AMIC Educational Newsletter

AMIC Trusted Radiology Experts

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AMIC Educational

Diagnostic Imaging

Trauma Imaging: A Radiologist's Perspective- The Elbow

Trauma imaging can present a unique set of challenges for the radiology technologist. Patients are in pain, and may be unable to cooperate with proper positioning. For technologists to provide the best images possible for the radiologist, it can be helpful to know what the radiologist is looking for on trauma radiographs. I know I've been guilty of saying in my report "Exam is technically limited due to suboptimal positioning" without communicating to the technologist what's wrong with the image or why it's diagnostically problematic. We're all busy and pressed for time, but it would benefit us all to have open communication in these situations. Radiologists should provide specific feedback to technologists about their studies, and technologists should be encouraged to approach the radiologist with questions they have about their exams. This is to everyone's benefit, and ultimately results in the best care for the patient.

Figure 1

In trauma imaging, the most common image quality issues relate to anatomic coverage, patient motion, and positioning. Coverage and motion issues should be readily apparent to the technologist who is carefully reviewing his or her images. Positioning issues may be less obvious.

As an example, I'd like to focus on the elbow, and more specifically, the lateral view. In a trauma setting, the true lateral projection is often the most critical view of the elbow for fracture detection. On the lateral view, the epicondyles of the distal humerus should be completely superimposed, producing a "teardrop" or "figure 8" sign along the distal humerus, formed by the anterior margin of the olecranon fossa and the posterior margin of the coronoid fossa (*Figure 1).* Lack of the "hourglass" may be an indicator that the image is not a true lateral. This is important because radiologists often rely on anatomic relationships that can only be determined on a true lateral image to determine if an abnormality is present. This is especially the case in pediatric exams, where a fracture may occur through the nonossified portion of the bone and not directly visible.

Two important lines we evaluate are the anterior humeral line and the radiocapitellar line (*Figure 2*). The anterior humeral line is drawn vertically along the anterior cortex of the distal humerus. On a true lateral view this line should continue through the middle of the capitellum of the humerus (or the rounded capitellar ossification center in a pediatric patient). Pediatric elbows are complex joints, with six separate ossifications centers that ossify and become visible at different ages. The first of these to ossify and become visible is the capitellum (usually by age 1). Assessing the anterior humeral line is especially important on a pediatric elbow exam. The most common type of pediatric elbow fracture is a supracondylar fracture of the distal humerus (representing up to 60% of pediatric elbow fractures).

(Continued on page 2…)

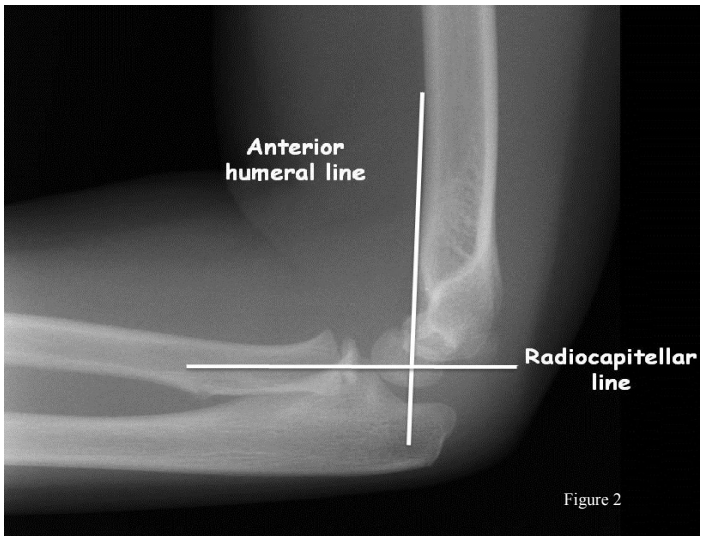


Figure 2

Inside this issue:

