Acute Pyelonephritis

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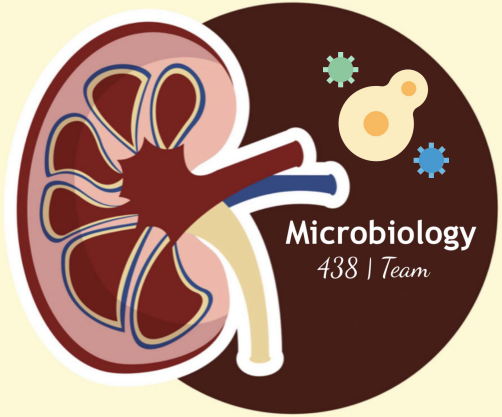


Objectives

Color index:
- Important,
- Doctor Notes
- Extra, TN

- Knowing the:
  - Epidemiology
  - Etiology
  - Pathogenesis
  - Pathophysiology
  - Pathology
  - Clinical presentation
  - Diagnosis
  - Treatment & prevention
  - Other syndromes

UTI Terminology

Uncomplicated
Infection in host without underlying renal or neurologic disease.
Young, Healthy, Female, Non-pregnant.

Complicated
Infection in setting of underlying structural, medical or neurologic disease.

Recurrent
>2 or 3 symptomatic UTIs within 12 mos, following clinical resolution of each previous UTI after therapy.

Reinfection
recurrent UTI **caused by different pathogen** at any time or original infection strain **>13 days** after therapy of original.

Relapse
recurrent UTI caused by **same species** causing original UTI within 2 weeks after therapy.

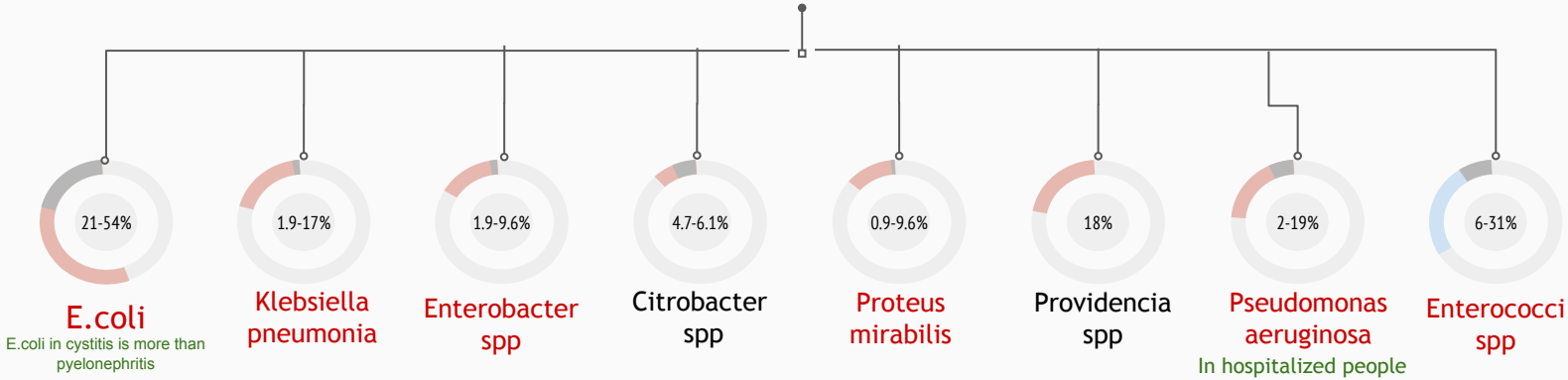
Pyelonephritis

- It's bacterial infection of the renal **pelvis**, **tubules**, & **interstitial** tissue of one or both kidneys.
- Potentially organ- and/or life-threatening infection that lead to renal scarring, nephritic, perinephric abscess formation, & sepsis with each infection & may lead to significant damage to the kidney that may lead to **hypertension**.
- Clinical presentation is Atypical in some patient. Elderly patients or children
- Pyelonephritis may be **acute** or **chronic**.

