Bacterial Infections Of The Genitourinary Tract

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Introduction

- Urinary tract infection is the second most common type of infection in humans and is encountered in about 75% of patients seen by urologists.

- Although most cases are susceptible to a variety of antibiotics and respond quickly to short-term therapy, infections with resistant organisms are difficult to treat.
Etiology & Pathogenesis

- Most UTIs are caused by aerobic gram-negative bacteria, especially *Escherichia coli*.
- There are 4 possible pathways of bacterial entry into the urinary tract.
Etiology & Pathogenesis

- **Ascending infection** from the urethra is clearly the most prevalent cause of UTIs in both men and women.

- **Hematogenous spread** of infection into the urinary tract is much less common in adults, but *staphylococcal* can do this way and can produce renal and perirenal abscesses.
Etiology & Pathogenesis

- Lymphatogenous spread is probably very rare. Theoretically, bacteria can travel through rectal and colonic lymphatics to infect the urinary tract, but there is little evidence.
- Direct extension of infection from neighboring organs may occur in certain circumstances. (intraperitoneal abscesses, vesicointestinal and vesicovaginal fistulas)
Classification of UTIs

- According to their location within the urogenital tract, UTIs can be classified as:
  1. **upper urinary tract infection** (acute or chronic pyelonephritis, renal abscess)
  2. **lower urinary tract infection** (cystitis or urethritis)
  3. **genital infection** (prostatitis, epididymitis, seminal vesiculitis, or orchitis).
Classification of UTIs

- According to their clinical presentations and patient’s conditions, UTIs can be classified as:
  1. Uncomplicated UTI
  2. Complicated UTI
  3. Asymptomatic bacteriuria
  4. Recurrent UTI
Classification of UTIs

- **Uncomplicated UTIs** are seen mostly in women who have none of the factors known to increase the risk of complications or of treatment failure.

- **A complicated UTI** is an infection associated with a condition, such as structural or functional abnormalities of the genitourinary tract or the presence of an underlying disease, which increases the risks of acquiring an infection or of failing therapy.
Classification of UTIs

- **Asymptomatic bacteriuria** means the patient has no symptoms of urinary tract infection, such as urinary frequency and urgency, but two cultures of mid-stream sample of urine show the same bacteria of $\geq 10^5$ colony-forming units uropathogen/ml.

- **Recurrent UTI** is defined in the literature by three episodes of UTI in the last 12 months or two episodes in the last 6 months.
Acute Pyelonephritis
**Etiology & Pathogenesis**

- **E coli** accounting for 80% of cases.
- Other gram-negative organisms, such as *Klebsiella*, *Proteus*, *Pseudomonas* can also cause acute pyelonephritis.
- Except in the presence of *stasis*, *foreign bodies*, *trauma*, *instrumentation*, pyelonephritis is an ascending type of infection. Pathogenic organisms usually reach the kidney from the bladder via an incompetent ureterovesical junction.
Clinical Features

- The abrupt onset of fever, chills, and unilateral or bilateral flank pain constitutes the classic presentation of acute pyelonephritis.
- Lower urinary tract symptoms, including dysuria, frequency, and urgency are also common.
- On physical examination: Palpation or percussion over the costovertebral angle on the affected side causes pain.
Laboratory Findings

- A complete blood count regularly shows significant **leukocytosis**, with a shift toward neutrophils and immature forms.
- The **urinalysis** typically shows numerous **leukocytes** as well, accompanied by bacteria.
- **Urine culture** is always positive and typically yields heavy growth of the pathogenic **bacteria** (≥100,000 CFU/mL).
**X-ray Findings**

- In acute attacks, only minimal changes such as renal enlargement, delayed function and poorer concentration are usually noted on intravenous urography.

