

## KIDNEY

– normal values:

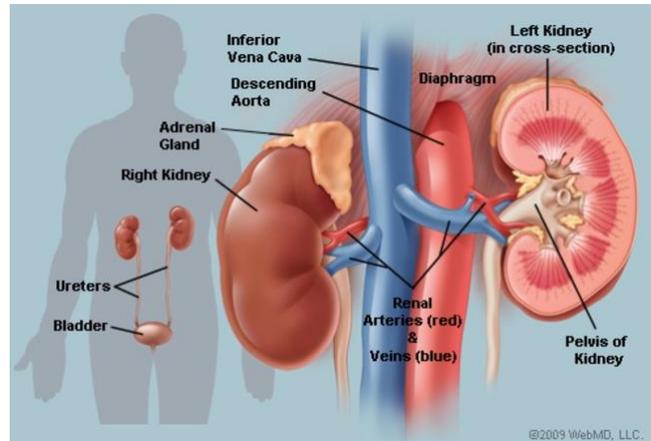
**BUN**= 6-20 mg/dL

### Creatinine

- Male: 0.6-1.3 mg/dL
- Female: 0.5-1.0 mg/dL

### Specific Gravity (urine)

1.010-1.025



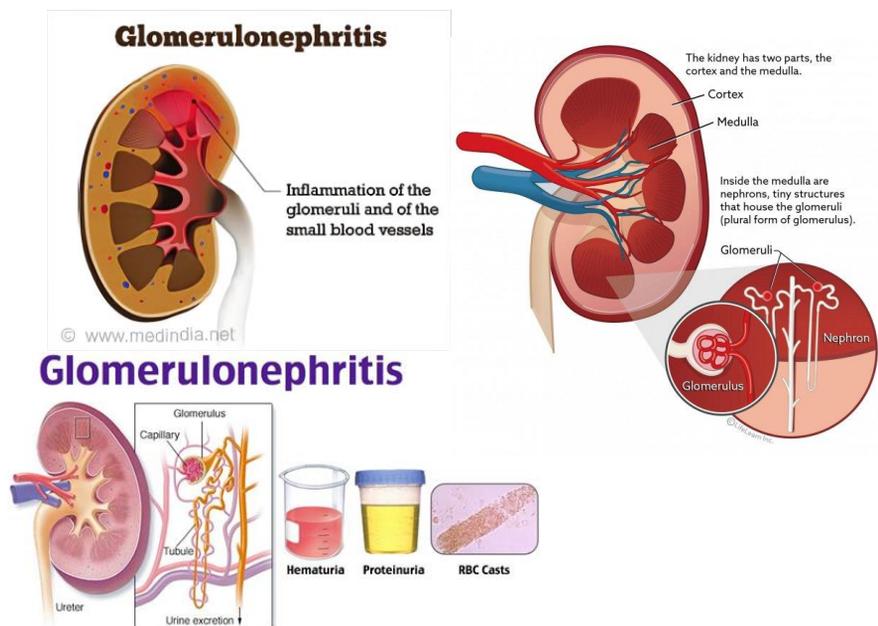
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## Glomerulonephritis

### Pathophysiology:

Acute can lead to chronic.

- Inflammatory reaction in the \_\_\_\_\_
- Antibodies lodge in the glomerulus
  - Scars => decreased filtering
- Main cause: \_\_\_\_\_



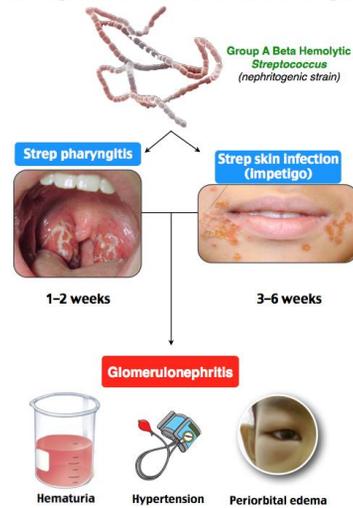
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### Glomerulonephritis Signs and Symptoms:

- sore throat (streptococcus)
- flank pain CVA (costovertebral angle) tenderness
- Malaise
- BP (↑ or ↓?)
- Headache
- facial edema
- BUN & Creatinine (↑ or ↓?)
- Urine Output (↑ or ↓?)
- sediment/protein in urine?
- urine specific gravity (↑ or ↓?)
- fluid volume \_\_\_\_ (excess or deficit?)
- Anemia => erythropoietin

