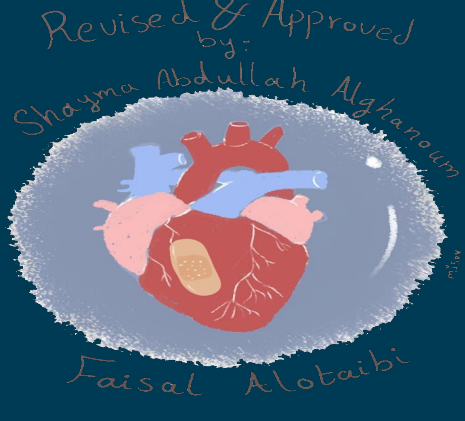
Cystitis

TEAM 439
MICROBIOLOGY



VERSION 1

Objectives

- Define the term cystitis and recall who commonly gets cystitis
- Describe the pathogenesis and risk factors of cystitis
- List the most common causative organisms of cystitis
- Recall the different types of cystitis (infectious and noninfectious)
- Describe the clinical presentation of cystitis
- Describe the laboratory pathogenesis of cystitis
- Recall the antimicrobial agents suitable for the treatment and prevention of cystitis

Colour index:

Red: Important.

Grey: Extra info & explanation.

Purple: Only in girl's slides.

Orange: Only in boy's slides.

Green: Lecture notes

Any future corrections will be in the editing file, so please check it frequently.

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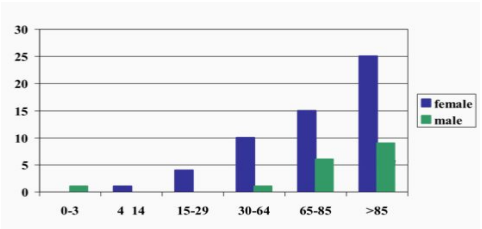
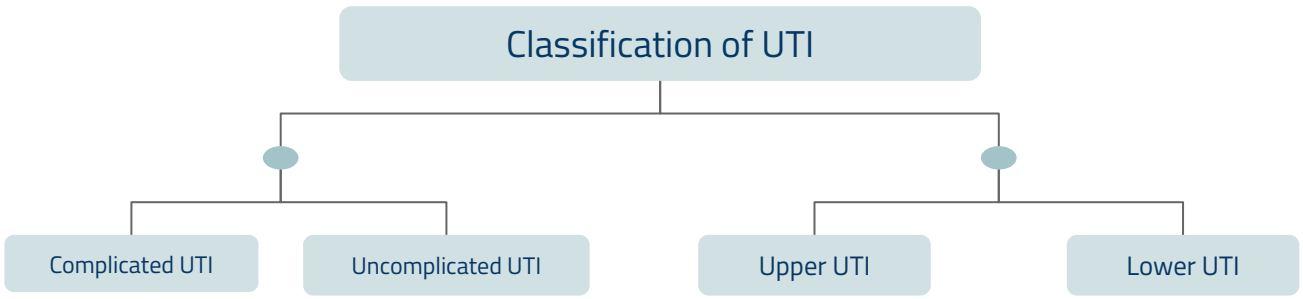
Introduction & Classification

- Urinary Tract infection (UTI) divided into upper (involves kidney) and lower urinary tract (involves urinary bladder) infections
- Patient presents with urinary **symptoms** and significant **bacteriuria** = 10^5 bacteria/ml
- Asymptomatic bacteriuria when the patient presents with significant bacteria in urine but without symptoms (most of the asymptomatic cases do not require any treatment)
- Prevalence of Bacteriuria in increases with age



Elderly females are most affected due to **hormonal changes** (less estrogen) which leads to more bacterial colonization in vagina and urethra



Lower UTI	**Cystitis**	Urethritis	Prostatitis & Epididymitis
	infection of the bladder; superficial mucosal infections	sexually transmitted pathogens) - urethritis in men & women	-
Upper UTI	• **Acute pyelonephritis** • Chronic pyelonephritis (uncommon)		
Complicated UTI (with RF)	• nosocomial UTI, relapses, structural or functional abnormalities • Patient with risk factors or **male** • Pregnant women with no additional risk factors		
Uncomplicated UTI (without RF)	• Usually in young sexually active **females with No risk factors (not pregnant** and without any structural or neurological abnormalities) • Empirical therapy is possible		

*Empiric antimicrobial therapy is directed against an anticipated and likely cause of infectious disease. It is used when antimicrobials are given to a person before the specific bacterium or fungus causing an infection is known

Cystitis

Pathogenesis of cystitis

Due to frequent irritation of the mucosal surfaces of the urethra and the bladder by two ways:

I. **Hematogenous**: through blood stream from other sites of infection (less common)
II. **Causative agent** (derived from the large intestine flora) **ascends** from the urethra to the urinary bladder

Conditions that create access to bladder

1) Sexual intercourse due to short urethral distance (Mainly in newly married female)
2) **Catheterization** of the urinary bladder, instrumentation

↓

These bacteria are residents or transient members of the perineal flora, and are derived from the **large intestine flora**.

