A Clinical Approach to Acute Renal Failure

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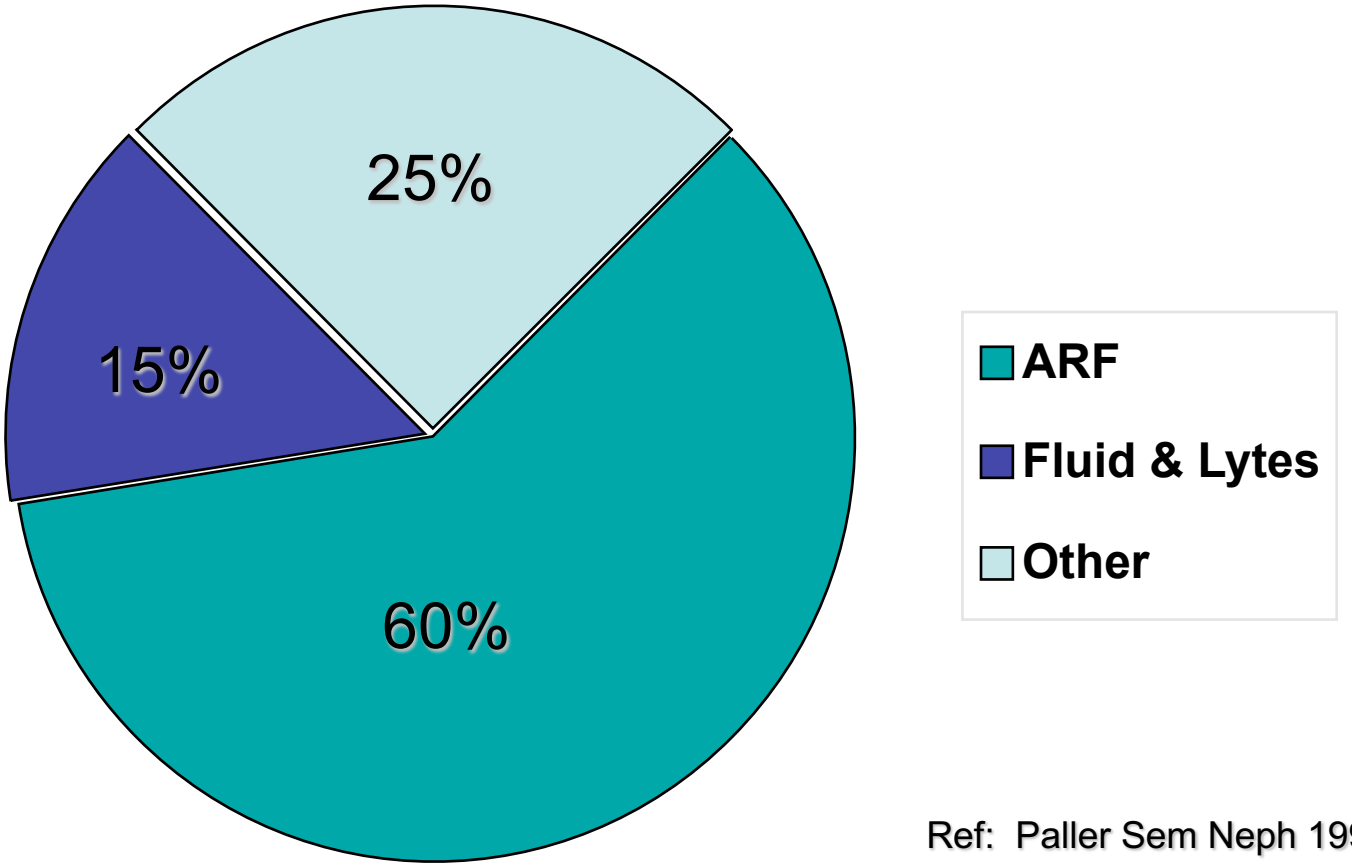
Summary

- Causes of Acute Renal Failure
  - Differential
  - Pre-Renal
  - Intra-renal
  - Post-Renal
- Initial treatment of ARF
- Cases to review
- RIFLE Criteria

Reason for Nephrology Consultation



Ref: Paller Sem Neph 1998, 18(5), 524.

