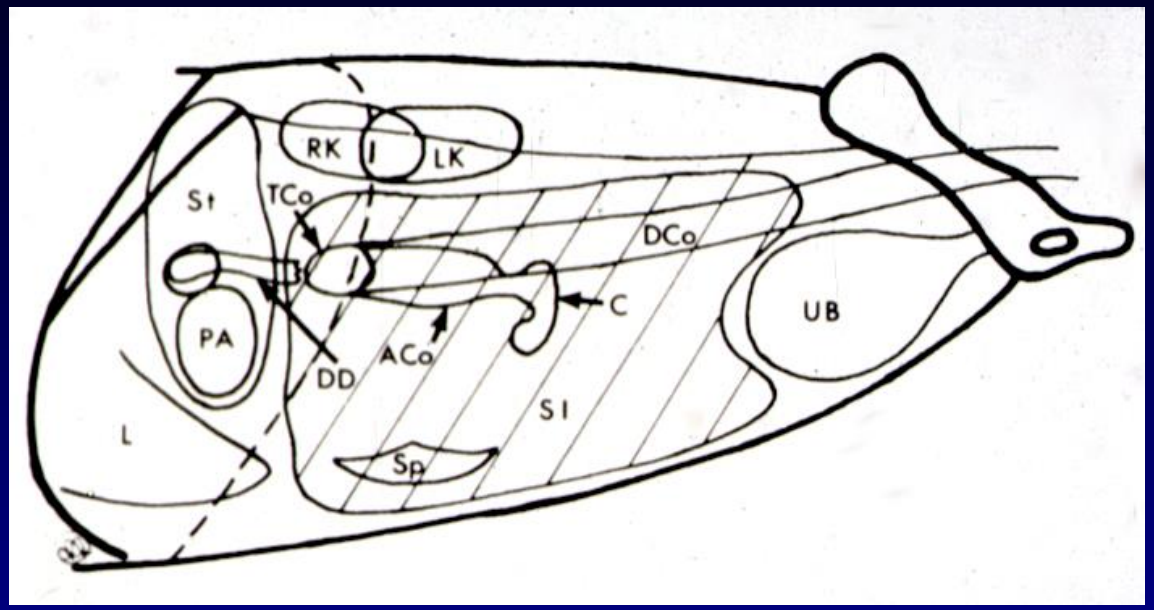
A= normal SI diameter:

< 2-3x rib width

< lumbar body height

< 12mm in cats

Cecum & Large Intestine

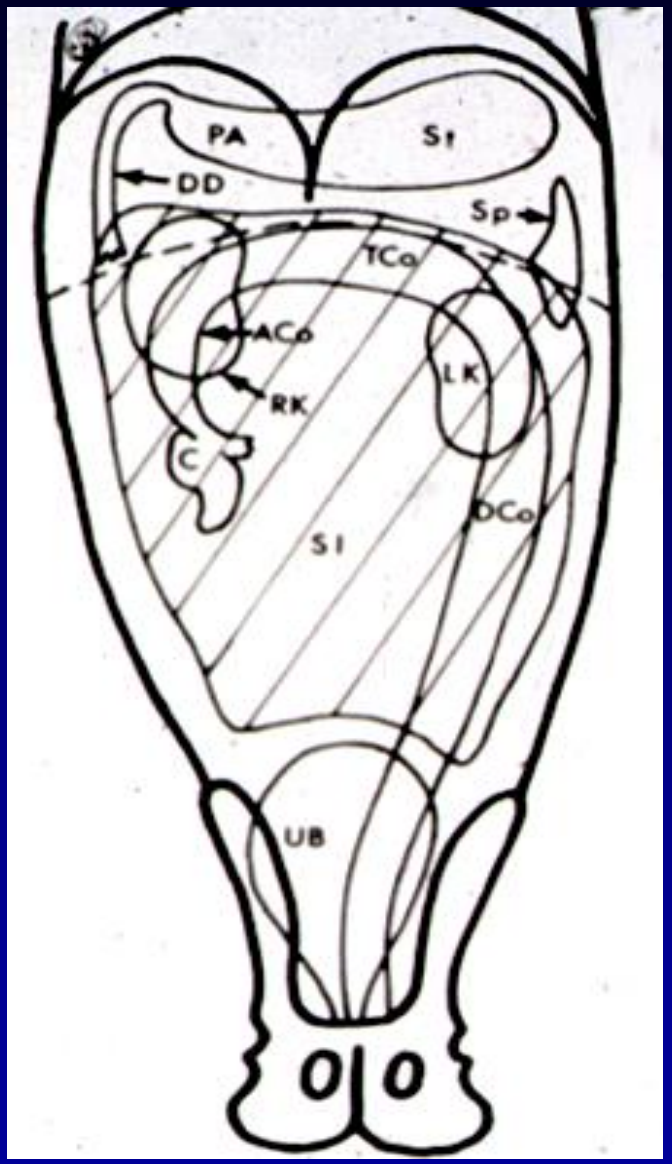


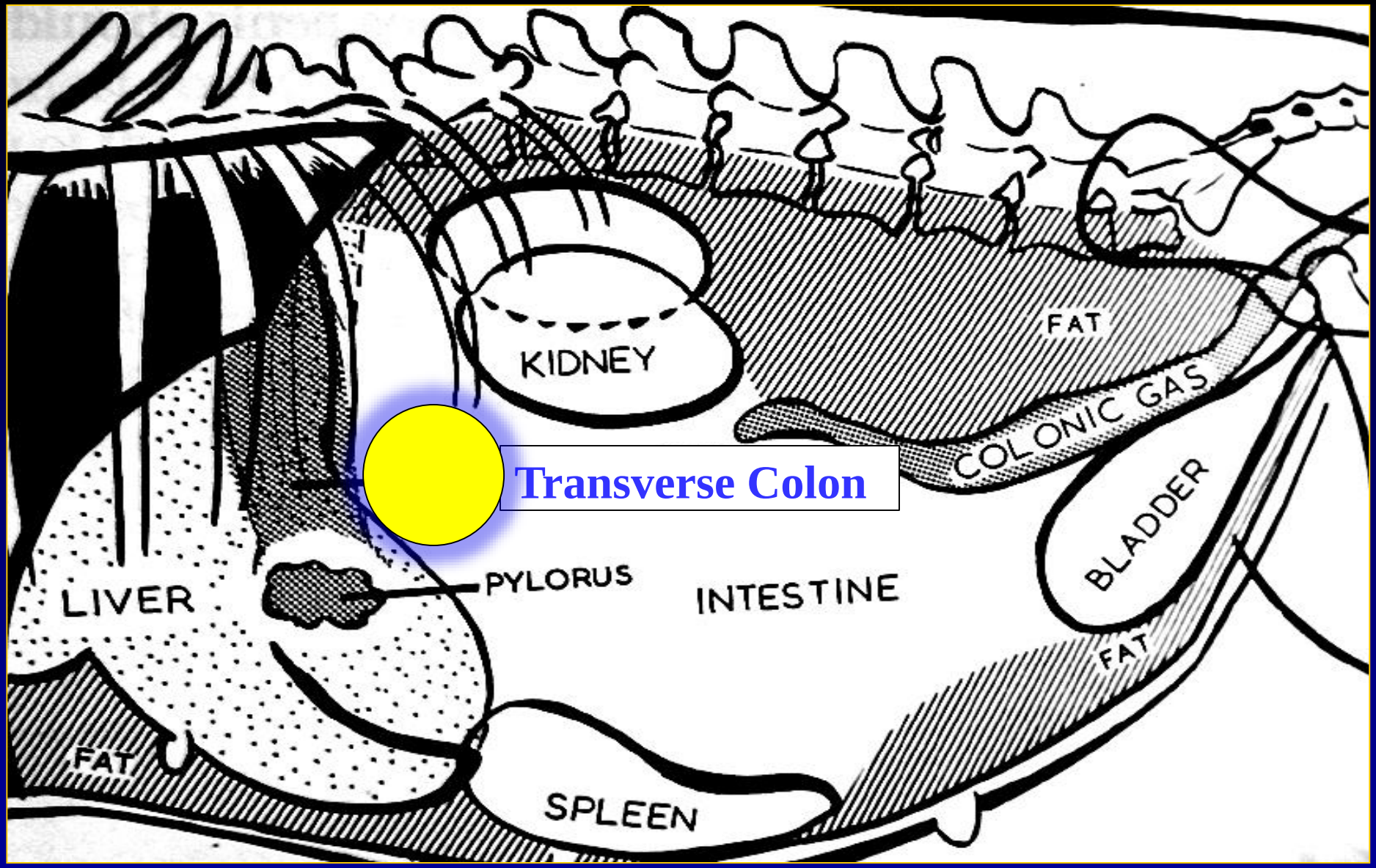
Cecum

Ascending colon

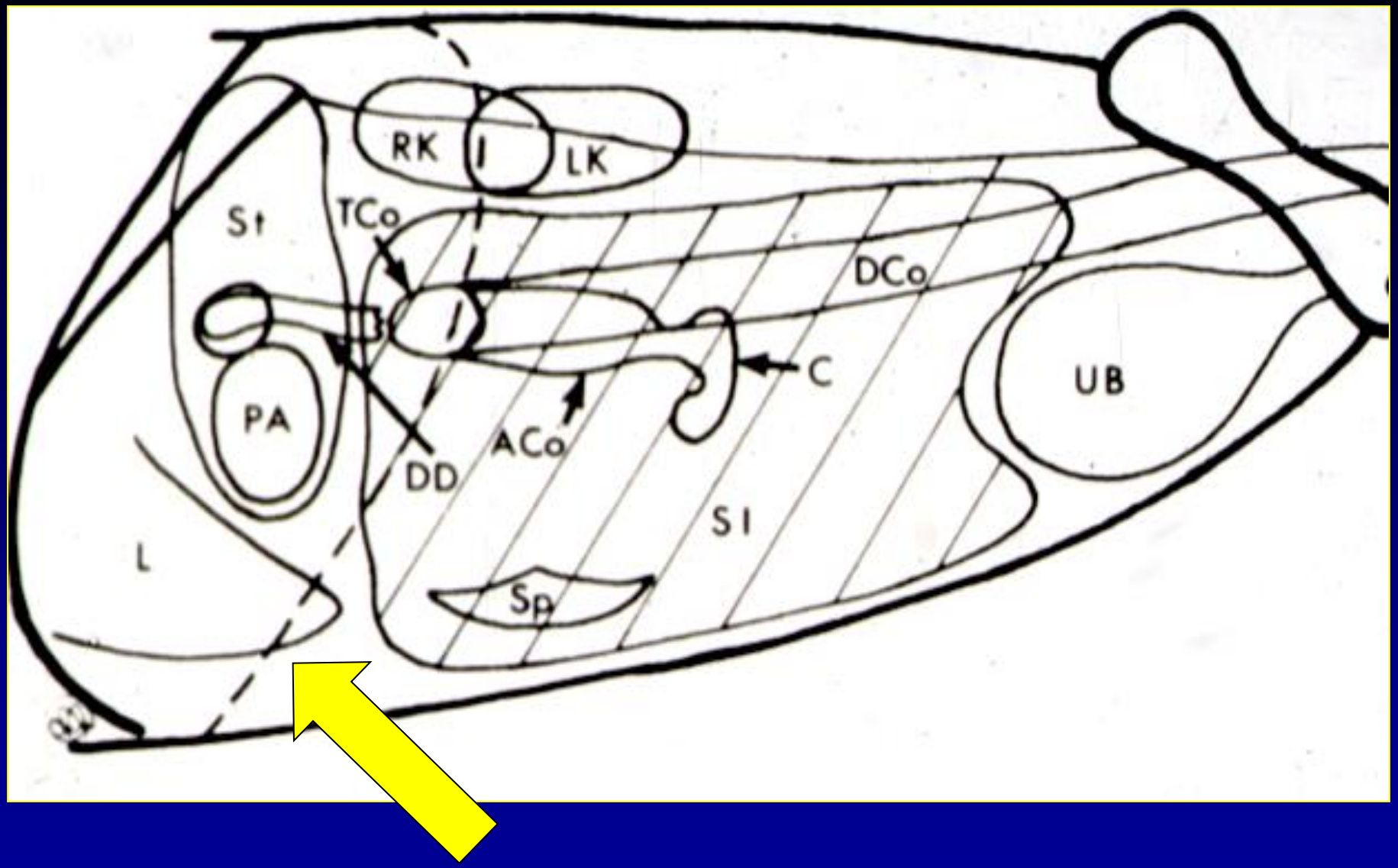
Transverse colon

Descending colon

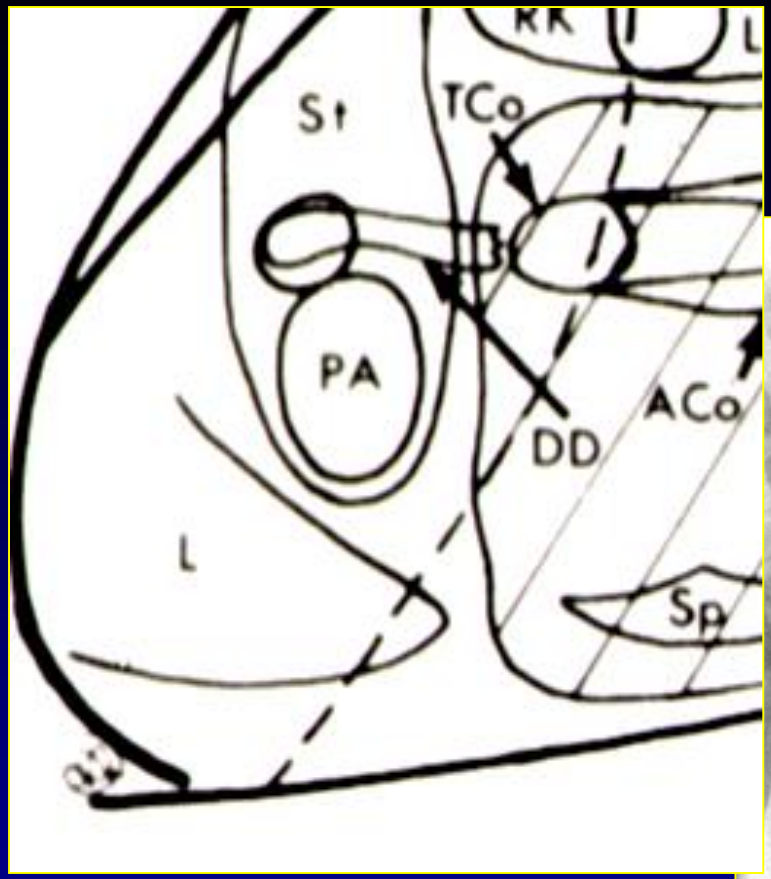




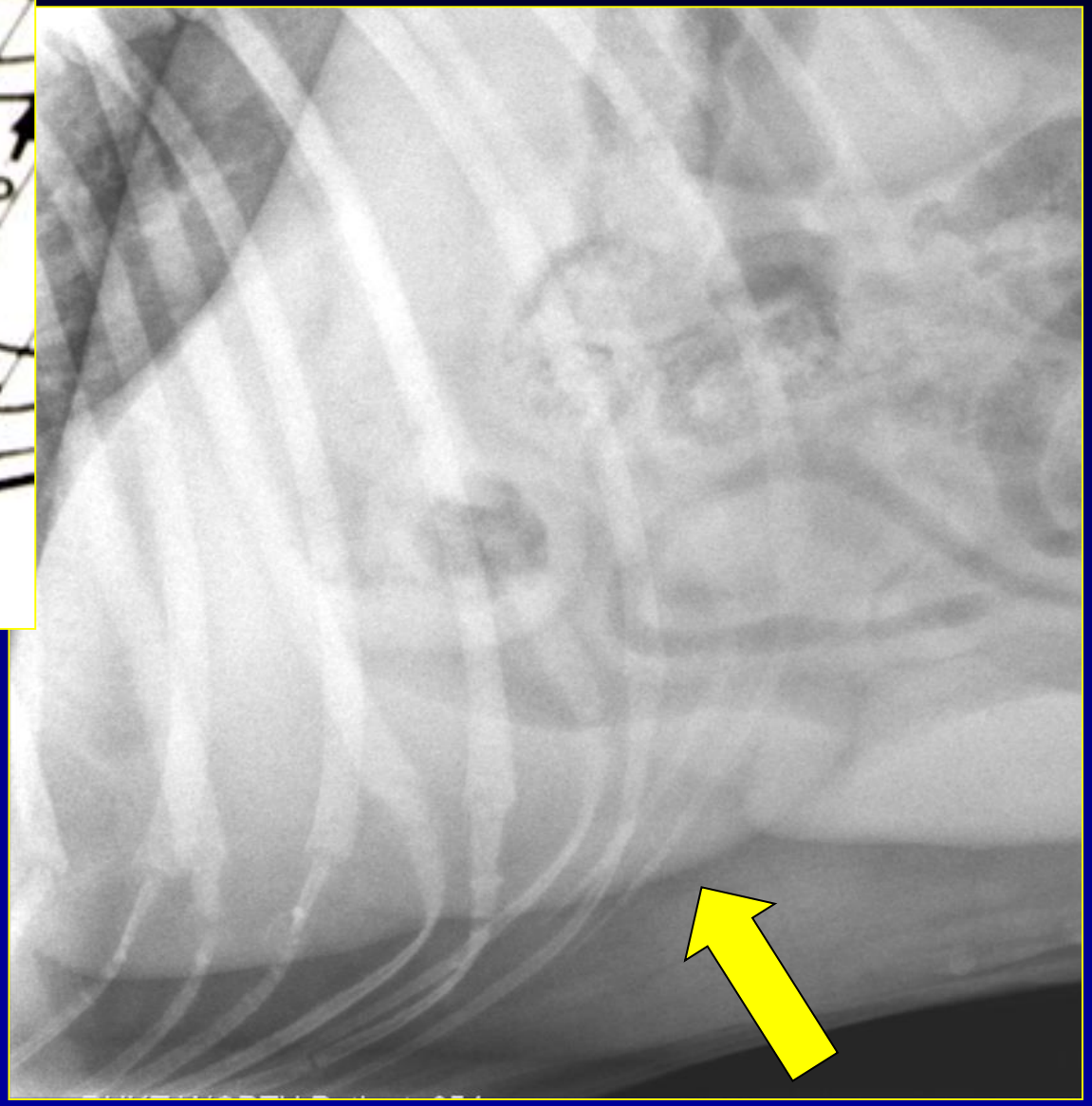
Radiographic Abdominal Anatomy: Colon = Landmark