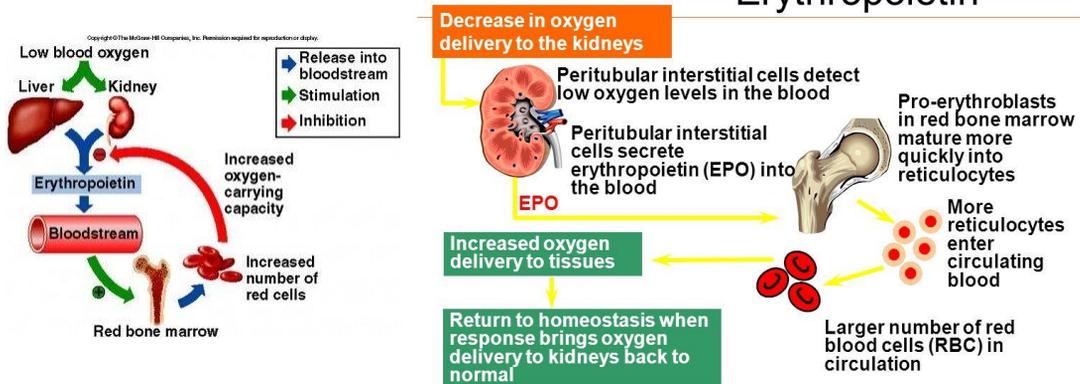


### Poststreptococcal Glomerulonephritis



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## Reviewing - Erythropoietin



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**Glomerulonephritis Treatment:**

- Treat the strep infection
- Dialysis
- If the BUN is increased what should be done with the protein in the diet?
- Na?
- Carbohydrates?
  - Keeps us from breaking down protein for energy.
- Bed rest
- I & O and daily weights
- How is fluid replacement determined?
  - losses + 500 cc (insensible fluid loss)
- Diuresis begins in 1-2 weeks after onset.
- Blood and protein may stay in the urine for months.
- Educate: teach what are the s/s of renal failure:
  - Malaise, headache, anorexia, nausea, vomiting, decreased output, weight gain



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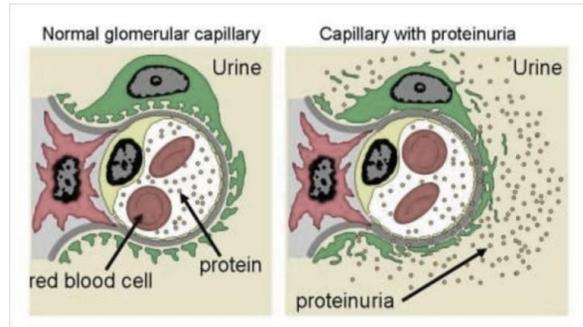
A patient with CKD has a low erythropoietin (EPO) level. The patient is at risk for?

1. A. Hypercalcemia
2. B. Anemia
3. C. Blood clots
4. D. Hyperkalemia

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## Nephrotic syndrome

- is a kidney disorder that causes your body to pass too much protein in your urine.
- Nephrotic syndrome is usually caused by damage to the clusters of small blood vessels in your kidneys that filter waste and excess water from your blood.
- The condition causes swelling, particularly in feet and ankles, and increases the risk of other health problems.

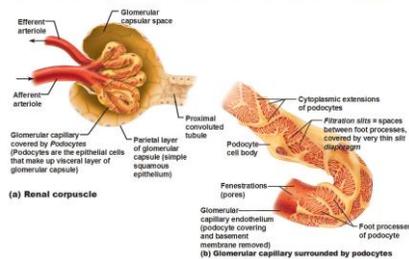


NEPHROTIC = Loss of foot processes

NEPHRITIC = Proliferative changes and inflammation of the glomeruli

Bottom line- "increased permeability of the glomeruli" leads to loss of proteins into the tubules

### Renal Corpuscle and the Filtration Membrane

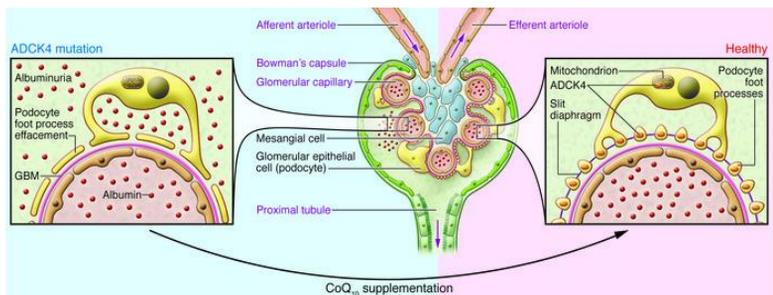


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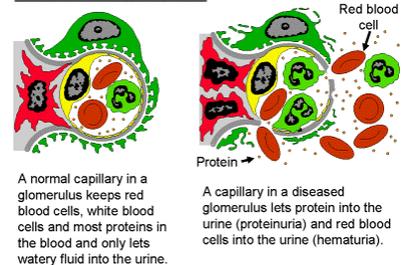
## Nephrotic Syndrome:

