CO2 Angiography Annual Conference

Contrast Induced Nephropathy at What Cost?

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Disclosures

Speaker’s Bureau:
- Abbott
- Asahi
- Bard
- Boehringer-Ingelheim
- Bristol-Myers-Squibb/Sanofi
- Cardiva
- Cook Medical
- Cordis
- DSI/Lilly
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- Abbott
- Boston Scientific
- Cardiva
- Cook Medical
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- Lake Regional Medical
- Medtronic
- Spectranetics
DEFINITION OF CIN

- Rise in serum Cr > .5 mg/dl
- Rise of serum Cr > 25% baseline
CIN (Iodinated contrast media)

• 3rd most common cause of hospital acquired acute renal failure (behind shock and nephrotoxic drugs).

• Dramatically increases mortality, morbidity, length of stay, and cost.

• Average increased cost $10,345 in hospital and $11,812 1st year.

• Only absolute prevention is no iodinated contrast.

Nash et al; Am Jour Kidney Dis.
Dangas, G et al; AmJCardio. 95 2005:13-19
Lindsey, J et al; AmJCardio. 94 2004:786-789
Figure Legend: Postulated Pathophysiology of Contrast-Induced AKI. In the presence of a reduced nephron mass, the remaining nephrons are vulnerable to injury. Iodinated contrast, after causing a brief (minutes) period of vasodilation, causes sustained (hours to days) intrarenal vasoconstriction and ischemic injury. The ischemic injury sets off a cascade of events largely driven by oxidative injury causing death of renal tubular cells. If a sufficient mass of nephron units are affected, then a recognizable rise in serum creatinine will occur.

From: Contrast-Induced Acute Kidney Injury
INDEPENDENT CIN RISK FACTORS

Scheme to define contrast-induced nephropathy (CIN) risk score. Anemia = baseline hematocrit value <39% for men and <36% for women; CHF = congestive heart failure class III/IV by New York Heart Association classification and/or history of pulmonary edema; eGFR = estimated glomerular filtration rate; hypotension = systolic blood pressure <80 mm Hg for at least 1 h requiring inotropic support with medications or intra-aortic balloon pump (IABP) within 24 h periprocedurally.
From: A simple risk score for prediction of contrast-induced nephropathy after percutaneous coronary intervention: Development and initial validation


Figure Legend: Risk score development dataset. Increasing risk of contrast-induced nephropathy with increasing risk score is evident with inclusion of either baseline serum creatinine value or estimated glomerular filtration rate in the multivariate model. Solid bars = serum creatinine-based model; open bars = estimated glomerular filtration rate-based model.
The contrast-induced nephropathy risk score derived from the development dataset predicted this complication in the validation set, as well. Blue bars = development dataset; Red bars = validation dataset.
**Figure Legend:**
In-hospital hemodialysis can be predicted by a high or very high risk score value similarly in the development and validation datasets. Blue bars = development dataset; Red bars = validation dataset.
The prognostic significance of the proposed risk score for contrast-induced nephropathy extended to prediction of one-year mortality, as indicated by the results obtained from both the development and validation datasets. Blue bars = development dataset; Red bars = validation dataset.
Risk of Contrast-Induced AKI According to Baseline Renal Function (eGFR or CrCl ml/min)
Contrast-induced acute kidney injury (AKI) was defined as serum creatinine increase of 25% and/or 0.5 mg/dl and is shown separately for patients with (solid circles) and without (open circles) diabetes. CrCl = creatinine clearance; eGFR = estimated glomerular filtration rate. Data adapted from McCullough et al. (12).
• Guidelines for Contrast-Induced Nephropathy (CIN) Prevention in Adults

• CIN is a common cause of acute renal failure in hospitalized patients. Radio contrast media has been associated with an increase in morbidity, mortality, and costs of medical care during hospitalization as well as prolongation of hospital stay. This nephropathy can result in the need for dialysis treatment and the development of CIN. Multiple prevention strategies have been investigated with varying results. Based on this data, the following algorithm has been developed to assist with selecting the most evidenced based strategies to prevent CIN. However, the most important strategy to prevent CIN is to avoid to minimize the use of contrast dye.
Patients receiving contrast dye: (SUGGESTED)
CT scan, angiogram, or heart catheterization

