University of Iowa Hospitals and Clinics
Radiologic Contrast – Policy of Use
Revised November 2009

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Purpose: The purpose of this policy is to:
1) Ensure appropriate premedication in patients with known/suspected allergic reactions;
2) Ensure contrast administration is performed according to hospital and departmental protocols with appropriate supervision by a licensed independent practitioner (LIP).
3) Ensure appropriate actions are undertaken in case of contrast reactions and extravasation of contrast;
4) Ensure laboratory testing requirements conducted in patients in whom contrast administration is considered.

Policy Statement: The policy will be based on the Manual on Contrast Media (ACR, 2008) and other relevant literature. The policy is specifically applicable to ADULT patients, but does take into account pediatric population as appropriate.
A. Intravenous Iodinated Contrast:

All contrast utilized for CT and fluoroscopic exams at UIHC utilizes iodine. The differing contrasts will vary based on the form that the iodine is organically bound. Other variables in the type of iodinated contrast will include ionic vs. nonionic, high osmolar (HOCM) vs. low osmolar (LOCM), and iso-osmolar.

Preparation for contrast administration:

1. Pre-administration Checks (4 Hs)
   The ACR manual describes the 4 Hs
   - history
   - hydration
   - have equipment and expertise ready
   - heads up
   These checks have an effect on the need for premedication, the risk of contrast extravasation, and the need for laboratory testing.

2. Renal failure-related Issues with iodinated contrast

   Iodinated contrast has been implicated in causing significant decreased renal function in some patients following its administration, an effect called contrast media nephrotoxicity.

   Significant contrast media induced nephrotoxicity may be defined as a >25% rise in serum creatinine from baseline (if < 1.5 mg/dl) or an absolute elevation of >1.0 mg/dl from baseline (if > 1.5 mg/dl) within 72 hours following administration.

   Risk factors for contrast induced renal failure include:
   - Pre-existing renal insufficiency
   - History of “kidney disease” as an adult, including tumor and transplant
   - Diabetes mellitus
   - Dehydration
   - Cardiovascular disease and use of diuretics
   - Age > 70 years
   - Myeloma or paraproteinemia syndromes/diseases
   - Uncontrolled Hypertension
   - Hyperuricemia (gout)

   Medications which may have serious interactions with iodinated contrast induced renal insufficiency. Drugs that carry increased risk include:
   - Metformin: this drug is excreted by the kidneys, and may be accumulated resulting in severe (even fatal) lactate acidosis.
• NSAIDs including COX-2 selective agents (e.g. ibuprofen, naproxen, ketorolac, fenoprofen, indomethacin, celecoxib, valdecoxib, etc.)
• nephrotoxic antimicrobials (gentamicin, tobramycin, amikacin, amphotericin B, cidofovir).

Checking creatinine prior to iodinated contrast exam: The following patients must have a serum creatinine checked within 60 days prior to the exam:

• Aged 70 years or older.
• Diabetes treated with insulin or other prescribed medications
• Renal insufficiency or failure
• Multiple myeloma or other paraproteinemia syndromes/diseases
• History of “kidney disease” as an adult, including tumor or transplant

