Effectiveness of High-Fidelity Simulation on Radiology Trainees in the Diagnosis and Management of Adverse Contrast Reactions

Anup Alexander MD, Rishi Ramakrishna MD, Carina Yang MD
Disclosure

• The authors have no actual or potential conflict of interest in relation to this program/presentation.
Background

• Cochran et al. (2009) reports a 0.7% incidence of adverse contrast media reactions for nonionic iodinated contrast.
• Although fairly uncommon, contrast reactions are potentially life-threatening events that require prompt recognition and management by radiologists.
• In the setting of a moderate to severe reaction, it is essential that the radiologist be capable of assisting in the diagnosis and management of a contrast reaction until the arrival of a code team.
• Most radiologists have little to no experience in managing serious contrast media reactions - an important and necessary expertise.
Background

• In years past, two didactic lectures were provided to radiology residents highlighting key points such as diagnosis, determination of the severity, and management of a contrast reaction.
• However, Tubbs et al. (2009) suggests didactic lectures alone may not provide adequate training. Additionally, neither the effectiveness of the lectures nor the ability of residents to appropriately act when faced with a contrast reaction has been evaluated.
Purpose

• To equip all participants with the appropriate skills to recognize and manage contrast reactions effectively.
• To emphasize teamwork and crisis management, as well as identify potential barriers to efficiently manage a contrast reaction.
Materials/Methods

• U of C Simulation Center is a high-tech simulation center where emergency codes are routinely run on high-fidelity mannequins.
• A variety of contrast reaction scenarios with differing severity were developed based off the American College of Radiology’s *Manual on Contrast Media* (v9), focusing on recognizing the type of contrast reaction and providing the appropriate immediate management that is indicated.
• 27 radiology trainees (PGY2-6) participated in all 7 scenarios: panic attack, hypertensive crisis, laryngeal edema, cardiovascular shock, bronchospasm, urticaria, and contrast extravasation.
• Following each scenario, participants are debriefed immediately, in a nonjudgmental manner, to help identify areas in need of improvement.
• A pre- and post-simulation subjective survey and objective assessment are administered. The subjective survey evaluates comfort levels while the objective assessment evaluates medical knowledge.
Results

• When prompted "what I learned today will help improve patient outcomes," participants reported an average of 4.6 (1=strongly disagree, 5=strongly agree).
Results

• Subjective evaluations for average comfort level (1=not comfortable, 5=very comfortable) in managing contrast reactions increased from 3.2 to 4.6 ($p<0.001$) following the simulations (left).

• When grouped by post-graduate year (PGY), average comfort levels also demonstrated a statistically significant increase following the simulations (right).
Results

• Average scores on the objective assessment increased from 74% to 84% (p<0.001) (left).

• Average scores increased when grouped by PGY in training although PGY4 and PGY6 groups were not statistically significant (right). This may be due to a low N number.
Results

- Each participant was given a “Quick Card” – a pocket-sized reference card highlighting the management of various contrast reactions based on severity.
- “Quick Card” (below) was posted in the radiology resident on-call room.