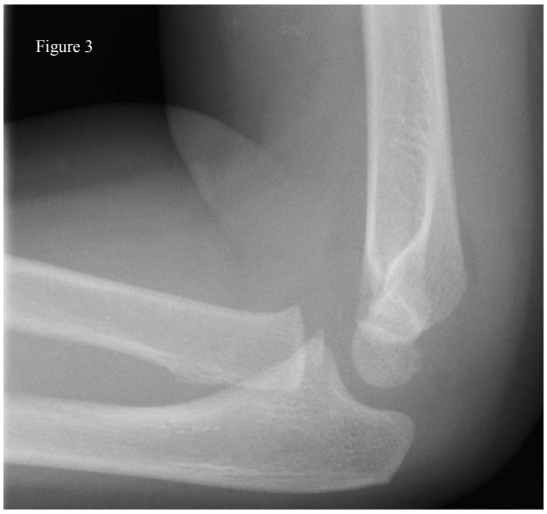


Figure 3

In many cases, particularly in younger children, the fracture may occur through the nonossified portion of the distal humerus, and may only be detectable as displacement of this capitellar ossification center relative to the humeral shaft, as determined by the anterior humeral line. In *Figure 3*, we can mentally draw the anterior humeral line along the humerus and note that it doesn't cross the capitellum – this represents a supracondylar fracture of the humerus.

"Two important lines we evaluate are the anterior humeral line and the radiocapitellar line."

Presence of the anterior and posterior fat pad signs along the distal humerus also raise the suspicion of a fracture, but also require a true lateral view to accurately detect. An anterior fat pad can be visible on a normal exam, but becomes large and triangular in the presence of a joint effusion – this has been called the "sail sign" because it looks like the sail of a boat. A posterior fat pad should never be visible on a normal exam, and its presence is highly suggestive of a joint effusion, which raises our level of suspicion for the presence of a fracture. But even slight obliquity on a lateral view can obscure these fat pads, and it also distorts the anatomic relationships in a way that make the anterior humeral line unreliable. This may result in missing a fracture, or diagnosing a fracture that doesn't exist.

The other line shown in *Figure 2* is the radiocapitellar line. This line, drawn longitudinally down the middle of the radial shaft, also should always cross the capitellum (or capitellar ossification center). This holds true on all views, not just the lateral view, and is therefore less dependent on proper positioning. When this line does not cross the capitellum, we can suggest a radiocapitellar subluxation or dislocation, sometimes referred to as a "nursemaid's elbow." This is also a common pediatric elbow injury (my oldest son in fact had this several times as a toddler). In *Figure 4,* we can see that the radiocapitellar line doesn't cross the ossification center of the capitellum (which is just a tiny dot in this 9-month old infant, but look closely, it's there!). This represents a nursemaid's elbow.

Radiologists and radiology technologists have different skill sets that complement each other in providing high-quality care to our patients. A technologist isn't expected to know every line and angle a radiologist is evaluating on a film, or to be able to detect these subtle fractures. But with these examples my hope is that technologists will appreciate why proper positioning is so important for a high-quality examination. For some patients, this may be impossible due to pain or limitations in motion from an underlying injury. That's understandable. But we should always be striving to provide these images whenever possible. With careful attention to these details, we can optimize the care we provide our patients.

Paul Johnson, MD

AMIC Radiologist

For a more comprehensive overview of the lateral elbow, including anatomic correlations and imaging landmarks, the interested technologist can refer to the following website: http://www.wikiradiography.net/page/The+Lateral+Elbow

