1. Introduction

“Various forms of contrast media have been used to improve medical imaging. Their value has long been recognized, as attested to by their common daily use in imaging departments worldwide. Like all other pharmaceuticals, however, these agents are not completely devoid of risk.” –ACR Manual on Contrast Media- Version 10.1, 2015

The majority of the following guidelines and policies are derived, many times verbatim, from the ACR Manual on Contrast Media Version 10.1, 2015. Additional references will be provided as needed or requested.

The major purpose of these guidelines and policies is to assist attending and resident radiologists, technologists, and referring clinicians in recognizing and managing the small but real risks inherent in the use of intravenous gadolinium-based contrast agents (GBCA) utilized at the University of Toledo Medical Center. The following applies to patients ≥14 years of age unless indicated. Please see separate section regarding patients ≤14 years of age.

As would be appropriate with any diagnostic procedure, preliminary considerations for the referring physician and the radiologist include:

1. Assessment of patient risk versus potential benefit of the contrast assisted examination.
2. Imaging alternatives that would provide the same or better diagnostic information.
3. Assurance of a valid clinical indication for each contrast medium administration.
2. Intravenous use of Gadolinium-Based Contrast

2.1. Policy for Steroid Preparations for Allergic-like Reactions

A. Background
The overall incidence for acute allergic-like reactions is extremely low with Gadolinium-based contrast. With regard to specific risk factors, a history of a prior allergy-like reaction is associated with an eight fold increased likelihood of the patient experiencing a subsequent reaction.

Although there is no cross-reactivity for patients who had previous allergic-like reactions to iodinated contrast, they are at an increased risk to an acute reaction to gadolinium-based contrast, but the benefit of a premedication regimen does not sufficiently outweigh the risk to warrant premedication.

B. Purpose
Improve patient safety by identifying at risk patients for allergic-like reactions to gadolinium-based contrast and recommend standardized premedication regimens when such a patient is identified.

C. Scope
All health care professionals involved in caring for patients in whom intravenous gadolinium-based contrast is administered.

D. Procedure
I. The technologist will screen all patients for any prior allergic-like reaction to gadolinium-based contrast prior to gadolinium-based contrast administration.
   a. Allergic-like reactions include any mild to severe reactions as follows:
      i. Skin Reactions (Hives, rash, erythema, itching, nasal congestion)
      ii. Facial or body edema
      iii. Bronchospasm
      iv. Laryngeal edema
      v. Difficulty breathing
      vi. Anaphylaxis (Tachycardia and hypotension)
      vii. Any reaction requiring hospitalization or ER visit
      viii. Cardiopulmonary Arrest
   b. This does not include:
      i. Vasovagal reaction
      ii. Nausea
      iii. Vomiting
II. Any patient found to have an above prior allergic-like reaction to gadolinium-based contrast will require a premedication regimen (see recommendations below) prior to intravenous administration.

III. In circumstances where the ordering physician requests gadolinium–based contrast without a premedication regimen despite a known allergic-like reaction, the injection will need to be directly supervised by a physician and the necessity for negating the radiology policy is to be documented in the medical chart.

IV. In circumstances where premedication is required, consideration should be given to performing the examination without intravenous contrast if diagnostic information can be obtained or considering alternate imaging such as US or CT.

V. Health care providers may choose to provide premedication regimens in other circumstances but that is at their discretion and not required for gadolinium-based contrast administration in the department of radiology.

2.1.1. Recommended Premedication Regimens

Standard Oral Preparation Regimen:
- Prednisone – 50 mg PO, 13, 7, and 1 hour prior
- Diphenhydramine – 50 mg PO 1 hour prior

Alternate Intravenous Preparation Regimen:
- Hydrocortisone – 200 mg IV 13, 7, and 1 hour prior
- Diphenhydramine - 50 mg IM or IV 1 hour prior

Urgent Intravenous Preparation Regimen:
- Diphenhydramine – 50 mg PO, IV or IM 1 hour prior; if blood pressure permits

Notes:
If clinician prefers methylprednisolone 40 mg IV can be substituted for hydrocortisone, dose for dose.

If an outpatient requires diphenhydramine, they will need to arrange for transportation, due to the possibility of drowsiness.
2.2. Policy for Minimizing Risk of NSF from GBCA Exposure

A. Background
At approved MR doses there is no nephrotoxicity from gadolinium-based contrast. Evidence suggests an association with Nephrogenic Systemic Fibrosis (NSF) with certain formulations of gadolinium-based contrast when administered intravenously in the setting of chronic kidney disease and acute kidney injury. The mechanism is probably related to prolonged clearance times causing free gadolinium ions to form insoluble precipitate, which deposit in various tissues and cause a subsequent fibrotic reaction.

Different formulations of gadolinium-based agents have different risk profiles. A recently FDA approved gadolinium-based contrast agent gadoteric acid (Dotarem) has no reported cases of NSF in over 25 years of use in Europe and is therefore considered to have the safest risk profile. Gadodiamide (Omniscan) is contraindicated in patients with eGFR < 30 as it has the most reported cases of NSF.