Measures to Prevent and/or Ameliorate Nephrotoxicity
1) Hydration if required. Normally, this can be achieved by oral administration of 1-2 liters of fluids extra in the 24 hours prior to contrast injection. In some cases, this can be achieved using 0.45% or 0.9% saline, 100ml/hr from 12 hours before until 12 hours after angiography
2) Withhold furosemide until 12-24 hours after contrast administration (depending on clinical need of the patient)
3) Withhold metformin for 48 hours after the procedure and should be reinstituted only after renal function had been redrawn and determined to be normal.
4) In patients with risk factors for contrast-induced renal failure administer acetylcysteine, 600 mg by mouth twice daily on the day before and on the day of contrast administration (4 total doses).
5) In patients who present acutely and who have an indication for acetylcysteine, patients with an ileus or non-intact GI tract, or patients who are unable to swallow and have no NG tube, two options are allowed:
   a. No contrast is administered; this is the preferred option for patients who present acutely
   b. In life-threatening situations where a contrast-enhanced CT is required immediately (e.g., suspected pulmonary embolism, suspected aortic dissection, suspected aortic rupture, immediate requirement for vascular intervention), and where a 24-hour delay is unacceptable based on clinical grounds, one may consider administration of IV acetylcysteine (Acetadote® 150 mg/kg over 30 minutes immediately prior contrast administration, following by 50 mg/kg over 4 hours after).
      i. If IV acetylcysteine is administered (> $100/vial), one has to be prepared for anaphylactic reactions and the epinephrine should be readily available for injection:
3. Protocol for iodinated IV contrast administration:
   1. A radiologic technologist or nurse may administer intravenous contrast under the supervision of a licensed independent practitioner (LIP) and in accordance with procedure defined in this policy and following protocols that are based upon the type of examination order and define the type, dose and route of contrast.
   2. The supervising LIP or his/her physician designee must be available to respond promptly to an adverse event related to contrast administration.
   3. Protocols for administration of intravenous contrast must be reviewed by the Drug Information Center and approved by the P&T Subcommittee and by the appropriate radiologist or radiologists when the standards of care and application change or when the characteristics of the intravenous contrast change.
   4. An LIP reviews all requests for radiology procedures with intravenous contrast to determine the appropriate protocol based on the clinical indications for the examination. Assigned protocol is indicated on the modality protocol sheet or the radiology requisition.
   5. A radiologic technologist or radiology nurse will review patient’s current medications and clinical conditions for contraindications related to intravenous contrast administration. These include allergy to contrast, use of particular medications (e.g. metformin – see below), and general physical condition which may impact risks for patient, such as heart failure and asthma.
   6. If contraindications are identified, the supervising LIP will be contacted to determine appropriate IV contrast use.
   7. Type of contrast and dose information is recorded in EPIC/MAR on the Contrast Administration form by the nurse or technologist.
   8. Contrast doses that are prepared and NOT immediately administered to patient must be labeled with:
      a. Drug name, strength and amount (if not apparent from container)
      b. Expiration date when not used within 24 hours

4. Contrast reactions to iodinated IV contrast:

Reactions to iodinated IV contrast occur in 1-3% of nonionic low-osmolar contrast injections. These range from mild urticaria (hives) to severe and life-threatening. The severe life-threatening reactions are relatively rare. Although overall adverse reactions are decreased following steroid premedication, the incidence of severe life-threatening adverse events has not been affected.

It should be noted that premedication is NOT needed for patients undergoing nephrostomy check or biliary tube change, as these are not i.v. administration.

Premedication

The following regimes are suggested:
a. **Planned** contrast administration in patients with previous documented/suspected reaction:
Prednisone 40 mg by mouth at 12 hours and 2 hours prior to contrast injection

b. **(Semi-) acute** investigations in patients with previous documented/suspected reaction:
Hydrocortisone 200 mg IV at least 4 hours prior and 3 hours post contrast injection AND
Diphenhydramine (Benadryl) 50 mg IV 1 hour prior to contrast administration

**IN THESE CIRCUMSTANCES PATIENTS ARE ADVISED NOT TO DRIVE.**

**Treatment of Iodinated contrast reaction:**

Treatment for contrast reactions is outlined in section G. In all cases, the treatment should begin with:
- IV access
- Maintain the ABCs – airway, breathing, circulation
- Notify the radiologist
- Consider calling code in severe reactions
B. Intravenous Gadolinium-based Contrast

There are possible serious side effects for patients receiving gadolinium-based contrasts who have impaired renal function. This population of patients is at risk for developing nephrogenic fibrosing dermopathy/nephrogenic systemic fibrosis (NFD/NFS).

Screening for impaired renal function
1. The following patients must have a serum creatinine with estimated GFR (eGFR) checked within 60 days of the MR exam (or within 30 days if the most recent eGFR is <40 mL/min/1.73m^2):
   - Aged 70 years or older
   - Diabetes
   - Renal insufficiency or failure
   - Multiple Myeloma

2. Patients with impaired renal function due to Hepato-Renal syndrome must have a serum creatinine with eGFR checked within 2 weeks of the MR exam. Such patients include the following:
   - Waiting or being evaluated for liver transplantation
   - Perioperative period post-liver transplantation
   - Ascites

3. Patients currently on dialysis do not need to have a creatinine with eGFR checked.

Administration of Gadolinium contrast agents for various MR exams
1. Contrast-enhanced MRI exams will be performed with single dose IV MultiHance (0.1 mmol/kg body weight) in all patients.