### Pathophysiology:

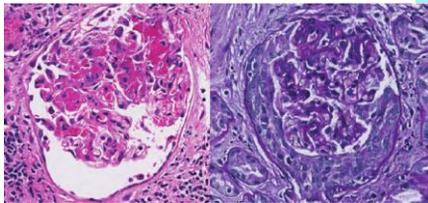
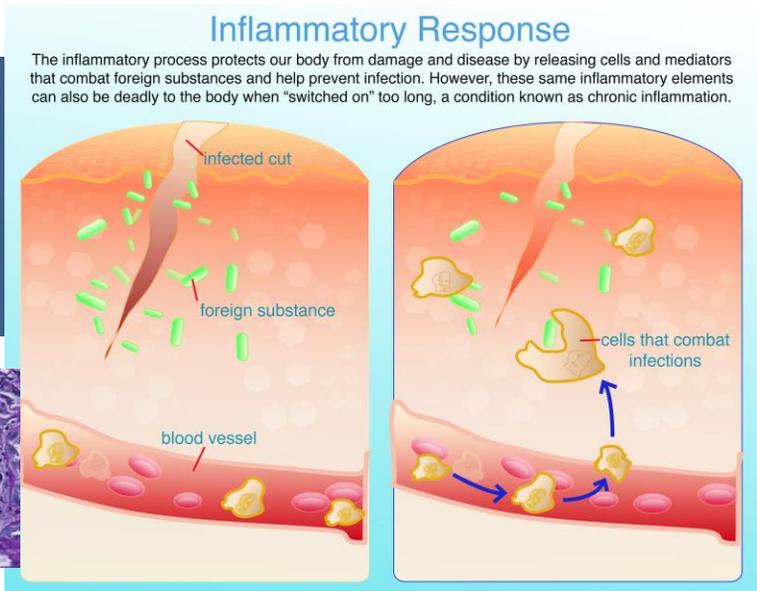
- *Inflammatory* response in the glomerulus => damage => proteinuria
- => pt hypoalbuminemic  
=> without albumin can it hold on to fluid in the vascular space?  
=> fluid goes to \_\_\_\_\_ => edema
- => fluid out vascular space into the tissue = circulating blood volume \_\_\_\_\_
- => the kidneys sense the decreased volume and try to help replace it  
=> renin-angiotensin system kicks in => aldosterone produced  
=> retention of \_\_\_\_\_ and \_\_\_\_\_
- => but without protein (albumin) in the vascular space to hold it  
=> this fluid go to \_\_\_\_\_
- Total Body Edema = \_\_\_\_\_



### Proteinuria and Hematuria



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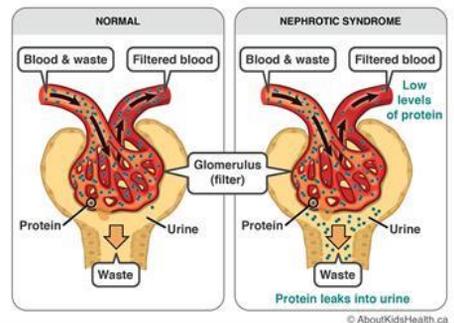
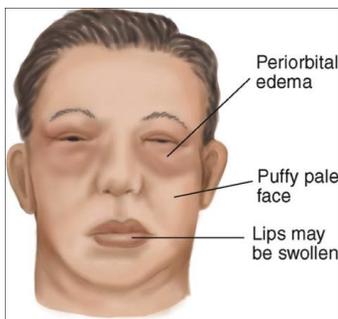
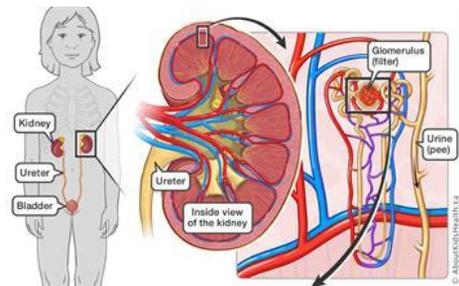


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### Causes of Nephrotic Syndrome

➔ think inflammation

- Many causes are idiopathic, but many clients that develop nephrotic syndrome will also have some systemic disease.
- Ex: NSAIDs, heroin, Hodgkin's disease, bacterial (strep or syphilis) or viral infection, allergic reactions, diabetes, systemic lupus erythematosus.