- CT with enhancement may show renal enlargement and perfusion deficits.
Figure 12-11. Acute right pyelonephritis: IVP, ULS, and MRI.
(A) Excretory urogram in acute right pyelonephritis showing enlarged kidney with delayed function. Arrows point to contrast in ureter. (B) Ultrasound in same patient showing renal parenchymal edema (contralateral kidney measured 102.5 mm). (C) T1-weighted MRI of same patient showing perinephric fluid collection (arrows).
Figure 12-12. Acute pyelonephritis. CT scan in a patient with bilateral acute pyelonephritis showing marked edema and striation of the renal parenchyma. (Photograph courtesy of Dr. D. M. Warshauer.)
Essentials of Diagnosis

- Chills, fever, and flank pain
- Frequency, urgency and dysuria.
- Pyuria and bacteriuria.
- Bacterial growth on urine cultures.
Treatment

- Empiric antibiotic therapy directed against the most common pathogens should be started.
- For adults being treated as outpatients, the fluoroquinolones or TMP-SMX are generally efficacious and well tolerated.
- According the urine culture results, sensitive antibiotic should be selected and therapy should be continued for **10-14 days**.
Treatment

- In patients with a more toxic appearance, hospitalization with **bed rest**, **intravenous fluids**, and **parenteral antibiotics** may be required.
- **Aminoglycoside** combined with ampicillin (or TMP-SMX), **fluoroquinolones** or parenteral **third-generation cephalosporins** as mono-therapy can be employed.
- Failure to simultaneously identify and treat predisposing factors (e.g., obstruction) is the principal cause of failure to respond to therapy.
Complications & Prognosis

- The most serious complication in adults is **septicemia** with shock and **renal abscess**.
- The prognosis is good with adequate treatment of both the infection and its predisposing cause.
Emphysematous Pyelonephritis

- Emphysematous pyelonephritis is a form of acute pyelonephritis secondary to a gas producing bacteria (most often *E. coli*, *Klebsiella* also seen).
- It is commonly seen in diabetic patients with upper urinary tract obstruction.
- The diagnosis is made by the usual signs of acute pyelonephritis and by the presence of gas in the renal collecting system, seen on plain films of the abdomen or intravenous urography.
Treatments

- Patients should be given fluids and broad-spectrum antibiotics intravenously.
- Prompt control of blood glucose and quickly relieve of ureteral obstruction should be achieved.
- The condition causes severe sepsis and may require emergency nephrectomy when response to antibiotics is not seen within a few hours.
Figure 12–15. Emphysematous pyelonephritis. Noncontrast CT scan with intraparenchymal gas collections (arrows) in a patient with right emphysematous pylonephritis.
Chronic pyelonephritis

- Chronic pyelonephritis is the result of poorly treated or recurrent acute pyelonephritis.
- The diagnosis is primarily made by x-ray, since patients rarely have signs or symptoms until late in the course, when they develop chronic flank pain, hypertension, anemia, or renal failure.
- Pyuria is not a consistent finding.
Chronic pyelonephritis

- Because chronic pyelonephritis may be a progressive local immunologic response initiated by bacteria long since eradicated, urine cultures are commonly sterile.

- Early cases may have no findings on intravenous urography, whereas late cases will reveal small kidneys with typical caliceal deformities, with evidence of peripheral scarring and a thin cortex.

- Voiding cystourethrography often reveals reflux. **Complications** include hypertension, stone formation, and chronic renal failure.
Chronic pyelonephritis

- Antibiotic treatment is usually not helpful in these patients unless a current infection can be documented.
- The prognosis depends on the status of renal function but is generally not good, particularly when the disease is contracted in childhood.
- Progressive deterioration of renal function usually occurs with time.
Xanthogranulomatous pyelonephritis

- Xanthogranulomatous pyelonephritis is a form of chronic pyelonephritis **common in middle-aged diabetic women**.
- Most often, the disease is unilateral and is associated with a long history of calculus obstructive uropathy.
- Patients often have **symptoms similar to those of acute pyelonephritis** but also have an enlarged kidney with calculi and a mass often indistinguishable from tumor.
Xanthogranulomatous pyelonephritis

- **Proteus species** are common causes.
- Nephrectomy with excision of all involved tissue is usually required, but partial nephrectomy has been successfully performed in some patients with focal lesions.
- The diagnosis is often made pathologically following nephrectomy performed because of unrelenting symptoms.
Renal Abscess
Etiology & Pathogenesis

- In the past, most renal abscesses are due to hematogenous staphylococcal infections arising from skin infections.
- Currently, most abscesses result from ascending infections and the pathogens are predominant aerobic gram-negative organisms commonly found in other UTIs.
- Patients with UTIs complicated by stasis, calculi, pregnancy, neurogenic bladder, and diabetes were more prone to abscess formation.
Clinical Features

