SUBJECT/TITLE: **INTRAVENOUS AND INTRAOSSEOUS CONTRAST ADMINISTRATION**

PURPOSE:

1) Ensure contrast administration is performed according to hospital and departmental protocols with appropriate supervision by a licensed independent practitioner (LIP);
2) Ensure appropriate premedication in patients with known/suspected allergic reactions.
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.

DEFINITION: None

BACKGROUND: The policy will be based on the (ACR Manual on Contrast Media (Version 10.3, 2017) and other relevant literature.

CONTENTS:

POLICY:

Guidelines for administration of Intravenous contrast:

1. A radiologic technologist or radiology nurse may order and/or administer intravenous contrast under the supervision of a licensed independent practitioner (LIP) and in accordance with procedure defined in this policy and following protocols used for contrast administration that are based upon the type of examination ordered 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 Department of Pharmaceutical Care Drug Information Center and approved by the P&T Subcommittee and by the Contrast Committee of the Department of Radiology 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 and/or modify the appropriate protocol based on the clinical indications for the examination and patient status. The assigned protocol is indicated in the radiology information system (RIS) or electronic medical record (EMR).
5. For those procedures where a contrast protocol has been established and approved by the Pharmacy and Therapeutics committee, the technologist may administer the contrast, following the established protocol, using a protocol order.
6. 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.
7. If contraindications are identified, the supervising LIP will be contacted to determine appropriate IV contrast use.
8. Type of contrast and dose information is recorded in the EMR by the nurse or technologist.
9. Contrast doses that are prepared and NOT immediately administered to patient by the person who prepared the dose must be labeled with:
    - Drug name, strength and amount (if not apparent from container)
    - Initials or name of the person preparing the syringe
    - Name of patient, medical record number, date of birth and location of the patient, if contrast dose is prepared based upon specific patient information
    - Oral contrast may be stored for up to 24 hours.

PROCEDURE:

A. INTRAVENOUS IODINATED CONTRAST

All intravenous contrast utilized for CT and fluoroscopic exams at UIHC utilize iodinated contrast. Type of iodinated contrast include ionic vs. nonionic, high osmolar (HOCM) vs. low osmolar (LOCM), and iso-osmolar contrast media.

Preparation for Contrast Administration

1. Pre-administration Checks (4 Hs)

a. History; check allergies, h/o diabetes and renal disease and review labs
b. Hydration; patients are asked to not consume food or carbonated drinks 2 hours prior to exam and no clear liquids 1 hour prior to exam for IV contrast. (Trauma and code strokes protocol are exempt from these instructions)
c. Have equipment and know the location of contrast reaction box and crash cart in your work area
d. Heads up; monitor every contrast injection

2. Review patients allergies

a. History of prior allergic-like reaction to contrast medium has an approximately 5-fold increased risk of developing a future allergic-like reaction if exposed to the same class of contrast medium again
b. A prior allergic-like or unknown type reaction to the same class of contrast medium is considered the greatest risk factor for predicting future adverse events
c. Patients with shellfish or povidone-iodine (e.g., Betadine®) allergies are at no greater risk from iodinated contrast medium than are patients with other allergies. There is no cross-reactivity between different classes of contrast medium. For example, a prior reaction to gadolinium-based contrast medium does not predict a future reaction to iodinated contrast medium, or vice versa, more than any other unrelated allergy.

3. Renal failure-related issues with iodinated contrast

Definitions:

a. Post-contrast acute kidney injury (PC-AKI) is a general term used to describe a sudden deterioration in renal function that occurs within 48 hours following the intravascular administration of iodinated contrast medium.
b. Contrast-induced nephropathy (CIN) is a specific term used to describe a sudden deterioration in renal function that is caused by the intravascular administration of iodinated contrast medium; therefore, CIN is a subgroup of PC-AKI
c. AKIN (Acute kidney Injury network) Criteria for the diagnosis of PC-AKI or CIN- if one of the following occurs within 48 hours after a nephrotoxic event (e.g., intravascular iodinated contrast medium exposure)

    1. Absolute serum creatinine increase ≥0.3 mg/dL (>26.4 μmol/L).
    2. A percentage increase in serum creatinine ≥50% (≥1.5-fold above baseline).
    3. Urine output reduced to ≤0.5 mL/kg/hour for at least 6 hours.

Risk factors for contrast induced renal failure include:

a. Pre-existing renal insufficiency
b. History of "kidney disease" as an adult, including tumor and transplant
c. Diabetes mellitus
d. Dehydration
e. Cardiovascular disease and use of diuretics
f. Age > 60 years
g. Multiple myeloma or paraproteinemia syndromes/diseases
h. Uncontrolled Hypertension
i. Hyperuricemia (gout)

Medications which may increase the risk of iodinated contrast-induced renal failure:

j. **Metformin** (oral hypoglycemic agent for diabetes): This drug is excreted by the kidneys, and may accumulate resulting in severe (even fatal) lactic acidosis.
k. **NSAIDs including COX-2 selective agents** (e.g., ibuprofen, naproxen, ketorolac, fenoprofen, indomethacin, celecoxib, etc).
l. **Nephrotoxic antimicrobials** (e.g., gentamicin, tobramycin, amikacin, amphotericin B, cidofovir).

Indications for renal function testing prior to iodinated contrast exam

The following patients must have a renal function testing within 60 days prior to IV contrast and within 24 hours for in patients

Age > 60
History of renal disease, including: • Dialysis • Kidney transplant • Single kidney • Renal cancer • Renal surgery
History of hypertension requiring medical therapy
History of diabetes mellitus
Metformin or metformin-containing drug combinations

Per the ACR guidelines, there is no agreed-upon threshold of serum creatinine elevation or eGFR declination beyond which the risk of contrast-induced nephropathy (CIN) is considered so great that intravascular iodinated contrast medium should never be administered. A risk versus benefit ratio is assessed in each case.

Screening for renal function

a. All prior renal function testing should be also reviewed for any interval change and to review the trend of renal function.
b. If patient is in acute renal failure consult a radiologist/nephrologist prior to administering contrast. A risk-benefit analysis for each patient, considering all the risks, possible benefits and alternatives test for obtaining the diagnosis is recommended.

