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Introduction
Contrast media is used to improve medical imaging. Various forms of contrast media can be administered intravenously, intra-arterially, or intraluminally. Contrast media is considered a pharmaceutical agent and like all other pharmaceuticals, contrast media is not completely devoid of risk. The purpose of these guidelines is to assist the radiologist in managing the small but real risks inherent in the use of contrast media.

Patient selection
Before any administration of contrast media, the radiologist should consider the following:
1. Assessment of risk versus benefit of the contrast administration
2. Alternate imaging that would provide the same or better diagnostic information without need for contrast media
3. Valid clinical indication for contrast administration

Administrative Process for Contrast Administration
Request for Examination
1. Should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.
   a. This should include: signs and symptoms and/or 2) relevant history (including known diagnoses).

Administration Requirements
1. The radiology team (radiologist and/or designee) will review the imaging request, determine the study that requires contrast administration or not, and select the appropriate established clinical division protocol. This protocol will be for the imaging technologist to follow when performing the imaging procedure.
   a. If the imaging request is protocolled by an imaging technologist per established clinical division protocol, the protocoling radiologist is the clinical division chief.
2. A radiologist must be available for timely intervention in the event of an emergency.
3. Upon arrival to the department, the contrast screening form must be completed and reviewed for any contraindications or serious risk factors prior to contrast administration.
4. The imaging technologist or nurse responsible for the administration of contrast media will check imaging orders and protocol for contrast.
   a. If contrast is indicated, the imaging technologist or nurse will enter order for contrast in the EMR and sign the order for contrast Dosage is determined by clinical division protocol and body weight per manufacturer's medication recommendations.
      i. The order mode is per protocol; no cosign required.
      ii. The ordering and authorizing provider is the original ordering provider.
Intravenous iodinated contrast media

Parameters for assessing patients requiring IV iodinated contrast media
1. All patients with a serum creatinine < 2.0 are eligible for intravenous iodinated contrast administration.
2. All patients > 60 years old require a serum creatinine performed within the last 30 days.
3. Patients < 60 years old, scheduled for a routine intravascular study, and do not have one or more risk factors (listed below), do not require a baseline serum creatinine determination before iodinated contrast medium administration.
4. Administration of intravenous contrast with serum creatinine < 2.0 requires discussion with radiologist. The radiologist should consider discussing the risks of contrast-induced nephropathy with a member of the patient’s care team, which may include the requesting physician or physician extender prior to approval of contrast administration.

Risk factors that may require serum creatinine determination
1. Renal disease: Patients with a history of significant renal disease (e.g. may result in impaired renal function), nephrectomy, kidney transplant, or recognized upward trend in creatinine may have a point of care creatinine performed at the discretion of the nurse, technologist, radiologist, or ordering provider.
2. Recent intravenous contrast: All patients who have received IV iodinated contrast in the last 24 hours require approval by a radiologist for additional intravenous contrast media administration and may have a point of care creatinine performed at the discretion of the nurse, technologist, radiologist, or ordering provider.

Emergency patients
1. The ordering physician can choose to bypass screening in an emergency and have IV contrast administered without screening. This screening process bypass must be documented by the nurse, technologist or the ordering physician in the study note. The ordering physician’s name must be included in the documentation.

Gadolinium

1. Eligibility criteria for administration of intravenous gadolinium are described in the policy Intravenous Contrast agents in MRI.
Specific conditions

1. **Allergic-Like and Physiologic Reactions to Intravascular Contrast Media**
2. **Premedication Guidelines**
3. **Renal Insufficiency and Contrast Induced Nephropathy**
4. **Pregnant or Breast-Feeding patients**
5. **Myasthenia Gravis**: This condition may be a relative contraindication for intravenous administration of iodinated contrast media (1, 3).
6. **Thyroid Disease**:
   a. Hyperthyroidism: patients with hyperthyroidism or other thyroid disease can potentially experience iodine-provoked delayed hyperthyroidism. This effect may appear 4-6 weeks after IV administration of iodinated contrast media. This condition is usually self-limited. However, patients with history of hyperthyroidism should follow-up with their endocrinologists after receiving iodinated contrast media (1, 4).
   b. Thyroid carcinoma: Iodinated contrast media may interfere with both diagnostic scintigraphy and radio-iodine treatment. Therapeutic uptake of $^{131}$I radiiodine therapy may be decreased substantially after iodinated contrast injection. Patients are required to wait a minimum of 4 weeks (preferably 6 weeks) after receiving intravenous iodinated contrast administration, before undergoing either $^{123}$I diagnostic scintigraphy or $^{131}$I radiiodine therapy (1, 4).
7. **Dialysis**: Most low-osmolality iodinated contrast media are not protein-bound, have relatively low molecular weights, and are readily cleared by dialysis. Unless an unusually large volume of contrast medium is administered, or there is substantial underlying cardiac dysfunction, there is no need for urgent dialysis after IV contrast medium administration (1).

