Pyelonephritis

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Urinary Tract Infection (UTI)

UTI occurs in all populations, from the neonate to the geriatric patient, but it has a particular impact on :

- females of all ages (especially during pregnancy)
- males at the two extremes of life
- kidney transplant patients
- anyone with functional or structural abnormalities of the urinary tract

Urinary Tract Infection (UTI)

- upper UTI－pyelonephritis
- lower UTI －cystitis

Pyelonephritis

- DEFINITION
- BACTERIOLOGY
- PATHOGENESIS
- PATHOLOGY
- CLINICAL PRESENTATIONS
- DIAGNOSTIC EVALUATION
- TREATMENT

DEFINITION

Pyelonephritis means inflammation of the kidney and its pelvis, but from a historical point of view and through common usage, the term has come to designate a disorder of the kidney resulting from bacterial invasion.

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Bacteriologic Findings Among 250 Outpatients and 150 Inpatients with UTI

Bacterial Species	Outpatients (%)	Inpatients (%)
Escherichia coli	89.2	52.7
Proteus mirabilis	3.2	12.7
Klebsiella pneumoniae	2.4	9.3
Enterococci	2.0	7.3
Enterobacter aerogenes	0.8	4.0
Pseudomonas aeruginosa	0.4	6.0
Proteus species	0.4	3.3
Serratia marcescens	0.0	3.3
Staphylococcus epidermidis	1.6	0.7
Staphylococcus aureus	0.0	0.7

Fungal Pathogens

The most common form of fungal infection of the urinary tract is caused by Candida species. Most such infection occurs in patients :

- with indwelling Foley catheters
- receiving broad-spectrum antibacterial therapy
- diabetes mellitus
- on corticosteroids

Other Pathogens

- C. Trachomatis--- important cause of the acute urethral syndrome
- U. Urealyticum, M.Hominis--- less common
- Adenoviruses--- 1/4~1/2 of hemorrhagic cystitis in school children

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PATHOGENESIS

How microorganisms, especially bacteria, reach the urinary tract in general and the kidney in particular?

PATHOGENESIS

Two potential routes :

(1) the hematogenous route, with seeding of the kidney during the course of bacteremia;

(2) the ascending route, from the urethra to the bladder, then from the bladder to the kidneys via the ureters.

Hematogenous Infection

- Because the kidneys receive 20% to 25% of the cardiac output, any microorganism that reaches the bloodstream can be delivered to the kidneys.
- The major causes of hematogenous infection are S. aureus, Salmonella species, P. aeruginosa, and Candida species.

Hematogenous Infection

Chronic infections (skin, respiratory tract)

→ blood circulation → kidney(cortex)

→ small abscess → renal tubular →

renal pelvis → renal papillary

Ascending Infection

- The reservoir from which urinary tract pathogens emerge is the gastrointestinal tract.
- Females, because of the proximity of the anus to the urethra, are at increased risk for UTI .

Ascending Infection

The ability of host defense ↓

Urinary tract mucosal cells damaged →

The power of bacterial adhesions(toxicity) ↑

organisms → urethra,periurethral tissues → bladder → ureters → renal pelvis → renal medulla

PATHOGENESIS

The normal bladder is capable of clearing itself of organisms within 2 to 3 days of their introduction.

- Defense mechanisms

(1) the elimination of bacteria by voiding

(2) the antibacterial properties of urine and its constituents

(3)the intrinsic mucosal bladder defense mechanisms

(4) an acid vaginal environment (female)

(5) prostatic secretions (male)

PATHOGENESIS

Factors predisposing to pyelonephritis

- Urinary Tract Obstruction
- Vesicoureteral Reflux
- Instrumentation of the Urinary Tract
- Pregnancy
- Diabetes Mellitus

Diabetes Mellitus

- UTI are 3-4 times more common in diabetic women than in nondiabetic ones
- Diabetic neuropathy affects bladder emptying
- Diabetic vascular disease increases pressures within the urinary tract resulting from poor bladder emptying
- The effects of hyperglycemia on host defense

PATHOGENESIS

- **Relapsing infection**
- **Reinfection**

Relapsing infection

- This is defined as recurrence of bacteriuria with the same organism within 3 weeks of completing treatment which, during treatment, rendered the urine sterile.
- Relapse implies that there has been a failure to eradicate the infection. This most often occurs in association with renal scars, stones, cystic disease, or prostatitis, or in those who are immuno-compromised.

