Chapter 21

Contrast Media and Introduction to Radiopharmaceuticals

Objectives
1. State the purpose of contrast media.
2. Differentiate between low and high subject contrast.
3. Compare negative and positive contrast agents.
4. Name the general types of contrast media used for specific radiographic procedures.
5. List the serious complications of the administration of barium sulfate.
6. Match specific procedures to particular patient instructions.

Objectives
7. Explain the importance of osmosis as it relates to various effects of iodinated ionic contrast media.
8. Discuss the advantages of nonionic iodinated contrast media.
9. Differentiate among the major adverse effects of various contrast agents.
10. Recognize clinical symptoms of adverse reactions to iodinated contrast media to the level of treatment required.
11. Relate the patient history to the possibility of adverse reactions.
12. Introduce the concept of radiopharmaceuticals.
Five (5) Radiographic Densities

Air (gas)
Fat (oil)
Water
Mineral
Metal

Purpose of Contrast Study

To visualize anatomic structures that are not normally seen on a diagnostic medical image

Contrast Media

- Visualizes anatomy normally not seen
- Takes advantage of the photoelectric effect and high-atomic number elements
- Requires the administration of media into patient
- Requires attention to indications and contraindications
- Warrants serious attention to patient reactions
Contrast Media

- Human tissues inherently have low subject contrast with each other
- Generally classified as negative or positive contrast agents
- Contrast media are used to increase the atomic number of tissues in order to visualize them through increased subject contrast

Photoelectric Interaction

Photoelectric interactions result in the x-ray photon being totally absorbed and not striking the image receptor.

Types of Contrast Media

- Positive
- Negative
Why Is Air Not Used More Often as a Contrast Material?

Low Persistence

FIG. 21 A, Barium sulfate and air are used together to visualize the lumen of the colon.

The Perfect Contrast Material

- Very–high-contrast visualization
- Extremely low toxicity to patient
- Persistence in patient anatomy until imaging is completed
- Low cost
- Minimal or no side effects
- No residual effects within patient

Key Contrast Characteristics

- Ability of agent to mix with body fluids
- Viscosity
- Ionic strength
- Persistence in the body
- Iodine content
- Osmolality
- Potential for toxicity
Popular Contrast Choices

- Barium sulfate
- Air/gas (CO₂)
- Oil-based iodine contrast agents
- Water-soluble iodine contrast agents

Contrast Media Choices

- Barium
  - Atomic no. 56
- Iodine
  - Atomic no. 53
- Air or Gas
  - Atomic no. 8

Barium Sulfate

- BaSO₄
Barium Studies of the GI Tract

- Radiopaque barium sulfate fills the colon in a lower gastrointestinal study.
- Barium sulfate and air are used together to visualize the lumen of the colon.

Water-Soluble Iodine Contrast Agents

Ionics vs. Nonionics

Ionic Contrast Agents

- Use iodine as the contrast material
- Dissociate into two ions
  - Anion
  - Cation
Ionic Contrast Agents

- Ionic media dissociate into two molecular particles in water or blood plasma
- Three iodine atoms attached to benzene ring
- R₂ and R₃ increase solubility and excretion by kidneys
- Methylglucamine increases osmolality

Osmolality

- The measure of the total number of particles in solution per kilogram of water
- Great biologic significance
- Most adverse reactions to contrast result from the osmolality of the agent
- Ionic contrast agents are HOCM
- Nonionic contrast agents are typically LOCM

Nonionic Contrast Agents

- Do not dissociate into anions and cations
- Water soluble
- Six iodine atoms per molecule
- Increased solubility in plasma
Advantages of Nonionic, LOCM

- Lower osmolality
- No ionic breakdown and less toxic at cellular level
- More water soluble in blood plasma
- Warmed to increase viscosity
- Less likely to cause patient reaction
- More tolerable by patients
- High contrast effect resulting from number of iodine atoms per molecule
- Reduced injection volumes

Oil-Based Iodine Contrast

- Made from fatty acids
- Iodine added to ester groups
- Insoluble in water
- Long persistence in body
- Infrequently used except for specific exams
- Cannot be used with plastic syringes

Contrast Considerations

- Patient history
- Renal function
- Contrast cost
- Metformin (Glucophage) should be discontinued for 48 hours before and 48 hours after the use of iodine contrast media
- Contrast-enhanced CT studies
Contrast Reactions

- Generally occur within the first minute of injection
- Can be unpredictable
- Mild reaction may worsen to severe at any time
- Reaction is different from a side effect
- Monitor the patient continually

Categories of Patient Reactions

- Mild
- Moderate
- Severe

Mild Reaction Signs and Symptoms

- Nausea
- Vomiting
- Cough
- Warm feeling
- Headache
- Dizziness
- Shaking
- Itching
- Strange taste in mouth
- Pallor
- Flushing chills
- Sweats
- Urticaria (hives)
- Nasal stuffiness
- Swelling about the eyes and face
- Anxiety
**Moderate Reaction Signs and Symptoms**

- Tachycardia
- Bradycardia
- Hypertension
- Pronounced cutaneous reaction
- Hypotension
- Dyspnea
- Bronchospasm
- Wheezing
- Laryngeal edema

**Severe Reaction Signs and Symptoms**

- Laryngeal edema
- Convulsions
- Profound hypotension
- Cardiac arrhythmias
- Unresponsiveness
- Cardiac arrest

**Radiopharmaceuticals**

- Not contrast agents
- Radioactive material chemically attached to a pharmaceutical that is metabolized in the body
- Biodistribution is very important
- Typically emit gamma radiation
- Detected by gamma camera in nuclear department
- Effective for cellular physiology assessment
- Contamination and spillage of critical importance
Health Professional Responsibilities When Administering Contrast Agents

• Administered under the supervision of a licensed physician with proper qualifications
• Patient assessment and history
• Patient comfort and education
• Recognize signs and symptoms of reaction and act appropriately
• Patient care and surveillance
• Postexam considerations for patient

Conclusion

• Contrast materials are an indispensable part of medical imaging.
• Classified as positive or negative.
• Rely on the photoelectric effect for contrast visualization.
• Iodine-based contrast media can cause anaphylaxis.
• Nonionic, low-osmolality contrast agents have reduced patient reactions, but still a reality of imaging.
• Radiopharmaceuticals are used to assess cellular physiology.
• Patient reactions and care are a constant responsibility of the radiologic sciences professional.