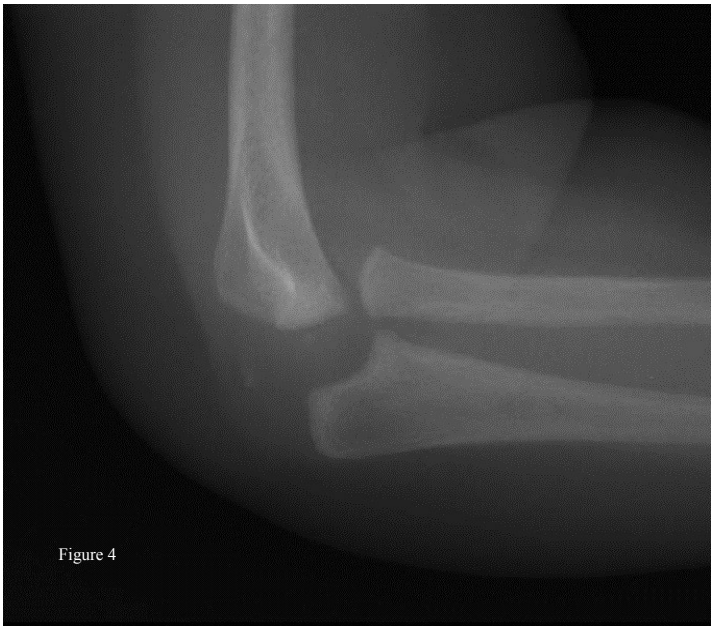


Figure 4

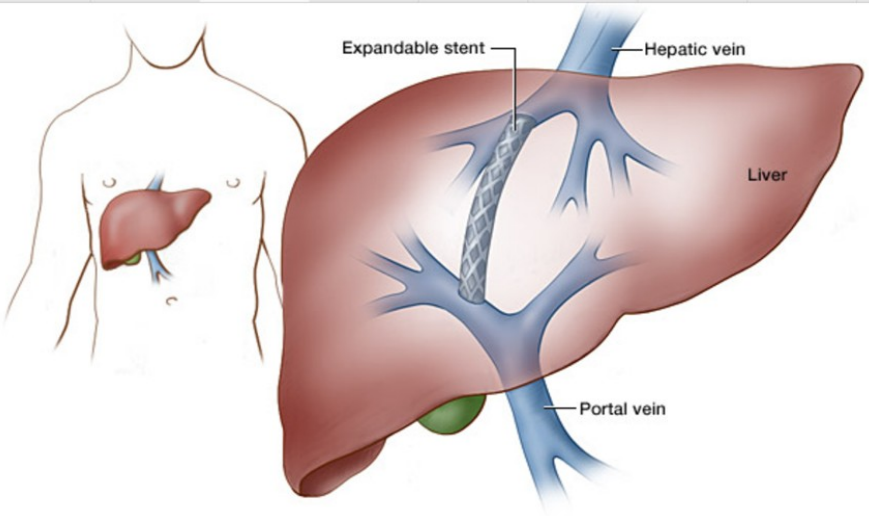
Interventional Radiology

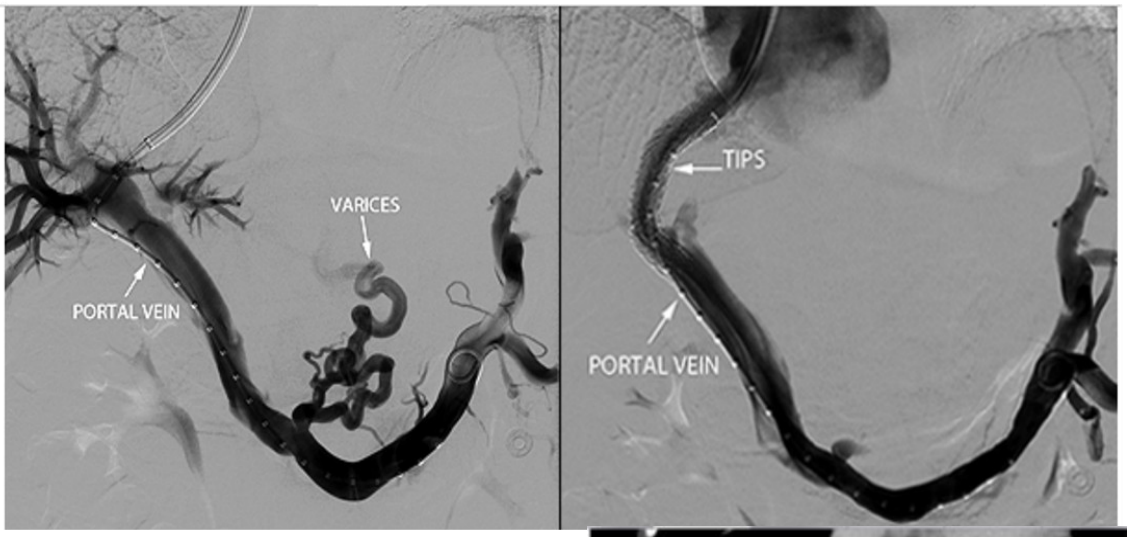
TIPS: Transjugular Intrahepatic Portosystemic Shunt

The Interventional Radiology Service has seen an increase in the number of requests to evaluate patients for TIPS procedure.

