

Urinary tract infection(UTI)

Lecture

11

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الطلبة الشطار الحاصلين على درجة كاملة

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Epidemiology

UTI is the most common bacterial infection treated in general medical practice.

50% of women had at least single UTI in their life.

UTI is more common in female except in 1st year of life, where it more common in male(that is due to the higher frequency of urethral malformations in boys)

20-30% of pregnant ladies had asymptomatic bacteriuria &

2-8% had UTI ,particularly upper UTI. In young men, bacterial UTIs are rare and often the result of underlying infections of the prostate. In the elderly, both symptomatic UTIs and asymptomatic bacteriuria are common. In women, that is often the result of an atrophic vaginal mucosa, and in men, to prostate hyperplasia or prostate cancer.

UTI is the most common type of hospital-acquired infection, because of the frequent use of bladder catheters

pathogenesis

Is the urinary tract sterile?

Is the urine sterile?

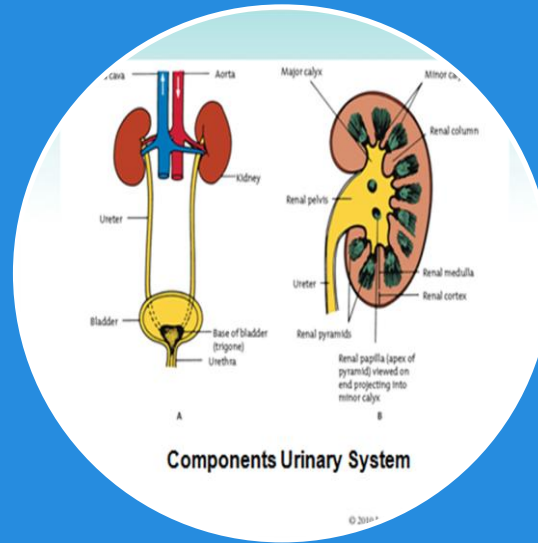
What are the factors which resist the growth of micro-organisms?

What are the routes of infection.?

What are the commonest micro-organisms?

What are the risk factors of developing UTI?

Why it is more common in women?



Urinary tract is sterile except distal urethra & meatus which colonized by commensal bacteria as bacteroids, staphylococcus & others



**Urine is sterile
Because:-
high concentration of urea
hypertonicity
acidity
Prostatic secretion**

**Flushing
mechanisms**

Routes of infection

Mostly ascending from the digestive system usually G - neg rods specially E.coli(Why?). Growth of anaerobic bacteria, such as *Bacteroides fragilis* , in the urine indicates a fistula(communication) between the intestines and the urinary tract.

**Haematogenous
&
lymphatic
transmission**

The microbiologic etiology

In all types of UTI, *E. coli* is the dominating bacterial species causing up to 85% of all symptomatic UTIs in women with community-acquired, sporadic, uncomplicated infections

E. coli 85%(Why?)

the second most common species causing such infections is *Staphylococcus saprophyticus*

Klebsiella , Proteus, Enterococcus Mixed ,
Other (Chlamydia & mycoplasma)

Viral : Rubella, Mumps and HIV

Fungal : Candida, *Histoplasma capsulatum*

Protozoal : *T. vaginalis*, *S. haematobium*

Virulence Factors of *E.coli*

- Fimbriae enable adherence to urethral epithelium
- Capsular polysaccharide inhibite phagocytosis
- Haemolysin production by *E. coli*
- Membrane damaging toxin

Note:- Production of urease enzyme (proteus spp.)

