

Common Nephrotoxic meds:
**(gentamycin,
 contrast dye, NSAID's
 hypertensive's
 immunosuppressant's**

*UO = ~ 1500 mL/day
 *Min = 30 mL/hr
 *I&O should be about same!
 *Specific Gravity: 1.005-1.030; fixed at 1.010 = inability to concentrate = ESKD
 *GFR best indicator of kidney function (creatinine clearance)
 WNL 125 mL/min
 *CVA: 12th rib and vertebral column intersect
 *Stenosis: BRUIT
 *Not palpable = WNL
 *K,U,B normally sterile!
 *Urosepsis!!
 *Uremia=s/sx in all body systems!!!

**antibiotics
 cephalosporins,
 (ibuprofen), some anti-
 (cyclosporine), chemo**

R- RISK stage 1 = (GFR > 90)
 I- INJURY stage 2 = mild (89-60)
 F- FAILURE stage 3 mild to mod (59-45, 45-30)
 L- LOSS stage 4 = severe (30-15)
 E- ESKD stage 5 (< 15 or dialysis)

Geriatrics:

-decrease in: tissue, number of nephrons, functions & excretion, GFR, tone, elasticity, capacity
 -increase in: BUN/Cr
 -stress and urge incontinence, hesitancy, frequency, urgency, nocturia, retention more common

| Diagnostic Tool | Purpose & Patient Education | NI's |
|----------------------------|---|--|
| <u>Urinalysis, C&S</u> | <ul style="list-style-type: none"> Specific gravity, pH, color, odor, glucose, ketones, protein, RBCs, WBCs, bacteria, casts, osmolality; C&S → identify organism growing Clean catch- cleansing towelettes | No special prep; can be done clean catch or catheter |
| <u>24 Hr. Urine</u> | <ul style="list-style-type: none"> determine the excretion rate of Na+ K+ Ca- Cl- Phos uric acid and + proteins; determines the amount of urine the being excreting; normal 1000-2000mL/hr Keep on ice! If urine discarded during 24 period = start over! First void discarded *need a start time | Collected for 24 hrs. |
| <u>Bladder Scan</u> | <ul style="list-style-type: none"> Noninvasive, estimates bladder volume male vs. female settings (peds) | -2 readings = accuracy -1.5" above pubic bone, point towards coccyx -male setting for hysterectomy |
| <u>Serum Values</u> | -BUN: overall renal function -Cr: balance between production and filtration, better indicator than BUN -GFR* -Lytes & Minerals: reflects concentration | |

| <u>Diagnostic</u> | Description | Nursing Responsibility |
|--|---|---|
| <u>KUB</u> | <ul style="list-style-type: none"> • Xray: estimate of kidney position, size, and calcifications | -no special prep |
| <u>IVP</u> | <ul style="list-style-type: none"> • visualization of the entire urinary tract; outlines the blood supply of kidney • npo after MN • no metformin for 48 hr after, hold before, r/f <i>lactic acidosis</i> • contrast = flushing, warm sensation, salt like taste | <ul style="list-style-type: none"> -allergies -consent -bowel prep night before -do not give to ↓ renal function -force fluids after |
| <u>Retrograde Pyelogram</u> | <ul style="list-style-type: none"> • Xray's • procedure performed with cystoscopy; contrast instilled upwards via catheter • best for clients with ↓ functioning kidneys • catheter & cystoscope | <ul style="list-style-type: none"> -prep as IVP -consent/ contrast -inform pt of pain and discomfort from distention of renal pelvis and from cystoscope -monitor for flank pain, dysuria, chills, fever for 24-48 hr post exam = <i>extravasation</i> -adequate hydration after |
| <u>Antegrade Pyelogram (Nephrostogram)</u> | <ul style="list-style-type: none"> • Upper UT: contrast injected percutaneously into renal pelvis or nephrostomy tube • Best for when pt has allergy to contrast, ↓ renal function, or abnormalities that prevent a ureteral catheter passing | <ul style="list-style-type: none"> -same prep as IVP -monitor for hematuria, infection, hematoma |
| <u>Renal Arteriogram (Angiogram)</u> | <ul style="list-style-type: none"> • Looks at blood vessels, supply & circulation • dye injected into renal artery via catheter in femoral artery | <ul style="list-style-type: none"> -consent -same prep as IVP & sensitivity testing -bedrest 12-24 hrs, leg straight -assess puncture site: hematoma, bleeding; assess peripheral pulses |
| <u>Renal Scan</u> | <ul style="list-style-type: none"> • Location, configuration, vascularity, GF, tubular function, excretion • Helpful in determining obstruction of the UT; ARF <48 hrs of onset • Radioactive isotope injected via IV - probes trace isotope -- scan and map | <ul style="list-style-type: none"> - no diet or activity restriction -should not have any pain during test |
| <u>Cystoscopy</u> | <ul style="list-style-type: none"> • Lighted scope inserted under local or general anesth. • Complications: retention, hemorrhage, infection, perforation of bladder | <ul style="list-style-type: none"> -anesth. Precautions - give IVF if general -May have pink-tinged urine post procedure & spasms, NOT bloody urine or severe pain -May have burning, dysuria, & frequency post procedure -sitz bath, analgesics, antispasmodics, need adequate fluids after, watch for retention |
| <u>Cystogram</u> | <ul style="list-style-type: none"> • Dye instilled into bladder with catheter or cystoscope; visualize bladder and evaluate for reflux | <ul style="list-style-type: none"> -consent -if cystoscope - follow care related to cystoscopy |
| <u>Cystometrogram</u> | <ul style="list-style-type: none"> • Insert catheter and instill water or saline into bladder • measures pressure (tone) against bladder | <ul style="list-style-type: none"> -ask about first urge to urinate, strong urge, & perception of fullness -observe for s/sx of uti after |
| <u>Biopsy</u> | <ul style="list-style-type: none"> • Pathology; needle, open, brush • Not done with single functioning kidney, coag disorders, and uncontrolled HTN • Contraindications: suspected infection, hydronephrosis, and lesions | <ul style="list-style-type: none"> -pre: consent, coag times, cross match-blood, RFP -no asa or warfarin prior -assess for BLEEDING -post: bedrest x 24 hrs, lay on affected side for 30-60 min, VS, hematuria x 24 hrs, no strenuous activities -brush: similar post-cystoscopy; flank pain common, disappears in 48 hrs, report severe pain or temp of 101 -no anticoags post until allowed |