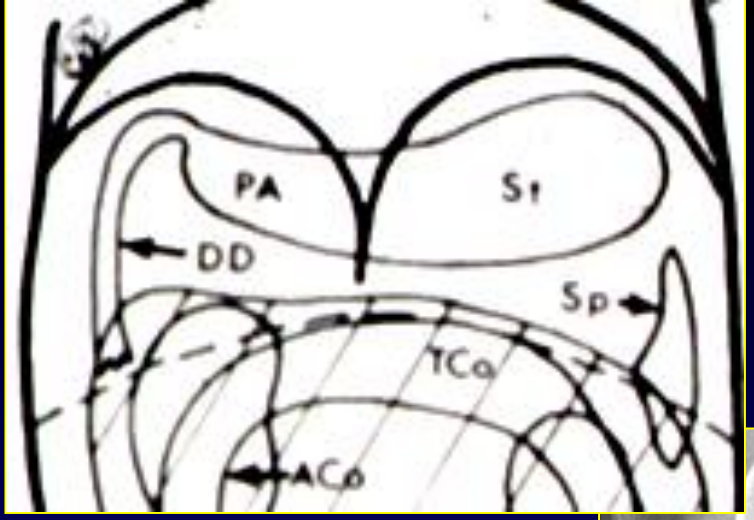


Liver on lateral view ~ caudal liver contained by costal arches

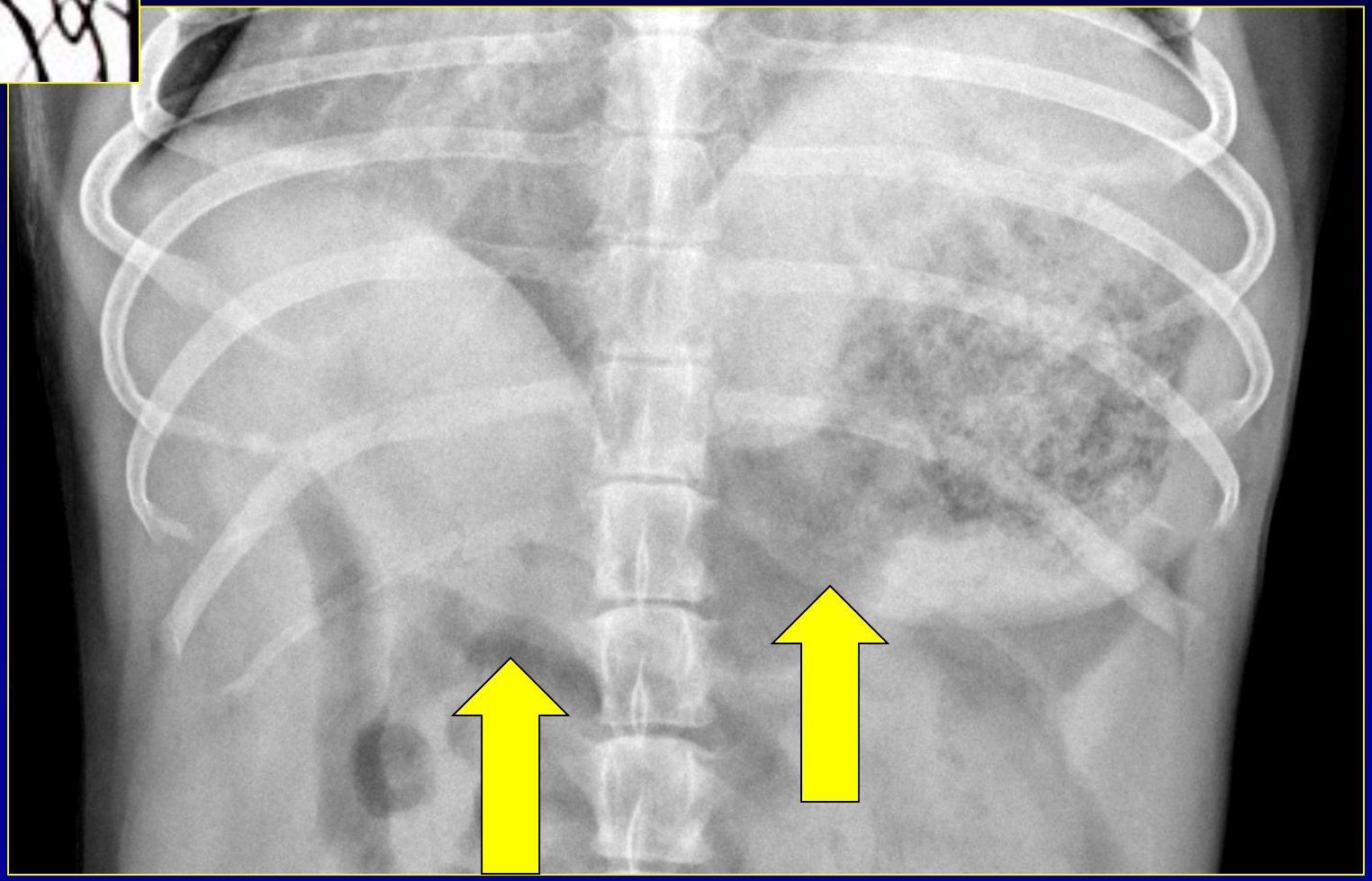


Liver Size &
caudal margins



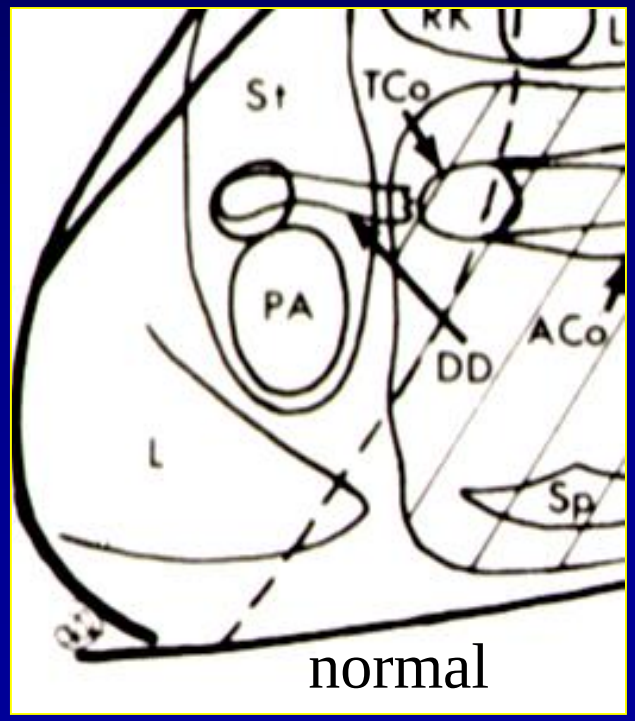


VD/DV Liver Radiography
~ stomach & colon displacement

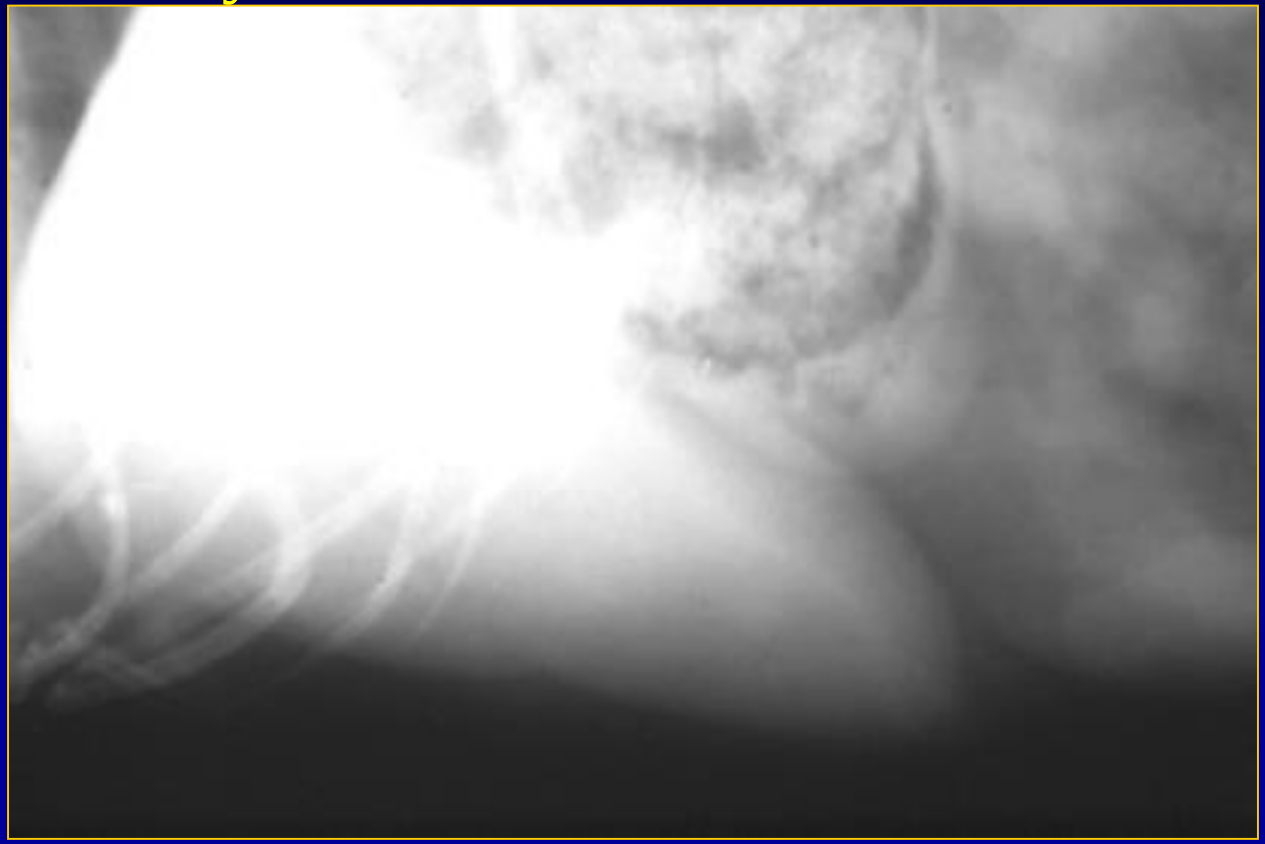


Hepatic enlargement:

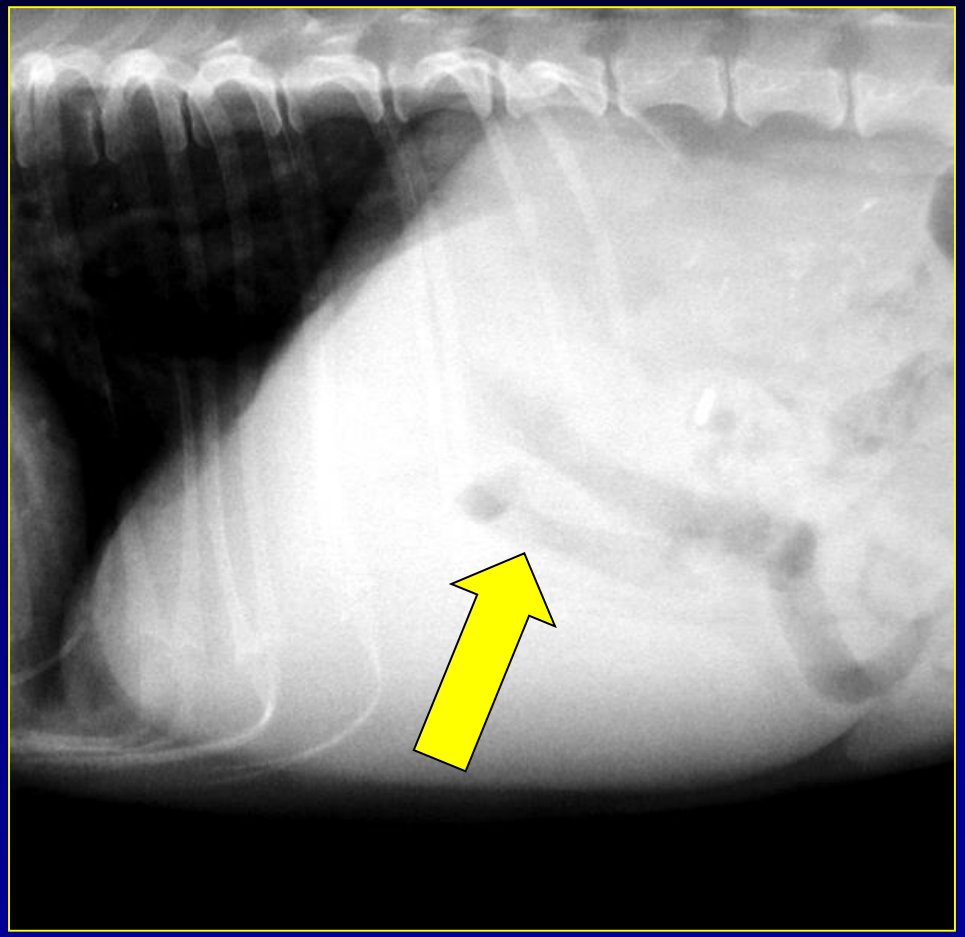
- Caudal margins extend beyond costal arches
- Rounding of caudal margins
- Gastric axis shifted caudally

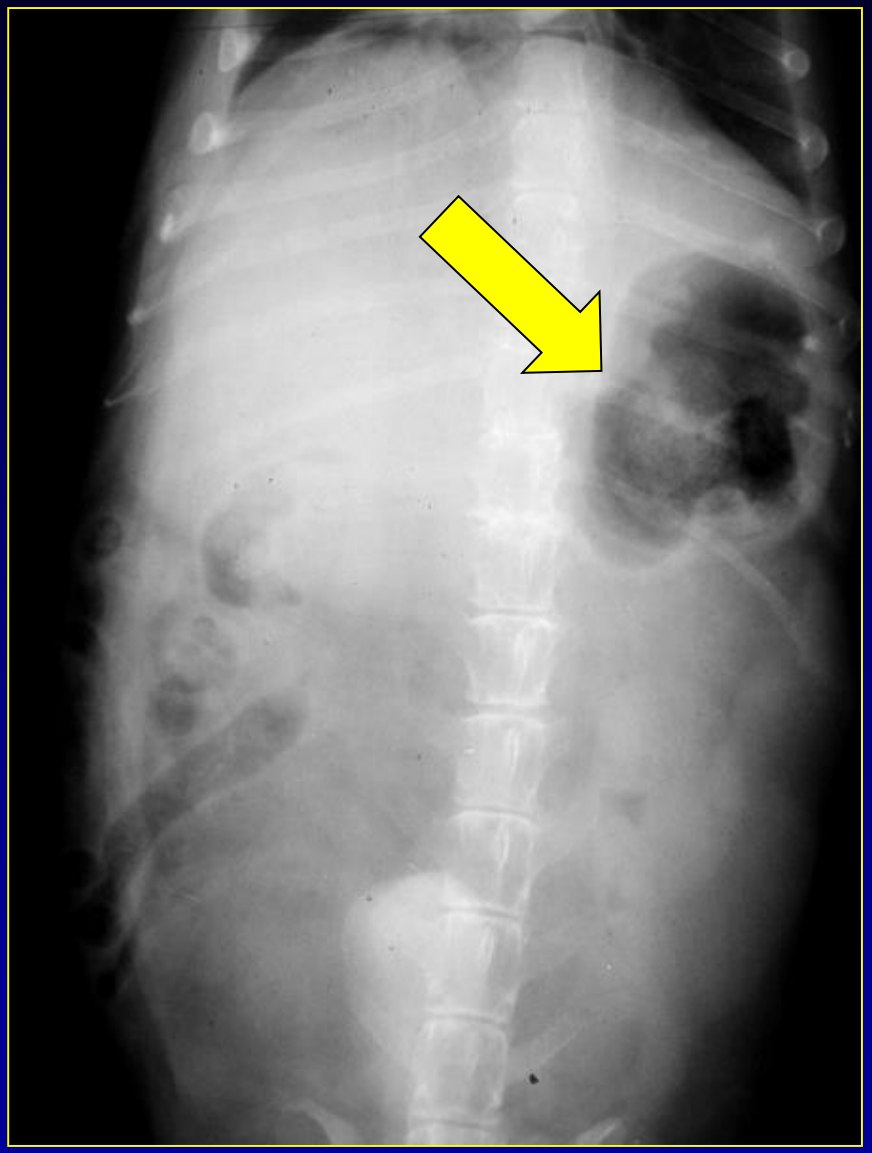


normal

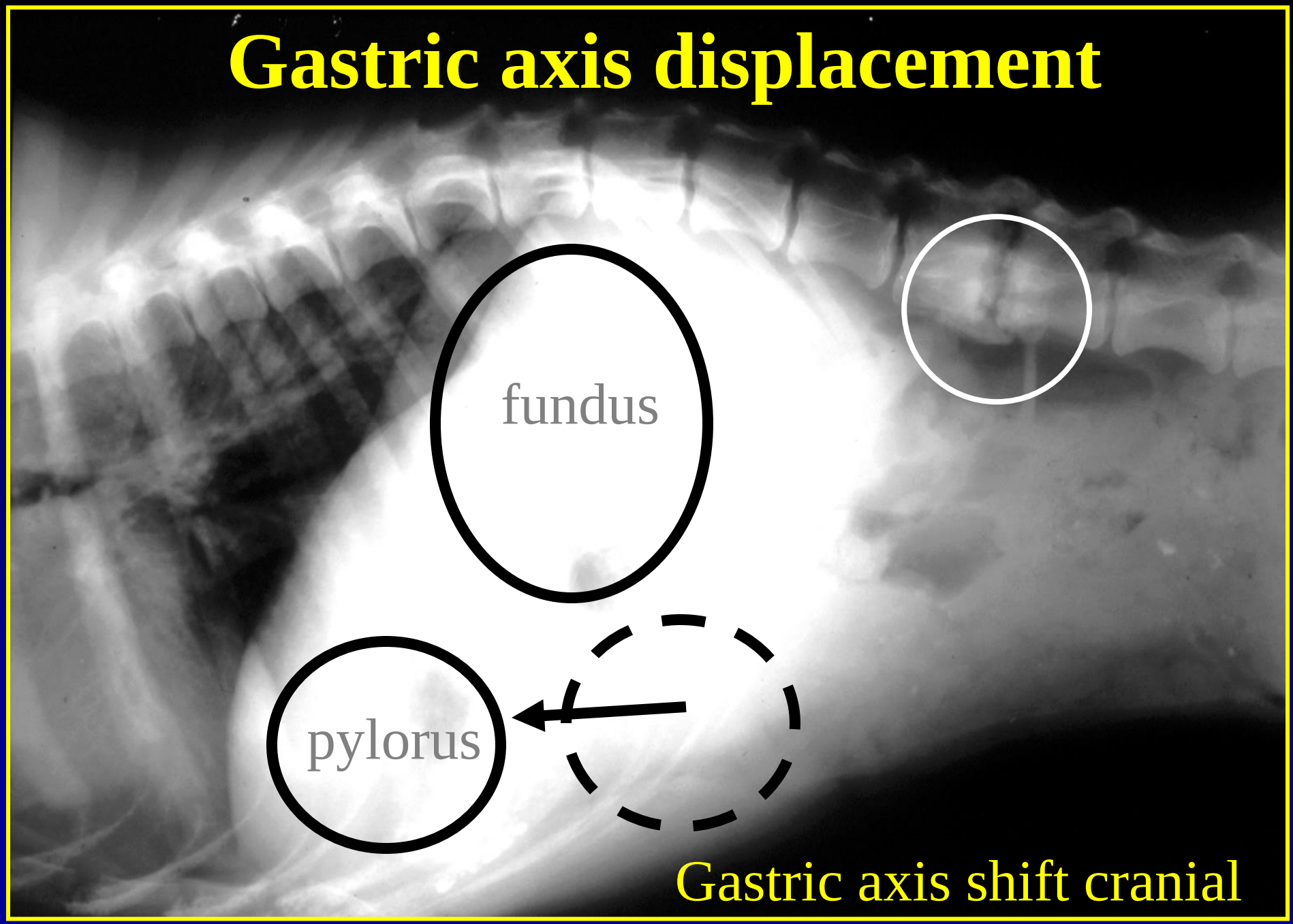


Hepatomegaly with displacement of stomach

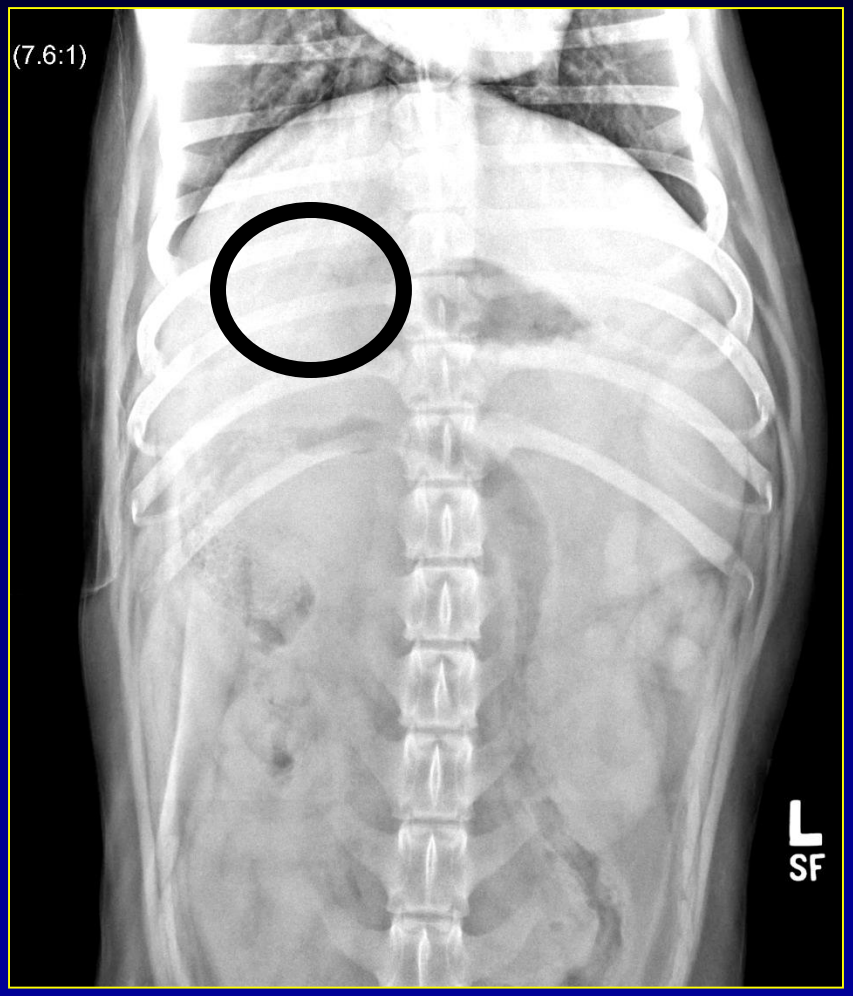


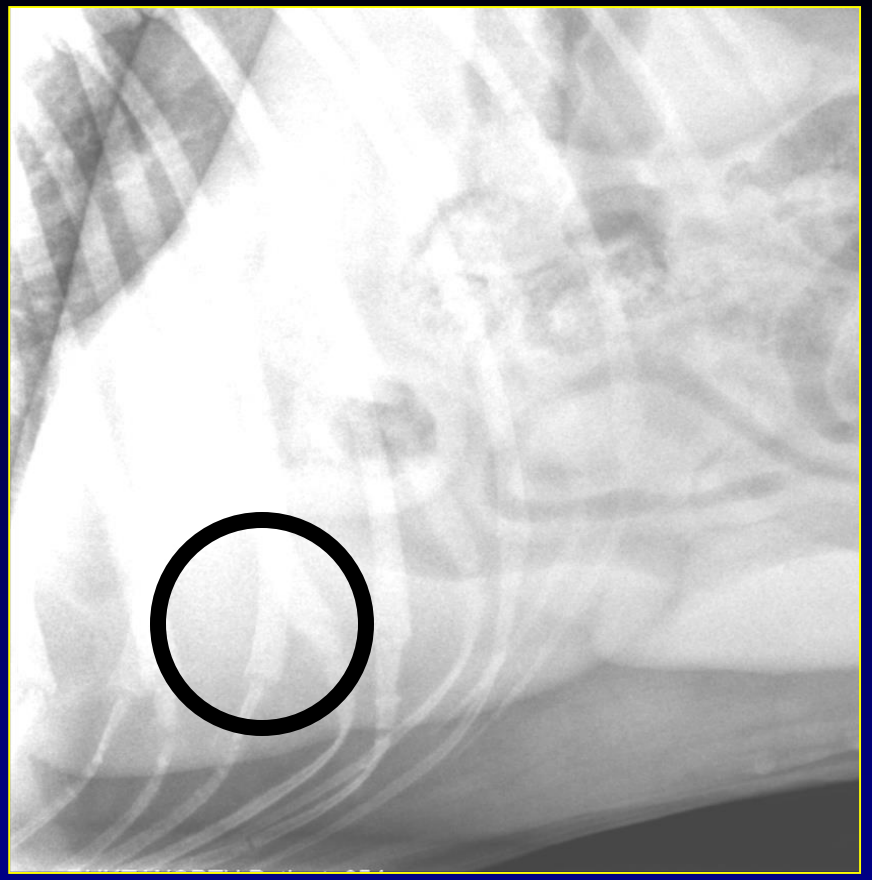


Gastric axis displacement



Gall Bladder Position



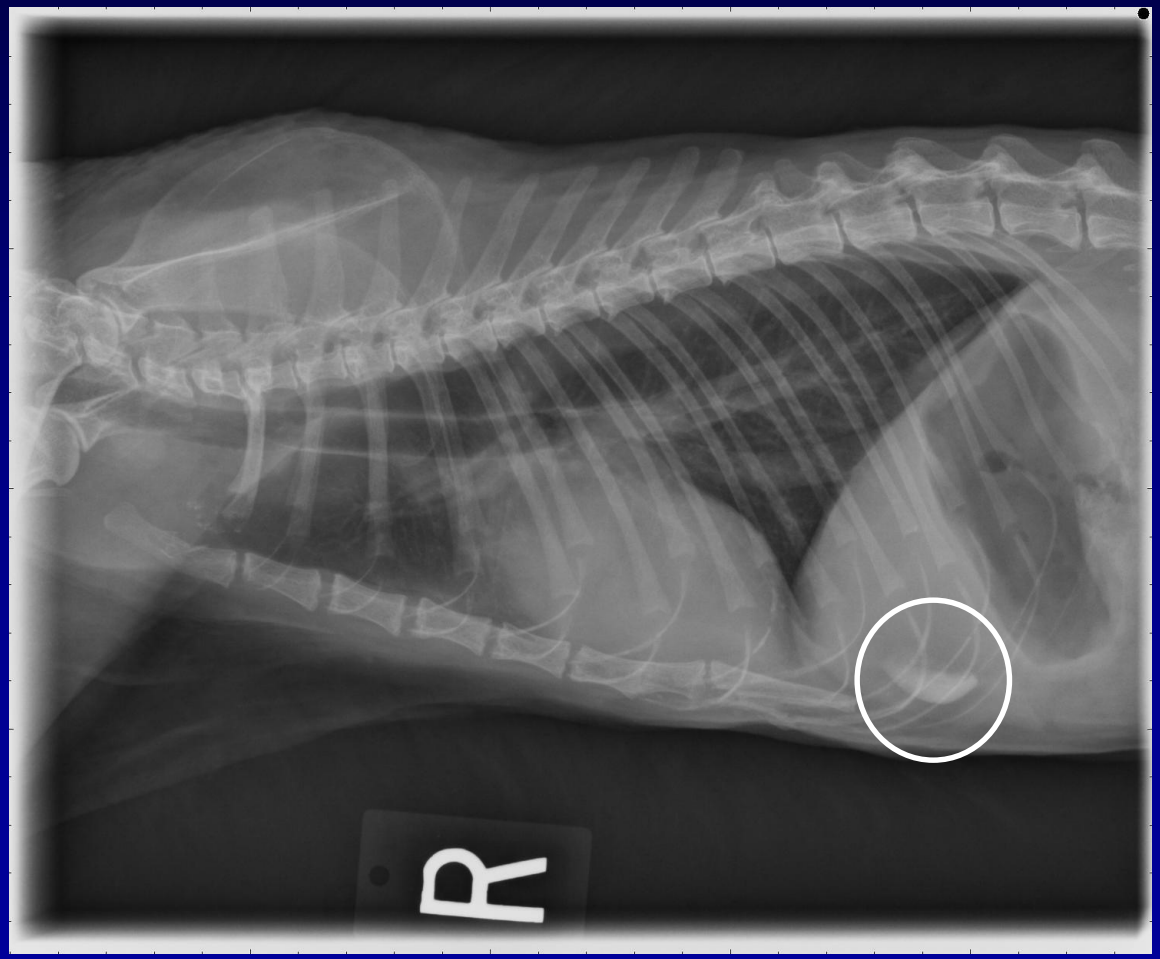


Normal gall bladder not visualized, unless sludge, choleliths or emphysematous cholecystitis