≥30 eGFR- Low risk- Per the ACR guidelines there is currently very little evidence that IV iodinated contrast material is an independent risk factor for AKI in patients with eGFR ≥30 mL/min/1.73m2. In patients with stable renal function, contrast can be administered if eGFR>30.

<30eGFR OR active acute kidney injury- Higher risk- IV contrast should not be administered **unless** there is a provider-to-provider conversation about the risks and benefits of IV contrast. The IV contrast is considered diagnostically imperative, if the benefits of contrast outweigh the risk of CIN and all other alternatives and options have been exhausted. In such a situation, the referring physician MUST document the indication of contrast and clearly state that the benefit of contrast outweighs the risk of CIN in the patient's EMR. This MUST be documented in the radiology report as well.

Measures to Prevent Nephrotoxicity

a. Avoidance of Iodinated Contrast Medium- Re-evaluate the indication of IV contrast and explore other options for imaging that do not involve IV or MR contrast. **This is the preferred option for patients with AKI**. Although it seems logical to use the lowest possible dose of contrast medium to obtain the necessary diagnostic information, robust data supporting a dose-toxicity relationship for IV iodinated contrast medium administration are lacking.
b. Volume Expansion- before and after the IV contrast to be done by clinical team
c. At the current time there is insufficient evidence for the use of N-acetylcysteine and sodium bicarbonate, mannitol, furosemide to reduce CIN.

Metformin and Metformin-Containing Medications

a. Patients taking metformin are not at higher risk than other patients for post-contrast acute kidney injury.
b. Iodinated contrast is a potential concern for furthering renal damage in patients with acute kidney injury, and in patients with severe chronic kidney disease (stage IV or stage V) Metformin does not confer an increased risk of CIN. However, patients who develop AKI while taking metformin may be susceptible to the development of lactic acidosis.
c. Metformin and Gadolinium It is not necessary to discontinue metformin when the amount of gadolinium-based contrast material administered is in the usual dose range of 0.1 to 0.3 mmol per kg of body weight

Management—Patients taking metformin can be classified into one of two categories based on the patient's renal function (as measured by eGFR):

- **Category I** - In patients with no evidence of AKI and with eGFR ≥30 mL / min/1.73m2, there is no need to discontinue metformin either prior to or following contrast. No need to reassess the patient's renal function following the test or procedure.

- **Category II** - In patients taking metformin with acute kidney injury 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 of or prior to the procedure, and withheld

for 48 hours post procedure and restarted only after renal function has been re-evaluated and found to be normal.

Pre procedure considerations in special situations:

Pheochromocytoma: There is no evidence that IV administration of modern iodinated or gadolinium-based contrast medium increases the risk of hypertensive crisis in patients with pheochromocytoma.

Sickle-Cell Trait/Disease: Patients with Sickle-Cell may receive contrast medium.

Myasthenia Gravis: There is a questionable relationship between IV iodinated contrast medium and exacerbations of myasthenic symptoms in patients with myasthenia gravis. At this time it is controversial whether iodinated contrast medium should be considered a relative contraindication in patients with myasthenia gravis. Prior to administration, refer to risk vs. benefits and contact a radiologist if you have questions.

Hyperthyroidism: There is no evidence that IV administration of modern iodinated contrast medium should be avoided in patients with acute thyroid storm ~~In~~ For patients considering radioactive iodine therapy or in patients undergoing radioactive iodine imaging of the thyroid gland, administration of iodinated contrast medium can interfere with uptake of the treatment and diagnostic dose. If iodinated contrast medium was administered, a washout period is suggested to minimize this interaction. The washout period is ideally 3-4 weeks for patients with hyperthyroidism, and 6 weeks for patients with hypothyroidism.

Patients on Dialysis
Patients on dialysis can receive IV contrast and early post-procedural dialysis is NOT routinely required in every case. The Nephrology Service should be consulted for these cases. The fact that a patient is on dialysis should NOT be regarded as automatically allowing the administration IV contrast.

Maximum Permissible Dose of Contrast
Currently, there is no clinical maximum permissible dose of contrast listed. Our recommended maximum general volume of contrast over of 300 CC in a 24 hour period should be avoided. Call a radiologist if it is determined there is a need to surpass this threshold. Separating multiple doses of contrast by 24 hour interval is suggested. Due regard should be given to the need of IV contrast for an optimal study, rather rigid adherence to a numeric value.

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 events. 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. Therefore, administration of IV contrast in patients with previous severe reactions should be done only in exceptional circumstances with full agreement by the patient, attending physician(s) and radiologist.

1. **Premedication**
   a. Premedication prior to intravenous iodinated and gadolinium-based contrast injections are indicated with history of prior moderate to severe reaction only, examples: increasing hives, facial swelling, itching, acute rash, wheezing, bronchospasm, stridor, laryngeal edema and anaphylaxis
   b. Premedication is not needed for history of asthma, reactions to other substances (regardless of number or severity, including shellfish and betadine) and physiologic reaction to iodinated contrast material such as a vasovagal reaction, nausea and vomiting.
   c. The risk of breakthrough reaction still exists in patients with severe reaction
   d. Corticosteroids are critical component of the premedication regimen and should be given at least 6 hours prior to the contrast.
   e. After diphenhydramine (Benadryl) patient must have a driver to and from the appointment, due to the possibility of drowsiness from the medication.

Adult Patient

a.

Standard oral premedication regimen:

- Prednisone—50 mg PO, 13, 7 and 1 hour prior to the procedure
  OR
- Methylprednisolone— 32 mg PO 12 hours and 2 hours prior
- **AND**
- Diphenhydramine—50 mg PO 1 hour prior to the procedure

Note: Doses may be distributed unevenly to allow a patient to get a reasonable night's sleep the evening prior to the CT; however, the first dose should be taken more than 12 hours before and a second dose within the last 6 hours of the scheduled exam.

b.

Alternate IV protocol if a patient cannot take oral medications:

- Hydrocortisone—200 mg IV, 13, 7 and 1 hour prior to the procedure
- Diphenhydramine—50 mg IM or IV, 1 hour prior to the procedure

c.

Accelerated IV premedication protocol, when there are no alternatives:

- Hydrocortisone—200 mg
  OR
- Methylprednisolone—40 mg IV, 4 hours and 1 hour prior to the procedure
  AND
- Diphenhydramine—50 mg PO/IM/IV, 1 hour prior to the procedure (if blood pressure permits)

Pediatric Patient

a.