- **Fever, chills, and flank pain** are the typical presenting signs.
- If the abscess-forming bacteria arose from a lower tract source, or if the abscess communicates with the collecting system, then cystitis-like symptoms may also be present.
- Localized **costovertebral angle tenderness** and a palpable flank mass may be found on physical examination.
**Laboratory Findings**

- The complete blood count discloses a pronounced **leukocytosis**, with a shift toward neutrophils and immature forms.
- **Blood cultures** usually indicate **bacteremia**.
- **Urinalysis** may show **pyuria** and **bacteriuria**.
- In the case of a staphylococcal abscess, the urine will not contain organism unless the abscess has broken into the pelvicaliceal system.
X-ray Findings

- **CT**, with and without enhancement, is the diagnostic procedure of choice. Early on, CT shows renal enlargement and focal areas of hypoattenuation. Once the abscess has matured to a discrete liquefied collection of pus, an inflammatory wall surrounds the mass. With its increased vascularity, this wall enhances with contrast material, producing a “ring” sign.

- Ultrasound is also effective in detecting renal abscesses, showing a hypoechoic area.
Treatments

- If organism sensitivity can be established by appropriate tests (blood and urine cultures and sensitivity tests), treatment with the proper antibiotic is indicated.
- If no favorable clinical response is apparent after 48h of antibiotic treatment, however, percutaneous CT-or ultrasound-guided aspiration and drainage should be employed.
- If the abscess still does not resolve on follow-up imaging, then open surgical drainage or even heminephrectomy may be necessary.
Figure 12–22. Renal abscess. Contrast-enhanced CT showing gas in right renal abscess (arrow). Note bilateral incidental cysts. (Photograph courtesy of Dr. D. M. Warshauer.)
Perinephric Abscess

- **Perinephric abscess** means abscess between the renal capsule and the perirenal fascia. If the abscess extends beyond Gerota’s fascia, it becomes **paranephric abscess**.

- Renal abscesses can rupture out into the perinephric space, and this probably represents the primary way in which perinephric abscesses develop.

- Ascending aerobic **gram-negative infection** is more common than staphylococcal infection.
Perinephric Abscess

- Clinical findings are similar to those of renal abscess.
- **CT** is the most sensitive tool and show a soft tissue mass that has a central area of low attenuation.
- Ultrasound is a useful imaging modality as well, but it is less sensitive than CT.
- IVU and plain abdominal films are less reliable tests in patients with perinephric abscess.
Perinephric Abscess

- Treatment involves prompt drainage of the abscess and use of appropriate systemic antibiotics.
- Percutaneous drainage with local antibiotic irrigations is often successful.
- However, open surgical drainage may be necessary if percutaneous drainage is incomplete.
Cystitis
Etiology & Pathogenesis

- Cystitis is more common in females and is usually an ascending infection.
- In males, it usually occurs in association with urethral or prostatic obstruction, prostatitis, foreign bodies, or tumors.
- Reports consistently indicate that nearly 80% of bladder infections in women are caused by E. coli.
Clinical Features

- **Irritative voiding symptoms** are the hallmarks of acute cystitis.
- Low back and **suprapubic pain** are also frequent complains.
- **Fever is unusual.**
- In chronic cystitis irritative symptoms are usually mild.
- Physical examination reveals few characteristic signs, except occasional suprapublic tenderness.
Laboratory Findings

- **Urinalysis** typically shows **pyuria**, **bacteruria**, and occasionally **hematuria**.
- Urine culture identifies the organism. But if the adult patient’s symptoms and urinalysis are strongly suggestive of an uncomplicated infection, a urine culture may be avoided.
- **Leukocytosis** is not common.
Diagnosis

- **Cystoscopy** is not advisable in acute phase. In chronic cystitis, evidence of mucosal irritation may be present.

- In any documented recurrent lower urinary tract infection (particularly in males), a complete urologic work up is indicated.

