

# Renal Disease and HD

## #Eckel

**Terry Barrett**  
**PGY4 Med/Peds**

# Goals and Objectives

Understand how to accurately diagnose, manage, and treat AKI

Understand etiology and staging of CKD

Recall indications for dialysis

Be able to identify and manage common complications in the dialysis patient population

# AKI - Definition!

ACUTE/ABRUPT worsening in renal function

- A rise in creatinine  $>0.3\text{mg/dL}$  from baseline\*
- A rise in creatinine  $>50\%$  from baseline\*
- Urine output of  $<0.5\text{mL/kg/h}$  for 6 hours or more

\*Within 48 hours

# AKI - Workup!

Always start with....

- HISTORY!

- Physical Exam

- Thorough review of medications

# AKI - Labs/Imaging

In most patients:

- RFP
- UA
- Urine Electrolytes
- Bladder Scan/Renal  
Ultrasound\*

In select populations:





- SPEP/UPEP
- C-ANCA and P-ANCA,  
C3/C4
- ANA
- HBV/HCV/HIV
- Biopsy

# The Humble UA

Urine Dipstick	
Measurement	Significance and uses
<b>Specific gravity</b>	Estimate $U_{osm}$ : each 0.001 above 1 $\approx$ 30 osm (SG 1.010 $\rightarrow$ $U_{osm} \approx$ 300) SG and $U_{osm}$ useful in evaluating AKI, dysnatremias, polyuria heavy substances (glucose, contrast) $\uparrow$ SG more than $U_{osm}$
<b>pH</b>	Range: 4.5–8.5; useful in evaluation of stones, RTAs, infection
<b>Protein</b>	Detects albumin (marker for glomerular dysfxn); see “Proteinuria”
<b>Blood</b>	See “Hematuria”; also $\oplus$ with myoglobinuria (rhabdomyolysis) False $\oplus$ : semen, dilute urine ( $\rightarrow$ osmotic cell lysis), $\uparrow$ pH, vaginal blood
<b>WBC</b>	Suggests inflammation (UTI, interstitial nephritis, GN)
<b>Ketones</b>	Detects acetoacetate (ie, ketoacidosis), but <i>not</i> $\beta$ -hydroxybutyrate
<b>Nitrite</b>	Suggests presence of nitrate reductase $\oplus$ bacteria (most enteric GNRs)
<b>Bilirubin</b>	$\uparrow$ in biliary or hepatic disease
<b>Glucose</b>	$\oplus$ in hyperglycemia ( $>180$ mg/dL), pregnancy, Fanconi’s syndrome

# UA - Microscopy

## Assessing patient with acute renal failure – Urinary Casts

Red cell casts	<b>Glomerulonephritis Vasculitis</b>	
White Cell casts	<b>Acute Interstitial nephritis</b>	
Fatty casts	<b>Nephrotic syndrome, Minimal change disease</b>	
Muddy Brown casts	<b>Acute tubular necrosis</b>	

