Contrast Media in Veterinary Radiology

A contrast medium is a substance that is administered to the patient that is either more radiopaque or more radiolucent than the surrounding tissue. This allows assessment of the position, size, shape and internal architecture of the organ that was not apparent on the original radiograph. Sequential films or the use of image-intensified fluoroscopy may also show the function of an organ, e.g., the rate of stomach emptying or the presence of peristalsis. Properties required in an ideal contrast medium include:

Different absorptive power from tissue, thereby producing effective radiographic contrast;

1- No irritant or toxic side effects

2-accurate delineation of the organ
3-Persistence for sufficient time to take radiographs

Total expulsion from body.

TYPES OF CONTRAST MEDIA

There are two tyes of contrast media, negative contrast media (more radiolucent than surrounding tissues) and positive contrast media (more radiopaque). They achieve this difference by absorbing less or more respectively of the incident radiation than do the surrounding tissues .

1-Negative contrast studies will show the location, size and wall thickness of the organ and will show marked wall thickening and large luminal filling defects such as masses or foreign bodies. They give little information about the mucosal surface, smaller filling defects such as bladder calculi may be overexposed and small tears in the wall may be missed.

2-Positive contrast studies give little more information than negative contrast studies but are the best way of detecting a small defect in the wall of the organ, as minor contrast leakage is easily seen.

Double contrast studies use a small amount of positive contrast medium to coat the mucosal surface of a hollow organ such as the bladder, followed by distension with air. This gives much better mucosal detail than a positive or negative study alone, and will also more reliably show small filling defects in the puddle of residual positive contrast medium.

NEGATIVE CONTRAST MEDIA

The most commonly used negative contrast agent used in veterinary radiography is room air. It is used mainly in the bladder (pneumocystogram) but can also be used in the gastro-intestinal tract (pneumogastrogram, pneumocolon) and in joints (negative arthrogram.(

POSITIVE CONTRAST MEDIA

Barium and iodine preparations are the commonest positive contrast media, appearing radiopaque due to their high atomic numbers (56 and 53 respectively). Barium is presented as barium sulphate and iodine as complex organic molecules.

1.Barium sulphate preparations

Barium is a chalky white material produced as a powder to mix with water, a paste or a thick colloidal suspension. Barium liquid can also be mixed with food. Since barium preparations are colloidal suspensions, not solutions, they must not be injected into blood vessels. Aspiration of barium into the lungs may cause pneumonia and severe aspiration may be fatal. Barium that has leaked from perforated gut remains indefinitely in the mediastinum or the peritoneal cavity causing granulomas and adhesions. It may delay healing of a subsequent enterotomy site, so it should not be used if surgery is likely.

BIPS (barium impregnated polyethylene spheres) may be used for diagnosis of intestinal obstructions and motility disorders. They are prepared as large (5mm diameter) and small (1.5mm diameter) spheres that are administered to the dog or cat inside large gelatin capsules either in food or directly by mouth. The large BIPS demonstrate the presence of obstructions by failing to pass along the gut, whilst the small BIPS behave like ingesta and show the gastric emptying rate and transit times of food in the gut. They do not show gut wall thickness, mucosal detail or foreign bodies

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2.Iodine preparations

a) Ionic, water-soluble iodine contrast media

These are derived from the benzene ring of benzoic acid with 3 iodine atoms added and variable side chains. When dissolved in water they dissociate into ions and this gives them a very high osmotic pressure 5-8 times that of normal body fluids, making them irritant in certain areas of the body. They are of high viscosity although this can be reduced by warming them to body temperature. The iodinated benzene rings to which the sodium and meglumine are attached are usually ions called diatrizoate, iothalamate or metrizoate. Different concentrations are available although stronger ones can be diluted; concentrations are measured in mg I/ml (usually 150-450 mg I/ml.(

Iodinated contrast media are excreted by the kidneys following intravascular injection and so are commonly used for intravenous (excretion) urography. They may also be used in other body cavities and in the gastrointestinal tract. Ionic media must not be used for myelography as their high osmotic pressure causes severe damage to nervous tissue that may be fatal.

