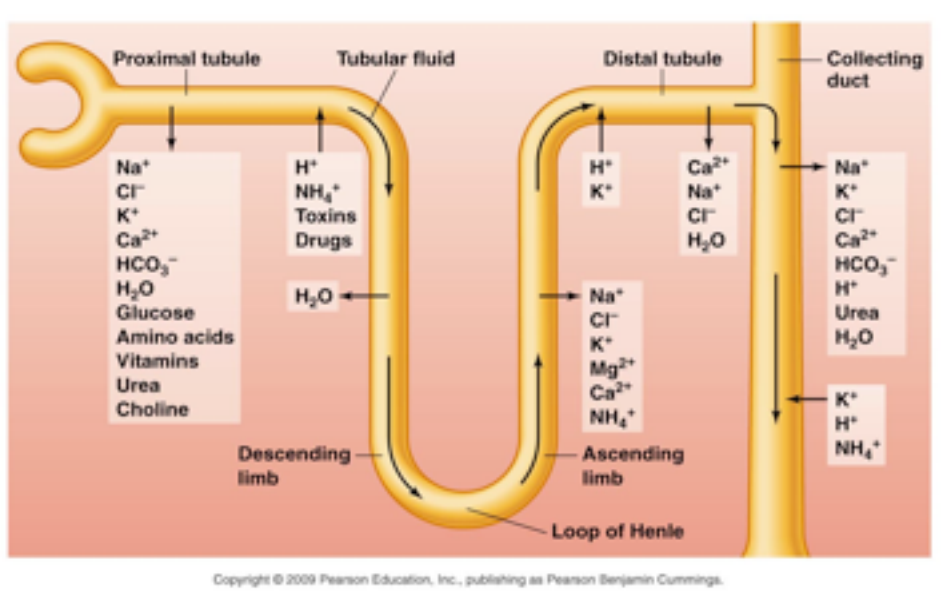


Renal Replacement Therapy (RRT)

- What is it?
 - A mechanism to remove accumulated toxins in the body through filtration in the setting of kidney insufficiency
- Functions of the kidney
 - Removal of metabolic wastes, drugs and other toxins
 - Fluid balance
 - Electrolyte balance
 - Acid-base regulation
 - Blood pressure control
 - Hormone production-erythropoietin, vitamin D, renin



- Who needs it?
 - Acute kidney injury
 - Types of injury
 - Prerenal- most common form
 - Hypovolemia, decreased CO, CHF, Medications
 - NSAIDs- causes vasoconstriction of the ___afferent___ arteriole
 - ACEi/ARBs- causes vasodilation of the ___efferent___ arteriole
 - Intrinsic-inflammation and reduced perfusion
 - Sepsis, ischemia, both exogenous and endogenous pathogens
 - Postrenal- blockage of urine output
 - Indications for dialysis
 - A= ___acidosis___
 - E= ___electrolyte imbalances___
 - I= ___intoxication___
 - O= ___overload___
 - U= ___uremia___

- Chronic kidney disease
 - Stages of kidney disease

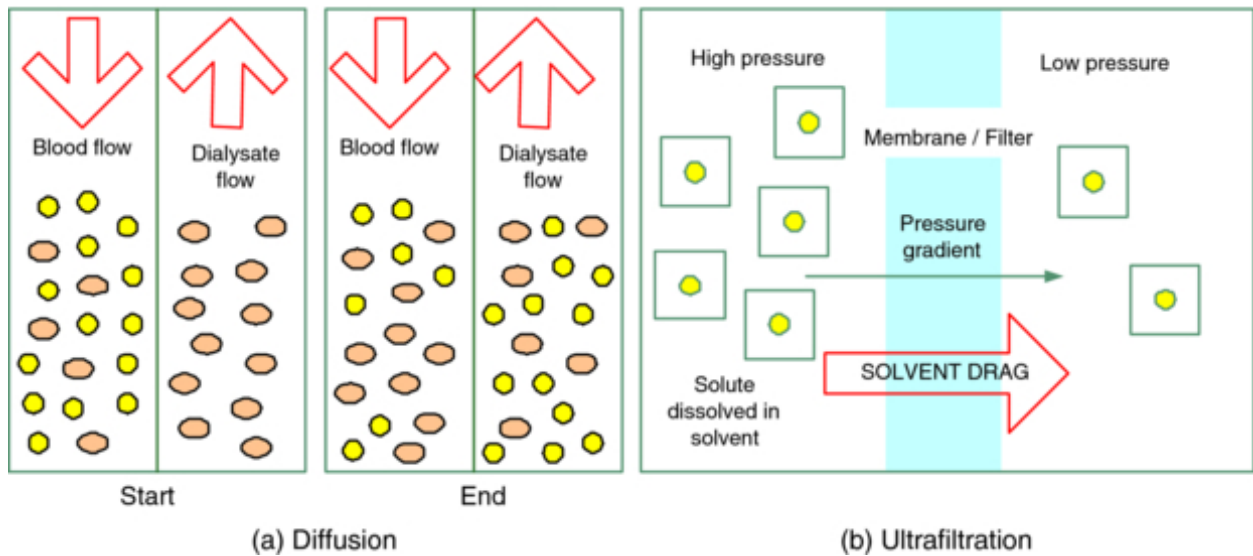
Prognosis of CKD by GFR and albuminuria categories: KDIGO 2012