Standard oral premedication regimen:

- Prednisone—0.5-0.7 mg/kg PO, 13, 7 and 1 hour prior to the procedure (50 mg maximum dose)
- Diphenhydramine—1.25 mg/kg PO 1 hour prior to the procedure (50 mg maximum dose)

2. Non-emergent contrast administration in premedicated patients

a. Patients who are premedicated for prior reactions, being imaged for n**on-emergent indications** should not be scanned after hours. The pre medication may be scheduled in such a way that the patient is scanned the first thing next morning, when adequate resources are available to handle any breakthrough reactions.
b. If clinical situation warrants emergent scanning after hours in a patient who has received the premedication for prior contrast allergy:
    - The afterhours scanning of the premedicated patient should be approved by the radiology faculty member during the day.
    - The on-call radiology resident must be informed by the day team about the scanning of premedicated patient.
    - The technologist will page the on-call radiology resident before administering the contrast.
    - The on-call radiology resident must request a LIP from the clinical team to be present with the patient at the time of contrast administration and for the duration of the entire scan. They must accompany the patient back to the floor cover for any delayed reaction.
c. On call and on weekends, any case with history of contrast allergy should go through the on-call radiology resident to determine alternative method of scanning vs. need for premedication.
d. For CT studies, imaging of premedicated patients after hours will be done in the ETC scanner where the radiology resident is readily available.

3. Emergent contrast administration in life-threatening situations

In cases of life-threatening emergency requiring administration of IV contrast and where clinical team cannot wait to complete the accelerated IV premedication protocol requiring administration of steroids 4 hours and 1 hour prior to the procedure AND the alternative test is not acceptable:

a. The clinical team must add a note in the EMR of the patient prior to the contrast administration which clearly states the following:
    - Indication of the urgent study.
    - Reason why the alternative exam (as offered by the radiologist) is not acceptable.
    - Ensure that sufficient staff capable of handling the severe contrast reaction; including intubation and administration of life support drugs is available during and after the procedure.

b. You may still consider giving hydrocortisone 200 mg IV and diphenhydramine (Benadryl®) 50 mg IV stat prior to contrast administration and 4 hours later to cover delayed reaction, Premedication regimens less than 4-5 hours in duration (oral or IV) have not been shown to be effective.

B. INTRAVENOUS GADOLINIUM BASED CONTRAST AGENTS

Since their introduction in 1988, gadolinium-based contrast agents (GBCA) for MRI have largely enjoyed an excellent safety profile. However, in 2006 reports first appeared linking GBCA with a rare but serious disease called nephrogenic systemic fibrosis (NSF) that primarily affects the skin and subcutaneous tissues and occasionally the muscles and internal organs. NSF has no known cure. All affected patients had severe or end-stage chronic kidney disease (CKD 4 or 5), acute kidney injury (AKI), or were on renal dialysis. The exact risk of developing NSF after exposure to intravenous GBCA is unknown, but a growing body of evidence indicates that the risk depends strongly on the molecular structure of the GBCA. The FDA, American College of Radiology (ACR) and European Medicines Agency have developed classification systems to reflect the differential NSF risk of the various GBCA. In the ACR system, which has three groups (I, II and III), GBCA in group 1 carry the highest NSF risk, perhaps as great as 1-7% per dose. In response to these data, the FDA banned the use of group I agents in patients with impaired renal function in 2010. At UIHC, all group I agents have been removed from the formulary. Group II agents carry the smallest NSF risk. The vast majority of MRI exams performed at UIHC utilize a group II agent, either Gadavist® (gadobutrol) or Dotarem® (gadoterate meglumine). Group III agents have insufficient data to determine their NSF risk. The only group III agent currently available in the USA is Eovist® (gadoxetate disodium). This agent is used selectively at UIHC for MRI exams of the liver and bile ducts.

In 2010 the FDA issued a Safety Announcement called a "black box" warning that requires patients to be screened for "acute kidney injury and other conditions that may reduce renal function" prior to receiving *any* GBCA. However, recent data have suggested that the FDA screening recommendations for group II agents are overly cautious. The ACR Manual on Contrast Media (2018, Version 10.3) directly addresses the latest thinking about screening recommendations: "Based on the most recent scientific and clinical evidence, the ACR Committee on Drugs and Contrast Media considers the risk of NSF among patients exposed to standard or lower than standard doses of group II GBCAs is sufficiently low or possibly nonexistent such that assessment of renal function with a questionnaire or laboratory testing is optional prior to intravenous administration." The latest ACR position informs our decision to update the UIHC contrast policy.

1. **Screening for impaired renal function**
   ***Outpatients/ED or inpatients scheduled to receive* Gadavist *or* Dotarem**:
   - No further screening is required.

   Adult Outpatients/ED scheduled to receive Eovist
   a. must be screened for conditions that increase the risk of impaired renal function (see below):

      - Diabetes Mellitus (insulin-dependent, oral hypoglycemic or diet-controlled)
      - History of renal disease (dialysis – any form, renal insufficiency or failure, solitary kidney, renal transplant, renal tumor or renal surgery)

- Other conditions as deemed appropriate by the responsible radiologist.

If the patient answers YES to any of the above risk factors (except dialysis or AKI), an eGFR must be checked within an acceptable time window, as described below.

- A documented eGFR ≥45 obtained <6 weeks prior to GBCA administration satisfies the screening.
- If no prior eGFR is available *or* if the prior eGFR was obtained >6 weeks ago, an eGFR should be checked <48 hours prior to GBCA.
- If the prior eGFR was <45 (***regardless*** of risk factors), an eGFR should be checked <48 hours prior to GBCA.
- If the rechecked eGFR is <30, see subheading "**4B**" below.

b. ***Adult Inpatients scheduled to receive Eovist*** must have a documented eGFR ≥30 obtained <48 hours prior to GBCA administration. If that eGFR is <30 or if the patient has acute renal failure (AKI) or is on renal dialysis, see subheading "**4B**" below.

c. ***Pediatric patients scheduled to receive Eovist*** . The eGFR screening policies for adult outpatients/ED and inpatients (b and c, above) need not be strictly followed in neonates and infants due to the high prevalence of low eGFR values in this population. The decision to use Eovist should be based primarily on clinical necessity.

d. Emergency MR Exams with IV Eovist contrast

This section pertains to the following unusual circumstances:

- Request is for an emergency Abdominal MRI exam with Eovist.
- Patient would ordinarily require eGFR screening for renal insufficiency
- No current serum eGFR is available
- The referring physician believes that a delay in performing the MR study due to obtaining a serum eGFR would compromise patient care.
- At the discretion of the responsible radiologist, the patient may undergo an MR exam with Eovist without a current eGFR.
- The ordering physician must add a note in the **medical record** of the patient prior to the contrast administration which clearly states the benefit outweighs the risk.