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**Allergic-Like and Physiologic Reactions to Intravascular Contrast Media**

The frequency of allergic-like and physiologic adverse events related to intravascular administration of contrast media is low. The majority of adverse side effects are mild, non-life threatening events that usually require only observation, reassurance, and/or supportive measures. Severe and potentially life-threatening adverse events continue to occur rarely and unpredictably. Nearly all life-threatening contrast reactions occur within the first 20 minutes after contrast medium injection.

All personnel who inject intravascular contrast media should be prepared to:

1. Recognize the variety of adverse events that may occur following ICM administration.
2. Institute appropriate measures to manage the reaction, which include notifying the supervising radiologist (or his/her designee) and radiology nurse; monitoring the patient, administering certain medications, and/or calling for additional service providers, “code team”, etc.).
Common Risk Factors for Acute Contrast Reactions
Although it is clear that certain patients are at increased risk of experiencing an adverse event to intravascular contrast medium, contrast reactions remain sporadic and unpredictable.

1. A history of previous allergic-like reaction to iodinated contrast medium (ICM). Please note: such a history is not an absolute predictor, and the incidence of recurrent allergic-like reactions in high-risk non-premedicated patients is unknown.
2. Atopic individuals (particularly those with multiple severe allergies) and asthmatics are also at increased risk for allergic-like contrast reactions, although probably not to as great an extent.
3. Those with a history of prior allergic-like reaction to gadolinium based contrast agents (GBCA) are at no greater risk for allergic-like reaction to ICM than other patients with a similar number of allergies and other risk factors (e.g., asthma).

Please see Appendix A for additional information regarding allergic-like reactions to contrast media.

Categories of Acute Reactions

<table>
<thead>
<tr>
<th>Mild</th>
<th>Signs and symptoms are self-limited without evidence of progression and include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allergic-like</td>
<td>Limited urticarial / pruritus cutaneous edema</td>
</tr>
<tr>
<td></td>
<td>Limited “itchy” / ”scratch” throat</td>
</tr>
<tr>
<td></td>
<td>Nasal congestion</td>
</tr>
<tr>
<td></td>
<td>Sneezing / conjunctivitis / rhinorrhea</td>
</tr>
<tr>
<td>Physiologic</td>
<td>Limited nausea / vomiting limited</td>
</tr>
<tr>
<td></td>
<td>Transient flushing / warmth / chills</td>
</tr>
<tr>
<td></td>
<td>Headache / dizziness / anxiety / altered taste</td>
</tr>
<tr>
<td></td>
<td>Mild hypertension</td>
</tr>
<tr>
<td></td>
<td>Vasovagal reaction that resolves spontaneously</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moderate</th>
<th>Signs and symptoms are more pronounced and commonly require medical management. Some of these reactions have the potential to become severe if not treated. Moderate reactions include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allergic-like</td>
<td>Diffuse urticarial / pruritus</td>
</tr>
<tr>
<td></td>
<td>Diffuse erythema, stable vital signs</td>
</tr>
<tr>
<td></td>
<td>Facial edema without dyspnea</td>
</tr>
<tr>
<td></td>
<td>Throat tightness or hoarseness without dyspnea</td>
</tr>
<tr>
<td></td>
<td>Wheezing / bronchospasm, mild, or no hypoxia</td>
</tr>
<tr>
<td>Physiologic</td>
<td>Protracted nausea / vomited</td>
</tr>
<tr>
<td></td>
<td>Hypertensive urgency</td>
</tr>
<tr>
<td></td>
<td>Isolated chest pain</td>
</tr>
<tr>
<td></td>
<td>Vasovagal reaction that required and is responsive to treatment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Severe</th>
<th>Signs and symptoms are often life threatening and can result in permanent morbidity or death if not managed appropriately.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allergic-like</td>
<td>Diffuse edema, or facial edema with dyspnea</td>
</tr>
<tr>
<td></td>
<td>Diffuse erythema with hypotension</td>
</tr>
<tr>
<td></td>
<td>Laryngeal edema with stridor and/or hypoxia</td>
</tr>
<tr>
<td></td>
<td>Wheezing / bronchospasm, significant hypoxia</td>
</tr>
<tr>
<td></td>
<td>Anaphylactic shock (hypotension + tachycardia)</td>
</tr>
<tr>
<td>Physiologic</td>
<td>Vasovagal reaction resistant to treatment</td>
</tr>
<tr>
<td></td>
<td>Arrhythmia</td>
</tr>
<tr>
<td></td>
<td>Convulsions, seizures</td>
</tr>
<tr>
<td></td>
<td>Hypertensive emergency</td>
</tr>
</tbody>
</table>
Premedication Guidelines