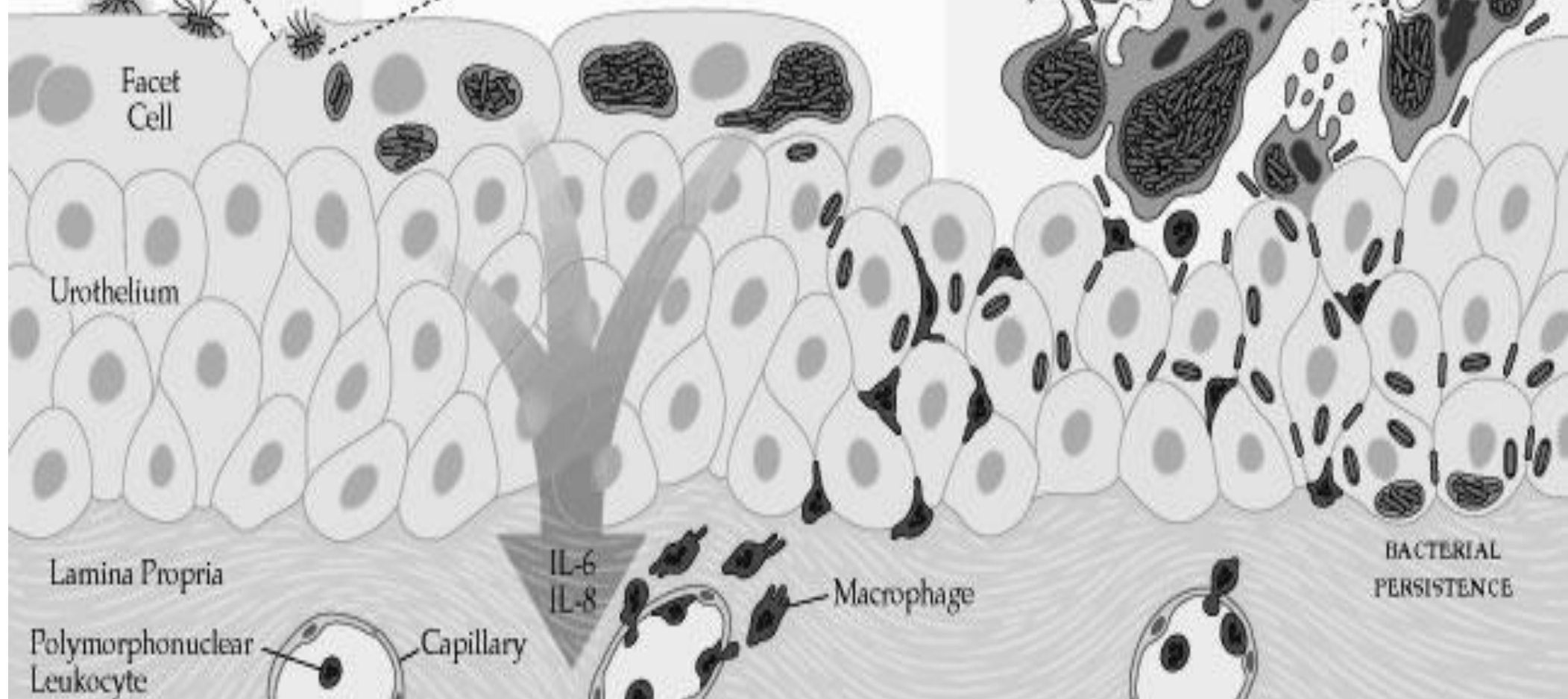
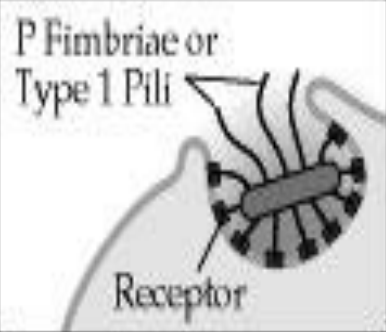
ATTACHMENT

INVASION

REPLICATION

EXPOLIATION

Uropathogenic
E. coli



Risk Factors for UTI?

Urinary catheters

Estrogen deficiency and loss of lactobacilli

Prostate hypertrophy, obstruction, catheterization

Gynecologic surgery, bladder neck obstruction

Uterine prolapse

Anatomic, Sexual intercourse, spermicidal use, previous UTI

Vesicoureteral reflux, neurogenic bladder.

Congenital abnormalities, uncircumcised penis

Congenital abnormalities,

Vesico-ureteric reflux

Anatomic/functional abnormalities: stones, stricture.

Anatomic/functional – Abnormalities

Loss of host defences mechanism.

Host Factors predisposing to UTI:

Diabetes mellitus

Post-menopausal

women(atrophic vaginitis).