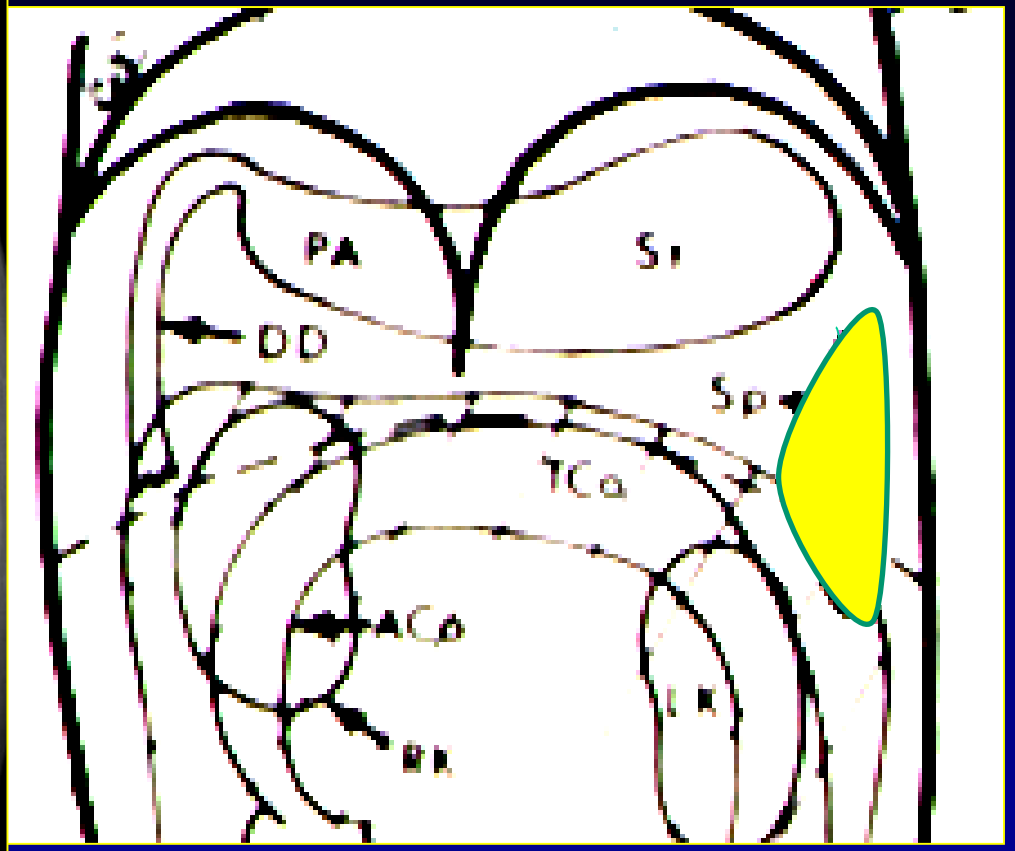
14 year old F/S Domestic Shorthair

Hyperthyroidism, presenting for I^{131} tx

1. Cardiomegaly
2. Mineral-opaque material - GB Sludge

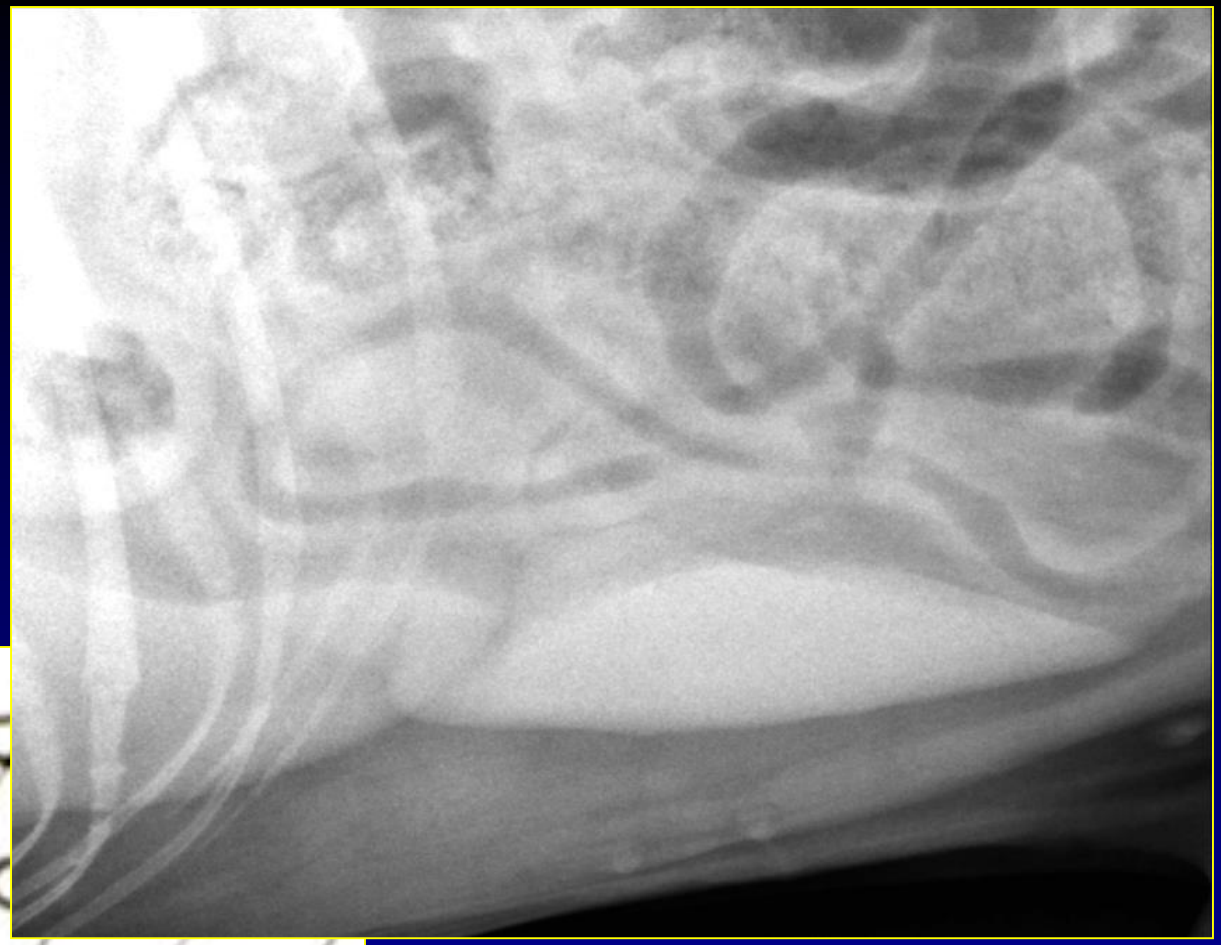


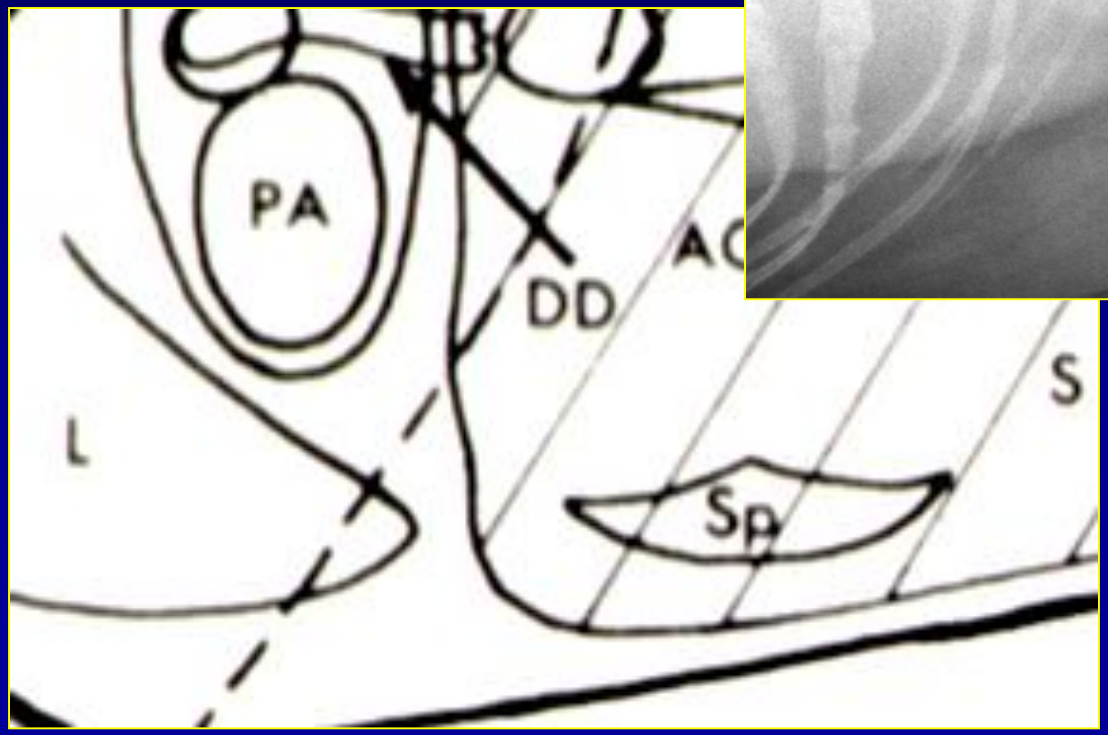
Spleen



Body of the spleen
along left abdominal wall

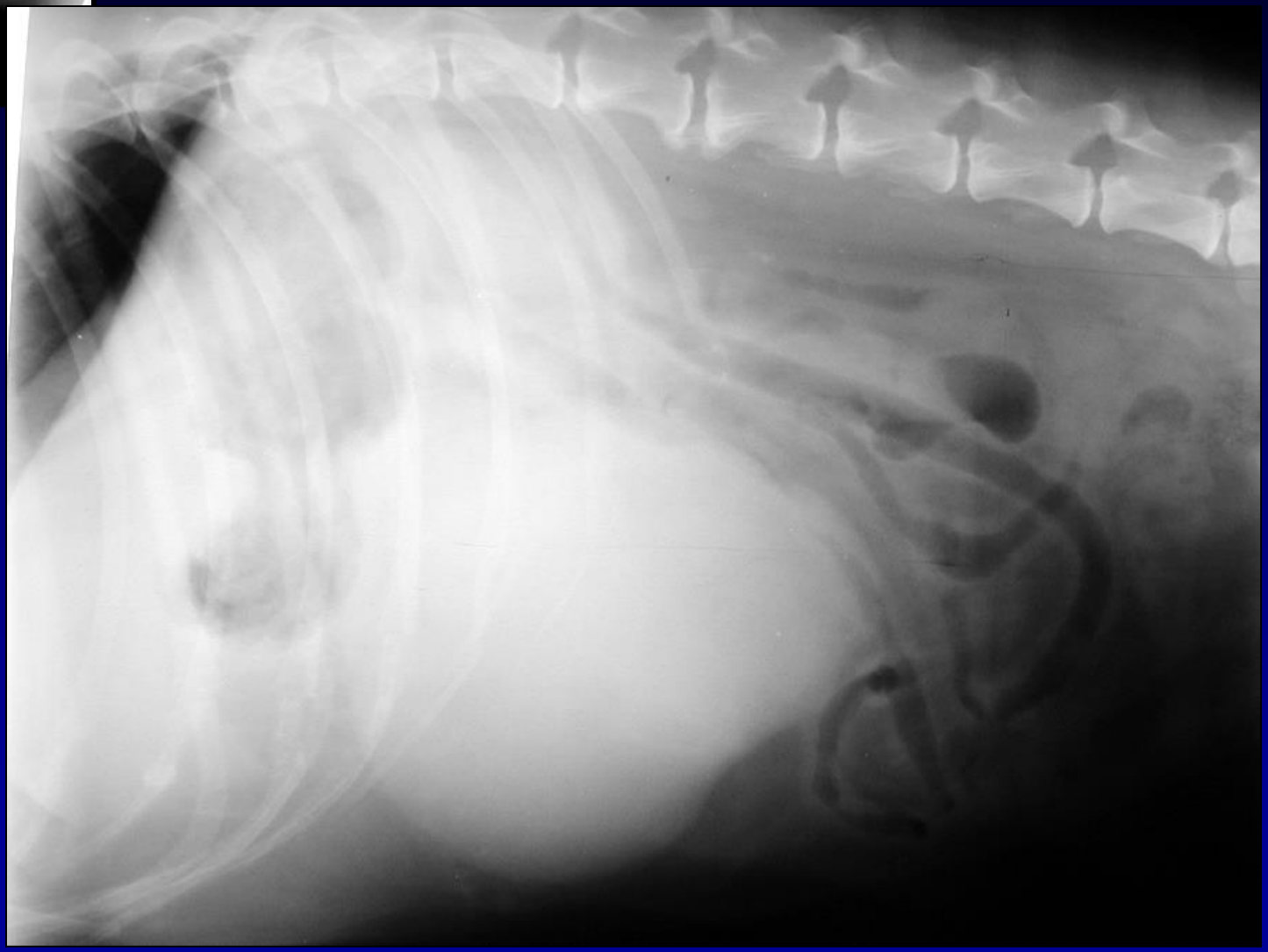
Spleen





Tail (extremity) of spleen
along ventral abdominal wall
triangular shape &
smooth margins

Central “mass effect”



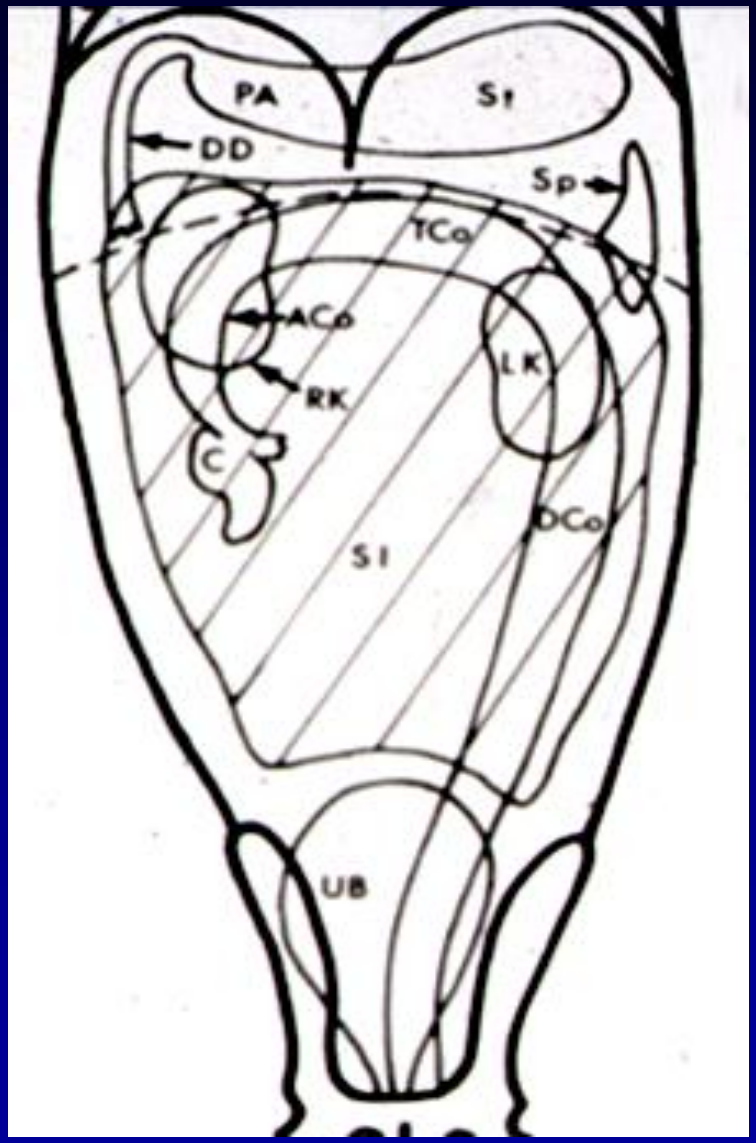
Splenic tumor displacing intestines

Cecum & Large Intestines

Cecum

- air filled structure
- “curly cue or corkscrew”