Approach to ARF

- Pseudo-ARF
- Pre-Renal
- Intra-Renal
- Post- Renal

Approach to ARF

- Pseudo-ARF
  - Pt hosp for liver lac, allowed to go home on weekends. Normal renal function.
  - First weekend, creat bumped to 1.5, not noticed
  - 2nd weekend, creat up to 1.8, hydrated and came down.
  - 3rd weekend, creat over 2.0, so we were consulted.
  - What was happening?

Approach to ARF

- Pseudo-ARF
  - Pt was eating steak dinners at home/restaurant
  - Texan so steak was WELL done
  - Creatine in muscle converted to Creatinine.
- Creatinine production also much higher in Rhabdomyolysis, so BUN / Creat ratio may be less than 10.

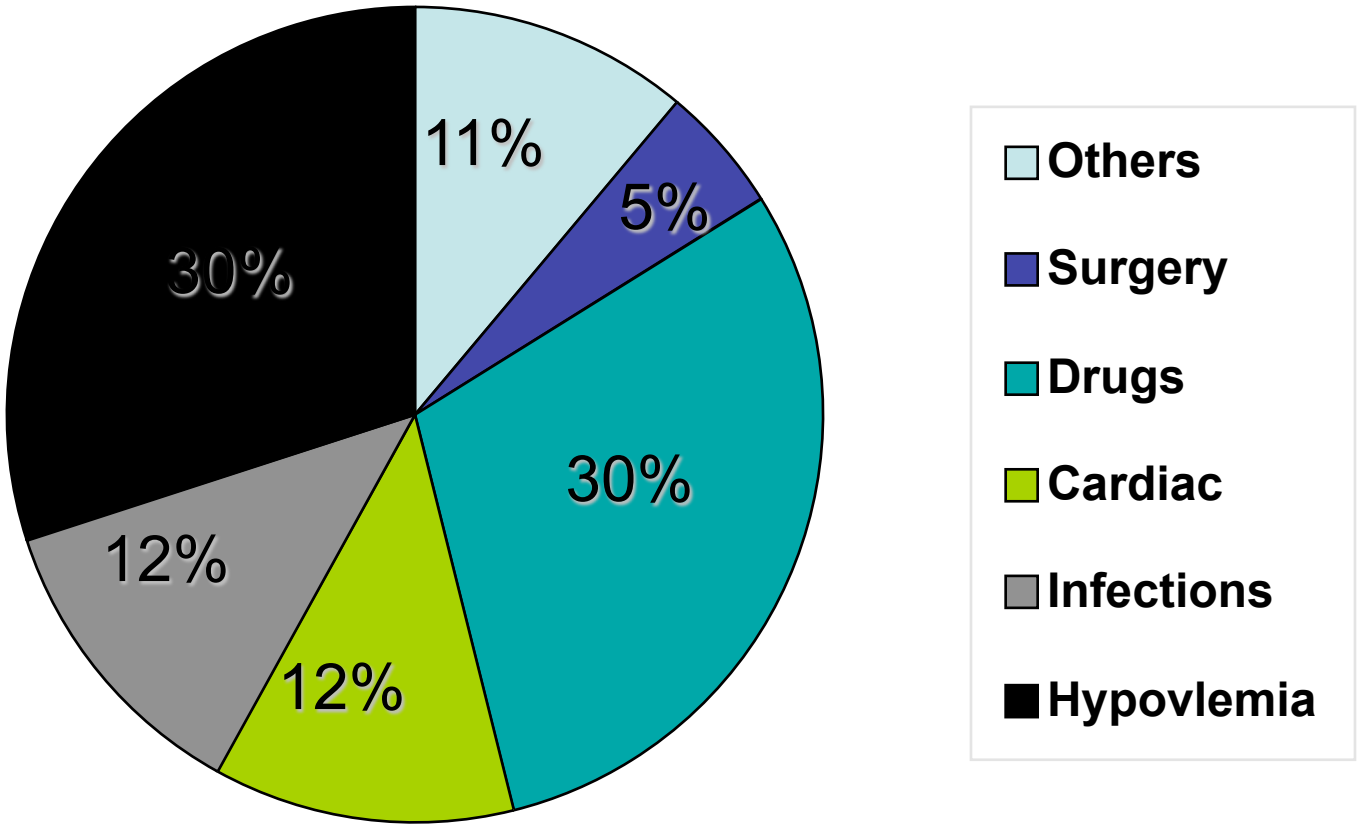
Approach to ARF

- Pre-Renal
  - Most common
  - Due to NPO, Diuretics, ACE inhibitors, NSAIDS
  - Due to renal artery disease, CHF with poor EF.
  - Usually BUN / creat ratio over 20.
  - Usually creat < 2.5

Approach to ARF

- Intra-Renal
  - Most commonly pre-renal tipping over into true renal injury.
  - Acute Tubular Necrosis is result (70%)
  - Tubulo-Interstitial Nephritis (20%)
  - Acute vasculitis/GN rare (5-10 %)

Instigating Factors for ARF in a Referral Hospital



Ref: Paller Sem Neph 1998, 18(5), 524.