2. **AKI**. Recognition of AKI requires a high clinical suspicion. Helpful clinical and laboratory findings include:
    - rise in serum creatinine (>0.3 mg/dl over 48 hours *or* 1.5 times increase above baseline over 7 days)
    - risk factors such as recent surgery, severe infection, severe trauma, and nephrotoxic drugs
    - Please note that eGFR is ***not*** a reliable indicator of AKI.

3. **Renal Dialysis**:
    - Patients currently on dialysis (hemodialysis, peritoneal dialysis or continuous dialysis) do **not** need to have their eGFR checked.
    - For patients currently on hemodialysis, dialysis should be performed as soon as reasonably possible, but no later than 24 hours after an MRI exam with IV GBCA. However, if the MRI is urgent and delaying the exam due to dialysis would

compromise patient care, the MRI exam may be performed irrespective of the dialysis schedule.

- Please be aware that hemodialysis has NOT been proven to decrease NSF risk after GBCA exposure.
- The ordering provider should indicate if the patient is on continuous dialysis (CVVD, etc.) as these patients are at increased risk for NSF, but may appear to have an eGFR >30.

4. Administration of GBCA in patients with impaired renal function

a. ***Gadavist and Dotarem***: In patients with impaired renal function (CKD 4 or 5, AKI, or dialysis) the risk of developing NSF from a group II GBCA is minimal. Thus, the decision to perform an MR exam with Gadavist or Dotarem in an adult or pediatric patient should not hinge on renal function. Instead, the responsible radiologist should consider issues that would apply to any patient undergoing advanced diagnostic imaging, mainly:

- Is the MR exam clinically appropriate and will it impact patient care?
- Is intravenous contrast necessary to obtain the desired diagnostic information?
- Can similar diagnostic information be obtained more safely and at lower cost with another imaging modality or diagnostic test?

b. ***Eovist***: There is insufficient data to determine the NSF risk of Eovist. Prior to administering this GBCA to a patient with impaired renal function (CKD 4 or 5, AKI, or dialysis), the responsible radiologist should determine if the marginal benefit of Eovist outweighs its potentially higher NSF risk. In many (but not all) clinical scenarios Gadavist or Dotarem can provide similar diagnostic information. If the responsible radiologist and ordering physician agree that Eovist is appropriate and clinically indicated, the following steps must be performed prior to contrast administration:

- The ordering physician must place a note in the patient's EMR prior to contrast administration that clearly states the benefits of Eovist outweigh the risks.
- The patient will be given copy of **Information Sheet for Patients Scheduled for Eovist-Enhanced MRI**. The responsible radiologist will explain the risks and benefits of the proposed MRI exam and the patient will have an opportunity to discuss any concerns. If the patient agrees to proceed with the MRI exam, the radiologist will obtain verbal informed consent.

5. **Administration of GBCA for various MR exams**

a. Most contrast-enhanced MRI exams will be performed with single dose IV Gadavist® gadobutrol) 0.1 mmol/kg (0.1 ml/kg) body weight. If a patient has had previous contrast reactions or nausea/vomiting to Gadavist® (gadobutrol), use Dotarem® (gadoterate meglumine) at 0.1 mmol/kg (0.2 ml/kg).

b. Some abdominal MRI exams of the liver and biliary tree may be performed with IV Eovist® (gadoxetate disodium) at a dose of 0.2 ml/kg.

c. MR Enterography exams will be performed IV Gadavist® (gadobutrol) at 0.15 ml/kg. If patient has a history of contrast reactions or nausea/vomiting to Gadavist® (gadobutrol), use Dotarem® (gadoterate meglumine) at 0.3 ml/kg.

d. Contrast-enhanced MRA exams will be performed with IV Gadavist® (gadobutrol) as follows:

- Single station MRA –10 ml Gadavist® (gadobutrol).
- Two or three station MRA – 15 ml Gadavist® (gadobutrol) diluted with 25 ml saline to 40 ml total volume.

e. Contrast-enhanced MR venography of the pelvis and lower extremities will be performed with 30 ml IV Dotarem® (gadoterate meglumine) diluted with 30 ml saline to a total volume of 60 ml.

f. Contrast-enhanced MRA of the pelvis and lower abdomen for Pelvic Congestion Syndrome will be performed with 10 ml Gadavist® (gadobutrol).

g. Contrast-enhanced cardiac MRI exams for myocardial viability will be performed with IV Gadavist® (gadobutrol) at 0.2 ml/kg or Dotarem® (gadoterate meglumine) at 0.4 ml/kg.

h. **Pediatric Patients**:
   - Contrast-enhanced MRI exams will be performed with single dose IV Gadavist® (gadobutrol): 0.1 ml/kg body weight.
   - MRA Neck, Brain, and MRV Brain will be performed with single dose IV Dotarem® (gadoterate meglumine): 0.2 ml/kg body weight for patients less than 50 kg (110 lbs).
   - All other MRA's below neck will be performed with double dose IV Dotarem® (gadoterate meglumine) for patients less than 50 kg (110 lbs): 0.4 ml/kg body weight in all patients.
   - Contrast-enhanced MRA exams for patients over 50 kg (110 lbs) will be performed with IV Gadavist® (gadobutrol) as follows:
     1. Single station MRA - 10 ml Gadavist® (gadobutrol)
     2. Two or three station MRA – 15 ml Gadavist® (gadobutrol) diluted to 40 ml with saline.
   - MR Enterography exams will be performed IV Gadavist® (gadobutrol) at 0.15 ml/kg or Dotarem® (gadoterate meglumine) 0.3 ml/kg if patient has had previous contrast reactions to Gadavist® (gadobutrol) or nausea/vomiting.