Cecum & Large Intestines



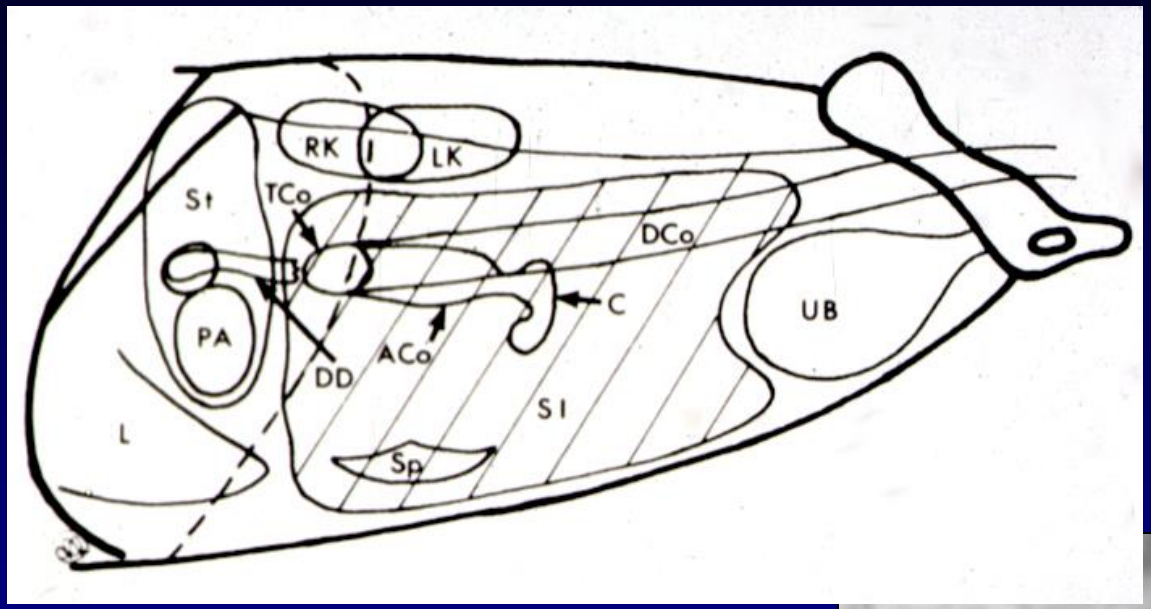
Ascending colon

Transverse colon

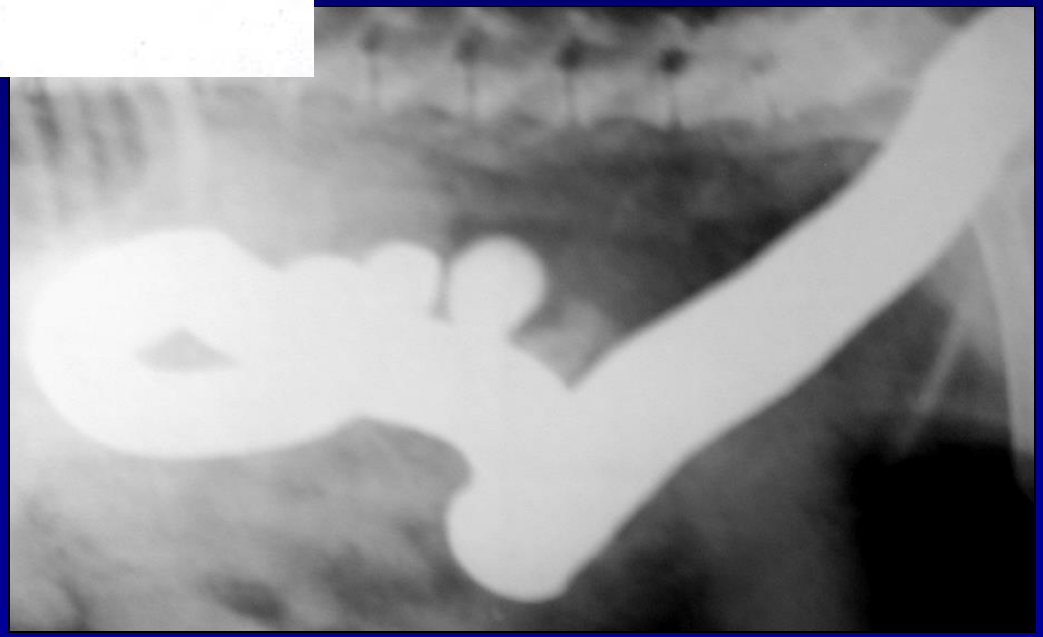
Descending colon

barium enema

Cecum & Large Intestines



barium enema

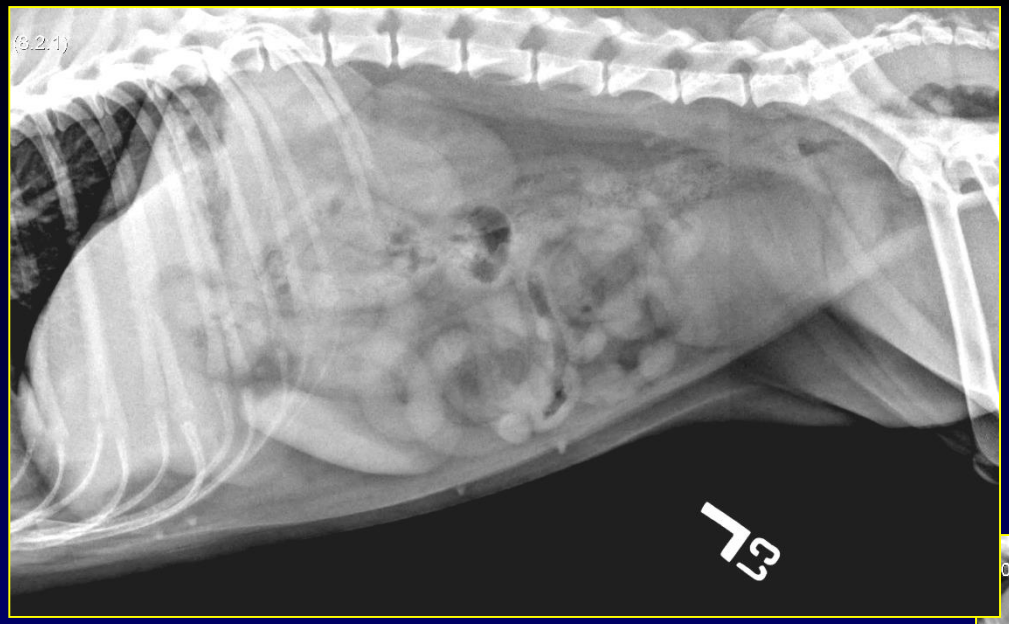


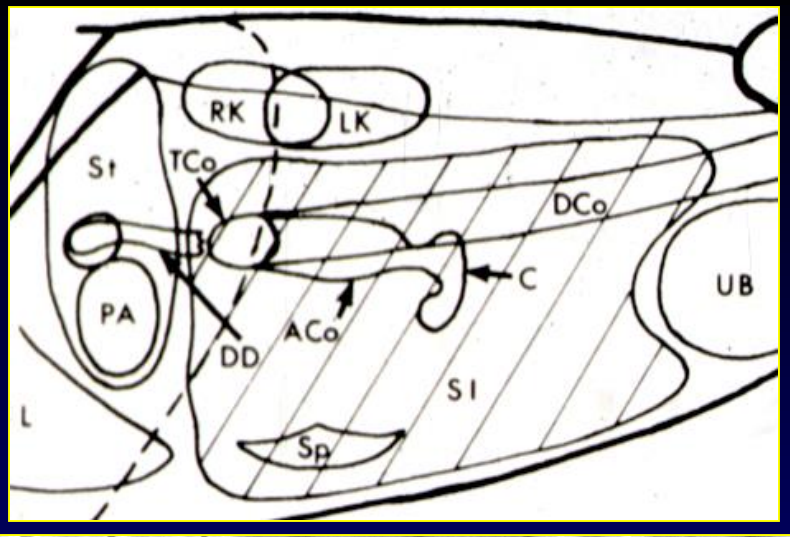
Cecum

Ascending colon

Transverse colon

Descending colon

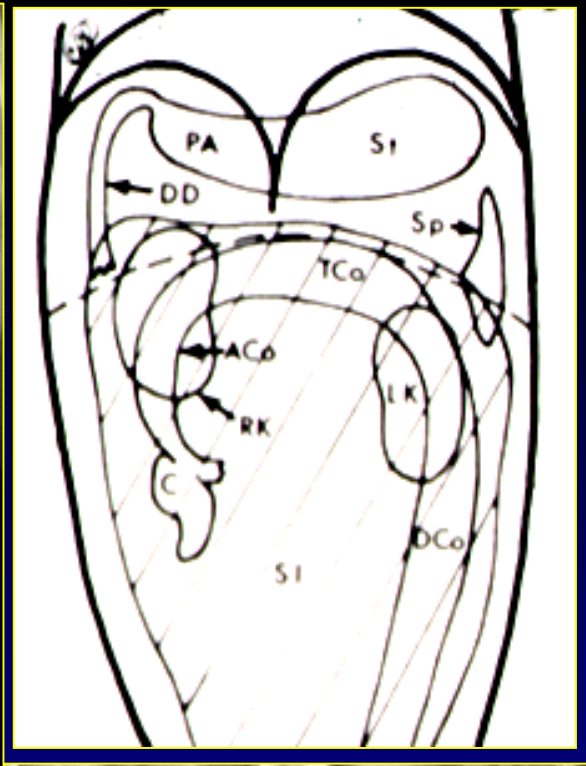


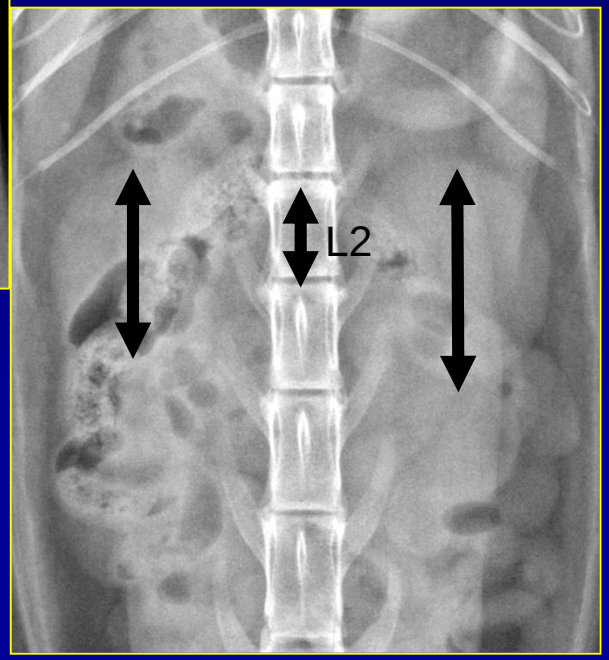


K9 Kidneys:
Rt @ T13-L1
Lt @ L2-L4

Kidney location on lateral views

Feline Kidneys:
Rt @ L1-L4
Lt @ L2-L5





K9 Kidneys:
Rt @ T13-L1
Lt @ L2-L4

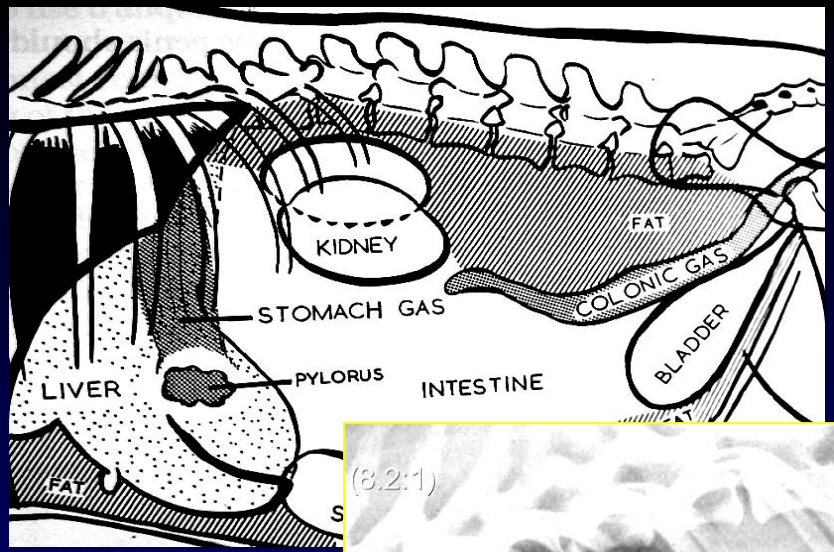
Size = 2.5 - 3.0 X L2

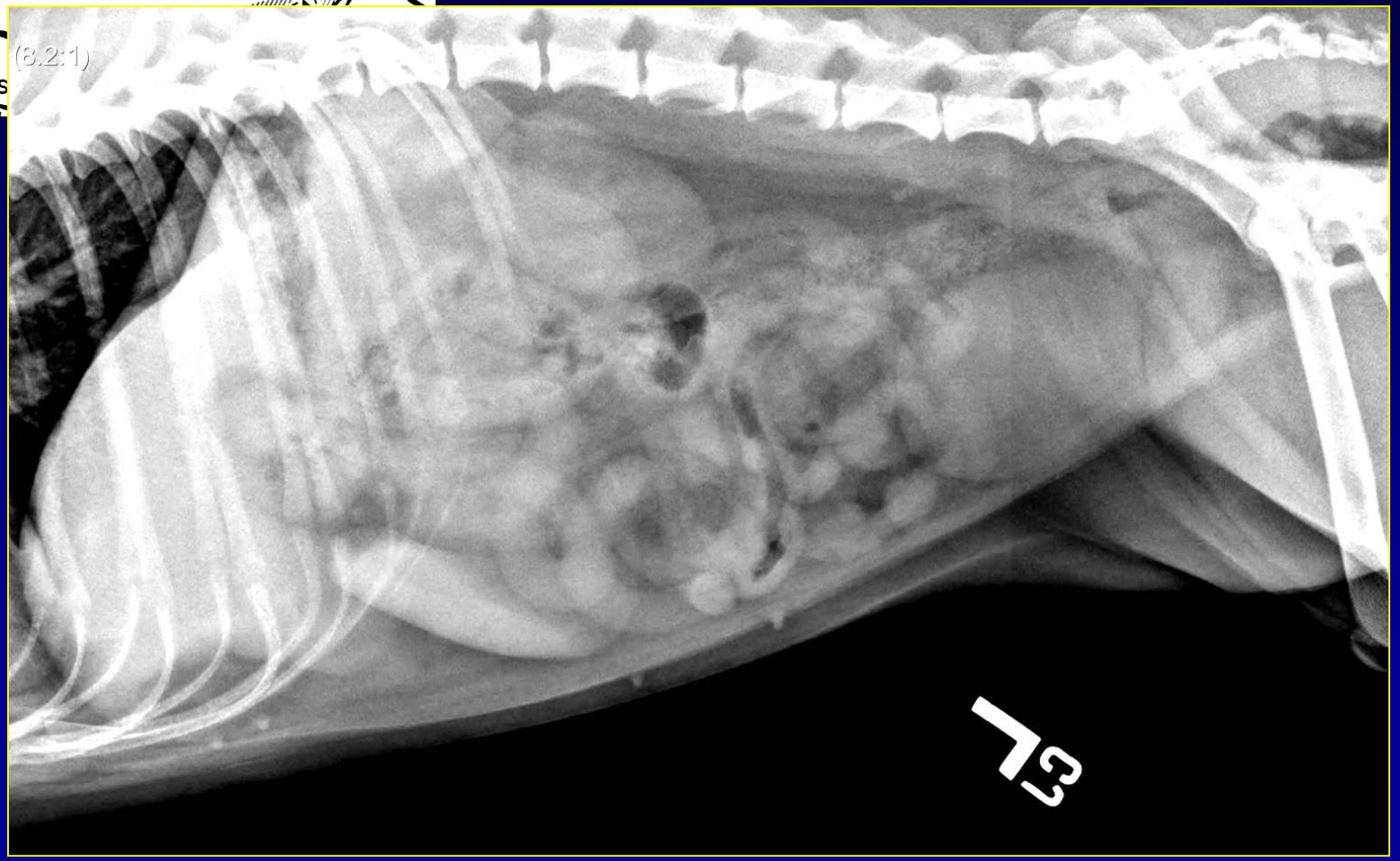
Feline Kidneys:
Rt @ L1-L4
Lt @ L2-L5

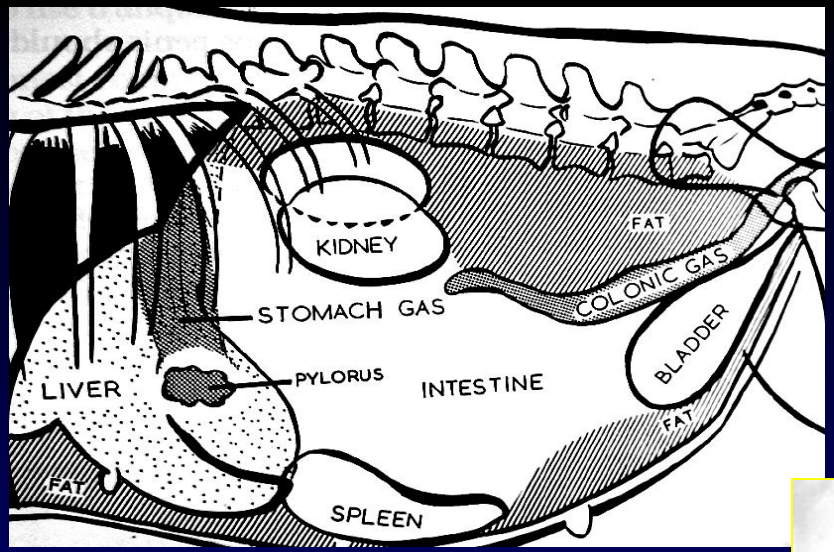
Size = 2.4 - 3.0 X L2

Ureters

~ retroperitoneal until trigone not visualized normally

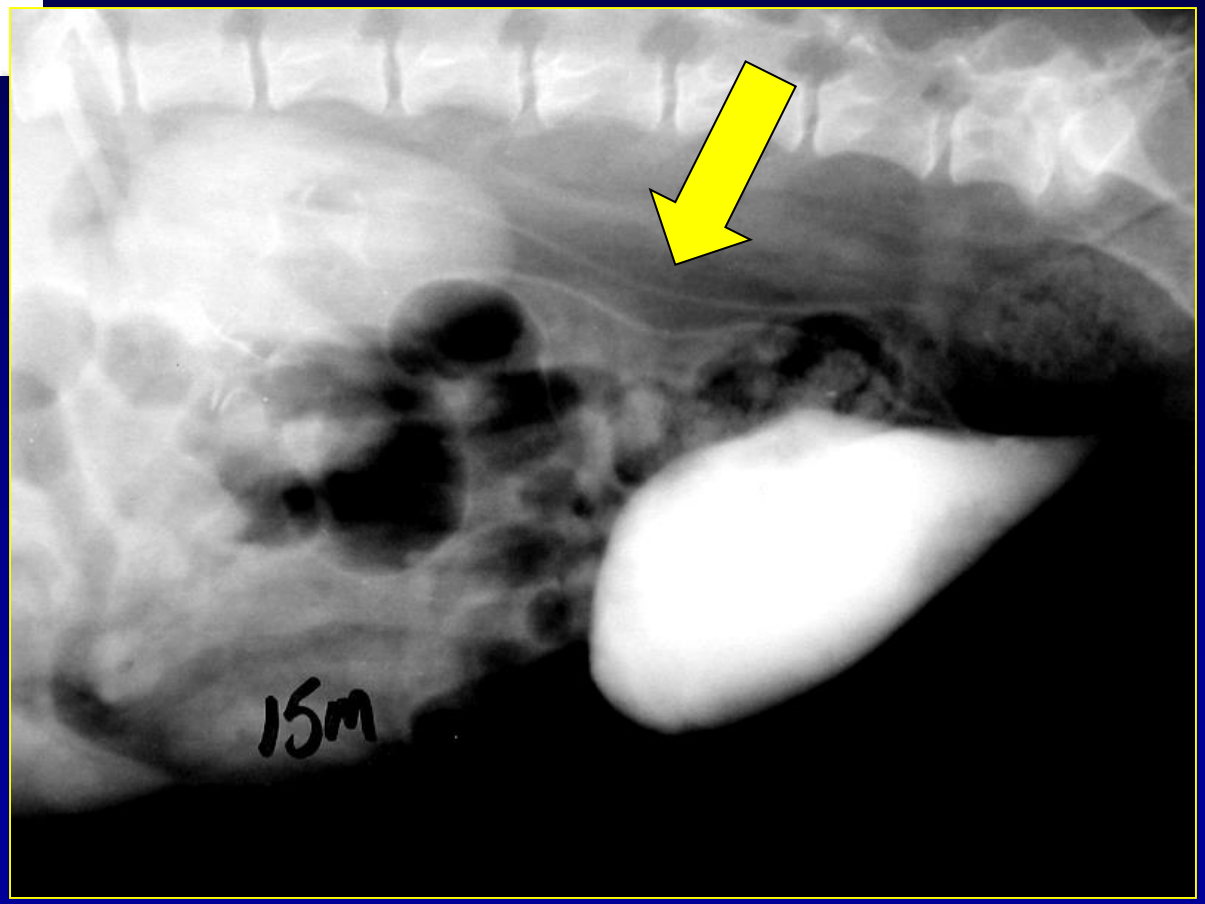






Ureters
~ 1-2 mm diameter
excretory urography to opacify

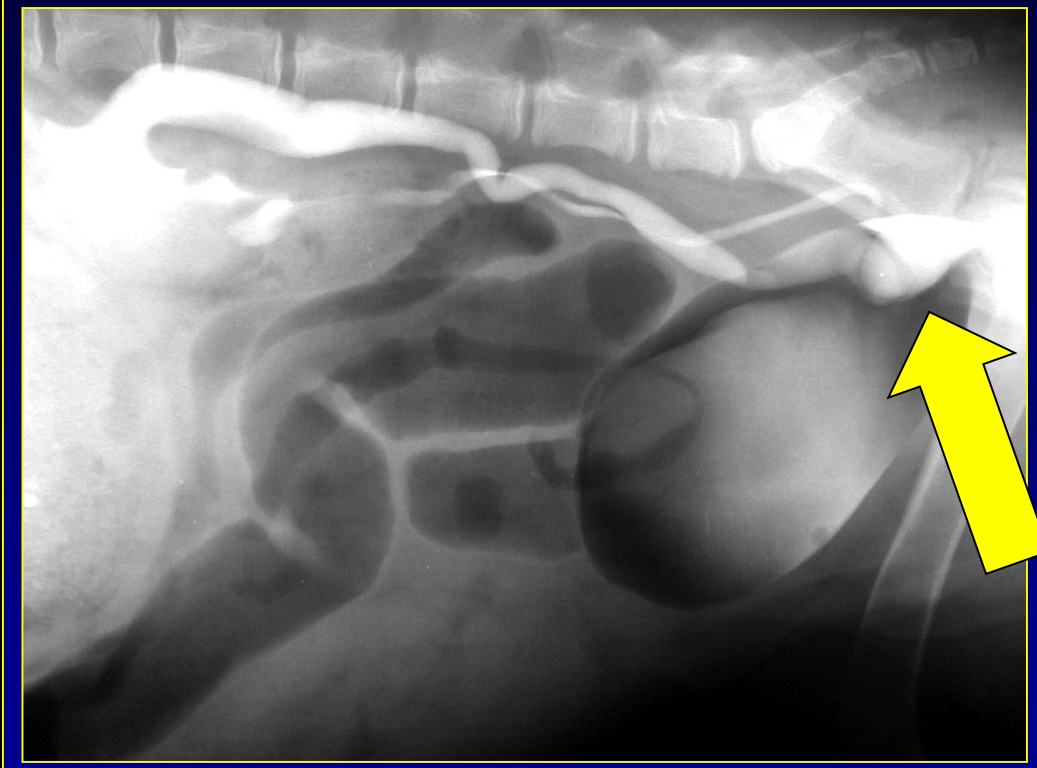
IV iodinated contrast (15min)
opacifies kidneys,
ureters & urinary bladder
880mg I/kg
(400mg I/lb)



