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Author(s): Jessica Holly, MD, (Utah), 2013

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When Kidneys Fail

Jessica Holly, MD
Department of Emergency Medicine
University of Utah

Objectives

- to discuss causes and disposition for patients in acute renal failure.
- to identify dialysis emergencies
- to identify the unique physiology of dialysis patients
- to discuss common problems associated with patients in renal failure.
- to discuss treatments of problems associated with chronic renal failure patients

AKI and ARF

- Syndrome characterized by rapid decline in GFR
- More than 30 definitions in literature
- Serum creatinine
- Glomerular filtration rate (GFR)

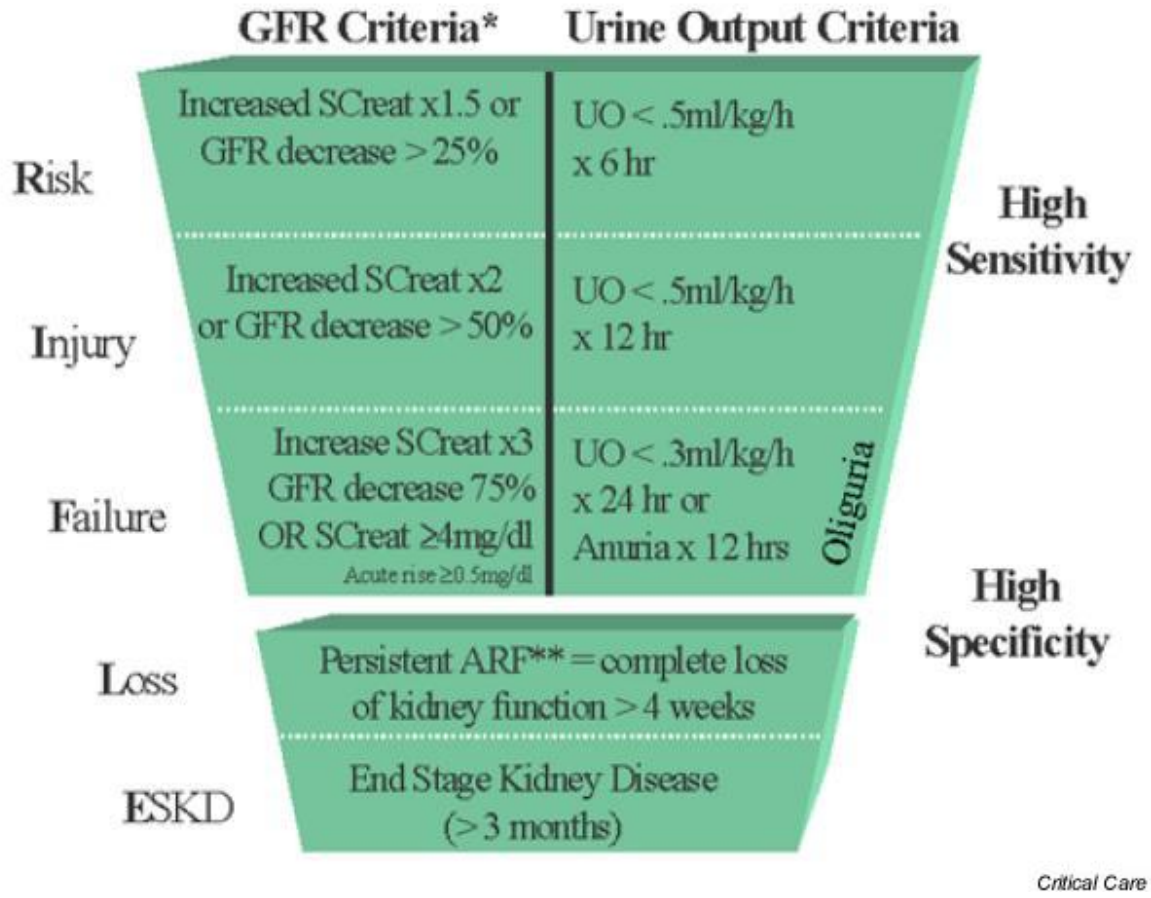
Estimation of GFR by serum Cr

Serum Cr (mg/dL)	GFR (mL/min)
1.0	Normal
2.0	50% reduction
4.0	70-85% reduction
8.0	90-99% reduction

Creatinine is simple to measure, however it remains in the normal range until GFR has fallen by >40%. Not useful in early renal impairment.