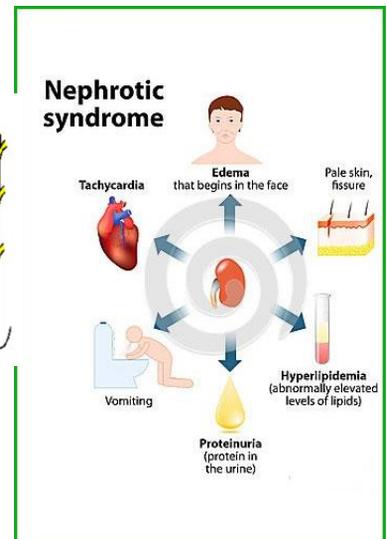
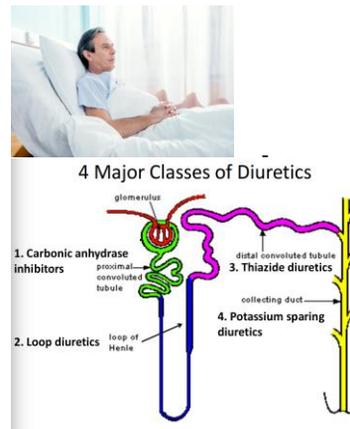
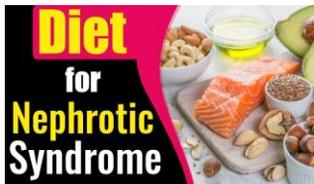


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## Nephrotic Syndrome Treatment:

- Bed rest and Diuretics => promote \_\_\_\_
- Prednisone => to decrease inflammation
  - shrink holes so protein can't get out
- 🤔 immunosuppression
- Diet:
  - Na? (↓ or ↑?)
  - Protein? (↓ or ↑?)
- Dialysis - not all pts
- Lasix and Albumin infusion (pull albumin and \_\_\_\_)

**kidney problems: Limit protein, except with Nephrotic Syndrome.**



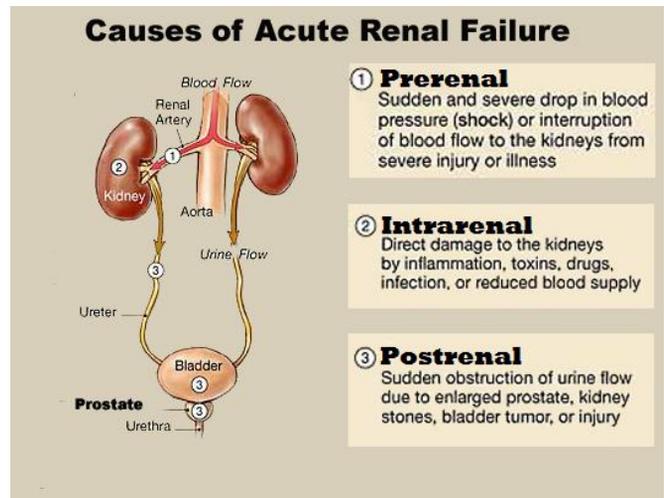
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## Renal Failure:

-Requires bilateral failure

### Causes:

- Pre** (blood can't get to the kidney) ↔ *Fluid Volume Deficit*
  - -Decreased cardiac output caused by arrhythmias, hypotension, decreased heart rate, any form of shock, sepsis, hemorrhage
- Intra** (damage has occurred inside the kidney)
  - -glomerulonephritis, nephrotic syndrome, dyes (X-ray), drugs,
  - -malignant hypertension (such as with gestational and Diabetes Mellitus) => malignant hypertension (uncontrolled HTN)
  - -Preeclampsia and DM can cause severe vascular damage
- Post** (urine can't get out of the kidney)
  - -enlarged prostate, kidney stone, tumors, ureter obstruction, edematous stoma

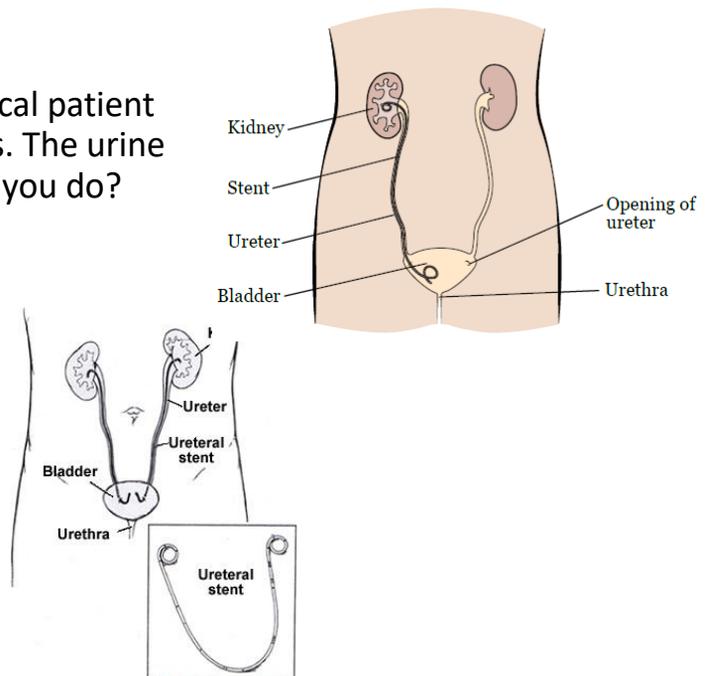


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**Question:**

- A 18 months old post surgical patient has bilateral ureteral stents. The urine output drops. What would you do?  
Chose a safe answer.

