Pre-Procedure Risk Assessments to Prevent Post Procedure Complications: Contrast Induced Nephropathy

Jude Hebert RN BSN
Cardiovascular Institute of the South Houma, La
Contrast Induced Nephropathy (CIN)

- Defined as an increase in the serum creatinine level of 25% or 0.5 mg/dl from baseline or higher
- Usually occurs 48 to 72 hours after exposure to contrast
- Third leading cause of acute kidney injury in hospitalized patients, accounting for up to 11% of iatrogenic renal insufficiency
- Affects in-hospital morbidity and mortality with significant financial impact by increasing adverse cardiac events and prolonging length of stay
Dangas et al, studied incidence and prognosis of patients developing CIN:

- Occurred in 16.7% of patients
- Major Cardiac Events 9.3% vs 1.1%
- In-hospital Mortality 6.3% vs 0.8%
- 1 year Mortality 22.6% vs 6.9%
- Hospital LOS 6.8-7.1 vs 2.5 days
- Dollar cost per occurrence > additional $5000 to $25,000
Who is at Risk?

- Older patients > 75 years old
- Pre-existing renal dysfunction: Cr > 1.5 or GFR < 60 ml/min
- Anemia (Hct < 39% men, < 36% for Women)
- Diabetes mellitus
- Decreased left ventricular ejection fraction
- Unstable hemodynamic status
Risk assessment

• Establishing **pre-procedure Risk Assessment Tools** with the use of proven methods will help categorize patients into several groups and allow for implementation of prevention measures:

  – Low
  – Medium
  – High
  – Very High
## Mehran Risk Score

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Mehran risk score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial hypotension for systolic blood pressure &lt; 80 mm Hg for at least 1 hour requiring inotropic support with medications</td>
<td>5</td>
</tr>
<tr>
<td>Use of an intra-aortic balloon pump within 24 hours of the procedure</td>
<td>5</td>
</tr>
<tr>
<td>Congestive heart failure rated class III/IV on the New York Heart Association classification</td>
<td>5</td>
</tr>
<tr>
<td>Documented history of pulmonary edema</td>
<td>5</td>
</tr>
<tr>
<td>Documented history of chronic kidney disease</td>
<td>5</td>
</tr>
<tr>
<td>Patient’s age &gt; 75 years</td>
<td>4</td>
</tr>
<tr>
<td>Documented anemia (hematocrit &lt; 39% for men and &lt; 36% for women)</td>
<td>3</td>
</tr>
<tr>
<td>Documented history of diabetes</td>
<td>3</td>
</tr>
<tr>
<td>Volume of contrast material used</td>
<td>1 for each 100 mL</td>
</tr>
<tr>
<td>Preprocedural serum level of creatinine &gt; 1.5 mg/dL&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4</td>
</tr>
<tr>
<td>or An estimated glomerular filtration rate &lt; 60/mL/min per 1.73 m²</td>
<td>2 for 40 - 60</td>
</tr>
<tr>
<td></td>
<td>4 for 20 - 40</td>
</tr>
<tr>
<td></td>
<td>6 for &lt; 20</td>
</tr>
</tbody>
</table>

<sup>a</sup>To convert to micromoles per liter, multiply by 88.4.
# Mehran Risk Score

## Risk Factors

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Integer Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Factors</td>
<td>5</td>
</tr>
<tr>
<td>IABP</td>
<td>5</td>
</tr>
<tr>
<td>CHF</td>
<td>5</td>
</tr>
<tr>
<td>Age &gt; 75 years</td>
<td>4</td>
</tr>
<tr>
<td>Anemia</td>
<td>3</td>
</tr>
<tr>
<td>Diabetes</td>
<td>3</td>
</tr>
</tbody>
</table>

## Contrast media volume

1 for each 100 cc³

## Serum creatinine > 1.5 mg/dl

<table>
<thead>
<tr>
<th>eGFR &lt; 60 ml/min/1.73 m²</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>eGFR (mL/min/1.73 m²) =</td>
<td>186 x (Scr) -1.154 x (Age) ^-0.203</td>
</tr>
<tr>
<td>x (0.742 if female) x</td>
<td>(1.210 if African American)</td>
</tr>
<tr>
<td>2 for 40 - 60</td>
<td>6 for &lt; 20</td>
</tr>
</tbody>
</table>

## Risk Score

<table>
<thead>
<tr>
<th>Risk Score</th>
<th>Risk CIN</th>
<th>Risk of Dialysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 5</td>
<td>7.5%</td>
<td>0.04%</td>
</tr>
<tr>
<td>6 to 10</td>
<td>14.0%</td>
<td>0.12%</td>
</tr>
<tr>
<td>11 to 16</td>
<td>26.1%</td>
<td>1.09%</td>
</tr>
<tr>
<td>≥ 16</td>
<td>57.3%</td>
<td>12.6%</td>
</tr>
</tbody>
</table>
Advantages to Pre-Procedure Assessment

• Quickly risk stratifies patients into 4 categories
• Can be easily carried out by nursing staff with readily available information
• Allows prevention methods to be implemented based on established hospital protocols
• Information regarding risk can be shared across the healthcare spectrum
CIN Prevention

• Currently, there is no FDA approved prevention Strategy for Contrast Induced nephropathy.