Approach to ARF

- Post- Renal
  - Most commonly due to obstruction at bladder outlet
    - Prostate problems
    - Neurogenic bladder
    - Stone
    - Urethral stricture (esp after CABG)

Distribution of ARF Cause

Distribution of causes:

Pre-renal	Intra-renal	Post-renal
CHF	ATN (70%)	Obstruction @
Nausea/vomiting	Interstitial Nephritis (15-20%)	Bladder Outlet
NPO status	Glomerulonephritis (5%)	most commonly
Medications (diuretics, ACE, NSAIDS)	Vasculitis (1%)	

Initial Treatment of ARF

- Fluid Resuscitation
- Always place Foley Catheter
- Stop offending agents
  - NSAIDS, Contrast, ACE/ARB, potassium
- Watch labs
- Consider diuretics/Natrecor

Indications for Dialysis

- A acidosis
- E electrolyte abnormalities
- I intoxication/poisoning
- O fluid overload
- U uremia symptoms/complications

Choice of Dialysis Modality

- Standard Hemodialysis - The gold standard, able to clear the most toxins quickest, requires stable patient
- Acute Peritoneal Dialysis - good for fluid and uremic waste product removal, avoids need for vascular access. Requires a closed abdomen, not good for poisonings
- CVVHD - useful for unstable/hypotensive patients.

ARF Case :Basic 1.