# Urine Electrolytes

$$FE_{Na} = \frac{U_{Na} * P_{Cr}}{P_{Na} * U_{Cr}} * 100$$

<1% = PreRenal

1-2% = Indeterminate

>2% = Intrinsic Renal

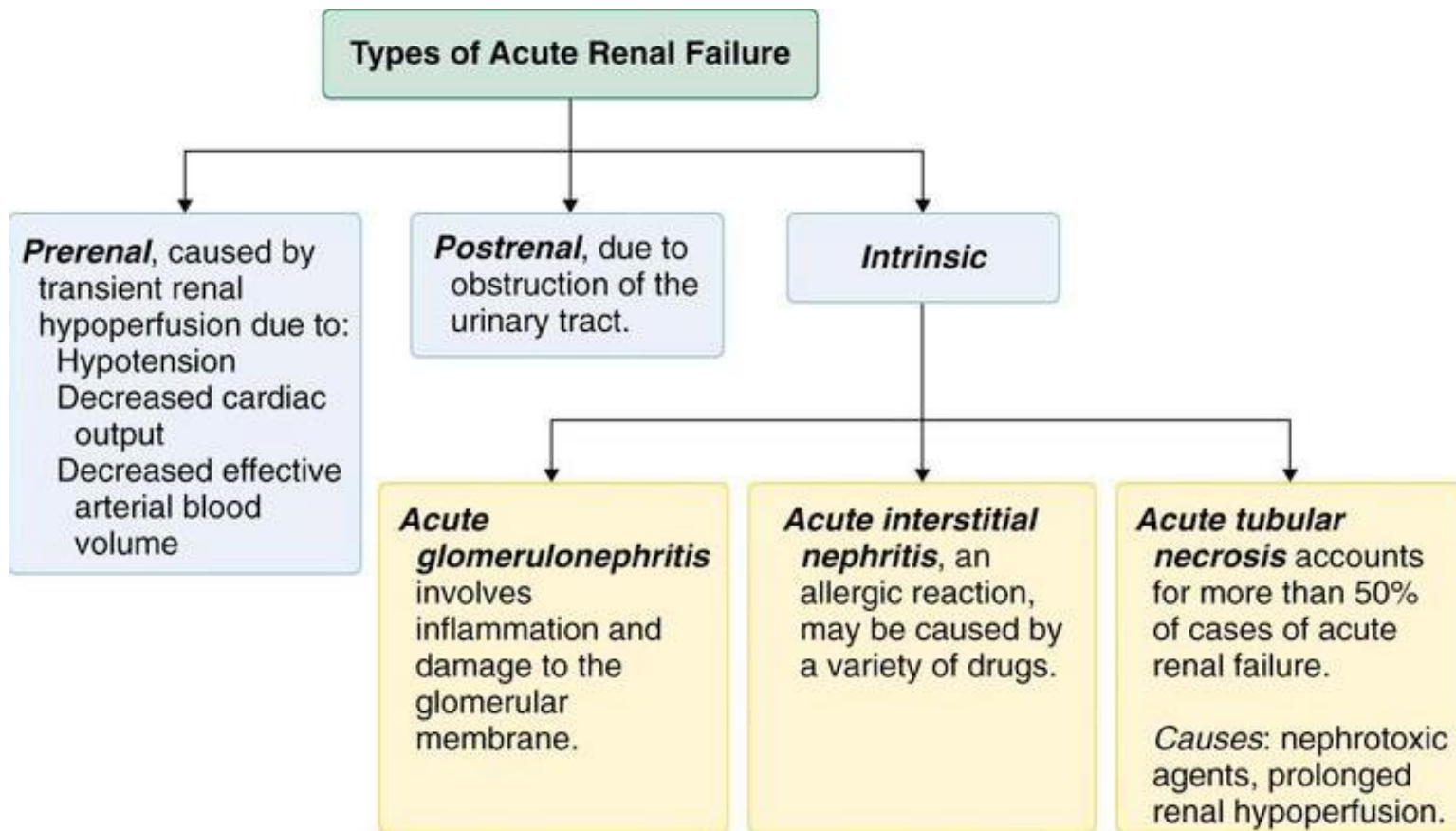
>4% = Post-renal (obstructive)

\*\*Use FeUrea for patients who have received diuretics

- FeUrea <35% = prerenal
- FeUrea >35% = intrinsic renal



# AKI Classification



# A brief detour: Cardiorenal syndrome

Heart failure can worsen renal function by several mechanisms:

- Reduced forward blood flow → decreased renal perfusion → prerenal azotemia
- Renal vein congestion causing increased pressure and reduced GFR

Treatment: optimize cardiac function +diuresis

\*\*Key here is clinical assessment of volume status

# AKI Treatment

## Prerenal

- Dehydration → fluids!
- Cardiorenal syndrome → diuresis!