• Multiple clinical studies have been performed to determine superior treatment options, but results have not confirmed clinical efficacy.
• **Hydration**
  – Remains the cornerstone in prevention
  – Increases Renal Blood Flow
  – Prevents Rennin-Angiotensin activation
  – Normal Saline or Na Bicarbonate> similar statistical benefit
  – Post Procedure hydration most beneficial
  – Very Familiar to nursing staff
  – Should continue with compensated CHF patients at lower rate> +/- use of diuretics
Prevention> What is Beneficial

• **Discontinuation of all Nephrotoxic Drugs:**
  – NSAIDs
  – Diuretics (pending CHF class)
  – Aminoglycosides
  – Hold Ace I/ARB > 24-48 hours pre-procedure
  – Metformin > Hold pre and post procedure

• **Contrast Agents:**
  – Use of low or iso-osmolar agents
  – Minimize amount: 50 ml or less for LHC and avoid LV gram
Prevention> Possibly Beneficial

• Administration of **N-Acetylcysteine** pre and post procedure:
  – Has been proven to be beneficial in small clinical trials
  – Low cost
  – Accepted Standard of care and usually advised by Nephrology
  – Dose 600-1200 mg BID x 2-3 days
  – **ACT trial** 2011, 2308 patients> identical results to placebo and no benefit on mortality
Prevention> Possibly Beneficial

- Administration of **Ascorbic Acid** pre and post procedure: (standard dose 1-2 grams day of and day following procedure)
  - Has been shown to be beneficial and non-beneficial in small clinical trials
  - Low cost
  - Easily tolerated by patients
  - Safe
  - Readily available
Prevention> Possibly Beneficial

- IV **Fenoldopam**:  
  - Dopamine-1 agonist and direct renal vasodilator  
  - Controversial Results  
  - Requires Intra-renal catheter placement and delivery

**CONTRAST Trial**

- No Benefit  
- Added cost  
- Caused Systemic Hypotension
Prevention > Nursing Involvement

• Key role in assessing a patient’s risk for CIN and facilitate patient’s understanding of risk involved
• Collaborate with physicians or other medical providers to ensure that nephrotoxic medications are discontinued in a timely manner
• Advocate for safe amounts and types of prophylaxis and administer IV hydration per protocols
• Ensure serum Cr levels are measured for 2 to 7 days after angiographic procedures
What have we Learned

**Contrast Induced Nephropathy (CIN)**

- occurs infrequently with significant impact
- Statistically affects morbidity and mortality
- Increases hospital LOS
- Elevates overall cost
What have we Learned

- **Risk Assessment** is key to Prevention>
  - develop a protocol
    - Diabetics
    - Minimize Dye Load
    - Cr level/GFR: Cr > 1.5 or GFR < 60
    - Anemia
    - Hypotension
Solid Proof Hydration Works!

• **POSEIDON Trial** (Prevention of Contrast Renal Injury with Different Hydration Strategies): Results presented at Society for Cardiovascular Angiography and Interventions Scientific Session May 9, 2013

  – Use of Sliding scale Hydration based on LVEDP
  – 5 mL/kg/hr for LVEDP < 13 mm Hg
  – 3 mL/kg/hr for LVEDP 13 mm Hg to 18 mm Hg
  – 1.5 mL/kg/hr for LVEDP > 18 mm Hg
POSEIDON RESULTS

• **LVEDP-Guided hydration**
  – resulted in a 59% relative reduction in contrast-induced nephropathy

• **6 months**
  – 68% less instances of death, MI, or dialysis compared with the standard hydration protocol
  – Results were most Beneficial in Diabetics
Alternatives: CO₂ Angiography

- Vascular imaging agent without nephrotoxicity or allergic reactions in high-risk patients
- CO₂ soluble in blood and useful in venous and below the diaphragm arterial studies
- Quality of images inferior to iodinated contrast, enhanced with digital subtraction technique
- Useful in PVD, aortic imaging, venous studies, and biventricular pacing
CO₂ angiography

Abdominal aortic and renal artery imaging

Femoro-popliteal arterial images
**CO₂ angiography -- Biventricular pacing**

- Implantation of biventricular pacers require imaging of the coronary sinus to identify appropriate target branches.

- Heart failure patients often with renal insufficiency with high risk of iodinated dye-induced nephrotoxicity.

- CO₂ angiography useful alternative.
Baseline venography to identify targets
Baseline venography to identify targets
Targets identified similarly with CO$_2$ angiography
Targets identified similarly with CO$_2$ angiography
References

• Maxwell, Yael L.; POSEIDON: SLIDING-SCALE HYDRATION PREVENTS CIN, ADVERSE EVENTS AT 6 MONTHS; TCTMD, Sunday May, 25 2014

• Solomon, Richard; Preventing contrast-induced nephropathy: problems, challenges and future direction; BMC Med. 2009; 7:24

• Raingruber, Bonnie et al.; Using the Mehran Risk Scoring Tool to Predict Risk for Contrast Medium-Induced Nephropathy in Patient Undergoing Percutaneous Angiography; Critical Care Nurse, Feb. 2011 vol 31 no 1, e17-e22

• Spargias, Konstantinos et al; Ascorbic Acid Prevents Contrast-Mediated Nephropathy in Patients with renal Dysfunction Undergoing Coronary Angiography or Intervention; ahajournals, circulation 2004; 110:2837-2842

• Bansul, Renu et al; Contrast-Induced Nephropathy Treatment and Management; emedicine.medscape.com/article/246751

• Weinstock, Barry S.; Contrast Induced Nephropathy: How to Avoid a Life of CIN; Cath Lab Digest, Vol. 22, No. 5, May 2014, pg 42-45
Thank You