| | <u>UTI/Cystitis</u> | <u>Acute Pyelonephritis</u> | <u>Chronic Pyelonephritis</u> | <u>Renal TB</u> | <u>Acute / Chronic Glomerulonephritis</u> |
|--------|--|---|--|---|--|
| Patho: | <ul style="list-style-type: none"> -ecoli most common -upper vs. lower UT -uncomplicated (only bladder, WNL UT) vs. complicated (coexists with other problems*) -WNL defense mechanisms interrupted -ASCENDING infection -multiple risk factors: anatomic, foreign bodies, stasis of urine, immunodeficient, functional, etc | <ul style="list-style-type: none"> -lower UTI ASCENDS look for sepsis! -reflux, obstructions - factors -leads to ↓ function | <ul style="list-style-type: none"> -slow, progressive → RF -obstruction, neurogenic bladder, reflux, recurrent uti's - factors -will lead to ESKD/CKD | <ul style="list-style-type: none"> -mycobacterium reaches kidney -lies dormant (many yrs) -slow progression, no s/sx until late -caseating masses destroy tissue | <ul style="list-style-type: none"> -both kidneys, acute or chronic -acute: post strep infection -chronic: many causes; development of uremia → CKD |
| S/sx: | <ul style="list-style-type: none"> -range from urinary complaints to systemic -LUTS -bladder storage: frequency, urgency, incontinence, nocturia, nocturnal enuresis -bladder emptying: weak stream, hesitancy, intermittency, dribbling, retention, dysuria -asymptomatic bacteriuria = nonspecific -geriatric: absent, confusion, abd discomfort | <ul style="list-style-type: none"> - mild fatigue → sudden onset of chills; fever; vomiting; malaise; flank pain; and the LUTS characteristic of cystitis, including dysuria, urgency, and frequency -CVA pain -MAY SUBSIDE | <ul style="list-style-type: none"> -asymptomatic -most common → HTN | <ul style="list-style-type: none"> -LATE -urinary symptoms with wt loss, low fever, night sweats ?, flank pain, hematuria, malaise | <ul style="list-style-type: none"> -acute: appear suddenly, temporary, reversible - 1-2 weeks after infection (<i>edema, HTN, oliguria, hematuria, proteinuria</i>) -chronic: proteinuria, hematuria, uremia → affects multiple body systems |
| Dx: | <ul style="list-style-type: none"> -H&P -UA (nitrites=bacteria, wbc's, leukocyte esterase = pyuria) -C&S (identify bacteria) -US, CT scan (obstruction) -Refrigerate! | <ul style="list-style-type: none"> -H&P, CVA palpation -UA, C&S, CBC - WBC -Blood cx's -US, CT - look for complications | <ul style="list-style-type: none"> -imaging and bx to confirm! | <ul style="list-style-type: none"> -C&S - mycobacterium -IVP - extent | <ul style="list-style-type: none"> -acute: UA, H&P, C&S -chronic: H&P, UA, c/o HTN US & CT preferred, bx- exact cause |
| Tx: | <ul style="list-style-type: none"> -uncomp: 3 days -comp: 7-14 days -<u>trimethoprim/sulfamethoxazole</u> (UNCOMP, cheap, BID, ecoli resistance) -<u>nitrofurantin</u> (UNCOMP, 3-4xday or BID preparation, avoid sunlight, notify if systemic s/sx) -<u>ampicillin, amoxicillin, cephalosporin</u> (UNCOMP) -<u>fluoroquinolone's</u> (COMP, cipro or levofloxacin) -<u>antifungals</u> (fungal, fluconazole, amphotericin) -<u>analgesics</u> (phenazopyridine, stains) -prophylactic (single dose prior to an event, limited use - resistance) | <ul style="list-style-type: none"> -IV abx & hospitalization for severe infections & complications -mild- outpt 14-21 days abx -may discharge when stable on oral abx (14-21 days) -NSAIDs, analgesics | <ul style="list-style-type: none"> -abx if bacteria -kidney rest -control HTN (meds, diet, etc) -same tx as ESKD/CKD | <ul style="list-style-type: none"> - same as TB (rifampin, isoniazid, pyrazinamide, ethambuol) -total vs. partial nephrectomy - if persistent infection -urinary diversion - if severe | <ul style="list-style-type: none"> -acute: symptomatic relief - see symptoms above; only abx if infection still present -chronic: depends on cause; dialysis, transplant |
| Nl's: | <ul style="list-style-type: none"> -identify risk patients -promote elimination, answer call lights, routine -hygiene! -adequate fluids -prevent CAUTI (gloves, aseptic, prompt removal) -avoid diet bladder irritants (etoh, caffeine...) -teach: meds, s/fx, notify if persistent s/sx | <ul style="list-style-type: none"> -relapse - tx with 6 wk abx -teach: f/u with c&s, & imaging -monitor for UROSEPSIS! -teach same as UTI -treat uti EARLY! | | <ul style="list-style-type: none"> - + TB test only indicates h/o inhalation, NAD | <ul style="list-style-type: none"> -chronic: long illness - need support; Antihypertensives, bed rest, low protein diet, blood transfusions, CKD tx |

