Eliminating Post-contrast Acute Kidney Injury in Patients with Advanced Kidney Disease: Guideline Adherence and Quality Improvement

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(LUMC, The Netherlands; 2021)
Purpose

A single institution effort to analyze and improve guideline adherence regarding PC-AKI prevention.

Patients with an estimated eGFR <30 undergoing a contrast-enhanced CT-scan in the LUMC. 500 patients with 713 CECT-scans were included.

Main queries based on the previously quality indicators detailed in “Safe Use of Contrast Media”:
- Do patients eligible for pre-/post-hydration (as described in the PC-AKI guidelines) receive hydration?
- Is kidney function (routinely) established both pre- and post contrast administration?

(Statistical) analysis of these patients based on characteristics and variables as previously described in literature on PC-AKI (e.g. comorbidities, state of hydration, nephrotoxic medication).
Background

- “Contrast-induced Nephropathy” definition: Serum Creatinine increase of 25% or absolute increase of 0.5 g/dL from baseline.

- Assumed leading cause of acute renal failure in hospitalized patients

- Estimated incidence ranging from <1% to 30%

- Predisposing factors: DM, hypotension, nephrotoxic medication

- Challenges in Assessing Contrast-Induced Nephropathy

Current SOP
- Intravenous administration of 250mL 1.4% NaHCO3 one hour before contrast administration with
  - optional post-hydration consisting of 500mL NaHCO3 administered in six hours after contrast administration for patients with an eGFR below 30 ml/min/1.73m2.

- Recent pre-contrast KFA

- Post-contrast KFA between 2-7 days
Is kidney function assessed routinely before contrast administration? (N = 709)

Key Findings

- No cases were found where time between contrast-administration and pre-contrast KFA exceeded the absolute limit (365 days).

- Pre CA kidney function in cases involving acute kidney injury is routinely assessed before the imposed time limit with no registered outliers.

- Pre CA kidney function is adequately assessed in patients with stable CKD with few outliers.
Do patients eligible for pre-/post-hydration receive hydration? (N = 713)

Key Findings

Intravenous hydration given in 556 cases (78% of total)

- Hydration as described in CI-AKI guidelines given in 347/556 cases (70% of hydrated)
- Alternative hydration (e.g. not in addition to IV hydration with NaBic) given in 168 cases (30% of hydrated, 24% of total)

Hydrated vs. Unhydrated (N = 713)

- No hydration without reason given
- No hydration due to signs of fluid overload
- No hydration due to RRT with residual diuresis
- No hydration due to RRT with little to no residual diuresis

Alternative Hydration

Hydration as described in CI-AKI guidelines

No. of cases

0 100 200 300 400 500

- No intravenous hydration given in 157 cases (23% of total)
- Hydration withheld due to RRT with no spontaneous diuresis in 64 cases (40% of no hydration, 9% of total)
- Hydration withheld due to RRT with spontaneous diuresis in 47 cases (30% of no hydration, 6% of total)
- Hydration withheld due to signs of fluid overload in 32 cases (20% of no hydration, 4% of total)
- No reason given for withholding hydration in 14 cases (9% of no hydration, 2% of total)
Is kidney function established routinely post contrast-administration? (N = 713)

Key Findings

- Kidney function assessed between two and seven days in 497 cases (70%)

- Forgoing KFA due to patient death or transition into EoL care between two and seven days in 35 cases (5%)

- Forgoing KFA with no valid reason in 181 cases (25%).

- Majority of missing KFA can be ascribed to outpatient cases (KFA between two and seven days in only 34% of total outpatient cases as opposed to ER (76%) and inpatient (95%) cases.

Kidney Function Assessment After Contrast-Administration (N = 713)
Key Findings

- In total, **117 cases** (17%) involved a kidney function deterioration fitting of the serum creatinine-based criteria of PC-AKI (SCr increase of at least 25% from baseline or absolute SCr increase of 0.5 mg/dl).

- Based on manual case review, a different etiology (e.g. dialysis-related or natural fluctuation, SIRS, hypovolemia, drug reaction, GvH) was deemed significantly more likely than PC-AKI in **91 cases** (77%).

- In total, PC-AKI was deemed a likely cause of kidney function deterioration in **27 cases** (of which 26 cases involved admitted patients (P 0.010)).
Key Findings

- A “crude” comparison of outpatient and inpatient groups using Student’s T Test, Pearson’s Chi-Square test and Mann-Whitney U test for binomial, parametric, and non-parametric variables, respectively.

- Inpatient cases more frequently involved AKI at baseline, unstable kidney functions.

- The median time between CA and post CA KFA is significantly longer in the outpatient than in inpatient group.

- Interestingly, SCreat-based PC-AKI is similar in both groups, while “true” PC-AKI differs significantly.

- The proportion of intravenously hydrated patients significantly differs both in frequency and quality.

- Groups are not comparable at baseline (!)
Propensity Score Matching

In total, 148 patients were matched using 1:1 propensity score matching (FUZZY Extension for SPSS 26.0, IBM, Armonk, NY, USA).

- As expected, the proportion of cases involving patients with signs of fluid overload differed significantly different between the two groups.
- All other baseline characteristics were similar following matching.
- After “double robust” correction using both propensity score matching and conditional logistic regression, ORs were established.
- Again, no statistically significant differences were found in any of the primary or secondary outcomes after correction.
- The width of the 95% CI-intervals can be ascribed to potential bias resulting from the relatively small sample size.

<table>
<thead>
<tr>
<th></th>
<th>Unhydrated</th>
<th>Hydrated</th>
<th>Odds Ratio (95%-CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of scans</td>
<td>74</td>
<td>74</td>
<td></td>
<td></td>
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<tr>
<td>sCr-based PC-AKI</td>
<td>27 (36)</td>
<td>19 (26)</td>
<td>1.73 (0.360-8.141)</td>
<td>.498</td>
</tr>
<tr>
<td>MCR-based PC-AKI</td>
<td>6 (8)</td>
<td>4 (5)</td>
<td>3.403 (0.113-95.069)</td>
<td>.489</td>
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<tr>
<td>Death in 30 days</td>
<td>14 (19)</td>
<td>8 (11)</td>
<td>.758 (0.048-9.124)</td>
<td>.758</td>
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<tr>
<td>after contrast administration</td>
<td></td>
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<tr>
<td>Emergent dialysis in 30 days</td>
<td>15 (20)</td>
<td>6 (8)</td>
<td>.078 (0.003-1.946)</td>
<td>.121</td>
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<td>after contrast administration</td>
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PC-AKI (based on SC criteria) and PC-AKI (Manual Case Review) were separately analyzed using conditional logistic regression due to multicollinearity.
- Be critical of what can be considered “unconfounded” PC-AKI
- Know which factors contribute to deviation from the current protocols and consider adjusting your protocol accordingly
- Consider kidney function assessment a shared responsibility
- Include specific guidelines for patients undergoing dialysis with residual diuresis based on expert opinion