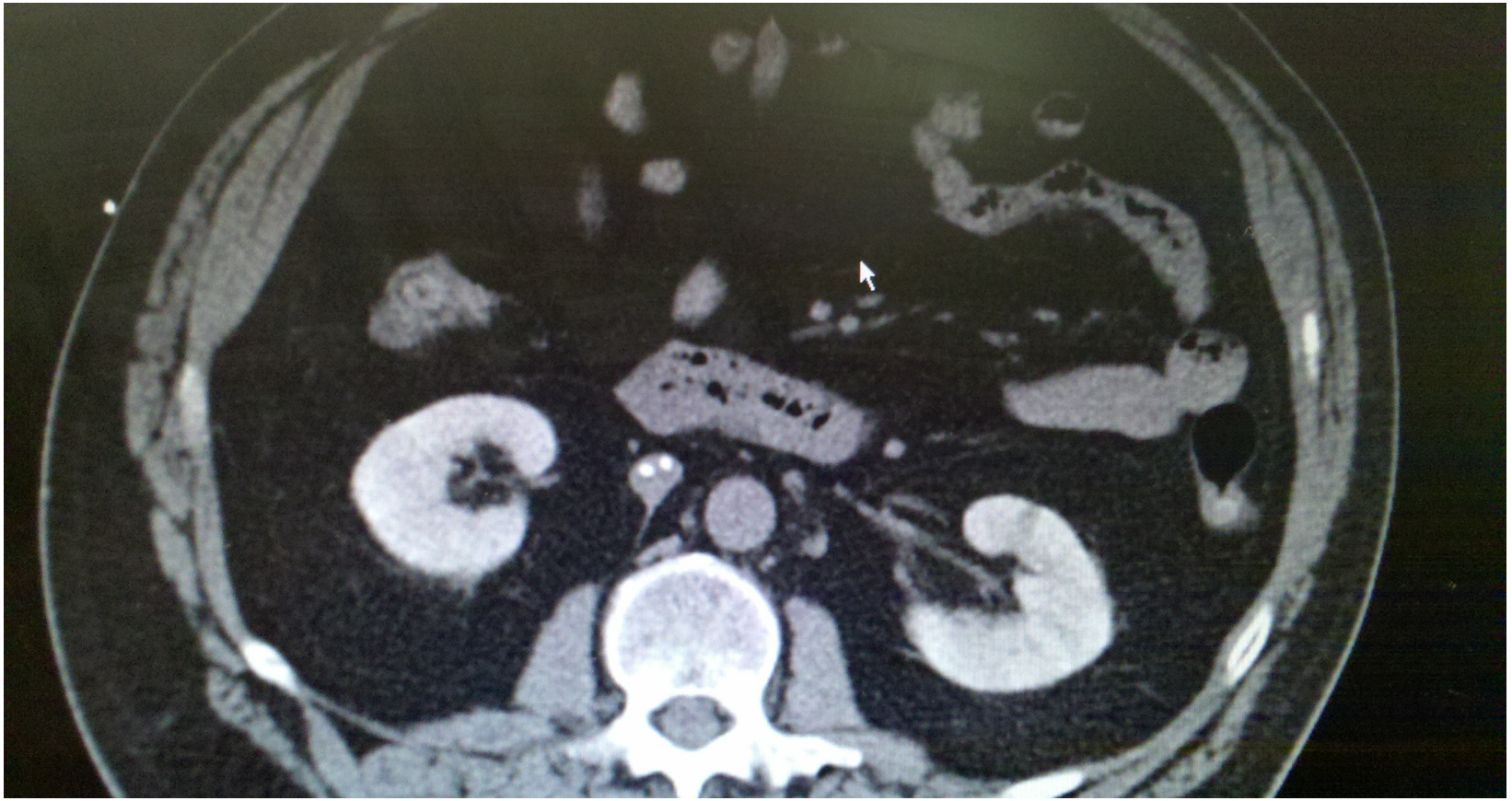
- 57 y.o. male on the surgery service for abdominal pain. Admitted and observed overnite, noted the next morning to have elevated creatinine from 1.5 on admission to 2.1. Urinalysis on admission is negative for blood or protein. Exam confirms abdominal tenderness, possible fullness in suprapubic region without specific mass. Patient denies difficulty voiding, has decent urine output since admission.
- Likely cause of renal failure:
  - Pre Post Intra - renal?
- What would you do to evaluate First ?

ARF Case: Basic 2

Basic 2: 63 y.o. male admitted with persistent nausea and vomiting, 2 weeks after cardiac cath for chest pain. Creatinine pre-cath was 1.8, no new medications given. Has history of diabetes mellitus and urinalysis shows proteinuria 3+. Your next test would be:

a. Upper endoscopy
b. CT scan of abdomen
c. Basic metabolic profile (lytes BUN, Creat)
d. Renal ultrasound .

