URI-205

URINARY TRACT INFECTIONS (UTI) PART 1

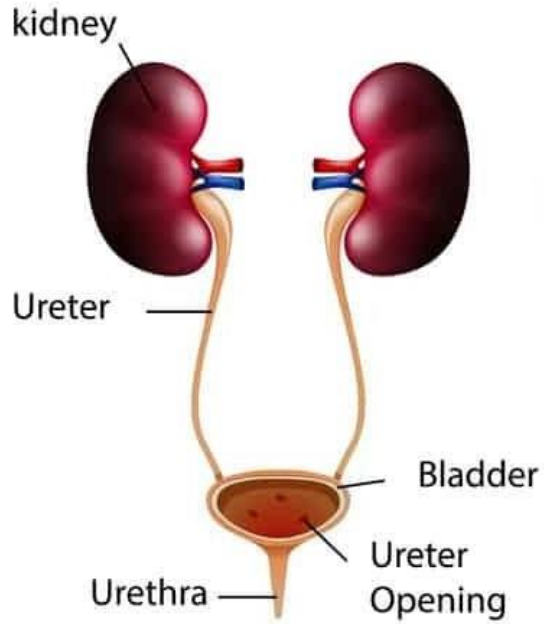
Microbiology & Immunology Department

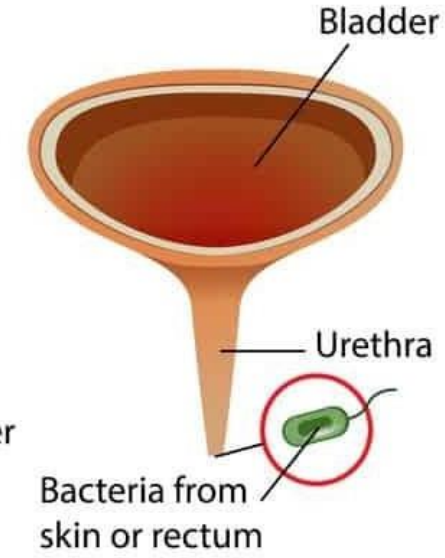
Objectives:

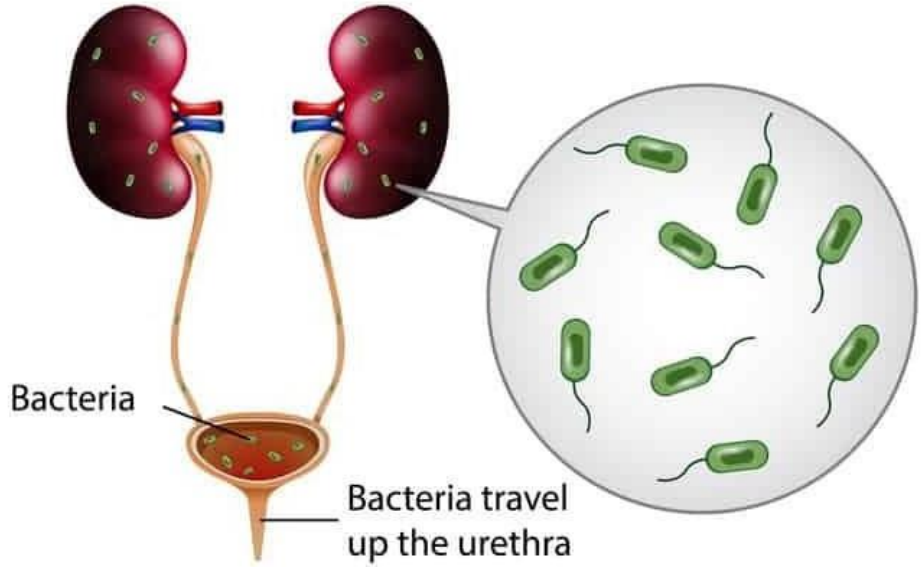
By the end of this lecture, you should be able to:

- ❑ Identify the epidemiology of UTIs
- ❑ Recognize risk factors for UTIs.
- ❑ Recognize classification of UTIs.
- ❑ List the commonest causative agents (Pathogens) of UTI.
- ❑ Explain the mode of transmission of UTI.
- ❑ Explain the pathogenesis of UTI.
- ❑ Describe clinical manifestations of UTI.
- ❑ Outline the laboratory diagnostic approach in different UTIs.

Urinary tract infections







Epidemiology

According to age: UTI is more common in elderly, and infants.

According to sex: UTI is more common in women (due to short urethra).