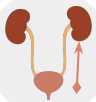
Etiology

- **Escherichia coli** is the most common pathogen in complicated (21-54%) & uncomplicated (70-90%) UTIs,
  - it's called uropathogenic E.coli (UPEC), which derives commonly from the phylogenetic groups B2 & D, which express distinctive O, K, & H antigens.
  - UPEC genes encode several postulated virulence factors (VFs), including **adhesion** P fimbriae pap+genotype family, **protectine**, **siderophores**, & **toxins**.
- **Staphylococcus saprophyticus** → seen just in **Young, Female, Sexual active** "honeymoon cystitis"
- **Proteus mirabilis** (Gram-ve non-formating lactose, oxidase -ve, urease +ve, swarming in BAP).→ associated with kidney stones
- **Staphylococcus aureus** (**hematogenous spread** to kidney, **it can be seen in urine & cause micro abscess,& it's an indication to other infection in other site of body e.g. endocarditis..**).
- Candida, viruses, brucella & MTB can cause UTI but it's **rare**.

Complicated UTI Etiology



Pathophysiology: In female slides only



Infection usually **ascends** from urethra, most bacteria causes bowel organisms e.g. E.coli (70-80%).

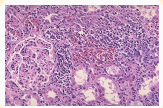
Hematogenous spread, which is rare e.g. Neonats with Staph.aureus & seen in cases of MTB.

Hospital-acquired infections may be due coliforms & enterococci, it's due to unneeded catheterization.

Frequently due to ureterovesical reflux.

Pathology:

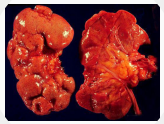
Kidneys enlarged.



Interstitial infiltration of inflammatory cells.

Abscesses on the capsule & corticomedullary junction.

Result in destruction of tubules & the glomeruli.



When chronic: kidneys become **scarred, contracted & non-functioning.**

Pathogenesis:

01 • Rectal and/or vaginal reservoirs.

02 • Colonization of perianal area.

03 • Bacteria migration to perivaginal area.

04 • Bacteria ascends through urethra to bladder.

05 • Intercourse may contribute urethral colonization & ascending infection.

06 • ASB (asymptomatic bacteriuria) in 1st trimester of pregnancy may cause pyelonephritis in 3rd trimester.

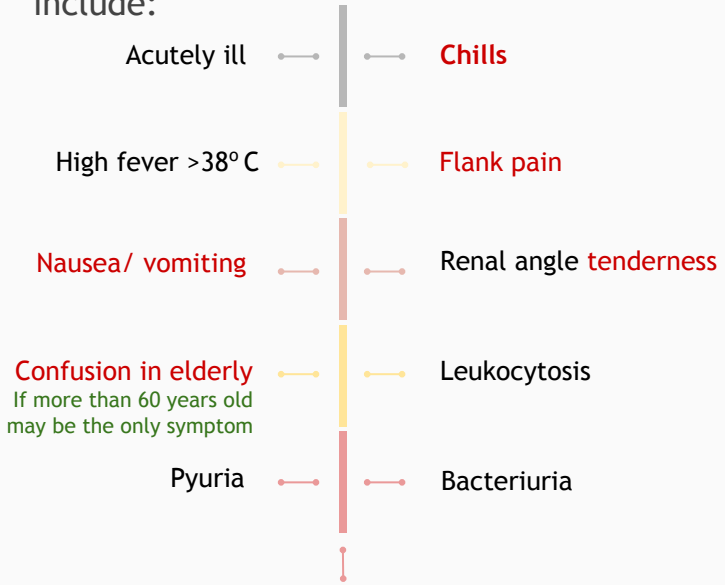
When to treat ?
1- elder people
2- pregnant women
3- children

07 • For optimal host defense function, intermittent & complete emptying of bladder must occur:
- Urine is excellent culture medium (MSU).
- Bactericidal secretion from uro-epithelial cells & glycoproteins inhibits bacterial adherence.

08 • Renal parenchyma infections result in inflammatory response to contain infection but contributes to potential **scarring**.abscess can develop in severe cases

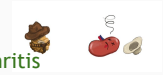
Clinical Manifestations of acute Pyelonephritis:

- Symptoms develop rapidly (<24 hs) & may include:



- In addition symptoms of LUTI involvement (*Dysuria, Frequency, & urgency*).
- Other Non-infectious causes of these symptoms are **renal infarct** & **Calculi** (same pain but no fever).

