I. Description
The following policy will provide guidelines for the administration of intravascular contrast for both CT and MR examinations. All CT and MR examinations are to be individually protocoled by a radiologist with specific oral and intravenous contrast doses.

Table of Contents
I. Description ........................................................................................................................................ 1
II. Rationale ........................................................................................................................................ 1
III. Policy/Procedure ......................................................................................................................... 1
   A. Computed Tomography (CT) Examinations .............................................................................. 1-3
   B. Magnetic Resonance Imaging (MRI) Examinations ............................................................... 3-5
   C. Contrast Extravasation Guidelines [Iodine and Gadolinium] .................................................. 5-6
   D. Contrast Reaction Guidelines [Iodine and Gadolinium] ........................................................... 6-7
VI. Reviewed/Approved by .............................................................................................................. 7
VII. Original Policy Date and Revisions ............................................................................................ 7
    Appendix 1: CT Contrast Flow Chart ............................................................................................ 8
    Appendix 2: MRI Contrast Flow Chart ............................................................................................ 9

II. Rationale

III. Policy/Procedure
   A. COMPUTED TOMOGRAPHY (CT) EXAMINATIONS:
      1. Intravenous Contrast Agents: (Please see CT contrast flow chart - Appendix A)
         a. Routine studies
            i. Adults: 75 or 100 mL of Omnipaque 350
            ii. Children (18 years of age or under): 2 mL/kg Omnipaque 300; Maximum 100 mL
         b. Angiographic studies
            i. Adults: 75 mL, 100mL or 150mL of Omnipaque 350 followed by 50 mL saline flush
      2. Renal Function
         a. GFR rates must be ≥ 30 for a patient to receive CT contrast.
            i. GFR ≥ 30 → Omnipaque 350 (Adults)/Omnipaque 300 (Peds)
            ii. GFR < 30 → Consult with a radiologist
         b. Creatinine/GFR should be obtained in the following patient populations within 30
days of the exam:
            i. Diabetics
            ii. History of renal disease, including:
• Kidney transplant
• Single kidney
• Renal cancer
• Renal Surgery

iii. Ongoing chemotherapy
iv. History of Hypertension requiring medical therapy
v. Patients that are on Metformin
vi. Patients 60 years of age and older

3. Other considerations:
   a. For patients with thyroid cancer who are planning on undergoing radioactive iodine therapy, pretherapy iodinated contrast administration may be contraindicated.
   b. For hyperthyroid patients, administration of intravascular contrast agents may cause a self-limited delayed hyperthyroidism 4-6 weeks following contrast administration.
   c. All female patients of child-bearing age will be asked if they could be pregnant. If a patient is unsure, the ordering physician/Radiologist will be required to obtain a pregnancy test prior to CT examination.
   d. The ACR indicates that it is safe for mothers to continue to breast feed following iodinated contrast administration.
   e. For patients taking Metformin:
      i. Category 1 – In patients with no evidence of Acute Kidney Injury (AKI) and with eGFR≥30 mL/ min/1.73m², there is no need to discontinue metformin either prior or following the intravenous administration of iodinated contrast media, nor is there an obligatory need to reassess the patient renal function post the test or procedure.
      ii. Category 2 – In patients taking metformin who are known to have AKI or severe chronic kidney disease (stage IV or stage V; i.e., eGFR < 30, or are undergoing arterial catheter studies that might result in emboli (atheromatous or other) to the renal arteries, metformin should be temporarily discontinued at the time or prior to
the procedure, and withheld for 48 hours subsequent to the procedure and re-instituted only after renal function has been re-evaluated and found to be normal.

4. Administering iodinated IV contrast to patients in sickle cell crisis or myasthenia gravis crisis may cause acute worsening of symptoms. Therefore, contrast should only be given for extenuating circumstances after the discussion with the Radiologist.

5. Contrast administration will be overseen by a CT technologist. The preferred site of venous access is an antecubital vein or large forearm vein.

6. Air embolism is rare, but may result in air hunger, dyspnea, cough, chest pain, pulmonary edema, tachycardia, hypotension, or expiratory wheezing. The radiologist should be consulted immediately. Treatment includes administration of 100% oxygen and placing the patient in a left lateral decubitus position.