Transjugular Intrahepatic Portosystemic Shunt (TIPS) is a tract created in the liver to connect the portal vein to the hepatic vein. The tract is created using a covered stent with one end in the portal vein and the other in the hepatic vein, usually the right hepatic vein. This allows venous blood from the bowel and spleen to return to the heart without having to traverse the sinusoids of the liver. In patients with cirrhosis and portal hypertension the increased pressure in the portal system can cause bleeding varices and ascites. Patients who have recurrent bleeding from varices or refractory ascites (not adequately treated by usual therapies) may benefit from a TIPS.

The right hepatic vein is accessed from the jugular vein (usually the right). A curved needle is then advanced under fluoroscopy into the portal vein which is located anterior and inferior to the hepatic vein. Once the portal vein is accessed, a covered stent can be placed from the portal vein across the liver parenchyma to the hepatic vein.





After the TIPS creation the blood flows directly from the portal vein through the stent into the hepatic vein without passing through the portal vein branches and the liver tissue. Note that the varices no longer fill.

Amy Hayes, MD
AMIC Radiologist

CT Image of a TIPS

Establishing a Patient Safety Program in Fluoroscopy

The Society of Interventional Radiology recommends that practices which perform fluoroscopic guided interventions (FGI) should implement policies and procedures requiring adherence to a patient safety program in fluoroscopy.

There are three phases during which patient safety must be considered: pre-procedure, intra-procedure and post procedure.

"There are three phases during which patient safety must be considered—pre-procedure, intra-procedure, and post-procedure."

Pre-Procedure Phase

All personnel involved in FGI should undergo training commensurate with their involvement in the procedure. At a minimum this includes training in radiation safety for all staff, training in basic radiation physics and management for technical staff, and comprehensive training in the physics of fluoroscopy,radiation biology, radiation safety and radiation management for fluoroscopic operators. Training and competency requirements should be part of the privileging process for physicians.

Part of the informed consent process for potentially high-dose FGI should include informing the patient about the small risk of a radiation-induced skin reaction. Risk factors include obesity, prior irradiation of the same skin site and diabetes.

Intraprocedure Phase

Select the appropriate radiation dose rate for different patients and clinical tasks during FGI. This might include specific imaging protocols for pediatric patients and adult imaging protocols at low, normal, and high dose rates. The operator, physician, and staff involved in FGI should be aware at all times of the total radiation dose and current dose rate.

Reference air kerma notification levels should be established and posted in each procedure room. Policies and procedures should assign responsibility for ensuring that a clear announcement or indication is made when a notification level is reached and should include suggested actions to be taken at each notification level.

Accuracy of dose monitoring devices on fluoroscopes should be evaluated by a medical physicist as regulation requires only that the displayed reference air kerma is within +/- 35% of the true level.

Post-procedure phase

Policies and procedures should specify a substantial radiation dose level (SRDL) for FGI. The SRDL is the dose metric, that when reached, triggers the organization's patient follow-up process. The National Council on Radiation Protection and Measurements recommends 5 Gy air kerma as the SRDL. All skin reactions following FGI should be considered radiation induced until proven otherwise. Management of the patient is the responsibility of the physician performing the procedure. After extremely large doses of radiation (eg >15 Gy) interim healing may be followed by ulceration or necrosis of the affected site. Keeping the skin intact is of utmost importance and some patients may require surgical intervention.

Fluoroscopy dose metrics including fluoroscopy time, dose area product (DAP) and air kerma should be recorded for each procedure and reviewed on a regular basis.

Information necessary for estimating peak skin dose from the air kerma should be recorded for all procedures during which the SRDL is exceeded. This should include patient table height and gantry angles for the acquired images. It is important to measure table height before lowering it to hold compression or transfer the patient. It is not possible to accurately estimate PSD from fluoroscopy time alone.

(Above referenced from IR Quarterly Vol. 3 No. 3)

Amy Hayes, MD
AMIC Radiologist

Magnetic Resonance Imaging

Musculoskeletal (MSK) Imaging in MRI

"Anytime the mention of infection or mass is in the indication, IV contrast should be given if possible."