2. Contrast-enhanced MRA exams will be performed with IV MultiHance as follows:
   - Single station MRA – the lesser of 20cc or double dose (0.2 mmol/kg)
   - Two or three station MRA – 30cc MultiHance diluted to 40cc with saline

3. Contrast-enhanced cardiac MRI exams for viability will be performed with IV gadolinium as follows:
   - GFR >30 mL/min/1.73m^2: 30cc Magnevist
   - GFR <30 mL/min/1.73m^2 or on dialysis: 30cc ProHance

4. Pediatric patients:
   - Contrast-enhanced MRI exams will be performed with single dose IV MultiHance (0.1 mmol/kg body weight) in all patients.
MRA Neck, Brian, and MRV Brain will be performed with single dose IV MultiHance (0.1 mmol/kg body weight) in all patients.
- All other MRA’s below neck will be performed with double dose IV MultiHance (0.2 mmol/kg body weight) in all patients.

Policy on MR exams in patients with impaired renal function or on dialysis
1. Patients with eGFR <30 mL/min/1.73m² or on dialysis may undergo IV contrast-enhanced MRI or MRA only after the following:
   - The ordering physician has discussed the MR exam with the radiologist
   - The patient has read the “Contrast-Enhanced MR Information Form” and has had an opportunity to discuss any concerns with a radiologist.

2. For current dialysis patients, dialysis should be performed on the same day as soon as possible after a contrast-enhanced MRI or MRA exam.

3. Only patients on hemodialysis need to have dialysis after a contrast-enhanced MRI or MRA exam. If they are on peritoneal dialysis they do not need to have dialysis after a contrast-enhanced MRI or MRA exam

Prevention of contrast reactions

Allergic-type reactions to gadolinium-based contrast are rare, and severe or anaphylactoid reactions are extremely rare. In patients who have previously reacted to a gadolinium agent, there are no definitive studies to support the efficacy of premedication in reducing the incidence of subsequent reactions. Nonetheless, in the absence of such data, it is reasonable to follow a common sense approach.

1) Use a different gadolinium-based agent.

2) Premedicate the patient with steroids and antihistamine in accordance with the policy for iodinated contrast.
C. Intra-arterial Iodinated Contrast

Dr Sun/Laroia please check that you agree with this statement !!!

For intra-arterial iodinated contrast injections, the same general rules apply as for intra-venous iodinated contrast injections. The only difference is that for run-off of peripheral vascular disease, Visipaque may be preferred by some (compared to Isovue) as it appears to have decreased heat and pain sensation in patients.
D. Oral Contrast

Procedure:

1. Oral contrast such as barium and gastrografin are medications and preparation and administration must be under the supervision of a licensed independent practitioner.

2. All procedures requiring the administration of oral contrast should have a written Radiology procedure protocol that is developed by a radiologist.

3. For swallow studies, where there is an inherent risk for aspiration, non-ionic iso-osmolar contrast (Visipaque) may be preferred.

4. Protocols for administration and preparation of oral contrast should be reviewed by the Drug Information and Medication Use Evaluation Service and by the appropriate radiologist or radiologists when the standards of care and application change or when the characteristics of the oral contrast change.

5. Orders for contrast administration are reviewed by a radiologist or licensed independent practitioner to determine appropriateness. The current used oral contrast preparation for C.T. procedures has no reported adverse effect.

6. Oral contrast that is sent to in-patient floor includes to following information:
   a. Time and date the contrast was prepared, expiration date
   b. Name, medical record number, date of birth and location of the patient
   c. Instructions on administration times in relation to Radiology procedure

Note: When barium contrast is administered, please be aware that this could impede subsequent imaging studies as barium takes time to clear the GI tract.
E. Ultrasound Contrast

Dr Abu-Yussef please check this statement!!

Currently, there is no FDA approved ultrasound contrast agent. However, at UIHC, clinical studies are performed under IRB and FDA guidance, for which patients will receive separate informed consent and detailed information. Should a clinician wish to discuss such studies, he should be directed to the body imaging staff in Ultrasound.
F. Pediatric Notes

For Iodinated contrast agents, the same principles apply in adults as in children. The dose of contrast is delivered based on weight of the patient. For Gadolinium agents, a dose is similarly prescribed based on body weight (see point 4 in Gadolinium administration paragraph)

Some useful references for use of contrast agents in the pediatric population:

2. bjr.birjournals.org/cgi/reprint/70/839/1104.pdf
3. Contrast media toxicity in children. Pediatric Radiology 38, supplement 2, pp 281-284
5. radiology.rsnaajnls.org/cgi/content/full/250/3/674
G. Treatment of Contrast Reactions

Treatment is dependent on the extent and type of reaction (See Table 1). ALL reactions should be reported through standard reporting procedures. General treatment measures include:

- maintain i.v. access
- observe vital functions (ABC)
- alert radiologist

Table 1

Suggested Treatments for Adult Patients for Adverse Effects to Contrast Agents

<table>
<thead>
<tr>
<th>Situation</th>
<th>Medication</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- no symptoms</td>
<td>none</td>
<td>observe until resolving</td>
</tr>
<tr>
<td>- symptoms</td>
<td>diphenhydramine (Benadryl)</td>
<td>50 mg oral or IV</td>
</tr>
<tr>
<td>Diffuse erythema</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- mild</td>
<td>secure IV access, IV fluids</td>
<td>0.9% NaCl or Lactated Ringer’s 1-2 liters IV</td>
</tr>
<tr>
<td></td>
<td>Consider: diphenhydramine</td>
<td>50 mg oral or IV</td>
</tr>
<tr>
<td></td>
<td>Consider hydrocortisone</td>
<td>200 mg IV</td>
</tr>
<tr>
<td>- severe</td>
<td>epinephrine</td>
<td>0.3 mg IM (1:1,000), if inadequate response, 0.1 mg (1:10,000) slow IV; up to 1 mg</td>
</tr>
<tr>
<td></td>
<td>CALL CODE</td>
<td></td>
</tr>
<tr>
<td>Laryngeal edema</td>
<td>secure IV access, O₂ by mask</td>
<td>10 l/min O₂</td>
</tr>
<tr>
<td></td>
<td>Epinephrine</td>
<td>0.1 mg/ml (1:10,000) slow IV; up to 1 mg</td>
</tr>
<tr>
<td></td>
<td>CALL CODE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hydrocortisone</td>
<td>200 mg IV, repeat if necessary</td>
</tr>
</tbody>
</table>
### Bronchospasm

<table>
<thead>
<tr>
<th>Severity</th>
<th>Treatment</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>- mild</td>
<td>albuterol inhaler</td>
<td>2 puffs</td>
</tr>
<tr>
<td></td>
<td>Secure IV access; O₂ by mask</td>
<td>10 l/min O₂</td>
</tr>
<tr>
<td>- moderate</td>
<td>epinephrine</td>
<td>0.3 mg (1:1,000) IM; may repeat once</td>
</tr>
<tr>
<td>- severe</td>
<td>epinephrine</td>
<td>0.1 mg/ml (1:10,000) slow IV, up to 1 mg</td>
</tr>
</tbody>
</table>

**CALL CODE**

### Pulmonary Edema

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>secure IV access; O₂ by mask</td>
<td>10 l/min O₂</td>
</tr>
<tr>
<td>Elevate head of bed</td>
<td></td>
</tr>
<tr>
<td>Furosemide</td>
<td>10-40 mg IV, slowly</td>
</tr>
<tr>
<td>Morphine</td>
<td>1-3 mg IV, repeat every 5-10 min as needed</td>
</tr>
<tr>
<td>Hydrocortisone</td>
<td>200 mg IV</td>
</tr>
</tbody>
</table>

**CALL CODE**

### Hypotension with Bradycardia

<table>
<thead>
<tr>
<th>Severity</th>
<th>Treatment</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>- mild</td>
<td>elevate legs, secure IV access</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IV fluids</td>
<td>0.9% NaCl or Lactated Ringer’s 1-2 liters</td>
</tr>
<tr>
<td></td>
<td>O₂ by mask</td>
<td>10 l/min O₂</td>
</tr>
<tr>
<td>- severe</td>
<td>atropine</td>
<td>0.6 mg – 1 mg IV, slow; up to 3 mg</td>
</tr>
</tbody>
</table>

### Hypotension with Tachycardia

<table>
<thead>
<tr>
<th>Severity</th>
<th>Treatment</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>- mild</td>
<td>elevate legs, secure IV access</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IV fluids</td>
<td>0.9% NaCl or Lactated Ringer’s 1-2 liters</td>
</tr>
<tr>
<td></td>
<td>O₂ by mask</td>
<td>10 l/min O₂</td>
</tr>
<tr>
<td>- severe</td>
<td>Epinephrine</td>
<td>0.1 mg/ml (1:10,000) slow IV; up to 1 mg</td>
</tr>
</tbody>
</table>

**CALL CODE**
Hypertension Crisis (diastolic BP > 120 mmHg)

Secure IV. access

O₂ by mask  10 l/min O₂
Furosemide  40 mg IV slowly
Nitroglycerin  0.4 mg sublingual; repeat after 5-10 min.