B. MAGNETIC RESONANCE IMAGING (MRI) EXAMINATIONS:

1. Background:
   A separate policy on gadolinium administration is necessary because of the uniquely different associations of iodine and gadolinium contrast agents. The condition nephrogenic systemic fibrosis (NSF) has been associated with prior administration of gadolinium chelate contrast administration, the standard contrast agent used in MRI.
   
   It appears that NSF arises from deposition of free gadolinium into skin connective tissue and connective tissues of other organs, and that gadolinium stimulates the activity of circulating fibrocytes to deposit collagen into these various tissues. The circumstances that result in NSF appear to be the combination of (1) less stable gadolinium chelates use and (2) patients who cannot readily eliminate the agents through glomerular filtration due to compromised renal function. Anyone with substantially diminished renal function may develop the condition. The agents currently in use at UNC are Multihance, Gadavist, Dotarem and Eovist, all of which have no or a very low association with NSF.

2. Evaluation Prior to Contrast Administration:

   **Patient Questionnaire for Gadolinium Use**

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you currently have kidney disease?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have a history of kidney disease?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you on dialysis (hemodialysis or peritoneal dialysis), or have you</td>
<td></td>
<td></td>
</tr>
<tr>
<td>received a kidney transplant?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have severe high blood pressure for &gt; 10 yrs?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have insulin dependent diabetes for &gt; 10 yrs?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you, or could you be, pregnant?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   **Laboratory Values**
3. Intravenous Contrast Agents: (Please see MR contrast flow chart – Appendix B)
   a. Pediatrics:
      i. Abdominal & MSK:
         1. Children with GFR > 30 mL/min/1.73 m²: Full dose (0.1 mmol/kg) Dotarem, Eovist or other approved agent.
         2. Children with GFR < 30 mL/min/1.73 m²: Need attending MD approval for administration of contrast.
      ii. Neuroradiology:
         1. Children with normal renal function: Full dose (0.1 mmol/kg) Dotarem.
         2. Children with renal impairment or failure: Non contrast exam OR full dose (0.1 mmol/kg) Dotarem for cases where contrast is deemed essential (use reading room check for urgent cases).
   b. Adults:
      i. Neuroradiology:
         1. Adults with normal renal function (GFR>60): full dose (0.1 mmol/kg) Multihance.
         2. Adults with renal impairment (60> GFR >30): full dose (0.1 mmol/kg) Dotarem.
         3. Adults with renal failure (GFR<30): non contrast exam OR full dose (0.1 mmol/kg) Dotarem for cases where contrast is deemed essential (use reading room check for urgent cases).
         4. Adults who may receive repeated yearly exams for 5 or more years and have normal life expectancy in particular pituitary tumors: full dose (0.1 mmol/kg) Dotarem.
         5. All MS patients: full dose (0.1 mmol/kg) Dotarem.
      ii. Abdominal and MSK:
         1. GFR >30 mL/min/1.73 m²: ½ dose (0.05 mmol/kg) Multihance
         2. GFR 15-30 mL/min/1.73 m²: full dose (0.1 mmol/kg) Dotarem if deemed medically necessary
         3. GFR < 15 mL/min/1.73 m²: non-contrast examination.
         4. Select liver studies with GFR over 30 mL/min/1.73 m²: 0.025 mmol/kg Eovist
   c. Prior acute adverse reaction or second line in pediatric studies:
      i. Full dose Gadavist (0.01 mmol/kg)
   4. MR technologists have been informed to evaluate patient history on EPIC for evidence of renal compromise, include sCr, eGFR, and other measures.
   5. No linear nonionic agent is administered to any patient.
   6. Third trimester pregnant patients in whom gadolinium is deemed necessary will undergo half dose (0.05mmol/kg) or full dose (1.0mmol/kg) Dotarem, at the discretion of the supervising radiologist.
   7. Gadolinium will generally be avoided in 1st and 2nd trimester pregnancies.
   8. No double dose gadolinium studies will be performed – except with attending approval.
   9. No gadolinium will be used as a substitute for iodine contrast in CT, on angiography, or other x-ray procedures.
   10. Repeat gadolinium-enhanced MR studies in less than 24 hours will be performed only in emergency situations and after consultation between the patient’s physician and the supervising Radiologist(s).
11. Patients with greater than 10-year history of poorly controlled hypertension, greater than 10-year history of insulin-dependent diabetes, and patients older than 70 years of age who are treated for hypertension or diabetes will undergo full dose Dotarem (0.1 mmol/kg).

