

The use of contrast media in small animal radiography

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Categories : [RVNs](#)

Date : February 1, 2009

Sarah Price VN, DipAVN (Medical), discusses the substances used in x-rays and how they can help the veterinary team with diagnoses

CONTRAST media is a substance that can be administered to a patient and is either more radiopaque or more radiolucent than the surrounding tissue. Soft tissue structures or organs can be difficult to identify on plain radiographs, due to lack of contrast between them and the surrounding tissues. The use of contrast media enables the position, size, shape and internal architecture of an organ to be assessed. In addition, a series of radiographs can be taken or fluoroscopy can be used to assess the functional ability of certain organs. This can be particularly useful when looking at stomach emptying.

Types of contrast media

There are two types of contrast media – positive and negative. A combination of both can be used in double-contrast studies. Positive contrast media, such as barium or iodine compounds, have a high atomic number.

They absorb more x-rays than soft tissue or bone and so appear white on radiographs. They can be used to outline a hollow organ, such as the bladder and alimentary tract. Sterile water-soluble iodine contrast media can be injected into blood vessels to assess vascular supply or to evaluate the excretion of the compound.

Positive contrast media

Barium preparations

Barium sulphate is the positive contrast media most commonly used for gastrointestinal studies. It is produced as a powder that is mixed with water, a paste or a thick colloidal suspension. Barium liquid can also be mixed with food.

There are disadvantages associated with barium sulphate. If there is perforation in the alimentary tract, the barium can leak through it and it can remain in the mediastinum or peritoneal cavity, causing granulomas and adhesions. Aspiration of barium can cause pneumonia and if large amounts are aspirated this can be fatal.

Barium-impregnated polyethylene spheres can be used to assess the gastrointestinal tract. They come in large and small sizes and are supplied in a gelatine capsule that can be administered with food.

Iodine preparations

Ionic water-soluble iodine contrast media

Ionic water-soluble iodine preparations have a high osmotic pressure that can be up to eight times that of normal body fluid. Following injection they are rapidly excreted by the urinary system and are commonly used for intravenous urography, as they opacify the kidneys and urinary tract. Ionic media is not used for myelography due to the high osmotic pressure, which can cause severe damage to the nervous tissue. Patients are usually anaesthetised when intravenously injected with this media. The high osmotic pressure can cause nausea and vomiting in the conscious patient.

Oral ionic iodine preparations can be used if a perforation is suspected. Unlike barium, they are rapidly absorbed by the peritoneal cavity if a leak occurs. They have a bitter taste and administration can, therefore, be challenging. They also have a high osmotic pressure and this can mean that fluid is drawn out of the small intestines, which is a concern in animals that may already be dehydrated.

Non-ionic water-soluble iodine contrast media

These are similar to ionic media, but they have a much lower osmotic pressure. They were introduced to reduce the adverse effects of ionic media. This type of media is suitable for myelography.

Negative contrast media

Negative contrast agents consist of gases. Although room air is most commonly used in veterinary radiography, carbon dioxide greatly reduces the chance of air embolism, and oxygen can also be

used. Gases have a low specific gravity and appear more radiolucent to x-rays than soft tissue, so appear black on radiographs. Negative contrast studies will show size, location and wall thickness of an organ.

Contrast studies of the alimentary tract

Oesophagus

A contrast study of this area may be indicated in patients with regurgitation, retching, dysphagia and vomiting undigested food. Patient preparation is minimal for this study; a premedication may be given if the animal is of a nervous disposition, but anaesthesia should not be administered for upper gastrointestinal tract studies. Plain/survey films should be taken before any contrast is administered.

Liquid barium is not ideal for assessment of the oesophagus, as barium will pass down to the stomach before radiographs can be taken. Barium sulphate paste can be used more effectively and is placed at the back of the patient's tongue and swallowed. The paste is ideal, as it adheres to the oesophageal mucosa. If megaesophagus is suspected from the plain radiographs, barium can be mixed with tinned food. This technique will allow the extent of dilation to be assessed. Partial obstructions could be missed during a plain liquid barium swallow and mixing barium with food is recommended in these cases. Lateral cervical and thoracic oesophageal radiographs should be taken along with dorsoventral radiographs if needed ([Figure 1](#)).

Stomach and small intestines

Gastrography is indicated if the patient is presented with acute or chronic vomiting, haematemesis or cranial abdominal pain.

If possible, food should be withheld for 24 hours. Plain radiographs should be taken before the barium is administered orally. Once the barium has been administered, ventrodorsal, dorsoventral, left and right lateral radiographs should be taken immediately to fully evaluate the stomach. Radiographs should be repeated 10 minutes after the initial film and at 10-minute intervals if needed. If more mucosal detail is needed a double contrast gastrogram can be performed.

Assessment of the small intestines involves lateral and ventrodorsal radiographs to be taken at regular intervals. Radiographs taken 30 minutes after the initial barium administration should ensure barium has reached the small intestines.

Large intestines

Indications for this study are tenesmus, melaena, chronic diarrhoea and suspected intestinal masses.

Preparation should include a warm-water enema three to four hours prior to the study. A barium enema is administered via a Foley catheter into the rectum and colon. Positive, negative and double contrast can be performed. Oral administration of barium will not fully distend the large intestines so a barium enema is necessary.

Contrast studies of the urinary system

Anaesthesia is needed for these studies, as it ensures correct positioning and reduces the occurrence of reactions to the contrast media. Contrast studies of the upper and lower urinary system evaluate the kidneys, ureters, bladder and urethra. Indications for a study of the urinary system include incontinence, haematuria, proteinuria, polyuria or dysuria.