CT abdomen



Risk Factors for Contrast Nephropathy

- Age over 60
- Diabetes
- Pre-Renal States
  - CHF
  - NSAIDS, ACE Inhibitors, Diuretics
- Proteinuria Includes, but not limited to Myeloma.
- Pre-existing Renal Disease

Etiology of Contrast induced AKI Two phases of injury:

- Immediate phase:
  - Contrast load (similar to Gentamicin or Amphotericin) causes intense renal vasoconstriction with immediate oliguria
  - Fluid shifts into vascular space, so patients can go into flash pulmonary edema
  - Can be treated with dialysis
  - Prevented by giving any sodium containing fluid – bicarb is not magical

Etiology of Contrast induced AKI Two phases of injury:

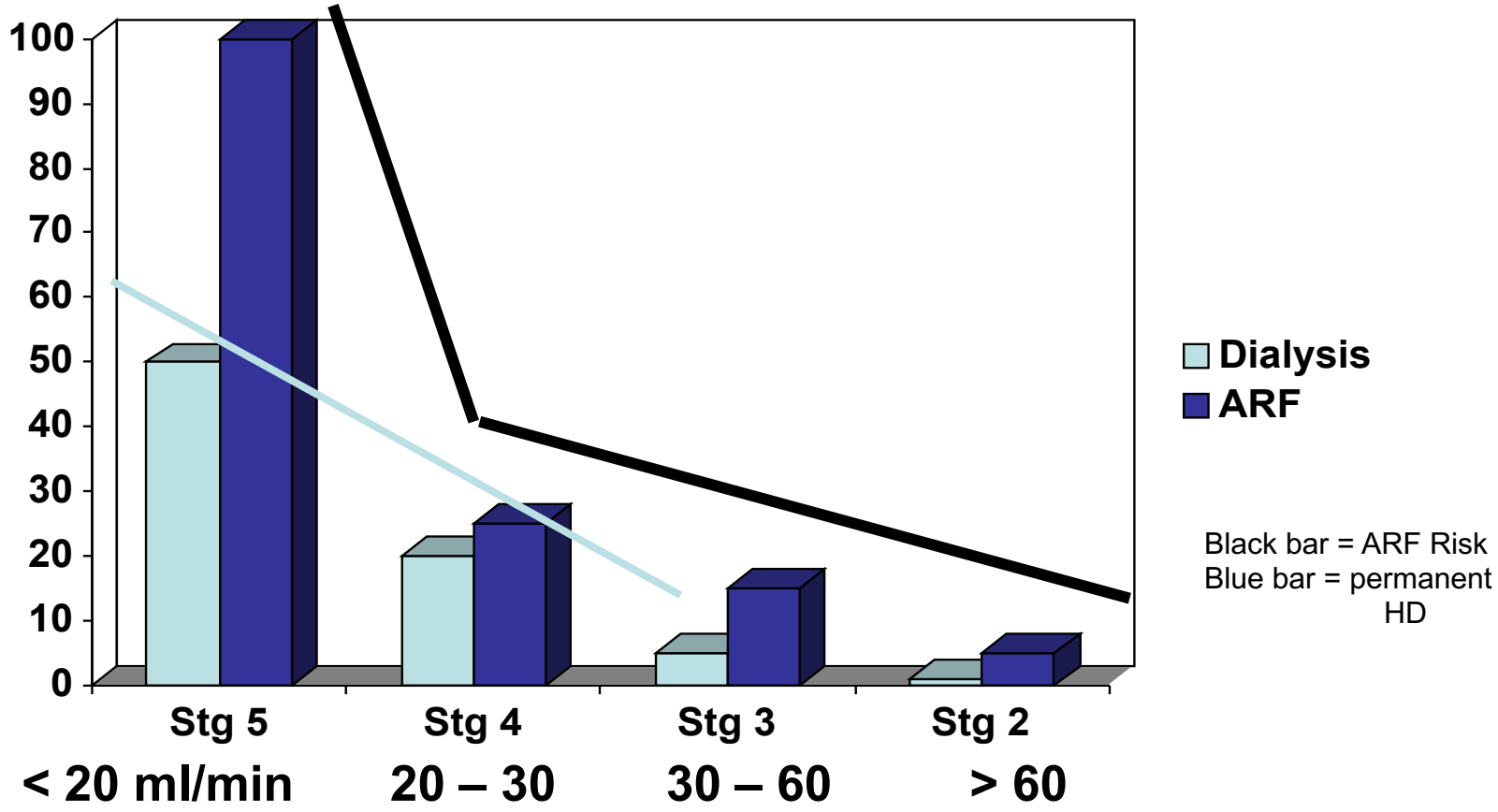
- Delayed/ secondary phase
  - Occurs at the time of the contrast infusion, but creatinine starts climbing 3-7 days after the contrast exposure
  - Due to direct tubular toxicity of the contrast (or gent/ Amphotericin)
  - Due to reactive oxygen radicals
  - Prevented by mucomyst

