Reducing Contrast Induced Renal Insufficiency

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Disclosure

I do not have any potential conflict of interest.
How to Define CIRI?

• Absolute rise in serum creatinine (SCr) of 0.5 mg/dL

• A 25% increase from the baseline value assessed within 48 hours after the procedure without an alternative etiology
Incidence of CIRI

Morbidity and Mortality Associated With CIRI

Grossman PM et al. J Interv Cardiol. 2017
Prevention of CIRI

• Recognize risk factors
• Withdrawal of all nephrotoxic medications
• Hydration
• Pharmacological strategies
• Minimizing volume of contrast media
Withdrawal of All Nephrotoxic Medications

<table>
<thead>
<tr>
<th>Drug Class</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSAIDs</td>
<td>Ibuprofen, Diclofenac, Celecoxib</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>Aminoglycosides</td>
</tr>
<tr>
<td>Antifungals</td>
<td>Amphotericin B</td>
</tr>
<tr>
<td>Antivirals</td>
<td>Acyclovir, Ganciclovir, Tenofovir</td>
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<tr>
<td>Immunosuppressants</td>
<td>Cyclosporine, Tacrolimus</td>
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<tr>
<td>Antineoplastic</td>
<td>Cisplatin, Ifosfamide</td>
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</table>


Angiotensin-converting enzyme inhibitors/ angiotensin receptor blockers

- CAPTAIN study demonstrated no nephrotoxicity

Hydration

• The most effective prophylactic intervention

• Guidelines:
  – AHA: isotonic saline infusion: 1 to 1.5 mL/kg/h for 3 to 12 hours before the procedure and 6 to 24 hours after the procedure
  
  – ESC: saline infusion: 1 to 1.5 mL/kg/h for 12 hours before and up to 24 hours after the procedure
Statins

- High-dose statin pretreatment significantly reduced overall incidence of CIRI in patients undergoing CAG

CIRI

- 3.6% (105/2889) in high-dose statin group
- 8.3% (245/2936) in control group

NNT of high-dose statin: 16

Pharmacological Strategies

- Furosemide with matched hydration
  - In patients with CKD undergoing coronary procedures significantly reduces the risk of CIRI

The Mythos Investig. JACC. 2012
Choice of Contrast Media

- Nonionic low-osmolar and iso-osmolar CM are safer than high-osmolar CM

- No differences were found in CIRI risk among types of LOCM
Volume of Contrast Media

• Maximum safe volume of CM has been proposed by Laskey, et al:
  – A ratio of the CM-volume: creatinine clearance < 3.7


• When contrast volume exceeds 3.7× of creatinine clearance:
  – Staged procedure at least 3 days later
Minimizing Volume of CM

- Use small diameter catheters without side-holes
- Perform simultaneous a cine angiogram when you inject CM
- Using a small syringe
- Remove contrast from the sheath/guide catheter by back bleeding prior to exchange of devices
- Display previous angiographic images to use as guidance during guide wire passage
- Use automated contrast injectors
- Percutaneous US guidance for interventions
- IVUS
- CO2 angiography
CO2 Angiography

• CO2 is an gaseous contrast medium, pioneered by Hawkins in the 1970s

• The technological solutions available up to today for injecting CO2
CO2 Angiography for Vascular Imaging

Visceral Angiography

Aortography
outflow assessment

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CO2 Angiography for Vascular Imaging

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CO2 for EVT of Aorto-iliac Disease

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CO2 for EVAR

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Incidence of CIRI With CO2

- Possible mechanisms of CIRI after CO2:
  - The vapor lock phenomena
  - Atheroembolization
  - The adjunctive use of CM with CO2

Ghumman SS et al. Catheter Cardiovasc Interv. 2017
Challenges With CO2 Angiography

- Non-renal adverse events up to 17%:
    - Limb and abdominal pain
    - Nausea and vomiting
    - NOMI and death

- Image quality with CO2:
  - Aortoiliac: artifacts due to the presence of bowel gas
  - Infrapopliteal: motion artifacts
What Is IVUS?

- Introduced originally in interventional cardiology in the late 1980s
- 2 clinical roles:
  - Assess and measure the severity of the disease before treatment
  - Demonstrate the complement of the treatment after intervention
- IVUS is now used in a variety of endovascular procedures
IVUS for Type-B Aortic Dissection

- Identifies the true and the false lumen
- Identifies the size of the graft to be implanted
- Visualizes:
  - The supra-aortic vessels
  - The visceral vessels
  - Retrograde dissection
  - Expansion of the true lumen after stent placement

Koschyk DH et al. Circulation. 2005
IVUS for EVAR
IVUS for Endovascular Treatment of PAD

Pretreatment
IVUS for Endovascular Treatment of PAD
IVUS for Endovascular Treatment of PAD

Post-treatment
IVUS to Reduce CIRI

### IVUS-Guided Endovascular Therapy for CTO

<table>
<thead>
<tr>
<th></th>
<th>Standard EVT</th>
<th>IVUS-Guided EVT</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>N</td>
<td>21</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Iliac Artery</td>
<td>86</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Fem-pop Artery</td>
<td>79</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>ABI after</td>
<td>0.89±0.22</td>
<td>1.00±0.14</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>CM</td>
<td>201±100</td>
<td>104±0.14</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Radiation exposure</td>
<td>65±55</td>
<td>60±35</td>
<td></td>
</tr>
</tbody>
</table>


- EVT of iliofemoral disease **WITHOUT CM** in pts with CKD
  - 36 pts, 51 lesions
  - Technical success: 100%
  - SCr did not change after treatment and at 3 months

Kawasaki et al. Circulation J. 2010
Conclusion

How to Prevent CIRI?

• Identify the high-risk patient
• Stop all nephrotoxic drugs
• Hydrate prior to and after the procedure
• Preload the patient with statins
• Minimize/eliminate the contrast media by liberal use of IVUS and/or CO2
Thank you!

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