dilation: pelvis & calyces uni or bilat
 obstruction → pressure = damage; muscles contract to try and push around; if not relieved = backflow and dilation → pelvis = hydronephrosis; eventually RF
 causes: strictures, calculi, tumors, trauma, BPH, congenital

UT: pain!, N/V, spasms, tenderness, ? mass
 LT: bladder distention, dullness, palpable bladder & tenderness

depends on where obstruction is suspected
 IVP, KUB, CT, US, Bx, UA
 CT best- quick (pain!)

the cause!
 pain , remove obstruction
 narcs, antispasmodics, abx if infection, alpha-adrenergic blockers

assess: pain, UO, intake, distention
 maintain: aseptic technique, drainage systems
 teaching: meds, diet, prevention, self-care

| <u>Strictures</u> | <u>Calculi</u> | <u>Lithotripsy</u> |
|---|---|---|
| -narrowing of urethra or ureter/s -urethral: congenital, infection, trauma -ureteral: scar tissue | -can develop anywhere along the tract; ranges in size -risks: diet, immobility, genetics, infections metabolic, men > women | Several techniques: ESWL, Laser, percutaneous ultrasonic, electrohydraulic |
| <u>S/sx</u> -stream: reduced size, split -dysuria, urgency, frequency, nocturia, incomplete emptying | <u>S/sx</u> -pain! Depends on location: pelvis = dull ache, moving along ureter = excruciating & intermittent colicky, urine changes -with pain - N/V, diaphoresis, diarrhea, hematuria, s/sx UTI: burning, fever, chills, foul urine | <u>Extracorporeal Shock Wave Litho (ESWL)</u> -shock waves, nonsurgical, breaks stones with waves via water bath pillow -sedative, fluoroscopy to locate stone, shocks fired during cardiac refractory to prevent arrhythmias -post: may pass stones up to 20 days after, mild discomfort, ache, bruise; hematuria, polyuria; observe for bleeding!, strain all urine, |
| <u>Dx</u> -s/sx -discovered during catheterization -retrograde urethrography -flow meter | <u>Dx</u> -H&P, CVA tenderness -KUB, IVP, US, CT, cystoscopy, UA -CT & KUB preferred – pain! Quick! | <u>Percutaneous Ultrasonic Litho</u> -nephroscope thru skin; ultrasonic or electrohydraulic or laser used to disintegrate stone -flushed and suctioned out -complications: hemorrhage, injury, sepsis; need lots of fluids post! |
| <u>Ix</u> -urethral dilation: 1. cath, change daily with larger cath; 2. abrupt = sounds, filiforms, followers 3. surgery: urethroplasty (w/ or w/o graft to create larger opening) | <u>Ix</u> -depends on phase -3 phases: acute, elimination, prevention -1. acute: narcs, antispasmodics, NSAIDs, antiemetics, IVF, alpha-adrenergic blockers -2. elimination: litho, surgical removal -3. Prevention: teaching: diets, ↑ activity, ↑ fluids, thiazide diuretics | <u>Laser Litho</u> -probe inserted through ureterscope, laser system emits energy to stone -longer probes to reach higher up in ureter -pieces are weakened and then flushed out or extracted <u>Electrohydraulic / Basketing</u> -stone removed by forceps, suction, irrigation or with basket -complications: hemorrhage, sepsis, abscess; hematuria common, will subside |
| <u>Ni's</u> -post dilation: sitz bath, analgesics, antibiotics -prevent infection! Aseptic technique! Remove foley promptly! | <u>Ni's</u> -strain urine, strict I&O, RFP, encourage ambulation -hematuria, stents x 2 wks for all litho's -low Na+, low Ca+, low oxalate, low animal protein, low purine diet- if stones = uric acid; *know examples of foods* | <u>Surgical Removal</u> -depends on location of stone! (nephro-, pyelo-, uretero-) -incision; most common complication: hemorrhage! <u>Litholapaxy</u> -stone broken with lithotrite, irrigated; complications: hemorrhage, retained fragments, infection |

