DISORDERS OF RENAL FUNCTION

CHAPTER 35
URINARY TRACT INFECTIONS

- Text doesn’t differentiate into lower tract infection vs. upper tract infections.
- Lower tract infections = cystitis = UTI.
- Upper tract infections = pyelonephritis.
- Generally, when we say UTI we mean cystitis.
URINARY TRACT INFECTIONS

- Most UTI’s are in females- more later.
- When a UTI is Dx’d in a male, need to think about underlying genitourinary pathology- malformations of the urinary tract, obstruction, retention, STD, immunocompromised state, diabetes, etc.
URINARY TRACT INFECTIONS

“UTI’s”

MOST COMMON ORGANISMS IN UTI:

- E coli- by far the most common bug.
- Others:
  - Gram –negative rods- Staph. saprophyticus, Klebsiella, Proteus, Enterobacter, Pseudomonas, Serratia.
  - Gram positive cocci- Staph. aureus, Group B Strep.
URINARY TRACT INFECTIONS

- Most UTI’s are ascending infections, ie via the urethra. The shorter female urethra predisposes the female to UTI’s as compared to the male.
- UTI’s in the female are from bacteria that colonize the urethra, vagina, and perinuem.
- The urethra is normally colonized by bacteria.
URINARY TRACT INFECTIONS

MECHANISMS THAT PROTECT AGAINST UTI

1) The “wash out” phenomenon.
2) Protective layer of mucin in the bladder, protective barrier, prevents attachment of bacteria, colonization of the bladder mucosa.
3) Host immune response- secretory IgA, phagocytes.
4) Normal periurethral and vaginal flora- lactobacillus- fend off urinary pathogens.
URINARY TRACT INFECTIONS

FACTORS THAT PREDISPOSE TO UTI

1) Obstruction- urinary stasis.
2) Reflux- more later.
3) Loss of normal flora- estrogen deficiency states.
4) Immunocompromised states- the elderly, diabetics, HIV, etc.
5) Instrumentation, catheterization.
OBSTRUCTION

- Static urine become infected.
- Once the bladder is infected, can ascend to the kidney → pyelonephritis.
- An obstructed bladder is distended → increased intravesicular pressure → decreased perfusion → decreased immune response.
- Obstruction can be anatomic or functional
REFLUX

- **2 TYPES:**
  - **1) Urethrovesical** - from the urethra to the bladder. From increased intra-abdominal pressure, coughing, lifting, etc., urine flows slightly into the urethra and then back into the bladder carrying bacteria with it.
  - **2) Vesicoureteral** - less common, more pathologic. See text. From the bladder into the ureter. Often due to congenital defects.
UTI’s IN WOMEN

PREDISPOSING FACTORS

- Short(er) urethra.
- Intercourse- bacteria forced into the bladder.
- Diaphragm use. Voiding after sex.
- Pregnancy- dilatation of the renal calyces, pelves, and ureters, ↓ ureteral peristalsis due to progesterone. Change in anatomic relationship between the bladder and ureters, more reflux.
UTI's IN CHILDREN

CAUSES

- Vesicoureteral reflux.
- Urinary tract anomalies.
- Immunologic disease.
- Uncircumcised males.
UTI’s IN CHILDREN

CAUSES

- Often involve the upper tract, can result in permanent kidney damage.
- Because of the high association w/ reflux and anomalies, and the potential for damage, a work-up is in order after the 1\textsuperscript{st} documented UTI.
- Often present w/ atypical features: sepsis, fever, diarrhea, vomiting, lethargy.
- Lower tract infections can have typical UTI Sx’s.
UTI’s IN THE ELDERLY

- 2nd most common infection after respiratory.

**CAUSES**

- 1) Incomplete emptying- prostatic enlargement, immobility.
- 2) Stones.
- 3) Estrogen deficiency.
- 4) Instrumentation, catheterizations.