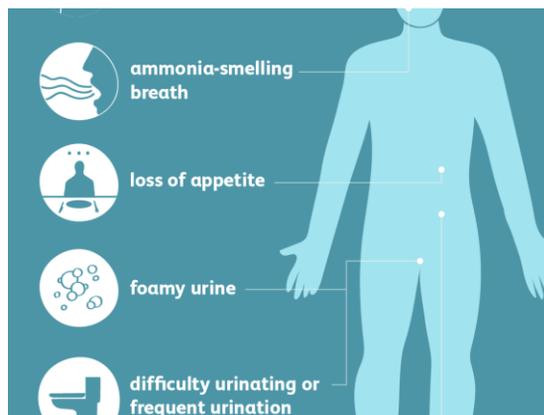
- a. Call MD
- b. Turn from side to side
- c. Irrigate
- d. Reassess in 15 min



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Medications that could cause Intra renal damage or should be used with caution in clients with renal damage:

- Loop Diuretics and Aminoglycosides:
- Streptomycin sulfate (Streptomycin),
- Amikacin sulfate (Amikin),
- Gentamicin sulfate (Garamycin),
- Netilmicin sulfate (Netromycin)
- Amphotericin B,
- Vancomycin,
- Ciprofloxacin (Cipro),
- Levofloxacin (Levaquin),
- Ofloxacin (Floxin),
- Azithromycin (Zithromax),
- Clarithromycin (Biaxin)
- Erythromycin ( Erythrocin)
- Clindamycin (Cleocin)



THINK "MYCIN"

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**RENAL FAILURE SIGNS AND SYMPTOMS:**

- -Creatinine and BUN
- -Specific gravity: Depending on the UO, initially is very concentrated. But renal failure can come to:
  - -Fixed specific gravity
    - -kidneys lose ability to concentrate and dilute urine, independent of amount of fluid in vascular space
  - -Fluid challenge, 250ml bolus (done in acute renal failure, not in chronic)
- -Anemia
  - -not enough erythropoietin
- -HTN and CHF => Retain volume
- -Anorexia, nausea, vomiting
- -Itching frost/ uremic frost
  - -good skin care
- -Acid-base/fluid and electrolyte imbalances
- -retain phosphorous => serum calcium \_\_\_\_\_ => calcium pulled from \_\_\_\_\_
- *In the **early stage** of renal failure, blood pH changes little because the remaining healthy nephrons can **compensate** by increasing their rate of acid excretion.*
- *In **later stages** of renal failure many nephrons are lost, acid excretion (hydrogen ions) is reduced and **metabolic acidosis** results*



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Which patient below is **NOT** at risk for developing chronic kidney disease?

1. A 58 year old female with uncontrolled hypertension.
2. A 69 year old male with diabetes mellitus.
3. A 45 year old female with polycystic ovarian disease.
4. A 78 year old female with an intrarenal injury.

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A patient with Stage 5 CKD is experiencing extreme pruritus and has several areas of crystallized white deposits on the skin. As the nurse, you know this is due to excessive amounts of what substance found in the blood?

- A. Calcium
- B. Urea
- C. Phosphate
- D. Erythropoietin



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- The answer is B.
- This patient is experiencing uremic frost that occurs in severe chronic kidney disease.
- This is due to high amounts of urea in the blood being secreted via the sweat glands onto the skin, which will appear as white deposits on the skin.
- The patient will experience itching with this.



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## Two phases of Acute Renal Failure:

### 1. Oliguric phase:

- What has happened to UO? (↓ or ↑?)
- This client is in a fluid volume \_\_\_ (↓ or ↑?)
- What do you think will happen to the K+ (↓ or ↑?)

### 2. Diuretic phase:

- What is happening to the UO (↓ or ↑?)
- This client is in a fluid volume \_\_\_\_\_ (↓ or ↑?)
  - worry about Shock
- What do you think will happen to the K+ (↓ or ↑?)