Risk Factors:

Mechanical:			Constitutional:
➔ Structural abnormalities to the kidneys & urinary tract:			➔ E.g.
• Calculi Especially chronic pyelonephritis 	• prostate disease (e.g. BPH) in elderly men.	• Nephrostomy	• Diabetes mellitus (10 time more admission).
• Bladder tumours	• Obstruction	• Urethral strictures	
• Urinary tract catheterisation	• Pregnancy (½ of asymptotic will developed pyelonephritis if not treat.	• Vesicoureteral reflux (VUR) especially in young children.	• immunocompromised states.
• Neurogenic bladder (e.g. due to spinal cord damage, spina bifida or multiple sclerosis).			

Complications: In boys slides only but imp:)

- Hypertension, septic shock, multi-organs failure, death.
- Renal or prinephric abscesses.
- Metastatic infection.
- Papillary necrosis.
- Acute renal failure.
- Emphysematous pyelonephritis.
- Renal gangrene.
- Localized or generalized atrophy/ permanent loss of function.
  Especially in the chronic it will become scarred and atrophied

Diagnosis

Urinalysis

A clean-catch or catheterized urinalysis with quantitative culture on Blood Agar Plate (BAP), & selective media & sensitivity identifies the pathogen & determines appropriate antimicrobial therapy

- Diagnosis is confirmed by:
  - **significant bacteriuria** (10^5/**ml** or 10^8/l) & pus
  - Positive result on leukocyte esterase dipstick test → ≥ 10 WBC/HPF (with specificity of 65-95% & sensitivity of 75-95%).
  - RBCs 20-40% in the urine & leukocytosis.
  - Positive nitrate dipstick test result for bacteriuria [bacteria reduce nitrate to nitrite] is only moderately reliable; false-negative results are common.

- What we are looking for in the urine ?
  1- bacteria. 2- WBCs. 3- RBCs.

Blood tests/culture

- Important in **asystamic infection**.
- Blood urea nitrogen (BUN) & creatinine levels of the blood & urine may be used to monitor kidney function

Radiological investigation

- IVP (intravenous pyelogram) will identify the presence of obstruction or degenerative changes caused by the infection process.
- Radionuclide imaging with gallium citrate & indium-111-labeled WBCs.
- Ultrasound or CT scan.

What we are looking for in radiology ?
1- vesicoureteral reflux. 2- stones

Micturiting cystourethrography (MCW showing bilateral VUR, grade IV on right and grade III on left-side. There is bilateral ureteral and pelvic dilation with blunting of fornices in the right kidney.

Bilateral reflux extending into the pelvicalyceal systems of the kidney without dilatation of the calyces or ureters. (Note catheter in bladder)

Management

All Antibiotics are selected according to results of urinalysis culture & sensitivity & may include broad-spectrum medications

Mild signs & symptoms

- **No** nausea, vomiting, or dehydration.
- Treat on an outpatient basis with antibiotics **for 7-14 days & Orally**.

1. **TMP-SMX** (Bactrim)

Is empirical treatment **(**only if uropathogenic is known to be susceptible because it's resistance around 50%**).**

2. **Fluoroquinolones** (Ciprofloxacin)

Is alternative.

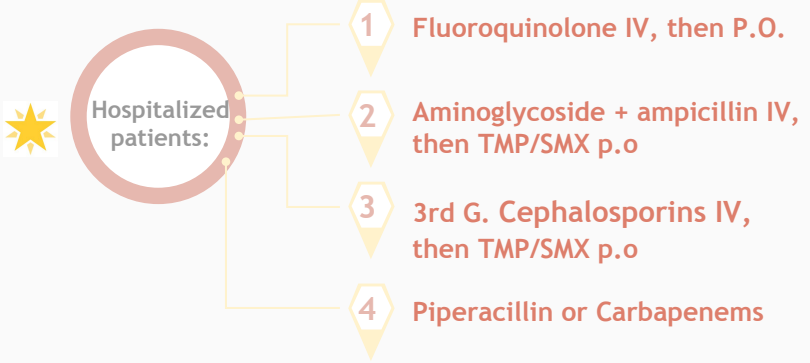
3. **Amoxicillin - or Amoxicillin-clavulanate**

If gram +ve pathogen

4. **Gentamicin with or without amoxicillin**

Severe cases

- very ill patient & pregnant women are **hospitalized** at least for 2-3 days for parenteral therapy.
- IV antibiotics first 48-72 hs, followed by 7 days of oral antibiotic therapy.