Intravenous urography

Intravenous urography (IVU) is used to assess the kidneys and ureters. There are two techniques, rapid-injection IVU or drip-infusion IVU. Preparation for these studies should include intravenous catheter, 24 hours' starvation, an oral cleansing solution (which can be administered the previous day to ensure the colon is empty) and a warm water enema four hours before the patient is anaesthetised.

Between premedication and general anaesthesia it is useful to take a lateral radiograph to ensure the colon is empty, as faeces will cause shadowing and obscure radiographic detail. A further enema may be required before the patient is anaesthetised. The patient is anaesthetised and plain survey radiographs are taken to check exposure and positioning before low-volume, rapid-injection IVUs. The patient is placed in dorsal recumbency and the contrast, water-soluble iodine is injected as rapidly as possible. The first radiograph is taken immediately and subsequent films, both lateral and ventrodorsal views, are taken at one, five, 10, 15 and 20-minute intervals.

The second technique is high-volume drip-infusion IVU ([Figure 2](#)). This is made of a more dilute solution. Watersoluble iodine can be diluted with dextrose to make up the solution. An animal's total dose is infused over 10 minutes intravenously. Positioning is similar to rapid-intravenous IVU; radiographs are taken at five, 10 and 15 minutes after the start of the infusion. This technique is sometimes preferred for the evaluation of the ureters. Pneumocystograms are often performed initially – especially if ectopic ureters are suspected. This helps to provide a translucent background that makes evaluating the ureters easier.

Cystography

This study may be performed in animals with clinical signs such as suspected urinary crystals, haematuria, dysuria, anuria and incontinence. Preparation includes starvation for 24 hours and an enema four hours prior to anaesthesia. The animal is anaesthetised, a urinary catheter placed and the bladder drained. Positive, negative or double-contrast studies may then be performed.

Intravenous cystography can be performed if urinary catheterisation is not possible; a rapid-injection IVU procedure is performed and both lateral and ventrodorsal radiographs are taken 30 minutes after injection.

A pneumocystogram ([Figure 3](#)) uses negative contrast media to assess the bladder size and position. The bladder is inflated with air via a urinary catheter, syringe and three-way tap. A positive contrast cystogram is similar to a pneumocystogram, but water-soluble contrast media is administered through the urinary catheter. Double contrast provides the best mucosal detail. The water-soluble iodine is injected into an empty bladder followed by air.

Retrograde urethrography and vagino-urography

This consists of filling the urethra with contrast media to highlight urethral trauma, stricture, obstruction or tumours. Retrograde urethrograms ([Figure 4](#)) require catheterisation of the penile urethra. Plain radiographs are taken first and lateral radiographs are taken immediately after the injection of contrast has finished. The hind legs are pulled cranially to allow the pelvic urethra to be assessed. [Figure 5](#) shows urethral repair.

Retrograde vagino urethrography involves placing a Foley catheter, which is already filled with contrast media, into the urethra and inflating the bulb of the Foley catheter so it does not move. Soft tissue forceps are used to occlude the vulval lips. The patient is placed in recumbency and the radiographs are taken immediately after the contrast media is injected.

Myelography

A myelogram is indicated to highlight a spinal lesion that cannot be seen on a plain radiograph. Non-ionic water-soluble iodine in the subarachnoid space can identify spinal cord compression (which may be due to a mass or disc) or spinal cord swelling.

General anaesthesia is needed and survey radiographs are taken to check positioning and exposure factors. The animal is placed in lateral recumbency and the skin caudal to the occipital crest is clipped and aseptically prepared. The head is held by an assistant, the patient's nose needs to be at right angles to the neck and the sagittal plane should be parallel to the table top. A spinal needle is then introduced into the cisterna magna. Cerebrospinal fluid should flow once it is in the correct place and a sample can be collected.

The contrast is then slowly injected over one to two minutes and a lateral and ventrodorsal radiograph taken immediately and then every few minutes. The patient's head should be elevated up at a 30-45 degree angle to prevent contrast media flowing back towards the brain, as this will increase the occurrence of seizures on recovery.

Lumbar punctures may also be performed at L3-4 or L4-5 for suspected problems in the lumbar

region ([Figure 6](#)). The animal should again be in lateral recumbency and with the spine and hips flexed or in sternal recumbency with the hindlimbs drawn forwards. A benzodiazepine can be injected before recovery to lessen the risk of seizures post-myelography.

Arthrography

This is a technique used to assess joints. It provides information on intra-articular structures that may not be seen on survey x-rays. It is particularly useful to assess within the shoulder joint. Articular cartilage, biceps tendon, joint capsule and the synovial surface outline can also sometimes be visualised on arthrograms. A non-ionic, low osmolar contrast is used and injected intra-articularly, after survey x-rays have been taken. The joint is then radiographed five minutes after the contrast is injected. Osteochondritis dissecans can be demonstrated and seen on contrast radiographs once the contrast has infiltrated beneath the articular cartilage. Abnormal synovial lining may also be seen on contrast radiographs, as well as enabling visualisation of “joint mice” and diagnosis of bicipital tendon problems.

Angiography

This involves the use of water-soluble iodine contrast media to assess part of the vascular system. It is an imaging technique in which an x-ray image is taken to visualise the lumen of blood vessels and organs of the body, paying particular interest to the arteries, veins and the heart chambers. An angiogram may be used to demonstrate occlusion of a blood vessel or to demonstrate a pathological lesion of the vascular system ([Figure 7](#)).

Conclusions

The use of contrast radiography has diminished of late, due to the increased availability of ultrasonography, endoscopy, computed tomography (CT) and magnetic resonance imaging (MRI). Radiography and CT can be used to evaluate bony change; MRI and ultrasound are sometimes preferred to assess soft tissue. However, there are still indications where contrast studies can be performed. It is especially useful in general practice, where certain other techniques may not be available.