- **Instrumentation** is contraindicated in acute phase, but it is essential in chronic or recurrent cases to identify the predisposing factor.
Treatments

- TMP-SMX, Nitrofurantoin, Fluoroquinolones may be the **first line choice** of antibiotics.
- The optimal duration of antimicrobial therapy for symptomatic acute uncomplicated cystitis in women is **3 days**.
- For complicated or recurrent cystitis, specific antibacterial therapy is given according to the results of sensitivity test.
Prostatitis
NIH categorization

- Category I: Acute bacterial prostatitis
- Category II: Chronic bacterial prostatitis
- Category III: Chronic pelvic pain syndrome
  - III A: Inflammatory type
  - III B: Noninflammatory type
- Category IV: Asymptomatic inflammatory prostatitis
NIH category criteria

- Category I: Acute, symptomatic bacterial infection
- Category II: Recurrent prostate infection
- Category III: No clearly identifiable infection
  - III A: Leukocytes present in prostatic fluid
  - III B: No leukocytes in prostatic fluid
- Category IV: No subjective symptoms; detected incidentally on biopsy or examination of prostate fluid
Acute Bacterial Prostatitis

- Aerobic **gram-negative** organisms principally cause acute bacterial prostatitis.
- Bacterial prostatitis probably results from **ascending urethral infection** and intraprostatic reflux of urine may play the most important role.
- **E coli** is implicated in 80% of infections.
Clinical features

- Acute bacterial prostatitis is marked by **fever and chills**; rectal, low back and perineal **pain**; and urinary frequency, urgency and dysuria.
- Prostatic swelling may produce acute **urinary retention**.
- DRE reveals an exquisitely **tender, enlarged** gland that is irregularly **firm** and **warm**.
Diagnosis

- Acute bacterial prostatitis is often diagnosed on the basis of symptoms and physical examination alone.
- A complete blood count typically shows leukocytosis, with a shift toward neutrophils and immature forms.
- The voided urine shows pyuria, microscopic hematuria, and bacteriuria.
Diagnosis

- Any **prostate massage** is not recommended owing both to the extreme discomfort of the procedure and to the possibility of inducing bacteremia.
- For much the same reasons, transurethral catheterization or cystoscopy should be avoided.
- Acute urinary retention requiring bladder drainage should be managed with a **suprapubic tube**.
Treatments

- Treatment with systemic antibiotics (aminoglycosides and ampicillin) should be started immediately and should be adjusted later when results of culture and sensitivity tests are known.

- The recommended duration of antibiotic treatment is 4-6 weeks to prevent the development of such complications as prostatic abscess and chronic prostatitis.
Prognosis

- A prostatic abscess usually requires open perineal drainage or transurethral unroofing.
- The prognosis is good if treatment is adequate and prompt.
- Some patients may progress to chronic bacterial prostatitis if attention is not focused on bacterial eradication.
Chronic bacterial prostatitis

- The causative organisms in chronic bacterial prostatitis are the same as those in acute prostatitis.
- **Intraprostatic reflux** of urine and the **ductal anatomy** contribute to chronic bacterial infection.
Clinical features

- Most patients report dysuria as well as urgency, frequency, and nocturia.
- Low back and perineal pain or discomfort are also common.
- The natural history is marked by disease relapse with occasional acute exacerbations, at which time fever, chills, and malaise might manifest.
Clinical features

- There are no characteristic findings on digital rectal examination.
- The prostate frequently feels normal, although tenderness, swelling, and firmness can be present.
- Sometimes there may be a clear white urethral discharge.
Diagnosis

- Laboratory diagnosis of chronic bacterial prostatitis is based on the **4-glass test**.
- This technique allows localization of bacteria by examining specimens from the urethra, midstream urine, and prostatic secretions.
Diagnosis

- The examiner obtains the first voided 10ml of urine (urethral specimen), a late midstream sample (bladder specimen), a specimen of prostatic secretions following prostatic massage, and the first voided 10ml of urine following massage.
- The specimens are labeled VB1, VB2, EPS, and VB3, respectively, and sent for bacterial identification and quantification.
Diagnosis

- If VB1 has high levels of leukocytes and bacteria relative to the other specimens, **urethritis** is likely. If VB2 has high levels, a site **above the bladder neck** is likely; and if the EPS, VB3, or both, have high counts, **prostatitis** is likely.