The department will use screening estimated glomerular filtration rate (eGFR) calculated using the Modification of Diet in Renal Disease (MDRD) formula (see Appendix A).

B. Purpose
Improve patient safety by identifying at risk patients for NSF through eGFR screening, subsequently decreasing their exposure to gadolinium-based contrast.

C. Scope
All health care professionals involved in caring for patients in whom intravenous gadolinium-based contrast is administered.

D. Procedure
I. The technologist will screen all outpatients for any of the following NSF risk factors:
   i. Acute kidney injury or acute renal failure
   ii. End-stage renal disease on chronic dialysis.
II. If a contrasted MRI is deemed clinically necessary under these circumstances the patient will require informed consent (see separate consent) by the referring physician, attending or resident radiologist prior to contrast administration.
   i. The gadolinium-based contrast agent administered will only be Dotarem with the dose limited to 0.1 mmol/kg (maximum of 20 ml).
   ii. Any readministration of contrast will not be performed for at least 1 week.
III. If a patient is on chronic dialysis an eGFR screening is not required.
   i. Every consideration should be made to perform a noncontrast study or another diagnostic test.
   ii. If contrast enhanced MRI is considered absolutely necessary consent should be obtained, Dotarem should be used (see dose above) and prompt post-procedural hemodialysis should be performed.
   iii. Peritoneal dialysis is not considered protective.

IV. In the setting of suspected or known acute kidney injury, gadolinium-based contrast should be avoided unless absolutely necessary.

2.3. Pregnant or Potentially Pregnant Patients
A. Background
   It is unclear how gadolinium-based contrast agents affect the fetus and should be administered with caution and only when there is substantial benefit to the risk of GBCAs administration.

B. Purpose
   Improve patient safety by minimizing exposure of the pregnant or potentially pregnant patient to intravenous gadolinium-based contrast agents.

C. Scope
   All health care professionals involved in caring for pregnant or potentially pregnant patients in whom intravenous gadolinium-based contrast agents may be administered.

D. Procedure
   I. The technologist will screen all patients prior to imaging for the potential of pregnancy (see separate policy details).
   II. If a patient is found to be pregnant an attending or resident radiologist should confer with the requesting physician.
   III. If contrast is deemed necessary the following should be documented in the diagnostic report:
      i. The diagnostic information cannot be obtained without the use of the GBCA or other modalities.
      ii. The diagnostic information needed affects the care of the patient and/or fetus during the pregnancy.
      iii. 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.
      iv. Informed consent must be obtained (see separate consent) and scanned into the medical record.
2.4. Breast Feeding Women

Imaging studies with GBCAs contrast may be needed in breast-feeding women. GBCAs contrast has a half-life of 2 hours with nearly 100% clearance by 24 hours in the setting of normal renal function.

The infant through the GI tract absorbs less than 0.0004% of the administered mother’s dose, which is far less than the recommended dose for infants. The risk for toxic or allergic-like reactions resulting from the ingested contrast is therefore remote.

Therefore, it is believed to be safe for mothers to continue breast-feeding after receiving intravenous GBCAs.

If the patient wishes to abstain from breast-feeding despite the above facts, stopping for a period longer than 24 hours has no benefit.

3. Intravenous Gadolinium-Based Contrast Media in Children

A. Background

Principles regarding contrast media in children and their adverse events are similar to the above adult recommendations as it relates to allergic-like reactions, extravasations, and NSF.

B. Purpose

Improve pediatric patient (defined as under 14 years of age) safety prior to intravenous gadolinium-based contrast administration.

C. Scope

All health care professionals involved in caring pediatric patients (defined as under 14 years of age) in whom intravenous gadolinium-based contrast agents may be administered.

D. Procedure

I. The technologist will screen for pregnancy, prior allergic-like reactions, and risk factors associated with NSF as already detailed above.

II. The bedside Schwartz equation (see Appendix B) for estimated GFR will be utilized.

III. Given the limited number of neonatal and pediatric cases performed at the University of Toledo Medical Center, all patients 14 years or younger that a contrast (iodinated or GBCA) study is requested will be need approval by the attending or resident radiologist prior to intravenous contrast administration. See separate Standard Operating Procedure P-02.
IV. Standard dosing of intravenous contrast agents per the package inserts will be followed.

V. Premedication regimens for prior allergic-like reactions will require weight based dosing.

See separate documents for consents and screening sheets.

Appendix A

**MDRD equation:**

\[
eGFR \text{ (ml/min/1.73 m\(^2\))} = 175 \times (\text{serum creatinine in mg/dl})^{-1.154} \times (\text{age in years})^{-0.203} \times (0.742 \text{ if female}) \times (1.212 \text{ if African American})
\]

Appendix B

**Beside Schwartz Equation:**

\[
\text{GFR (mL/min/1.73 m\(^2\))} = (0.41 \times \text{height})/\text{serum creatinine}
\]

- Height in cm
- Serum creatinine in mg/dL