↓

Infection results when bacteria from the **perineal flora ascends** through the urethra to the urinary bladder

↓

- Those pathogens usually have virulence factors (e.g. producing toxins, adhesions,villi invasiveness), that helps the pathogen to ascend
- They are called **uropathogens** = renal pathogens.

Risk factors

In women	In both sexes	In men
Natural Risk Factors • **Short urethra** • Pregnancy • Decreased estrogen production during menopause (change in flora)	• Presence of bladder stone • Urethral stricture (narrowing) • **Instrumentation (e.g Urinary Catheter)** • Diabetes mellitus • Obstruction • Structural abnormalities mainly in children	Persistent bacterial infection of the prostate. *Rare in healthy males due to **long urethra,** usually affect males with prostate abnormalities

Etiologic agents

Cystitis

Check our practical team for further understanding of the bacterial classification

Gram negative **rods**

Enterobacteriaceae:

★ **E.coli**, most common 90% cause of cystitis (indole positive) (lactose-fermenting) (both complicated & uncomplicated)

- **Klebsiella pneumoniae** (indole negative)(lactose-fermenting)
- Proteus spp

Pseudomonas aeruginosa

Gram positive bacteria

★ **Enterococcus faecalis** (diplococci)

★ **Group B streptococcus** (a.k.a Streptococcus agalactiae) **:**Catalase -ve anaerobe, β-hemolytic that mainly affects pregnant females and can cause meningitis in neonates acquired during birth.

- **Staphylococcus saprophyticus** (honeymoon cystitis), (Catalase +ve, coagulase -ve)novobiocin-resistant, mainly seen in young sexually active females.

Bacteria associated with Venereal diseases (sexually transmitted diseases) may be present with cystitis

- Chlamydia
- Gonorrhea

Candida species

Schistosoma haematobium (parasite) in endemic areas.

Complicated UTI

E.coli

- Other Enterobacteriaceae like Klebsiella.
- Pseudomonas spp
- Acinetobacter spp

Targets hospitalized patients with high risk factors.

% is not possible to judge, often multi resistant strains

Uncomplicated UTI

E.coli 64%

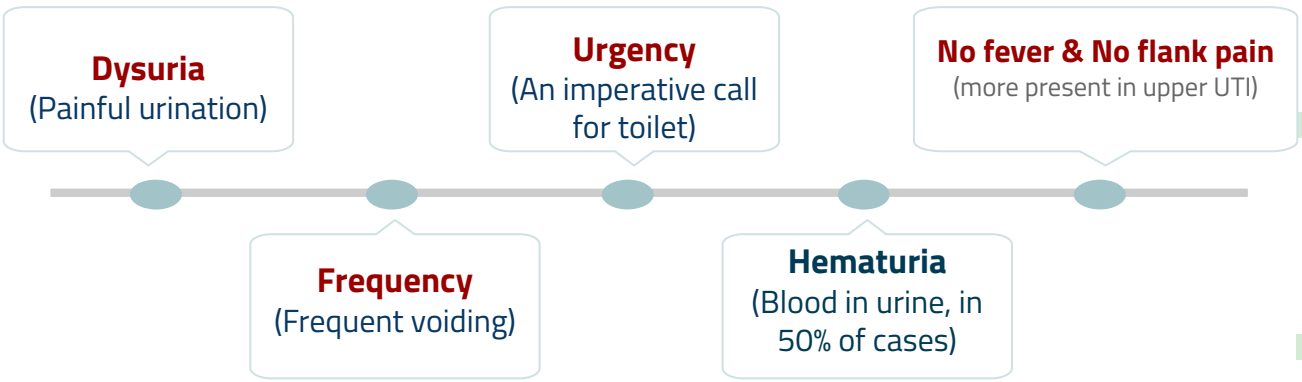
- Other Enterobacteriaceae 16%
- **Enterococcus** spp 20%
- Pseudomonas spp <1%
- S.aureus <1%