1. **Steroid prep needed (if no prep given, consult radiologist; if prep given, do not consult radiologist):**
   a. Prior allergic-like contrast reaction (mild, moderate) to the same class of contrast media agent (iodinated/gadolinium)
   b. Prior mild breakthrough reaction. Note: an individual radiologist may elect to not perform the examination in this setting. This decision should be coordinated such as during ordering/scheduling process.

2. **Steroid prep not needed (may scan patient without consulting radiologist):**
   a. Physiologic reaction to contrast media such as nausea or vomiting
   b. Seafood or shellfish allergy (mild or moderate)
   c. Allergy to a different type of contrast agent (e.g., allergy to gadolinium if receiving iodinated contrast or allergy to iodinated contrast if receiving gadolinium)

3. **Contrast media administration is relatively contraindicated (consult radiologist):**
   a. Prior severe reaction to any substance (active angioedema, laryngeal edema, anaphylactic shock) including any type of contrast media agent (iodinated or gadolinium); if such a history is present, please consult a radiologist.
   b. Prior moderate or severe breakthrough reaction. For prior mild breakthrough reaction, contrast media may be administered after a steroid prep (see 1c above)

4. If an alternate prep has been given, consult the radiologist. If all scheduled doses of a full steroid prep (12-13 hours) have been given but the timing is off by 2-3 hours, no consultation is required and the scan can be performed. The initial dose of steroids must precede contrast material administration by not less than 4 hours.

**Elective Prep: 13-Hour Prep (Greenberger Protocol)**

1. **Adults:**
   Prednisone 50 mg (oral) q 6 hours x 3 doses starting 13 hours prior to scan: 13 hours + 7 hours + 1 hour prior to scan
   Optional: Benadryl 50 mg maximum dose 1 hr prior to exam

Steroid Equivalences
Decadron (dexamethasone) 8 mg X 3 doses, IV or oral
OR
Solu-Cortef (hydrocortisone) 200 mg X 3 doses, IV or oral (IV preferred)
OR
Solu-Medrol (Methylprednisolone) 40 mg x 3 doses, IV or oral (IV preferred)

Total Doses required for full strength prep prior to contrast media
50 x 3 = 150 mg Prednisone
8 x 3 = 24 mg Decadron (Dexamethasone)
200 x 3 = 600 mg Solu-Cortef (Hydrocortisone)
40 x 3 = 120 mg Solu-Medrol (Methylprednisolone)

2. Pediatrics:
   a. Prednisone 0.5-0.7 mg/kg PO (up to 50 mg) q 6 hours x 3 doses starting 13 hours prior to scan: 13 hours + 7 hours + 1 hour prior to scan
   b. Benadryl (optional) 1.25mg/kg PO 1 hour prior to scan (50 mg maximum dose)

Emergency Prep: 4-hour Prep

Use the following prep when you do not have 13 hours to follow the Greenberger protocol listed above.