<table>
<thead>
<tr>
<th>Adult Reaction</th>
<th>Adult Medications/Dosing</th>
<th>Pediatric Reaction</th>
<th>Pediatric Medications/Dosing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hives</td>
<td>Diphenhydramine 25-50 mg PO/Epi (IM/Pen) 0.3 mg 1:1000 dilution/Epi (IV) 1-3 ml 1:10,000 dilution</td>
<td>Hives</td>
<td>Diphenhydramine 1mg/kg (max 50mg) PO/Diphenhydramine 1mg/kg (max 50mg) PO, IM, IV/Epi (IV) 1-3 ml 1:10,000 dilution</td>
</tr>
<tr>
<td>Erythema</td>
<td>Fluids if hypotensive (1L)/Epi (IM/Pen)/Epi (IV)</td>
<td>Erythema</td>
<td>Fluids if hypotensive (1L)/Epi (IM/Pen)/Epi (IV) - Epi repeat (1 mg total)</td>
</tr>
<tr>
<td>Bronchospasm</td>
<td>Albuterol inhaler/Epi (IM/Pen)/Epi (IV) - Epi up to 3 times (1 mg)</td>
<td>Bronchospasm</td>
<td>Albuterol inhaler/Epi (IM/Pen)/Epi (IV) - Epi repeat (1 mg total)</td>
</tr>
<tr>
<td>Laryngeal Edema</td>
<td>Epi (IM/Pen)/Epi (IV) - Epi up to 3 times (1 mg)</td>
<td>Laryngeal Edema</td>
<td>Epi (IM/Pen)/Epi (IV) - Epi repeat (1 mg total)</td>
</tr>
<tr>
<td>Hypotension (&lt;90)</td>
<td>Fluids/ Atropine IV 0.6 to 1 mg (up to 3 mg) for vasovagal/Epi (IM/Pen)/Epi (IV) - Epi up to 3 times (1 mg) for anaphylactoid</td>
<td>Hypotension (&lt;90)</td>
<td>Fluids/ Atropine IV 0.02mg/kg (0.2ml/kg) (max single dose 1.0mg; max total 1mg children, 2mg adolescents) for vasovagal/Epi (IM/Pen)/Epi (IV) - Epi repeat (1 mg total)</td>
</tr>
<tr>
<td>Hypertensive (S &gt;200; D &gt;120)</td>
<td>Labetalol IV 20 mg over 2 mins (double q 10 mins x 2) or Nitroglycerin SL 0.4 q 5-10 mins plus Lasix IV 20-40 mg over 2 mins</td>
<td>Hypertensive (S &gt;200; D &gt;120)</td>
<td>Lasix IV 0.5-1.0mg/kg over 2 mins (max 40 mg)</td>
</tr>
<tr>
<td>Pulmonary Edema</td>
<td>Lasix IV 20-40 mg IV over 2 mins/ Morphine IV 1-3 mg q 5-10 min PRN</td>
<td>Pulmonary Edema</td>
<td>No meds. O2 only.</td>
</tr>
<tr>
<td>Seizure</td>
<td>Lorazepam IV 2-4 mg administered slowly, max dose of 4 mg</td>
<td>Seizure</td>
<td>No meds. O2 only.</td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>Oral Glucose/D50% IV (25 g) over 2 mins with D5W or D5NS at 100 ml/hr as adjunct/Glucagon IM 1 mg if no IV access</td>
<td>Hypoglycemia</td>
<td>Oral Glucose/D50% IV (25 g) over 2 mins/Glucagon SQ 0.5mg (&lt;20kg) or 1.0mg (&gt;20kg)</td>
</tr>
</tbody>
</table>

Rapid Response Team (RRT) Dial 1-4-7
Provide 1) Location, 2) Room Number, 3) Phone Number
Looking Forward

• We hope that the contrast media reaction simulations can be expanded to include not only radiology trainees, technologists and nurses, but all hospital staff who work with intravenous contrast agents.

• Specialists such as interventional cardiologists, gastroenterologists, and vascular surgeons, among others, would benefit from this valuable curriculum.

• After providing initial training, this course can be used for maintenance of skills and team-based dynamics; the CT technologist manager is submitting the course for approval as a continuing education program.

• Additional contrast media reactions scenarios are being drafted including pediatric cases.

• Prospective analysis on management of future contrast reactions in the radiology department may be performed.
References

ACR Manual on Contrast Media V9. ACR Committee on Drugs and Contrast Media, 2013


Katayama H, Yamaguchi K, Kozuka T, Takashima T, Seez P, Matsuura K. Adverse reactions to ionic and nonionic contrast media. A report from the Japanese Committee on the Safety of Contrast Media. Radiology 1990; 175(3); 621-628
