



# Essential Radiography for Veterinary Nurses Mini Series

## Session Three: Radiographic Contrast Studies

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## **Radiographic Contrast Studies**

Radiographic contrast studies are done to help in the evaluation of soft tissue structures or organs that we are not able to assess adequately using only plain radiography. Contrast studies of the alimentary tract and genito-urinary tract are the most common type of radiographic contrast studies done in practice. All examinations using contrast medium should follow specific protocols so that important information or views are not excluded.

### Types of Contrast Media

#### **Negative**

- Radiolucent -"black" in radiographs.
- Non plasma soluble vs plasma soluble.
- Non-plasma soluble – Air.
- Plasma soluble – Oxygen (O<sub>2</sub>), carbon dioxide (CO<sub>2</sub>); nitrous oxide (N<sub>2</sub>O).

#### **Positive**

- Markedly radiopaque – "white" in radiographs.
- Two main types: barium and iodinated water soluble contrast media.

### Barium

- Used to outline the alimentary tract.
- It comes packaged as a powder (to be mixed with water) or as a liquid suspension.
- Not to be used if perforation of the gastrointestinal tract is suspected, since it can cause granulomatous adhesions. If perforation is suspected use iodinated contrast media instead.
- If inadvertently inhaled by the patient it can cause aspiration pneumonia.

### Iodinated Water Soluble Contrast Media (WSCM)

- Ionic – Urografin® (sodium meglumine diatrizoate); Conray® (sodium iothalamate). Can cause adverse reactions, including vomiting, irritation and anaphylaxis.
- Non ionic – Omnipaque® (iohexol); Ultravist® (iopromide). More expensive than ionic types but less side effects.

Negative and positive contrast media can in some cases be used in conjunction to create a double contrast study. Positive contrast is used to coat any hollow structure and air used to distend that same structure.

## General Practical Principles

To successfully perform a contrast study, the following general guidelines should always be considered beforehand:

- Make sure you understand the exact area of interest and the indications for the study you will be performing.
- Make sure all equipment is ready to use.
- Plan the order of the technique to perform.
- Be aware of contra-indications and possible complications.
- *Always take survey radiographs!*

## **Alimentary Tract Contrast Studies**

### General Points

#### **Restraint**

- Better to be done conscious if possible because it will show real function/motility.
- Use sedation only if necessary.

#### **Types of contrast**

- Air.
- Barium – Used in most cases but do not use if gastrointestinal rupture is suspected.
- Non ionic water soluble contrast media can be used particularly if rupture of the gastrointestinal tract is suspected.

### Barium Swallow

#### **Indications**

- Motility disorders
- Hiatal hernias

#### **Contraindications**

- If known megaesophagus should avoid doing.

#### **Technique**

##### Liquid Phase

- 5 ml (cat) to 50 ml (large dog) of liquid barium.
- Administer into the oral cavity or allow to drink.
- Take lateral radiographs or perform fluoroscopy to include: oral cavity, oesophagus and thorax.

### Solid Phase

- Mix barium with solid food.
- Repeat lateral radiographs or perform another fluoroscopy loop.

### **Possible Complications**

- Patient does not collaborate.
- Aspiration pneumonia.

### Oesophagography

#### **Indications**

- Confirm the presence of: megaesophagus, mediastinal mass, diverticulum.
- Identify foreign bodies and masses.
- Diagnose and locate vascular ring anomalies.

#### **Technique**

- Administer or allow to drink liquid barium – 10 to 20 ml.
- Perform lateral and ventrodorsal (VD) radiographs.
- Solid phase can also be performed.
- Danger of aspiration pneumonia when recumbent.

### Barium Meal

#### **Indications**

- Gastrointestinal motility disorders.
- Obstruction – e.g. wall masses; foreign bodies.
- Identify abdominal masses or diaphragmatic ruptures.
- Patient preparation and restraint as for barium swallow.

#### **Contraindications**

- Do not use barium if suspected perforation.

#### **Technique**

- Administer liquid barium with a gastric tube: 6-12 ml/kg for gastric studies; 10ml/kg for intestinal studies.
- Take radiographs
  - Always note the time for each radiograph taken.
  - For the stomach – Right and left lateral views first followed by VD and dorsoventral (DV) views.
  - For gastric emptying and intestine take radiographs at 5, 15, 30, 60, 120 minutes and 24 hours; or stop before if a diagnosis is reached.
  - Obtain orthogonal views.

## Possible Complications

- Insertion of the gastric tube in the trachea.
- Granulomatous peritonitis if administered barium in case of perforated gastrointestinal tract.



Figure 1 – Normal barium meal in a cat.

## Pneumogastrography

### Technique

- Administer air instead of barium.
- Can also administer air after gastric emptying of barium.
- Can improve chances of identifying foreign bodies or masses in stomach.

## Barium Enema

### Indications

- Rectal or colonic intraluminal masses, strictures, ulcerations.

### Technique

- Do an enema the day before and on the day of the study.
- Anaesthetise the patient – uncomfortable procedure.
- Place Foley catheter in anus and introduce 7-14 ml of barium/kg into the terminal rectum.
- Allow contrast to drain cranially by gravity.
- Can also inflate rectum and colon with air to produce a double contrast study. Can also do a pneumoabdomen on its own.

### Contra-Indications and Complications

- Intestinal rupture due to overdistension.
- Granulomatous peritonitis if barium used in the presence of a perforation/ rupture.