Always beware in the young and the old

RIFLE classification



ADQI group*

Source Undetermined

Who Cares

- ARF is Present in 5% of hospitalized Pts
- Mortality 20-50% of hospitalized Pts
- Mortality 40-70% in ICUs

- Has not improved despite dialysis

  Dialysis can affect morbidity

Acute Renal Failure

- Clinical features
  - Oliguria or anuria
  - Dehydrated or volume overloaded
  - Anorexia, nausea/vomiting
  - Confusion
  - Pericardial rub if uremic
  - Kussmaul breathing if acidotic
  - Bruising/GI bleeding
  - Often none

Acute Renal Failure

- Pre
- Intrinsic
- Post

- How do we identify them?

Pre-renal Failure

Pre-renal Failure

- Hypovolemia (dehydration, shock)
- Peripheral Vasodilation (sepsis)
- Impaired Cardiac Output
- Renal Vascular Obstruction
- Hepatorenal Syndrome

Community Acquired AKI = 70%

Hospital Acquired AKI = 20%

Intra-renal Failure

Intra-renal Failure

- Tubular, glomerular, interstitial or vascular damage
  - Ischemic
  - Drugs (amphotericen, gent, vanc, cephalosporins, penicillins)
  - Infectious (leptospirosis, falciparum malaria, strep)
  - Massive intravascular hemolysis (G6PD deficiency)
  - IV contrast
  - Snake bite
  - Myoglobin in rhabdo

Hospital Acquired AKI = 70%
Community Acquired AKI = 20%

Post-renal Failure

Post-renal Failure

- Prostate
- Uterus
- Retroperitoneal fibrosis
- Neurogenic bladder
- Acyclovir precipitate

NOT ALWAYS ANURIC

10% of AKI

BUN and Cr

- Often the first signs of AKI
- Cr is more specific as BUN can be elevated for other reasons
  - GI bleed
  - Hemolysis
  - Excessive protein intake
  - Steroids
- BUN/Cr often > 20 in prerenal

FENa

- Fractional Excretion of Sodium (FENa) = $(P_{Cr} \times U_{Na}) / (P_{Na} \times U_{Cr}) \times 100$

	Prerenal	Intrinsic	Post
Urine Na	<20	>40	>40
FENa	<1%	>1%	>4%

78% sensitive 75% specific
FEUr with diuretics? 79% sensitive 33% specific

NGAL

- Neutrophil gelatinase-associated lipocalin

- New test may be sensitive and specific for AKI in ED settings
  - Nickolas 2008

Who gets to stay?

- Rate of creatinine change is more predictive of GFR than the number
  - For GFR = 0, Cr increases by 1-3mg/dL daily
- ‘Pts with ARF should be admitted with early appropriate consult’ –Tintanelli

Stolen Kidneys

Koc 1989 - Turkish man in Britain had kidney stolen

Urban Legend spun in US

National Kidney Foundation has asked victims to come forward in US. None have.

1998 Indian surgeons arrested for stealing patients' kidneys

To sell $1000 to buy $6000 to $10000

How do we damage kidneys?