Etiology of Contrast induced AKI Two phases of injury:

- Delayed/ secondary phase
  - Prevented by mucomyst
  - Mucomyst provides sulfhydryl groups to the Pentose Phosphate shunt, which makes NADP and other free oxygen scavengers
  - PPS runs concurrently with the Krebs cycle, which is producing ATP and a lot of free oxygen radicals.

Risk of CN By Stage of CKD

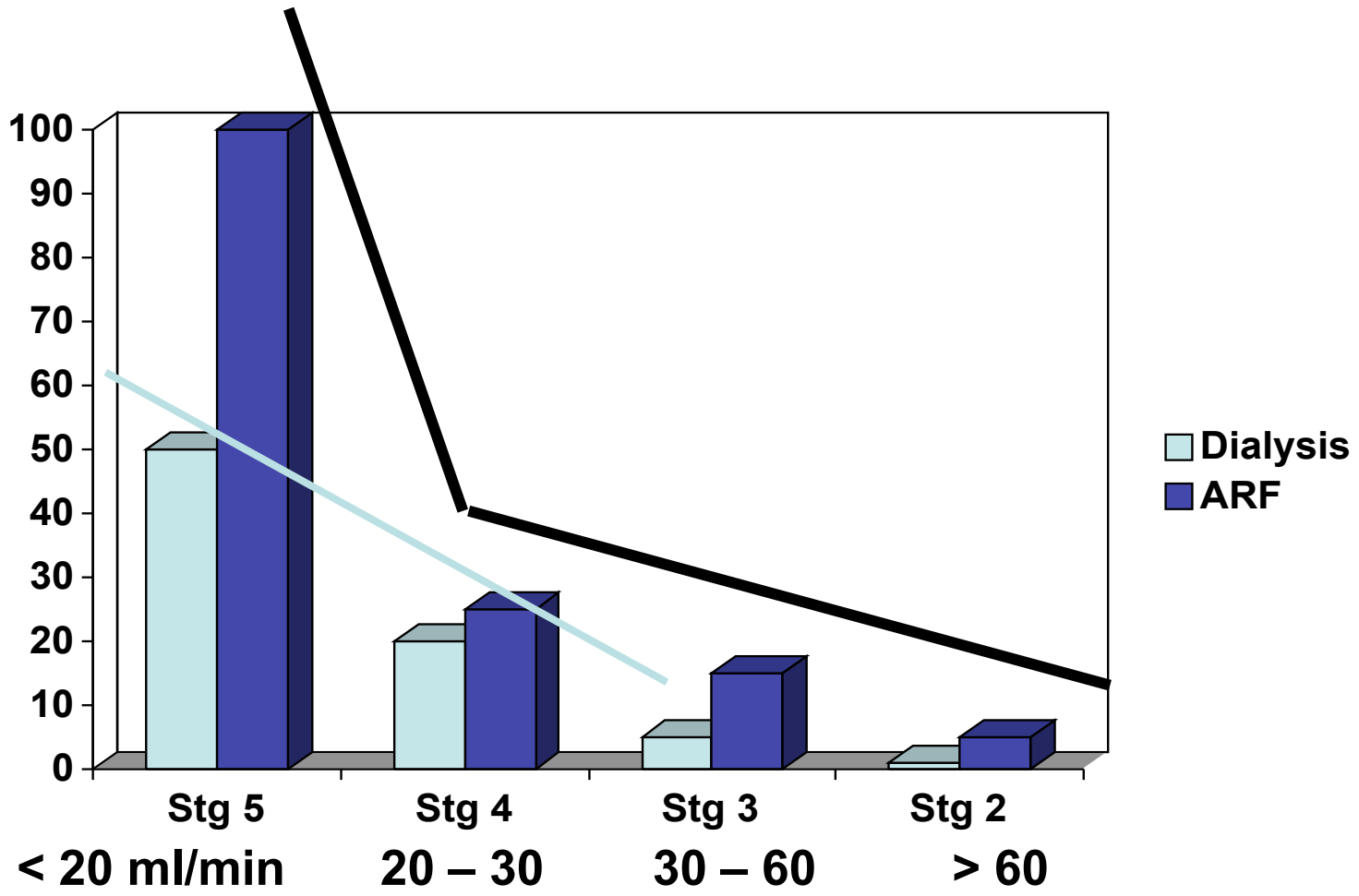
The Kaufhold Nomogram, 2003



Policy / Recommendations

- Stop ACE/ ARB, NSAIDs, Diuretics day before procedure
- IVF for everyone
  - NS for low risk pts
  - Bicarb for high risk pts?
- Urinalysis for all pts/ calculate Creat Clear for all pts.
  - Proteinuria or creat clear < 40 considered High risk.
- Mucomyst for High risk pts
- Limit volume of contrast in High Risk Pts.
- Consider Nephrology consult if considering Mannitol, Corlepam, or identified as high risk.

Risk of CN By Stage of CKD



ARF Case: Basic 3.

Basic 3. 77 y.o. female with no prior history of renal disease admitted with nausea and vomiting and diarrhea for 3 days. Found to have creat of 6.0 on admission lab. Serum bicarb: 15, K+ is 3.8, Na+ is 120.

Likely Cause of renal failure: Pre Post Intra?

Why is her potassium LOW?

Why is her sodium LOW?

Why is she acidotic?