Special cases

- **S. Epidermidis** (Gram + cocci,Catalese +,Coagulase -,Non viboacin, Sensitive)unusual but mainly causes infections when the patient has a prosthetic tissue e.g urinary catheter.
- **S. Saprophyticus** (young sexually active females)
- Yeasts (catheter related)
- Viruses (adeno, varicella)
- Chlamydia trachomatis

Clinical Presentation of Cystitis

- Symptoms usually of acute onset
- Symptoms are associated with inflammation and infection of the urinary bladder.
- Examination of **supra pubic area** (above the bladder) **reveals tenderness, pain and discomfort.**



Other diseases that can be present with **Dysuria and Frequency**

Cystitis (80%)

E. coli, S. saprophyticus, Proteus spp., Klebsiella spp.

Urethritis(10-15%)

C. trachomatis, N.gonorrhoeae, H. simplex, Other bacteria.

Vaginitis (5%)

Candida spp., T. vaginalis

Non-infectious (<1%)

Hypoestrogenism, Functional obstruction, Mechanical obstruction, Chemicals.

Differential diagnosis (types of cystitis)

Non-infectious cystitis such as: (not as common as infectious cystitis)

- **Traumatic cystitis** in women usually after delivery
- **Interstitial cystitis** (unknown cause, may be due to autoimmune attack of the bladder)
- **Eosinophilic cystitis**
- **Hemorrhagic cystitis** due to radiotherapy or chemotherapy.

Laboratory Diagnosis of Cystitis :

Specimen collection

- Most important is clean catch urine **[Midstream urine (MSU)]** to bypass contamination by perineal flora and must be before starting antibiotic. Urine is normally sterile, The reason we collect a midstream urine sample is to avoid collecting the first or last portion of urine that comes out as it might get contaminated by skin flora.
- **Supra-pubic aspiration** (direct sample from the bladder) or **catheterization** (by in & out catheter) may be used in **children**.
- **Catheter urine should not be used for diagnosis of UTI.**
- In-out catheter, also called short term catheterization is more appropriate for diagnosis, unlike the long term used catheter which can easily be colonized by exogenous bacteria.

لانه قديم وقاعد مدة طويلة في الجسم فصار ملوث، واذا لقينا فيه بكتيريا في الغالب تكون من الخارج فمو شرط تصير نفس نوع البكتيريا اللي مسببه للمريض الانفكشن عشان كذا ما نفضله.

Microscopic examination

- About 90% of patients have > 10 WBCs /cu.mm
- Gram stain of uncentrifuged sample is sensitive and specific.
- One organism per oil-immersion field is indicative of infection.
- Blood cells, parasites or crystals can be seen
- **Microscopic examination mainly looks for Bacteria and WBC**

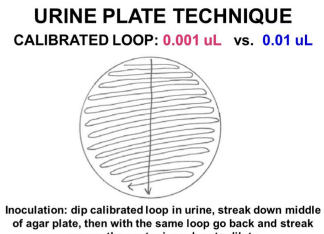
Chemical screening tests

- **Urine dipstick:** rapid, **detects nitrites** released by bacterial metabolism and **leukocyte esterase** from inflammatory cells**. Not specific**. (If the result is **negative** it does not indicate that patient is not UT infected)
- Used in emergencies with the microscopic examination of WBC's (both give quick results)

Urine culture

- Important to **identify bacterial cause** and **antimicrobial sensitivity** (takes time)
- **Quantitative culture** typical of UTI ($>10^5$ cfu/ml) , Lower count ($<10^5$ or less eg. 1000 cfu/ml) is indicative of cystitis if the patient is symptomatic.

Quantitative identification of specific amounts of the bacteria is preferred because presence of small amounts may be caused by catheterization or contamination while collecting the sample.



Using 0.001/ml loop

- ➢ 1 colony = 1000 CFU/ml
- ➢ 100 colonies = 10^5 > CFU/ml

Treatment of cystitis

- **Empiric treatment** is commonly used depending on the knowledge of common organism and sensitivity pattern.
- Treatment is best guided by susceptibility pattern of the causative bacteria

Duration of treatment

- Uncomplicated: **3 days**
- Complicated or recurrent: **10** (7)**-14 days**

- Common agents:
  - Ampicillin
  - Amoxicillin
  - Amoxicillin-Clavulanic acid
  - Cephradine (first generation cephalosporin)
  - Ciprofloxacin (Fluoroquinolone)
  - Norfloxacin (Fluoroquinolone)
  - Gentamicin I.V used for severe cases
  - TRM-SMX (Trimethoprim/sulfamethoxazole)