- IV contrast
- Diuresis
- Inadequate resuscitation
- Nephrotoxic drugs
- Decreased cardiac output

IV contrast

- ‘Clinically significant nephrotoxicity is highly unusual in Pts with normal renal function’
- Unknown mechanism but dose dependant
- Risk factors- ARI, DM, age>70, dehydration, cardiovascular dz, diuretic use, MM, HTN, hyperuricemia
- Beware in post-resuscitations

ACR Manual 2010

CIN (contrast induced nephropathy)

- Cr rises within 24h and peaks at 4 days
- Often returns to baseline at 1 week
- Can rarely become chronic and significantly morbid

Preventing CIN

- Hydration benefit is theoretical and studied for 12h pre and post
- NAC- oral given day before study or IV given day of study
  - Disagreeing results and meta-analyses
  - Possibly masks CIN by improving Cr
- Low dose contrast is beneficial
- Average threshold Cr 1.78 in nml pt and 1.68 in DM

Metformin and IV contrast

- Can cause lactic acidosis
- No increase in mortality

Meds

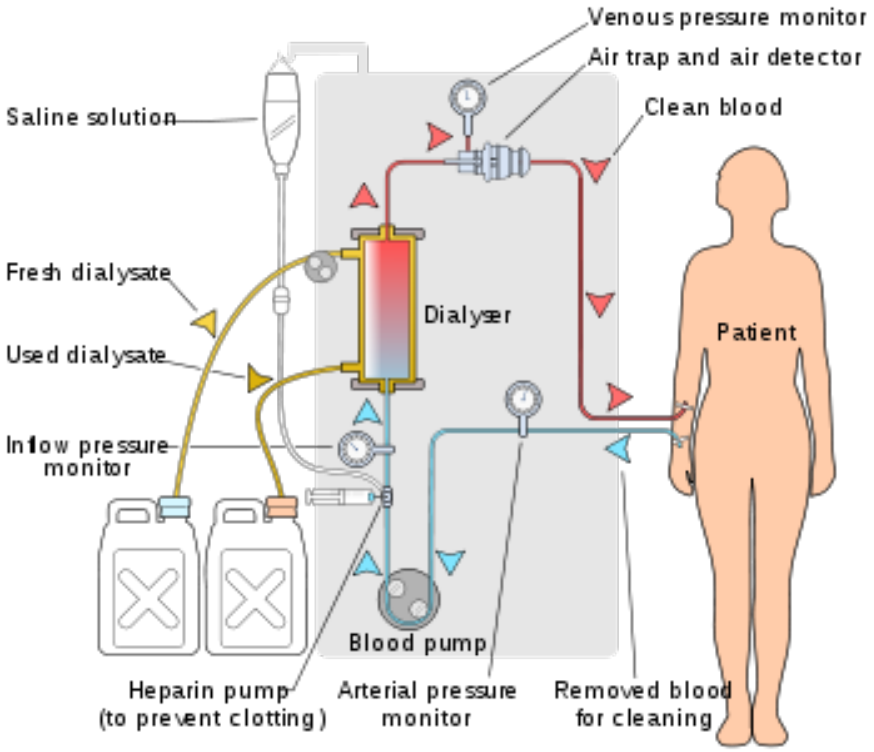
- Be careful adding NSAIDs to elderly Pt with low GFR
- Mild renal insufficiency can be made worse with combo of NSAIDS and diuretic, ACE-I, thiazide

CHF Exacerbation Tx

- Decreased CO is a risk factor for AKI
- Do diuretics help?
- What is first line treatment?
- Nitrates!!!
- Beware of nitroprusside

Dialysis

- A
- E
- I
- O
- U



YassineMrabet, Wikimedia Commons

Hard indications

- Refractory acidosis
- Unresponsive hyperkalemia
- Toxins that are dialyzable
- Acute pulmonary edema or tamponade
- Uremic pericarditis, encephelopathy, or coagulopathy (usually Ur> 100)

Soft indications

- Missed dialysis and has significant comorbidities
- Early use in anticipation of resuscitation

Toxins Dialyzed

- Methanol
- Ethylene glycol
- Theophylline
- Aspirin
- Lithium

Water soluble and not protein bound

Meds Dialyzed

- Valproate
- Trimeth –sulfa
- Pippercillin-Tazobactem
- Procainamide
- Phenytoin
- Phenobarb
- Octreotide
- PCN
- Nitroprusside
- Minoxidil
- Metformin
- Meropenom
- Mannitol
- Levotericatem
- Enalapril
- Esmolol
- Atenelol
- aspirin

CKD in the ED

- Are they on dialysis?
- Why are they requiring dialysis?
  - Can this identify comorbidities
- When was last dialysis?