6. **Gadolinium Retention**

Recent studies have shown that minute amounts of gadolinium are retained in the brain and other organs for months to years after administration of gadolinium-based contrast agents (GBCA). In December 2017 the FDA addressed the issue of gadolinium retention in a Safety Announcement. The document notes that "patients at higher risk for gadolinium retention include those requiring multiple lifetime doses, pregnant women, children, and patients with inflammatory conditions." However, the document also states that "Gadolinium retention has not been directly linked to adverse health effects in patients with normal kidney function" and concludes that "the benefit of all approved GBCAs continues to outweigh any potential risks." The Safety Announcement goes on to explain that the amount and duration of gadolinium retention in the human body depends on the chemical structure of the GBCA. At UIHC, we perform >95% of contrast-enhanced MRI exams with the two GBCAs associated with the lowest levels of gadolinium retention: Dotarem (gadoterate meglumine) and Gadavist (gadobutrol). Going forward, the FDA will require GBCA manufacturers to develop new "Medication Guides" to provide educational information that every patient will be asked to read before receiving a GBCA. Once available, they will be distributed as required. As new data become available on the health effects of gadolinium retention, this contrast policy will be updated accordingly.

7. Prevention of Contrast Reactions

Allergic-type reactions to GBCA are rare and severe or anaphylactoid reactions are extremely rare. In patients who have previously reacted to a GBCA or experienced nausea/vomiting, 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.

a. Use a different gadolinium-based agent.
b. At the discretion of the radiologist, premedicate the patient with steroids and antihistamine in accordance with the policy for iodinated contrast may be considered: Premedication for Iodinated IV contrast

C. INTRA-ARTERIAL IODINATED CONTRAST ADMINISTRATION

1. For intra-arterial iodinated contrast injections, the same general rules apply as for intravenous iodinated contrast injections.
2. For run-off angiograms for peripheral vascular disease, use of Visipaque® (iodixanol) may be preferred by some (compared to Isovue® [iopamidol]) in effort to decrease the somatic effects typical of iodinated contrast.
3. Inpatients with severe contrast allergy, gadolinium may be used per protocol in section B.

D. NON-INTRAVENOUS CONTRAST AGENTS

1. Oral contrast agents such as barium and diatrizoate sodium-meglumine (MD-Gastroview®, 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 agents must 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® (iodixanol) is preferred.

4. Protocols for administration and preparation of oral 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 oral contrast agent change.

5. Orders for contrast administration are reviewed by a radiologist or licensed independent practitioner to determine appropriateness. The currently used oral contrast preparations for CT, MRI, and fluoro procedures have minimal adverse effects. A pharmacist is available on the 4JP satellite to answer any questions the radiologist or licensed independent practitioner may have.

6. Oral contrast agents that are sent to the in-patient floor by radiology technologist must include the following information:

    a. Drug name, strength, and amount (if not apparent from the container)
    b. Time and date the contrast was prepared, an expiration date, and initials of the person who prepared the container.
    c. Name of patient, medical record number, date of birth, and location of the patient.

d. Directions for use and any applicable cautionary statements. Instructions on administration times in relation to Radiology procedure.

7. Quality control procedures are implemented to prevent retrieval errors.
    a. Oral contrast is stored segregated from other medications and clearly labeled.

8. A percentage of records for cases that did not have a pharmacy review prior to dispensing are sampled quarterly per protocol to determine if the system functions successfully as designed.

E. INTRAOSSEOUS IODINATED CONTRAST ADMINISTRATION

Indication: Intraosseous (IO) lines are used for rapid access for administration of IV contrast in critically ill patients with no intravenous access. These guidelines are based on most common IO device (EZ-IO, 15G of variable lengths and FAST1 device for sternum) used at UIHC. Note EZ-10 device has stainless steel parts and is not MRI compatible. For any other device, check MR compatibility.

Placement of IO needle and catheter: The catheter is placed by the clinical team in the tibia, humerus or sternum. Humerus is the preferred site as it allows higher achievable flow rates when compared to tibial access. Pediatric patients usually have IO placed in the lower leg below the knee joint.

Pre-contrast administration protocol:

a. Confirm intramedullary placement with a control CT scan through the IO device. For humeral IO access the arm will be on the side of the patient and the position of the upper extremity may not be changed after confirming the proper positioning.
b. The needle position must be confirmed appropriate for contrast administration by a radiologist prior to administration.
c. Flush IO line with 20 mL of normal saline. If line does not flush easily, do not use.
d. If patient is unconscious, no analgesia is required. If patient is conscious and responsive to pain, 2% preservative and epinephrine-free lidocaine should be administered by the accompanying LIP or RN just before contrast injection.

Protocol for non-sedated adult patient:

e. Prime EZ-Connect extension set with lidocaine. Priming volume of EZ-Connect is approximately 1.0 mL.
f. Slowly infuse lidocaine 40 mg IO over 120 seconds
g. Allow lidocaine to dwell in IO space for 60 seconds.
h. Flush with 5-10 mL of normal saline.
i. Slowly administer an additional 20 mg of lidocaine IO over 60 seconds.

Protocol for non-sedated pediatric patient:

j. Usual does is .5mg/kg, not to exceed 40 mg.
k. Prime EZ-Connect extension set with lidocaine. Priming volume of EZ-Connect is approximately 1.0 mL
l. Slowly infuse lidocaine over 120 seconds.
m. Allow lidocaine to dwell in IO space for 60 seconds
n. Flush with 2-5 mL of normal saline.

o. Slowly administer subsequent lidocaine (half initial dose) over 60 seconds.

Contrast administration: Hand inject pre-warmed contrast agent directly into IO line hub using same volumes as would be used with power injector in adults. Contrast agent is injected over 1 minute or a tolerated. Total contrast volume in children is up to 1.5 mL/kg. The vascular phase of these scans will be of parenchymal phase and not arterial quality. Flush IO line with 20 mL of normal saline and then immediately perform scan per usual protocol.

