Alterations in Renal and Urological system
Advanced pathophysiology Nurs 511

Congenital >> Developmental abnormalities

Horseshoe kidney

- Conjoined kidneys usually connected at the lower lobe
- Abnormally located in lower abdomen, gets caught on the lower mesenteric artery during descent from pelvis to abdomen
- 2x more common in males
- Common malformation 1/400 births
- Associated with Turner syndrome and Trisomy 18 (Edwards syndrome)

- Clinical presentation
  - Asymptomatic (most common)
  - Increased rate of UTI
  - Hydronephrosis due to ureteropelvic junction obstruction
  - Renal stones
- On physical exam:
  - Abdominal fullness upon palpitation

Renal agenesis

- Absent kidney formation (uni or bi lateral)
- Failure of the ureteric buds to form
- Unilateral=Leads to hypertrophy of the existing kidney
  - Hyperfiltration increases risk of renal failure later in life
- Potter's syndrome (bilateral)
  - Bilateral agenesis leads to oligohydramnios w/ pulmonary hypoplasia, flat face, low set ears, developmental defects of extremities , incompatible w/ life

Dysplastic kidney

- Not inherited
- congenital malformation of renal parenchymal characterized by cysts and abnormal tissue
- unilateral most common
- If bilateral - must be distinguished from inherited polycystic dz

Polycystic kidney dz

- Most common Inherited defect leading to bilateral enlarged kidneys with cysts in the renal cortex and medulla=ultimately leads to ESRD
- Autosomal recessive form –juvenile presentation 1/20000 births
- presents in infants as worsening renal failure and HTN
- Hepatomegaly in infants
- newborns may present with Potter sequence
- Autosomal dominant form- presents in young adults
- HTN, hematuria and worsening renal failure

- Clinical presentation
- Adult
    - Abdominal or flank pain
    - Low back pain
    - Hematuria
    - UTI

- Juvenile
    - HTN
    - hepatomegaly
    - bilateral abd mass

Medullary cystic kidney dz

- Inherited (autosomal dominant) defect leading to cysts in the medullary collecting ducts
- Parenchymal fibrosis results in shrunken kidney and worsening renal failure
- Progressive and slow impairment =ESRD
- No or minimal proteinuria

Upper urinary tract

- Stricture or congenital compression
- Calculi
- Malignancy
- Causes dilation of the upper tract proximal to blockage and urine accumulates = hydroureter
- Causes dilation of the renal pelvis and calyces proximal to blockage = hydronephrosis

Renal Calculi (Nephrolithiasis)

- presence of crystalline stones (calculi) within the urinary system (kidneys and ureter)
- usually in response to elevated levels of urinary solutes, such as calcium, uric acid, oxalate, and sodium
- Epidemiology: 12% men >7% women
- Low urinary volume and abnormally low or high urinary pH also contribute to this process

Clinical presentation

Colicky flank pain may radiate to groin/ lower abdomen dysuria Urgency /Frequency Physical exam: lower abdominal tenderness CVA tenderness costovertebral angle	groin pain/severe flank pain/testicular pain Tachycardia/hypotension Fever previous episodes of nephrolithiasis N/V urinary frequency/urgency/hematuria fever costovertebral angle and ipsilateral flank tenderness

- Diagnostics
  - urinalysis
  - CBC and differential
  - serum electrolytes, BUN, and creatinine
  - urine pregnancy test
  - Non-contrast helical CT scan
  - stone analysis

Lower urinary tract obstruction

- Primarily related to storage of urine in bladder or emptying of urine through the urinary outlet
- Neurogenic or anatomical
- Characterization of the type necessary to help to elucidate the underlying etiology and help to guide management
- Includes: neurogenic bladder, overactive bladder, prostate enlargement, urethral structure, pelvic organ prolapse, cancer
- Incontinence
- Involuntary, spontaneous urine loss

- occurs with strenuous activity and may be preceded by uncontrollable sense of urgency
- May be caused by alterations in anatomic support and/or neuromuscular function of the pelvic floor, or may be idiopathic
- Risk factors are multifactorial
- Increased prevalence in puerperal period and in older, white, or obese women

Incontinence

- Type of incontinence (stress, urge, mixed)
- rule out the presence of a complex or potentially life-threatening underlying condition (spinal cord compression or multiple sclerosis) that warrants specialist assessment and treatment

Pelvic Organ Prolapse

- POP describes:
- cystocele (bladder prolapse)
- rectocele (prolapse of rectum or large bowel)
- enterocele (prolapse of small bowel)
- *** all of these are often associated with prolapse of the uterus****