Especially prevalent in nursing homes.
UTI’s IN THE ELDERLY

- Sx’s- range from asymptomatic, to typical lower tract Sx’s, to vague Sx’s commonly seen in the elderly (frequency, urgency, incontinence), to sepsis.
- Often, initial signs of pyelo such as fever, chills, flank pain, may be absent until the infection is advanced. **Sepsis can be the 1st evidence of a UTI in the elderly.**
MANIFESTATIONS

CYSTITIS (LOWER TRACT)

- Frequency, dysuria.
- Abdominal or back pain.
- Fever usually absent in adults.
- Urine may be cloudy.
- In my experience, odor is unreliable as a discriminating factor.
- Sx’s similar to urethritis, can be confused w/ vaginitis.
MANIFESTATIONS

PYELONEPHRITIS (UPPER TRACT)

- Fever, chills, flank pain. N/V. Looks ill.
- Lower tract Sx’s may be present or absent.

2 EXCITING FLAVORS

1) ACUTE PYELO.

2) CHRONIC PYELO- refers to recurring episodes of pyelo, or a continuous infection; can be asymptomatic, and result in scarring and loss of kidney function. Often found only during work-up for hypertension.
**DRUG-RELATED NEPHROPATHIES**

- They happen. See text.
- Note the association between NSAID’s and renal damage.
- NSAID’s work by inhibiting the production of prostaglandins, which contribute to the regulation of renal blood flow.

- Instead, let’s talk about glomerulonephritis
GLOMERULONEPHRITIS

- The leading cause of chronic renal failure.

**THE TAKE HOME LESSON**

- Results from diseases that provoke a proliferative inflammatory response of the endothelial, mesangial, or epithelial cells of the glomeruli. Inflammation damages the capillary wall.

- The result is diminished glomerular filtration (GFR), proteinuria, hematuria, oliguria, and hypertension.
GLOMERULONEPHRITIS

- Can be primary or secondary to another disease such as lupus, diabetes.
- Most have an immunologic basis:
  1) Antibodies directly attacking antigens on the cells of the glomerulus.
  2) Circulating immune complexes that deposit (become “trapped”) in the glomerulus.
- EXCEPTION- Hypertension- causes sclerotic changes from vascular thickening and diminished perfusion.
GLOMERULONEPHRITIS

- 2 GENERAL TYPES: ACUTE AND CHRONIC.
- Also categorized by type of cellular changes affecting the glomerulus: acute proliferative, rapidly progressive, membranous, focal, etc.
ADULT KIDNEY CANCER

- 85% are renal cell carcinomas, the rest are transitional cell and squamous cell.
- Symptoms not typically present until disease is advanced. 1/3rd have mets at time of Dx.
- Hematuria, flank pain, fever, polycythemia.
- Chemo of limited success.
- Risk factors: smoking, obesity exposure to asbestos, petroleum products, heavy meals.
RENAL FAILURE

- Rapid decline in renal function; acute form is potentially reversible.
- Results in:
  1) Decrease in glomerular filtration rate (GFR).
  2) Azotemia- nitrogenous wastes.
  3) Impaired fluid and electrolyte balance.

most common cause for kidney failure: diabetes.
ACUTE RENAL FAILURE

3 FLAVORS:

1) PRERENAL.  before kidney - blood supply lost for some reason.

2) POSTRENAL.  blockage like enlg prostate or stones in kid, can't excrete.

3) INTRINSIC.  like glomeruloneph.
ACUTE RENAL FAILURE

PRERENAL FAILURE

- Most common form of acute renal failure.
- Due to decrease in renal blood flow.
- Chart 36-1:
  - HYPOVOLEMIA- hemorrhage w/ shock, dehydration
  - DECREASED VASCULAR FILLING: septic shock, anaphylactic shock,
  - Cardiogenic shock, CHF, drugs.
POSTRENNAL FAILURE

- Results from urinary obstruction.
- Ureteral- stones, strictures.
- Bladder- tumors, neruogenic bladder.
- Urethra- prostatic enlargement.
- Reversible if obstruction is reversed before damage to the nephrons occurs.
INTRINSIC RENAL FAILURE

- Results from damage to:
  - 1) Glomeruli.
  - 2) Tubules.
  - 3) Interstitial tissue.

- Caused by: ischemia from prerenal failure, toxic insult to the tubules, intratubular obstruction, acute glomerulonephritis, acute pyelonephritis.

