

Renal Disease and HD ☺

Racquel Wells - PGY3 🙌🙌🙌



Goals + Objectives

- Understand the diagnosis, management and treatment of acute kidney injury
- Understand etiology and staging of CKD
- Indications for dialysis
- Common complications of End Stage Renal Disease patients

Define AKI

- Acute/Abrupt worsening of renal function (<48 hours)
- \uparrow Cr > 0.3mg/dl
- \uparrow Cr > 50% from baseline
- UOP < 0.5mL/kg/hr for >6 hours



AKI – the Work Up!

- History. History. History.

- What is the baseline creatinine?

- Physical Exam

- Fluid Down?

- Review Medications

- NSAIDs, ACEi, diuretics

AKI - the Work Up!

○ LABS/IMAGING

○ RFP

○ UA

○ ELECTROLYTES!

○ FeNA, FeUrea

○ Bladder Scan/PVR

○ Renal US

○ Biopsy

○ The Others...

○ SPEP/UPEP


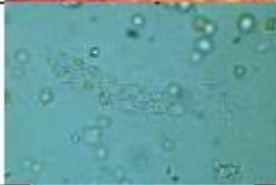


○ ANCA, Complements

Urine Dipstick

Measurement	Significance and uses
Specific gravity	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}
pH	Range: 4.5–8.5; useful in evaluation of stones, RTAs, infection
Protein	Detects albumin (marker for glomerular dysfxn); see "Proteinuria"
Blood	See "Hematuria"; also \oplus with myoglobinuria (rhabdomyolysis) False \oplus : semen, dilute urine (\rightarrow osmotic cell lysis), \uparrow pH, vaginal blood
WBC	Suggests inflammation (UTI, interstitial nephritis, GN)
Ketones	Detects acetoacetate (ie, ketoacidosis), but <i>not</i> β -hydroxybutyrate
Nitrite	Suggests presence of nitrate reductase \oplus bacteria (most enteric GNRs)
Bilirubin	\uparrow in biliary or hepatic disease
Glucose	\oplus in hyperglycemia (>180 mg/dL), pregnancy, Fanconi's syndrome

UA - MICROSCOPY

Assessing patient with acute renal failure – **Urinary Casts**

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

FeNa, FeUrea!

FeNa

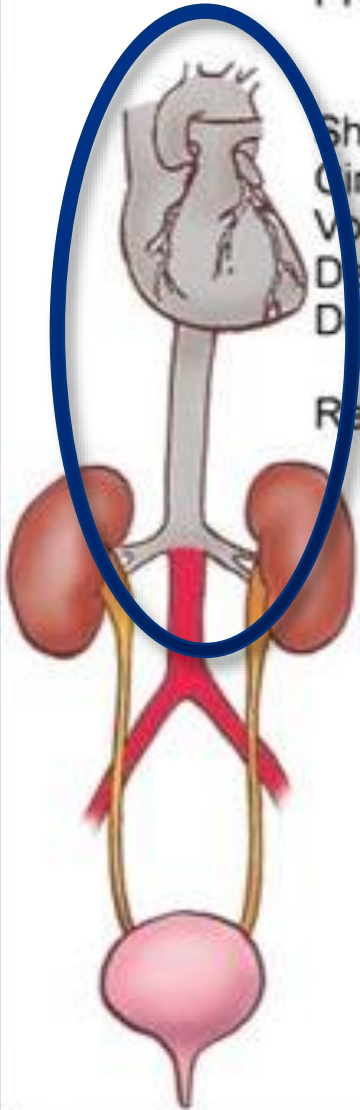
- $(\text{Urine Sodium} \times \text{Plasma Cr}) / (\text{Plasma Sodium} \times \text{Urine Cr})$
 - $<1\%$ = PreRenal
 - $>2\%$ = Intrinsic Renal
 - $>4\%$ = Post-renal (obstructive)

FeUrea (on diuretics)

- $(\text{Urine urea} \times \text{Plasma Cr}) / (\text{Plasma Urea} \times \text{Urine Cr})$
 - $<35\%$ = prerenal
 - $>35\%$ = intrinsic renal