Risk factors for UTI

1. Any cause of urinary stasis or any foreign body predisposes to UTI e.g. stones, strictures
2. Sexual intercourse in women (“honeymoon cystitis”)
3. Catheters (major cause): the risk is directly related to the length of catheterization.
4. Risk increases during pregnancy and postmenopausal.
5. Immunocompromised patients.
6. Diabetes mellitus.

Classification of UTI

There are several methods of classification:

Lower UTI:
Cystitis.
Urethritis.
Prostatitis.

Upper UTI:
Pyelonephritis.
Intra-renal abscess.
Perinephric abscess.

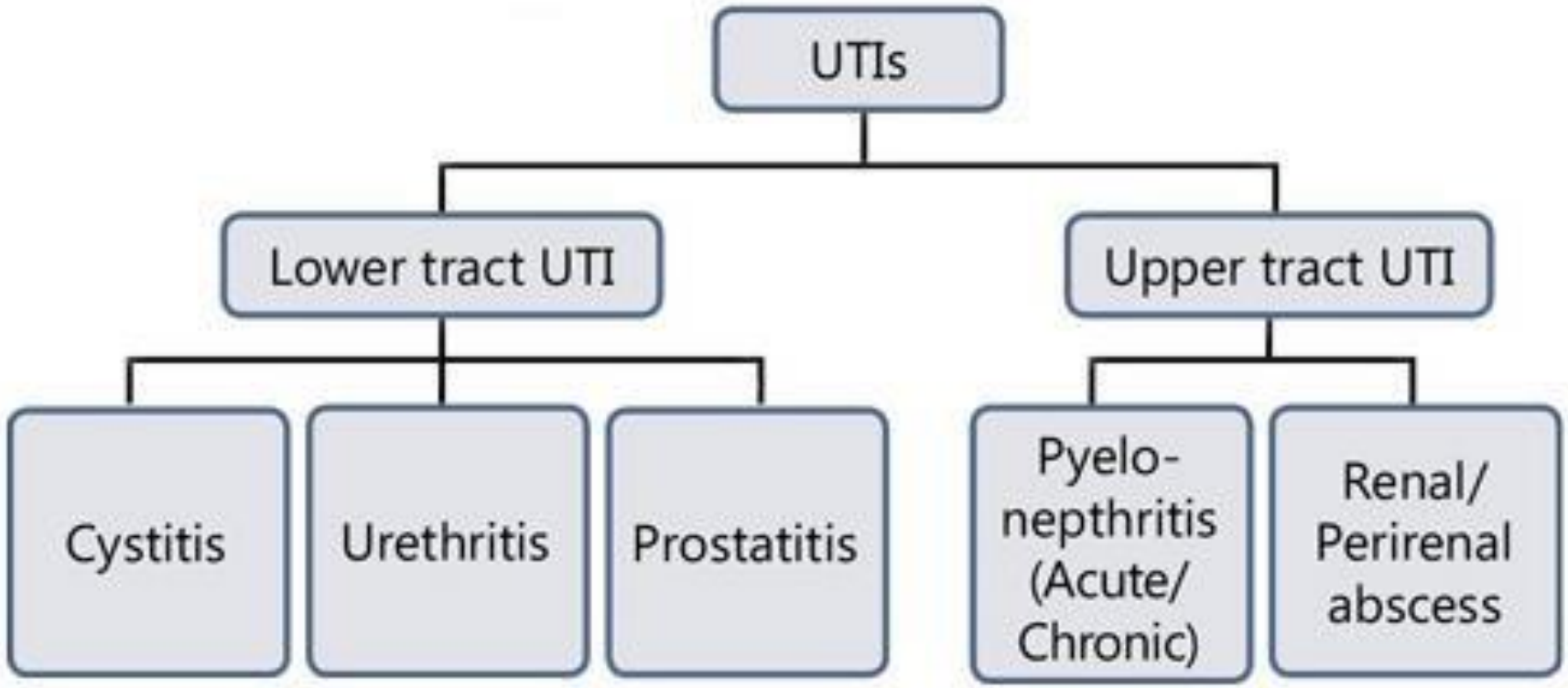
Uncomplicated UTI:
- Infection in a structurally and neurologically normal urinary tract.
- Usually of short (1-5 day) duration

Complicated UTI:
- Infection in a urinary tract with functional or structural abnormalities (e.g. indwelling catheters and renal calculi).
- Usually of long duration

Community Acquired: 80% are due to E.coli

Hospital acquired (Nosocomial)
- E coli, Pseudomonas, Enterococcus.
- commonly caused by urinary catheters