## ACUTE KIDNEY INJURY (AKI)

- SIGNS & SYMPTOMS -

### Oliguric Phase

- Oliguria - <400mL/day; occurs within 1-7 days of kidney injury
- Urinalysis – casts, RBCs, WBCs, sp gr fixated at 1.010
- Metabolic Acidosis
- Hyperkalemia and Hyponatremia
- Elevated BUN and Creatinine
- Fatigue & Malaise

### Diuretic Phase

- Gradual ↑ in urine output - 1-3 L/day; may reach 3-5 L/day
- Hypovolemia, Dehydration
- Hypotension
- BUN and Creatinine Levels Begin to Normalize

### Recovery Phase

- Begins when GFR Increases
- BUN and Creatinine Levels Plateau, then ↓



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## Dialysis:

### Hemodialysis:

- The machine is the glomerulus (the filter)
- If the client is allergic to \_\_\_ they can't be hemodialyzed

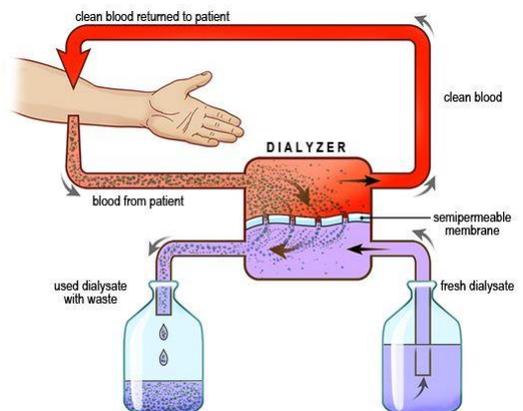


-This is a generally accepted standard in many areas (a good way to think for NCLEX); however, if the client is allergic to heparin, hemodialysis can be used if another solution with an anti-clot property (ex. sodium citrate) is used.

-In regard to the site used for hemodialysis (the access area/port): ==> If this client is allergic to heparin, then we must use another solution to prevent a clot from forming at the end of our access port (vascular access catheter); usually a product called Alteplase (Cathflo) is used instead of heparin in this situation.

- 3-4 times per week => pt. should watch between treatments: \_\_\_\_\_
- depression
- suicide is a possibility
- Electrolytes and BP are watched constantly.
- Can all clients tolerate hemodialysis? (yes or no?)

Ex: -unstable cardiovascular system can't tolerate hemodialysis  
=> go to shock



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**Circulatory Access:**

-Must have a circulatory access:

**1) Types of Access:**

- A-V shunt
- Fistula
- Graft
- Temporary catheters (Asch catheter)
  - utilized for short term access while the permanent access "matures"
  - Typically used for 90 days or less due to the increase risk of infection

**2) Nursing Care of Access:**

- Do not use any of the above for IV access (drawing blood, administering meds) – no needle sticks
- No constriction on that arm (BP, etc.)

**3) Assessment of Access:**

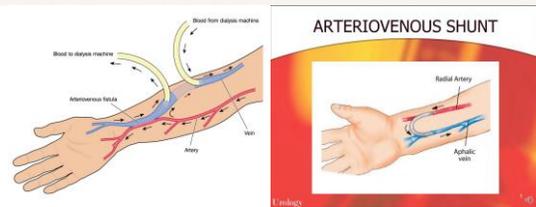
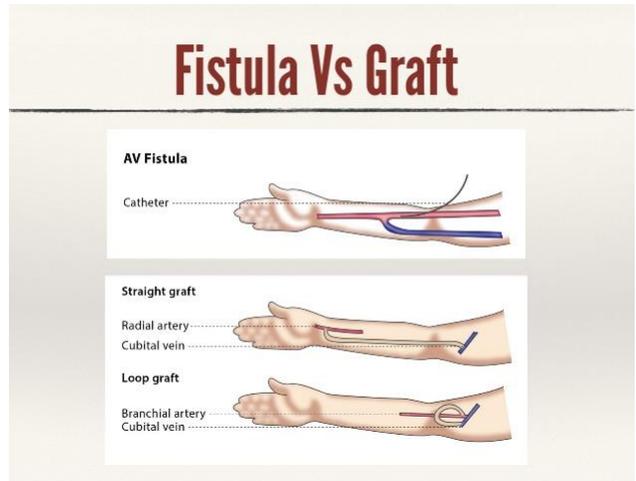
If palpate: => Thrill—cat purring sensation- and pulsate

If auscultate: => Bruit



**NURSES! => Feel a thrill.....Hear a bruit!**

**-If you do not feel the thrill or hear the bruit the physician should be notified**



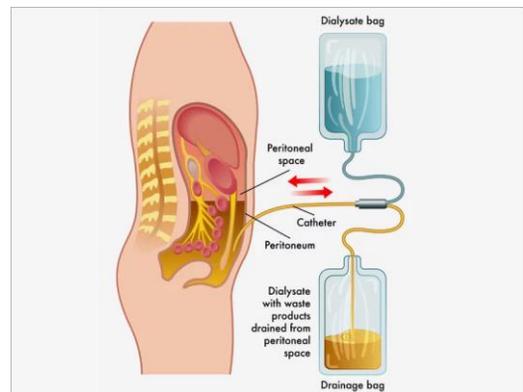
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**Peritoneal Dialysis:**

- 1) the dialysate is warmed and infused into the peritoneal cavity by gravity through a catheter.
  - The fluid (2000-2500 ml) stays in for an ordered amount of time (dwell time).
- 2) the bag is lowered and the fluid along with the toxins, etc., are drained

**Nursing Considerations:**

- Why do we warm the fluid?
  - Cold promotes vasoconstriction => limits blood flow
  - We want vasodilatation
- What should the effluent/drainage/fluid look like?
  - \_\_\_\_\_, straw-colored
  - cloudy = \_\_\_\_\_
  - should be able to read a newspaper through the drainage/effluent
- What type of client gets peritoneal dialysis?
- What if all the fluid doesn't come out?