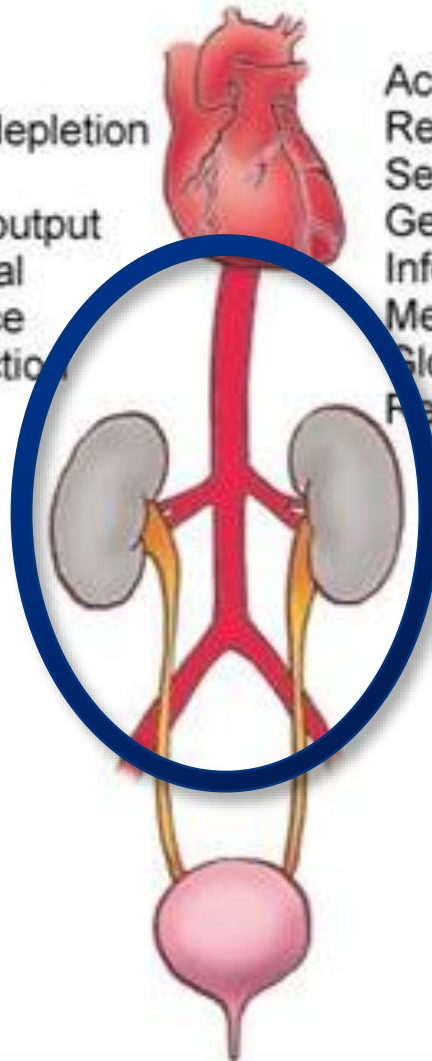
PRERENAL

Shock
Circulating volume depletion
Volume shifts
Decreased cardiac output
Decreased peripheral
vascular resistance
Renal artery obstruction



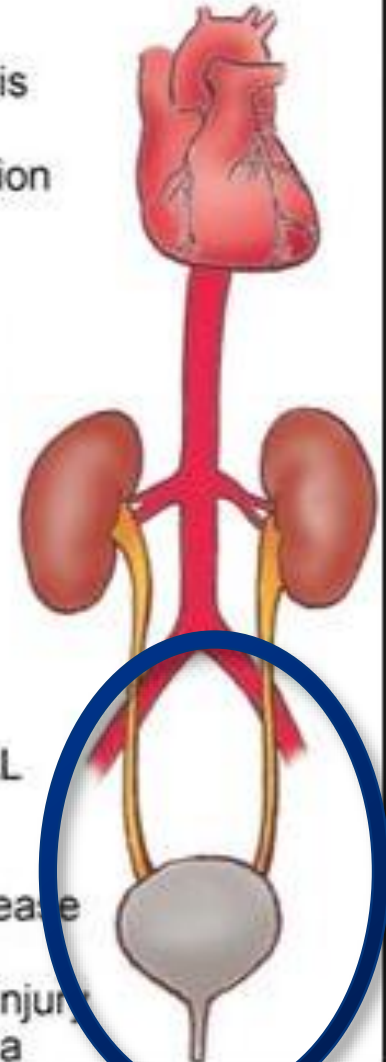
INTRARENAL

Acute tubular necrosis
Renal trauma
Severe muscle exertion
Genetic conditions
Infectious disease
Metabolic disorders
Glomerulonephritis
Renal artery lesions