Immunocompromised

individuals (e.g.

transplant recipients,

immunosuppressive drugs

,HIV infection)

UTI in Women: Factors Predisposing to UTI

- Short urethra**
- Sexual intercourse & lack of
post coital voiding**

Pregnancy

- Diaphragm, spermicide use**
 - Estrogen deficiency**

UTI: Definitions

- **Lower UTI: cystitis, urethritis, prostatitis, epididymitis/orchitis.**
- **Upper UTI: pyelonephritis (acute or chronic)**
Acute pyelonephritis may be complicated by septicemia, intra-renal abscess, perinephric abscess (usually late complications of pyelonephritis)
- **Uncomplicated UTI – Infection in a structurally and neurologically normal urinary tract. Simple cystitis of short (1-5 day) duration**
- **Complicated UTI – Infection in a urinary tract with functional or structural abnormalities (ex. indwelling catheters and renal calculi). Cystitis of long duration or hemorrhagic cystitis**

Asymptomatic bacteriuria

- The colony forming units(CFU) more than 100.000/ml of MSU on 2 consecutive cultures.
- The incidence about 40% in women & 30% in men in geriatric age group(No treatment)
- Treatment indicated:-
- 1st & 2nd trimester of pregnancy.
- Infants
- Those with abnormalities of renal system.

Clinical features

Lower UTI:

Rapid onset of:

Dysuria(burning pain on passing urine)

Urgency(the urgent need to pas urine)

Frequency of micturition

Suprapubic discomfort & tenderness

Upper UTI (Pyelonephritis):

Fever

Chills

vomiting

Dysuria

Urgency

Frequency of micturition

Dehydration , toxic , hypotension(features of septicaemia)

Loin pain & tenderness

URETHRITIS

- S&S

- urethral discharge

- burning on urination

- Asymptomatic

- Gonococcal vs. Nongonococcal

- DX:

- G.U.E

- swab

- Serum: Chlamydia-specific ribosomal RNA

Cystitis

- **Affects only the bladder**
 - More common in women than men; shorter female urethra, and, in young sexually active women, sexual intercourse promotes transfer of bacteria from urethra to bladder
 - Common in older men, because enlarged prostate interferes with complete bladder emptying
- **Clinical manifestations**
 - Burning pain on urination
 - Desire to urinate frequently
 - Urine contains many bacteria and leukocytes
 - Responds well to antibiotics
 - May spread upward into renal pelvis and kidneys

Pyelonephritis

Involvement of upper urinary tract from

- Ascending infection from the bladder (ascending pyelonephritis)
- Carried to the kidneys from the bloodstream (hematogenous pyelonephritis)

• **Clinical manifestations: acute infection, fever, chills & rigor, sweating, & the patient may be toxic (septicaemia)**

- Localized pain and tenderness over affected kidney
- Responds well to antibiotics
- Cystitis and pyelonephritis are frequently associated
- Some cases become chronic and lead to kidney failure

investigations

Urinalysis: for all patient

An aseptic collection technique essential to prevent contamination.

- The first urine passed by patient in the morning.
- A "mid stream" urine sample under a septic precaution

Urine culture: certain indications.

CBC, B.urea, s.creatinine, electrolytes & blood culture: indicated in infants, children & complicated UTI.

Renal imaging techniques; Ultrasonography ; CT-scan & others + PV in female & PR in male: indicated in case of pyelonephritis, male , children & recurrent UTIs in women.

Cystoscopy: indicated in case of persistent haematuria despite antimicrobial therapy (bladder pathology).



What are the significant abnormalities in urinalysis test helpful in diagnosis of UTI?

1-Detection of bacteriuria by nitrite test. Bacteriuria can be detected chemically when bacteria produce nitrite from nitrate.

A positive nitrite test indicates that bacteria may be present in significant numbers in urine. Gram negative rods such as E. coli are more likely to give a positive test. E Coli, Klebsiella and Proteus produce nitrite from nitrate, Pseudomonas, enterococci and S Saprophyticus do not.

4 hours of bladder incubation are required for bacteria to convert nitrate to nitrite.

2-Detection of pyuria by urine microscopy: can be detected and quantified microscopically by measuring the urinary leukocyte excretion rate, counting leukocytes in a centrifuged specimen.

3-Detection of pyuria by leukocyte esterase tests. A positive leukocyte esterase test results from the presence of white blood cells either as whole cells or as lysed cells. Pyuria can be detected even if the urine sample contains damaged or lysed WBC's.