Plain radiography is very important when considering to get an MRI of a joint or even a long bone.

It is recommended to ALWAYS get a plain film first. Cortical bone fragments and complex postoperative anatomy is much better delineated on plain films and can sometimes answer clinical question without MRI

This figure illustrates the use of radiography to delineate complex foot anatomy in an elderly patient with diabetes, great toe ulceration and a past history of toe amputations.
Without foot radiographs the pertinent anatomy would not be discernible on the MRI study.
The radiographs enabled proper protocoling and tailoring of the study.

An MRI examination was ordered inappropriately for a 43-year-old diabetic woman who turned out to have a fifth metatarsal base fracture that could easily have been diagnosed with foot radiographs.
The patient presented with left foot pain and a history of soft tissue ulcers. No history of trauma was provided

Other MSK points to consider in regards to MRI:

*When an exam is ordered with IV contrast and for some reason or another you cannot give contrast, for example, IV infiltrated or severe renal failure and there is concern for NSF:

*you should revert back to a standard non-contrast protocol; DO NOT continue on with the post contrast protocol.

*a Fat saturated T1 series without contrast or without a subsequent contrasted Fat sat T1 has virtually ZERO diagnostic value which is another way of saying NON-diagnostic. Therefore please do not continue on with a contrast MRI protocol if contrast can't be given.

Andrew Mills, MD
AMIC
Radiologist

**ANYTIME the mention of infection or mass is in the indication, IV contrast should be given if possible. If the initial order does not have contrast, please try to do your best and get a contrast order in that situation.

***IF in doubt over any of these ideas, please contact 970-225-X-RAY and ask to speak with an MSK Radiologist BEFORE moving forward with an MRI scan or even a CT scan so that we may get the best exam possible for the patient.

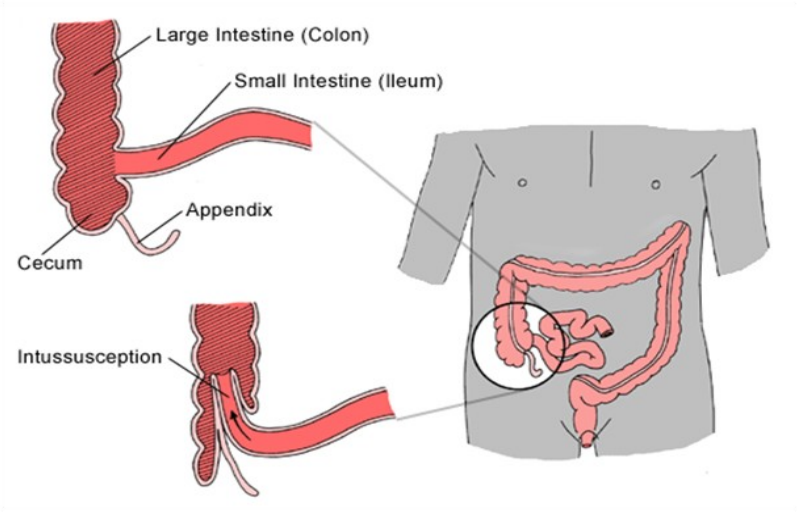
Ultrasound

Summary of Normal Fetal Landmarks Correlated with LMP and bHCG

First Trimester Normal Landmarks and Correlation with bHCG				
Weeks from LMP	4-5	5-6	6-7	7-8
Structure	Gestational Sac	Yolk Sac	Embryo with FHT	
qBHG 2nd International Standard	Approx 1000	4000	13000	

Intussusception-Diagnosis and Treatment

Intussusception is a condition in which a segment of bowel invaginates into an immediately adjacent segment, often likened to a telescope. The proximal inner (inverting) layer is called the intussusceptum and the distal outer layering segment is called the intussusipeins.



The classic clinical presentation is colicky abdominal pain, distension, and vomiting. Peak age is in the first 2 years of life with peak incidence 3-9 months of age.

Ultrasound diagnosis of intussusception is increasing utilized in the evaluation of pediatric intussusception. There are 4 types of intussusception: ileo-colic, ileo-ileo-colic, colo-colic and small bowel. Ileo-colic is the most common accounting for 80% of all intussusceptions.