Anatomical classification of UTIs:



Common pathogens causing UTI

Urethritis	**Gonococcal urethritis** caused by Neisseria gonorrhoeae **Nongonococcal urethritis** caused by Chlamydia trachomatis (commonest), Ureaplasma urealyticum, Mycoplasma hominis..
Cystitis	• E. coli in >80% • Other coliforms (gram-negative bacilli) such as *Proteus*, *Pseudomonas aeruginosa* etc. • *Staphylococcus saprophyticus* (in young women)

Common pathogens causing UTI

Pyelonephritis	• *E. coli* is most common pathogen • others include *Klebsiella, Proteus,* and *Enterococcus*. • Patients who are immunosuppressed and subjected to indwelling catheters are more prone to *Candida*.
Viruses: adenovirus, mumps, HIV and cytomegalovirus can cause hemorrhagic cystitis in children and immunocompromised patients.	

Mode of transmission of UTI

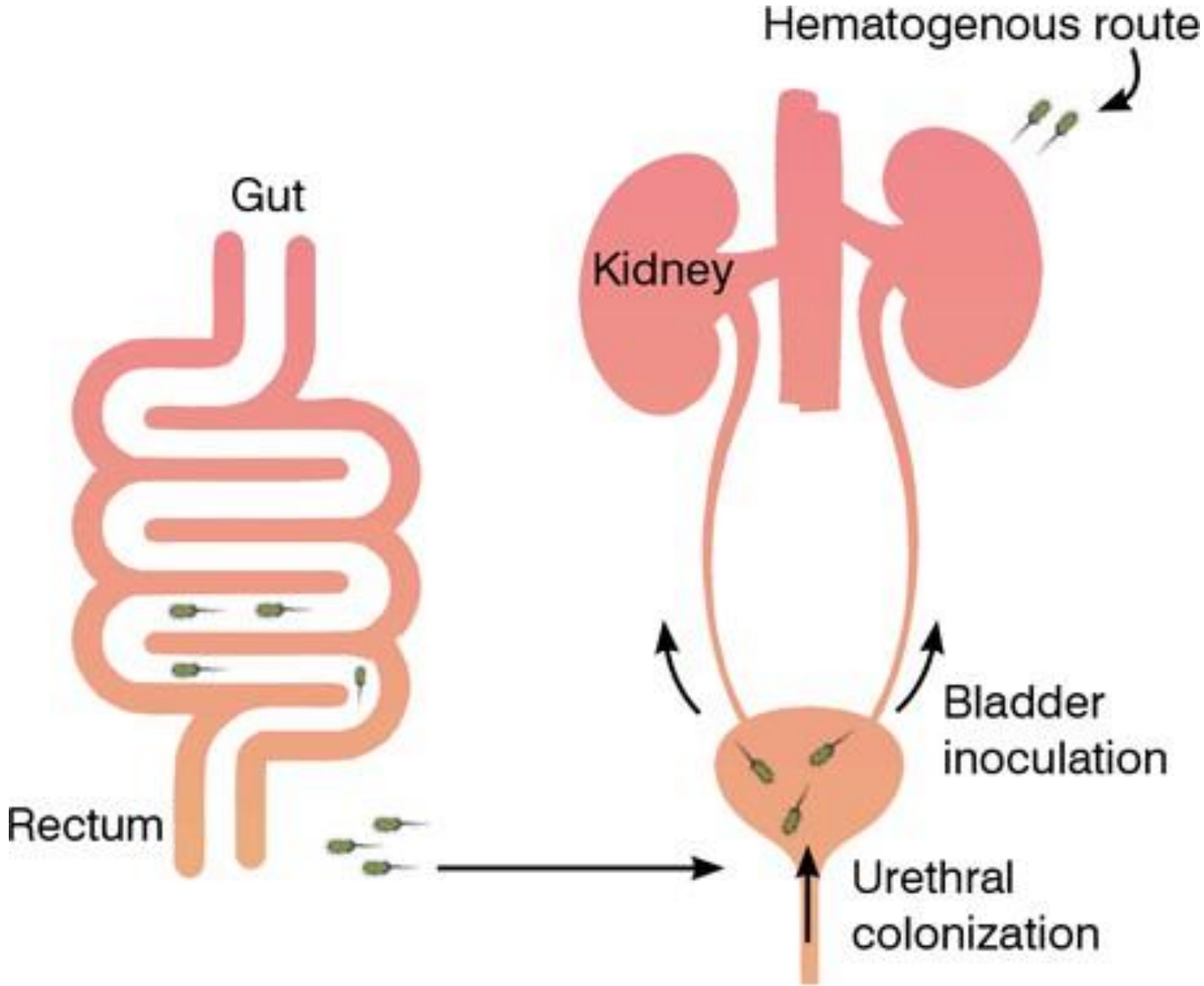
1. Ascending route:

- Bacteria can ascend from the anus to the urethra (urethritis) especially with *E coli* or
- from the urethra to the bladder (cystitis) or
- ascend through the ureter and infect the kidney causing a renal parenchymal infection (pyelonephritis).

