Contrast induced nephropathy
Myth or reality?

Evidence Review in Emergency Medicine
Wollongong March 2nd 2017
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Royal Prince Alfred Hospital
Emergency imaging procedures requiring contrast media administration e.g. acute stroke, acute bleeding, trauma etc. should not be delayed in order to obtain renal function testing results prior to the procedure. Iodinated Contrast Media Guideline, 2016 Edition
80 yo male with sharp chest pain
BG/ Diabetes and hypertension
ECG non specific changes
No acute rise in serial troponins
eGFR 40
A 80 yo male with ill defined abdominal pain
BG/ Diabetes and hypertension
Lactate 2
eGFR 40
Intravenous contrast vs Intra-arterial (eg coronary angiography)
Is Contrast-induced nephropathy the third most common cause of acute renal failure in hospitalised patients?
Does IV contrast cause renal impairment?

Intravenous contrast $\rightarrow$ Increased Creatinine $\rightarrow$ Patient outcome (Renal transplant, dialysis)
Contrast Induced Nephropathy (CIN) definition

absolute (44 mmol/L)

or relative (25%)

increase in baseline serum Cr concentration at 48-72 hours
Propensity matching
Contrast Material–induced Nephrotoxicity and Intravenous Low-Osmolality Iodinated Contrast Material: Risk Stratification by Using Estimated Glomerular Filtration Rate

Davenport et al

Radiology: Volume 268: Number 3—September 2013
Methods

8826 non-enhanced and 8826 IV contrast enhanced CT studies

A 1:1 propensity score matched cohort analysis

Patients were subdivided according to eGFR into four discrete ranges (60, 45–59, 30–44, and 30 mL/min/1.73 m2)

Post-CT AKI as the primary outcome measure
Effect of IV Iodinated Contrast Material on the Development of Post-CT AKI in Patients with Stable Renal Function after Controlling for All Tested Covariates

<table>
<thead>
<tr>
<th>Pre-CT eGFR</th>
<th>No.</th>
<th>No Post-CT AKI</th>
<th>Post-CT AKI</th>
<th>Post-CT AKI Rate (%)</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>eGFR ≥ 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With contrast</td>
<td>6971</td>
<td>6592</td>
<td>379</td>
<td>5.4</td>
<td>1.00</td>
<td>0.86, 1.12</td>
</tr>
<tr>
<td>Without contrast</td>
<td>6996</td>
<td>6612</td>
<td>384</td>
<td>5.5</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>eGFR 45–59</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With contrast</td>
<td>1273</td>
<td>1139</td>
<td>134</td>
<td>10.5</td>
<td>1.06</td>
<td>0.82, 1.38</td>
</tr>
<tr>
<td>Without contrast</td>
<td>1207</td>
<td>1077</td>
<td>130</td>
<td>10.8</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>eGFR 30–44</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With contrast</td>
<td>538</td>
<td>448</td>
<td>90</td>
<td>16.7</td>
<td>1.40</td>
<td>0.997, 1.97</td>
</tr>
<tr>
<td>Without contrast</td>
<td>551</td>
<td>473</td>
<td>78</td>
<td>14.2</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>eGFR &lt; 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With contrast</td>
<td>44</td>
<td>28</td>
<td>16</td>
<td>36.4</td>
<td>2.96*</td>
<td>1.22, 7.17</td>
</tr>
<tr>
<td>Without contrast</td>
<td>72</td>
<td>58</td>
<td>14</td>
<td>19.4</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Risk of Intravenous Contrast Material–mediated Acute Kidney Injury: A Propensity Score–matched Study Stratified by Baseline-estimated Glomerular Filtration Rate

McDonald et al

Radiology: Volume 271: Number 1—April 2014
Methods

All patients who underwent contrast-enhanced or unenhanced CT between 2000 and 2010 were identified and stratified according to baseline eGFR.

12508 propensity score–matched patients with 1:1 matching of patients in each eGFR subgroup.
Propensity Score–adjusted Risk of AKI Following Contrast-enhanced or Unenhanced CT

<table>
<thead>
<tr>
<th>eGFR Subgroup (mL/min/1.73 m²)</th>
<th>AKI Following Contrast-enhanced Scanning*</th>
<th>AKI Following Unenhanced Scanning*</th>
<th>OR†</th>
<th>P Value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 90</td>
<td>10/821 (1.2)</td>
<td>11/821 (1.3)</td>
<td>0.91 (0.38, 2.15)</td>
<td>.82</td>
</tr>
<tr>
<td>60–89</td>
<td>40/1935 (2.1)</td>
<td>39/1935 (2.0)</td>
<td>1.03 (0.66, 1.60)</td>
<td>.99</td>
</tr>
<tr>
<td>30–59</td>
<td>161/2755 (5.8)</td>
<td>170/2755 (6.2)</td>
<td>0.94 (0.76, 1.18)</td>
<td>.65</td>
</tr>
<tr>
<td>&lt; 30</td>
<td>102/743 (14)</td>
<td>105/743 (14)</td>
<td>0.97 (0.72, 1.30)</td>
<td>.89</td>
</tr>
</tbody>
</table>

Diminished eGFR is associated with an increased risk of serum Cr-defined AKI following CT examinations.