| Diagnosis | Patho | S/Sx | Dx | Tx | NI's |
|---------------------------------------|---|--|---|---|--|
| Acute & Chronic Bacterial Prostatitis | Inflammation; ascending bacteria or descent from bladder or bloodstream; Chronic-inadequately tx acute; recurrent infection*** UTI's *** | Acute: sudden onset→ fever, chills, muscle tenderness, back & perineal pain, arthralgia; urgency, frequency, nocturia, dysuria, burning sensation after voiding, hematuria, pain before or after ejaculation Chronic: asymptomatic, milder sx's, frequent UTI's | Acute: UA, urine c&s; CBC- NO PROSTATIC MASSAGE Chronic: segmental urine culture (pre-massage & post-massage test); boggy prostate | Acute: trimethoprim/sulfamethoxazole; cipro x 4 wks, if + blood cultures = IV abx; antispasmodics Chronic: long term abx 8-12 wks, lifetime if immunocompromised; | *Treat pain – analgesics, sitz, ↑ fluids, stool softeners Sexual activity helps drain prostate |
| Chronic Pelvic Pain Syndrome | Prostate and urinary pain with no infection* May occur after viral illness or STI or ↓ in activity | Asymptomatic, milder symptoms than acute prostatitis- s/sx similar to chronic bacterial prostatitis | Negative culture; leukocytes in prostatic secretions | Symptomatic relief – sitz baths, analgesics-anti-inflammatory's May be treated as a STI | |
| Asymptomatic Inflammatory Prostatitis | Inflammatory process of the prostate with no symptoms | NONE | Diagnosed during evaluation of other urinary problems Leukocytes + in seminal fluid (prostate) | Anti-inflammatories | |
| BPH | -Hypertrophy or hyperplasia -Cells grow inward - ↑ estrogen, ↓ testosterone = ↑ DHT | *insidious -stream lacks force* -nocturia, hesitancy, dribbling, straining, frequency, hematuria, inability to empty | -Rectal exam-DRE -flow studies, IVP, MRI, cystoscopy | -alpha adrenergic receptor blockers: DOES NOT ↓ SIZE; terazosin, tamsulosin, doxazosin- relax smooth muscles to ↑ urine flow and ↓ s/sx; 2-4 wks for results; sfx- ↓ BP, dizziness, fainting -5 alpha-reductase inhibitors: SHRINKS PROSTATE finasteride, dutasteride; stops DHT conversion; sfx- ↓ libido -TURP vs. Prostatectomy: TURP no incision, partial removal, CBI after*** know incision types and risks for prostatectomy*** | -encourage prostatic massage, sitz baths -encourage to urinate when urge, avoid large quantities of fluid over short time periods, avoid OTC cough/cold meds, avoid ETOH/caffeine -TURP: i&o, pain relief, sexual activity in 4-8 wks, retrograde ejaculation, kegel's, CBI: large balloon to minimize bleeders, hematuria, ensure drainage, flush for clots, TRUE URINE VALUE |

Prostate Cancer

-Most common CA among men, excluding skin CA; slow growing; common mets site = bone
-Risk Factors: age, African American, first-degree relative ↑ risk, diet (red, processed meat, high fat, low veg/fruit), chemical exposure, ?smoking
-watchful waiting = life expectancy < 10 yrs, low grade & low stage tumor, severe comorbidities

Signs & Symptoms:

-early-asymptomatic
-similar to BPH (LUTS, urgency, hematuria, nocturia, retention, recurrent infections), classic CA sign – unexplained weight loss

Diagnosis:

-variable!! Informed decision making!!
-annual PSA & DRE (high risk- start ages 40-45)
-PSA (WNL 0-4 ng/mL)
-DRE (abnormal = hard, nodular, asymmetrical), annual 50 yrs of age or older
-↑ PAP
- **BX! (done with TRUS)**
-CT,MRI,TRUS, Bone Scan – location & spread

Treatment:

-Radical Prostatectomy (entire prostate, seminal vesicles, part of bladder neck) (retropubic, perineal approach) not an option for advanced stages, urinary control issues postop, other complications: hemorrhage, retention, infection, dehiscence, DVT, PE
-Cryosurgery/Cryoablation (destroy cells by freezing with liquid nitrogen) done with TRUS, complications: fistulas, ED, incontinence, prostatitis, hemorrhage
-Radiation (external vs. brachy)
External: side effects- acute or delayed, skin rxns, GI, GU, & ED, fatigue, lasts 2-3 wks after completion
Brachytherapy: radioactive seeds into prostate with TRUS, best in early stages, irritated or obstructive urinary effects, ED, can be done in combo
-Chemo (palliative) for hormone-resistant in late stages
-Orchiectomy (bilat done alone or w/ prostatectomy) permanent! For advanced stages
-ADT → before surgery, radiation, and with advanced stages; ↑ PSA = therapy no longer working; OP & fx's common, ↑ r/f CV effects, 2 classes:

ADT: Androgen Synthesis Inhibitors

- 1. LH-RH agonists:** mimic's body function, triggers a flare before causing chemical castration; sfx = hot flashes, gynecomastia, ↓ libido, ED
- 2. LH-RH antagonist:** blocks the action, immediate suppression (3days), no flare, sfx= injection site issues & ↑ liver enzymes

ADT: Androgen Receptor Blockers

Compete for receptor sites, can be combined with LH-RH agonists, daily oral, sfx= ↓ libido, ED, hot flashes, breast pain, gynecomastia

Initiation (1)

- Begins at time of insult
- Continues until s/sx apparent
- Hours to days

Oliguric (2)

- Within 48hr of agent, can be up to 7 days
- < 400 ml/24 hr
- Urine: bloody, protein casts, WBC's, RBC's; specific gravity 1.01 (wnl = 1.003-1.03)