12. Patients who have experienced a moderate to severe reaction with a specific agent (e.g.: Multihance) will receive another formulary gadolinium agent on follow-up study (e.g.: Dotarem, Gadavist).

13. Renal Function:
   a. Outpatients: Creatinine/GFR should be obtained in the following patient populations within 30 days of the exam:
      i. Diabetics
      ii. History of renal disease, including:
         - Kidney transplant
         - Single kidney
         - Renal cancer
         - Renal Surgery
      iii. Ongoing chemotherapy
      iv. History of Hypertension requiring medical therapy
      v. Patients that are on Metformin
      vi. Patients 60 years of age and older
   b. Inpatients and ER patients: ALL REQUIRE A Cr LEVEL/GFR RATE PRIOR TO CONTRAST INJECTION.
      i. ER: Same day
      ii. Inpatients: Within 3 day
      iii. Exceptions: Trauma and Acute Stroke

C. CONTRAST EXTRAVASATION GUIDELINES: [Iodine and Gadolinium]

Extravasation of contrast medium is toxic to the surrounding tissue, particularly the skin, and can produce an acute inflammatory response. Ulceration and necrosis may result and can be identified as early as 6 hours after the injury.

1. All patients with IV contrast extravasation are to be examined by a radiologist (examination should include a physical examination with evaluation of the extremity, presence of distal pulses, capillary refill, sensation, and motor skills.

2. Treatment protocol:
   a. Elevate arm.
   b. Place hospital cold pack (or ice) adjacent to the region of extravasation. Note - ice to be wrapped in a sheet or towel to reduce the risk of frost bite.
   c. Loosely wrap the affected extremity with ace bandage to hold cold pack or ice in place.
   d. Plastics should be consulted immediately for elderly, children and patients that are unable to communicate/respond.
   e. If either at the time of extravasation or at check at 30 minutes intervals (up to 2 hours), there is a concern of intense pain and decreased sensation, call plastic surgery for an emergent consult.
The 2018 ACR Manual of Contrast Media recommends an immediate surgical consult for the following: progressive swelling or pain, altered tissue perfusion as evident by decreased capillary refill at any time after the extravasation has occurred, and change in sensation in the affected limb. It is important to note that initial symptoms of a compartment syndrome may be relatively mild (such as limited to the development of distal paresthesia).

f. If the injury does not seem severe, continue with steps (a – c) above.
   • If there is any skin ulceration or blistering, apply:
     • Xeroform, Bacitracin, or Vaseline Gauze.

g. If no appreciable injury, damage or abnormal patient sensation, then the patient can be discharged, at one hour at the earliest. If there is any uncertainty, then patient should be kept and monitored for 2 hours.

h. When discharging, patient instructions must include returning to the emergency department if arm pain or significant abnormal sensation occurs in the injection site and areas distal to it.
   • For outpatients, the radiology nurse follows up with the outpatient via a phone call the next day and subsequent days if needed based upon the patient assessment and physician orders.
   • For inpatients and ER patients, the clinical team will resume care of the patient.

i. Steps (a – c) above are standing orders for Imaging nursing/Imaging Technologists. Steps (d – f) are to be initiated by a physician or physician assistant in Radiology.

Note: Document the contrast agent, volume of contrast extravasated and location of extravasation in the Electronic Medical Record (EMR).

D. CONTRAST REACTION GUIDELINES: [Iodine and Gadolinium]

1. Mild – Nausea and vomiting, urticarial, erythema, and transient hypotension. Mild reactions do not require treatment according to ACR, 2018, but the patient should be monitored for 20-30 minutes to ensure that the symptoms do not worsen.

