Project: Ghana Emergency Medicine Collaborative

Document Title: When Kidneys Fail

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

License: Unless otherwise noted, this material is made available under the terms of the Creative Commons Attribution Share Alike-3.0 License: http://creativecommons.org/licenses/by-sa/3.0/

We have reviewed this material in accordance with U.S. Copyright Law and have tried to maximize your ability to use, share, and adapt it. These lectures have been modified in the process of making a publicly shareable version. The citation key on the following slide provides information about how you may share and adapt this material.

Copyright holders of content included in this material should contact open.michigan@umich.edu with any questions, corrections, or clarification regarding the use of content.

For more information about how to cite these materials visit http://open.umich.edu/privacy-and-terms-use.

Any medical information in this material is intended to inform and educate and is not a tool for self-diagnosis or a replacement for medical evaluation, advice, diagnosis or treatment by a healthcare professional. Please speak to your physician if you have questions about your medical condition.

Viewer discretion is advised: Some medical content is graphic and may not be suitable for all viewers.
Use + Share + Adapt

{ Content the copyright holder, author, or law permits you to use, share and adapt. }

- **Public Domain – Government**: Works that are produced by the U.S. Government. (17 USC § 105)
- **Public Domain – Expired**: Works that are no longer protected due to an expired copyright term.
- **Public Domain – Self Dedicated**: Works that a copyright holder has dedicated to the public domain.
- **Creative Commons – Zero Waiver**
- **Creative Commons – Attribution License**
- **Creative Commons – Attribution Share Alike License**
- **Creative Commons – Attribution Noncommercial License**
- **Creative Commons – Attribution Noncommercial Share Alike License**
- **GNU – Free Documentation License**

Make Your Own Assessment

{ Content Open.Michigan believes can be used, shared, and adapted because it is ineligible for copyright. }

- **Public Domain – Ineligible**: Works that are ineligible for copyright protection in the U.S. (17 USC § 102(b)) *laws in your jurisdiction may differ

{ Content Open.Michigan has used under a Fair Use determination. }

- **Fair Use**: Use of works that is determined to be Fair consistent with the U.S. Copyright Act. (17 USC § 107) *laws in your jurisdiction may differ

Our determination **DOES NOT** mean that all uses of this 3rd-party content are Fair Uses and we **DO NOT** guarantee that your use of the content is Fair.

To use this content you should **do your own independent analysis** to determine whether or not your use will be Fair.
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

<table>
<thead>
<tr>
<th>Serum Cr (mg/dL)</th>
<th>GFR (mL/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Normal</td>
</tr>
<tr>
<td>2.0</td>
<td>50% reduction</td>
</tr>
<tr>
<td>4.0</td>
<td>70-85% reduction</td>
</tr>
<tr>
<td>8.0</td>
<td>90-99% reduction</td>
</tr>
</tbody>
</table>

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 (amphotericin, 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) = \( \frac{P_{Cr} \times U_{Na}}{P_{Na} \times U_{Cr}} \times 100 \)

<table>
<thead>
<tr>
<th>Prerenal</th>
<th>Intrinsic</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine Na</td>
<td>&lt;20</td>
<td>&gt;40</td>
</tr>
<tr>
<td>FENa</td>
<td>&lt;1%</td>
<td>&gt;1%</td>
</tr>
</tbody>
</table>

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
- Levotericate
- 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 HCO3-
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 subdural bleeding
- 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
- $\frac{dk}{dt}$ 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 achieved
• 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
- AI 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