Renal Failure

- Pre-renal, intrarenal and postrenal
- Disease duration
    - Acute
        - Rise in serum creatinine or abnormal urinalysis that has developed within hours/days
        - Serum rise >/= 0.3 mg/dl relative to KNOWN baseline within 48 hours OR an increase of >1.5 times the baseline value within 7 days OR decrease in urine volume to <3 ml/kg over 6 hours
    - Chronic
        - Present if GFR <60 or evidence of kidney damage such as albuminuria or abnormal findings on renal U/S
    - Subacute
        - Encompasses any decrement in renal function in less than 3 months (48 hours to 3 months)
    - ESRD

Studies	Prerenal	Intrarenal	Postrenal	
Urine Osmol	>500	<350	<350	
FeNa+	<1%	>2%	<1% mild cases >2% in severe	
Urine NA+	<20	>40	>40	
Serum BUN/Creat ratio	>20:1	<15:1	Variable	

Acute Kidney Injury/ARF

- STARTING POINTS
  - Acute severe decline in renal function (develops within days)
  - Hallmark is azotemia (increased BUN/creatinine, often w/ oliguria)
  - Divided in prerenal/ post renal /intrarenal azotemia based on etiology

- Classification based on etiology
  - Prerenal: failure due to impaired renal perfusion (hypovolemia, burns etc)
  - Intrarenal: failure due to direct injury to renal parenchyma (ATN, nephrotoxic ATN, etc)
  - Post-renal: failure due to obstruction of urinary outflow (enlarged prostate, tumors)

- Clinical presentation
  - Symptoms
  - may be asymptomatic
  - Oliguria or anuria
  - polyuria
  - Confusion
  - Flank pain
  - PND (paroxysmal nocturnal dyspnea)
  - Hematuria

- Physical exam
    - Hypertension/hypotension
    - edema
    - decreased urine output
- Labs: increases serum creatinine, fluid overload, hyperphosphatemia, metabolic acidosis and elevated BUN
    - Labs of importance in AKI (red items are important)
    - increase in serum creatinine by ≥ 0.3 mg/dL within 48 hours
    - blood urea nitrogen (BUN):creatinine ratio
    - urinalysis
        - Dipstick is to assess for protein, glucose, leukocyte esterase, hemoglobin and myoglobin, and specific gravity
        - Microscopy
            - red dysmorphic cells suggest a glomerular etiology (glomerulonephritis)
            - muddy brown casts suggests tubular necrosis
            - white blood cell casts suggest pyelonephritis or acute interstitial nephritis
        - fractional excretion of Na+ (FeNa+)
        - if patient is on diuretics use FeUrea
        - urine osmolality and Na+

Pre-renal

- Decreased blood flow to kidneys results in decreased GFR, azotemia and oliguria
- renal response = lower perfusion pressure is to enhance NA+ and H20 reabsorption. Baroreceptors in the carotid artery and aortic arch respond to lower BP with sympathetic stimulation.
- Etiology: hypoperfusion, hemorrhage, CHF, diuretic use (overdiuresed)

Acute tubular necrosis

- Injury and necrosis of tubular epithelial cells
- Most common cause of intrarenal azotemia
- Necrotic cells plug tubules obstructions decrease GFR
- Dysfunctional tubular epithelium results in decreased reabsorption of BUN decreased reabsorption of NA+ and inability to concentrate urine
- Etiology can be ischemia or nephrotoxic

Acute interstitial nephritis

- Drug induced hypersensitivity (IV) involving the interstitium and tubules
- T-cell attack on tubular cells
- Eosinophils may be seen in urine
- Resolves when offending agent removed
- May progress to renal papillary necrosis

- Diagnostic criteria
    - elevated creatinine
    - urinalysis with white cell casts and eosinophiluria
- Etiology:
    - Typically develops between 1-9 weeks
    - 5P's
        - Pee(diuretics, sulfa)
        - Painfree (NSAIDS)
        - PCN and cephalosporins
        - PPI
        - rifamPin
    - Autoimmune-lupus
        - Sarcoidosis
- Clinical presentation
    - Oliguria
    - Fevers/chills
    - Hematuria
    - Arthralgias
    - Asymptomatic
    - Rash (maculopapular)
    - CVA tenderness

Post renal azotemia

- Due to obstruction of urinary tract
- Decreased outflow results in decreased GFR, azotemia and oliguria
- During early stages of obstruction, increased tubular pressure "forces" BUN into the blood serum BUN /creat ratio >15

- Ureteral obstruction may result from stones, transitional cell carcinoma, external compression (tumors, enlarged lymph nodes, retroperitoneal fibrosis), blood clots, and fungus balls. When obstruction has been relieved with a stent, obstruction of the stent can lead to recurrent hydronephrosis.