## Intrinsic Renal (ATN, AIN)

- Maintain euvolemia
- Maintain blood pressure and MAP
- Withdraw potential offending agents

## Postrenal

- Relieve the obstruction!
- Foley catheter
- Ureteral stenting (if unilateral), percutaneous nephrostomy

# CKD staging

**Stage 1** (GFR > 90) – Treat underlying condition/comorbidities

**Stage 2** (GFR 60 – 89) – Estimate Progression of disease

**Stage 3a** (GFR 45-59) – Evaluate + treat complications

**Stage 3b** (GFR 30-44) – Evaluate + treat complications

**Stage 4** (GFR 15-29) – Prepare for RRT

**Stage 5** (GFR <15) – HD if indicated

**ESRD** - on dialysis or s/p renal transplant

# CKD - most common causes

1. Diabetic Nephropathy (55%)
2. Hypertensive nephropathy (33%)
3. Glomerulonephritis
4. Polycystic Kidney Disease
5. Obstructive Uropathy

# Indications for Dialysis

A

E

I

O

U

# Indications for Dialysis

**A** - Acidosis (intractable, not responding to bicarb)

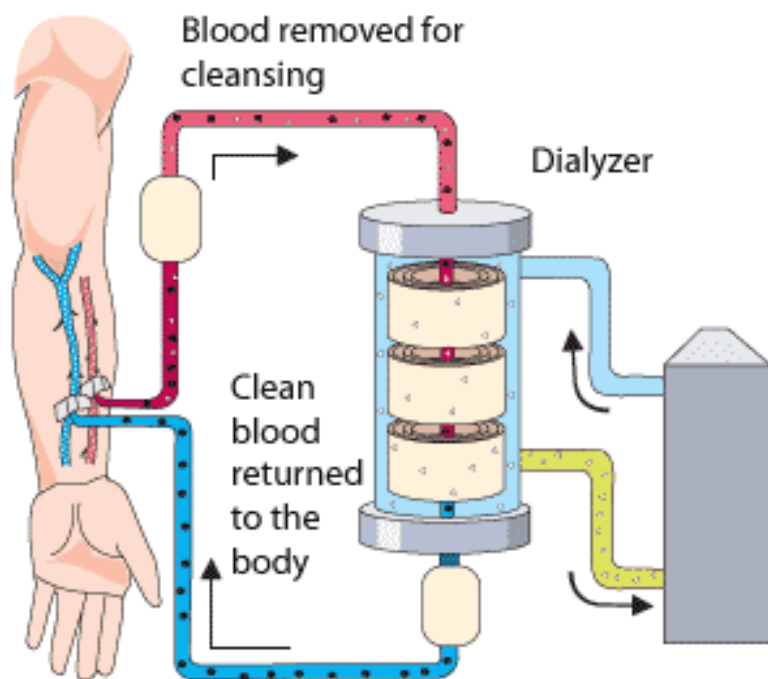
**E** - Electrolyte abnormalities (K, Na, Ca)