What IVF would you start and Why?

ARF Case: Basic 4

- 34 y.o. recruiter for the Army admitted with weakness, confusion, 2 days after his fitness test (required run, pushups, etc.) Admission labs show normal electrolytes but BUN is 38, Creatinine is 8.0. Urinalysis shows 2+ protein, 4 + blood but microscopic doesn't show much RBC's, no casts. Likely cause of renal failure: Pre Post Intra?
- What confirmatory test would you order next?
- a. CT scan of head
- b. CPK with MB's, troponin
- c. ANA, ANCA, renal biopsy
- d. Renal ultrasound.

ARF Case: Basic 5

- 49 y.o. diabetic with no prior history of renal disease is admitted with cellulitis of the leg. Started on Unasyn at appropriate dose, creat on admission is 0.9. 2 days into therapy the leg is improving and the creatinine is 1.8. Urinalysis shows 3+ leukocytes, 2 + blood, 1 + glucose, and 2 + protein
- Cause of ARF: Pre Intra Post ?
- What would you see in the urinalysis ?
- How would you treat this?

ARF Case: Advanced 1

- Same story as Basic #1, but the surgeons perform CT scan of the abdomen. The CT shows para-aortic adenopathy with possible colon primary. Hydronephrosis is present bilaterally.
- Potential causes of the renal failure?
- How would you relieve the obstruction?