Guidelines for IV access for Contrast in Radiology (Both central venous and peripheral venous)

All injections are monitored by the staff

Acceptable IV access: Lines that CAN be used for power injection in accordance to the label for rate of permitted flow/sec / < 300psi):

- Power rated triple lumen catheter
- Power rated port
- Power PICC line port (most common is the purple PICC from Bard)
- Single lumen power rated Cordis sheath in the neck (in the internal jugular vein only) or groin
- Standard 20g – 22g peripheral IV catheter located in an antecubital, upper forearm, wrist, or hand vein. For 22g in the hand use a reduced rate of injection < 3 ml/sec
- 20-24g power rated Diffusic. For the 24g Diffusic use a reduced rate up to 3 ml/sec injection rate only
- Any additional power rated lines must be verified as compatible for power injection
- BD Nexivia

Lines that CANNOT be used for power injection: Need to get an alternative IV access

- Hickman
- Port-A-Cath (except for a power rated port)
- Single lumen central line, not power rated
- PICC and mid-lines, not power rated

Lines to be hand injected only

- Short/ peripheral IV cannulas in the external and internal jugular veins terminating in the neck may be only hand injected by radiology technologists due to the risk of secondary to risk of neck hematoma from extravasation.
- 24g peripheral IV catheter (non-Diffusic)

Dialysis catheters are NOT to be used for IV contrast

F. ULTRASOUND CONTRAST AGENTS

Intravenous Ultrasound Contrast are microbubbles mounted on albumin, lipid or polymer, that is injected intravenously by sonographers under supervision of US radiologist, with the purpose of characterizing liver lesions. Advantage of Intravenous Ultrasound Contrast is that it can be used in patients with renal failure and patients on dialysis. The contraindications for contrast enhanced Ultrasound includes right to left shunt, uncompensated COPD and severe CAD. The exam typically takes 4 minutes during which a video clip that records the pattern of lesional enhancement is recorded. Contrast US is especially helpful in finding lesions that may not be detectable by routine US. Exam may be repeated once or twice as needed.

G. PEDIATRIC IV CONTRAST ADMINISTRATION

1. For iodinated contrast media agents, the same principles apply in adults as in children. The dose of contrast is delivered based on weight of the patient (2 ml/kg).

2. For gadolinium agents, a dose is similarly prescribed based on body weight (see point 3 in gadolinium administration paragraph). Pediatric patients

   References for pediatric contrast media use:
   a. https://www.acr.org/-/media/ACR/Files/Clinical-Resources/Contrast_Media.pdf#page=54
   b. http://www.springerlink.com/content/3211318t384ug062/fulltext.pdf
   c. http://emedicine.medscape.com/article/422855-print
   d. http://radiology.rsna.org/content/243/1/80.full.pdf+html

3. Gadolinium in neonates: Normal neonates have immature renal function with a GFR at birth of below 30 ml/min/1.73^2. It is important to weigh the risks and benefits of using this medication. Gadoterate meglumine (Dotarem) can be used for patients with borderline renal function (GFR 30-90 mL/min), patients under two years of age, patients with preexisting renal anomalies such as a solitary kidney, or patients whom recent laboratory tests were not available. In addition, any patient who is likely to need multiple contrast-enhanced MRIs over time, such as cancer patients, may receive gadoterate meglumine. (http://appliedradiology.com/articles/the-use-of-gadolinium-based-contrast-agents-in-children). In high risk patients, non-contrast imaging or alternative modality without contrast should be considered.

4. In neonates - use of a high-risk gadolinium agent is contraindicated. For medium-risk or low-risk agents, use a single lowest possible dose and do not repeat for at least 7 days. https://www.gov.uk/drug-safety-update/gadolinium-containing-contrast-agents-new-advice-to-minimise-the-risk-of-nephrogenic-systemic-fibrosis.

5. In infants - use a single lowest dose of agent possible and do not repeat for at least 7 days. https://www.gov.uk/drug-safety-update/gadolinium-containing-contrast-agents-new-advice-to-minimise-the-risk-of-nephrogenic-systemic-fibrosis

6. According to recent study, neonates show no adverse effects from CT, MRI contrast.http://pubs.rsna.org.proxy.lib.uiowa.edu/doi/full/10.1148/radiol.2017160895

On the basis of current evidence, the risk classification is as follows: https://www.gov.uk/drug-safety-update/gadolinium-containing-contrast-agents-new-advice-to-minimise-the-risk-of-nephrogenic-systemic-fibrosis

- High risk—Omniscan (gadodiamide), OptiMARK (gadoversetamide), Magnevist (gadopentetic acid)
- Medium risk—MultiHance (gadobenic acid), Primovist (gadoxetic acid), Vasovist (gadofosveset)
- Low risk—Gadovist (gadobutrol), ProHance (gadoteridol), Dotarem (gadoteric acid)

TREATMENT OF CONTRAST MEDIA REACTION

In all cases, treatment should begin with:

- IV access and monitor frequent vitals
- Maintain the ABCs (airway, breathing, circulation)
- Notify the radiologist
- Call Code Blue, Rapid Response or 911 (at IRL) for severe reactions
- Complete contrast reaction note and document allergy in EMR
- Follow up call to patient the next day (done by nursing staff and documented in EMR)

Table 1: Suggested Treatments for Adults w/ Adverse Effects to Contrast Agents

Hives		
Mild (Scattered & transient)	None	Observe until resolving
Moderate (numerous & bothersome to the patient)	Diphenhydramine (Benadryl®) OR Fexofenadine (Allegra®)	25-50 mg oral (causes drowsiness; patient will need a designated driver) 180 mg po (for patients without a driver)
Severe (profound)	Secure IV access	50 mg IV Diphenhydramine (Benadryl®)
Diffuse erythema		
Mild	Secure IV access, IV fluids	0.9% NaCl or Lactated Ringer's 1-2 liters IV
	Consider: diphenhydramine	50 mg oral or IV
	Consider: hydrocortisone	200 mg IV
Severe	Epinephrine	0.3 mg /0.3 ml IM (1:1,000), if inadequate response; 0.1 mg/1 ml (1:10,000) slow IV; repeat as needed up to 1 mg/10 ml total dose
	CALL CODE	
Laryngeal edema		
	Secure IV access, O_2 by mask	10 l/min O_2
	Epinephrine	0.1 mg/1 ml (1:10,000) slow IV; repeat as needed up to 1 mg/10 ml total dose
	CALL CODE	
	Hydrocortisone	200 mg IV, repeat if necessary
Bronchospasm		
Mild	Albuterol inhaler	2 puffs, repeat as necessary

	Secure IV access, O_2 by mask	10 l/min O_2
Moderate	Epinephrine IM*	0.3 mg/0.3 ml (1:1,000) IM; may repeat once
Severe	Epinephrine IV	0.1 mg/1 ml (1:10,000) slow IV; repeat as needed up to 1 mg/10 ml total dose
	CALL CODE	