1. Adults:
   a. Solu-Medrol (Methylprednisolone) 60 mg IV Q 4 hours x 2 doses prior to contrast administration (the first dose is given 4 hours prior to the scan and the second dose is given before the patient is put on the CT table)
   b. Benadryl (Diphenhydramine) 25-50 mg IV one-hour prior to scan (per Radiologist)

2. Pediatrics:
   a. Please consult radiologist for further instructions.

Contrast Extravasation

1. Risk Factors:
   a. Non-communicative patients: infants, small children, non-English speaking and unconscious
   b. Small peripheral veins (hands and feet)
   c. Injection of an older IV line
   d. Multiple attempts at IV access
   e. Abnormality in limb to be injected (trauma, lymphedema, etc.)
   f. Higher injection rates (4-5 mL/sec)

2. Sequela of Extravasations:
Iodinated contrast media is toxic to surrounding tissues/skin resulting in an acute local inflammatory response. The vast majority of patients recover with no significant injury.

Possible significant injuries include:

a. Compartment syndrome: more likely to occur with large volumes or injection in a small tight space (i.e. ventral or dorsal surface of wrist)
b. Skin ulceration/blister/tissue necrosis

3. Actions/Treatment:

1. Document extravasation as incident report using the RLS Safety Reporting System (SRS) 
   https://rlapp.dhe.duke.edu
2. Document via study note

Renal Insufficiency and Contrast Induced Nephropathy

Information included in the ACR Manual on Contrast Media

Pregnant or Breast-Feeding patients

1. Pregnant or Potentially Pregnant patients

Iodinated contrast agents

Diagnostic iodinated contrast media have been shown to cross the human placenta and enter the fetus when given in the usual clinical doses. For those patients who are known to be pregnant or may be pregnant and for whom iodinated IV or (or internal) contrast enhancement is most appropriate for performance of the CT examination, there is no need to get signed, informed consent to use contrast media.

2. Breast Feeding Patients

Iodinated contrast agents

Per the ACR Manual on Contrast Media, it is safe for the mother and infant to continue breast-feeding after receiving iodinated contrast agents. An informed decision to temporarily stop breast-feeding 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 12-24 hours (“pump-and-dump”).
Pediatric Considerations

1. **IV Iodinated Contrast Kidney Screening Pediatric CT (in general applies to patients <16 years)**

**General Procedures**
1. Check the computer for prior SCr value for all patients.
2. If the history of significant kidney disease question is answered “no” and/or e-GFR is normal, then administer Isovue 300 (unless radiologists requests Isovue 370) per standard protocol weight-based protocol.
3. If the history of kidney disease question is answered “yes”, a Cr POC must be ordered unless there is a SCr result available within the last 6 months. Draw SCr and calculate e-GFR using the appropriate formula for age.
   a. SCr within 6 months of contrast administration is suitable for any outpatient without an acute history needing e-GFR calculation.
4. If e-GFR >60 ml/min/1.73 m², administer Isovue per standard protocol.

**Positive response to the history of kidney disease question and/or reduced e-GFR**
1. If e-GFR <60 and >30 ml/min/1.73 m²
   a. Contact radiologist to review
   b. Administer Isovue at standard dose (2ml/kg) - 50% reduced dose (1ml/kg) based on the scan indication
   c. Nursing or MD will notify the ordering provider of e-GFR <60 ml/min/1.73 m² and suggest consultation with nephrologist/urologist. Radiologist should be available to speak to ordering provider as well if needed.
   d. Document action in a nursing note.
   e. If contrast is warranted administer Isovue at standard dose (<2ml/kg) per the scan indication

2. If e-GFR <30 ml/min/1.73 m², or patients with acute kidney failure
   a. Notify radiologist.
   b. Consider non-contrast CT
   c. Nursing or MD will contact the ordering provider to request consult with nephrologist/urologist. A formal consult must be completed prior to any IV iodinated contrast administration. Rescheduling may be necessary. Radiologist will be available to speak to ordering provider if needed.
   d. Document action taken in a nursing note.

**Special Populations**
1. All pediatric ICU patients must have a SCr drawn and e-GFR calculated within 24 hours of IV contrast administration.
2. Patients on long-term hemodialysis do not require a SCr to be drawn. Standard dose of Isovue will be given per standard protocol. Referring service should be notified prior to administration.
Emergency patients
The ordering physician can choose to bypass screening in an emergency and have IV contrast administered without screening. This screening process bypass must be documented by the nurse, technologist or the ordering physician via study note. The ordering physician’s name must be included in the documentation.