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| | <ul style="list-style-type: none"> • Azotemia • <u>Excess Fluid</u> • <u>Metabolic acidosis</u>: kussmaul breathing • <u>Electrolyte imbalances</u>: <ul style="list-style-type: none"> o Hyperkalemia: ≥ 5.5 o Hyponatremia: < 130; s/sx- warm moist flushed skin, muscle weakness, twitching, confusion, delirium, convulsions o Hypocalcemia & hypophosphatemia: s/sx- irritability, muscle cramps, hyperflexia, N/T • Restrict fluids |
| <p style="text-align: center;"><u>Diuretic (3)</u></p> <ul style="list-style-type: none"> • Duration: 48-72 hrs to 2-3 weeks • Excrete urine • \wedge UO \rightarrow 4-5 L/day (dilute) • <u>Deficient fluid volume</u> • <u>Electrolyte imbalances</u>: <ul style="list-style-type: none"> o Hypokalemia o Hyponatremia • BUN/Cr high then stabilize at end of phase • Excrete waste products • Increase fluids | <p style="text-align: center;"><u>Recovery (4)</u></p> <ul style="list-style-type: none"> • GFR – sustain life (concentrate & dilute urine, maintain lytes) • May take 3-12 months • Some left with permanent damage to GFR (ESKD) |

AKI:

CKD:

-progressive, irreversible loss of kidney function; defined as: 1. Kidney damage or 2. Low GFR $< 60\text{mL}/\text{min} \times 3$ months or longer

-see RIFLE above

-CKD not recognized until LATE!

-End result = every body system; prognosis variable

-Leading causes: DM & HTN

-S/Sx relate to retain substances!!

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|----------------------------------|--|
| CKD Body System: | Manifestations: |
| Urinary | <p>Polyuria- most noticeable symptom; inability of kidneys to concentrate urine; Occurs most often at night; Specific gravity fixed around 1.010 (WNL)</p> <p>Oliguria – Occurs as CKD worsens</p> <p>Anuria – Urine output lower than 40 mL per 24 hours</p> <p>As CKD progresses → increasing difficulty with fluid retention and require diuretic therapy</p> |
| Metabolic | <p>Waste product accumulation:</p> <ul style="list-style-type: none"> -As GFR ↓, BUN and serum creatinine levels ↑ -BUN level ↑: kidney failure, protein intake, fever, corticosteroids, and catabolism <p>s/sx: N/V, lethargy, fatigue, impaired thought processes, and HA's as bun ↑</p> <p>GFR * more accurate than BUN/Cr</p> <p>Altered carbohydrate metabolism:</p> <ul style="list-style-type: none"> -Caused by impaired glucose metabolism → cellular insensitivity to the normal action of insulin; cells less sensitive to insulin- insulin dosages in DM I need to be individualized and monitored -Mild to moderate hyperglycemia and hyperinsulinemia <p>Insulin and glucose metabolism may improve (but not to normal values) after the initiation of dialysis = less insulin after dialysis initiated; Insulin is excreted by kidneys- in circulation longer:: change dose for diabetics</p> <p>↑ Triglycerides:</p> <ul style="list-style-type: none"> -↑ glucose levels → increased insulin levels, and insulin stimulates hepatic production of triglycerides → atherosclerosis -Almost all develop dyslipidemia, with ↑ (VLDLs), ↑ (LDLs), and ↓ (HDLs) <p>-Most with CKD die from CVD</p> |
| Electrolyte/Acid-Base Imbalances | <p>Hyperkalemia:</p> <p>Most serious electrolyte disorder; Causes Fatal dysrhythmias (7-8 mEq/L); causes: ↓ excretion, cellular protein breakdown, bleeding, from food, supplements, drugs, IVF</p> <p>Sodium:</p> <ul style="list-style-type: none"> -elevated, normal, or low; impaired excretion = water retained; can cause s/sx: Edema, Hypertension, HF -dilutional hyponatremia with ↑ water retention -intake must be individually determined → restricted to 2 g/day <p>Calcium and phosphate:</p> <ul style="list-style-type: none"> -hypocalcemia due to low vit d → reduce ca absorption; increased phosphates due to low excretion & released from bone demineralization <p>Hypermagnesemia:</p> <p>not a problem unless the patient is ingesting more magnesium</p> <p>s/sx: absence of reflexes, decreased mental status, cardiac dysrhythmias, hypotension, and respiratory failure</p> <p>Metabolic acidosis:</p> <p>→ Inability to excrete excess acid; Defective reabsorption/regeneration of bicarbonate</p> <p>plasma bicarbonate level (indirect measure of acidosis)</p> |
| Hematologic | <p>Anemia:</p> <p>Due to ↓ production of erythropoietin; in turn, from ↓ of functioning renal tubular cells</p> <p>Other factors → nutritional deficiencies, decreased RBC life span, increased hemolysis of RBCs, frequent blood samplings, and bleeding from the GI tract.</p> <p>s/sx: weakness, fatigue, HA, dizziness, paleness, SOB, chest pain</p> <p>Bleeding tendencies:</p> <p>Defect in platelet function; Defect in platelet function is caused by impaired platelet aggregation and impaired release of platelet factor III.</p> <p>Infection:</p> <p>Changes in WBC function; Altered immune response and function; all causes a Diminished inflammatory response = risk for infection</p> <p>Other factors → hyperglycemia and external trauma</p> |
| Cardiovascular | Most common cause of death in CKD patients* |