ARF Case: Advanced 2

- You are called to consult on a Pt in the SICU 2 days post-op with acute renal failure. Had bowel obstruction and after conservative treatment failed, was taken for lysis of adhesions. No ischemic changes were seen. Initially post op he looked OK and was extubated on the first post op day. The night before you were consulted he developed resp failure and was re-intubated. Looking back through the labs, you see that his creatinine was 1.0 pre-op, lytes were fairly normal, but phosphorus was 2.0. Pt had not received TPN during his 9 day hospitalization, but this was started post-op. His labs which prompted your consult show Na+ 128, K+ 5.5, CO2 14, BUN 78, creat 3.1, Phosphorus 6.0.
- Are the lab disturbances due to the TPN?

Advanced Case 2

- Differential for the ARF would include which of the following?
- a. Contrast nephropathy
- b. ATN from hypotension, surgery, volume depletion.
- c. Rhabdomyolysis
- d. Sepsis
- e. Nephrotoxic antibiotics
- f. Hypoxia and poor perfusion due to resp failure
- g. Obstruction
- h. Allergic interstitial nephritis (AIN)
- i. Acute Glomerulonephritis/RPGN
- j. Cholesterol Embolism syndrome.

Acute Dialysis Quality Initiative

- RIFLE Criteria Helps risk stratify patients with renal failure.
- Increased mortality seen with increases in creatinine of 0.3 to 0.5 mg/dl (70 % increase for all pts, 300 % increase in cardiac surgery pts

RIFLE criteria

- Risk low uop for 6 hours, creat up 1.5 to 2 times baseline
- Injury creat up 2 to 3 times baseline, low uop for 12 hours
- Failure Creat up > 3 times baseline or over 4, anuria
- Loss of Function Dialysis requiring for > 4 weeks
- ESRD Dialysis requiring for > 3 months

RIFLE estimate of Mortality

	Uchino	Hoste
• Two studies		
• No renal failure	4.4 %	5.5
• Risk	15%	8.8
• Injury	29%	11.4
• Failure	53.9%	26%
• Loss of Function		
• ESRD		

Crit Care Med 2006; 34:1913-7, Hoste CCM 2006; 10:R73

RIFLE criteria

- When markers of severity of illness are looked at *excluding* renal data, no difference in groups is seen.

New markers for ARF

- Creatinine is not very sensitive
- Cystatin C identifies ARF 1.5 days earlier than creatinine
  - KI 2004; 60:1115-1122
- KIM-1
- NGAL

New markers for ARF

- Insulin like growth Factor 7 in urine
- Tissue inhibitor of metalloproteinases also in urine
- Can rapidly identify patients at risk for ARF in 76-92% of cases
- False positive in half of patients in the ICU who do not develop ARF
- NephroCheck
  - ACP Hospitalist, Nov 2014, pg 45

Agents to Treat ARF

- Lasix still improves urine output, but may worsen mortality
  - Intensive care Med. 2005; 31: 79-85, JAMA 2002;288:2547-2553
- Fenoldapam may be helpful, especially in cardiac surgery pts
  - AmJKid Dis 2005;46:26-34
- Atrial Natriuretic Peptide may reduce need for dialysis and mortality
  - Crit Care Med 2004;32:1310-5.
- Dopamine still doesn't work
  - Ann Int Med 2005;142:510-24.

New approach to AKI

- German study in Deutsches Arzteblatt International 2020.
- Early warning system using creatinine,
  - Triggers immediate nephrology consult and a passport to go with patient to any procedure, identifying them as AKI.
- 50% of intervention group recovered renal function, vs 42% of control, Complications reduced from 39% to 15%, mostly reduced hyperkalemia, but also less pulmonary edema, acidosis.

How do you differentiate ARF from CRF.

- What physical exam finding tells you the pt has Chronic Kidney Disease?
- What Would you see on renal Imaging for a pt with CKD?

Lindsey’s Nails

Atrophic Kidneys on C