Why do dialysis Pts die?

Why do dialysis Pts die?

- Sepsis
- Cardiovascular disease
- Arrhythmias
- Blood clots
- Bleeds

Sepsis in CKD

- Pts accessed frequently
  - 2-5% of fistulas get infected
- Often have indwelling hardware
  - 10% of grafts get infected
- Immunocompromised
- Difficult fluid resuscitation
- Significant comorbidities

Sepsis in CKD

- Always get blood cultures!
- Streptococcal septicemia 9%
- Staphylococcal septicemia 38%
- anaerobes 1%
- Gram-negative organisms 2%
- Hemophilus influenzae 1%
- Escherichia Coli 5%
- Pseudomonas 3%
- Serratia 1%
- other 11%

Beware of subacute endocarditis

Sepsis in CKD

- Be careful when resuscitating
- Fluids add up quickly
  - Drug fluids
  - IV contrast
  - 1A HCO_3^-

MI in CKD

- CKD doubles the risk of cardiovascular disease
- At risk for clots with precarious hemodynamics
- All have anemia
- Is troponin useful?
  - Yes
  - No
  - Maybe
- Need a baseline or a change

Cardiovascular disease in CKD

- High incidence of cor pulmonale
  - Shunt ~50%
  - Without shunt ~40%
- Easy to fluid overload

Pulmonary Edema Treatment

- BIPAP
- Nitrates
- Lasix
- Dialyze
- Phlebotomy (200mL)
  - Check HCT before
- Occlude shunt?
  - Branham sign

Blood Clots in CKD

- Hardware
- Dehydrated causing sludge
- Heparin induced Abs 20%
- Anticardiolipin Abs 86%

- At risk for PE

Bleeding and CKD

- Higher incidence of subdurals
- GI bleed
- Intraocular bleed
- Heparinization
- Platelet dysfunction
  - Mechanical
  - Uremic

Electrolytes and CKD

- Hyponatremia, hyperkalemia, hypocalcemia
- Hyperkalemia
  - #1 cause is hemolysis
  - Get an EKG
- Peaked T 5.5-6.5
- Loss of P 6.5-7.5
- QRS wide >8
- Sine wave …

Hyperkalemia in CKD

- Pts somewhat desensitized to it
- Correctable often
- Check EKG to see effects on heart
- dk/dt is more important factor in determining cardiac effects

Hyperkalemia - treatment

- Calcium
  - Is a pressor
  - Is pro-arrhythmic
  - Trashes veins
- Only give if QRS widened
- Ca gluconate is 1/3 potency Ca Cl

Hyperkalemia - treatment

- Insulin/glucose
  - 2A D50 and 10u reg insulin
- Albuterol will lower k by 1
  - Good for prehospital
- HCO3- only works if acidotic
- Lasix
- Dialysis

Resuscitation in CKD

- Early dialysis may be beneficial if ROSC acheived
- Can use grafts for access in emergency
- Grafts indicate clues in cause for undifferentiated Pt found down

Altered Mental Status

- Fluid shifts
- Sepsis
- Postictal
- Arrhythmia
- Hypoglycemia
- Overdose
- Brain bleed
- PE
- MI
- Al toxicity
- Dialysis dementia
- Cerebral edema

Summary

- ARF is poorly defined but important to identify
- Be careful to identify Pts at risk for AKI and CIN
- Prehydrate for CIN as much as possible and avoid huge contrast loads
- Be careful with meds in Pts at risk (diuretics and NSAIDs)
- Nitrates are first line for CHF

Summary

- Know the hard indications for dialysis
- METAL toxins that are removed
- Dialysis Pts are at risk for bad things
- Beware of fluid resuscitation and need for early dialysis in septic CKD
- Understand physiologic changes that increase risks for CKD Pts
- Tx hyperkalemia if there are EKG changes