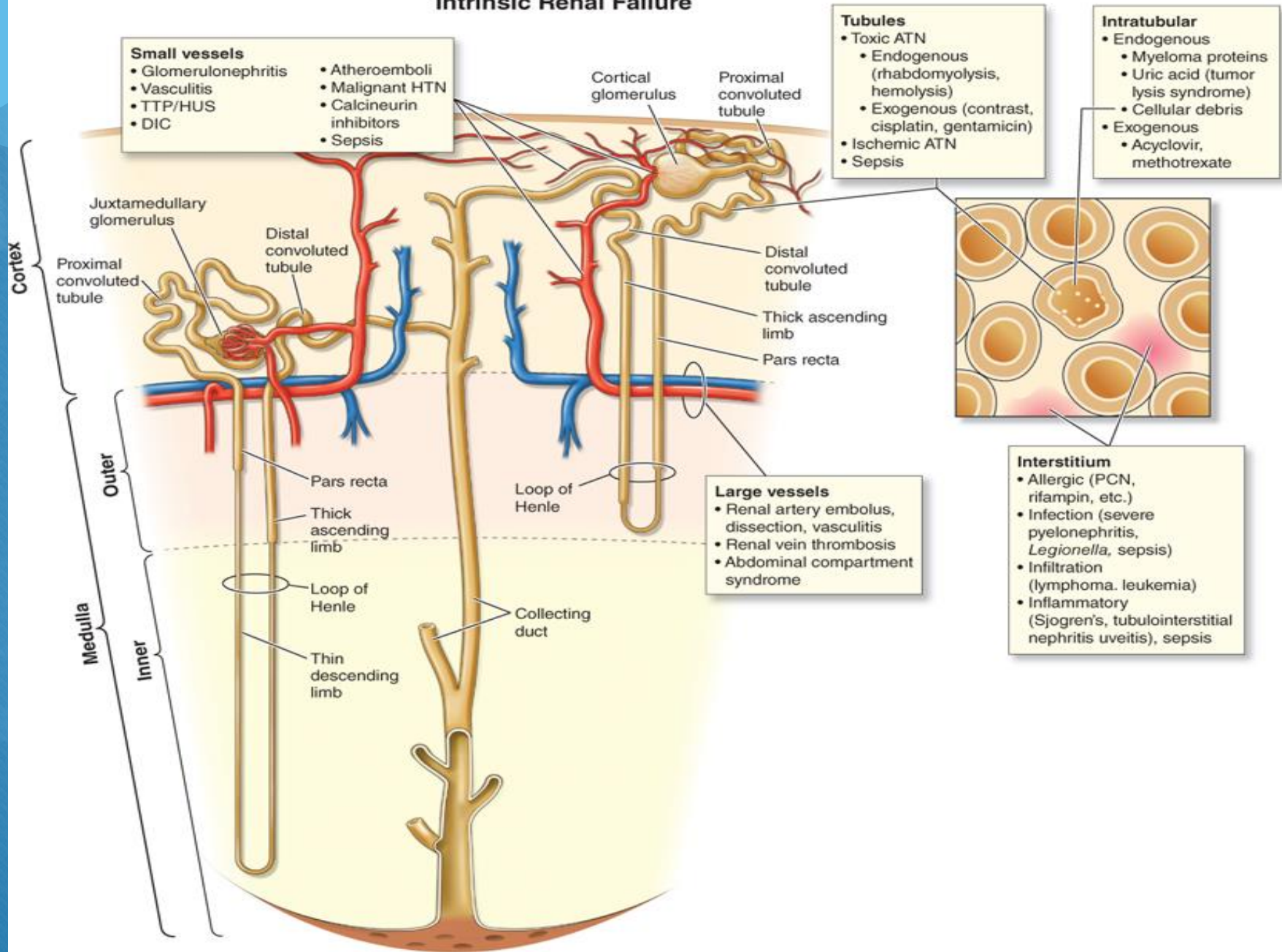


POSTRENAL

Prostate disease
Obstruction
Spinal cord injury
Pelvic trauma



Intrinsic Renal Failure





I Digress...

Cardiorenal Syndrome

○ Heart failure can worsen renal function by several mechanisms:

1. Reduced forward blood flow → decreased renal perfusion → prerenal azotemia

2. Renal vein congestion causing increased pressure and reduced GFR

◆ Treatment: optimize cardiac function + diuresis

○ ****ALWAYS ASSESS VOLUME STATUS****

Decreased Cardiac Performance



Decreased Cardiac Output

Neurohormonal Activation

Diminished Blood Flow

Decreased Renal Perfusion

Increased Water & Na⁺ Retention

Impaired Renal Function



AKI Management!