2. Descending route (through blood or lymph):

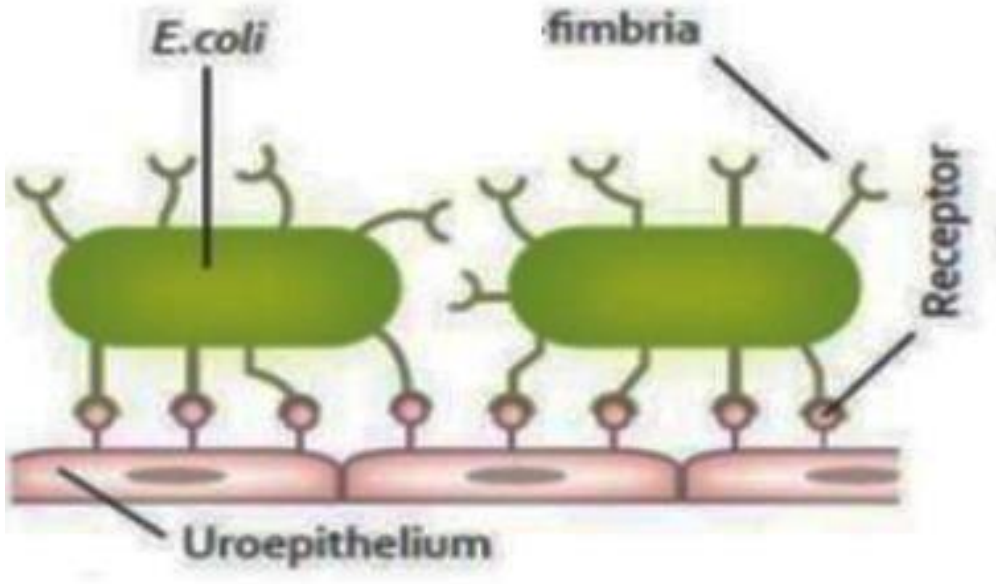
- *Staph aureus, Candida,* T.B

3. Direct extension: from intestinal fistula.


Hematogenous route
Gut
Kidney
Rectum
Bladder
inoculation
Urethral
colonization

Bacterial Virulence Factors allowing initiation of UTI

1) Adherence of *E. coli* to receptors on uroepithelial cells by adhesins on pili (fimbria).



2) Capsular polysaccharides with antiphagocytic activity e.g. *Klebsiella*

3) Enhanced motility by means of flagella

4) Production of hemolysins (membrane damaging toxins) e.g. *E coli* induces pore formation in cell membrane

5) Production of urease and changing the urinary PH into alkaline is correlated with pyelonephritis and stone formation e.g. *Proteus.*

Pathogenesis of urinary tract infections (UTIs)

1) Begins when uropathogens able to colonize the urethra contaminate the periurethral area (step 1)
2) Bacterial migration to the bladder (step 2)
3) Expression of pili and adhesins results in colonization and invasion (step 3).
4) Host inflammatory responses, including neutrophil infiltration begin to clear extracellular bacteria (step 4)
5) Some bacteria evade the immune system and resist the neutrophils so these bacteria undergo multiplication (step 5)

6) Biofilm formation (step 6).