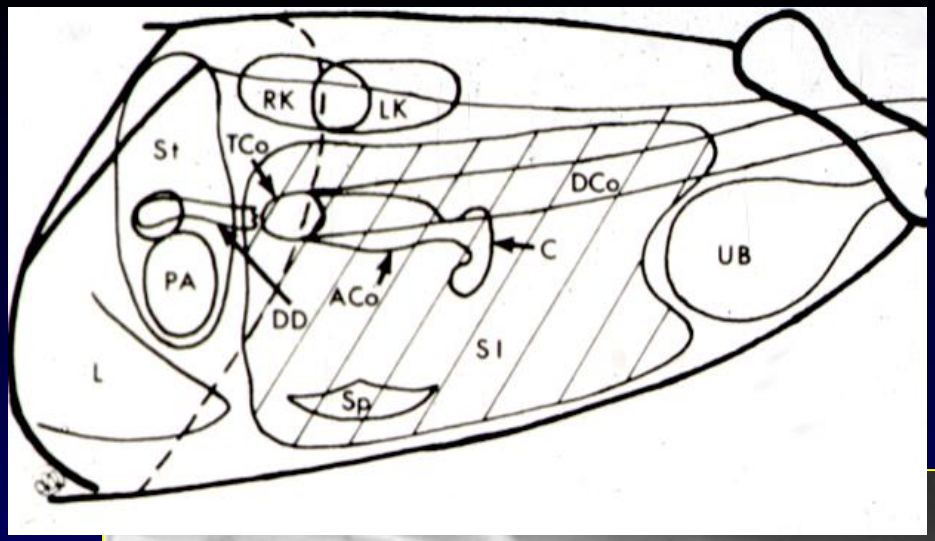
Ureters

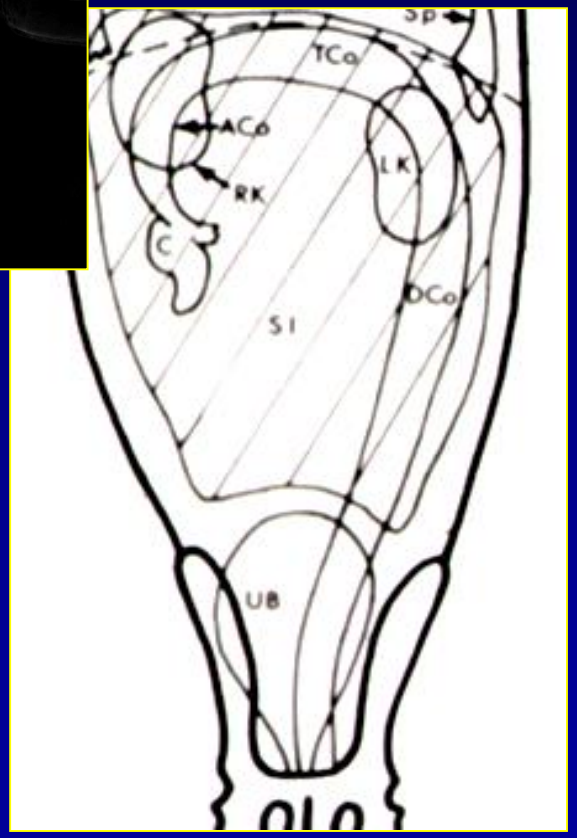
norm ~ 1-2 mm diameter

excretory urography to opacify



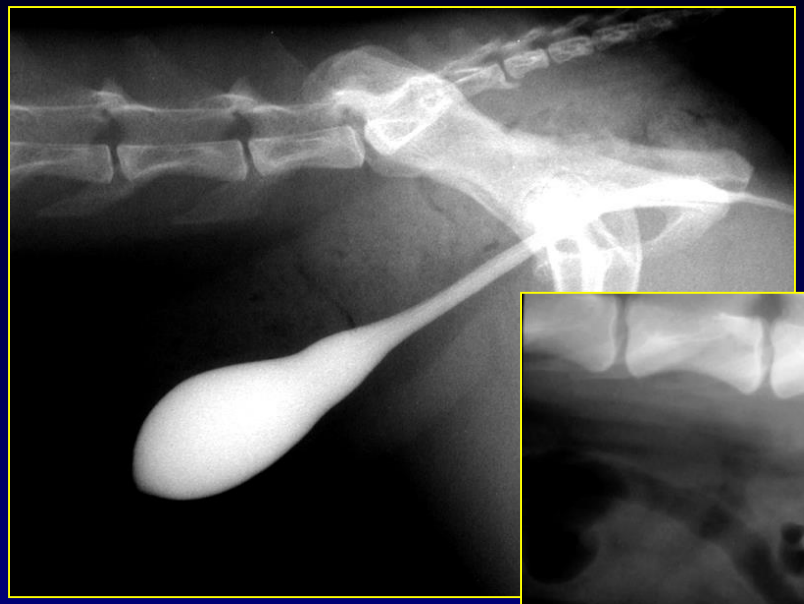
Ectopic ureter





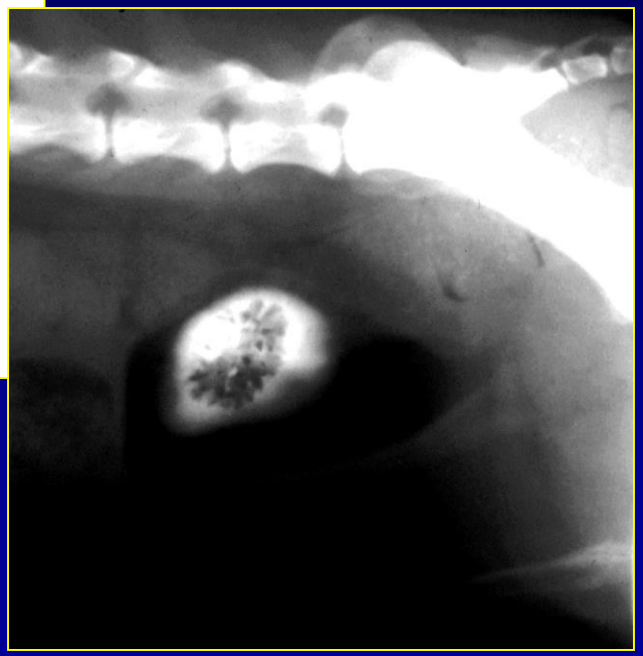
Urinary Bladder ~ volume

Contrast Urography



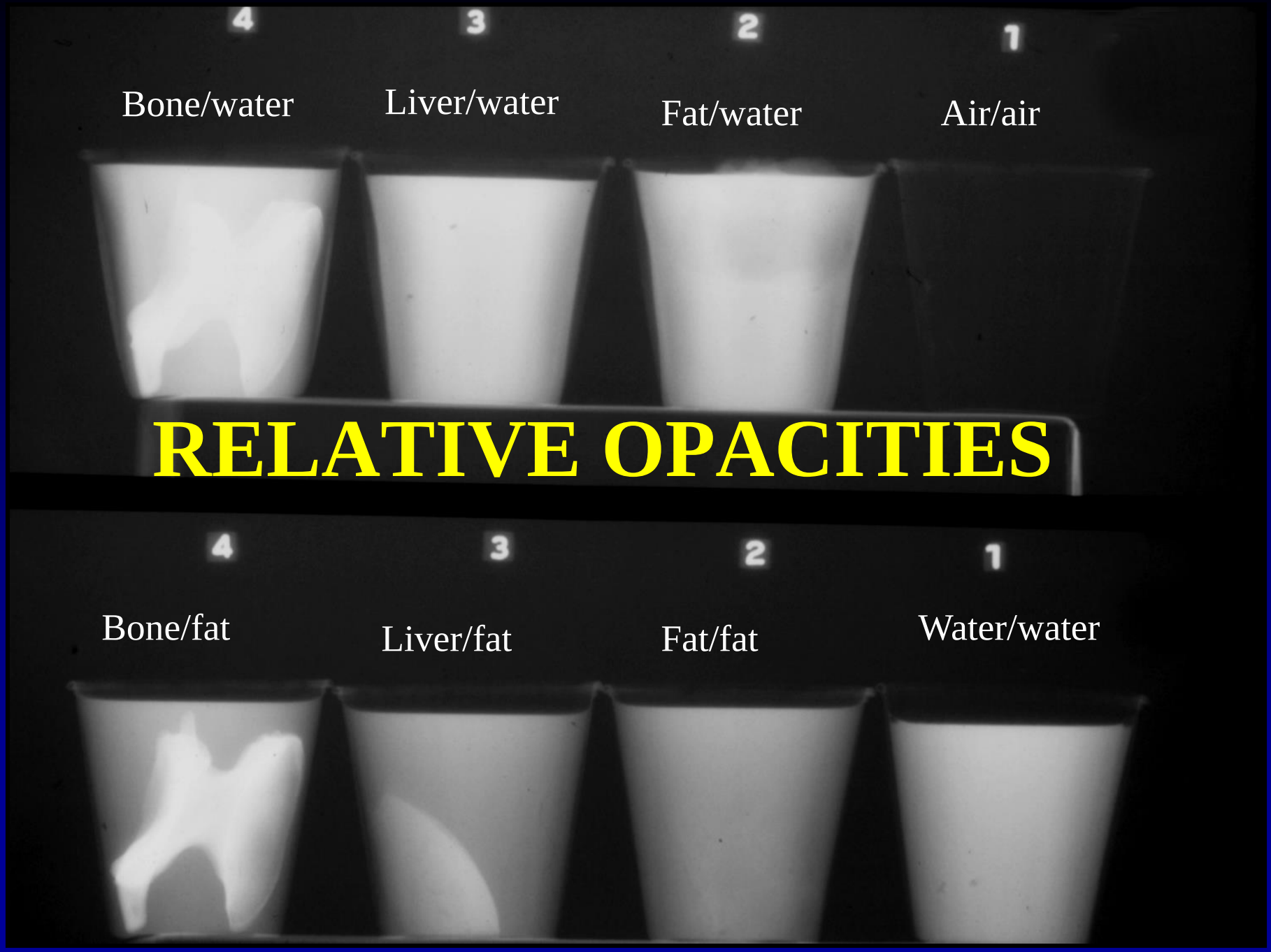
positive contrast

negative contrast

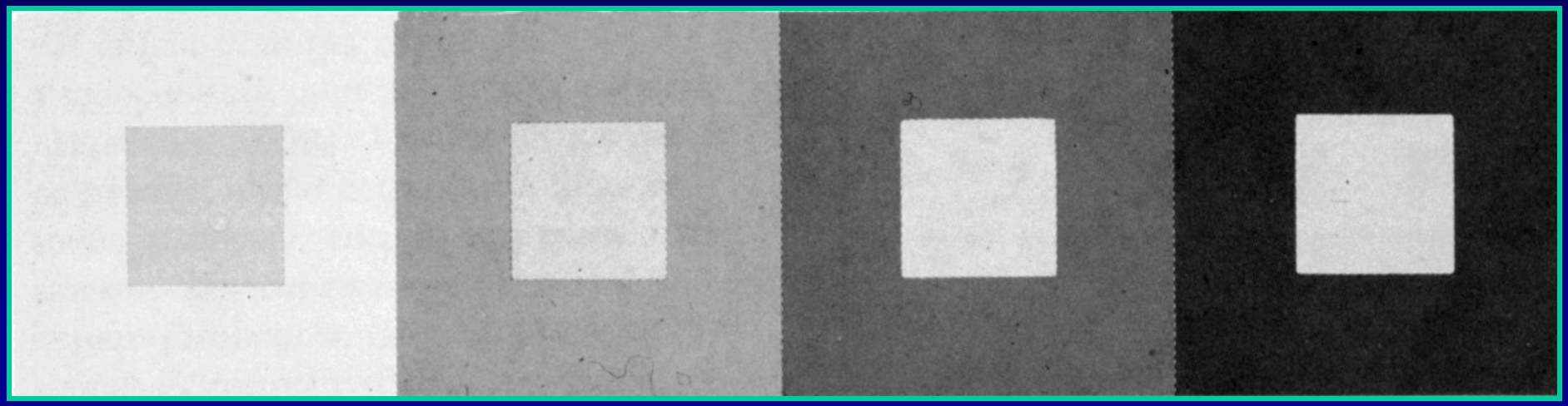


double contrast

5-10 mg I/kg
2-5 mg I/lb

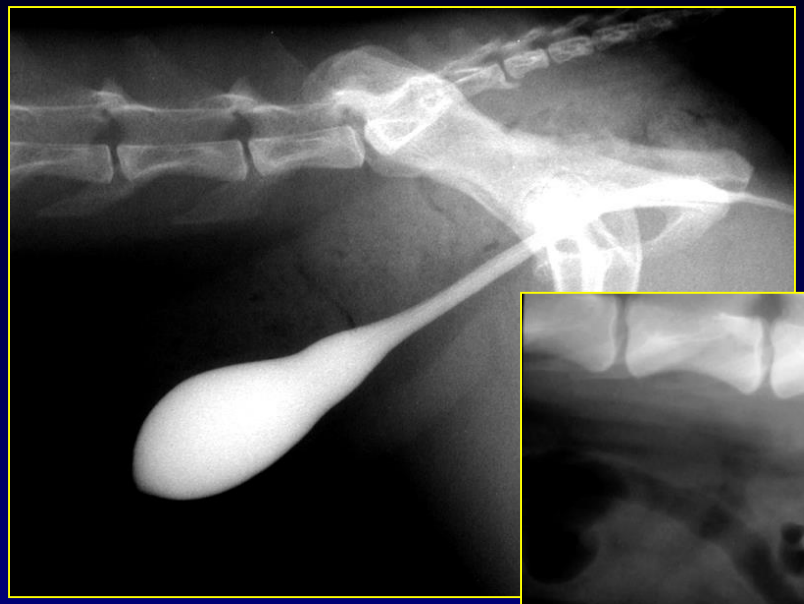

4
3
2
1
Bone/water
Liver/water
Fat/water
Air/air
RELATIVE OPACITIES
4
3
2
1
Bone/fat
Liver/fat
Fat/fat
Water/water

BACKGROUND ENHANCEMENT EFFECT



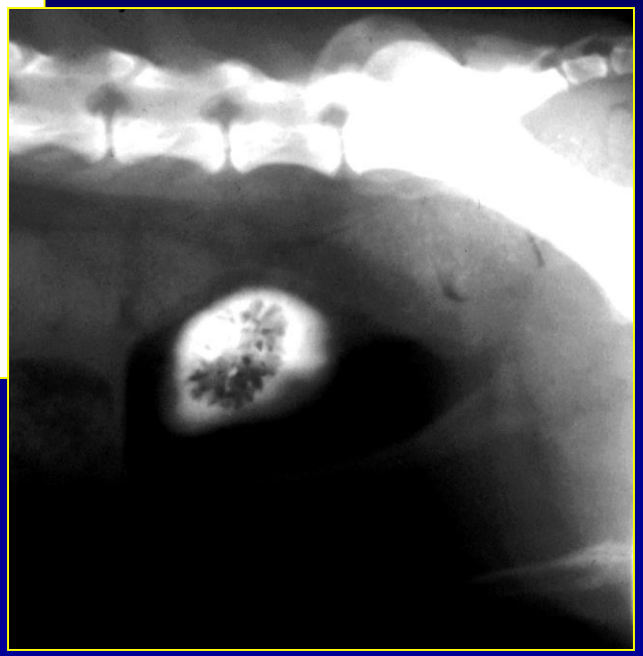
center squares identical, but look like different gray shades
in the different surrounding backgrounds

Contrast Urography



positive contrast

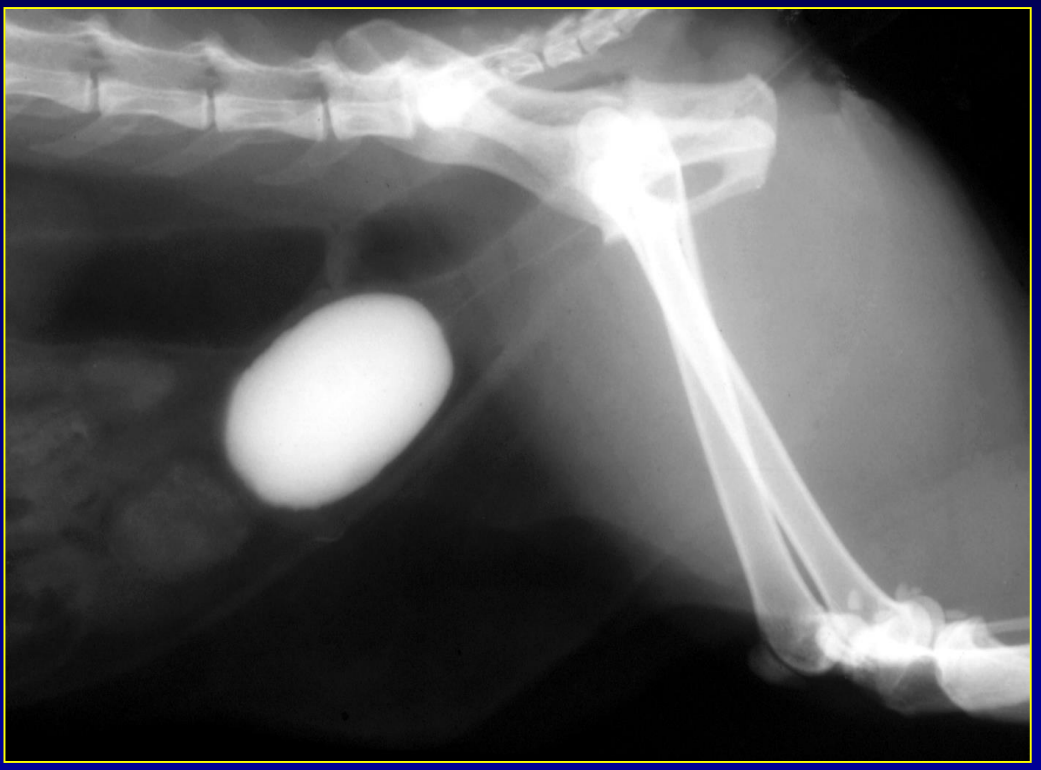
negative contrast



double contrast

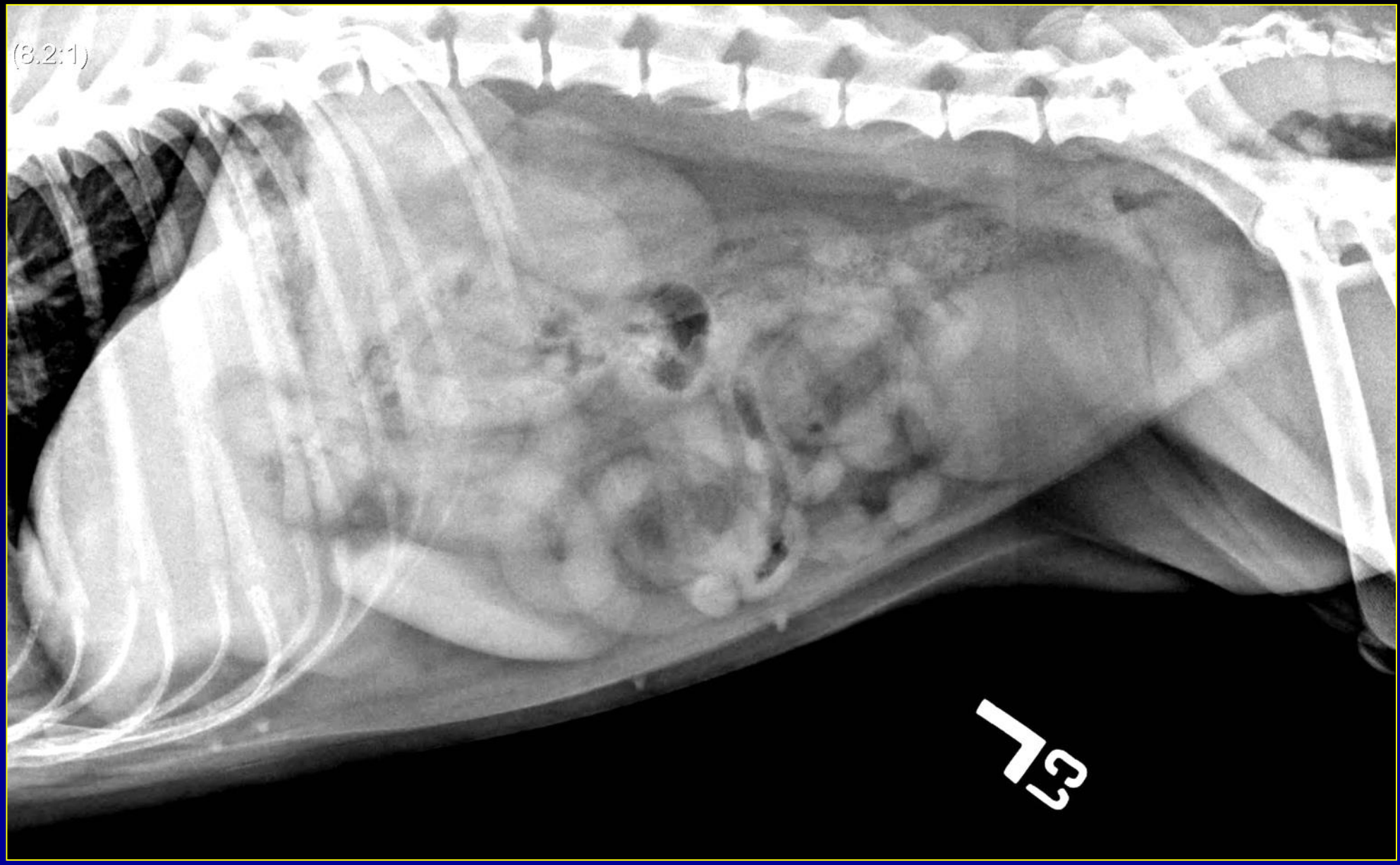
Urethra

- Requires positive contrast to visualize
  - Retrograde urethrography
  - Normograde urethrography



Helpful to have bladder distended

Dose dependent on size



Interpretation of Abdominal Radiography

Abdominal Radiographic Interpretation

- More an Art Than a Science ~ D. E. Thrall
- Requires organized approach to interpretation
  - Follow routine procedure on every patient
  - Becomes 2nd nature in abdominal interpretation
  - Abdominal radiography checklist can be helpful
- Determine pathology as the last step

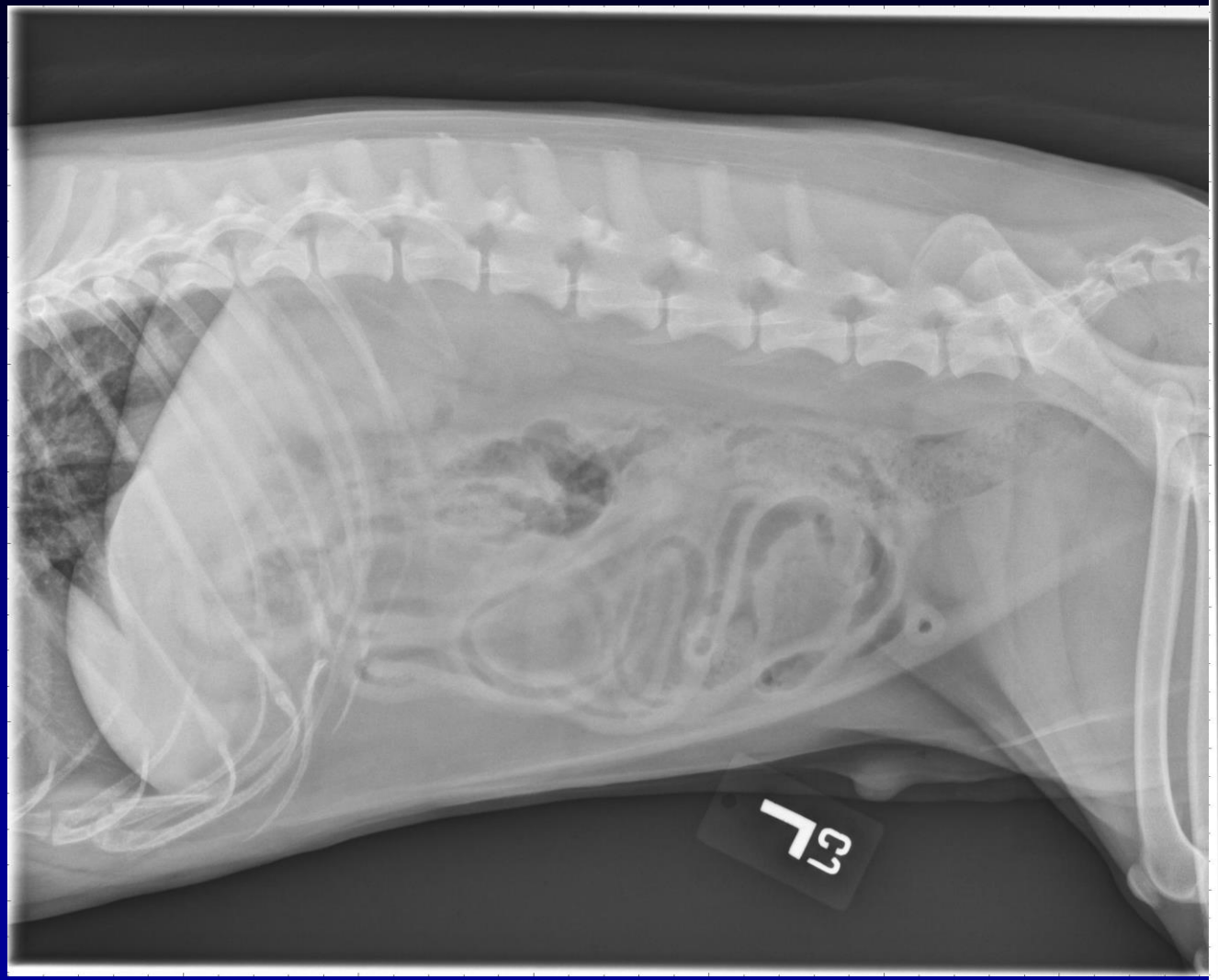
Abdomen Radiographic Interpretation

- **Systematic Review Guidelines**
  - Are all views needed obtained?
  - Are there positioning problems or influences
  - Is the radiographic technique adequate (exposure/motion)?
  - Is scatter radiation or phase of respiration affecting views?
  - Was sedation or general anesthesia employed?
  - Is the breed or body habitus affecting interpretation?
  - Are there morphologic aspects of this patient to consider?

