Contrast Nephropathy

Myth or Fact?

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Disclosures

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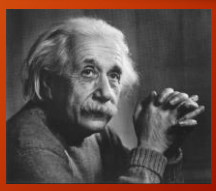
Outline

- CIN vs CA-AKI
- Historic Perspective
- Pathogenesis
- Clinical Presentation and Course
- Risk
- Prevention
- Summary

Why talk about Contrast?

- Recent controversy with basic science and clinical studies in conflict → is contrast kidney injury overestimated clinical entity?
- "Renalsim" → selecting out CKD for contrast procedures
  - Do we avoid angiography at the detriment of patients with CKD?
- Has become a integral part of diagnostic testing in modern medicine.

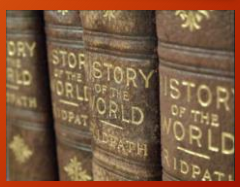


CIN vs. CA-AKI???

- Contrast Induced Nephropathy (CIN) VS. Contrast associated AKI (CA-AKI)??
  - Often difficult to prove sole injury agent
  - Multifactorial
    - Hypotension
    - Intra-aortic ballon pump (IABP)
    - CHF
    - Cholesterol Emboli*
  - Definition of CA-AKI: AKI occurring after administration of iodinated contrast may or may not be directly caused by the contrast material.
  - Contrast Nephrotoxic?
    - Based on Animal Studies
    - Large uncontrolled Human trails

Historic Perspective

- First report of contrast media related Acute Kidney Injury (AKI) was ~ 1954
  - Multiple Myeloma patient developed anuria following intravenous pyelography
- In 1980s larger case series began to appear
  - Contrast media exposure from coronary angiography
  - Particularly patients with CKD and DM

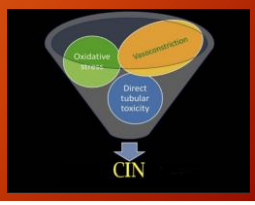


The Controversy of Existence: The Evidence???

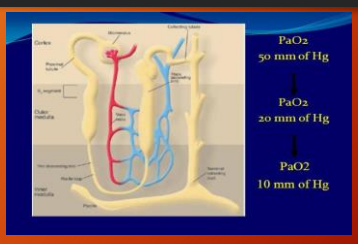
- Most conclusion of nephrotoxicity have been from prospective randomized trials (RCT)
- Previous assertions and contradictions are due:
  - Limitations non-randomized trials, uncontrolled, and observational
- RCT(S) risk of AKI:
  - high-osmolar contrast media >>> low-osmolar contrast media
- RCT(s) show prevention of contrast associated AKI:
  - Volume expansion prophylaxis
- Difference in risk in Arterial versus Venous contrast media:
  - Comorbidities of patient
  - Procedural Risk
  - Contrast Volumes
    - Similar rate when comparable amounts used
    - Grams of iodine contrast per ml/min of eGFR

Pathogenesis of Injury

- Suspected from Animal Models:
  - Vasoconstriction
    - Medullary Toxicity
  - Direct Cytotoxic effects

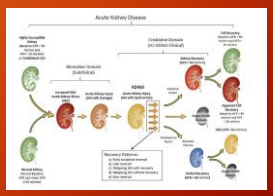


Pathogenesis of Injury



Clinical Presentation and Course

- Acute Kidney Injury typically has rapid recovery.
- Suspected AKI more "mulit-hit" for development of ATN
- Rise in creatinine typically occur in 24 to 48 hours after exposure
- Typically mild rise in creatinine nonoliguric
- *Oliguria and Severe AKI are less common findings of CIN



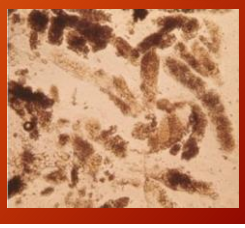
Staging of AKI

AKI Staging – KDIGO

AKI stage	Serum Creatinine criteria	Urine output criteria
1	SCr increase ≥26 µmol/L within 48 hrs or SCr increase ≥1.5–2 fold from baseline	<0.5 mL/kg/hr for 6 consecutive hrs
2	SCr increase ≥2–3 fold from baseline	<0.5 mL/kg/hr for 12 hrs
3	SCr increase ≥3 fold from baseline or SCr increase ≥354 µmol/L or initiated on RRT (irrespective of stage at time of initiation)	<0.3 mL/kg/hr for 24 hr or anuria for 12 hr

Clinical Presentation and Course

- Early presentation may be a "Pre-Renal" Picture:
  - Vasoconstriction → "Sodium Avid State"
  - FENA < 1%
- Later phase maybe Acute tubular necrosis/tubular injury
- Renal US would be normal
- Typically Bland UA
  - Doesn't exclude if present
- Kidney Bx non-specific ATN



Clinical Presentation and Course

- Most patients kidney function improves 3 to 7 days
- Dialysis is rare for CIN
  - Multiple hit
  - DM/CKD
- Persistent CKD?
  - Usually recovery to baseline
  - DM/CKD at risk for continued chronic elevation (CKD or worsening CKD)

Risk for Contrast Associated and Induced Nephropathy

Procedure Related
- Volume of Contrast
- Multiple exposures
- High-osmolar contrast
- Intra-arterial??