Radiography is insensitive although occasionally helpful.

(Continued on page 7)

Classic signs:

Meniscus sign outlines the intussusception

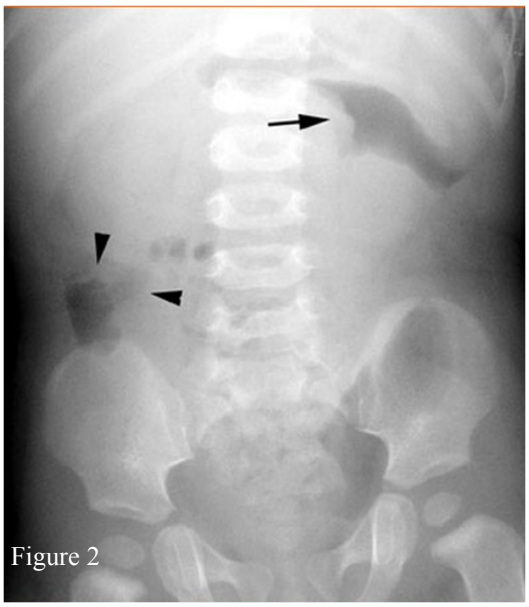


Figure 2

Absence of gas in the RUQ or RLQ

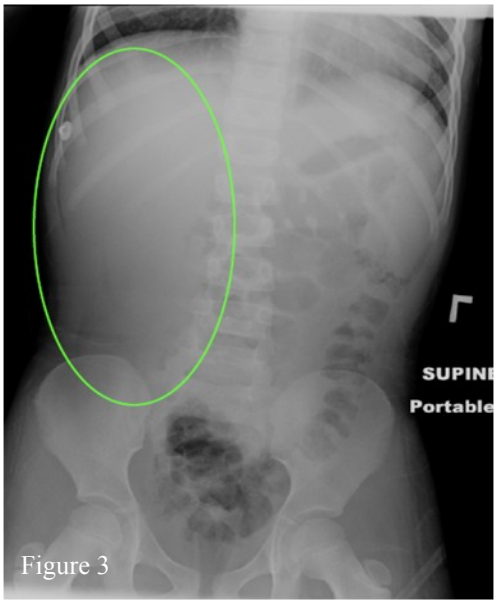


Figure 3

Sonographically intussusceptions are usually superficial masses measuring 2.5-5.0 cm found in the right abdominal quadrants.

Obstruction

Figure 4

Target sign-transverse view

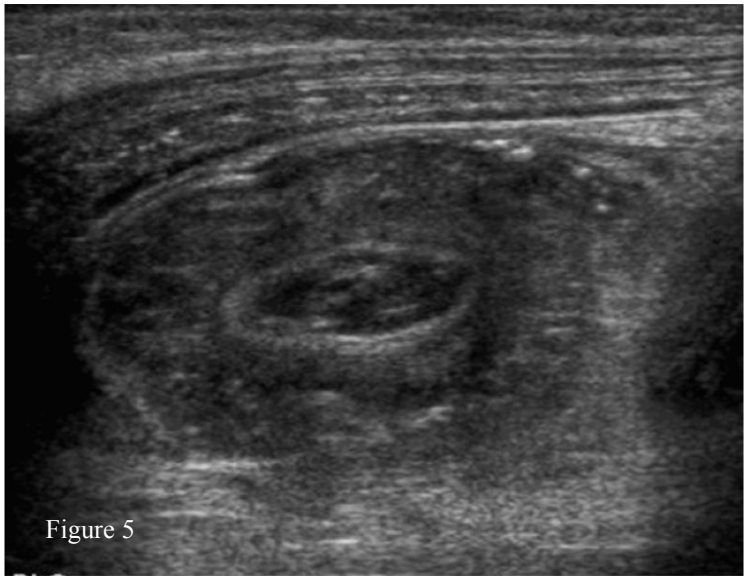


Figure 5

Sandwich sign-longitudinal view


Figure 6

Therapy-Surgical consultation is advised although radiographic reduction is often possible. Hydrostatic reduction with water soluble contrast media has traditionally been used.

