

How to Perform Contrast Radiography: Classic But Still Useful

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The inherent poor contrast within the abdomen and the fact that soft tissue and fluid cannot be differentiated radiographically means that contrast media are required for assessment of luminal surfaces, and therefore wall thicknesses of the gastrointestinal tract. Contrast studies are most commonly performed to identify anatomy not visible on plain radiographs and to evaluate the integrity the hollow viscus organs. They may be used to determine function, as in gastric emptying and small intestinal transit.

Contrast media

Positive contrast media includes barium and iodinated options. The choice may depend on clinical, cost and availability limitations. The most important variable is the clinical situation.

Barium is very, very opaque and very inexpensive. We depend on barium contrast media for routine studies of most components of the gastrointestinal tract. Barium is inert, relatively palatable, has no osmotic potential and coats the mucosal of the gastrointestinal tract very well. Barium may be mixed with food for esophageal studies, although this will compromise a subsequent upper GI series. Barium is formulated as a suspension is not osmotically active.

Barium sulphate comes in a variety of concentrations, normally classified by "weight-to-volume" (w/v). We usually dilute the concentration to make it 60% w/v for esophageal or 30% w/v for gastric and intestinal studies. Aspiration of barium has morbidity associated more with the volume and concurrent acidic gastric contents, then from any direct effect of the barium sulphate. Barium is relatively contraindicated in species with extremely slow transit time (especially reptiles) and with known gastrointestinal tract rupture.

Iodinated media

Iodinated contrast media are based on attachment of the iodine molecule to benzene ring compounds. These tri-iodinated monomers or dimers protect against many adverse reactions of unprotected iodine in the body. Iodinated media are water soluble and therefore osmotically active. Iodinated agents are preferred if endoscopic evaluation of the GI tract is being considered after the GI radiographic contrast study.

High-osmolar iodinated contrast media

These are less expensive than low-osmolar agents. There are contraindications to the high osmolarity and when used as a gastrointestinal agent the contrast material becomes more dilute as it passes along the GI tract. This may be clinically important in dehydrated or neonatal patients. The high osmolarity irritates the GI mucosa and GI transit times are faster with iodinated agents, compared to barium agents. Aspiration of high osmolar agents results in severe pulmonary edema. These agents are diluted by their osmolar effects pulling fluid in from the interstitium into the lung alveoli.

Low-osmolar iodinated contrast media

Both ionic and non-ionic agents are available in this category of ionic agents. These agents result in fewer adverse effects including pulmonary edema if aspirated. Low-osmolar agents are preferred for the GI tract because they are not diluted as they pass through the GI tract.

Survey radiographs

Survey radiographs provide the basis of our contrast imaging of patients. In the abdomen we gain a tremendous amount of information regarding the gastrointestinal tract; overall dimensions, content and evidence of regional disease. Survey radiographs fall short of providing a definitive diagnosis when our confidence is low, there are ambiguous radiological findings, the radiological findings conflict with the clinical signs or the disease is entirely occult on survey radiographs.

Esophagography

Esophagography is very useful to identify a cause of regurgitation or to rule-out a possible stricture, perforation or foreign body. Other differentials include broncho-esophageal fistula, hiatal hernia and gastroesophageal hernia. Verify location of pulmonary mass in relationship to esophagus. A dose of 1 ml/10 lb body weight of barium suspension per os is usually sufficient. However, extravasation of barium into the mediastinum is a relative contraindication and may make the use of a nonionic iodinated contrast safer. The contrast is administered per os, trying to avoid overdosing while the patient alternatively breathes and swallows. Radiographs should be taken within 5 sec of start of contrast administration. Whilst this study is still "state of the art" for functional pharyngeal disorders, these studies are dynamic and require videofluoroscopy and slow motion frame-by-frame analysis for complete evaluation.

Pneumogastrography

There are two locations in the GI tract where use of a negative contrast study is indicated. The first is a the negative contrast gastrogram or pneumogastrogram. The most common indication is suspected lucent foreign body; ball, cloth, hair, toys. Air is administered by orogastric tube. I hardly think that this audience needs tutoring on passing an orogastric tube, but I usually recommend as small a gauge as possible (we are not lavaging the stomach) and making sure to allow the dog to swallow each time the tube reaches a sphincter; upper and lower esophageal. The end point of "full gastric distension". Although a dosage (6 ml/lb body weight of air) is provided, I have always just blown into the tube a volume subjectively thought to be appropriate for the patient size. This study has the utility that if diagnostically negative, does not preclude a subsequent upper gastrointestinal series. However, if an ultrasound examination is being considered, than the US exam should be performed prior to any negative contrast study.

Positive contrast gastrography

This study is especially indicated to quickly determine stomach positioning or for suspected gastric or duodenal perforation. The contrast used depends on the indication. For cases of suspected perforation, nonionic iodinated contrast is indicated. Extravasation of barium suspension may cause unacceptable adhesions and barium granuloma formation if the surgery is delayed following the study. However barium extravasation is much easier to detect than iodine in cases of perforation, so decreased sensitivity must be balanced against surgical complications. If surgery can be performed immediately following the study, barium is the contrast of choice. In either case the dose is 3 ml/lb body weight of contrast via orogastric tube.

Upper gastrointestinal (UGI)

Although largely supplanted by ultrasound, the UGI series may be a faster and more sensitive test for certain small intestinal diseases. Indications still include suspected gastrointestinal obstruction, intussusception or linear foreign body. The UGI series works best in an emergency setting with a proximal ("high") small intestinal lesions where the lesion is noted after only a brief wait for passage of barium. Distal lesions may require many hours for passage barium. Larger and older dogs have slower small intestinal transit, compared to cats or smaller and younger patients. Normal gastric emptying is 4 hours in dogs and 2 hours in cats. The dose for an UGI study is 6 ml/lb body weight of 20% weight/volume barium suspension via orogastric tube.

Pneumocolonogram

This is the most common gastrointestinal contrast study performed in our academic setting. The indication is suspected, but not highly suspected, small intestinal obstruction. Maybe there is one or two loops of intestine which are moderately enlarged and you cannot tell whether they are small intestinal or colonic loops. This study very quickly provides the information as to "who is the colon". The dose is 4 ml/lb body weight via rectum by Foley catheter. The balloon of a large diameter catheter is very gently filled to seal the rectum and the air slowly infused. A single VD view may suffice, although lateral projections may augment the study.

References

O'Brien, RT and Barr, F. 2009. BSAVA Manual of Canine and Feline Abdominal Imaging. 252pp.