**Definition**

A rise in serum creatinine of $\geq 50\text{umol/L}$ after intravenous or intra-arterial contrast. This small rise in creatinine does not usually lead to permanent renal sequelae but is associated with increased in-hospital morbidity & mortality. Bigger rises in creatinine may accelerate the need for dialysis.

**Assessing the Risk**

- **Low** (eGFR >60 ml/min).
- **Medium** (10% risk) eGFR 25-60 ml/min -
  - 40% risk if
    - decline in renal function is progressive before contrast
    - volume depletion
    - multiple contrast studies
    - heart failure
    - diabetes,
    - myeloma.
- **High** (50% risk) eGFR 15-25 ml/min

**Estimating the GFR**

*The estimated GFR (eGFR) is usually available on the computer pathology results*

If not, calculate the GFR using the Cockcroft Gault Formula:

\[
\text{Creatinine Clearance} = \frac{[(140\text{-age}) \times \text{weight (kg)}]}{[\text{Serum creatinine (umol/l)} \times 0.814]} \]

(Multiply answer x 0.85 for females)

**Clinical Features**

Renal failure is predominantly non-oliguric.

Dialysis is rarely required (<1%) except in High-risk group.

Permanent small loss of renal function is not uncommon.

*Acute renal failure with and without the requirement for dialysis increases in-hospital and later mortality, hence the significance of this disorder.*
Prevention for medium and high risk (not required for low risk)

1. Check with the radiologist whether intravenous or intra-arterial contrast is mandatory
2. Use **non-ionic iso-osmolar contrast (Iodixanol)** – aim for use of <70mls in total.
   - Ask whether CO2 angiography can be used instead
   - Avoid Gadolinium for MRI if eGFR <30ml/min to avoid nephropathy and/or nephrogenic systemic sclerosis
3. **When procedure is planned:**
   - Normal saline @ 1ml/kg/hr for 6 hours before contrast, during contrast and for at least 6 hours after the procedure
   - **AND**
   - N-Acetylcysteine (NAC) 600mg (3ml in 200ml orange juice or other flavoured drink) bd orally the day before and the day of the procedure. **Only these 4 doses are necessary**
4. **If procedure is urgent or patient is ‘nil by mouth’:**
   - Intravenous normal saline
   - @ 3ml/kg/hr for 1 hour **pre-procedure**
   - then 1ml/kg/hr **during procedure** and
   - 1ml/kg/hr for 6 hours **post-procedure** (maximum fluid rate 300ml/hr pre contrast and 100ml/hr post contrast).

**Notes:**

I. Oral hydration with water alone is inadequate to prevent contrast nephropathy

II. There is currently considerable uncertainty about the relative merits of saline vs. bicarbonate intravenously with some believing these to be equivalent, others favouring superiority of bicarbonate.

III. There is also debate over the merits of NAC; in general, data favour use of oral N-acetylcysteine but this may sometimes be unavailable in our pharmacy. In such cases just use normal saline as above. Data on the routine use of ivi N-acetylcysteine are inconclusive and as such the simpler regimens recommended above are employed routinely.

6. Cease metformin at least 12hrs, preferably 48hrs, before procedure to avoid lactic acidosis & restart once it is clear that baseline renal function has not altered.

7. **If patient is fluid overloaded do not use intravenous saline; use oral NAC as above:**

8. Strategies which probably do not work include Theophylline, Atrial Natriuretic Peptide, Nifedipine, Captopril, Fenoldopam, Dipyridamole, Mannitol, Frusemide., ascorbic acid

**Evaluation**

- It is the clinician’s responsibility to assess whether renal insufficiency and/or other risk factors for contrast nephropathy exist before the procedure.
- Check serum electrolytes and creatinine and eGFR pre contrast.
- Check electrolytes and creatinine within 48 hrs of contrast in medium and high-risk patients
  - If renal function has deteriorated check again by day 5 at the latest.
- Do not recommence non-steroidal anti-inflammatory drugs until creatinine has returned to pre contrast base line

**Key Points**

- Determine whether the patient is at risk of contrast nephropathy.
- If the procedure is planned then use intravenous saline beginning at least 1 hour and preferably 6 hrs before the procedure in most cases.
- If the patient is fluid overloaded use oral NAC as above.

**Selected References**

**Original protocol references:**
Merten GJ et al. JAMA 2004; 291:232,8-34
Bagshaw SM & Ghali WA. BMC Medical 2004;2:38
NEJM.2006 Jun 29;259(26):2773-82

**Updated references 2010:**


Gonzales DA; Norsworthy KJ; Kern SJ; Banks S; Sieving PC; Star RA; Natanson C; Danner RL. A meta-analysis of N-acetylcysteine in contrast-induced nephrotoxicity: unsupervised clustering to resolve heterogeneity. BMC Med. 2007 Nov 14;5:32.


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