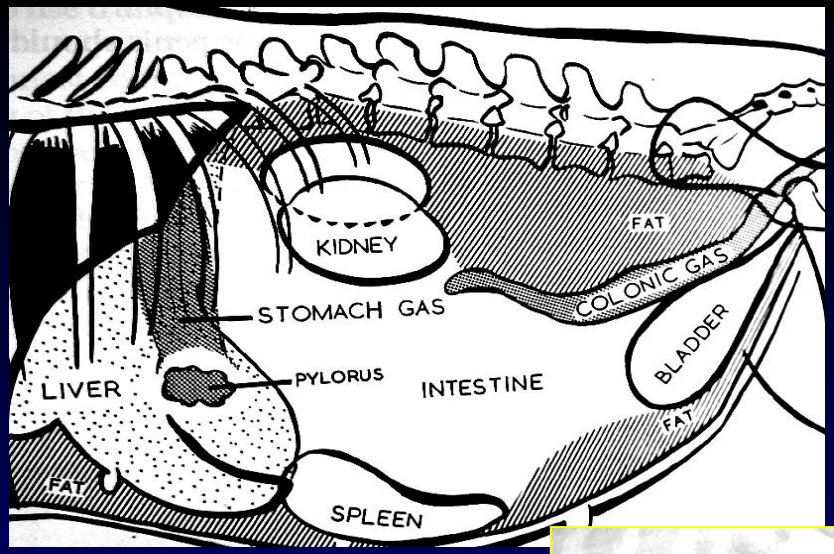
Radiographic Interpretation

- **Systematic Review: Zones or Regions**
  - Peripheral zones, middle zones, central zone
  - Esophagus, stomach, DD, small bowel, large bowel, pelvis
  - Kidneys, ureters, bladder, urethra
  - Liver, Spleen, peritoneal detail
  - Lymph nodes, retroperitoneal spacs,
  - Surrounding skeletal structures & musculature
  - Develop a checklist to follow
  - Viewing of radiographs in unconventional image positioning

“Serosal Detail”



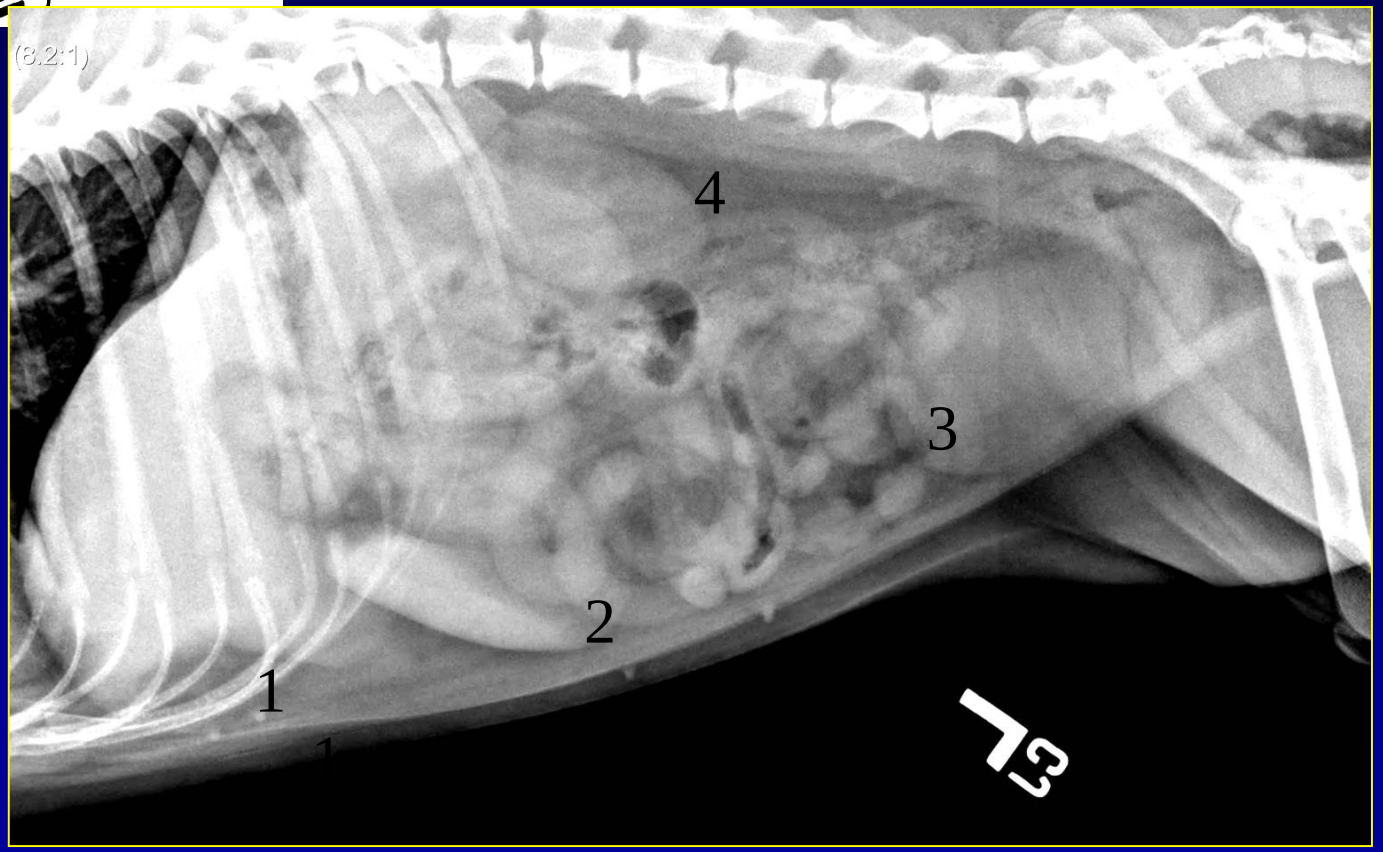
= visualization of serosal margins

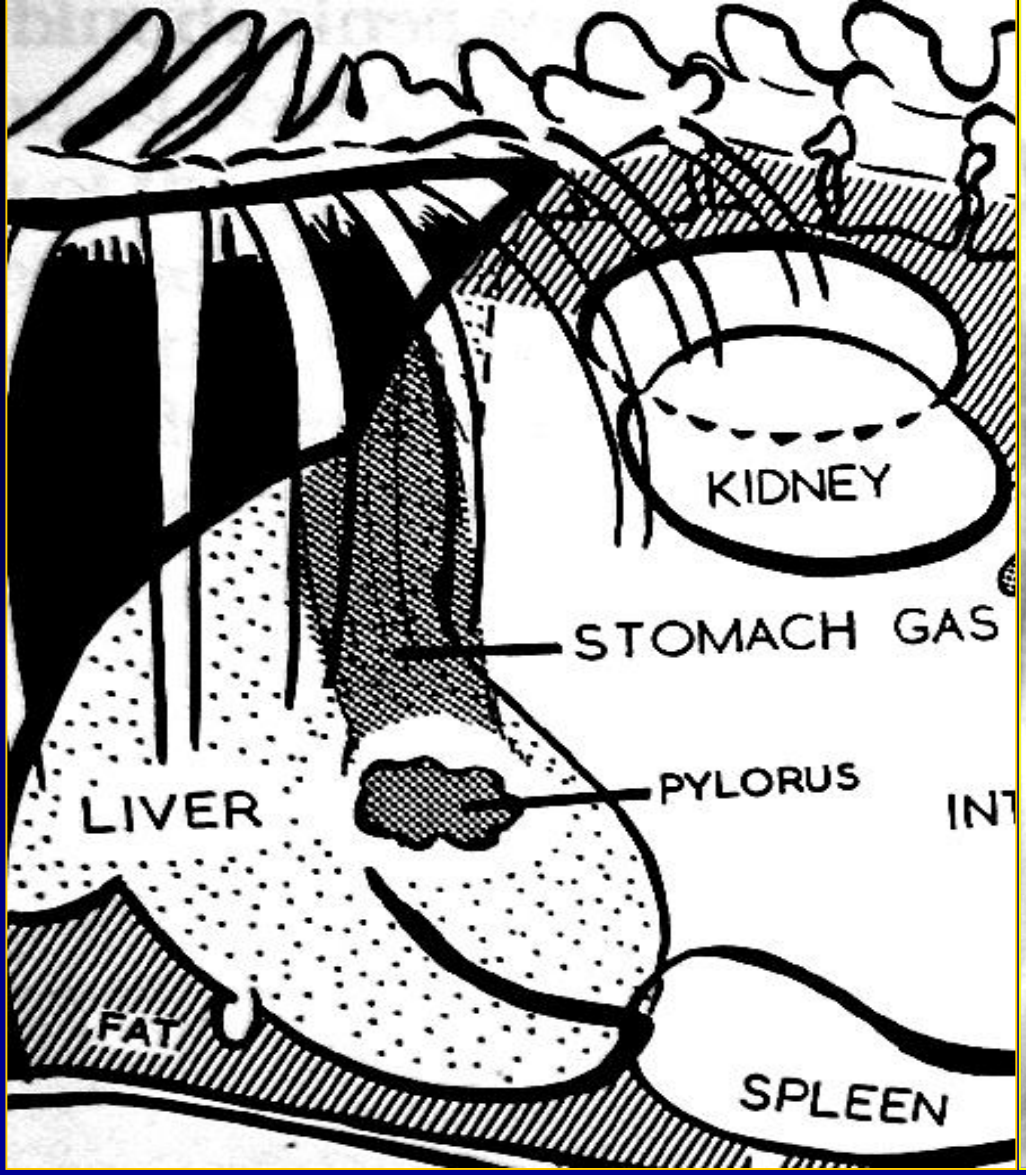


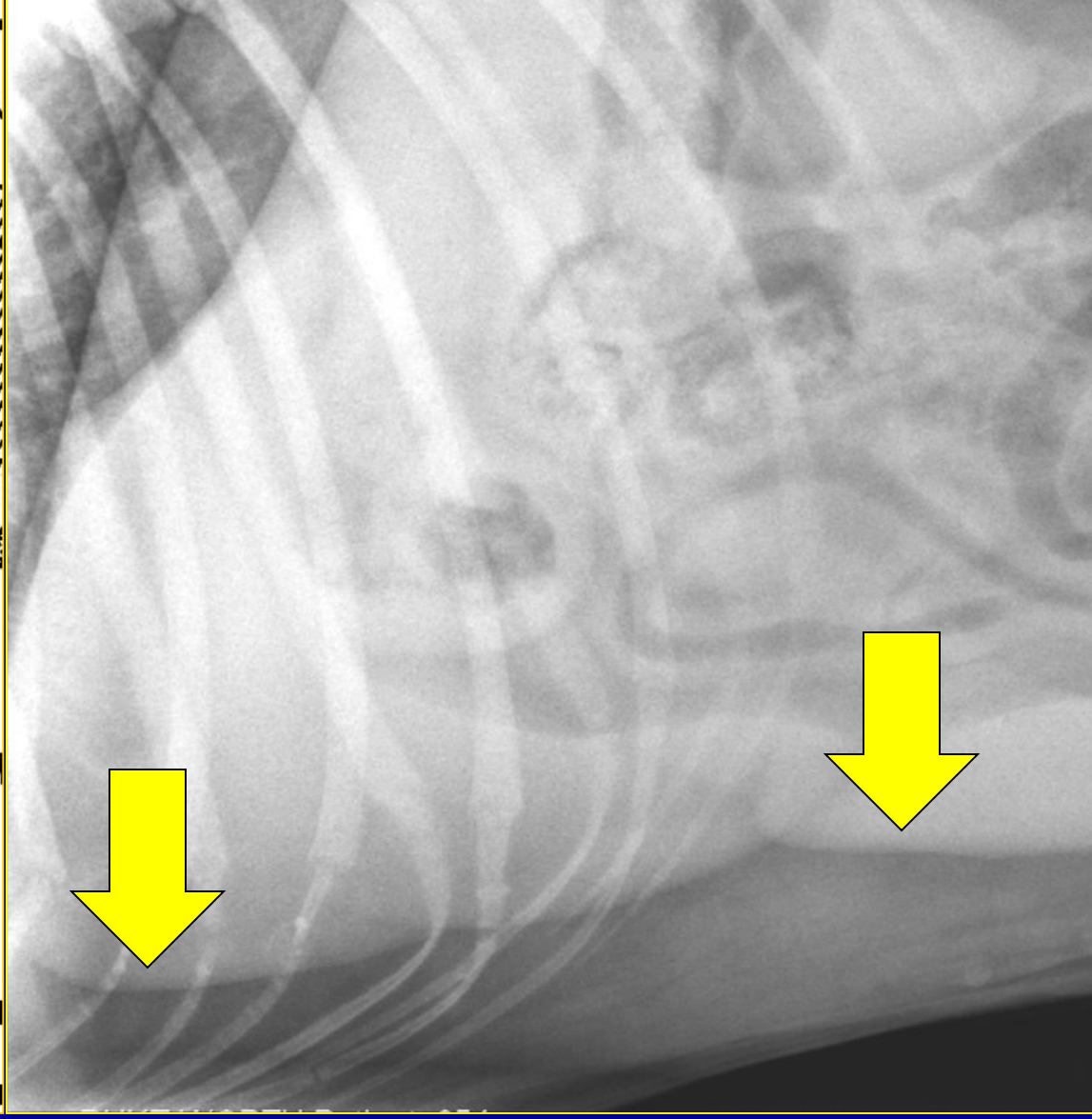
Abdominal Serosal Detail

- critical sites to review

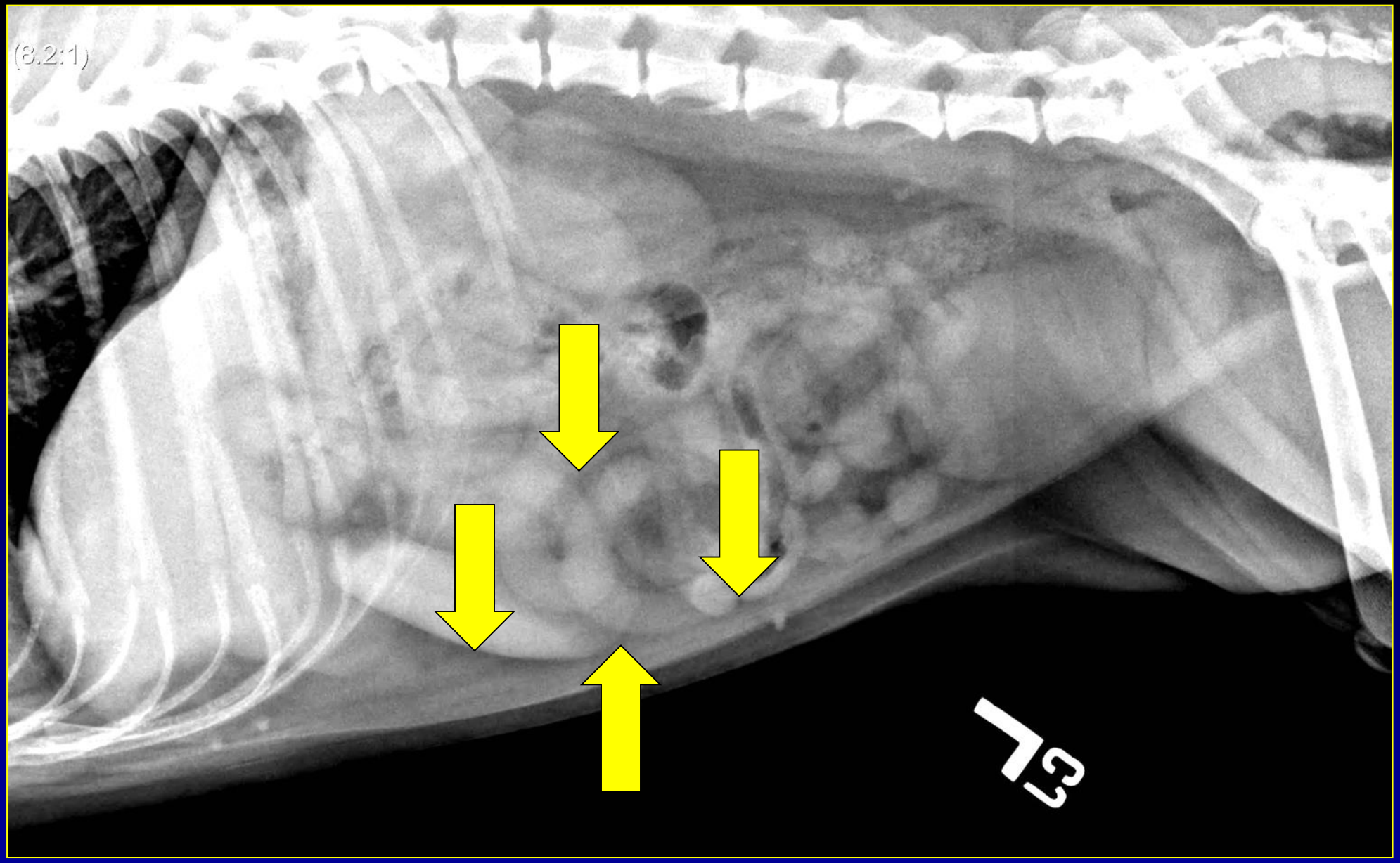
1. Cranial - ventral
2. Central - ventral
3. Caudal - ventral
4. Retroperitoneal



