

### Kidney Hormones

|                |                                                                                         |
|----------------|-----------------------------------------------------------------------------------------|
| Renin          | Raises blood pressure as result of angiotensin (local vasoconstriction) and aldosterone |
| Prostaglandins | Regulate intrarenal blood flow by vasodilation or vasoconstriction                      |
| Bradykinins    | Increase blood flow (vasodilation) and vascular permeability                            |
| Erythropoietin | Stimulates bone marrow to make red blood cells                                          |
| Vit D          | Promotes absorption of calcium in the GI tract                                          |

### Pyelonephritis

|                   |                                                          |
|-------------------|----------------------------------------------------------|
| Top renal disease | Inflammation of renal parenchyma and upper urinary tract |
| S/S               | Fever, chills, flank pain                                |
| Acute             | Bacteria                                                 |
| Chronic           | immune disorder                                          |
| Urosepsis         | bacteria in urine                                        |
| s/s               | lower BP, fever, high HR, lower IOC                      |
| lead to           | septic shock, multisystem failure                        |

### Renal Calculi

|                 |                                                                                   |
|-----------------|-----------------------------------------------------------------------------------|
| Causes          | Male, high sodium, calcium, protein, genetics, dehydration, immobility, gout, UTI |
| S/S             | depends on size and location - Upper= flank pain Lower = genital/abdominal pain   |
| Calcium stone   | 60%-80%                                                                           |
| Uric Acid Stone | low PH, 10%                                                                       |
| Cystine         | genetic, 3%                                                                       |
| Testing         | UA, serum calcium, uric acid, XR, cystoscope                                      |

### Renal Calculi (cont)

|         |                                                                                              |
|---------|----------------------------------------------------------------------------------------------|
| Surgery | Lithotripsy - Shock wave stones < 2cm -Percutaneous Nephrolithotomy - stones > 2 cm under GA |
| Diet    | 2 1/2 - 3L /d, low sodium, low calcium                                                       |
| IVP     | Intravenous pyelogram to look at kidneys and ureters                                         |

### AKA Kidney Stones

### Urine formation

|                       |                                                                                               |
|-----------------------|-----------------------------------------------------------------------------------------------|
| glomerular filtration | hydrostatic pressure, filters by size                                                         |
| GFR                   | 125mL/m / 180L/d - influenced by BP and volume max 70mmHg                                     |
| 2nd phase             | Tubular moves water back to blood, ADH/aldosterone increases water reabsorption up to 220mg/d |
| 3rd phase             | solutes from blood to filter - potassium, iron, keeps homeostasis                             |

### UTI

|                  |                                                               |
|------------------|---------------------------------------------------------------|
| risks            | Female, increased age, catheters                              |
| S/S              | Dysuria, frequency, urgency, pain, hematuria, suprapubic pain |
| Causes           | E. coli                                                       |
| Complications    | drug resistance, urethritis, pyelonephritis, renal assess     |
| Urethritis       | inflammation of urethra                                       |
| Cognitive issues | falls, dizzy, lower appetite                                  |
| teaching points  | 2-3L/D, Void after intercourse,                               |

### UTI (cont)

|                   |                                                                    |
|-------------------|--------------------------------------------------------------------|
| Houdini           | Hematuria, obstruction, edema, surgery, end of life care, immobile |
| get urine culture | keep on ice                                                        |
| TX                | Antibiotics                                                        |

### Hypo/Hyper

|                    |                                           |
|--------------------|-------------------------------------------|
| Hyponatremia S/S   | Brain damage, seizures, coma              |
| Hyponatremia TX    | salt, fluid restriction, IV fluids        |
| Hypernatremia S/S  | coma, seizures, delusions, thirst, tachy  |
| Hypernatremia Tx   | Increase fluids, decrease sodium,         |
| Hypokalemia S/s    | short QT, bradycardia                     |
| Hypokalemia tx     | ALBUTEROL, DOPAMINE, DIURETICS, ST        |
| Hypomagnesemia S/S | HTN, hyperactivity, tachycardia, chvostek |
| Hypomagnesemia tx  | fall precautions, iv ma sulfate           |

### Kidney Structure

|                    |                                                                                   |                                                                                                        |
|--------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| Afferent arteriole | Delivers arterial blood from the branches of the renal artery into the glomerulus | Autoregulation of renal blood flow via vasoconstriction or vasodilation Renin-producing granular cells |
|--------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|

### Kidney Structure (cont)

|                    |                                                                                                |                                                                                                     |
|--------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Efferent arteriole | Delivers arterial blood from the glomerulus into the peritubular capillaries or the vasa recta | Autoregulation of renal blood flow via vasoconstriction vasodilation Renin-producing granular cells |
|--------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|

|            |                                                   |                                                                                                                                                                               |
|------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Glomerulus | Capillary loops with thin, semipermeable membrane | Site of glomerular filtration Glomerular filtration occurs when hydrostatic pressure (blood pressure) is greater than opposing forces (tubular filtrate and oncotic pressure) |
|------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                       |                                                       |                                                                  |
|-----------------------|-------------------------------------------------------|------------------------------------------------------------------|
| Bowman's capsule (BC) | Thin membranous sac surrounding 2/3 of the glomerulus | Collects glomerular filtrate (GF) and funnels it into the tubule |
|-----------------------|-------------------------------------------------------|------------------------------------------------------------------|

|                                  |                                                                                                                   |                                                                                                                             |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Proximal convoluted tubule (PCT) | Evolves from and is continuous with Bowman's capsule Specialized cellular lining facilitates tubular reabsorption | Site for reabsorption of sodium, chloride, water, glucose, amino acids, potassium, calcium, bicarbonate, phosphate and urea |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|