- Acute tubular necrosis from ischemia or toxins is most common.
INTRINSIC RENAL FAILURE

ACUTE TUBULAR NECROSIS

- “ATN”
- Destruction of tubular epithelial cells.
- From: ischemia, chemical toxins, tubular obstruction, toxins from infection.
INTRINSIC RENAL FAILURE

ATN FROM ISCHEMIA

- Surgery, severe hypovolemia.
- Trauma, sepsis, burns.
- If ischemia is prolonged and causes cortical necrosis → irreversible renal failure.

NEPHROTOXIC ATN

- Aminoglycosides, chemo, radiocontrast agents.
INTRINSIC RENAL FAILURE

ATN FROM TUBULAR OBSTRUCTION

- Obstruction from:
- Myoglobin- from muscle breakdown- trauma, seizures, sepsis, hyperthermia, and from rare side effect of statins → rhabdomyolysis.
- Hemoglobin- from hemolysis, transfusion reactions.
- Uric acid- release of urate from destruction of tumor cells.
- Multiple myeloma- Bence-Jones proteins
CHRONIC RENAL FAILURE

- Progressive, irreversible destruction of kidney structures, decrease in GFR.
- CAUSES:
  1) Hypertension.
  2) Diabetes- Pg. 826. #1 cause in the U.S.
  3) Glomerulonephritis.
  4) Polycystic kidneys. born with this.
- Loss of renal cells w/ deterioration in glomerular filtration, tubular reabsorption, and endocrine fxn
CHRONIC RENAL FAILURE

- 4 STAGES:
- 1) DIMINISHED RENAL RESERVE. 50% loss.
- 2) RENAL INSUFFICIENCY. 50-70% loss.
- 3) RENAL FAILURE. 80% loss of GFR.
- 4) END STAGE RENAL DISEASE. 95% loss.

Nephrons compensate by undergoing hypertrophy, signs and Sx’s develop only when disease is far advanced.
CHRONIC RENAL FAILURE

MANIFESTATIONS

1) Accumulation of nitrogenous wastes.
2) Altered water and electrolyte balance.
3) Altered acid-base balance.
4) Mineral and bone disorders.
5) Hypertension, cardiovascular function.
6) GI, skin, hematologic disorders.
7) Neurologic, Immune disorders.
DISORDERS OF URINE ELIMINATION

CHAPTER 37
INCONTINENCE

- Control of bladder function involves both voluntary and involuntary reflexes, both the sympathetic and parasympathetic arms of the autonomic nervous system.

- 3 NEUROLOGIC LEVELS INVOLVED IN CONTROL:
  1) Spinal cord.
  2) Micturation center in the pons.
  3) Cortical and subcortical centers.
INCONTINENCE

4 TYPES:

1) Stress urinary incontinence (SUI).
2) Urge incontinence / Overactive bladder.
3) Overflow incontinence.
4) Mixed incontinence - combination of stress and urge incontinence.
INCONTINENCE

STRESS INCONTINENCE

- Loss of the posterior urethrovesical angle. See Fig. 37-5.
- Increases in intra-abdominal pressure with coughing, sneezing, lifting, laughing are normally transmitted to the urethra, so intraurethral pressure exceeds intravesical pressure. With loss of the PU-V angle, increases in intra-abdominal pressure cause intravesical pressure to exceed intraurethral pressure → loss of urine
INCONTINENCE

STRESS INCONTINENCE

- In women, due to childbirth, aging, estrogen deficiency, weakening of the pelvic floor muscles.
- In men, due to trauma or surgery to the bladder neck such as with prostatectomy.
- Since this is an anatomic problem, surgical correction is an option.
- Also used: Kegel’s exercises, periurethral collagen injections.
INCONTINENCE

URGE INCONTINENCE

- Cause is often unknown, but 2 categories are recognized:
- 1) Neurogenic- Parkinson’s, M.S.
- 2) Myogenic- detrusor muscle hyper-excitability. Results from changes in the smooth muscle itself or the efferent fibers going to it, from obstruction / overdistention, aging, diabetes.
INCONTINENCE

OVERFLOW INCONTINENCE

- Urinary retention causing intravesical pressure to exceed intraurethral pressure.
- Neurologic- meningomyelocoel, spinal cord injury, etc.
- Outflow obstruction- most commonly prostatic enlargement.
- Can be treated with intermittent self-catheterization.
BLADDER CANCER