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

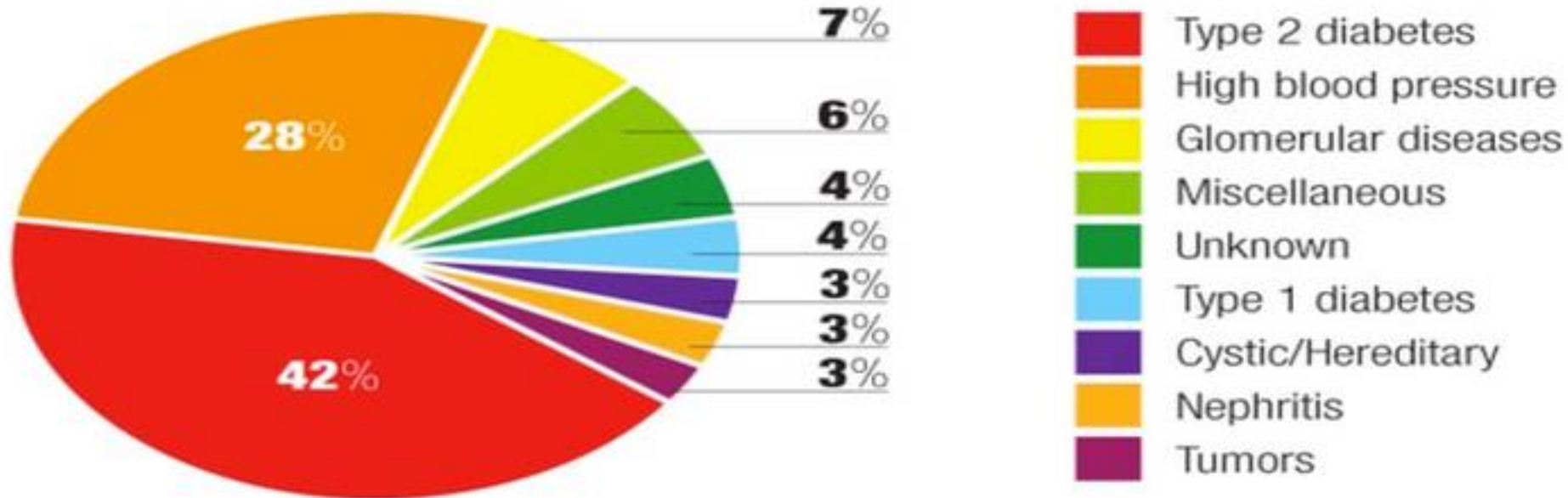
Stages of CKD

*Table 1. Definition of CKD Stages Based on GFR**

CKD Stage	Definition
1	Kidney damage with GFR ≥ 90 mL/min/1.73 m ²
2	Kidney damage with GFR of 60–89 mL/min/1.73 m ²
3	GFR of 30–59 mL/min/1.73 m ²
4	GFR of 15–29 mL/min/1.73 m ²
5	GFR < 15 mL/min/1.73 m ² , or kidney failure treated by dialysis or transplantation

CKD = chronic kidney disease; GFR = glomerular filtration rate.

* Adapted from reference 3. The Kidney Disease: Improving Global Outcomes Work Group recently updated its definition of CKD progression to include consideration of both GFR and albuminuria stages (2).



Causes of Chronic Kidney Disease

Complications of CKD

- Hyperparathyroidism (↑ Phos, ↓Ca, ↓calcitriol)
- Hyperkalemia
- Ischemic Vascular Disease
- Anemia
- Calciphylaxis
- Heart Failure, LVH, HTN



Source: Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J: *Harrison's Principles of Internal Medicine, 18th Edition*: www.accessmedicine.com
Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

Nephritic...Nephrotic

○ Nephritic

○ Blood >> Protein

○ 1-2g/day, pyuria, hematuria w/ casts, HTN, fluid retention

○ Anti-GBM, Churg-Strauss, Wegener's, Microscopic Polyangiitis, IgA Nephropathy, Post Strep GN, MPGN

○ Nephrotic

○ Protein >> Blood

○ 3.5g/day (definition) for 'nephrotic range' proteinuria

○ MCD, FSGS, Membranous, Membranoproliferative, DM, Amyloid



Indications for Dialysis

O A - ACIDOSIS

O E - ELECTROLYTES (\uparrow K, \uparrow P, \uparrow Mg, \downarrow Ca, \downarrow Na)

O I - INGESTION/TOXINS

O O - OVERLOAD (not responding to diuretics)

O U - UREMIA (pericarditis/encephalopathy)

What is Dialysis?