- The colony counts in EPS and VB3 should exceed those of VB1 and VB2 by at least 10-fold.
Diagnosis

- If no organisms can be cultured, and the prostatic fluid has an increased leukocyte count (>10 per HPF), a diagnosis of **chronic pelvic pain syndrome** can be made.
Treatments

- Most antibiotic agents have poor penetration into prostatic fluid and **chronic bacterial prostatitis** is **difficult to treat**.
- Recent testings show the newer **fluoroquinolones** have the most favorable diffusion characteristics and can serve as the **first line antibiotics**.
Treatments

- Other useful agents include TMP-SMX, carbenecillin, doxycycline, minocycline, amikacin.
- At least **3-4 months** of treatment is generally recommended.
- Addition of an **alpha blocker** to antibiotic therapy significantly reduced the number of symptom recurrences over antibiotics alone.
Chronic pelvic pain syndrome

- **CPPS** is both the most common form of prostatitis and the most poorly understood.
- The category is divided into inflammatory (III A) and noninflammatory (III B) forms, based on the presence of leukocytes in prostatic fluid.
- The **inflammatory type** has previously been called nonbacterial prostatitis and the **noninflammatory type** been called prostatodynia.
Clinical features

- Clinical features of CPPS are similar to those of chronic bacterial prostatitis.
- Pain symptoms predominate, especially in the perineum, penis, and testicles.
- Voiding dysfunction consisting of dysuria, slow stream, urgency, and frequency also occurs commonly.
- Clinical symptoms between the two subgroups are essentially the same.
Clinical features

- On physical examination, their prostates can be normal or tender.
- They may have tenderness of pelvic floor musculature on palpation and a tight anal sphincter.
Treatments

- Definitive treatment for CPPS is not available.
- Some patients do enjoy symptomatic improvement on antibiotics, so antibiotic therapy may be recommended.
- **Antibiotics** and **alpha blockers** in combination can reduce the symptom recurrence rate.
Treatments

- Pelvic floor relaxation techniques, biofeedback, prostate physical therapy (massage), and muscle relaxants may all reduce pelvic floor spasticity and, in turn, chronic pain symptoms.
- Anti-inflammatory agents, sitz bath, and normal sexual activity may provide symptomatic relief.
Prostatitis

Acute prostatitis (illustrated here) is an acute, febrile condition caused by bacterial infection. The gland is very tender, swollen, firm, and warm. Examine it gently.

Chronic prostatitis does not produce consistent physical findings and must be evaluated by other methods.
Acute Epididymitis
Acute epididymitis is most commonly a disease of young males, caused by bacterial infection ascending from the urethra or prostate. The disease is less common in older males, but when it does occur, it is most often due to infection secondary to urinary tract obstruction or instrumentation.
Clinical features

- The patient often feels a sudden severe pain in the scrotum and the pain can radiate along the inguinal canal and even to the flank.
- Often notes that scrotal size has increased rapidly, often doubling over a short time.
- Fever may be present.
Clinical features

- On examination, the scrotum is usually enlarged and reddened.
- The epididymis is often indistinguishable from the testis, as the two become obscured by one large inflammatory mass.
- The spermatic cord is thickened.
Diagnosis

- Laboratory findings reveal **pyuria**, **bacteriuria**, and marked **leukocytosis**.
- The most important aspect of diagnosing acute epididymitis is differentiating it from **testicular torsion**.
  - Doppler ultrasonography and radionuclide scanning may be employed for the differentiation.
  - Radionuclide scanning is more accurate than Doppler ultrasound.
Treatment}

- Treatment consists of **bed rest, scrotal elevation**, and **antibiotics** (usually tetracycline in men under age 35 and trimethoprim-sulfamethoxazole, ampicillin, or cephalosporin in those over age 35).

- Nonresponders may require parenteral amino-glycosides or third-generation cephalosporin.
complications

- Severe epididymitis may lead to abscess formation and requiring open drainage.
- Patients may sometimes develop chronic epididymitis after an acute attack and repeated mild infections.
Chronic epididymitis leads to induration and fibrosis of part or all of the organ, often with resulting tubular occlusion.

As a consequence, these patients can become secondarily infertile.

In addition, they may also have symptoms of chronic scrotal pain.

Once they have reached this stage, epididymectomy may be the only therapeutic option.