CAUSES

- Carcinogens secreted in the urine and stored in the bladder:
  - 1) Breakdown products of aromatic amines: used in dyes, manufacture of rubber, textiles, paint, chemicals, and petroleum.
  - 2) Smoking- 80% associated w/ smoking.
  - 3) Chronic bladder infections, stones.
BLADDER CANCER

MANIFESTATIONS

- Painless hematuria. Gross, microscopic.
- Occasionally frequency, urgency, dysuria.
ANOREXIA

- Loss of appetite.
- Hunger controlled by the hypothalamus and other centers.
- Anorexia produced by:
  - Smells.
  - Emotional factors- anxiety, depression, fera.
  - Drugs.
  - Systemic diseases.
NAUSEA

- Results from stimulation of the medullary vomiting center.
- Precedes vomiting.
- Often accompanied by anorexia.
- Caused by:
  1) Foods, drugs.
  2) Distention of the duodenum or upper jejunum.
- Accompanied by sweating, pallor, tachycardia.
- Warning signal of diseases.
VOMITING

- See text.
GI BLEEDING

- UPPER GI BLEEDING DUE TO:
  - 1) Peptic ulcer disease.
  - 2) Esophageal varices.
  - 3) Abnormalities of clotting.
  - 4) Carcinoma- stomach, esophagus.

- HEMATEMESIS- presence of blood in the vomitus.
  - Bright red or “coffee ground” in appearance.
GI BLEEDING

- LOWER GI BLEEDING DUE TO:
  - 1) Carcinoma of the colon.
  - 2) Colon polyps.
  - 3) Inflammatory bowel disease- ulcerative colitis, Crohn’s Disease.
  - 4) Hemorrhoids.
  - 5) Abnormalities of clotting.
  - 6) Some types of infectious diarrhea- dysentery, enterotoxigenic E coli (covered more in Biomedical Treatment of Disease I).

- HEMATOCHEZIA
GI BLEEDING

- **HEMATEMESIS** - blood in the vomitus. Indicates blood is from the upper digestive tract.
- **HEMATOCHEZIA** - bright red blood in the stool. Indicates the blood is from the lower GI tract.
- **MELENA** - black, tarry stools. Indicates the source of the bleeding is above the level of the ileocecal valve. Black due to oxidation of heme.
- **OCCULT BLOOD** - hidden; only found by use of the hemoccult test, uses the guiaic-based method of detecting heme.
DYSPHAGIA

- Difficulty swallowing.
- Odynophagia- painful swallowing.
- See text for causes.
GERD

- Gastroesophageal reflux disease.
- Due to incompetence of the lower esophageal sphincter.
- Stomach contents reflux into the lower esophagus.
- Stomach acid irritates the esophageal mucosa, causing heartburn, and in some patients esophagitis.
- **Barrett’s Esophagus.** A complication of GERD. Squamous cells lining esophagus, become columnar due to irritation.
CANCER OF THE ESOPHAGUS

- SQUAMOUS CELL- most are due to smoking and alcohol abuse.
- ADENOCARCINOMA- on the rise, attributable to the malignant transformation of Barrett’s Esophagus.
- DYSPHAGIA- the most common symptom of cancer of the esophagus. First w/ solid food, then soft food, then w/ liquids. Late sign.
- Weight loss, anorexia, fatigue, odynophagia.
Most are due to infection w/ *Helicobacter pylori* = *H. pylori*.

Acute gastritis from chemical irritants- alcohol, aspirin.

Chronic gastritis- from *H. pylori*.

Chronic infection w/ *H. pylori*- leads to gastric atrophy, peptic ulcer disease, and adenocarcinoma of the stomach.
CANCER OF THE STOMACH

- Major cause of cancer death worldwide.
- 7th leading cause of cancer death in the U.S.
- RISK FACTORS:
  1) Genetic predisposition.
  2) Dietary carcinogens: N-nitroso compounds and benzopyrene found in smoked and preserved foods.
  3) Autoimmune gastritis.
  4) Gastric adenomas and polyps.