- 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
- Fluid removal occurs via hydrostatic pressure gradient
- ***UF = ultrafiltration - fluid removal only

Types of Dialysis

Continuous Renal Replacement Therapy/CVVH

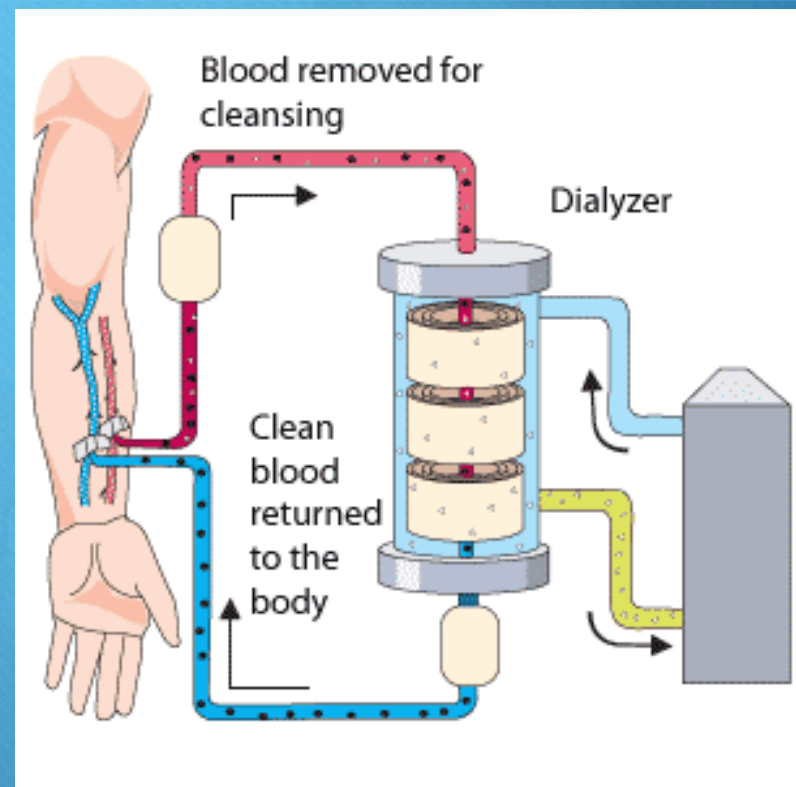
- Slow removal of fluid/toxins
- Low pressure system
- ICU setting



Types of Dialysis

Intermittent Hemodialysis

- 3-4x/week for 2-4hrs
- Outpatient (Dialysis Center)

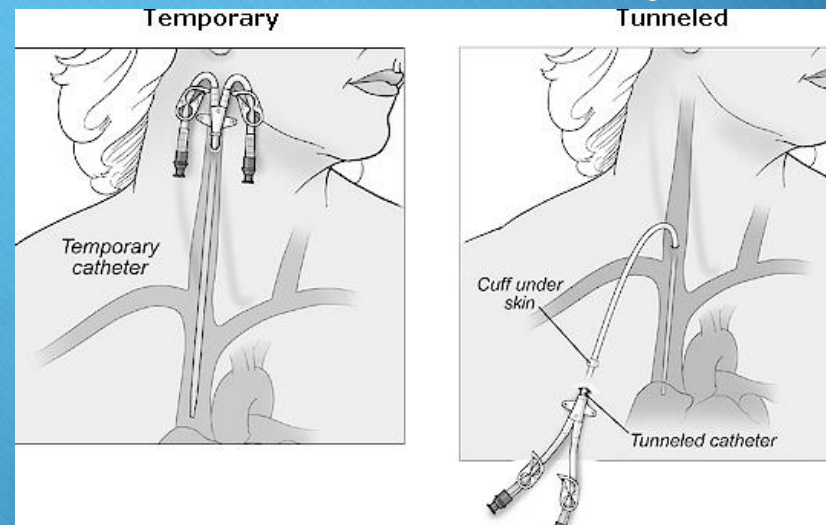


Vascular Access

	Advantages	Disadvantages
AV Fistula	Highest patency Lowest risk of bacteremia	Long maturation time (2–6 mo) Primary nonfunction (20%)
AV Graft	Easier to create than AVF Maturation time (2–3 wks)	Poor 1° patency, often requiring thrombectomy or angioplasty
Catheter	Immediate use Use as bridge to AVF/AVG	Highest risk of bacteremia ↓ blood flow → ↓ HD efficiency