Use of Serum Creatinine to evaluate renal function
1. Glomerular Filtration Rate (GFR) or Creatinine Clearance (CrCl) is calculated using the appropriate calculation equation depending upon serum creatinine testing method:
   a. Serum Creatinine use:
      i. No calculation for patients less than 1 year of age.
      ii. Use serum creatinine to evaluation renal function; should be < 0.54mg/dL.
   ii. For patients 1 to 16 years old
      Use the “Bedside Schwartz Equation”:
      \[
      \text{Age} = \frac{0.413 \times \text{Height}}{\text{SCr}}
      \]

   Age = age in years
   SCr = serum creatinine concentration in mg/dL
   Height = height/length in centimeters

Non-vascular Contrast Media
Contrast media may be administered into the body through the gastrointestinal tract, genitourinary tract, cutaneous fistulae, lymphatics, and intrathecal space. Adverse reactions to non-vascular contrast agents are rare; however, the appropriate management of contrast media in this setting is described in this section.

Barium sulfate
Barium contrast agents are frequently used for outpatient conventional fluoroscopic gastrointestinal studies and as an oral agent for some abdominal/pelvic CT scans (Redicat, Volumen).

Complications
1. Allergic-like reactions to Barium are exceedingly rare. If a patient reports a history of allergic-like reaction to Barium, then an alternate intraluminal agent (Isovue or Gastrografin) may be substituted. Alternatively, if the reported reaction is mild, the patient may undergo a standard steroid pre-medication (see pages 6-8).
2. Leakage into the pleural space, mediastinum, or peritoneal cavity: Barium leakage can lead to mediastinitis or peritonitis and is contraindicated in situations where extraluminal leakage is possible.
3. Aspiration: While Barium is generally inert when aspirated, large volume aspiration can lead to inflammation or pneumonia and therefore should be avoided in patients at risk for aspiration.

Iodinated contrast media
Water-soluble iodinated contrast media agents which are specifically designed for enteric opacification can be used for certain indications. These include, but not limited to, suspected bowel perforation, leak, or to confirm feeding tube position.

Complications
1. High-osmolar contrast media agents, e.g. Gastrografin: these agents are hypertonic and if aspirated can cause a life-threatening pulmonary edema and pneumonitis. These agents are contraindicated in patients at risk for aspiration. In these patients, low-osmolar contrast media agents, e.g. Isovue, should be substituted.
2. Allergic-like reactions to luminal administration of iodinated contrast media are rare. Nonetheless, the potential for systemic absorption of iodinated contrast media exists. Therefore, patient with a history of allergic like reaction to contrast media should be treated the same as if receiving intravenous dosing and undergo steroid pre-medication if appropriate (see pages 6-8).
References

Appendix A

Frequently Asked Questions Regarding Pretreatment in Pediatric and Adult Patients with a History of Allergy-like Reactions to Contrast

1. If a patient has a prior reaction (mild/moderate) to contrast media, should we generally begin a pretreatment regimen?
   Yes, a pretreatment regimen with steroids should be prescribed.

2. If a patient has a mild or moderate allergy to shellfish, should we begin a pretreatment regimen?
   No.

3. If a patient has multiple allergies but no documented reaction to iodinated contrast media, should we begin a pretreatment regimen?
   This is a controversial area. In general, no, but a strong history of allergies should increase awareness of the risk for reaction. In most cases, there is no need to avoid injection of contrast media in a patient with multiple mild or moderate allergies.

4. If a patient has a remote history of an allergic reaction to contrast media, but has had intervening, uneventful, contrast enhanced scans without a prep, should they receive a pretreatment regimen with steroids?
   No, in general, but these patients remain at risk for an adverse reaction. This is a controversial area.

5. If a patient with a prior contrast media reaction has undergone a steroid prep, what is their risk for a reaction?
   The risk is lowered but a breakthrough reaction may occur.

6. If a patient has had a severe and life-threatening reaction to contrast media (such as anaphylaxis) should we pretreat them?
   We should avoid administration of iodinated contrast media to such patients. An alternative imaging procedure should be considered. If a contrast enhanced scan is deemed absolutely necessary, a steroid prep should be given.
7. If a patient has had a steroid prep that differs from the Duke steroid prep, should we cancel the study and reschedule with a Duke prep?
No. There are several appropriate steroid preps that have been recommended. It is not clear whether one prep is advantageous over another. In these scenarios, consult the radiologist. If all scheduled doses of a full steroid prep (12-13 hours) have been given but the timing is off by 2-3 hours, no consultation is required and the scan can be performed.