## Genito-Urinary Contrast Studies

### General Principles

#### **Restraint**

- In most cases should be done under general anaesthesia.
- In trauma cases where general anaesthesia is contra-indicated heavy sedation can be considered.

#### **Preparation**

- Apply general principles for contrast studies.
- In most cases it will be beneficial to perform enemas the day before and on the day of the study.

#### **Contrast media**

- Water soluble Ionic contrast medium - Do not use in case of renal disease.
- Water soluble non ionic contrast medium – More expensive but minimal adverse reactions.
- Contrast media can be diluted from their original concentration.
- If a urine sample is required it should always be obtained before the contrast study.
- Remember to empty the urinary bladder at the end of the study.

#### **Equipment**

- Male and female urinary catheters.
- Small torch, vaginal speculum, tongue forceps.
- Sterile water.
- Needles and syringes.
- Plain pots and culture pots.
- Sterile Vaseline.
- Gloves and incontinence pads.
- Kidney dish.

### Intra-venous urography

#### **Indications**

- Renal disease
  - Haematuria
  - Dysuria
  - Pyelonephritis
  - Neoplasia
  - Cysts
  - Trauma
  - Function assessment
- Ectopic ureters

### Contra-indications

- Marked hypotension.
- Severe renal failure.

### Technique

- Place the patient on intra-venous fluidotherapy to maintain the blood pressure and renal filtration.
- Perform a pneumocystogram first.
- Perform intra-venous injection of contrast medium - 600-800 mg of Iodine/kg (at 300 mg of Iodine/ml this will correspond to 2 ml/kg of Omnipaque 300 ®)
- Take radiographs in the following sequence:
  - 0-30 seconds after injection of contrast take a VD view of the abdomen (vascular phase).
  - Between 1-5 minutes after injection of contrast take at least another VD view of the abdomen (nephrogram).
  - 10 min after injection of contrast take a VD and a lateral view of the abdomen (pyelogram and ureterogram).
  - After more than 10 minutes if may be useful to take oblique views to evaluate better the opening of the ureters into the urinary bladder.

### Possible complications

- Drug induced renal failure.
- Nauseas.



Figure 2 – Normal intra-venous urography in a dog.

## Pneumocystography

### **Indications**

- Assessment of urinary bladder size, shape, position, contents and wall.
- Complementary first step to other genito-urinary studies.

### **Contra-indications**

- If severe wall disease or lack of elasticity/ small bladder, a plasma soluble gas (e.g. O<sub>2</sub> or CO<sub>2</sub>) should be used instead of room air to decrease the risk of thromboembolism.

### **Technique**

- Empty bladder completely and collect urine for analysis.
- Inject gas or air – approximately 6-12 ml/kg or same amount as of urine removed.
- Take a lateral view of the caudal abdomen
  - Male dogs – place catheter in the tip of the penis, clamp and take the x-ray while injecting.
  - Female dogs – remove the catheter or push into the bladder.
  - Cats – remove catheter or push into the urinary bladder.

### **Complications**

- Urinary bladder rupture – overdistension of previously damaged wall.
- Intramural air – due to traumatic catheterization in cats.
- Air thromboembolism.

## Double Contrast Cystography

### **Indications**

- Cystitis, wall and intraluminal lesions.

### **Technique**

- Perform pneumocystogram.
- Take a survey lateral view radiograph.
- Inject 1-5 ml of water soluble contrast medium at 300 of Iodine/ml and massage the bladder.
- Take a lateral view radiograph.

### **Complications**

- Bleeding is common but resolves.



## Positive Contrast Cystography

### **Indications**

- Suspicion of bladder or urethral rupture.
- In trauma cases where general anaesthesia might be contraindicated it can be done under heavy sedation.

### **Technique**

- Do not catheterise
- Place catheter tip in penis or vulva (using Foley catheter).
- Inject 1 ml (cats) to 30 ml (large dogs) of water soluble contrast media at a concentration of 150 mg of Iodine/ ml (diluted Omnipaque 300® in sterile water 1:1).

### **Complications**

- Worsening of the urinary bladder or urethral rupture can happen in some cases.

## Retrograde Urethrography

### **Indications**

- Dysuria, incontinence, stranguria, haematuria, etc.

### **Contraindications**

- It should be avoided in bitches in season – risk of pyometra and difficult to obtain a good study because of the larger vagina with lack of pressure.

### **Complications**

- Urethral rupture
- Vaginal rupture.

### **Technique – Males**

- Pneumocystogram and lateral view – allowing filling and maximal distension of the urethra.
- Remove some of the air in the bladder.
- Prepare 2 to 25 ml of water soluble contrast medium at 150 mg of Iodine/ml.
- Place pre-filled catheter in the tip of the urethra and clamp with tongue forceps in dogs.
- Place hindlimb in a suitable position
  - Cranially for urethra
  - Caudally for bladder neck and prostate
- Inject, take lateral radiograph at the end of the injection - Always suitably protected!
- Can be repeated if underfilled.

## Technique – Females

- Pneumocystogram and lateral view – allowing filling and maximal distension of the urethra.
- Remove some of the air in the bladder.
- Prepare 0.5 ml /kg of water soluble contrast medium 150 mg of Iodine/ml.
- Cut the tip of the Foley catheter in vestibule.
- Inflate Foley balloon and clamp vulvar lips with tongue forceps. Do not clamp in cats, use suitable Foley catheter instead.
- Position for the normal lateral view.
- Slightly pull on the catheter and inject taking a lateral radiograph at the end of the injection - Always suitably protected!
- Can be repeated if underfilled.