Did you ever tense up when you heard the dreaded “we need to do an Upper G. I.?” Special procedures are a necessary evil in our world. Yes, it is still radiographs, but it means so much more. They are timed, and you have to get it right the first time, as you cannot go back; “the card that is laid is the card that is played.” It is crucial that the position as well as the time and techniques be just right. Miss a shot, and the doctors could miss a diagnosis. Modern medicine has given us a wonderful tool besides radiographs, ultrasound. But sometimes ultrasound cannot be as useful as we like. It is almost impossible to see a foreign body when there is an abdomen full of gas. We will discuss some common as well as some not so common specials, going over why we do these as well as how to, including what contrast media to use and how much, as well indications for doing the studies in the first place and contraindications.

When a contrast medium is used, it makes it possible to visualize structures or organs that would otherwise be hard or impossible to see on plain radiographs. In some instances, contrast procedures can be used to evaluate organ function. The substances used for these procedures, contrast media, usually have a high atomic number (e.g., iodine or barium). These media, because of their high atomic number, absorb a large amount of the X-rays. This produces a positive contrast to the tissue, which appears white on the radiograph. A negative contrast medium (e.g., air) is also used for some studies. Because of the low atomic number of air, there is very little absorption of X-rays. Therefore the radiograph is black. The contrast medium may be introduced so that it fills or outlines an organ (e.g., the stomach or the small and large bowel), or may be injected into the bloodstream to produce immediate results (e.g., intravenous pyelogram or angiogram). This also will show the function of organs such as the kidney or the liver as the contrast is being secreted.

Plain radiographs must be taken prior to any contrast procedure, as contrast studies are not an excuse for poor radiography. The plain films must be evaluated

1. For good techniques, so to avoid retakes during the procedures.
2. Because a possible diagnosis may give the answers without having to do the procedure.
3. To see if the patient is properly prepared for the study (e.g., has had an enema).
4. To check the patient to see if there is a reason not to use the normal amount of medium or to see if a different medium should be used.

I will summarize some of the common and not so common procedures we do, including the media we use. Keep in mind that there may be several brands of contrast available to purchase. There have been many compounds used as contrast agents in radiography. In addition, different drug companies market many of the same contrast agents under different names and different concentrations. There are 5 types of media, but we will only address 3: barium sulfate, water soluble iodinated products, and negative contrast agents.

**Contrast Media**

**Barium Sulfate**

This contrast medium is used exclusively for radiography of the gastro-intestinal tract. It is NEVER injected into the venous system, as we all well know. The advantage of barium is that it is totally insoluble and inert. Therefore it is neither absorbed nor acted upon by the gastro-intestinal secretions. Barium is usually prepared in a fine suspension, and it provides excellent visualization of the mucosal pattern. Barium should never be used if a perforation is suspected; instead, a water soluble iodinated agent is the medium of choice. This type of medium, iodinated, can be absorbed, whereas barium cannot be absorbed and can cause severe complications. Barium sulfate usually comes in 3 forms, a prepared colloidal suspension, a powder that must be mixed with a certain amount of water before administering, and a thick paste.

**Water Soluble Iodinated Product**

Iodine-based contrast media forms the largest single group of contrast agents. There are several important criteria for this group. They

1. All contain iodine with a high atomic number
2. Are opaque to X-rays.
3. Are inert.
4. Are soluble in water, so they can be injected in high concentrations.
5. Are chemically stable, so that iodine is not released into the body.
6. Are rapidly excreted by the kidneys.
7. Have low viscosity for injecting quickly with a small gauge needle or catheter.
8. Have low toxicity and are low irritant.

The most common agents are sodium or meglumine salts of iothalamic, diatrizoic, or metrizoic acids. These are normally injected into the vascular system. This gives the immediate visualization of the vascular system. It will then be excreted by the kidneys and travel down the rest of the urinary tract. These agents can cause perivascular irritation, so care should be taken to make sure they are only injected intravascularly. This one property prevents their use in myelography. In myelography, the use of water-soluble preparations, which mix freely with cerebrospinal fluid, would be an advantage.

There have been side effects noticed in human medicine when iodinated contrast agents have been injected. These include hot flashes, palpitations, nausea, vomiting, metallic taste, and dizziness. In animals, especially cats, we have seen vomiting and increased heart rate. There has been an occasional anaphylactic reaction that resulted in death, so it is important to warn the owners of these complications. There are 2 reasons for these side effects: hypertonic (5–8 times the osmolality of the normal body fluids) and ionic change.

The sodium salts are more toxic that the meglumine. Warming the contrast medium to body temperature prior to administration can reduce the viscosity of the solution. This is often thought to also reduce the adverse reaction.

New low osmolar contrast media were introduced to reduce the prevalence of adverse reactions. Iopamidol and iohexol are the 2 agents used in myelograms; they have the advantage of being non-ionic.

Iodinated contrast solutions are often used when a perforation is suspected in the G.I. tract and also in the perineum, to check for a diaphragmatic hernia.

Common Studies—G.I.
Esophagram
This procedure is commonly done to evaluate for swallowing and motility disorders, esophageal foreign bodies, strictures, masses, and perforations.
What you need: Barium—liquid, kibble (barium soaked)

Gastrogram
This procedure is used to evaluate the stomach and rate of gastric emptying.
What you need: Barium, tube, and a mouth gag
Dose: 10ml/kg

Double Contrast Gastrogram
This procedure is used to evaluate the gastric wall for regions of irregularities, ulcers, masses, and foreign bodies. If a perforation is suspected, an iodinated contrast should be utilized.

Upper Gastro-Intestinal (UGI)
This procedure is done mainly to rule out an intraluminal foreign body or some other reason supported by findings of obstructive ileus.
What you need: Barium 30%, mouth gag, stomach tube
Dose: 10 ml/kg large dog; 15 ml/kg small dog; 10 ml/lb cats
Transit times (approximate): large dog .5–3 hrs; young dog 1–2 hrs; cat-.5–1 hr.

Common Studies—Urography
Ultrasound has greatly reduced the need for urography; however, there are specific instances where urography provides the greatest amount of information. Reasons for doing a study are hematuria, pyuria, dysuria, straining, and frequency of urinating.
Contrast Media
The usual agents are a positive-contrast, water-soluble, ionic product with high osmolarity containing iodine. There are also lower-osmolar, water-soluble, non-ionic agents (iohexol (Omnipaque), and iopamidol (Isovue).

IVP—Intravenous Pyelogram or Excretory Urogram
Intravenous injection of an iodinated contrast agent which is excreted through the kidneys, ureters, and into the bladder. It is very important the animal be well hydrated. Also make sure patients are well prepared.
What you need: contrast medium, in-dwelling catheter, supplies for abdominal compression, marker to identify timed exposure
Dose Rate: 2 ml/kg; maximum 90 ml dog, 15 ml cat

Cystogram Double Contrast
A study performed to evaluate the urinary bladder for extramural, mural, or intramural lesions.
What you need: contrast medium, urinary catheter (either a polypropylene or foley), three-way stopcock, female adapter, lube (Lidocaine jelly works well), sterile gloves, speculum
Dose: 5–12 ml positive contrast, air to effect; cats maximum 36 ml total

Vaginogram/Urethrogram
This procedure is used to evaluate urinary incontinence in a young female dog and look for calculi, masses, or strictures.
What you need: contrast medium, Foley catheter, female adapter, lube, clamp to clamp off vulva (not metal)