- Risk Factors:
  - Hypotension (SBP < 80 mmHg)
  - Heart Failure (NYHA III/IV)
  - Use of intra-aortic balloon pump (IABP)
  - Preexisting renal dysfunction
    - **SC > 1.5 mg/dl OR CrCl <60 ml/mim**
  - Age ≥ 75 years
  - Diabetes
  - Hematocrit <39% for men, or <36% for women
  - Dehydration
  - Concomitant use of nephrotoxic drugs and/or renal perfusion reducing agents
    - **ACEI’s, Aminoglycosides, Vancomycin, Diuretics, NSAID’s, etc**

Steven Dunn, Pharm.D, BCPS, University of Kentucky Chandler Medical Center (UK HealthCare)
Low Risk: 0 Risk Factors

- No additional steps necessary

Moderate Risk: 1 Risk Factor

- Decompensated heart failure/pulmonary edema or hyponatremia present?
  - No
    - Hydration with Saline\(^1\) OR Bicarbonate\(^2\)
      - +/-
      - Acetylcysteine (NAC)\(^3\) (PO/NG/PT)
  - Yes
    - Acetylcysteine (NAC)\(^3\) (PO/NG/PT)

High Risk: ≥ Risk Factors

- Decompensated heart failure/pulmonary edema or hyponatremia present?
  - No
    - No
  - Yes
    - Bicarbonate\(^2\) OR Hydration\(^1\) + Acetylcysteine (NAC)\(^3\) (PO/NG/PT/IV\(^**\))

\(^{**}\) see Acetylcysteine Dosing Guidelines\(^3\) for restrictions on IV acetylcysteine
Hydration with Saline Guidelines

**IVF** = 1 mL/kg/hr (MAX 100 ml/hr) 12 hours pre & 12 hours post contrast* (24 hour total infusion duration)

(*NS preferred IVF but MD can modify based on clinical status of patient)

**CHF or left ventricular ejection fraction (LVEF) < 40%?**
0.5 ml/kg/hr (max 50 ml/hr) 12 hrs pre & post contrast (24 hour total infusion duration)

**Emergent procedure?** (suggested regimen):
Fluid bolus of 500 – 1000 ml prior to procedure. Hydration during procedure and/or 12 hrs after if possible (dependent on clinical status)
Bicarbonate Dosing Guidelines

**IVF** = 150 meq of sodium bicarbonate in 1 liter of D5W

3 ml/kg bolus (MAX 300 ml) 1 hour prior to procedure AND 1 mL/kg/hour (MAX 100 ml/hr) during and for 6 hours post-procedure

**Glycemic control issues (including patients with diabetes)?**
Consider mixing sodium bicarbonate in 1 liter of sterile water instead of D5W
Acetylcysteine Dosing Guidelines

Tolerating PO intake?
600-1200 mg capsules PO Q12h X 4 doses
2 doses pre-contrast and 2 doses post-contrast is optimal

Feeding tube or NG-access?
Acetylcysteine 600-1200 mg (3 mL of 20% soin.) liquid PT/NG Q12h x 4 doses total

Emergent Procedure?
1 dose before and 3 doses post cath or procedure is acceptable (Q12h x 4 doses total)

IV Acetylcysteine?
600-1200 mg IV x 1 over 15 minutes, then 600-1200 mg PO/PT q12h x 4 doses post-procedure:
For a high risk patient undergoing cardiac catheterization or PE protocol CT scan with no PO access
**Monitor patient for anaphylactoid infusion reaction**
IV Alternatives:
• Ascorbic Acid 3 gm IV x1 dose 2 hours prior to procedure, then 2 gm IV BID x 2 doses post-procedure
• Aminophylline 300 mg IV x 1 (infused over 1 hour) prior to procedure
CIN RISK IS INCREASING IN PAD CASES

- Diabetes is epidemic
- More interventions are being performed
- More complex interventions (limb salvage)
- Older patients
CIN SUMMARY

- CIN increases acute and long-term mortality
- CIN increases acute and long-term morbidity
- CIN increases acute and long-term cost
- CIN is strongly associated with independent risk factors that should be assessed
- CIN MUST BE AVOIDED
AVOIDING CIN
IF IODINATED CONTRAST MUST BE USED

• Aggressive pre and post hydration
• Withhold nephrotoxic drugs
• Maintain adequate blood pressure
• Use iso-osmolar contrast
• Avoid anemia (meticulous access site management)
• Limit contrast
CONCLUSION

• The only way to absolutely avoid CIN is to not administer iodinated contrast.

• In PAD there are viable options
  • External duplex guidance
  • CO2 angiography- THIS HAS TOTALLY CHANGED MY PRACTICE
    1) No renal function too impaired
    2) No limit on imaging – better results
    3) No pre-admission or prolonged stay
    4) Can image with smaller catheters (less viscous)
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