Contrast induced nephropathy: Are we adhering to guidelines? A retrospective analysis and audit

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**Aims and objectives**

Use of contrast media has allowed improved differentiation of body tissues in a number of modalities however its use is associated with various risks, including contrast induced nephropathy (CIN). This is particularly so for patients with risk factors predisposing to renal disease.

The onset is usually within the first 24 hours, peaking at 48-72 hours with recovery usually within 3-5 days but in some cases taking up to 14 days. A proportion of patients require dialysis and in these patients the median 2-year survival rate is 19% (1,2). This dramatic effect on mortality rates is also seen in those who do not require dialysis - an increased 1-year mortality rate (1,2).

More patients are being exposed to this risk as the contrast enhanced investigation demand rises. In the UK, over the past 5 years the average year-on-year increase in CT scans has been 10.3% (3).

Basildon and Thurrock University Hospitals NHS Foundation Trust released the guideline 'Renal complications after administration of iodinated contrast media - Guidelines for the identification and care of patients at risk' in September 2012. This document detailed the identification of patients at risk of contrast induced nephropathy, roles and responsibilities of involved parties, pre-procedural care, management of contrast media related risks and post-procedural care.

According to these guidelines, at-risk patients were defined as those who are elderly (over 75 years of age), have certain co-morbidities (e.g. underlying renal disease or diabetes) or are taking nephrotoxic medication (e.g. diuretics).

Our aim was to assess trust performance in identification and follow-up of patients at risk of contrast induced nephropathy (CIN).
Methods and materials

This was a retrospective audit performed against aforementioned guidelines. Objective and standards were selected from recommendations made in these guidelines (see Table 1). At-risk groups studied were those with age over 75 or estimated glomerular filtration rate (eGFR) of <60 ml/min.

All in-patient and out-patient CT pulmonary angiograms (CTPAs) performed in January 2014 and in June 2014 were included (total 214). This study uses a set volume of contrast. These seasonally opposite months were chosen to balance any demand related factors which could affect the outcomes. Two cases were excluded: one case was an external study that was imported into our picture archiving and communications system (PACS), therefore our trust was not in a position to manage their risk of nephropathy; the second case was a patient double-booked onto the system. After exclusion, the total sample size was 212 patients, 128 in January and 84 in June.

Cases were identified through the hospital Radiology Information Systems (RIS). Blood test results and outcomes of scans were reviewed using the hospital Results Reporting System and PACS.

Patients' healthcare records were not reviewed. In order to measure performance in criteria 4, renal team follow up if CIN was diagnosed, an alert system currently in place within the hospital pathology system was used as a proxy. This alert system (ZIMAG) notified a designated renal consultant via email should a patient's eGFR fall below 45 ml/min, provided the ZIMAG code was written onto the blood test request form used following contrast administration.
**Table 1:** Criteria (objectives) and expected standards

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Standard</th>
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<tbody>
<tr>
<td>1. Assessment of renal function prior to contrast (within 1 week for inpatients; 3 months for outpatients)</td>
<td>100%</td>
</tr>
<tr>
<td>2. Assessment of renal function 48-72 hours following contrast administration, for at-risk patients (age&lt;75, eGFR&lt;60)</td>
<td>100%</td>
</tr>
<tr>
<td>3. Assessment of renal function 5 days after CIN diagnosed</td>
<td>100%</td>
</tr>
<tr>
<td>4. Renal team follow up if CIN diagnosed</td>
<td>100%</td>
</tr>
</tbody>
</table>
Results

Objective one, assessment of renal function prior to contrast, was not achieved in the January cohort (98%) but was achieved in the June cohort (100%) (see figure 1).

There were 134 patients deemed high risk: 72 with age over 75 and 62 with a pre-contrast eGFR <60 ml/min. In patients aged over 75, 32 (47%) had renal function assessment following contrast. Similarly, in patients with an eGFR<60 ml/min, 28 (45%) had renal function assessment following contrast. Objective two, assessment of renal function following contrast in patients at risk, was not achieved in either at-risk cohort (see figure 2).

The total number of patients diagnosed with CIN was 6, giving an incidence of 3% (9% in January and 6% in June). This incidence includes only patients who had an available pre-contrast and post-contrast creatinine level. Of these CIN patients, 50% of the January cohort had a renal function assessment 5 days after CIN was diagnosed and 0% in June (objective 3; see figure 3). There were 83 cases (65%) in January and 50 cases (60%) in June where CIN could not be diagnosed as no pre-contrast or post-contrast results were available (‘unknown’ column in figure 3). If we allowed for a renal function assessment up to 14 days from the contrast examination, the diagnosis of CIN was still unknown in 98 (46%) of patients (‘Delayed unknown’ column in figure 3).

No patients were alerted through the ZIMAG alert system (objective 4). Three of the 6 patients had a post-contrast eGFR of >45 ml/min and the remaining three were not alerted as the ZIMAG code was not put onto the blood test request form.
Images for this section:

**Fig. 1**: Objective 1 results - assessment of renal function prior to contrast administration

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**Follow up blood test carried out in at-risk patients (%)**

<table>
<thead>
<tr>
<th>Age &gt;75</th>
<th>eGFR &lt;60</th>
</tr>
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<tbody>
<tr>
<td>January</td>
<td>48</td>
</tr>
<tr>
<td>June</td>
<td>47</td>
</tr>
</tbody>
</table>

Target - 100%
**Fig. 2:** Objective 2 results - Assessment of renal function 48-72 hours following contrast administration, for at-risk patients

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**Fig. 3:** Incidence of CIN and objective 3 results - assessment of renal function 5 days after CIN confirmed

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Conclusion

Standards were only met in one objective - assessment of renal function prior to contrast. The trust performed poorly in follow up renal assessment of patients who were at risk of CIN as well as follow up renal assessment of patients with confirmed CIN.

In addition, CIN could not be confirmed in a large proportion of patients due to lack of post-contrast renal function assessment, thus the true incidence of CIN remains unknown. The reasons for this poor performance are likely to be multifactorial, including a lack of awareness with regard to the risks of contrast media, the risk factors which predispose patients to CIN and the consequences of CIN. In most cases, CIN could not be confirmed due to post-contrast renal function assessments not being performed, as opposed to a delay in this assessment past the recommended 48-72 hours window. This is demonstrated in the 'Delayed unknown' column in figure 3 and further reinforces the lack of awareness or compliance as opposed to other potential factors causing delay in blood testing.

In the current climate of increased demand and time pressures, this audit serves as a reminder of the importance to minimise harm to patients, first and foremost. Especially after employing imaging as a decision making tool. Findings are awaiting local presentation at the radiology department audit meeting, as well as medical and surgical audit meetings. This will serve to raise awareness of CIN and local trust guidelines. A proposal is being prepared in collaboration with pathology to update trust policy according to new Royal College of Radiology guidelines for CIN, released in collaboration with The Renal Association and British Cardiovascular Intervention Society (4).

A re-audit will be performed 6 months after implementation of these changes in order to assess their impact.

A limitation of this audit is that only performance in CTPAs was assessed. Due to the nature of the management pathway for this condition, the results may not represent that of other contrast examinations.

Further work could include assessment of performance in patients with additional risk factors such as those with other co-morbidities or those taking nephrotoxic medication.
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References