**I** - Intoxicants (ASA, methanol, ethylene glycol)

**O** - Fluid Overload (not responding to lasix)

**U** - Uremia (pericarditis, seizure/altered mentation, bleeding)

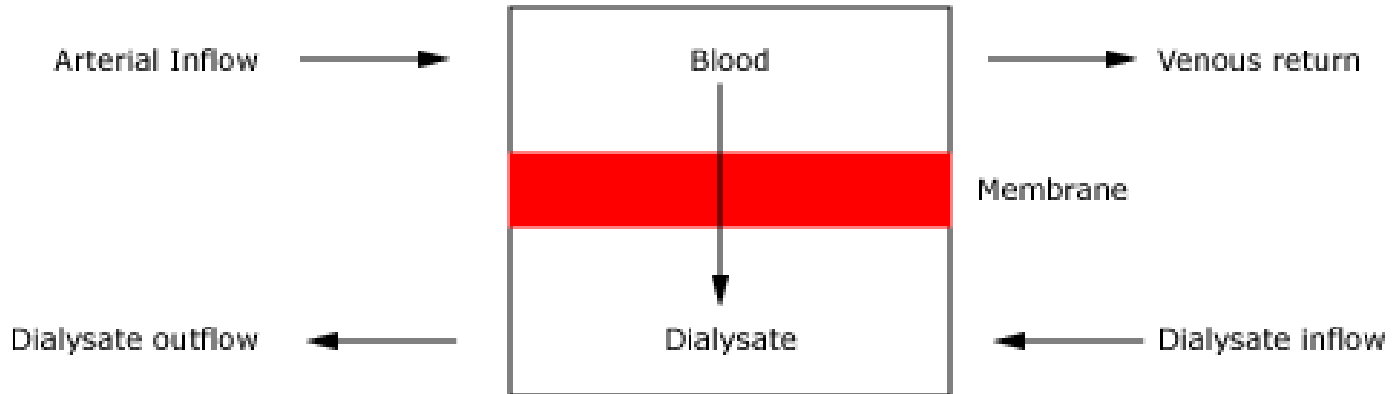
# Hemodialysis





# Hemodialysis

- Diffusion of solutes proceeds down a concentration gradient from blood to dialysate or vice versa
- Blood and dialysate flow in opposite directions through the dialyzer
- $F_{li}$



# Hemodialysis

“HD” - the process of cleansing the blood of toxins

“UF” - refers only to removal of fluid, not toxins

“PD” - refers to peritoneal dialysis

# Continuous renal replacement therapy

CVVH = “continuous veno-venous hemodialysis”

Slow removal of fluid/solutes, ideal for hemodynamically unstable patients

Only done in the ICU



# Vascular Access

- **Catheter**

- Tunneled - placed by IR, typically safe to go home with or to SNF with
- Non-tunneled - usually placed in ICU, may be referred to



- **AV Fistula**

- Surgeon connects artery to vein
- Needs 3-4 months to “mature” before use
- Least risk for infection in long-run



- **AV Graft**

# Vascular Access

Closely assess the access point

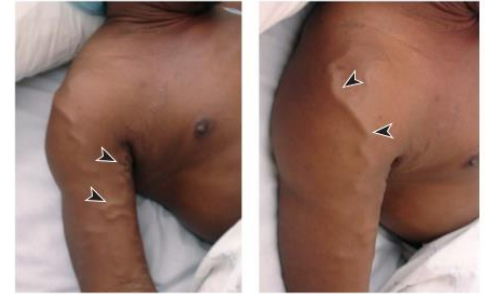
-Erythema? Swelling? Tenderness?

-Feel for pulse and thrill, listen for bruit

-Central vein engorgement/facial swelling can be seen in cases of AVF stenosis

-Evaluate perfusion distal to the access site for evidence of “steal syndrome”

## Central Vein Stenosis



Forty-five-year-old male with a right forearm loop AVG placed in 2003 has marked central vein stenosis. The collateral veins are visualized on his shoulder and chest (arrowheads).

The patient has a right subclavian vein stent with recurrent stenosis as shown in next image.

60



# Hemodialysis - the patient experience

Consider this...

3 treatments a week X 6 hours (treatment time, wait time, travel time, etc.) X 52 weeks =  
936 hours a year.  $936 \text{ hours} / 40 \text{ hours} = 23$  full-time work weeks!

