Complications of Contrast Use in the Cardiac Catheterization Laboratory

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Objectives

- Hypersensitivity Contrast reactions
  - Severe reactions are rare
  - Incidence <1/100,000 of life threatening events
- Contrast induced nephropathy
  - More common
  Incidence in high risk patients almost 45%
- Methodology of ultra-low contrast use in angiography for patients with chronic kidney disease

Background

- Contrast agents have been in use since 1920
- Newer molecules have decreased risk of severe adverse reactions
  - Hypersensitivity
    Terminated Anaphylactoid reactions
- Over 15 million contrast-requiring procedures performed annually in the US
  - 350% increase in the # of cardiac caths from 1979-2005 with 1.3 million PCIs in 2005 alone

Risk of Adverse Reactions

- Overall risk of hypersensitivity reactions
  - 1-3% with nonionic agents
  - 4-12% ionic agents
  - Nausea, vomiting, flushing sensation
- Severe Reactions: Anaphylactoid
  - 0.03% low osmolality agents
  - 0.16% higher osmolality agents

Etiology

- Likely due to activation of vasoactive substances such as bradykinin, serotonin, and histamine
- Categorized as anaphylactoid due to direct complement or mast cell activation
- No evidence of specific IgE to contrast media
**Anaphylactoid Reactions**

- **Mild**
  - Nausea, vomiting, localized urticaria with pruritus

- **Moderate**
  - Laryngeal/facial edema and mild bronchospasm

- **Severe**
  - Respiratory or cardiac arrest
  - Anaphylactoid shock
  - Death most commonly due to respiratory arrest

**Identifying Patients at Risk**

- Previous anaphylactoid reaction to contrast material
- Underlying medical conditions
  - Asthma, heart disease, renal disease, DM
  - Hematologic conditions
  - - Myeloma, sickle cell disease
  - Food or medication allergies, or hayfever
  - Medications: NSAIDs, beta-blockers, biguanides
  - Advanced Age (> 60 years old)
  - Females > Males

**Shellfish Allergy**

- Medical Misconception
  - High iodine content in seafood led to the belief of purported risk with contrast administration
  - Iodine and Iodide do not cause allergic reactions because of their small molecule size
  - Culprit behind shellfish allergy is thought to be tropomyosin proteins which are structurally unrelated to iodine

**Prevention**

- Prednisone 50 mg orally 13, 7, and 1 hour prior to procedure or Hydrocortisone 100 mg intravenously 1 hour prior to procedure
- Cimetidine 300 mg orally 1 hour prior
- Diphenhydramine 50 mg orally 1 hour prior
- Montelukast 10 mg orally 1 hour prior
- Non-ionic low or iso-osmolar contrast agent

**Diagnosis**

- Unexplained hypotension
  - Rule out bleeding, tamponade

- Vigilant inspection and physical examination
  - Remove sterile drapes to expose skin and inspect for urticaria
  - Laryngeal edema should be suspected when hoarse voice or inspiratory stridor encountered
  - Expiratory wheezing denotes onset of bronchospasm

**Treatment**

- Mild: Nausea, Vomiting, and Localized Urticaria with Pruritus
  - Self-Limiting, Observation
  - Moderate: Laryngeal, or Facial Edema and Mild Bronchospasm
  - Epinephrine
    - 1:1,000 dilution at 0.1-0.3 ml IM or
    - 1:10,000 dilution at 1-3 ml IV
  - Diphenhydramine 25-50 mg IV

- Severe: Respiratory or Cardiac arrest and Anaphylactoid Shock
  - ACLS resuscitation (ABC, airway, breathing, circulation)
  - Epinephrine drip* at 10-20 mcg/min up to 30 minutes after resolution of symptoms
  - Aggressive IV Fluids (1-2 Liters Normal Saline)
  - Corticosteroids
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- Anaphylactoid Reactions to Radiocontrast agents: Prevention and Treatment in the Cardiac Catheterization Laboratory

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Contrast Induced Nephropathy

- Most common complication after angiography
- Accounts for 10% of all hospital-acquired renal failure
- Can occur in 11-44% of patients with existing renal insufficiency
- Increased in-hospital mortality
  - CIN not requiring dialysis 7.1%
  - CIN requiring dialysis 35.7%

CIN

- Defined as new onset of renal dysfunction after contrast administration
  - >25% above baseline SCr or >0.5mg/dl
- Risk is directly related to baseline renal function
- CIN develops 24-48 hours post contrast with SCr peaking 3-5 days later and returning to baseline within 7-10 days

Risk Score: Prediction of CIN

- Volume Expansion
- Theophylline/aminophylline
- Ascorbic Acid
- N-acetylcysteine
- Sodium Bicarbonate
- Hemofiltration
- Ultra-low contrast volume

Ultra-low contrast volume

- <30 cc for diagnostic
- <100 cc for interventional procedures
- Lessens the risk of CIN
  - Even small volumes of contrast can cause CIN in high risk patients as there does not appear to be a threshold volume below which CIN does not occur
  - We have a series of cases <15 cc of contrast for diagnostic and interventional procedures combined
Method of Ultra-low contrast volume

- Awareness of patient’s GFR
- TIMEOUT announcing patient’s GFR for entire team
- Small catheter size/contrast delivery syringe used by primary operator
- Biplane angiography if available
- Avoidance of left ventriculography
- Digital/fluoroscopic road-mapping
- Liberal use of Intra-vascular ultrasound
- Resulted in 3 cases of complex interventions with 7.5 cc, 10cc, and 14 cc of contrast in patients with SCr of 2.7, 2.3, 3.1 respectively

Pending submission to Circulation: Cardiac Interventions

- Prevention of Contrast Induced Acute Kidney Injury using the technique of Ultra-Low Contrast Delivery during Angiography and Percutaneous Coronary Intervention in Patients with Chronic Kidney Disease.
  - Keshav Nayak, MD, Hirsch Mehta, MD, Curtiss Stinis, MD, Matthew Price, MD, David Kandzari, MD and Paul S. Teirstein, MD

References