### Kidney Structure (cont)

|               |                                                                                                                    |                             |
|---------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Loop of Henle | Continues from PTC Juxtamedullary nephrons dip deep into the medulla Permeable to water, urea, and sodium chloride | Regulation of water balance |
|---------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------|

|                  |                                                                                |                                                                     |
|------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Collecting ducts | Collect formed urine from several tubules and deliver it into the renal pelvis | heceptor sites for antidiuretic hormone regulation of water balance |
|------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------|

### Bladder Cancer

|              |                                                                                                |
|--------------|------------------------------------------------------------------------------------------------|
| Risk Factors | begins in urothelial cells that line the bladder, men>women, chronic inflammation, carcinogens |
|--------------|------------------------------------------------------------------------------------------------|

|                |                                                  |
|----------------|--------------------------------------------------|
| Manifestations | hematuria, frequent/painful urination, back pain |
|----------------|--------------------------------------------------|

|    |                           |
|----|---------------------------|
| TX | Chemo, radiation, surgery |
|----|---------------------------|

|           |                               |
|-----------|-------------------------------|
| Surgeries | cystectomy, urinary diversion |
|-----------|-------------------------------|

|            |                   |
|------------|-------------------|
| neobladder | no external pouch |
|------------|-------------------|

|                     |                            |
|---------------------|----------------------------|
| continent diversion | stoma hidden in. umbilicus |
|---------------------|----------------------------|

|               |                            |
|---------------|----------------------------|
| complications | bleeding, clots, infection |
|---------------|----------------------------|

### Acute renal failure

common in hospitalized patients

|                    |                            |
|--------------------|----------------------------|
| oliguria, prerenal | HTN, lower CU, hypovolemia |
|--------------------|----------------------------|

### ABG interpretation

|        |                                   |
|--------|-----------------------------------|
| Normal | PH: 7.35 PaCO2: 35-45 HCO3: 22-26 |
|--------|-----------------------------------|

|                    |                 |
|--------------------|-----------------|
| Metabolic Acidosis | Low pH LOW HCO3 |
|--------------------|-----------------|

|                     |                   |
|---------------------|-------------------|
| Metabolic Alkalosis | High pH High HCO3 |
|---------------------|-------------------|

|                      |                    |
|----------------------|--------------------|
| Respiratory Acidosis | Low Ph High. PaCO2 |
|----------------------|--------------------|

|                       |                   |
|-----------------------|-------------------|
| Respiratory Alkalosis | High PH Low PAco2 |
|-----------------------|-------------------|

### Causes of Nephrotic Syndrome

|                            |                                                                                                                                |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Primary Glomerular Disease | Membranous proliferative glomerulonephritis, Primary nephrotic syndrome, Focal glomerulonephritis, Inherited nephrotic disease |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------|

|                     |       |
|---------------------|-------|
| Multisystem Disease | Lupus |
|---------------------|-------|

|           |           |
|-----------|-----------|
| Allergens | Bee Sting |
|-----------|-----------|

|           |       |
|-----------|-------|
| Infection | Strep |
|-----------|-------|

|           |          |
|-----------|----------|
| Neoplasms | Leukemia |
|-----------|----------|

|       |                   |
|-------|-------------------|
| Drugs | Penicillin, NSAID |
|-------|-------------------|

### Acute Glomerulonephritis

|              |                             |
|--------------|-----------------------------|
| inflammation | 3rd cause of kidney failure |
|--------------|-----------------------------|

|       |                                                  |
|-------|--------------------------------------------------|
| cause | great b strep, autoimmune - lupus, good pastures |
|-------|--------------------------------------------------|

|     |                                                                            |
|-----|----------------------------------------------------------------------------|
| S/S | HTN, decrease output, decrease GFR, edema, proteinuria, hematuria, dysuria |
|-----|----------------------------------------------------------------------------|

|             |                                                         |
|-------------|---------------------------------------------------------|
| medications | ABX, diuretics, plasmapheresis, protein restricted diet |
|-------------|---------------------------------------------------------|

### Benign Prostatic Hyperplasia

noncancerous enlargement of prostate

S/S Difficulty urinating, bladder outlet obstruction (BOO)

DX rectal exam, prostate specific antigen

PSA elevates if prostate cancer

medications Finasteride, dutasteride, tamsulosin

surgeries TUIP, go home with foley

Finasteride women don't touch, reduces size

Tamsulosin flowback

TUIP incision into prostate to relieve compression and make urine flow easier

CBI continuous bladder irrigation prevents blood clots

TURP due to prostate irrigation - lower BP, Sodium and Hgb

### Prostate Cancer

slow growing malignant tumor

risk African American, 50 years+

characteristics slow growing, asymptomatic, can metastasize to lymph nodes, bone, rectum, bladder

DX curable early detection, PSA levels, rectal exam

TX external radiation, prostatectomy, ABX

teaching points symptoms go away 34-48hrs, don't quit ABX

### Urine Retention

<400ml Oliguric

TX kiegels, scheduled bathroom, Bethanechol

Cause anticholinergics

### Medications

Cymbalta depression, neuropathic pain

oxybutynin decrease muscle spasms in bladder

Tolterodine overactive bladder

darifenacin treats symptoms of overactive bladder

Trospium overactive bladder

Salifencin neurogenic overactivity

### PKA

common genetic disorder cysts

autosomal dominate appears age 30-40

s/s HTN, obstruction, hematuria, pain

DX UA, blood.bacteria, radiographic

TX dialysis

labs anemia, increases BUN, Creatinine, NA, K, HR, lower CA, fever