				Persistent albuminuria categories description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30–300 mg/g 3–30 mg/mmol	>300 mg/g >30 mg/mmol
GFR categories (ml/min/1.73 m ²) description and range	G1	Normal or high	≥90			
	G2	Mildly decreased	60–89			
	G3a	Mildly to moderately decreased	45–59			
	G3b	Moderately to severely decreased	30–44			
	G4	Severely decreased	15–29			
	G5	Kidney failure	<15			

Dialysis options

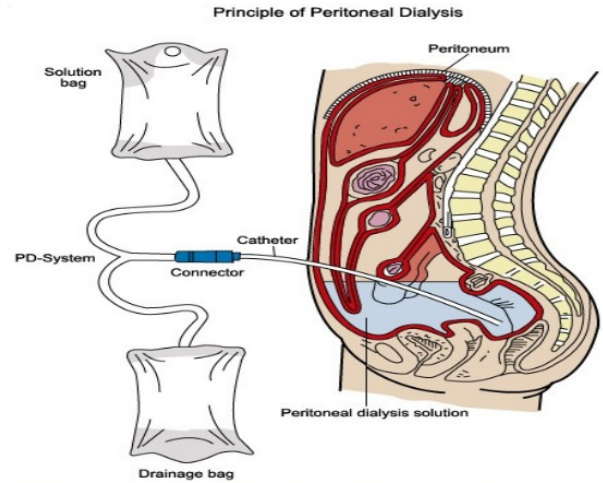
Definitions

- Diffusion- solutes are removed via a concentration gradient without the aid of pressure gradients (passive)
- Convection- solutes are removed via pressure gradients
- Ultrafiltration- volume is removed via pressure gradients (from high to low pressure) between the blood and fluid compartments



Intracorporeal

- **Peritoneal-** the blood is cleansed using a solution that is administered into and subsequently removed from the abdominal cavity
 - Uses diffusion, osmosis, ultrafiltration
 - Solutions are typically comprised of a dextrose solution but vary depending on each patient.
 - **Advantages-**hemodynamic stability, at home
 - **Disadvantages-**unreliable, slow removal, hyperglycemia



Extracorporeal

- **Hemodialysis-**blood is removed from the body and passed through a filtration device
 - Diffusion-based and pressure driven water removal
 - **Advantages-**large volume removal
 - **Disadvantages-** hemodynamic instability, rapid electrolyte shifts, performed in clinic, clotting
- **Continuous VenoVenous Hemo-**“something or another”... (CVVH_) is a type of dialysis that is extended over a 24 hour period.

	Removal of fluid	Convection/ filtration	Diffusion
Hemofiltration (CVVH)	X	X	
Hemodialysis (CVVHD)	X		X
HemoDia-filtration (CVVHDF)	X	X	X

- **Advantages-** mimics normal physiology, slow removal of fluids, hemodynamic stability
- **Disadvantages-**continuous assessment, blood clots may form
- Other things to consider
 - **Dialysate composition**
 - Dependent on osmolarity (i.e, the measure of the solute concentration)
 - Higher osmolarity=higher Na (dilutional)
 - Lower osmolarity= lower Na
 - Normal levels=280-295 mOsm/kg
 - CVVH is/are type(s) of dialysis that require(s) a dialysate
 - CVVHD, CVVHDF is/are type(s) of dialysis that do not require dialysate
 - **Flow rates**
 - High flow rate=greater amounts of drug delivered to dialysis membrane= greater removal
 - **Clotting**
 - Heparin/protamine
 - Calcium citrate/ Carbonate

Complications

- Hypotension- due to inadequate fluid replacement, major fluid shifts
- Electrolyte imbalances- incorrect dialysate, citrate anticoagulation, pH shifts
- Hypothermia
- Hyperglycemia- dependent on dialysate solution
- Clogged filters

Pharmacology and dialysis

- The extend of drug dialyzability determines whether supplemental doses are necessary during or following dialysis
- Properties that determine whether a drug will be removed with dialysis
 - **Protein bound**
 - Drugs that are highly protein bound will have a small plasma concentration of unbound drug available for dialysis
 - When drugs are bound to proteins (e.g., albumin, glycoprotein) the large molecular size and drug-protein complex is too large to cross the dialysis membrane
 - However, protein binding may decrease in uremic patients
 - **Molecular size**
 - Small molecules will pass through the membrane more easily than larger molecular weight substances
 - Note that the pore size in peritoneal dialysis is larger and allows for the passage of
 - **Volume of distribution**
 - Large volumes of distribution are associated with a wide distribution throughout the tissues and less within the blood will be minimally dialyzed
 - Example: drugs that are lipophilic and have low protein binding will be less removed
 - **Water solubility**
 - The more hydrophilic= more dialyzable

Dosing Drugs for patients on RRT

- **iHD**
 - Assess drug properties (listed above)
 - CrCl is unreliable ~ may estimate that CrCl roughly 10 ml/min
 - If patients receive drugs that are dialyzable before iHD, patients may likely require supplemental doses
- **CVVHD**
 - Estimating CrCl based on flow rate
 - Flow rate is 2 L/ hr
 - =2000 (ml/hr) x (1 hr /60 min) ~33 ml/min
 - Drug properties
 - Patient volume status

Test your knowledge

Based on the following drug properties, determine whether or not the drug will be removed by dialysis

1. Protein binding ~50%
Excretion- Urine 80-90%
Vd=0.4-1 L/kg
Antibiotic

___ vancomycin, yes ___

Any guess on which drug this is?

2. Protein binding- 90-95%
Excretion-Urine
Vd- 0.6-0.7
Anticonvulsant

___ phenytoin, no ___

Any guess on which drug this is?