8. If a patient has had a prior breakthrough reaction, should they be prevented from having another contrast-enhanced exam?
The answer depends on the severity of the reaction. Prior moderate or severe breakthrough reaction (anaphylaxis, laryngeal edema, hypotension): The patient should in general not be exposed to the same class of contrast (iodinated / gadolinium), regardless of premedication. Prior mild breakthrough reaction (itching, rash, hives): The patient can safely receive contrast if premedicated. An individual radiologist may elect to not perform the examination in this setting. This decision should be coordinated such as during ordering/scheduling process.

9. What is the likelihood that a patient will have a severe contrast reaction?
   - Patients with no risk factors have a risk of 4 in 10,000.
   - Patients with a history of a prior contrast reaction have a risk of 18 in 10,000.
   - Patients with a history of asthma have a reported risk of 23 in 10,000, but this data is likely somewhat skewed.
   - Patients with a history of a prior contrast reaction that are premedicated have a theoretical risk that is similar to someone with no risk factors. This has not been confirmed experimentally.

10. If someone has a reaction history to iodinated contrast, should they be premedicated before gadolinium contrast exposure (or vice versa)?
No

11. What is the definition of a mild, moderate, and severe reaction? Are all adverse events considered contrast media reactions?
The definitions are not set in stone, but these are the most commonly published categories:
   a. Mild (prep needed) – Rash, scattered hives, mild facial swelling, sneezing, cough, nasal stuffiness
   b. Moderate (prep needed) – Mild laryngeal edema (“scratchy throat”, hoarseness), without dyspnea, wheezing without hypoxia, diffuse urticaria, significant facial swelling
   c. Severe (avoid test altogether; if no other option, prep needed) – Severe respiratory distress, moderate or severe laryngeal edema, cardiopulmonary arrest, anaphylactic shock (hypotension and tachycardia)
d. Not an allergic-like reaction (no prep needed) – Nausea, flushing, vomiting, sensation of warmth
Appendix B

Basic Management of Adverse Reactions to Contrast Media

Adults:

ALL ADVERSE EVENTS
1. Stay calm
2. Obtain vital signs
3. Get help
4. Communicate with the patient (before and after treatment)
5. At conclusion, call referring physician
6. At conclusion, document in the medical record

URTICARIA:
1. No treatment needed in most cases
2. If severe: Diphenhydramine (Benadryl) 25-50 mg PO, IM, or IV
3. Patients receiving Benadryl need a driver

LARYNGEAL EDEMA:
1. Call a code (115)
2. Oxygen 10L/min by facemask
3. ADULT Epi Kit: 0.3 mL IM (1:1000 sol) repeat every 5-15 min up to 3 times. Available on Omnicell medication cart. IM is the preferred initial treatment route.
4. Epinephrine 1-3 mL IV (1:10,000 sol); inject slowly up to 10 mL
5. Do not intubate. Use bag-mask ventilation if needed

ANGIOEDEMA (DIFFUSE ERYTHEMA AND HYPOTENSION)
1. Call a code (115)
2. Oxygen 10L/min by facemask
3. ADULT Epi Kit: 0.3 mL IM (1:1000 sol) repeat every 5-15 min up to 3 times. Available on Omnicell medication cart. IM is the preferred initial treatment route. Note that with profound hypotension, decreased peripheral perfusion may limit IM absorption.
4. Epinephrine 1-3 mL IV (1:10,000 sol); inject slowly up to 10 mL
5. Do not intubate. Use bag-mask ventilation if needed.
6. Isotonic IV fluids (normal saline or Lactated Ringer’s)
   • One or more liters wide open
7. Raise legs 60 degrees
8. Remove compression if present

MILD / MODERATE BRONCHOSPASM
1. Oxygen 10L/min by facemask
2. Albuterol 2-3 puffs with spacer (If spacer available)
3. Do not intubate. Use bag-mask ventilation if needed.
4. See below if condition worse
MODERATE/SEVERE BRONCHOSPASM:
1. Call a code (115)
2. Oxygen 10L/min by facemask
3. ADULT Epi Kit: 0.3 mL IM (1:1000 sol) repeat every 5-15 min up to 3 times. Available on Omnicell medication cart. IM is the preferred initial treatment route.
4. Epinephrine 1-3 mL IV (1:10,000 sol); inject slowly up to 10 mL
5. Do not intubate. Use bag-mask ventilation if needed