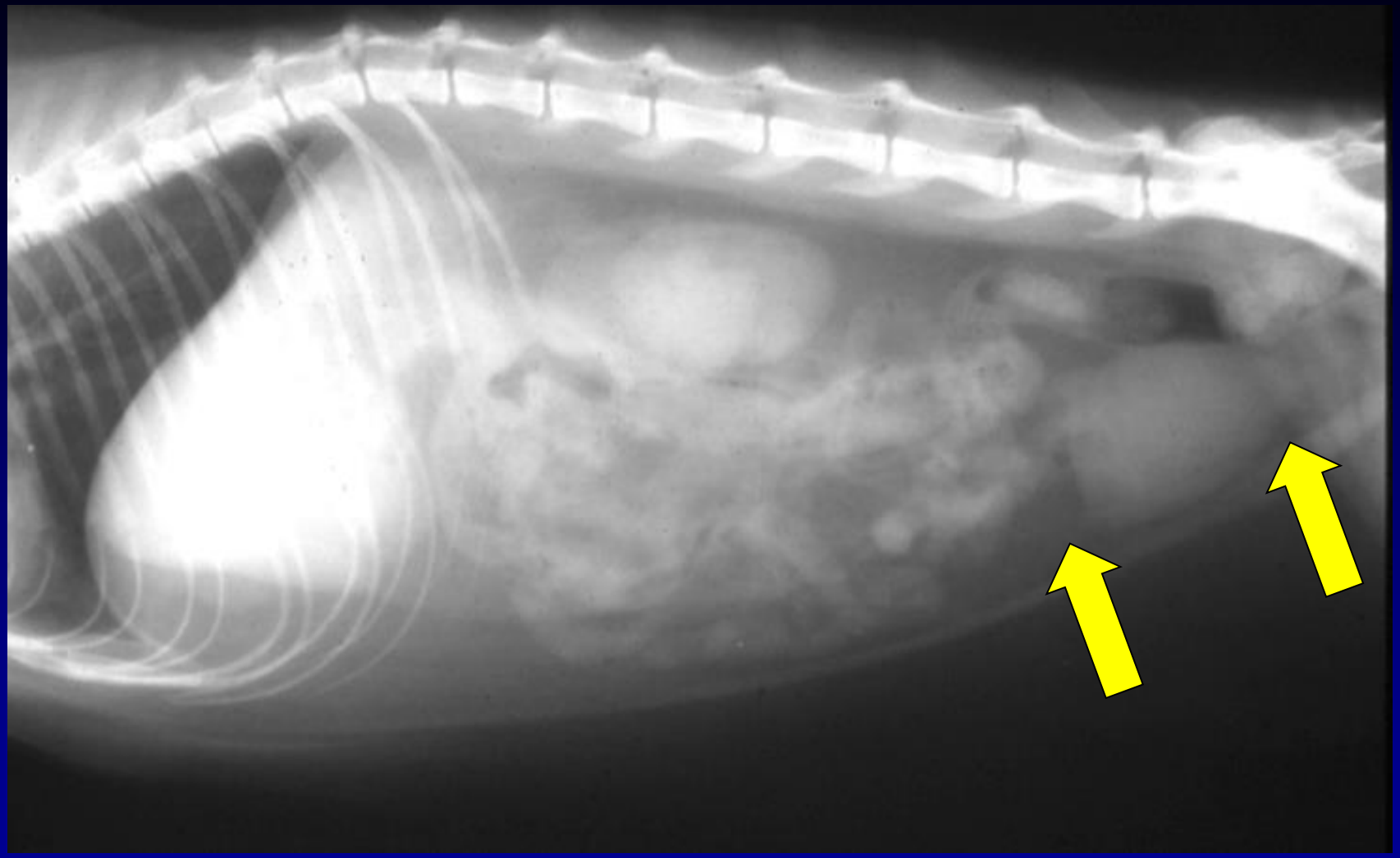




1. Cranial Ventral Abdominal Serosal Detail (falciform fat deposition)
   ~ ventral margin of liver lobes & spleen

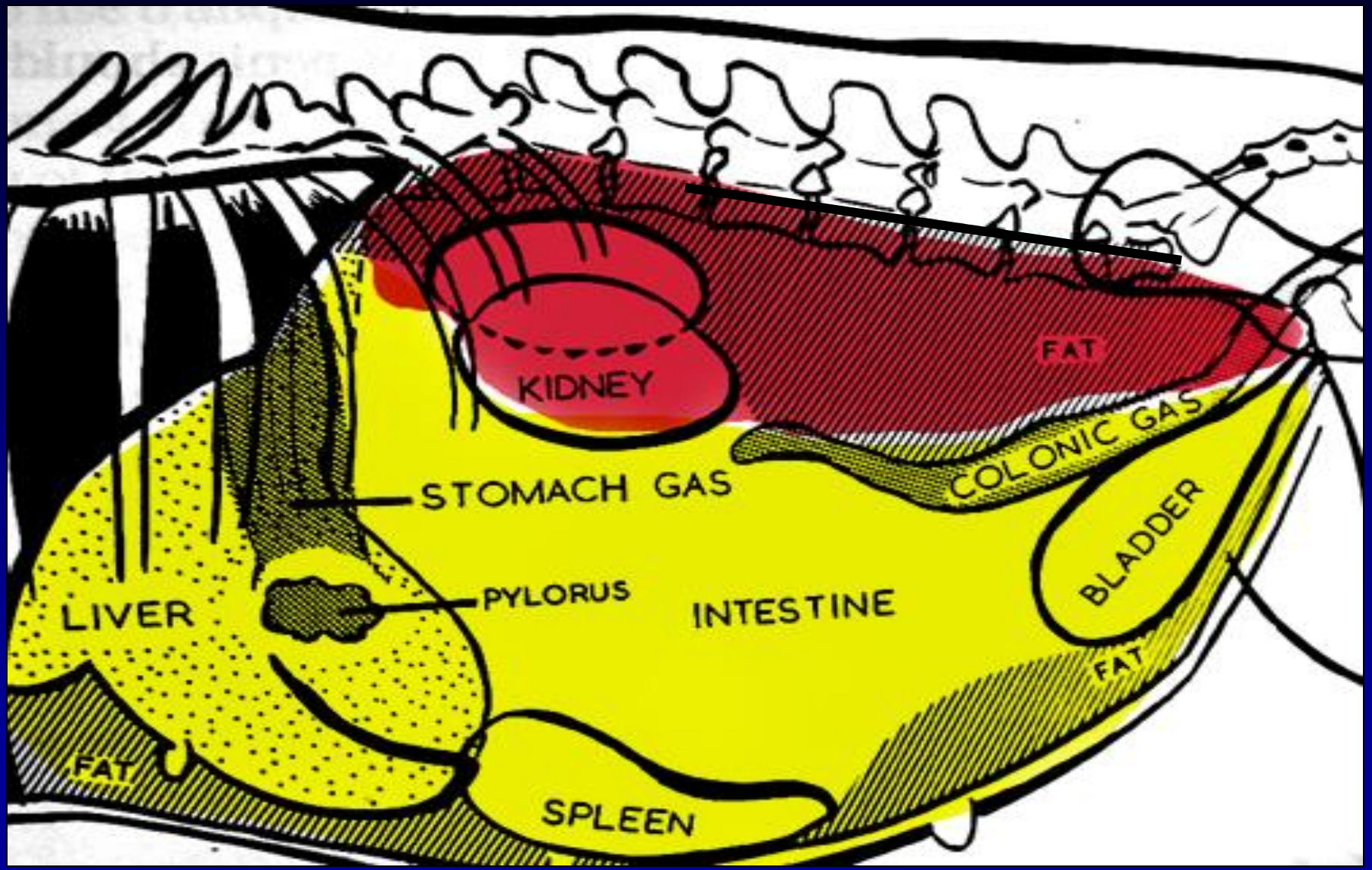


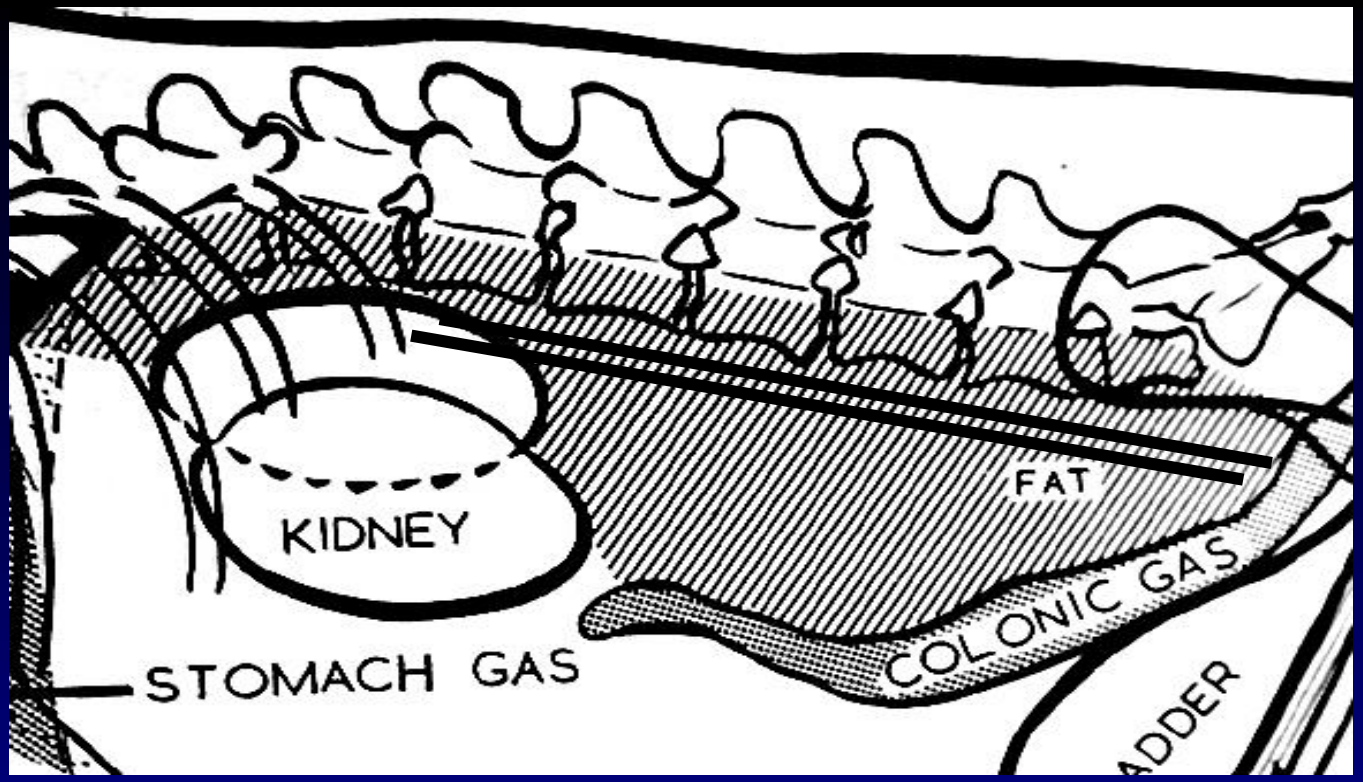
2. Central Ventral Abdomen Serosal Detail



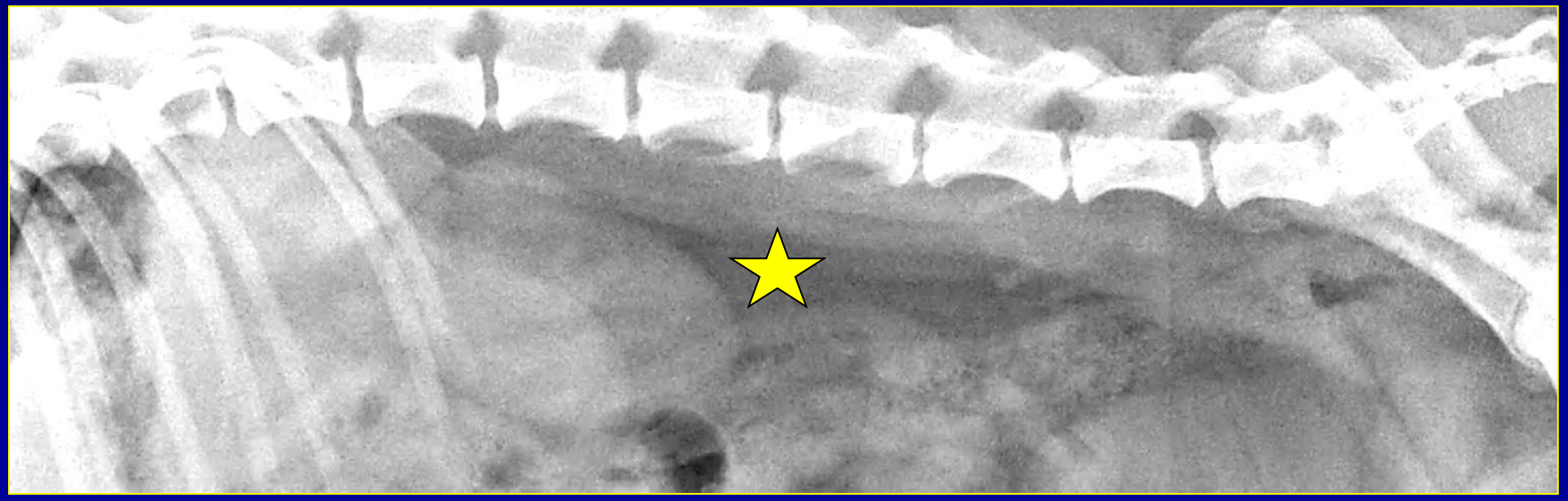
3. Caudal Ventral Abdomen Serosal Detail

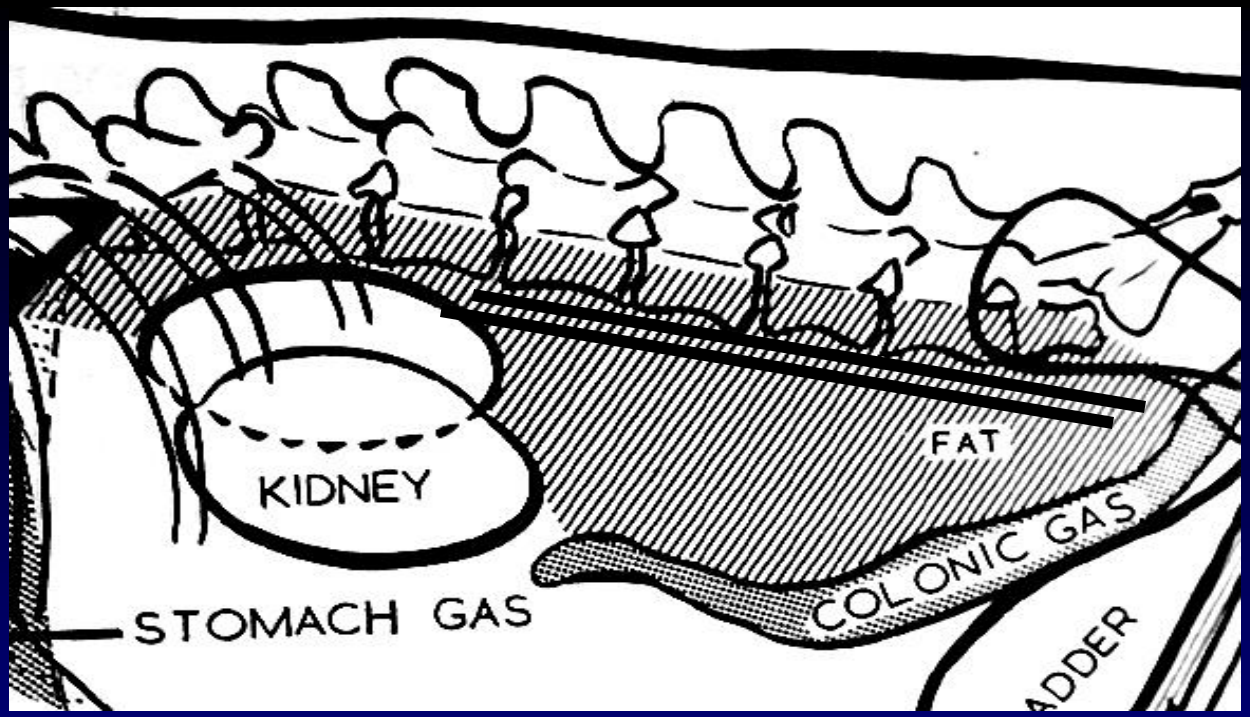
Peritoneal vs Retro-peritoneal





Serosal/Fascial Detail of 4. Retroperitoneal Space

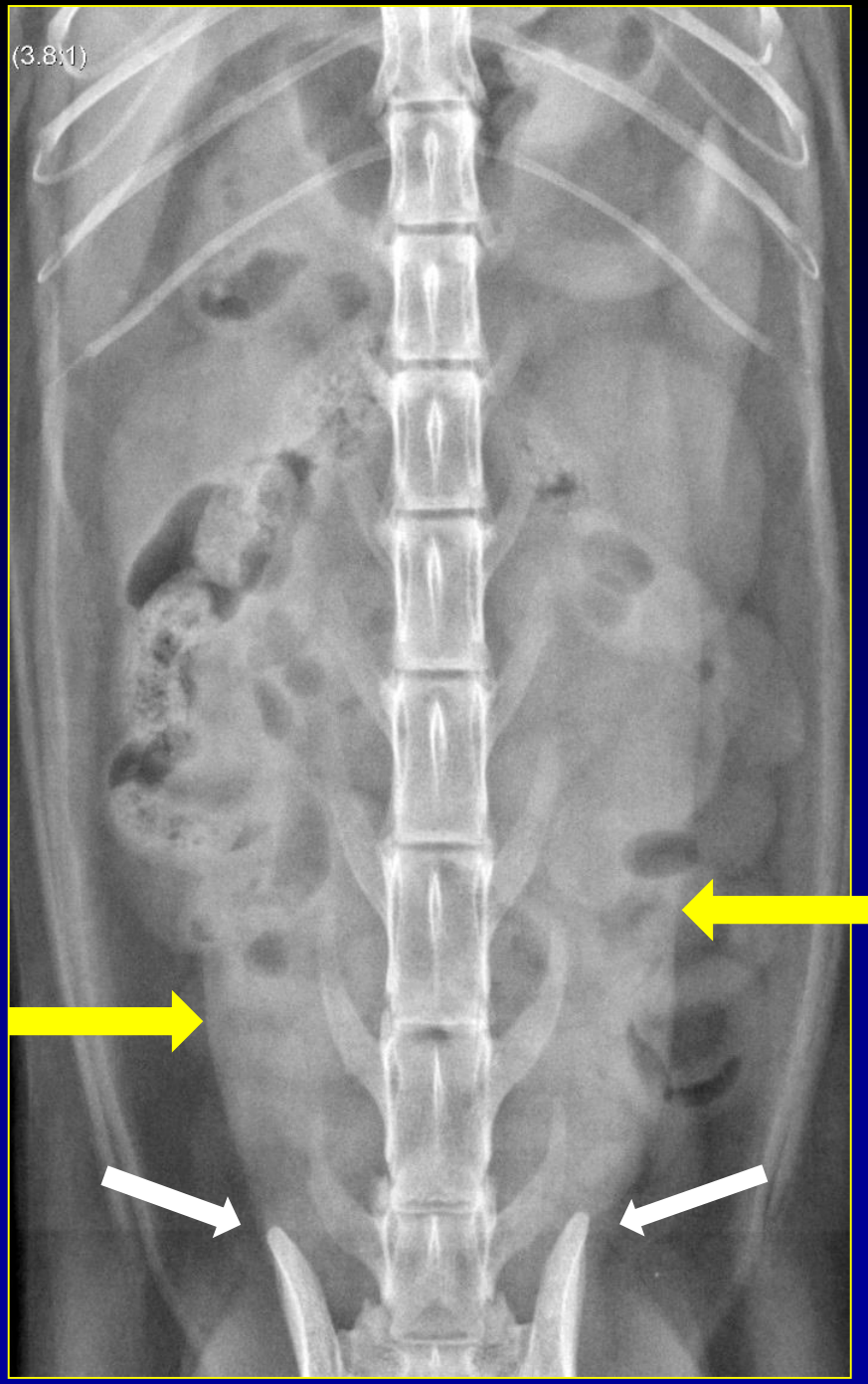




Serosal/Fascial Detail

lateral margins spinal musculature

attaches to ilial wings

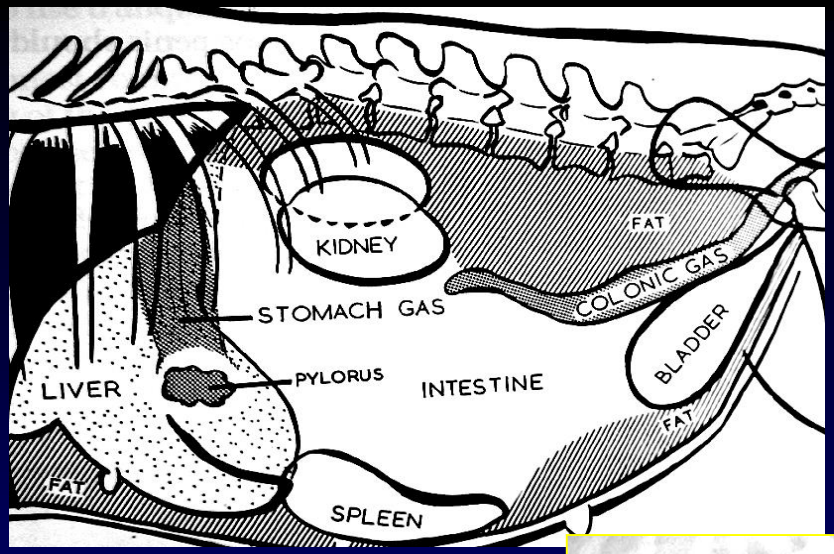


Loss of Abdominal Serosal Detail
= effusion/peritonitis
(volume dependent)

especially in this overweight dog

Young Animal Serosal Detail

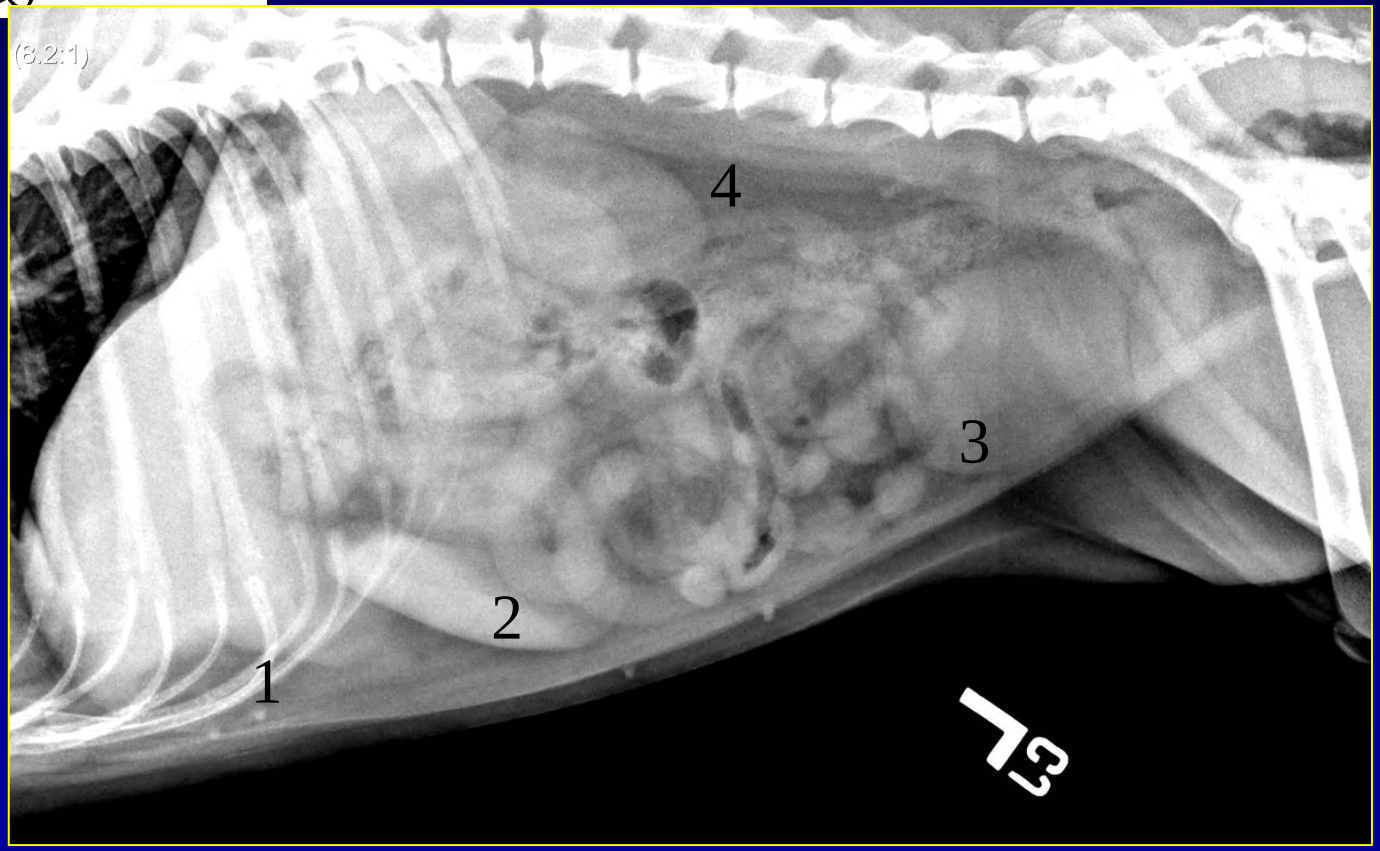
normal poor serosal detail ≤ 1 yr old
~ ultrasound exam if concerned



Abdominal Serosal Detail

- evaluate the entire abdomen

1. Cranial - ventral
2. Central - ventral
3. Caudal - ventral
4. Retroperitoneal
5. Entire abdomen



Abdominal Serosal Detail on VD/DV views

- Spleen margins
- Kidney outlines
- SI serosal margins
- Urinary bladder

Evaluate entire abdomen

- compression technique

“Standard” Radiographic Views

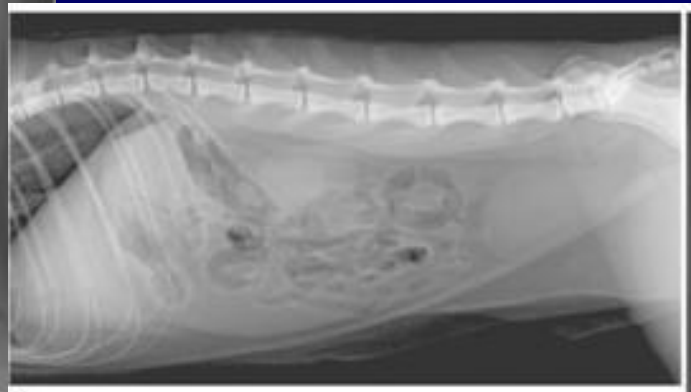
- VD
- DV
- Rt Lateral
- Lt Lateral
- Special Views

?