Patient Related
- Chronic Kidney Disease**
- DM**
- Volume depletion
- Reduced cardiac output
- Concomitant nephrotoxins
- Proteinuria**
  - >300 mg/day of albuminuria
  - >500 mg/day of proteinuria
- Age**

Risk for Contrast Associated and Induced Nephropathy

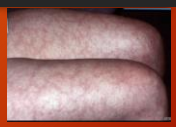
- eGFR > 60 mL/min/1.73 m2 negligible risk
- eGFR >30 to 44 mL/min/1.73 m2 negligible risk???*
- eGFR between 30 and 44 mL/min/1.73m2 are at intermediate risk
- eGFR < 30 mL/min/1.73m2 are greatest at risk
- Diabetes increases risk in all patients

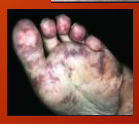
Risk for Contrast Associated and Induced Nephropathy

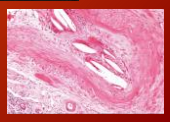
- Question: "Is it okay to give contrast to patient with abnormal kidney function?"
- COMPLEX ANSWER:
  - Must always way risk versus benefit
  - Emergency versus elective
  - "Will this change my management?"
  - Stability of Creatinine
  - Alternative Studies?

Potential Differential Diagnosis

- Cholesterol Emboli (intra-arterial)
  - Livedo reticularis
  - Urine eosinophils
  - Hypocomplementemia
- Pre-renal Injury (ie Heart Failure)
  - Venous Congestion
  - Decreased Stroke Volume



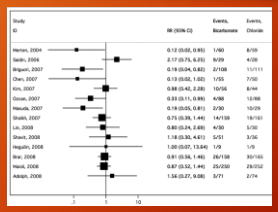




Prevention

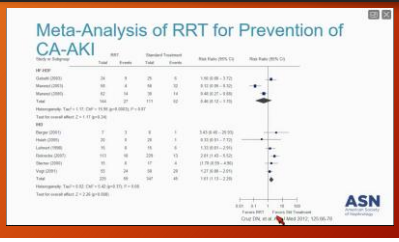
- Use minimal volume of contrast
  - Staged Procedures
  - Wait at least 72 hours for next contrast media load
  - Carbon dioxide below the diaphragm
  - Use low-osmolal (Grade 1B) or iso-osmolal agents
- Isotonic Fluids
- (Grade 1B, assuming no contraindication)
  - No difference between Bicarbonate or Normal Saline (Grade 1B)
  - Outpatient: 3 mL/kg over one hour pre and 1-1.5 mL/mg/kg/hr for 4 to 6 hours post
  - Inpatients: 1 mL/kg/hr for 6 to 12 hours pre and post
- Dialysis
  - Hasn't been shown to have any clear benefit in prevention

Prevention



Bicarbonate vs. Normal Saline
CJASN October 2009

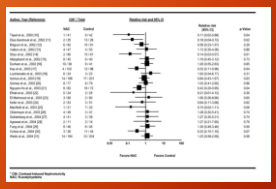
Prevention



Prevention

- Statins
  - Some studies suggested risk reduction
  - Not recommended as standard prevention strategy
- Diuretics or mannitol
  - Not recommended
- NAC (Acetylcysteine)
  - Meta-analyses yielded conflicting results
  - Not recommended as standard (grade 2B)

Prevention



The efficacy of NAC

Types of Contrast

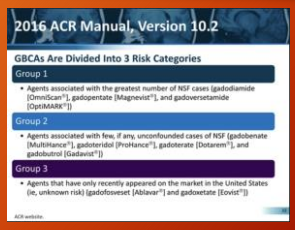
Commonly used iodinated contrast agents

	Name	Type	Iodine Content	Osmolality	
Ionic	Diatrizoate (Hypaque 50)	Ionic Monomer	300	1550	High Osmolar
	Metrizoate (Isopaque Coronar 370)	Ionic	370	2100	
	Ioxaglate (Hexabrix)	Ionic	320	580	Low Osmolar
Non-Ionic	Iopamidol (Isovue 370)	Non-ionic monomer	370	796	
	Iohexol (Omnipaque 350)	Non-ionic	350	884	
	Iodixanol (Visipaque 320)	Non-ionic dimer	320	290	Iso Osmolar

Gadolinium/MRI contrast media

- Not nephrotoxic
- Can Cause nephrogenic systemic fibrosis (NSF) → typically fatal
- Would Avoid use of Group I and Group III agents in eGFR < 30 ml/min/1.73 m2
- Consider alternative study o no contrast (gadolinium) if eGFR < 30 ml/min/1.73m3
- If no choice, use Group II agent
  - Few if any reported cases of NSF
- Patients on dialysis do require post administration dialysis with gadolinium. (unclear if this is protective)

Types of Gadolinium



Summary

- Contrast Injury to the kidney does exist:
  - CIN
  - CA-AKI
- Isotonic fluids are a good strategy for prevention
- Weigh the benefits versus the risks
- Consider alternative testing if advanced CKD
- Diabetes matters!

The Proud Purple Podocyte