Chronic renal failure

- Proteinuria or hematuria, and/or a reduction in the <60 GFR for more than 3 months' duration
- most common causes= diabetes mellitus (DM) hypertension (HTN)
- often unrecognized until the most advanced stages
- 1:10 Americans has chronic kidney disease
- African American ,Hispanic people, and those with a family member who has a diagnosis of kidney disease have a higher prevalence than the general population

Nephrotic and Nephritic syndromes

- Nephrotic Syndromes Starting points
  - Glomerular disorders characterized by proteinuria (>3.5 grams/day)
  - resulting in:
    - Hypoalbuminemia (pitting edema)
    - Hypogammaglobinemia (increased risk of infections)
    - Hypercoagulable (due to loss of anti-thrombin III)
    - Hyperlipidemia and hypercholesterolemia (may result in fatty casts in urine)

- Etiology
  - Primary
    - Focal segmental
    - Membranous nephropathy
    - Minimal change dz
  - Secondary
    - Diabetic nephropathy
    - Lupus
    - Amyloidosis
- Proteinuria
  - 3 categories of proteinuria:
    - glomerular, tubular, and overflow
  - Glomerular proteinuria develops when the components of the filtration barrier are disrupted by disease
  - primary insult =high-grade glomerular proteinuria, heavier the protein loss the more likely the development of the full-blown syndrome and worsening of renal function
  - hypoalbuminemic due to the urinary loss of albumin
  - Clinical presentation
    - Edema
    - Periorbital/LE/genital
    - Frothy urine
    - Ascites
    - Weight gain
    - Fatigue
    - SOB

- Physical exam
  - Hypertension
  - Edema
  - Leukonychia
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Minimal change disease

- ?immune related mechanism
- Most common cause of nephrotic syndrome in children
- Peripheral edema associated with heavy proteinuria (>50 mg/kg/day or >40 mg/square meter of body surface area/hour)
- hypoalbuminemia (serum albumin <2.5 g/dL)
- hyperlipidemia
- Usually idiopathic, may be associated w/ Hodgkin lymphoma, leukemia, and hepatitis B /C infection (rare)

Focal segmental glomerulosclerosis

- Most common cause of nephrotic syndrome in adults
- chronic pathologic process caused by injury to podocytes in the renal glomeruli or decreased filtration barrier

- manifests initially with proteinuria, which progresses to nephrotic syndrome and ultimately to end-stage renal failure

Membranous nephropathy

- most common cause of nephrotic syndrome in Caucasian adults
- usually idiopathic (associated with autoantibodies, especially to phospholipase A2 receptor present on podocytes)
- Can be 2/2 hepatitis B, autoimmune disease, malignancy, and adverse drug reactions (including gold, penicillamine, and NSAIDs)
- New basement membrane growth between subepithelial immune deposits leads to the classic "spike and dome" appearance

Diabetic glomerular nephropathy

- ***microalbuminuria, then a progressive fall in GFR
- pathogenic processes occurs including glomerular hyperfiltration (albumin leak), basement membrane thickening, hypertrophy, sclerosing, podocyte injury
- Response to the hyperglycemia and glycation of matrix proteins

Systemic amyloidosis

- Derived from immunoglobulin light chains (primary systemic amyloidosis or AL)
- associated with clonal plasma cell dyscrasia
- kidney is the primary target organ in AL
- monoclonal light chain assembles and deposits extracellularly, resulting in disruption of the glomerular basement membrane. The light chains interact with mesangial cells, which catabolize them into fragments that form amyloid fibrils

Nephritic Disease Starting points

- Renal disease characterized by Glomerular inflammation and bleeding
- Limited proteinuria (<3.5 grams/day)
- Oliguria and azotemia
- Salt retention w/ periorbital edema and HTN
- RBCs casts and dysmorphic RBCs in urine

- INCLUDES:
- IgA nephropathy, Post-infectious GN, Rapidly progressive GN (vasculitis and Anti-GBM GN)

Post streptococcal glomerulonephritis

- pathologic glomerular injury is limited to the kidney and not part of a systemic disease manifestation
- extrinsic antigens that have been trapped within the glomerulus
- Nephritic syndrome that arises AFTER group AB hemolytic strep infection or the skin or pharynx
- Type III hypersensitivity
- Dec C3 levels
- Self-resolving

Rapidly progressing glomerulonephritis

- GoodPasture Syndrome –type II hypersensitivity
- antibodies to the alveolar basement membrane result in hemoptysis and lung disease

Alport Syndrome

- Collagen type IV mutation that results in an abnormal basement membrane
- X-linked dominant disorder
- Key characteristics:
    - Ocular involvement
    - Renal involvement
    - Sensorineural hearing loss

IgA nephropathy (Berger Dz)

- IgA immune complex deposition in glomerular mesangial cells
- patients present with hematuria and upper respiratory tract or gastrointestinal infection