AMIC radiologists are now preferentially using an air reduction technique. Air is administered with maximum pressures of 120 mm HG.
If unsuccessful after 3 attempts surgical reduction is usually necessary.

Curtis Markel, MD
AMIC Radiologist

Reference Source and Figures from ep.bmj.com January 23, 2008
Article: Imaging and Intussusception, Author: H Williams

Computed Tomography

A Refresher on IV Contrast in CT

IV contrast is used every day, all over the world in radiology departments. Because IV contrast is so safe, it is sometimes easy to forget that it is like any other pharmaceutical: safe, but not devoid of risk. In this article, I will describe the risks of contrast, treatment choices for allergic reaction and contrast extravasation, pretreatment regimens, and some common questions asked by patients about IV contrast.

A good start is to review how often a serious allergic reaction occurs when low osmolar contrast is used. The short answer is virtually never. The data shows a serious contrast reaction occurs 4 out of 10,000 injections. Minor and moderate reactions (hives, cough) occur 2 to 6 times per 1,000 injections. The mortality rate from intravascular injections is unknown. A large Japanese study found no fatal reactions after low osmolar IV contrast, despite over 170,000 injections! US FDA data demonstrated 2 fatalities per 1,000,000 studies. However, just because reactions hardly ever occur, it is important to be prepared if one does occur.

This is how I try to think about treating contrast reactions. When a tech notices a problem after an injection, he or she should contact the radiologist to come to the scanner. The tech should describe quickly what he or she sees, so the radiologist can be preparing on the way to the scanner. The radiologist evaluates the situation quickly: how is the patient breathing, are they stable, what are their vital signs. If the patient has mild hives, 25 – 50 mg of Benadryl PO or IV may be needed. If the reaction is mild or moderate, the patient should be observed in nursing for at least 30 minutes. However, if the patient is unresponsive, or clearly is in great difficulty, the code team is called and the tech should get the epinephrine medication 1:10,000 concentration. 1 mL of Epinephrine 1:10,000 concentration IV is used for the following situations: severe bronchospasm, laryngeal edema, and hypotension with tachycardia. If there is hypotension with bradycardia (<60 bpm) then the feet are raised, fluid given, and possibly atropine (vasovagal response). For pulmonary edema, furosemide is given. Lorazepam is given if there is a seizure. Usually for these three options, the code team is there to help.

For those patients who have had prior reactions, pretreatment is used. The ACR has two premedication regimens. The one I have used is: Methylprednisolone (Medrol) 32 mg PO 12 hrs and 2 hrs prior to injection. Benadryl can be added. If the study is emergent, then the ACR recommends Solumedrol 40 mg IV q 4 hrs until the study is obtained plus Benadryl 50 mg IV 1 hour prior to the study.

If there is contrast extravasation, the technologist should contact the radiologist and try to measure how much contrast extravasated. Previously, it was policy at some hospitals that if over 100 cc of contrast extravasated, then the pt would get a surgical consult. Current recommendations by the ACR do not describe a volume amount. Instead, a surgical follow up should be based on the radiologist's physical exam. Ice packs or hot compresses can both be used, as there is no consensus over which is better. I personally use ice packs for contrast extravasation.

Some providers ask patients about allergies to seafood, particularly shellfish. There is no evidence to support that shellfish allergy predispose a patient to contrast allergy, and this practice should stop. Pregnant patients also ask about breast feeding after IV contrast. The ACR recommends breast feeding should continue. Previously, the ACR recommended that mothers pump their breast milk for 24 hours after IV contrast, a practice called "pump and dump." That advice is outdated.

I hope this refresher has helped to remind you about IV contrast and how it can affect patients. Serious contrast reactions are very, very rare, but that does not mean techs and radiologists shouldn't be prepared for one. Knowing where the epinephrine 1:10,000 is located is important. Also, knowing what pretreatment options are available, how to treat contrast extravasations, and keeping updated on common questions like shellfish allergies and breast feeding/contrast concerns is always a good topic to review.

"Data shows a serious contrast reaction occurs 4 out of 10,000 injections. Minor and moderate reactions occur 2 to 6 per 1,000 injections."

Source: ACR Manual on Contrast Media, Version 10 (2015)

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