2. Moderate – Symptomatic urticarial, vasovagal reactions, bronchospasm, tachycardia and mild laryngeal edema. Moderate reactions require close monitoring (vital signs every 5 minutes, pulse oximeter in place and continuous observation by staff). Treatment may include diphenhydramine for symptomatic hives, leg elevation for hypotension, use of a beta-agonist inhaler for bronchospasm, or epinephrine for mild laryngeal edema.


Note: All contrast reactions and treatments protocols are to be documented in the EMR. The patient is to be educated prior to discharge.

Patients with a prior history of a severe contrast allergy such as anaphylaxis, cardiac or respiratory arrest should not routinely receive IV contrast and alternative imaging studies should be discussed with the ordering physician. Deviation from this protocol will require:

• Radiology attending approval is preferred, but resident approval is acceptable in an
urgent/emergent situations.
- Premedication orders to be placed in EPIC.
- EPIC note or statement in the Radiology report documenting:
  - Consultation between Radiologist and the ordering physician stating the reason(s) behind the approval decision
  - Risk and benefits discussion with the patient
- A Radiology resident, fellow or an attending physician needs to be immediately available
- A Radiology RN must be present for the procedure

All patients with PRIOR moderate contrast allergies should be premedicated prior to the study.

- 13 hour prep (PREFERRED)
  - Prednisone 50 mg PO 13 hr, 7 hr, and 1 hr prior to contrast
  - Benadryl 50 mg PO/IV 1 hr prior to contrast
  - MUST have a driver if Benadryl administered by Imaging Nursing
- 4 hour prep (EMERGENCY PREP ONLY)
  - Solumedrol 40 mg IV 4 hours prior to contrast
  - Benadryl 50 mg PO/IV 1 hour prior to contrast
- For a mild reaction/prior reaction of hives, no pretreatment is required.

If the patient has a break-through reaction to iodinated contrast, future contrast-enhanced imaging should be discussed with the referring physician.

**Note:** Modifications of this policy may be implemented on a case by case basis when a risk-benefit analysis has been made and the administration of contrast is deemed medically necessary by the attending radiologist. Such determination will be noted in the patient’s record.

---

**IV. Reviewed/Approved by**

Quality and Safety Committee

**V. Original Policy Date and Revisions**

Feb 2007, May 2017, April 2018, August 2018
Appendix A: CT Contrast Flow Chart

Appendix A:

Order for CT Contrast Received

Check Allergy History

Yes

Radiologists Consult

No Contrast

Reschedule Exam

Premed, per Dept ACR protocol

Patient’s Age

<18

GFR<30

Omni 300

>18

GFR>30

Omni 350

Radiologists Consult

No Contrast

Complete the Exam
Appendix B: MRI Contrast Flow Chart

Appendix B:

Order for MRI Contrast Received

Patient’s Age

< 18

> 18

Body and MSK

Neuro

Body and MSK

Neuro

GFR < 30

GFR > 30

GFR < 30

GFR > 60

60 > GFR > 30

GFR < 30

GFR > 30

30 > GFR > 15

GFR < 15

No Contrast

Full Dose

Dotarem 0.1 mmol/kg

RR

Full Dose Multihance 0.1 mmol/kg

Consult attending MD

No Contrast

Full Dose Dotarem 0.1 mmol/kg or Eovist 0.025 mmol/kg

No Contrast

Full Dose Dotarem 0.1 mmol/kg

No Contrast

No Contrast

No Contrast

½ dose

Multihance 0.05 mmol/kg

Full Dose Eovist 0.025 mmol/kg

Full Dose Dotarem 0.1 mmol/kg

No Contrast

If contrast deemed necessary

Complete the Exam

If contrast deemed necessary

If contrast deemed necessary

If contrast deemed necessary

If contrast deemed necessary

Consult attending MD

Full Dose Dotarem 0.1 mmol/kg or Eovist 0.025 mmol/kg

Full Dose Dotarem 0.1 mmol/kg

Full Dose Dotarem 0.1 mmol/kg

Full Dose Eovist 0.025 mmol/kg (selected Liver Studies)