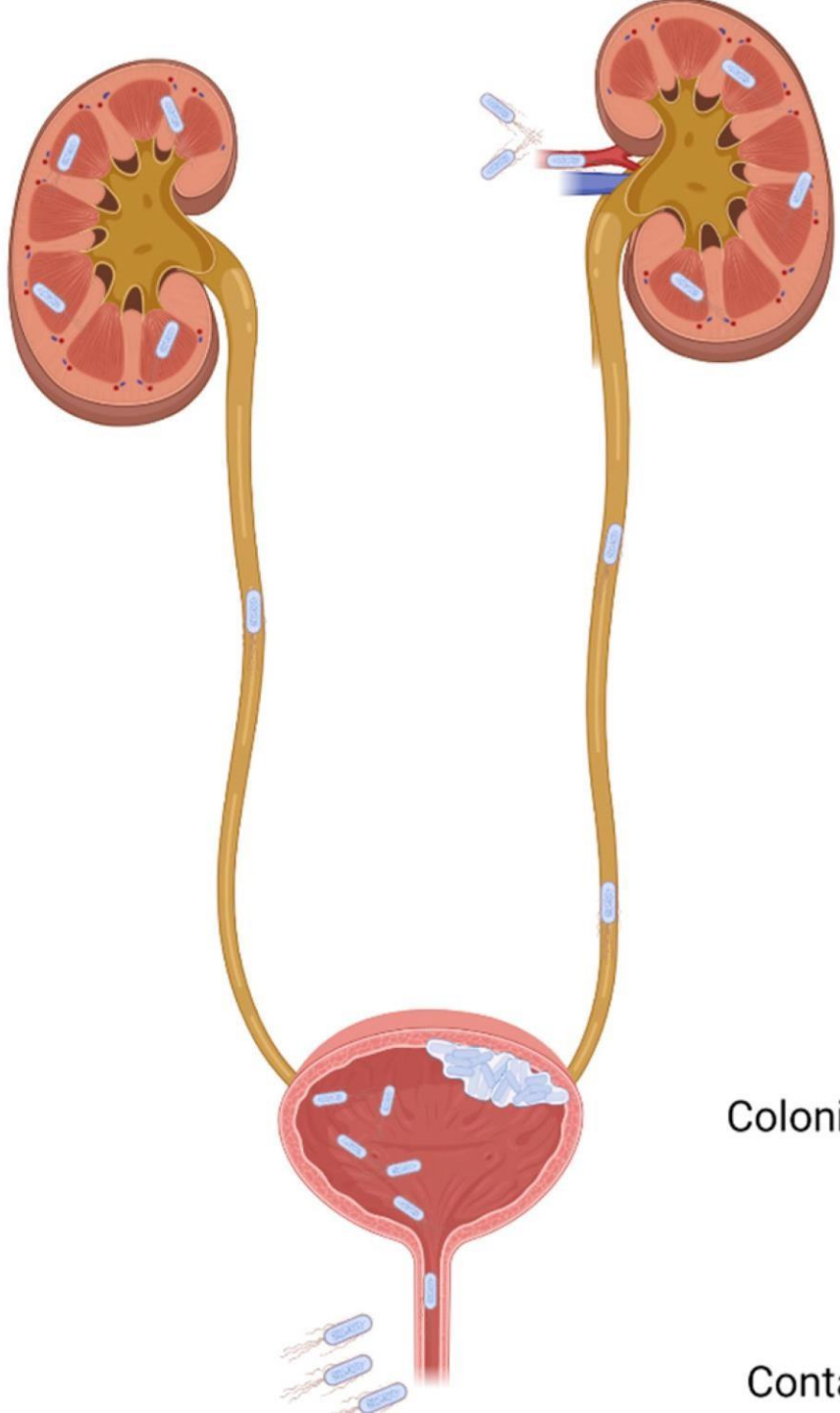
7) These bacteria produce toxins and proteases that induce host cell damage (step 7).

8) Bacterial survival and ascending to the kidneys (step 8).

9) Kidney colonization (step 9).

10) Bacterial toxin production and host tissue damage (step 10).

11) UTIs can progress to bacteremia, If left untreated (step 11).



Systemic spread

Colonization of kidneys

Ascend to kidneys

Biofilm formation

Colonization and invasion of bladder

Ascend via urethra

Contamination of periurethral area

Clinical manifestations of UTIs

Urethritis	▪ Purulent urethral discharge ▪ Dysuria ▪ Urgency and frequent urination.
Cystitis	▪ Dysuria ▪ Urgency and frequent urination. ▪ suprapubic pain. ▪ Hematuria (less common). ▪ On examination → suprapubic tenderness (but no flank tenderness).
Acute bacterial pyelonephritis	▪ Chills and fever. ▪ Flank pain (costovertebral angle tenderness). ▪ Dysuria ▪ Increased frequency in urination.