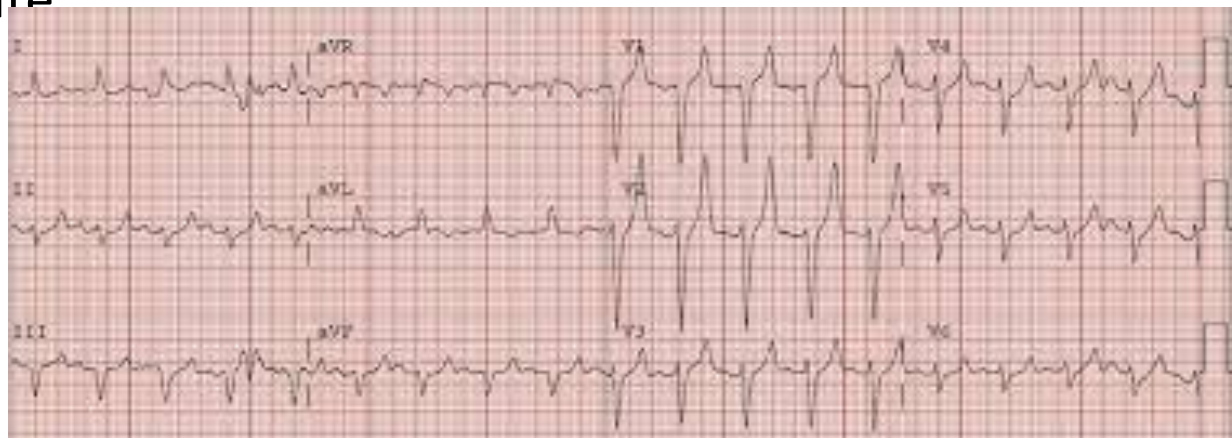
# Eckel - Tricks of the Trade

- Etiology of ESRD
- Route of dialysis (HD or PD) – mostly HD
- Location and days of HD (last day of HD)
- Access
- Nephrologist
- Dry Weight
- Review labs closely
- Review medications and make sure renally dosed

# Common ECKEL Scenarios

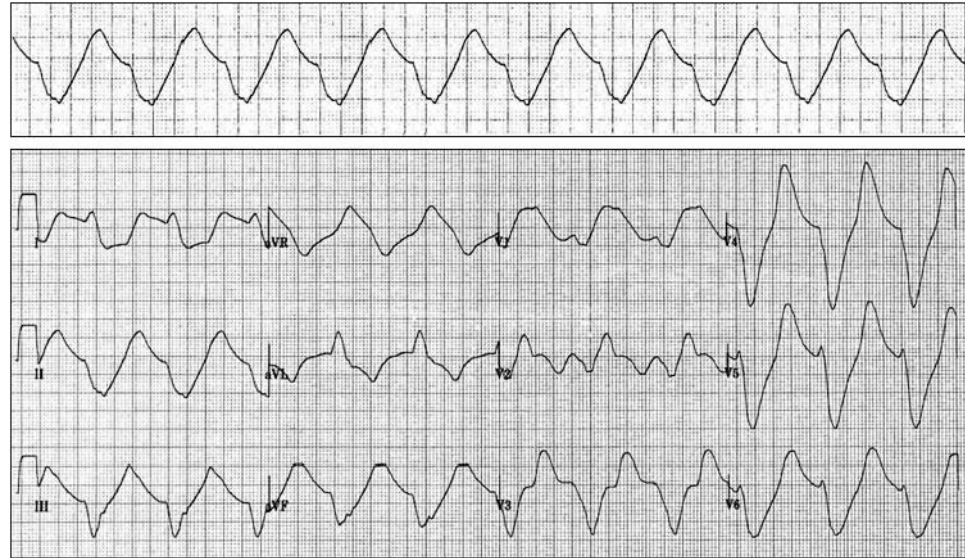
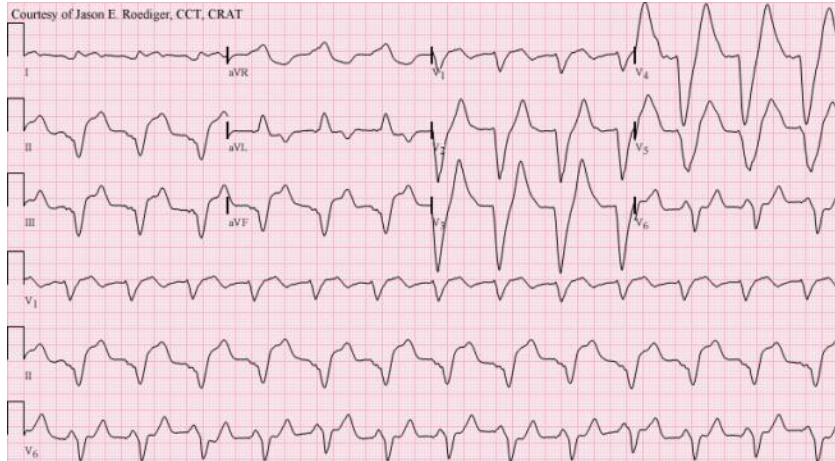
Hyperkalemia:

- Get STAT ECG
- 2g IV calcium gluconate
- 10U insulin +D50
- Albuterol
- Kayexalate
- Lasix