- Ambulatory patients:
  - 7-14 days of P.O. therapy with one of the antimicrobials above

Prevention In boys slides only

- Used in recurrent patient.
- For antimicrobial prophylaxis use the half dose.

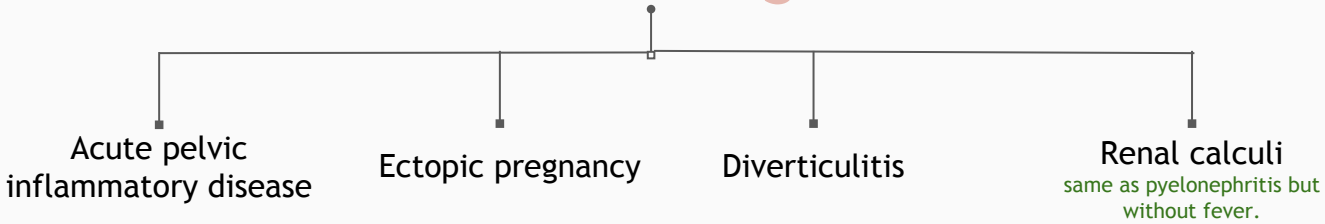
TMP-SMX or Fluoroquinolones (for 3 weeks), or Nitrofurantion daily (not used in treatment of UUTI, but it's useful for prevention in treatment of the lower).

Intravaginal estradiol

300 ml of Cranberry juice.

If the patient on catheter, you should remove it ASAP if it unneeded, or use condom catheter.

Differential diagnosis In boys slides only



Prognosis:

- It's dependent upon **early detection** & successful treatment, and also it depend on the patient him/herself, if old it may be severe.
- Baseline assessment for every patient must include urinary assessment because pyelonephritis may occur as a primary or secondary disorder.
- If relapse : another 6 weeks course
- We have to follow up urine culture 2 weeks after completion of therapy

Chronic pyelonephritis

- Repeated bouts of acute pyelonephritis may lead to **chronic pyelonephritis** that may lead to kidney damage & hypertension.
- Progressive scarring ⟶ **renal failure.**

Clinical manifestations	Assessment & diagnostic findings
• No symptoms of infection unless an acute exacerbation occurs • patient may show unremarkable symptoms such as: ○ Nausea. ○ Vomiting. ○ Polyuria. ○ excessive thirst. ○ Weight loss. ○ **Hypertension.** ○ General malaise. ○ diarrhea. ○ Fatigue. ○ Headache. ○ Poor appetite.	• Serum creatinine. • blood urea. • culture & sensitivity. • Intravenous pyelogram (IVP).
Complications	**Medical management**
• Hypertension occur when more than 90% of glomeruli are damaged • End stage renal disease (ESRD). • Kidney stones.	• According to culture & sensitivity. • Drugs carefully titrated if renal function is impaired.

Nursing management

- Fluid balance - I/O chart.
- Fluids encouraged unless contraindicated.
- 4th hourly temp.
- Antibiotics.
- Bed rest.
- Teach how to prevent recurrent infections:
  - adequate fluids, emptying the bladder regularly, & performing recommended perineal hygiene taking antibiotic as a prescribed.

it's very Important understand the difference between:
1-Reinfection: is more than 2 Weeks and Different organism.
2-Relapse : less than 2 weeks and same organism.

Risk factor:
Women are more likely to get Pyelonephritis than men, this may be because:
-In Pregnancy:
- Due to smooth muscle Relaxation
- vesicoureteral reflux

other Risk factor:
- ***Catheter***:
-Introduce the outside bacteria

The most common organism :
-E.Coli
a Nasty type of E.Coli causing recurrent infection by :
adhesion to the kidney through its Capsule.

Hematogenous spread:
When you see staph. Aureus in urine then this is a hematogenous spread and bacterial so we most do a test to blood.
Staphylococcus aureus is a very bad organism in pyelonephritis.
It causes: **microabscess** in kidney , Septic shock

• Understanding difference between upper and lower UTI
-lower UTI: -In lower, abdominal pain, no Fever /or mild fever.
-upper UTI: high fever,flank pain, vomiting and Hypertension

• complication of Acute pyelonephritis:
-Peritonitis They feel pain when moving
Caused by Diverticulosis.

