A Multifaceted Approach to Improving Radiology Resident Proficiency in Managing Acute Adverse Reactions to Intravenous Contrast Administration

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Background

- A wide spectrum of adverse reactions to intravenous contrast media is encountered in the daily practice of radiology
  - Adverse reactions for low-osmolar IV media occur at rate of 0.2-0.7%
  - Per the ACR Contrast Media Guidelines, ongoing quality assurance and quality improvement program for all radiologists is recommended
- Highly variable training models for radiology residents in managing these reactions
- Prior to 2014 at our institution (UT Houston Radiology Department), the model being used consisted of one noon conference lecture with a quiz on contrast allergies
- PDSA cycle performed from a committee of rising second year residents (Class of 2018), and multifaceted intervention was developed

Objectives

- **IOM** aims addressed
  - **Safe**: Avoiding harm to patients from the care that is intended to help them
  - **Patient-centered**: Providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions
  - **Timely**: Reducing waits and sometimes harmful delays for both those who receive and those who give care

- **ACGME Competencies** addressed
  - Practice-Based Learning and Improvement
  - Patient Care and Procedural Skills
  - Systems-Based Practice
  - Medical Knowledge
  - Interpersonal and Communication Skills
  - Professionalism

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Intervention

- Created approach that would be most interactive, and avoided use of didactic lectures

  - Developed plausible contrast reaction scenarios to be run in the Simulation Lab
  - Resident participants viewed interactive PowerPoint modules prior to Simulation Lab Exercise
  - Simulation Lab Day comprised of anxiety, bronchospasm, laryngeal edema, vasovagal reaction and cardiovascular collapse scenarios
  - Evaluation of knowledge gained via pre- and post-intervention surveys

**Bronchospasm Scenario**

**Manikin Person**
- Initial vitals: SBP 110/70
- Age: 47
- Pulse: 97
- RR 20

**Clinical Scenario Person**
- Age: 64 yr old female
- Presenting complaint: Projectile vomit during sleep
- Initial vitals: SBP 110/70
- Pulse 97
- RR 20

**RESIDENT ACTIONS**
- Give 6 mg IV atropine (IV push)
- Monitor cardiac monitor
- Oxygen therapy
- Administer 10 mg IV epinephrine
- Administer 100 mg IV methylprednisolone

**Post Scenario Debriefing Questions:**
1. What were the patient’s primary complaints?
   - Projectile vomit
2. What was the diagnosis?
   - Acute Coronary Syndrome
3. What was the initial management plan?
   - Oxygen therapy
   - Atropine
   - Epinephrine
   - Methylprednisolone

**Severe Contract Reaction Case Study**

**Manikin Person**
- Initial vitals: SBP 110/70
- Age: 47
- Pulse 97
- RR 20

**Clinical Scenario Person**
- Initial vitals: SBP 110/70
- Age: 47
- Pulse 97
- RR 20

**RESIDENT ACTIONS**
- Administer 10 mg IV epinephrine
- Monitor heart rate
- Oxygen therapy
- Endotracheal intubation

**Post Scenario Debriefing Questions:**
1. What were the patient’s primary complaints?
   - Severe contract reaction
2. What was the diagnosis?
   - Severe contract reaction
3. What was the initial management plan?
   - Oxygen therapy
   - Epinephrine
   - Endotracheal intubation
Mean comfort level in the pilot group scored on a scale of 1-10 (1: not prepared at all for any adverse event due to use of intravenous contrast; 10: very well prepared for any adverse event)

- Pre-intervention, the residents rated their comfort level at an average 4.9
- Post-intervention, the residents rated their comfort level at an average 7.5

Analysis of pre and post-intervention test consisting of ten questions
- an improvement in knowledge in 7 of the participants
- no change in 4 participants
- decrease in score (by one point) in 2 participants
Mean comfort level in two subsequent classes (n=25) to undergo training group was scored on a scale of 1-10 (1: not prepared at all for any adverse event due to use of intravenous contrast; 10: very well prepared for any adverse event)
- Pre-intervention, the residents rated their comfort level at an average 4.2
- Post-intervention, the residents rated their comfort level at an average 7.9

Analysis of pre and post-intervention test consisting of ten questions demonstrated:
- an improvement in knowledge in 14 of the participants
- no change in 10 participants
- decrease in score (by one point) in 1 participant

Discussion
- Modules, simulation lab and reference cards were well received by the residents
- “Flipped classroom” model- participants benefitted by preparing for Simulation Lab Day with modules beforehand
- Subjective feedback overwhelmingly positive for both modules and Simulations
- We were able to objectively demonstrate improvement in knowledge in 62% of residents from pre to post-intervention test over four years of implementation
- This new curriculum has been integrated into the training provided to new first year radiology residents at our institution
- Future plans include revising scenarios based on participant feedback, possibly expanding to faculty based upon interest, and evaluating how often re-training should be considered during residency