Sensitivity is 94% when a UTI is suspected clinically. However false-positive results are common when the urine is contaminated with bacteria present in vaginal fluid.

4- Alkaline urine (high pH) is seen in infection with urease-splitting organisms, and may be associated with the formation of stag-horn calculi.

5- White blood cell count (WBCs) IN URINE > 5-10 WBC is considered to be pyuria, which usually indicates a UTI.

Red Blood Cell (RBCs) >3/hpf in the urine is abnormal. Hematuria (blood in urine) associated with cystitis or urethritis.

Epithelial cells in urine usually indicate contamination of the specimen from the distal urethra in men and the opening of the vagina in women. Bacteria

6- Bacteria are common in urine specimens because of the abundant normal microbial flora of the vagina or external urethral meatus and because of their ability to rapidly multiply in urine standing at room temperature. Therefore, microbial organisms found in urine sample collected by MSU clean catch technique in our practice is not significant.

Diagnosis of bacteriuria in a case of suspected urinary tract infection requires culture. A colony count may also be done to see if significant numbers of bacteria are present. Generally, more than 100,000/ml of one organism reflects significant bacteriuria. Multiple organisms reflect contamination. However, the presence of any organism in catheterized or suprapubic tap specimens should be considered significant.

Routine bacterial urine cultures.

Urine culture may not be necessary as part of the evaluation of outpatients with uncomplicated UTI. Urine cultures are necessary for outpatients who have recurrent UTI, experience treatment failures, or have complicated UTI. Urine cultures are also necessary for inpatients who develop UTI. The bacterial culture remains an important test in the diagnosis of UTI, not only because it helps to document infection, but also because it is necessary for determination of the identity of the infecting microorganism(s) and for antimicrobial susceptibility testing. This is particularly true because of the increased incidence of antimicrobial resistance.

**CBC(leukocytosis)
blood cultures(20%
+ ve in cases of
pyelonephritis ,
which indicate
septicaemia)**



Renal abscess on ultrasonography Ultrasonic examination of the kidney showing an abscess cavity (arrow). The internal echoes within the lesion can also be seen with a malignancy but not with a simple cyst. Courtesy of Alain Meyrier, MD.

Treatment

General Principles

- Quantitative cultures may be unnecessary before treatment of typical cases of acute uncomplicated cystitis.
- Culture urine in patients with upper UTI, complicated UTI, or with treatment failure.
- Susceptibility testing is necessary in all recurrent or complicated infections, perhaps not for uncomplicated cases.
- Identify or correct factors predisposing to infection
 - Obstruction, calculi
 - Diabetic patients who are at risk for recurrent infections, pyelonephritis and perinephric abscesses

Empiric Antimicrobials

- Choice of antimicrobial agents
 - Primary excretion routes through the urinary tract
 - Achieve high concentration in urine and vaginal secretions
 - Inhibit *E.coli*, the primary pathogen in cystitis
- Short course (3-day in women but 10 days in men) therapy for uncomplicated lower UTI.
(TMP/SMX ,Fluoroquinolones).
For pregnant ladies Rx for 7 days with other drugs as Amoxil or cephalosporine.
- Longer duration (10-14 days) for complicated infection (e.g. pyelonephritis) + drainage of abscess.
- Oral vs. intravenous agents (TMP/SMX, Fluoroquinolones) or 3rd generation cephalosporine.
Prostatitis treated for 28 days.

Recurrent UTI

- **Risk factors for recurrent uncomplicated UTI**
 - Postmenopausal status; diabetes
 - Recent antimicrobial use
 - Behavioral risk factors
- Frequency of sexual intercourse
- spermicide use, oral contraceptive use
- first UTI <15 years old.

Prevention Strategies

- **Prevention Strategies**
 - **Alternative methods of contraception**
 - **Postcoital voiding and increased fluid intake**
 - **Cranberry juice (sexually active women with previous UTI)**
 - **Antibiotic prophylaxis**
- **>2 symptomatic UTIs within six months or >3 over 12 months**

Single dose (Trimethoprim, nitrofuradantoin 50mg, augmentine 375mg) at bedtime for 6 months or may be for life

Thank you

Next lecture

**Isolated defects of
renal tubules**