Differential diagnose:-

- Renal calculus causes - pain - with movement.
- ectopic pregnancy: Not clinically significant as Renal calculus

Diagnosis :
Nitrate indicate: gram -ve infection
Leukocyte esterase indicate Bacteriuria.

Complicated pyelonephritis :
If the patient is adult we have to check the prostate, tumors, stones

TREATMENT:
nitrofurantoin is not used in UUTI, but useful for treatment of LUTI & prophylaxis of UUTI
Start TMP-SMX
If hospitalized : aminoglycoside (Gentamicin) + Ampicillin
If sever : Carbapenems + Piperacillin
PROPHYLAXIS IS IMPORTANT: TMP-SMX + nitrofurantoin

Quiz

1- To prevent urinary tract infections, some doctors recommend that people drink which liquid?

A. Lemonade
B. Cranberry juice
C. Green tea
D. Apple juice

2- Which of the following patients is most likely to have uncomplicated UTI?

A. A 40-year-old female with diabetes
B. A 65-year-old male
C. A 22-year-old healthy female
D. A 10-year-old female with a history of vesicoureteral reflux

3- Which of the following is the most probable reason females will experience at least one urinary tract infection (UTI) in their lifetime?

A. Increase bacteria in their GI tract
B. Their tendency to take baths more often than males
C. Their anatomical predisposition
D. Increased use of antibiotics in their younger years

4- which of the following symptoms present pyelonephritis ?

A. Chills, flank pain, fever
B. Dysuria, oliguria, fever
C. Dyspnea, increase heart pulse
D. Polyurea, fever, chills

SAQ

1- A 2 year old boy is brought into your Paediatric ED with a fever of 38.5 deg C and vomiting of 2 days duration. He has had no coryza or cough. He has no rash. The nurses have done a urine dipstick which is positive for leukocytes esterase and nitrites.

A- What is the most likely diagnosis?

B- Give two complications according to the diagnosis

Answers:

A- Acute pyelonephritis

B- Acute renal failure - papillary necrosis

Key answers:
1-B 2-C 3-C 4-A

Case 1

You are contacted by a resident regarding the use of a FQ [FLUOROQUINOLONES] in a 24 year old semi-professional soccer player with an apparent UTI. He has complained of dysuria and frequency for the last 24 hours. His UA is **positive** for bacteria using a nitrate dipstick and BCs using a dipstick esterase test. His past medical history is significant for **DM**. He has no allergies other than his diabetes there has been no other significant medical problems.

Questions

1- Mention the risk factors that the patient have.

- Diabetes mellitus

2- what is your opinion about using FQ?

It is effective in the case of UTI and should be used for (7 - 14) days, orally.

Symptoms	• Dysuria • Frequency
Findings	• +ve nitrate dipstick • +ve leukocyte esterase
Risk factors	Diabetes mellitus

Case 2

An asymptomatic 84 year old male with hypertrophy of the prostate has an indwelling foleys catheter has a positive urine culture for **P. aeruginosa**. You have been contacted regarding the appropriate dose and interval for ciprofloxacin to begin therapy.

Question

1- Mention the risk factors that the patient have.

- Prostatic hypertrophy
- Catheterization

2- what is the interval for ciprofloxacin ?

2-3 days IV then orally for 7 days

Findings	positive urine culture for **P. aeruginosa**
Risk factors	• Prostatic hypertrophy • Catheterization

Case 3

You have been consulted on a 72 year old female nursing home patient. She recently was treated for 10 days with ceftriaxone and azithromycin for presumed CAP. During her hospitalization a foley catheter was placed. She is currently afebrile and asymptomatic of any UTI symptoms but a culture of her urine at the end of her antibiotic therapy had a significant growth of **yeast**. How should she be managed?

Questions

1- Mention the risk factors that the patient have.

- Catheterization

2- what is the plan of management ?

Remove the catheter and start antifungal drug.

Symptoms	Asymptomatic
Findings	Significant growth of **yeast**
Risk factors	• Catheterization

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Thank you

Special thanks to our amazing designer
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