Table 1 (cont): Suggested Treatments for Adults w/ Adverse Effects to Contrast Agents		
Pulmonary Edema		
	Secure IV access O_2 by mask	10 l/min O_2
	Elevate head of bed	
	Furosemide	20-40 mg IV, slowly (≥10 mg/minute)
	Morphine	1-3 mg IV, repeat every 5-10 min as needed
	CALL CODE	
Hypotension with Bradycardia		
Mild	Elevate legs	
	Secure IV access, IV fluids	0.9% NaCl or Lactated Ringer's 1-2 liters
	O_2 by mask	10 l/min O_2
Severe	Atropine	0.6 mg – 1 mg IV, slow; up to 2-3 mg total dose (0.04 mg/kg)
Hypotension with Tachycardia		
Mild	Elevate legs	
	Secure IV access	
	IV fluids	0.9% NaCl or Lactated Ringer's 1-2 liters
	O_2 by mask	10 l/min O_2
Severe	Epinephrine	0.1 mg/1 ml (1:10,000) slow IV; repeat as needed up to 1 mg (10 ml total dose)
	CALL RAPID RESPONSE	
Hypertension Crisis (diastolic BP > 120 mmHg)		
	Secure IV access	
	O_2 by mask	10 l/min O_2
	Labetalol (first choice)	20mg IV over 2 minutes, may repeat q 10 minutes
	Furosemide (if labetalol is not available)	40 mg IV slowly (over at least 4 minutes)
	Nitroglycerin	0.4 mg sublingual; repeat after 5-10 min x 3
	CALL RAPID RESPONSE	
Hypoglycemia (blood sugar below 50-60)		
If patient is able to swallow safely	Secure IV access	
	O_2 by mask	6-10 L/min O_2
	Administer oral glucose	15 grams of glucose tablet/gel or ½ cup (4 oz) of fruit juice
If patient is unable to swallow safely	If IV access present, administer Dextrose 50% IV	D50W IV 1 ampule (25 grams) IV push over 2 minutes (rate 100 mL/hr)
	If IV access not present, administer Glucagon	1 mg (1 mg/mL) IM/SQ Following Glucagon treatment provide a snack

* In hypotensive patients, the preferred route of epinephrine delivery is IV as the extremities may not be perfused sufficiently to allow adequate absorption of IM administration

I. TREATMENT AND PREVENTION OF CONTRAST EXTRAVASATION

Extravasations have incidence of 1/1000 to 1/106 patients when a power injector is used. Extravasated iodinated contrast media are toxic to the surrounding tissues, particularly to the skin, producing an acute local inflammatory response that sometimes peaks in 24 to 48 hours. The most commonly reported severe injuries after extravasation of LOCM are compartment syndromes. A compartment syndrome may be produced as a result of mechanical compression. A compartment syndrome is more likely to occur after extravasation of larger volumes of contrast media; however, it also has been observed after extravasation of relatively small volumes, especially when this occurs in less capacious areas (such as over the ventral or dorsal surfaces of the wrist). Extravasation of MRI contrast media is rare and generally constitutes relatively small quantities, thus limiting the risk for compartment syndrome.

1. **Methods to Decrease the Risk of Extravasation during Injection of Contrast Media**
    a. 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.
    b. 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 Extravasation of IV Contrast Media**
    NOTIFY THE RADIOLOGIST IMMEDIATELY IF:
    a. Elevate the affected extremity above the level of the heart. Remove all tight clothing above injection site. Serial neurovascular examination conducted by the radiologist to assess for early signs of compartment syndrome. Evaluation of 5 P’s (pain, paresthesia, paresis, pallor and pulselessness) is useful to evaluate for compartment syndrome.
    b. There is no clear evidence favoring the use of either warm or cold compresses.
    c. Aspirating the extravasated contrast medium not recommended.
    d. Outpatients may be released from the radiology department once the radiologist is satisfied that signs and symptoms are improving and no new or concerning symptoms have developed. The patient is instructed to seek medical attention if they notice increasing pain, any change in sensation distal to site of extravasation, skin blistering or ulceration or any discoloration
    e. Reliance on volume threshold for surgical consult is unreliable. Plastic Surgical Consultation should be obtained only when there is concern for a severe extravasation injury/symptoms of a compartment syndrome.

f. All extravasation events and their treatment are to be documented in the medical record and the radiology report and the referring physician should be notified.

J. PREGNANCY AND BREAST FEEDING

1. Pregnancy

a. Given that there are no available data to suggest any potential harm to the fetus from exposure to iodinated contrast medium via maternal IV or intra-arterial injection, we do not recommend routine screening for pregnancy prior to contrast media use. This recommendation is also supported by the FDA classification of most iodinated contrast agents as category B medications

b. Gadolinium-based contrast agents (GBCAs) should only be used if their usage is considered critical and the potential benefits justify the potential unknown risk to the fetus. The radiologist should confer with the referring physician and document the following in the radiology report or the patient's medical record:

c. That information requested from the MRI study cannot be acquired without the use of IV contrast or by using other imaging modalities.

- That the information needed affects the care of the patient and/or fetus during the pregnancy.
- That the referring physician is of the opinion that it is not prudent to wait to obtain this information until after the patient is no longer pregnant
- It is recommended that informed consent be obtained from the patient after discussion with the referring physician.

d. In pregnant patients with severely impaired renal function, the same precautions should be observed as in non-pregnant patients.

2. Breast Feeding

a. *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.

b. *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* (Appendix B) prior to their MRI procedure.

c. If the patient has any questions or concerns they can speak to a radiologist.

d. Ultimately, an informed decision to temporarily stop breast-feeding after IV contrast or Gadolinium should be left up to the mother after these facts are communicated. If the mother remains concerned about any potential ill effects to the infant, she may abstain from breast-feeding from the time of contrast administration for a period of 12 to 24 hours. There is no value to stop breast feeding beyond 24 hours. The mother should be told to express and discard breast milk form both breast after contrast administration until breast feeding resumes. In anticipation of this, she may wish to use a breast pump to obtain milk before the contrast-enhanced study to feed the infant during the 24-hour period following the examination.

