

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

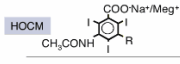



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Background

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

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Chemical Structures of Contrast Media

HOCCM		1950s	Ionic monomer eg, Diatrizoate Iothalamate
LOCM		1980s	Nonionic monomer eg, Iopamidol Iohexol Ioversol
LOCM		1980s	Ionic dimer Ioxaglate
IOCM		1990s	Nonionic dimer Iodixanol

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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

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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

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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

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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

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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

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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

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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

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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 10-20mcg/min up to 30 minutes after resolution of symptoms
 - Aggressive IV Fluids (1-2 Liters Normal Saline)
 - Corticosteroids

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Accepted for Publication
Journal of Invasive Cardiology

- **Anaphylactoid Reactions to Radiocontrast agents: Prevention and Treatment in the Cardiac Catheterization Laboratory**
- Keshav Nayak, MD¹, Andrew White, MD², Jeffrey Cavendish, MD³, Colin Barker, MD⁴ and David Kandzari, MD⁵

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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%

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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

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Scheme to Define Contrast-Induced Nephropathy Risk Score

Risk Factors	Integer Score
Hypotension	5
IABP	5
CHF	5
Age >75 years	4
Anemia	3
Diabetes	3
Contrast media volume	1 for each 100 cc ²
Serum creatinine >1.5 mg/dl	4
OR	
eGFR <60 ml/min/1.73 m ²	2 for 40-60
	4 for 20-40
	6 for <20

Risk Score	Risk of CIN	Risk of Dialysis
≤5	7.5%	0.04%
6 to 10	14.0%	0.12%
11 to 16	26.1%	1.09%
≥16	57.3%	12.6%

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Strategies for Prevention

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

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Ultra-low contrast volume

- <30 cc for diagnostic
- <100cc 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

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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

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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

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