HYPOTENSION WITH TACHYCARDIA (ANAPHYLACTIC SHOCK):
1. Call a code (115)
2. Oxygen 10L/min by facemask
3. ADULT Epi Kit: 0.3 mL IM (1:1000 sol) repeat every 5-15 min up to 3 times. Available on Omnicell medication cart. IM is the preferred initial treatment route. Note that with profound hypotension, decreased peripheral perfusion may limit IM absorption
4. Epinephrine 1-3 mL IV (1:10,000 sol); inject slowly up to 10 mL
5. Do not intubate. Use bag-mask ventilation if needed
6. Isotonic IV fluids (normal saline or Lactated Ringer’s)
   - One or more liters wide open
7. Raise legs 60 degrees
8. Remove compression if present

HYPOTENSION WITH BRADYCARDIA • VASOVAGAL REACTION
1. Oxygen 10L/min by facemask
2. Raise legs 60 degrees
3. Remove compression
4. Medications not normally needed
5. If persistent:
   - Isotonic IV fluids (normal saline or Lactated Ringer’s)
     - One or more liters wide open
6. Atropine 0.6-1.0 mg IV slowly into running fluids, repeat up to 3 mg total
7. Call a code if persistent hypotension (115)

HYPERTENSION, SEVERE (Diastolic BP > 12 mmHg; systolic BP > 200 mm Hg):
1. Oxygen 10L/min by facemask
2. Labetalol 20 mg IV; administer slowly over 2 min; double dose every 10 min (e.g. 40 mg 10 min later, 80 mg 10 min after that)
3. Watch for iatrogenic bradycardia or heart block
4. If labetalol is not available:
   1. Furosemide (Lasix) 20-40 mg IV slowly over 2 min
   2. Nitroglycerine 0.4 mg SL; repeat every 5-10 min

PULMONARY EDEMA:
1. Oxygen 10L/min by facemask
2. Elevate head
3. Stop IV fluids
4.  Furosemide (Lasix) 20-40 mg IV slowly over 2 min

**Pediatrics:**

**ALL ADVERSE EVENTS**
1. Stay calm
2. Obtain vital signs
3. Get help
4. Communicate with the patient (before and after treatment)
5. At conclusion, call referring physician
6. At conclusion, document in the medical record

**URTICARIA:**
1. No treatment needed in most cases
2. If severe: Diphenhydramine (Benadryl) 1 mg/kg (max 50 mg) PO, IM, or IV slowly over 1-2 min
3. Patients receiving Benadryl need a driver

**LARYNGEAL EDEMA:**
1. Call a code (115)
2. Oxygen 6-10L/min by facemask
3. 15 - 30 kg: PEDIATRIC Epi Kit--0.15 mL IM (1:1000 sol) repeat every 5-15 min up to 3 times. Available on Omnicell medication cart. IM is the preferred initial treatment route.
   < 15 kg: Epinephrine 0.01 mL/kg IM (1:1000 sol); max single dose of 0.30 mL (0.3 mg); can repeat every 5-15 min up to 1 mL total dose
   > 30 kg: use ADULT Epi Kit, as above
4. Epinephrine 0.1 mL/kg IV (1:10,000 sol); inject slowly, max single dose of 1 mL (0.1 mg); can repeat every 5-15 min up to 1 mL total dose
5. Do not intubate. Use bag-mask ventilation if needed.