# Hyperkalemia = badness



# Hypotension

- Check mentation
- Determine how much fluid was taken off during last dialysis
- Can start with small fluid boluses (250 or 500)

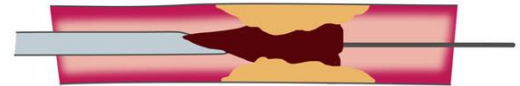
# Access Issues

## AVG Thrombosis

- Clot formation within the graft - absence of a thrill or bruit on assessment of site
- Urgent evaluation by vascular surgery
- Thrombectomy

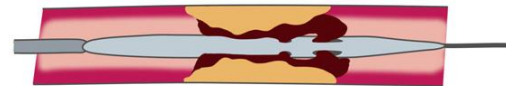
### Thrombectomy

#### Catheter aspiration thrombectomy



Blood clot is removed using suction

#### Mechanical thrombectomy



Blood clot is broken up into small pieces and removed

# Access issues

## AVG stenosis

- Narrowing of lumen within the graft
- Bruit that can only be heard during systole rather than continuous
- Evidence of decreased flow across the graft; imaging of choice is called a venogram
- Treatment: percutaneous angioplasty vs surgical revision

# Fever

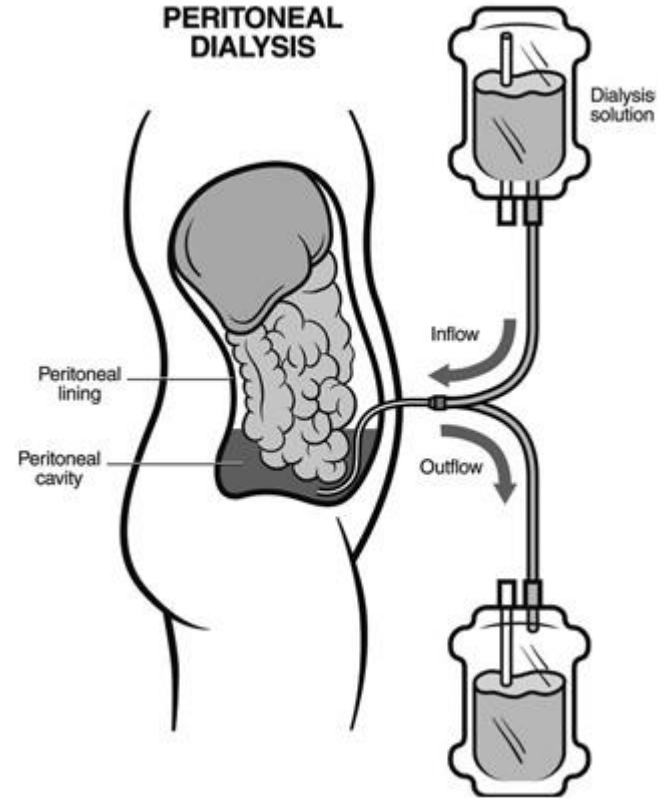
- What kind of access does patient have?
- Cultures peripherally AND from dialysis site (if HD line and not in MICU, needs a dialysis nurse to access)
- If coming from a CDC dialysis center, can call to get any blood culture results drawn in the center
- Antibiotic coverage: skin flora most likely culprit
- If AVG, imaging may be useful to eval for abscess

# Common Complications in Dialysis Patients

- Hypotension
- Hypertension
- Arrhythmia
- Bleeding
- Infection
- Hyperkalemia
- Volume overload

# Peritoneal Dialysis - “PD”

- Catheter surgically inserted into peritoneal space
- Dialysis solution instilled into abdomen through catheter and allowed to dwell
- Peritoneal membrane acts as “filter”; solutes diffuse across this. Then used fluid is drained
- PD can be continuous or intermittent (night only)
- Can be done at home



# Renal diet???

- Low sodium
- Low potassium
- Low phosphorous
- Fluid restricted

Off-limits foods: potatoes, tomatoes, bananas, chocolate, pizza

Limited amounts of: milk, cheese, juice



**Thank you!!**