Their very high osmotic pressure causes unpleasant side effects such as nausea, vomiting etc. when they are injected intravenously into the conscious patient (as is usual in man) and therefore heavy sedation or general anaesthesia is recommended in veterinary patients. They are irritating if they leak perivascularly and so they should be injected via an intravenous catheter. They are contra-indicated in patients with cardiac or renal failure.

Oral ionic iodine preparations may be used if gastrointestinal perforation is suspected, since they will be absorbed if they leak out of the gut into a body cavity. However, they have a bitter taste so are hard to administer. Their high osmotic pressure means that fluid is drawn into the gut causing progressive dilution and loss of contrast and definition, and further dehydration and possible collapse may occur in a dehydrated animal. Interpretation is as for barium studies of gastrointestinal tract, although contrast medium dilution means that radiographic contrast and definition are reduced.

b) Non-ionic, water-soluble iodine contrast media

These are similar to ionic media, being based on tri-iodinated benzene rings, but they do not dissociate in solution and so have a much lower osmotic pressure; side-effects are therefore very much reduced. They are mainly used for myelography, but they may also be used for any other study suitable for iodinated media. Their low osmolarity means that they become diluted with tissue fluid much more slowly than the ionic media, and so they will produce better images as well as being safer for animals with cardiac or renal insufficiency, GIT perforation or at risk of aspiration. However, they are more expensive.

INTERPRETATION OF CONTRAST STUDIES

Gastrointestinal Tract

Oesophagus (barium or iodine swallow)-oesophageal dilation, diverticula, stricture, redundancy, filling defects, mucosal pattern. Barium paste is normally used, but barium mixed with food may be necessary to show oesophageal dilation or strictures.

Stomach(pneumo-, positive or double contrast gastrogram)-distensibility, wall thickness, filling defects, mucosal pattern, rate of emptying. A double contrast gastrogram is usually the best study to use, but a mixture of liquid barium and food may be needed to demonstrate pyloric outflow problems.

Small intestine(barium or iodine series)-location, lumen diameter, wall thickness, filling defects, strictures, obstructions, plication, mucosal pattern, transit time. Inherent intestinal gas often gives a double contrast effect.

Large intestine (pneumocolon, positive or double contrast enema)-location, lumen diameter, wall thickness, filling defects, strictures, mucosal pattern.

Urogenital Tract

Kidneys (positive contrast intravenous urogram)-number, location, size, shape, pattern of nephrogram and pyelogram.

Ureters (positive contrast intravenous urogram)-number, location, diameter, leakage of urine/contrast.

Bladder (pneumo-, positive or double contrast cystogram)-location, size, shape, wall thickness, filling defects, mucosal pattern. A pneumocystogram is adequate for assessing bladder location; positive contrast study for small tears and double contrast cystogram for other purposes.

Urethra and vagina (positive contrast retrograde urethrogram or vaginourethrogram)-diameter, filling defects, mucosal pattern.

Other

Spine (myelography)-subarachnoid space location, diameter, degree of filling, filling defects, rate of passage of contrast medium.

Liver (positive contrast portal venography)-venous vascular pattern of liver, mainly for portosystemic shunts.

Joints (positive, negative or double contrast arthrography)-size and extent of joint capsule, filling defects, synovial surface pattern, capsule ruptures, outline of biceps tendon.

Salivary glands (positive contrast sialography)-mucocoeles, duct strictures.

Sinuses and fistulae (positive contrast sinography, fistulography)-extent of tract, filling defects, involvement of other structures.

PREPARATION FOR ELECTIVE CONTRAST STUDIES

.1Fast the animal and administer a cleansing enema, to empty the gut and/or prepare for general anaesthesia.

.2Sedate or anaesthetise the patient.

.3Obtain plain (survey) radiographs even if these were performed the previous day-check exposure factors and adequacy of preparation, and use as a baseline image for interpretation of contrast radiographs.

.4-Administer the contrast medium noting the time (with the patient positioned for the first radiograph if it must be taken quickly.(

.5-Obtain lateral, ventrodorsal/dorsoventral and oblique radiographs at regular time intervals depending on the study, until a confident diagnosis is reached. Mark the time of exposure on each radiograph.

.6-When viewing the radiographs, it is often helpful to examine films taken from the same angle together, as consistent abnormalities will be more readily apparent.