However, the risk of AKI is independent of contrast material exposure, even in patients with eGFR < 30
Risk of Acute Kidney Injury After Intravenous Contrast Media Administration
Hinson et al
Ann Emerg Med.
2017 Jan
Methods

single-centre retrospective cohort analysis
2009 to 2014
using a propensity-matched case-control design
compared patients who underwent contrast-enhanced, unenhanced or no CT
primary outcome was incidence of acute kidney injury
secondary outcome - new CKD, dialysis or renal transplant
Study inclusion flowchart

272,961 patient visits without CT scan on 115,102 patients

**Excluded**
1. CT scan at other visit (118,578)
2. No initial SCr (111,417)
3. No follow-up SCr (35,975)
4. ED encounter in 180 days prior to start date of study (111)
5. History of dialysis/renal transplant (485)
6. Initial SCr ≤ 0.3 or ≥ 4.0 mg/dL (255)
7. CECT <72 hours after ED departure (906)

82,729 patient visits with CT scan on 54,740 patients

**Excluded**
1. No initial SCr (10,830)
2. No follow-up SCr (49,937)
3. CT Scan in the prior 6 months (5,735)
4. ED encounter in 180 days prior start date of study (499)
5. History of dialysis/renal transplant (983)
6. Initial SCr ≤ 0.3 or ≥ 4.0 mg/dL (475)
7. CECT <72 hours after ED departure (1,570)

**Final Inclusion**
17,934 patient visits
16,801 patients

7,201 CT scans with contrast
5,499 CT scans without contrast
5,234 patients without CT
Risk of acute kidney injury after IV contrast administration
Rate of AKI by CIN criteria (%)

<table>
<thead>
<tr>
<th>EGFR</th>
<th>CONTRAST ENHANCED CT</th>
<th>UNENHANCED CT</th>
<th>NO CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>OVERALL</td>
<td>766/7201 (10.6)</td>
<td>559/5499 (10.2)</td>
<td>569/5234 (10.9)</td>
</tr>
<tr>
<td>&gt;90</td>
<td>510/4127 (12.4)</td>
<td>261/2039 (12.8)</td>
<td>304/2360 (12.9)</td>
</tr>
<tr>
<td>60-89</td>
<td>179/2176 (8.2)</td>
<td>11/1337 (8.3)</td>
<td>304/2360 (9.7)</td>
</tr>
<tr>
<td>45-59</td>
<td>59/575 (10.3)</td>
<td>68/714 (9.5)</td>
<td>59/589 (10)</td>
</tr>
<tr>
<td>30-44</td>
<td>12/241 (5.0)</td>
<td>57/768 (7.4)</td>
<td>44/550 (8.0)</td>
</tr>
<tr>
<td>15-29</td>
<td>6/78 (7.7)</td>
<td>53/599 (8.8)</td>
<td>27/345 (7.8)</td>
</tr>
<tr>
<td>&lt;15</td>
<td>0/4</td>
<td>9/42 (21.4)</td>
<td>2/16 (12.5)</td>
</tr>
</tbody>
</table>
Results

rates of acute kidney injury were similar among all groups

contrast administration was not associated with increased incidence of acute kidney injury

contrast administration was not associated with increased incidence of chronic kidney disease, dialysis, or renal transplant at 6 months.
If CIN exists, can it be prevented?

IVF    NAC    Statins

NaHCO3
N-Acetylcysteine Plus Intravenous Fluids Versus Intravenous Fluids Alone to Prevent Contrast-Induced Nephropathy in Emergency Computed Tomography

Traub et al Annals of Emergency Medicine
Volume 62: 5 2013
Randomised to NAC vs NS
Inclusion criteria

ED patients
Contrast Enhanced CT Scans
At least one CIN risk factor
Results

NAC plus NS CIN rate 7.6 % (14/185)
NS CIN rate 7% (12/172)
NAC doesn't work
But

< 1 L IVF NS rate of CIN 12.9% (19/147)

>1 L IVF Rate of CIN 3.3 % (7/210)

Risk difference of 9.6% (3.7% to 15.5%)
Do fluids make a difference?
Prophylactic hydration to protect renal function from intravascular iodinated contrast material in patients at high risk of contrast-induced nephropathy (AMACING): a prospective, randomised, phase 3, controlled, open-label, non-inferiority trial
Hypothesis:
That withholding prophylaxis would be non-inferior to the standard-of-care administration of intravenous normal saline.
Single centre study
Elective patients (IV and IA)
660 consecutive patients
“High risk” (eGFR 30-59)
Randomised to pre and post IV NS or no hydration
Results

Rate of Contrast-induced nephropathy

2.6% (8/307) no hydration
2.7% (8/296) hydration

5.5% (18/328) had complications associated with IV hydration
Take home messages

Risk of contrast induced nephropathy is over-rated

Severe renal function impairment is not a contraindication to iodinated contrast media administration

Role of peri-procedural hydration is unclear
5. The High Risk of Contrast-induced Nephropathy in Patients with Suspected Pulmonary Embolism Despite Three Different Prophylaxis: A Randomized Controlled Trial Turdei et al Academic Emergency Medicine 2016;23:1136–1145
7. Prophylactic hydration to protect renal function from intravascular iodinated contrast material in patients at high risk of contrast-induced nephropathy (AMACING): a prospective, randomised, phase 3, controlled, open-label, non-inferiority trial The Lancet February 20, 2017