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## Two TYPES of Peritoneal Dialysis:

### 1) CAPD (Continuous Ambulatory Peritoneal Dialysis):

### 2) CCPD (Continuous Cycle Peritoneal Dialysis):

-connects their peritoneal dialysis catheter to a cyclor at night and performs the exchange while sleeping; Disconnects in the AM; has more freedom



### CAPD:

-Must have a semi-strong client that has the energy and the desire to be active in their treatment and that also has the ability to learn and follow instructions.

- Done 4 times per day; 7 days a week
- Is an exchange done at night?
- Could a client with disc disease or arthritis do this?
  - Fluid causes pressure on back
- Could a client with a colostomy do this?
  - high risk for \_\_\_\_\_

## Complications of Peritoneal Dialysis:

#1 concern => peritonitis

s/s: abd pain, peritonitis, cloudy effluent 1st sign

- constant sweet taste
- anorexia
- hernia
- low back pain
- altered body image/sexuality



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## Dietary Needs of the Peritoneal Client:

- -Increase what in the diet?
  - -Fiber => have decreased peristalsis due to abdominal fluid
  - -Protein => Big holes in peritoneum and lose protein with each exchange

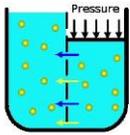


## Continuous Renal Replacement Therapy (CRRT):

- "Prisma" (kidney (filter) utilized in many facilities)
- Typically done in an ICU setting on clients whose cardiovascular status would have difficulty with hemodialysis due to the drastic fluid shifts.
  - Hemodialysis is more aggressive; at any given time during hemodialysis there is approximately 300 ml of blood in the machine (kidney); however, with CRRT there is only approximately 80 ml of blood in the machine



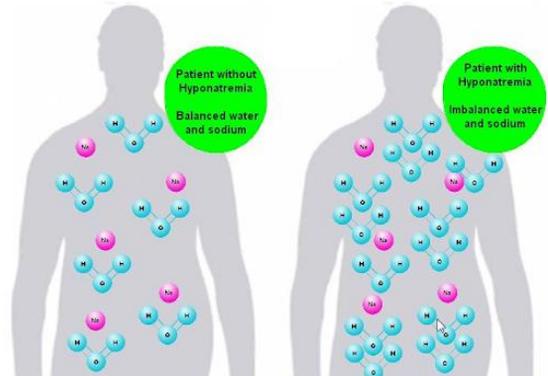
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**Ultrafiltration**  
(Solution moves by pressure gradient)

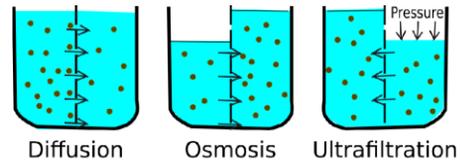
**Ultrafiltration:**

- Only pulling off water
- pt. high fluid volume = hyponatremic
- May be utilized with peritoneal dialysis or hemodialysis
- Same principles applied as with hemodialysis



**Ultra filtration**

- ▶ Ultra filtration is defined as water moving under high pressure to an area of lower pressure. This process is much more efficient at water removal than osmosis.
- ▶ Ultra filtration is accomplished by applying negative pressure or a suctioning force to the dialysis membrane.

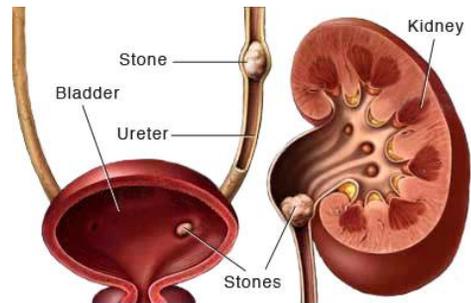


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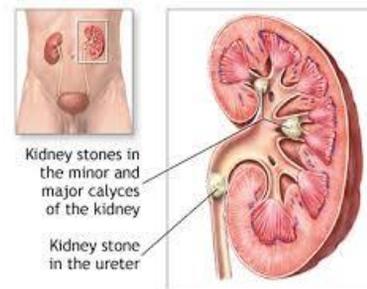
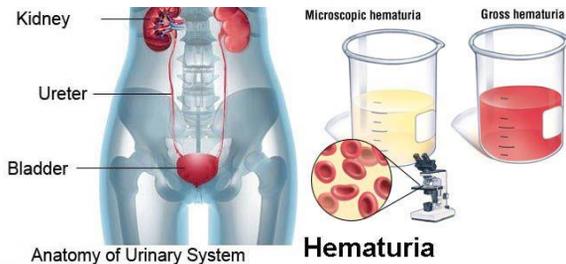
**Kidney Stones (urolithiasis, renal calculi):**

**Signs and Symptoms:**

- Pain (nausea/vomiting/vasovagal response)
- WBCs in urine
- Hematuria**
- Anytime you suspect a kidney stone get a urine specimen ASAP and have it checked for RBCs.
- If RBCs are present, then it's probably a kidney stone and the client will get pain medicine immediately.