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|-----------------|---|
| | <p>Hypertension- most common cv problem due to hypervolemia and stimulation of RAAS system</p> <p>Heart failure- due to htn and fluid overload</p> <p>Left ventricular hypertrophy</p> <p>Peripheral edema</p> <p>Dysrhythmias- due to high k high mag low ca, acidosis and ↓ coronary perfusion</p> <p>Uremic pericarditis (can progress to pericardial effusion and cardiac tamponade) s/sx friction rub, chest pain, low grade fever</p> |
| Respiratory | <p>Kussmaul Respirations: severe acidosis</p> <p>Dyspnea: fluid overload, pulmonary edema, uremic pleuritis, effusions, infections (PNA)</p> <p>Uremic pleuritis = r/f infections (PNA)</p> |
| GI | <p>Cause: excessive urea</p> <ul style="list-style-type: none"> -Mucosal ulcerations -Stomatitis- with exudates and ulcerations, a metallic taste in the mouth (Dysgeusia) -Uremic fetor -GI bleeding- risk because of mucosal irritation and the platelet defect -Anorexia, nausea, vomiting- if CKD progresses to ESKD and is not treated with dialysis -Constipation- due to the ingestion of iron salts and/or calcium-containing phosphate binders, limited activity and fluid restrictions |
| Neurologic | <p>All related to: ↑ nitrogenous waste products, electrolyte imbalances, met. acidosis, atrophy, demyelination of fibers</p> <ul style="list-style-type: none"> -Lethargy apathy fatigue- general cns depression -Restless legs syndrome -Muscle twitching -Irritability -Decreased ability to concentrate -Peripheral neuropathy -Altered mental ability -Seizures & Coma: ↑ BUN & hypertensive encephalopathy (sudden - HA, vomiting, balance issues, confusion) -Dialysis encephalopathy |
| Musculoskeletal | <p>CKD-MBD</p> <p>Kidney function ↓ = ↓ vit D = ↓ ca absorption = PTH demineralizes bone to ↑ ca levels = release of phosphates (hyperphosphatemia) which results in FURTHER ↓ Ca & Vit D activation</p> <p>-osteomalacia, osteitis fibrosa, vascular calcifications</p> |
| Integumentary | <ul style="list-style-type: none"> -yellow-gray discoloration of skin- due to absorption and retention of urinary chromagens -pruritus = multifactoral: dry skin, calcium-phosphate deposition in the skin, and sensory neuropathy → bleeding or infection secondary to scratching -Uremic frost = rare, urea crystallizes on the skin and is usually seen only when BUN levels are extremely elevated (over 200) -Dry brittle hair- tends to fall out; thin nails -petechiae and ecchymosis- due to clotting abnormalities |
| Reproductive | <ul style="list-style-type: none"> -Infertility -Decreased libido -Low sperm counts -Sexual dysfunction→ anemia? Or decrease hormones |
| Psychological | <ul style="list-style-type: none"> -Personality and behavioral changes- can be dramatic depending on underlying personality -Emotional lability -Withdrawal -Depression |

CKD Drug Therapy:

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| Hyperkalemia | <ul style="list-style-type: none"> • IV insulin & IV glucose: pushes K+ back into cell and prevents hypoglycemia • IV 10% calcium gluconate: helps prevent dysrhythmia's • Sodium bicarbonate: corrects acidosis • Sodium polystyrene sulfonate (Kayexalate): excrete <ul style="list-style-type: none"> o Cation-exchange resin (diarrhea!) |
| HTN | <ul style="list-style-type: none"> • The ACE inhibitors and ARBs are given to diabetic patients and those with non-diabetic proteinuria because <u>they decrease proteinuria</u> and possibly delay the progression of CKD • Digoxin – promotes cardiac output • Diuretics- Lasix/furosemide • CCB- Nifedipine-Procardia; amlodipine- Norvasc; diltiazem-Cardizem • ACE- captopril-lapoten; Lisinopril • ARB- irbesartan- avapro, losartan-cozaar , valsartan-diovan • **** ace and arb's decrease GFR and ↑ serum K+: use with caution! |
| CKD-MBD | <ul style="list-style-type: none"> • Phosphate binders: admin with meals due to phosphate absorbs within 1 hr of eating; s/fx constipation; never give mag antacids!!!! <ul style="list-style-type: none"> o Calcium acetate(PhosLo), calcium carbonate (Caltrate/Tums), sevelamer HCl (Renagel) • Vitamin D: oral or IV; phosphate must be lowered first! <ul style="list-style-type: none"> o Calcitriol, zemplar, doxercalciferol • Control hyperparathyroidism <ul style="list-style-type: none"> o Calcimimetic agents (cinacalcet/sensipar) increases sensitivity of calcium receptors in PT glands |
| Anemia | <ul style="list-style-type: none"> • Erythropoietin (Epogen, Procrit...) IV or subq; use lowest dose first to prevent cardiac events; s/fx = HTN, iron def. • Iron supplements: s/fx dark stool, constipation <ul style="list-style-type: none"> o Do not give oral at the same time as phosphate binders-prevents absorption o Give with OJ (vitamin C) • Folic Acid |
| Dyslipidemia | <ul style="list-style-type: none"> • Statins (most effective to lower LDL) • Fibrates (↓ triglycerides and ↑ HDL) |