University of Iowa Hospitals and Clinic
Department of Radiology
MRI
0440 JCP
200 Hawkins Drive
Iowa City, Iowa 52242-1077
319/356-2236
319/353-7886 ***Fax***

J. APPENDIX A: INFORMATION SHEET FOR CONTRAST ENHANCED MRI

Information Sheet for Patients Scheduled for Contrast-Enhanced MRI

Your doctor has ordered a Magnetic Resonance Imaging (MRI) test. It needs to be done using intravenous (IV) contrast. This test is to help your doctor learn more about your medical condition.

Contrast
The MRI contrast has a metal called gadolinium in it. This metal increases the diagnostic power of MRI. Some X-ray dyes used for other scans have iodine in them. MRI contrasts do not have iodine in them. They have been very safe for 20 years. More than 200 million doses have been given worldwide.

Risk
Some risks have been found. A link between gadolinium contrast and Nephrogenic Systemic Fibrosis (NSF) has been noted.

- NSF is a rare and debilitating disease.
- It was first described in 1997. It can affect the skin, muscles, and internal organs. The skin can become thick, hard, tight, dark, and itchy.
- NSF happens most often when people have very poor kidney function. People on kidney dialysis are at higher risk.
- It rarely causes death, but there is no good treatment choice.
- The cause of NSF and the role of gadolinium contrast are unknown.
- The risk of NSF from gadolinium contrast is also not clearly known. It is believed to be small, about 3 to 7%. This means 3 to 7 people out of 100 will get NSF.

Benefit
Your doctor and radiologist (a doctor who is an expert in medical imaging) have reviewed your health record. They believe that a MRI with gadolinium contrast is needed. Your doctors believe the benefits of the test outweigh the risks. It is more likely to give them the diagnostic information they need than any other test.

Safety Steps
We will use the gadolinium contrast thought to pose a smaller risk of NSF.
We will use the lowest dose we can.
If you are on hemodialysis, you will have dialysis right after your MRI. This will help remove the contrast from your body.

Warning
The US Food and Drug Administration (FDA) warns that all gadolinium contrast may pose a risk of NSF.

Questions
Your radiologist will be glad to answer any questions you may have.

University of Iowa Hospitals and Clinic
Department of Radiology
MRI
0440 JCP
200 Hawkins Drive
Iowa City, Iowa 52242-1077
319/356-2236
319/353-7886 ***Fax***

K. APPENDIX B: MRI BREAST FEEDING INFORMATION FORM

Your doctor has ordered a Magnetic Resonance Imaging (MRI) test. It needs to be done using an intravenous (IV) gadolinium contrast. This test is needed to help your doctor learn more about your medical condition.

After the gadolinium contrast is put into the IV in your arm, a tiny amount will be excreted into your breast milk. Please talk with your radiologist if you have any questions or concerns. They can help answer your questions so you can decide to keep breastfeeding or to stop for a short time.

- Studies show that the tiny amount of gadolinium in your breast milk will not harm your baby. It is safe for you to keep breastfeeding your baby.
- You may choose to stop breastfeeding for 24 hours, pump both breasts as needed, and throw the pumped breast milk away. After 24 hours you can start normal breastfeeding again.

University of Iowa Hospitals and Clinic
Department of Radiology
MRI
0440 JCP
200 Hawkins Drive
Iowa City, Iowa 52242-1077
319/356-2236
319/353-7886 ***Fax***

L. APPENDIX C: INFORMATION SHEET FOR CONTRAST ENHANCED CT

INFORMATION FOR CONTRAST MEDIA INJECTIONS

Your physician has referred you (or your family member) to the Department of Radiology for an X-ray examination requiring an injection of a contrast material, a solution that permits the visualization of a blood vessel or body organ. An injection of a solution will be made into one of your veins. Soon after the injection is made, you may experience a warm sensation or hot flash and a strange taste in your mouth caused by the injection -- both of which will fade away and not recur.

Most patients experience no unusual effects from this injection. As with any procedure; however, a few risks are involved. During this injection, as previously stated, you may experience a warm sensation, nausea, or vomiting. A few patients have an allergic-type reaction, with itching and hives (raised skin reactions resembling mosquito bites), swelling of the eyes and lips, sneezing, or difficulty in breathing. Medications are on hand to treat these conditions, should they occur.

More serious reactions occur infrequently, and while it would be impractical or misleading to describe them all, these complications include shock, kidney failure, and cardiac arrest. We have facilities to treat these reactions immediately. The risk of fatal complications is exceedingly rare (less than 1 in 100,000) and in your situation the benefit of contrast administration far outweighs these risks as determined by your doctor.

Your radiologist will be happy to answer any specific questions you may have about the procedure, either before or at the time of the study.

University of Iowa Hospitals and Clinic
Department of Radiology
MRI
0440 JCP
200 Hawkins Drive
Iowa City, Iowa 52242-1077
319/356-2236
319/353-7886 ***Fax***

M. APPENDIX D: CT BREAST FEEDING INFORMATION FORM

Your doctor as ordered a CT exam that requires us to give you an iodinated contrast agent for this exam. Iodinated contrast agent that will be injected in a vein in your arm and will give the radiologist additional information when reading your images. After injection of the iodinated contrast agent a tiny amount will be excreted into your breast milk. A Review of the literature shows there is no evidence to suggest that the oral intake of your breast milk by your baby that contains the tiny amount of iodinated contrast would cause toxic effects to your baby. It is believed that the available data suggest that it is safe for you to have your baby continue breast feeding after receiving an injection of the iodinated contrast agent. If you remain concerned about any potential ill effects, you can speak to a radiologist so you can make an informed decision as to whether to continue breast-feeding or temporarily stop breast-feeding after receiving an iodinated contrast agent. If you so desired, you can stop breast-feeding for 24 hours and just pump both breast if needed and throw the pumped breast milk away. After 24 hours you can resume normal breast feeding. If you have any questions and would like to speak to a radiologist please ask the receptionist.

Approved:

_____ _____

Leonel Vasquez, MD **Date**
Vice Chair, Clinical Operations
Department of Radiology

_____ _____

Archana Laroia, MD **Date**
Chair, Contrast Committee
Department of Radiology

Reviewed and approved by Department of Pharmaceutical Care (March 2012, March 2013, March 2018)
Approved by Radiology Quality Assurance and Safety Committee (March 2012, January 2013, April, 2018)