Herbpathy
Make Life Healthy

Signs and Symptoms of a UTI

Frequent Urination (FREQUENCY)

Strong urge to Urinate that cannot be Delayed (URGENCY)

Cloudy or Blood-Tinged Urine with strong odour

Burning or Painful Urinatio (DYSURIA)

Lower Abdomen or Lower Back Pain

Fever (with chills)

Nausea or Vomiting

Costovertebral angle tenderness

Supra-pubic pain

Laboratory diagnosis of UTIs

Urinalysis

Specimen: (collected in sterile container)

- Midstream urine (before starting antibiotic) is necessary to avoid contamination with vaginal or perineal skin flora

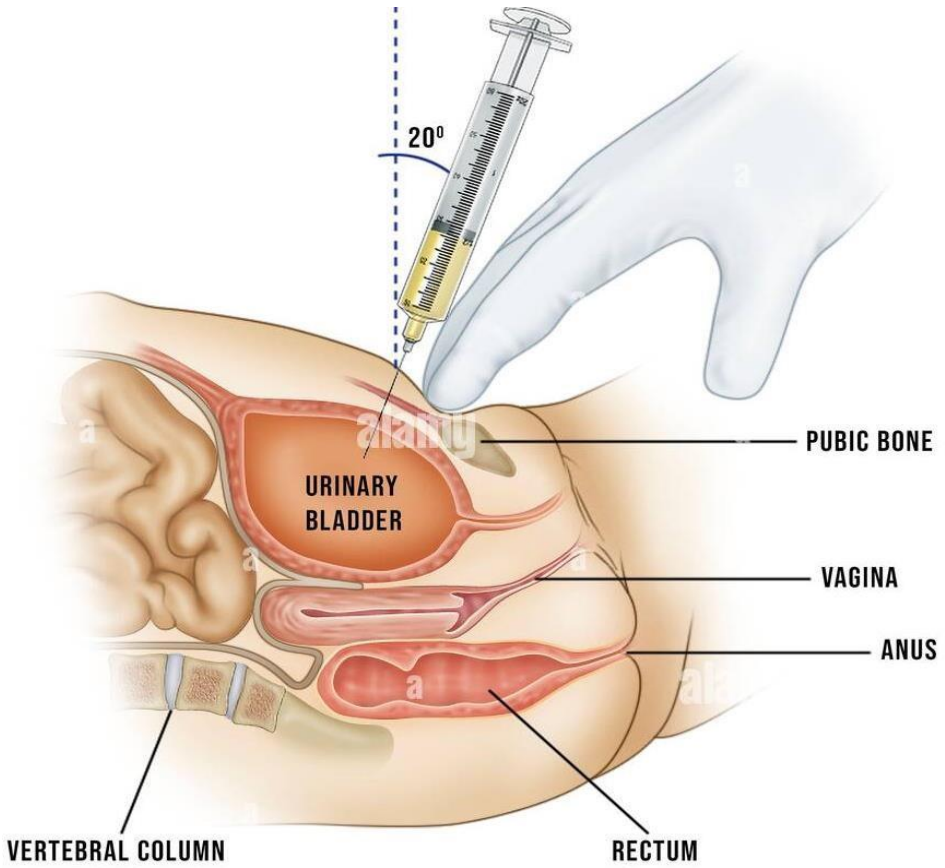
- Suprapubic aspiration or urinary catheter

aspiration can also be performed

if a clean catch cannot be obtained

without contamination (e.g. in children

who are not toilet trained.)



1. Dip stick urine test:

❑Urease positivity:

Urine pH >7 (alkaline) suggest *Proteus mirabilis* infections.

❑Proteins:

Proteinuria may be caused by glomerular or tubular disease, although glomerular disease leads to greater amounts.

❑Nitrites:

Gram-negative bacteria reduce nitrate to nitrite, which is a marker of urinary infection.

2. Urinalysis with microscopy:

❑ Examination of wet preparation:

✓ For white blood cells, red blood cells, cast, crystals, yeasts and bacteria.

❑ Gram staining:

✓ When bacteria or pus cells are seen in wet preparation.

✓ Bacteriuria: presence of bacteria on Gram stain (most commonly gram-negative rods)

NB: Leukocyte (WBCs) casts: should be absent in lower UTIs (cystitis), however it is a diagnostic finding of an upper UTIs (e.g. pyelonephritis)

3. Urine culture:

- Culture on specific media.
- Negative culture is associated with TB, viruses, and recent antibiotic treatment.

4. Antibiotic sensitivity tests especially in case of recurrent infections.

NB: Diagnostic criteria for UTI:

- Significant bacteriuria defined as ≥ 10^5 colony forming units (CFU)/mL serves to confirm a UTI.
- Any bacteriuria in urine from a suprapubic aspiration of the bladder is abnormal.


THANK YOU!