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| <p>C – comfort Comfort measures for terminally ill Open sacral or perineal wounds in an incontinent patient</p> <p>H – hemodynamic monitoring Close monitoring of urinary output- diuretics critically ill and postop with strict I&O</p> <p>O – obstruction</p> | <p>Types of catheters General info: -Vary in construction materials- silicone latex etc, tip shape, and lumen size -Size used varies with the size of the individual -Lower #- smaller size, larger #- larger size -4 cath routes: -Urethral- in urethra -Ureteral- in ureters -Suprapubic- in bladder -Nephrostomy tube- in renal pelvis</p> | <p>Non-retentive cath- (straight cath) a. Robinson or simple a. Straight catheter with 1 or more side openings b. Uses: analysis with or without culture; residual urine; Relieving retention b. Whistle tip a. oblique open end b. primarily when hematuria +/- or +blood clots</p> | <p>Self-retaining catheters a. foley- most used catheter b. Double lumen- 1 lumen for continuous drainage and 1 lumen leads to an inflatable balloon near its tip c. Tips may be straight, coude, short, or long d. Most common balloon sizes- 5ml to 30ml – some urological procedures require a larger balloon e. 75-100 ml balloons available Council a. Modification of a foley with an opening in its tip-</p> |
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| <p>Outlet obstruction (i.e. – BPH, blood clots) can be (anatomical or physiological)</p> <p>R – retention Urinary retention- intermittent catheterizations</p> <p>U – urologic Urologist placed catheter-urological studies neurogenic bladder dysfunction</p> <p>S – surgery Urologic, GYN, or perineal surgeries Epidural catheter Orthopedic fracture before OR</p> | <p>-Risks Associated with Urinary Drainage: UTI & Tissue Trauma!</p> <p>NI's:</p> <ul style="list-style-type: none"> • Prevent complications • Maintain patency • Maintain closed system / aseptic technique • Avoid backflow • Perineal care • Secure with leg strap • Assure proper operation of drainage system • Select proper size catheter • Empty drainage bag q 8 hours & prn • Provide adequate fluid intake • Acidify the urine (cranberry juice, vitamin C) • Record time & amount of 1st void | <p>c. Hollow-tipped or multi-eyed</p> <ol style="list-style-type: none"> many openings lavage the bladder, +blood clots <p>d. Coude tipped</p> <ol style="list-style-type: none"> Straight catheter with a semi-rigid curve- olive shaped tip and a ridge around the opposite end negotiate a tortuous urethra, the posterior tip of the bladder neck, or part the middle lobe of the enlarged prostate | <p>this allows a special catheter guide stylet with a male screw tip to protrude the opening for attachment to a threaded filiform</p> <ol style="list-style-type: none"> Stricture present: requiring passage of a filiform to lead the catheter also for when the catheter is to be left indwelling After the balloon has been inflated, the guide and attached filiform can be removed <p>3 way catheter- 3 lumens</p> <ol style="list-style-type: none"> 1 lumen= to inflate the balloon 1 lumen= to instill solution 1 lumen= to drain the bladder |
| <p>Retention:</p> <ul style="list-style-type: none"> - Mechanical (stricture, calculi, inflammation...) vs. Functional (muscle atrophy, anxiety, medications...) - s/sx: - absence of voided urine: <ul style="list-style-type: none"> o distinguish between <i>Oliguria</i> and <i>Retention</i> - distended bladder - frequent voiding (25-80 ml at a time more than 1x hr) - Treatment: catheterizations, urethral dilation, surgery (remove tumor or calculi...), other NI's: - Palpate the bladder frequently to check for distention - Provide privacy - Warm the bedpan- helps relax sphincter muscles - Place in the correct voiding position - Pour warm water over the perineum - Place hands in warm water - Run water - Encourage use of the BR when possible | <p>Incontinence:</p> <ul style="list-style-type: none"> - Bladder capacity: 200-250 ml when urge to void - Incidence increases with age - Causes: <ul style="list-style-type: none"> o Cerebral clouding; Disturbances in CNS pathways; Spinal cord lesions; Damage to peripheral nerves of the bladder; Sphincter damage; Relaxed pelvic musculature o D – delirium, dehydration, depression o R – restricted mobility, rectal impaction o I – infection, inflammation, impaction o P – polyuria, polypharmacy - Stress incontinence - Causes: conditions that weaken the tone of the pelvic floor muscles- multiple pregnancies, obesity, menopause - Treatment: Kegel exercises; Medications to ↑ closure pressure- antidepressants, estrogen, anticholinergics/antispasmodics; Bladder suspension surgery; Vaginal cone therapy - Urge incontinence - Causes: neurological, UTI, meds - Treatment: retraining programs and drainage devices, medications (tricyclic antidepressants, antispasmodics) - Reflex / Overflow incontinence - Causes: outlet obstruction, spinal cord degeneration, lesions - Treatment: frequent toileting, self-cath, schedule intake, surgery, meds: Urecholine, CredÉ method - Total incontinence - Causes: anomalies, trauma, radiation - Treatment: implants, external collectors, artificial sphincters - Functional incontinence - Causes: cognitive impairment, dementia, mentally handicapped - Treatment: basic care and comfort, toileting, meticulous skin care | | |