**ANGIOEDEMA (DIFFUSE ERYTHEMA AND HYPOTENSION)**
1. Call a code (115)
2. Oxygen 6-10L/min by facemask
3. 15 - 30 kg: PEDIATRIC Epi Kit--0.15 mL IM (1:1000 sol) repeat every 5-15 min up to 3 times. Available on Omnicell medication cart. IM is the preferred initial treatment route.
   < 15 kg: Epinephrine 0.01 mL/kg IM (1:1000 sol); max single dose of 0.30 mL (0.3 mg); can repeat every 5-15 min up to 1 mL total dose
   > 30 kg: use Adult Epi Kit, as above
   Note that with profound hypotension, decreased peripheral perfusion may limit IM absorption
4. Epinephrine 0.1 mL/kg IV (1:10,000 sol); inject slowly, max single dose of 1 mL (0.1 mg); can repeat every 5-15 min up to 1 mL total dose
5. Do not intubate. Use bag-mask ventilation if needed.
6. Isotonic IV fluids (normal saline or Lactated Ringer's)
   • One or more liters wide open
7. Raise legs 60 degrees
8. Remove compression if present

MILD BRONCHOSPASM
1. Oxygen 6-10L/min by facemask
2. Albuterol 2-3 puffs with spacer (If spacer available)
3. Do not intubate. Use bag-mask ventilation if needed
4. See below if condition worsens

MODERATE/SEVERE BRONCHOSPASM:
1. Call a code (115)
2. Oxygen 6-10L/min by facemask
3. 15 - 30 kg: PEDIATRIC Epi Kit--0.15 mL IM (1:1000 sol) repeat every 5-15 min up to 3 times. Available on Omnicell medication cart. IM is the preferred initial treatment route.
   < 15 kg: Epinephrine 0.01 mL/kg IM (1:1000 sol); max single dose of 0.30 mL (0.3 mg); can repeat every 5-15 min up to 1 mL total dose
   > 30 kg: use Adult Epi Kit, as above
4. Epinephrine 0.1 mL/kg IV (1:10,000 sol); inject slowly, max single dose of 1 mL (0.1 mg); can repeat every 5-15 min up to 1 mg total dose
5. Do not intubate. Use bag-mask ventilation if needed.

HYPOTENSION WITH TACHYCARDIA (ANAPHYLACTIC SHOCK):
1. Call a code (115)
2. Oxygen 6-10L/min by facemask
3. 15 - 30 kg: PEDIATRIC Epi Kit--0.15 mL IM (1:1000 sol) repeat every 5-15 min up to 3 times. Available on Omnicell medication cart. IM is the preferred initial treatment route.
   < 15 kg: Epinephrine 0.01 mL/kg IM (1:1000 sol); max single dose of 0.30 mL (0.3 mg); can repeat every 5-15 min up to 1 mL total dose
   > 30 kg: use Adult Epi Kit, as above
   Note that with profound hypotension, decreased peripheral perfusion may limit IM absorption
4. Epinephrine 0.1 mL/kg IV (1:10,000 sol); inject slowly, max single dose of 1 mL (0.1 mg); can repeat every 5-15 min up to 1 mg total dose
5. Do not intubate. Use bag-mask ventilation if needed.
6. Isotonic IV fluids (normal saline or Lactated Ringer's)
   • One or more liters wide open
7. Raise legs 60 degrees
8. Remove compression if present
HYPOTENSION WITH BRADYCARDIA • VASOVAGAL REACTION

1. Oxygen 6-10L/min by facemask
2. Raise legs 60 degrees
3. Remove compression if present
4. If mild, medications not normally needed
5. If persistent: Call a code (115)
6. Isotonic IV fluids (normal saline or Lactated Ringer's)
7. Atropine 0.2 mL/kg of 0.1 mg/mL solution IV slowly in running fluids; minimum single dose 0.1 mg; maximum single dose 0.6-1.0 mg; maximum total dose 1 mg for infants and children, 2 mg for adolescents

PULMONARY EDEMA:

1. Oxygen 6-10L/min by facemask
2. Elevate head
3. Stop IV fluids
4. Furosemide (Lasix) 0.5-1.0 mg/kg; over 2 min; maximum 40 mg
Appendix C

EPI-KIT Guidelines

IM administration will be used as the first option for all patients (even with existing lines) with anaphylactic or potentially anaphylactic reactions. All department Omnicells now contain epi-pen equivalent kits for IM administration with instructions on each kit (see picture). There is an adult kit and a pediatric kit; the weight appropriate for the pediatric kit is printed on the kit. There are Omnicell cabinets in every area of radiology where contrast is administered, except the offsite locations. They have drug boxes. The residents, fellows, and faculty do not have Omnicell access, so retrieving the kits will require nursing staff.

Adult Anaphylaxis Kit

Pediatric Anaphylaxis Kit