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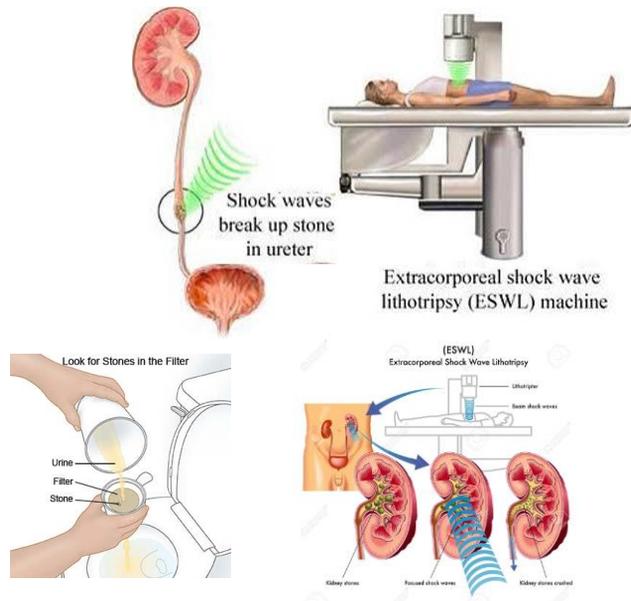


ADAM

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## Kidney Stones Treatment:

- Ketorolac (Toradol)
  - NSAID => be sure to take good bleeding history!
  - may not be given as it may lead to renal damage.
- anti-emetics
  - Promethazine (Phenergan),
  - Ondansetron (Zofran),
- Hydromorphone (Dilaudid)
- Increase fluids (stones can reoccur)
- Surgery
- Strain urine
- Extracorporeal shock wave lithotripsy (ESWL)
  - -worry about arrhythmias
  - client will also have blood in urine and possible bruising on back area due to the shock waves post procedure.



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A 65 year old male patient has a glomerular filtration rate of 55 mL/min. The patient has a history of uncontrolled hypertension and coronary artery disease. You're assessing the new medication orders received for this patient. Which medication ordered by the physician will help treat the patient's hypertension along with providing a protective mechanism to the kidneys?

- Lisinopril
- Metoprolol
- Amlodipine
- Verapamil

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- The answer is A.
  - There are two types of drugs that can be used to treat hypertension and protect the kidneys in patients with CKD. These drugs include angiotensin converting enzyme inhibitors (ACE inhibitors) and angiotensin receptor blockers (ARBs).
  - The only drug listed here that is correct is Lisinopril.
  - This drug is known as an ACE inhibitor.
- Metoprolol is a BETA BLOCKER.
- Amlodipine and Verapamil are calcium channel blockers.

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You are providing education to a patient with CKD about calcium acetate. Which statement by the patient demonstrates they understood your teaching about this medication? **Select-all-that-apply:**

- A. "This medication will help keep my calcium level normal."
- B. "I will take this medication with meals or immediately after."
- C. "It is important I consume high amounts of oatmeal, poultry, fish, and dairy products while taking this medication."
- D. "This medication will help prevent my phosphate level from increasing."

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- The answers are B and D.
- Calcium acetate (also known as PhosLo) is a phosphate binder, which will help keep the patient's phosphate level from becoming too high.
  - It helps excrete the phosphate taken in the food by excreting it out of the stool.
  - Therefore, it should be taken with meals or immediately after.
- Option C is wrong because the patient should AVOID these types of foods high in phosphate.

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While assessing morning labs on your patient with CKD. You note the patient's phosphate level is 6.2 mg/dL. As the nurse, you expect to find the calcium level to be?

- A. Elevated
- B. Low
- C. Normal
- D. Same as the phosphate level

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- The answer is B.
- A normal phosphate level is 2.7-4.5 mg/dL.
- This patient is experiencing HYPHERphosphatemia.
  - When hyperphosphatemia presents the calcium level DECREASES because phosphate and calcium bind to each.
  - When there is too much phosphate in the blood it takes too much calcium with it and it decreases the calcium in the blood. Therefore, the nurse would expect to find the calcium level decreased.