Membranoproliferative glomerulonephritis

- Immune-complex and/or complement protein deposition in the mesangium and sub endothelium of capillaries
- Results in remodeling of the capillary wall
- May be 2/2 Hep B/C – C3 nephritic

Urinary Tract Infection Starting points

- Infection of urethra, bladder, or kidney
- Classified as uncomplicated/complicated & acute/recurrent
- Most commonly from ascending infection
- increased incidence in females, elderly, and infants
- Risk factors include:
  - Female
  - Sexual intercourse, urinary stasis/incontinence, DM, BPH, and catheters

Urinary tract infection

- In females >> via an ascending pathway
- Colonization of the vagina may occur first, then ascends into the urinary tract. Ascending UTI is amplified by factors that promote the introduction of bacteria at the urethral meatus and by iatrogenic means

- Uncomplicated cases can be diagnosed and treated on the basis of the history alone
  - ASB (asymptomatic bacturia) typically no treatment
  - Uncomplicated
    - Non pregnant
    - No anatomic abnormalities or instrumentation

- Complicated
  - Pregnant women
  - Preterm deliver
  - Perinatal death
  - Pyelo in mom
  - anatomic abnormalities
  - pyelonephritis

Interstitial cystitis

- Chronic, often debilitating clinical syndrome
- Symptoms vary with bladder filling
- common age range =20 to 60 years
- Common presentation: dysuria, frequency, urgency, nocturia, suprapubic discomfort, gross hematuria
- etiology unknown
- Multifactorial ??
- Patho: poorly understood
- Theories include upregulation of nerve growth factors leading to chronic stimulation of afferent pain
- Leads to pelvic floor dsfxn, myofascial trigger points and pain

Prostatitis

- Inflammation of the prostate
- Age differential
- <35 c.trachomatis or N.gonorrhea
- >35 e.coli , P aeruginosa or K.pneumoniae
- Infectious or non-infectious
- acute or chronic
- Risk factors: catheter and BPH
- Patho:

- Common presentation: dysuria, frequency, pain in prostatic pelvic or perineal region, Bladder outlet obstruction, Fever/chills
- DRE= enlarged prostate
- tender with acute
- less tender with chronic

Acute Pyelonephritis

- Greek "pyelo" (pelvis), "nephros" (kidney), and "-itis" (inflammation)
- describes a severe infectious inflammatory disease of the renal parenchyma, calices, and pelvis
- acute, recurrent, or chronic
- enteric bacteria (Escherichia coli) that ascend from the lower urinary tract or that spread hematogenous to the kidney

- Clinical Presentation
    - Fever** main determinant between cystitis vs pyelo
    - CVA tenderness
    - Obstructive uropathy in DM
    - Emphysematous pyleo in DM

HUS (Hemolytic Uremic syndrome)

- Characterized by microangiopathic hemolytic anemia, thrombocytopenia, and nephropathy
- cases are in children and are related to epidemic gastroenteritis caused by verotoxin-producing Escherichia coli
- Etiology:
  - Infection
  - Drugs
  - bone marrow tnsplt
- Clinical presentation
  - Child <5
  - Bloody diarrhea

Wilms tumor

- Genetic, 2 hit hypothesis with tumor suppressor genes and chromosomal inactivation
- Most common renal malignancy in children
- SX: unilateral, painless, abdominal/flank mass; rarely presents bilaterally
- first 2 to 5 years of life
- risk for developing Wilms tumor is increased in certain congenital overgrowth syndromes, congenital nonovergrowth syndromes, and children with congenital urogenital anomalies
- Patho:

Renal cell carcinoma

- malignancy arising from the renal parenchyma/cortex
- Accounts for 80-90% of kidney cancers
- Sporadic or 4 hereditary synd. Identified
- Median age 64
- Risk factors: smoking, obesity, HTN
- Surgery curative 90%; Mets at diag. poor survival but improving w/ targets therapies
- Clinical presentation
  - Asymptomatic
  - Hematuria
  - Flank pain
  - Palp abd mass
- Diagnostics
    - CBC
    - LDH

- CMP
- CT abd/pelvis

Bladder cancer

- 10th most common cancer
- More than 90% of new cases occur in people ≥55 years of age.
- Gross or microscopic hematuria is the primary symptom of bladder cancer.
- Screening for hematuria appears to markedly improve the prognosis of bladder cancer.
- Risk factors: smoking, chemical carcinogens, pelvic irradiation, systemic chemo, male, chronic bladder infections

- Epidemiology:
- Egypt, Western Europe, and North America have the highest incidence
- Asian countries the lowest rates.
- Etiology:
    - Smoking, occupation exposure
    - T2DM
    - Carcinogens –nitrosamines
- Patho:
    - Malignant transformation from carcinogens concentrated and excreted in the urine

References
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