Reinfection

- It is defined as eradication of bacteriuria by appropriate treatment, followed by infection with a different organism after 7 to 10 days.
- Reinfection does not represent failure to eradicate infection from the urinary tract but is due to reinvasion of the system. Prophylactic measures must be initiated.

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PATHOLOGY

Acute pyelonephritis

- Macroscopic: kidneys are enlarged and contain a variable number of abscesses on the capsular surface and on cut sections of the cortex and medulla
- Histologic: interstitial edema, inflammatory cells infiltration, tubular cell necrosis

PATHOLOGY

Chronic pyelonephritis

- Macroscopic: kidneys are smaller than normal, renal scarring, consisting of corticopapillary scars overlying dilated, blunted, or deformed calices
- Histologic:unequivocal evidence of pelvocaliceal inflammation, fibrosis, and deformity

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CLINICAL PRESENTATIONS

Cystitis

- dysuria (burning or discomfort on urination)
- frequency
- nocturia
- suprapubic discomfort

CLINICAL PRESENTATIONS

Acute Pyelonephritis

- recurrent rigors and fever
- back and loin pain
- colicky abdominal pain
- nausea and vomiting
- dysuria, frequency, and nocturia
- Gram-negative sepsis
- septic shock

CLINICAL PRESENTATIONS

The physiologic derangements that result from the long-standing tubulointerstitial injury

- hypertension
- inability to conserve Na+
- decreased concentrating ability
- tendency to develop hyperkalemia and acidosis

Complications

- Sepsis
- Peri-renal abscess
- Acute renal failure
- Renal papillary necrosis

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DIAGNOSTIC EVALUATION

- History and Physical Examination
- Chemical tests for the presence of bacteriuria
- Urinary concentrating ability
- Measurement of urinary enzymes
- Measurement of C-reactive protein
- Measurement of antibody responses to bacteria
- Radiologic and Urologic Evaluations

Laboratory findings

- Urine dipstick

  pyuria on microscopic examination

  urine WBC ↑
- Middle stream urine culture

  bacterial account > 10^5/ml
- blood culture

Laboratory findings

- Urinary concentrating ability

  Maximal urinary concentrating test SG ↓
- Urinary enzymes

  NAG, $ß_2$-MG
- Urinary tract X-ray

  KUB+IVU

  (children, adult man, women recurrent UTI)

	upper UTI	lower UTI
• Fever	+	-
• Percussion of the costovertebral angle	+	-
• WBC casts	+	-
• Urinary concentrating ability	decrease	normal
• Urine NAG, ß$_2$-MG	increase	normal
• Ab-coated bacteria in urine	+	-
• Recurrent	early, same bacteria	late, new bacteria
• IVU	may abnormal	usually normal

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Treatment

- Rest
- Drinking large amount of water
- Antibiotics: 10-14 days until symptom free
- Treat related diseases: diabetes, renal stones, vaginal infection, etc

Antimicrobial therapy

- **Three goals**

  - control or prevention of the development of urosepsis

  - eradication of the invading organism

  - prevention if recurrences

- **Medications**

  - trimethoprim-sulfamethoxazole

  - fluoroquinolones

  - ampicillin, amoxicillin, first-generation cephalosporins

Antimicrobial therapy

- Short-course therapy
  - single-dose therapy
  - a 3-day course of therapy
- Extended course

  a prolonged 4- to 6-week course of therapy
- Low-dose prophylactic regimen

  low-dose antibiotics three times weekly at bedtime for ½ to 1 year

Women who present with complaints of dysuria and frequency

↓

Treat with short-course therapy

↓

Follow-up 4-7 days later

↙ ↘

Asymptomatic

↙

No further intervention

Symptomatic

↓

urinalysis, urine culture

↙ ↓ ↘

Both negative

↓

observe treat with urinary analgesia

pyuria no bacteriuria

↓

treat for chlamydia trachomatis

bacteriuria with or without pyuria

↓

treat with extended course

Thank You!