Standard 2 View Abdomen Exam

Canine Survey Films

Right Lateral + Ventral Dorsal



Feline Survey Films

WHY NOT BOTH LATERALS?

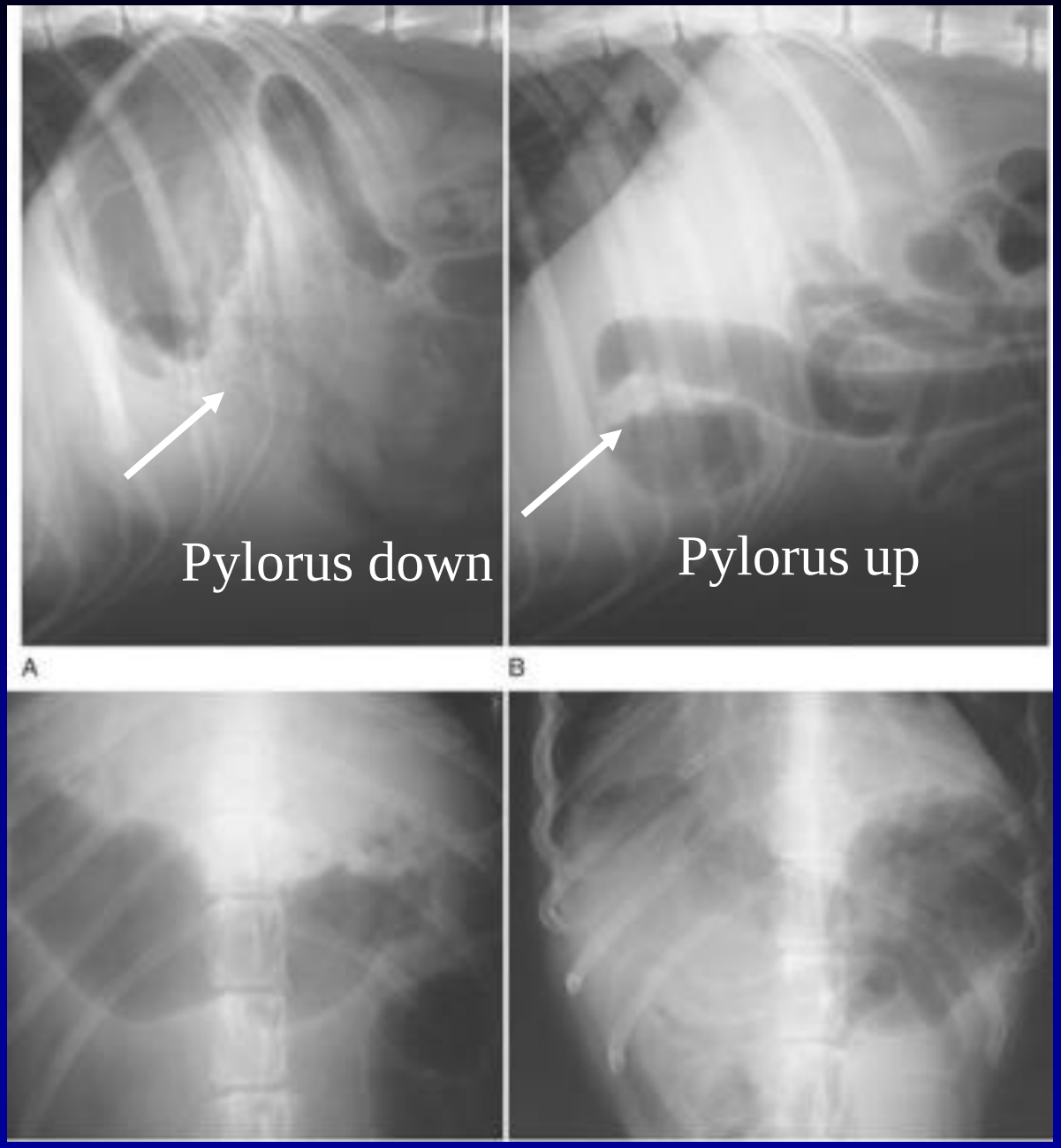
3 or 4 View Abdomen Exams

- no expendable supplies with digital radiography
- encourages quality radiographs & improved diagnosis
- follow proper radiation safety precautions

Lt & Rt Laterals + VD & DV Views

Right Lateral

Left Lateral



VD view

DV view

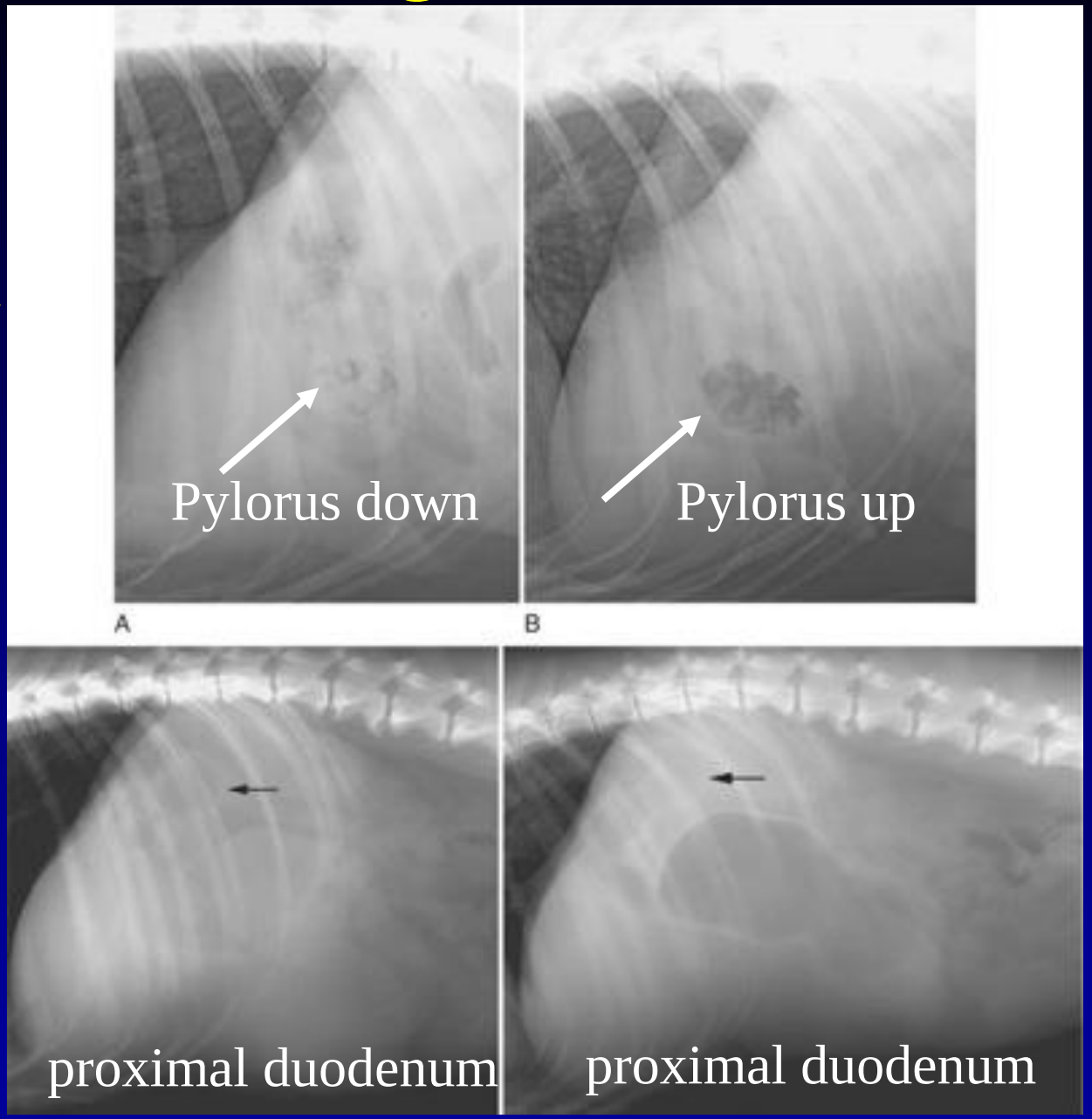
Left & Right Lateral Views

- **Different visualization of stomach regions**
- **Diaphragm difference in Rt vs Lt lateral**
  - Dorsal cura separation
  - Caudal vena hiatus on right side
- **Alters gas patterns within intestines**
- **Occasionally yields liver & spleen repositioning**

Left & Right Lateral Views

Right Lateral

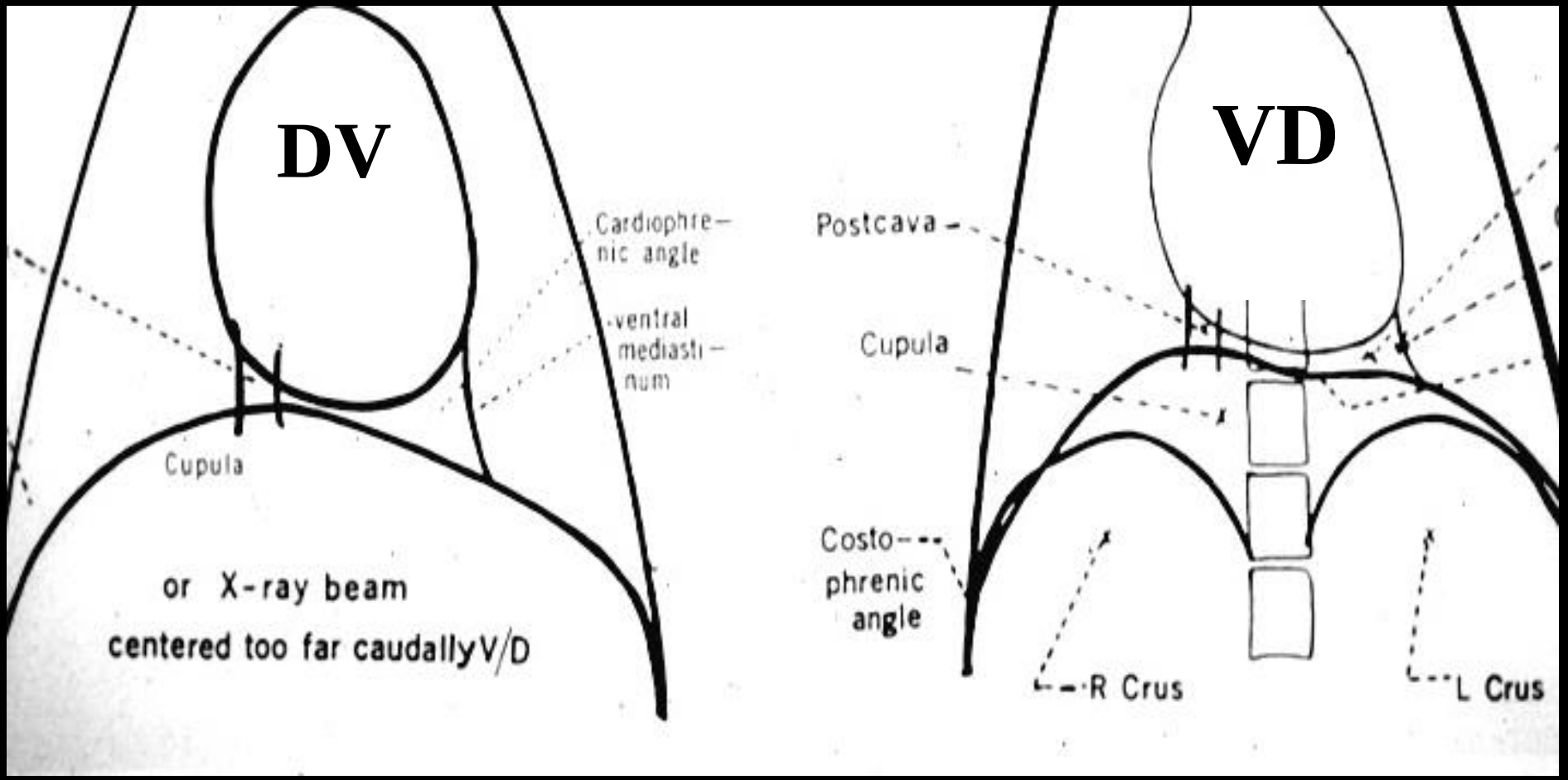
Left Lateral



Right Lateral

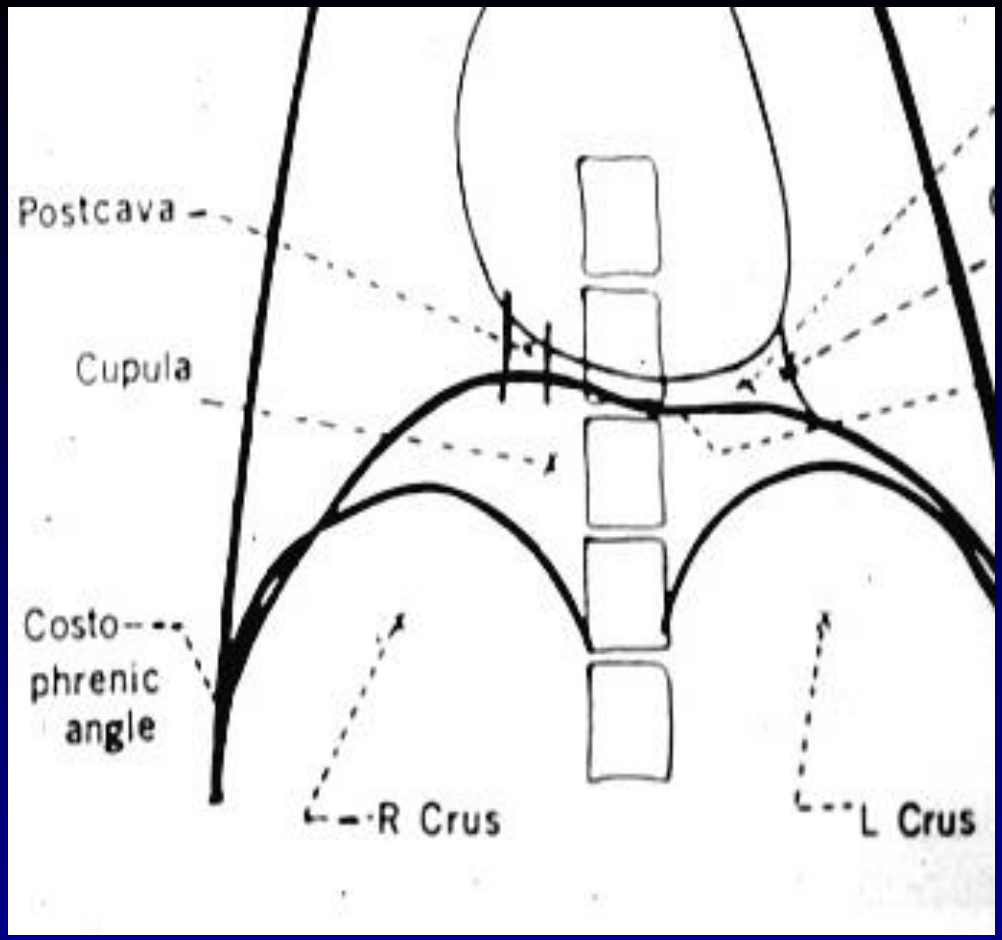
Left Lateral

DV vs VD ~ Diaphragm Contour



DV: central cupula pushed forward

VD: 3 “humps” visualized

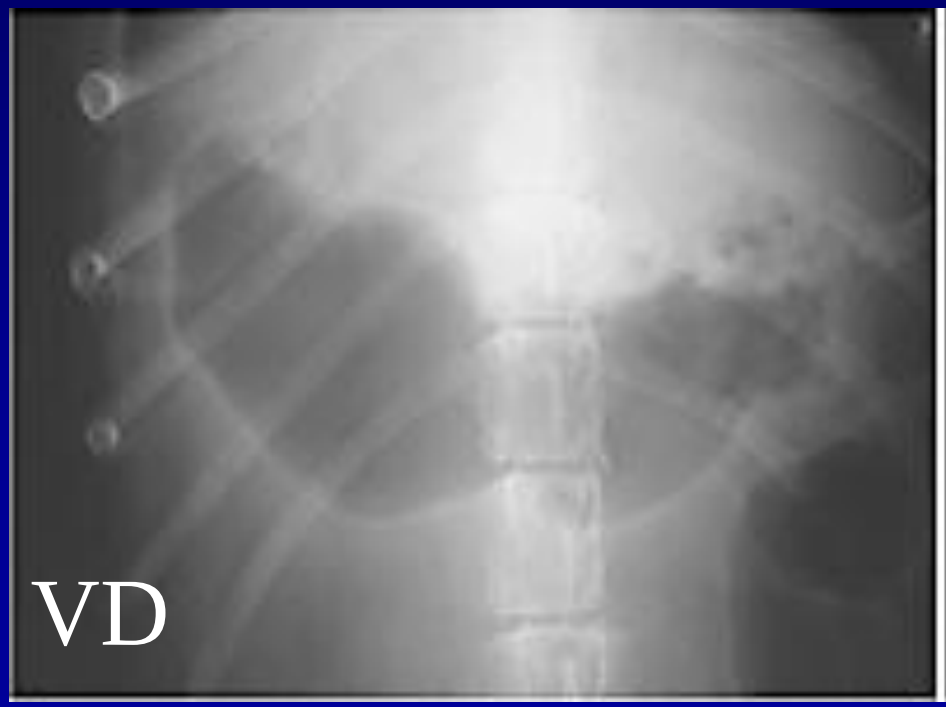


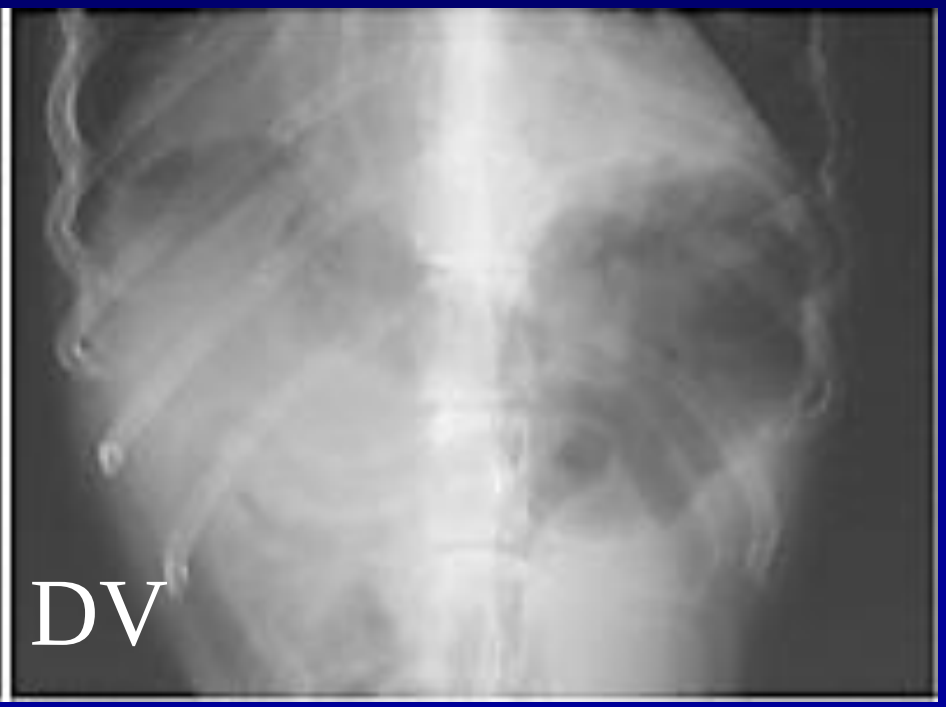
Ventrodorsal positioning
does not always show 3 humps!

VD projection

VD vs DV Views

- VD easiest to position (use V-pad)
- DV typically superimposes HL's under abdomen
  - Use with respiratory distress patients
  - Dorsal structures magnified (kidneys)
  - Repositions gas within the stomach regions





Abdominal Radiographic Technique

- Conventional Film – Screen Radiography
- Lower kVp + Higher mAs technique optimal
- Yields “shorter scale of contrast" (shades of gray)
- Abdomen inherently similar contrast of soft tissues
- Thickness >10 cm use grid to reduce scatter
- DR & CR = enhanced contrast resolution & adjustable

Abdominal DR & CR Technique

- Digital Radiography
- Less critical technique required
- Pre-set abdominal algorithms & image processing
- Adjustable contrast with viewing software
- Magnification & image manipulation possible
- Repeat radiography easier & more acceptable

Challenge Case:

Radiographic findings?

trachea rupture leading to