| Vascular Disorders | Patho | S/Sx | Dx | Tx |
|-----------------------|--|---|--|--|
| Renal Artery Stenosis | <ul style="list-style-type: none"> Narrowing of the lumen of the renal artery usually due to atherosclerosis. Results in ↓ blood flow to the kidneys Change in renal perfusion causing an increased secretion of renin and activation of the RAAS High bp if not tx and leads to further pathologic changes in the kidneys Severe stenosis leads to ischemic atrophy and fibrosis | <ul style="list-style-type: none"> Htn- usually abrupt Renal bruit Disparity in the size of the kidneys | <ul style="list-style-type: none"> renal arteriogram- best dx tool Delayed appearance of contrast medium in renal arteriogram; lesion evidence on renal arteriogram Hyper-concentration of contrast medium in the kidney's calyceal system on IVP | <ul style="list-style-type: none"> Antihypertensives, anticoagulants, analgesics surgery in severe cases <ul style="list-style-type: none"> percutaneous transluminal renal angioplasty nephrectomy embolectomy balloon angioplasty w/ or w/o stent renal artery bypass |
| Nephrosclerosis | <ul style="list-style-type: none"> Severe htn can cause renal function to deteriorate; can be benign or malignant Damage to the renal arteries, arterioles and glomeruli caused by prolonged elevated bp Slow progression of vascular changes occurs over the years -- spasm, thickening, hypertrophy, and hyaline degeneration of the renal arterial system Changes lead to renal failure - due to dec filtration Benign=adults 30-50; vascular changes- early stages with normal renal function; malignant -associated with malignant htn- sharp inc in bp with dbp>130 | <ul style="list-style-type: none"> Same as for renal failure High bp Tachycardia Ha Dizziness Fatigue Palpitations Dec uo Blurred vision | <ul style="list-style-type: none"> htn Ua - proteinuria and hematuria serum- high bun and cr High serum k Low serum ca Ivp and kub- small kidneys bilaterally | <ul style="list-style-type: none"> Best management is prevention through adequate control of htn Control htn- antihypertensives- diuretics, adrenergic blockers, vasodilators, ccb, ace inhibitors Diet: restrict na; smoking restriction, etoh restriction relaxation/stress reduc Goal- maintain the remaining renal function Interventions for chronic renal failure (diet and fluid restrictions; glycemic control- dm; smoking cess; s/s of electrolyte imbalances) |
| Diabetic Nephropathy | <ul style="list-style-type: none"> Associated with Type I DM and related to duration of diabetic state Glomeruli affected by diffuse sclerosis and thickening of the basement membrane Afferent (bring blood to glomerulus) and efferent (takes blood away from glomerulus) arterioles are affected by thickened walls and hyaline deposits Glomerular filtration rate decreases and azotemia occurs (high bun/cr) | <ul style="list-style-type: none"> Same as for chronic renal failure Htn, inc BS Edema Nausea Oliguria - low Dizziness Ha Weakness | <ul style="list-style-type: none"> Blood chemistries- inc bun/cr; dec albumin; Ua- proteinuria and lowered cr clearance Renal bx- diffuse or nodular thickening of the glomerular basement membrane | <ul style="list-style-type: none"> Same as for nephrosclerosis Adequate control of diabetes is essential |

| Cancer of the Bladder | Cancer of the Kidney |
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| <ul style="list-style-type: none"> • More in males; white males > black or Hispanic males • Most common site of CA in urinary tract • Cigarette smoking*** | <ul style="list-style-type: none"> • More in males, ave age 64 • Smoking, obesity, HTN, chemical exposure • Can arise anywhere in kidney • Usually unilateral and slow growing • Mets at any stage - lungs lymph liver bone |
| <p>Dx</p> <ul style="list-style-type: none"> • cystoscopy and biopsy - confirmation • urine cytology • IVP • Need to determine invasiveness to determine effective tx | <p>Dx</p> <p>CT scan, ultrasound, angiography, biopsy, MRI; radionuclide isotope scan</p> |
| <p>S/Sx</p> <ul style="list-style-type: none"> • PAINLESS HEMATURIA - most common warning sign, intermittent (delay medical care) • Dysuria, frequency, urgency • Possible cystitis | <p>S/Sx</p> <p>Classic triad of symptoms- occur late in the disease</p> <ul style="list-style-type: none"> • Intermittent gross hematuria (delay medical care since intermittent) • Pain- flank • Palpable mass in flank <p>Other s/s- Unexplained wt loss, weakness, anemia, htn-activation of the renin-angiotensin system</p> |
| <p>Tx</p> <ul style="list-style-type: none"> • Depends on how quickly it's growing, #, size, and location of tumor(s), mets, age/general health • Surgery <ul style="list-style-type: none"> o TURB (transurethral resection of bladder) - early superficial bladder ca o Partial Cystectomy o Radical Cystectomy: Men—bladder, prostate, and seminal vesicles (causes impotence); Women—bladder, uterus, cervix, urethra, anterior vagina, and ovaries o Urinary diversion • Radiation: primary tx or in combo with cystectomy • Chemotherapy • Immunotherapy • Intravesical therapy <ul style="list-style-type: none"> o Local instillation of immuno or chemo, retained x2 hrs, position changes q15 minutes, weekly intervals x6-12 weeks | <p>Tx</p> <ul style="list-style-type: none"> • Surgeries— *Nephrectomy: partial, simple total, or radical; open or laparoscopic *tx of choice • Ablation • Radiation - palliative • Chemo - mets • Immunotherapy—α-interferon and interleukin-2 (IL-2); nivolumab • Targeted therapy |