Prophylaxis

- **Nitrofurantoin** (Only used in cystitis not for upper UTI)
- TRM-SMX

- **Prevention:** Drinking plenty of water and take prophylactic antibiotics the (more urination = less bacterial colonization)

Recurrent cystitis

- Patient would have a history of **three or more episodes of cystitis/year**
- Recurrent cystitis requires further investigation such as Intra-Venous urogram (**IVU**) dye used to check the flow of urine or ultrasound to detect obstruction or congenital deformity. (you should look for the cause)
- Cystoscopy منظار is required in some cases

How to differentiate between cystitis and urethritis?

Cystitis is

- more acute onset
- More severe symptoms
- Pain, tenderness on the supra-pubic area.
- Presence of bacteria in urine (bacteriuria)
- Urine cloudy, malodorous and may be bloody
- No fever

SAQ

SAQ1: A 25-year-old female seen in a walk in clinic with 2 days history of dysuria and frequency. Examination revealed supra pubic tenderness. But no fever or flank pain A) What is the diagnosis? B) Is this case complicated or uncomplicated UTI? C) What is the appropriate specimen type? D) And what lab work should be done? E) What is most likely causative organism? F) What risk factors does this patient have?

SAQ2: A 7-year-old previously hospitalized male suddenly developed pain during urination and increased frequency with gross hematuria. A dipstick urine test was positive for nitrites and leukocyte esterase. A) What is the most likely diagnosis? B) Name 3 possible causative agents? C) Name a method used to obtain a specimen?

SAQ3: A 75-year-old woman is diagnosed with cystitis underwent catheterization due to urinary incontinence. Blood culture and gram stain showed a gram +ve cocci in clusters that are coagulase -ve. A) What is the most likely causative organism? B) And what is the pathogenesis?

SAQ1: A- Cystitis B- uncomplicated C-MDU D- Microscopy/urine dipstick test/Quantitative urine culture E- E-coli F- Short Urethra

SAQ2: A-Cystitis B- E.coli, Pseudomonas, Acinetobacter C- Supra-pubic aspiration/in & out catheterization

SAQ3 A- Staph. epidermidis B-Ascending infection

MCQs

Q1: A 25-year-old pregnant woman, G2P1 at 14 weeks of gestation, comes to the emergency department because of dysuria for the past 3 days. She states she otherwise feels well. Physical examination shows suprapubic tenderness. Urinalysis is positive for leukocyte esterase and nitrites and culture shows greater than 100,000 CFU/mL of gram-negative rods. Which is the most likely causative organism in this patient?			
A-Pseudomonas aeruginosa	B- Escherichia coli	C-Staphylococcus saprophyticus	D- Proteus mirabilis
Q2: The most common uropathogen, accounting for about 80% of UTIs acquired in the community is			
A- Pseudomonas aeruginosa	B- E. coli	C- Klebsiella pneumoniae	D- Chlamydia
Q3: A 31-year-old (outpatient) woman visits her local clinic for 2 days of dysuria, increased voiding frequency, urgency, and intense suprapubic pain. She just came back a day ago from a short honeymoon trip to Prague. On physical examination, the patient is found with exquisite suprapubic pain. Costovertebral tenderness is absent and pelvic examination is normal. Her vital signs are: temperature 36.5°C (97.7°F), heart rate 78/min, respiratory rate 15/min. Which of the following organisms would be most likely isolated in this patient?			
A- Streptococcus agalactiae	B- Enterococcus faecalis	C- Staphylococcus saprophyticus	D- Klebsiella pneumoniae
Q4: what are the lab investigations for cystitis.			
A- Microscopic examination	B- Chemical screening tests	C- Urine culture	D- all of them
Q5: Dipstick testing the urine of a patient with a suspected UTI involves detecting			
A- Nitrite & leukocyte esterase	B- Protein & glucose	C- Ketones	D- Albumins
Q6: What is the most common cause of young sexually active females			
A- S. Saprophyticus	B- E.coli	C- Pseudomonas	D- Acinetobacter spp
Q7: Cystitis is common In women due to			
A- pregnancy	B- long urethra	C- decreased estrogen	D- A/C
Q8: Duration of treatment In complicated UTI			
A- 3 days	B- 4 days	C- 10-14 days	D- 8-12 days

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
B	B	C	D	A	A	D	C

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