Suspected Pheochromocytoma

Phentolamine  5 mg/50 ml IV push  NEEDS TO BE CHECKED
H. Extravasation of Contrast – Prevention and Treatment

1. Methods to Decrease the Risk of Extravasation during Injection of Contrast Media

Most CT and MRI protocols use power injectors. In angiography/intervention there is a mix of power and hand injections. There is preference for 20-G or larger catheters/cannulas with flow rates of 3 ml/second or higher. Patients should be instructed about potential extravasation and how to alert the technician. All injections should be monitored during the first 10-15 seconds of injection to ensure no extravasation occurs early. Communication with the patient should continue via intercom during injection. Use of standard central venous catheters should be discouraged, but Power PICC lines (purple) and Power Ports may be used for contrast injection should the situation demand it.

Extravasation of MRI contrast media is rare and generally constitutes relatively small quantities, thus limiting the risk for compartment syndrome. Non-ionic contrast media (e.g. ProHance) are less likely to cause symptomatic extravasation than hypertonic agents (e.g. Magnevist or MultiHance). Extravasation of any contrast volume should be treated in accordance with the following paragraphs.

Several risk factors that have been identified for contrast extravasation include:
- Inadequate communication (elderly, altered consciousness)
- Severely ill/debilitated patients
- Patients with abnormal circulation to limb to be injected (atherosclerosis, Raynaud’s disease, venous thrombosis/insufficiency, prior radiation therapy, previous [axillary] surgery)
- More peripheral injection sites (hand, wrist, foot, ankle)
- Injection through line that has been present >24 hrs

2. Treatment of Contrast Extravasation

Extravasations have incidence of 1/1000 to 1/106 patients when a power injector is used.

Observation is required if extravasation <50 ml high osmolar or <100 low osmolar contrast media:
- notify radiologist
- elevate affected limb
- apply ice packs intermittently
- if > 5 ml extravasated: observation for 2-4 hours

Surgical (plastic surgery) consultation is required in the following situations:
- extravasation >50 ml high osmolar or >100 low osmolar contrast media
- increased swelling or pain after 2-4 hours
- altered tissue perfusion
- change in sensation or temperature
- development of skin ulceration or blistering
I. Pregnancy and Breast Feeding

1. Pregnancy

During pregnancy, it is safe practice to limit ionizing radiation as well as MRI investigations as much as possible. Nevertheless, the risk of missing a diagnosis or mismanagement in the absence of a significant diagnosis will take precedent over any risks to the mother and fetus.

The administration of iodinated contrast and oral contrast agents are safe during any trimester.

For Gadolinium-based contrast agents there is insufficient data at present, and therefore these agents should NOT be routinely administered during pregnancy.

- The decision to use intravenous contrast must be made on a case-by-case basis by the attending radiologist, who will confer with the referring physician to assess the risk–benefit tradeoffs for that patient. The medical necessity to use contrast during pregnancy must be documented in the patient’s medical record by the attending physician who requested the study must be in the patient’s medical record before procedure can be performed.
- If it is determined that contrast is needed, the patient or legal guardian must sign a procedural consent form (G-2d2) after they are made aware of the potential risks and benefits of the proposed MR procedure and the availability of alternative diagnostic tests (if any).

2. Breast feeding

The literature on the excretion into breast milk of iodinated and gadolinium-based contrast media and the gastrointestinal absorption of these agents from breast milk is very limited however, several studies have shown that 1) less than 1% of the administered maternal dose of contrast medium is excreted into breast milk; and 2) less than 1% of the contrast medium in breast milk ingested by an infant is absorbed from the gastrointestinal tract. Therefore, the expected dose of contrast medium absorbed by an infant from ingested breast milk is extremely low.
Iodinated contrast agents are excreted rapidly through the kidneys, and less than 1% is excreted into breast milk during the first 24 hours. Therefore, it is considered safe for the mother to continue breast feeding after receiving iodinated contrast.

Gadolinium contrast is excreted rapidly through the kidneys, and less than 0.04% is excreted into breast milk during the first 24 hours. Therefore, it is considered safe to continue breast feeding after receiving Gadolinium contrast.

Patients will be given the “Breast Feeding Information Form” prior to their CT or MRI procedure. If the patient has any question or concerns they can speak to a radiologist.

If the patient still has concerns they can pump and throw their milk away for the next 24 hours after their injection of gadolinium.
References (this is merely a sample!)

Approved:

__________________________________   _______________________
Laurie Fajardo, MD      Date
Chair
Department of Radiology

__________________________________   _______________________
Janet Roe       Date

Reviewed by Department of Pharmaceutical Care (....)
Reviewed by Department of Anesthesiology (.....)
Approved by the Pharmacy and Therapeutics Subcommittee (.......)
Approved by Radiology Quality Assurance Committee (.....)