*Tunneled Catheter is done by IR

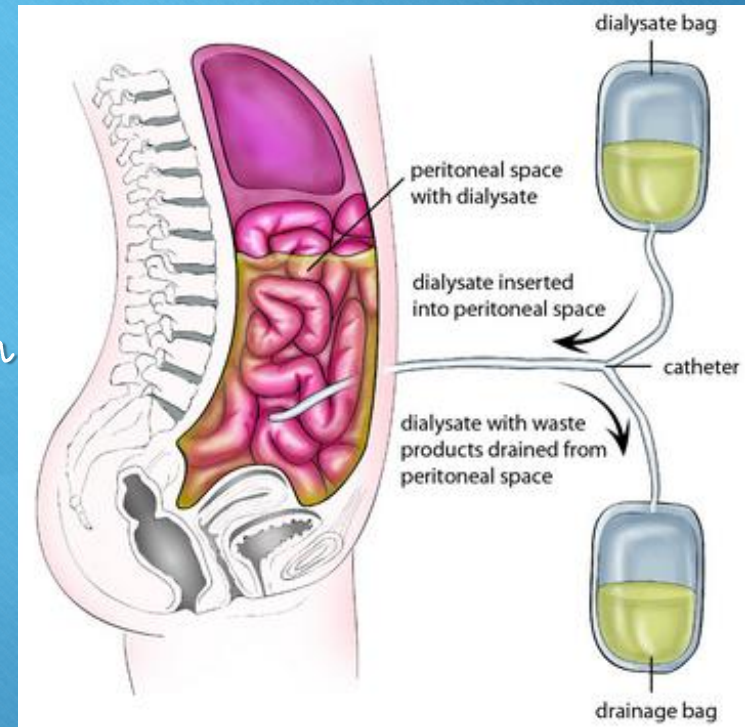
*AVF and AVG are done by vascular surgeon, not available to use immediately



Types of Dialysis

Peritoneal Dialysis

- Daily or Continuous
- Outpatient (home)
- 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



Complications of HD

◆ Hypotension

- ◆ Recheck, May need fluid back, Infection

◆ Hypertension

- ◆ May need med change...

◆ Arrhythmia

- ◆ Get ECG, check electrolytes

◆ Bleeding

- ◆ Hold pressure, check CBC, hemolytic panel

◆ Infection

- ◆ Blood cultures (peripheral and HD site)

Complications of HD

◆ Hyperkalemia

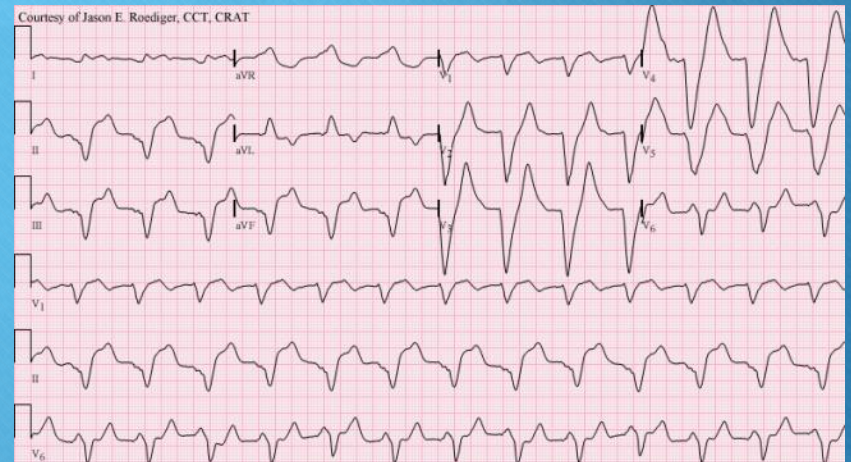
- ✓ Kayexelate, Insulin/D50, Lasix, Calcium Gluconate

◆ Volume overload

- ✓ UF

◆ Access issues

- ✓ Stenosis
- ✓ Thrombus
- ✓ Pseudoaneurysms



← Fistulogram, IR, Vasc Surg

When on Eckel...

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