



Clinical Practice Guidelines

Contrast Associated Nephrotoxicity

Overview: Renal failure due to contrast media has been reported to be the third most common cause of in-hospital renal failure, after hypotension and surgery. Transient renal effects are seen after intravascular contrast and may be due to renal hemodynamic changes or direct tubular toxicity of the contrast media. Patients with normal renal function are at extremely low risk for contrast-associated nephrotoxicity.

The clinical course of contrast-associated nephrotoxicity depends on the patient's baseline renal function, co-existing risk factors, degree of hydration, and (perhaps) dose of contrast media. Serum creatinine begins to rise within the first 24 hours, peaks within 96 hours (4 days), and usually returns to baseline within 7-10 days. It is rare for patients to require temporary or permanent dialysis.

Target Audience: Healthcare Providers, Imaging Nurses, Radiological Technologists, Medical Students and Interns, Radiology Residents, Radiologists, Radiology Administrators

Content/Strategies:

- Screen for risk factors in the patient population receiving intravenous contrast:
 - Pre-existing renal insufficiency (serum creatinine ≥ 1.5 mg/dl and serum glomerular filtration rate of <60)
 - Low osmolality contrast media (LOCM) are generally less toxic than high osmolality contrast media (HOCM) in patients with underlying renal insufficiency. The exact mechanism for this is unclear.
 - Patients with renal insufficiency who require intermittent or occasional dialysis are at substantial risk for contrast-associated nephrotoxicity, with further permanent worsening of their renal functioning. Alternate non-contrast imaging studies should be considered.
 - Diabetes Mellitus (DM)
 - Patients with DM who are taking metformin or drugs containing metformin fall into a special category – see *Clinical Practice Guideline on Metformin Therapy and Lactic Acidosis Risk*.
 - Dehydration and/or use of diuretics
 - At highest risk: Patients with DM and renal insufficiency and dehydration
 - Cardiovascular disease
 - Advanced age (≥ 70 yrs)
 - Nonionic LOCM are less nephrotoxic in this population than ionic HOCM.
- Prevention of Contrast-Associated Nephrotoxicity:
 - Obtain a baseline serum creatinine and glomerular filtration rate in the following patients:
 - History of kidney disease – including transplant and tumor
 - LOCM or Iso-osmolality contrast media (IOCM) are suggested for patients with renal insufficiency.
 - Family history of renal failure
 - DM treated with insulin or other prescribed hypoglycemic agent
 - Paraproteinemia syndromes (e.g., multiple myeloma)
 - Collagen vascular disease (e.g., lupus, scleroderma)
 - Medication use that includes one or more of the following:
 - Metformin or medications containing metformin
 - Nonsteroidal anti-inflammatory drugs
 - Antibiotics – particularly the nephrotoxic aminoglycosides

- BUN may help in determining hydration status but cannot reliably evaluate renal function.
- If renal dysfunction is identified, the referring physician should be made aware of alternate imaging approaches. If no alternatives are available, a recommendation to extend the intervals between contrast exams and reduce contrast dose should be made, and renal function should be followed closely.
- Hydration can be initiated to prevent contrast-associated nephrotoxicity. In the dehydrated state, renal blood flow and glomerular filtration rate (GFR) are decreased, and the effects of contrast media on these parameters are accentuated. There is a theoretical concern for prolonged tubular exposure to contrast media because of low tubular flow rates.
 - Patients who are not able to take oral hydration can receive intravenous hydration with 0.45% or 0.9% saline at 100 ml/hr for 6-12 hours prior to and 4-12 hours after administration of contrast.
 - The addition of pre- and post-treatment with parenteral or oral sodium bicarbonate can have a protective effect against contrast nephropathy.
 - The use of N-acetylcysteine for renal protection is based on the hypothesis that contrast nephropathy is due to renal vasoconstriction and free radical release (N-acetylcysteine has both vasodilating and antioxidant properties). Studies are mixed in their support of this method.
 - Chronic renal dialysis patients with end stage renal disease (ESRD) do not need immediate dialysis unless there is an underlying cardiac dysfunction or very large volumes of contrast are used. Contrast can have a deleterious direct cardiotoxic effect on a damaged or diseased heart.
- Limit the dose of contrast used and choose LOCM or IOCM if there is a risk of adverse effects of hypertonicity.
- Contrast is not protein bound and has a low molecular weight so that it is readily cleared by dialysis.

Suggested Readings

American College of Radiology. (2008). *Manual on contrast media* [Version 6.0]. Reston, VA: Author.

Forrest, W. (2006, June 15). *Assessing patient risk will help prevent contrast-induced nephropathy*. Retrieved from AuntMinnie.com

Merton G.J., Burgess, W.P., Gray, L.V., Holleman, J.H., Roush, T.S., Kowalchuk, G.J., et al. (2004). Prevention of contrast-induced nephropathy with sodium bicarbonate; A randomized controlled trial. *Journal of the American Medical Association*, 291, 2328-2334.

Pannu, N., Mannus, B., Lee, H., & Tonelli, M. (2004). Systemic review of the impact of N-acetylcysteine on contrast nephropathy. *Kidney International*, 65(4), 1366-1374.

Rao, Q.A., & Newhouse, J.H. (2006). Risk of nephropathy after intravenous administration of contrast material: A critical literature analysis. *Radiology*, 239, 392-397.

Solomon, R.J., Natarajan, M.K., Doucet, S., Sharma, S.K., Staniloae, C.S., Katholi, R.E., et al. (2007). Cardiac Angiography in Renally Impaired Patients (CARE) study: a randomized double-blind trial of contrast-induced nephropathy in patients with chronic kidney disease. *Circulation*, 115, 3189-3196.

Tepel M., Aspelin, P., & Lumiere, N. (2006). Contrast-induced nephropathy; A clinical and evidence-based approach. *Circulation*, 113, 1799-1806.

Author: Delma Armstrong, BSN, RN, CRN

Reviewers: Kate Little, RN, Sharon Lehmann, ACNS-BC, University of Minnesota Radiology Nurses

Approved by the ARNA Board of Directors: August 14, 2006

Updated: September 2009

Association for Radiologic & Imaging Nursing (ARIN)
 390 Amwell Road, Suite 402
 Hillsborough, NJ 08844
 Phone: 866-486-2762 or 908-359-3508 Fax: 850-484-8762
 www.arinursing.org info@arinursing.org