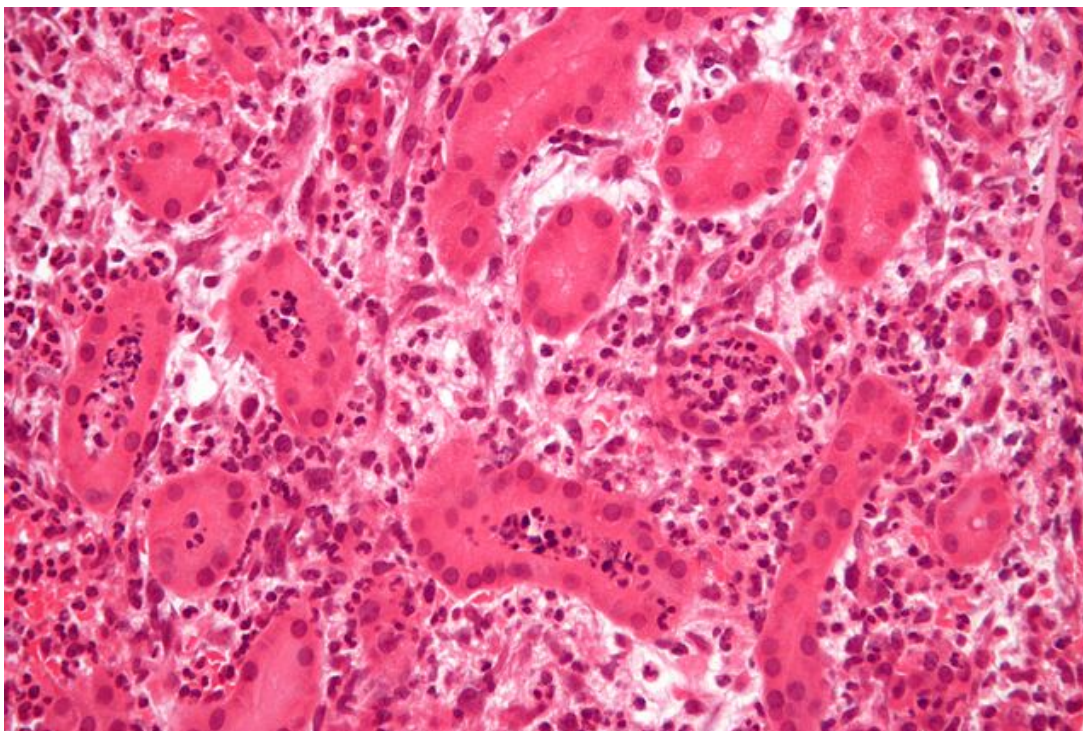


Kidney Infection (Acute and Chronic Pyelonephritis): Symptoms and Treatment

[See online here](#)

The bacterial infection is the most common cause of pyelonephritis. Acute complicated pyelonephritis is an acute emergency and needs immediate treatment with intravenous antibiotics. Infection in acute pyelonephritis is usually due to ascending infection, or due to hematogenous infection. The presence of recurrent infections, usually due to structural and functional anomalies in the genitourinary tract is the hallmark of chronic pyelonephritis. Clinical features include fever and abdominal flank pain with or without symptoms of cystitis. WBC casts are the characteristic findings seen in the urine analysis. Fluoroquinolones and cephalosporins are the mainstays in the treatment of pyelonephritis. Prognosis is excellent in uncomplicated pyelonephritis, while it is poor in emphysematous pyelonephritis.



Definition

Pyelonephritis is a life-threatening infection, caused by a bacterial infection of the **kidney** (involving the tubules, renal pelvis, and interstitium), resulting in pyelonephritis. The presentation is either **acute or chronic**. Acute pyelonephritis is caused by an ascending infection of the urinary tract or from the **hematogenous spread of systemic infections**. Generally, chronic pyelonephritis is due to chronic

recurrent infections secondary to **urinary reflux** or an obstruction in the **genitor-urinary tract**.

Epidemiology

The prevalence of acute pyelonephritis is to be 15–17 cases per 10,000 females and 3–4 cases per 10,000 males in the United States. It is more common in **pregnant females** diagnosed with asymptomatic **bacteriuria**.

Chronic pyelonephritis is common in children and is associated with **vesicoureteral reflux disease**.

Pyelonephritis has no racial predilection, and its distribution indicates that it is more common in the extremes of age with 2 peaks; 1 at 0–4 years and the other at > 65 years.

Women	Men	Either Gender
Risk factors similar to acute cystitis <ul style="list-style-type: none">• Sexual intercourse• History of previous UTI• Post-menopausal state<ul style="list-style-type: none">• Pregnancy• Anatomic or functional abnormality of urinary tract	<ul style="list-style-type: none">• UTI often complicated• Frequently associated with urologic abnormalities• Anal-insertive sexual intercourse	<ul style="list-style-type: none">• Urinary tract instrumentation• Diabetes mellitus• Immunosuppression

Classification

Acute pyelonephritis: is a medical emergency. If untreated, it can progress to an **abscess, sepsis, and organ failure**. **Urinary tract infections** (UTIs) due to Escherichia coli, Proteus mirabilis, or Klebsiella are associated with an increased risk by ascending the ureters. **Hematogenous infection** is usually due to **staphylococcus aureus**.

Chronic pyelonephritis: is due to recurrent bacterial infections and occurs predominantly in children with **genitor-urinary tract anomalies**. **Vesicoureteric reflux** in these patients results in chronic infections. Chronic pyelonephritis eventually leads to scarring of the kidney.

Pathophysiology

Acute Pyelonephritis

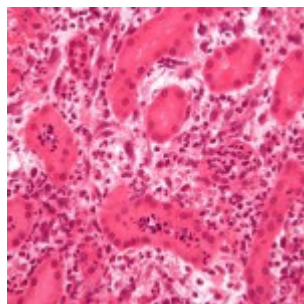


Image: "Very high magnification micrograph of acute pyelonephritis. H&E stain."

E. coli, Proteus, and Pseudomonas are the typical organisms associated with urinary tract infections. E. coli is the most common organism involved in acute pyelonephritis. The routes of infection are either **hematogenous** or an **ascending infection**.

Ascending Infection

Ascending infection with E. coli is by far the most common cause of **acute pyelonephritis**.

Favorable urothelium helps the bacteria attach. Instrumentation, especially with **cystoscopy** and **catheterization**, predisposes ascending infection to the **bladder** and the **renal pelvis**. A short urethra and the close proximity of the **urethra** to the **rectum** increases the risk of infection. **Urine** present in the bladder is usually sterile unless an ascending infection contaminates it. The infection gradually ascends from the bladder to the renal pelvis and kidney, resulting in acute pyelonephritis.

Hematogenous Spread

Hematogenous spread is usually uncommon. It occurs due to **staphylococcus** and **E. coli** infection. It results in the seeding of the **bacteria** in the **kidney**, which can result in **pyelonephritis**.

Chronic Pyelonephritis

The causes of pyelonephritis include:

Vesicoureteral reflux

Primary vesicoureteral reflux is seen in patients where the pathology is primarily in the urethrovesical junction. Usually, there is normal closure of the intravesical part of the **ureter**. However, a defect in the urethrovesical junction leads to reflux into the ureters and renal pelvis, resulting in vesicoureteral reflux.

Secondary vesicoureteric reflux develops in patients with neurogenic bladder.

Urinary Tract Obstruction

Lower urinary tract obstruction is the predominant cause of **chronic pyelonephritis**, which can be due to **benign prostatic hyperplasia** and **renal calculus**.

Renal Papillary Necrosis

This variant of **pyelonephritis** occurs predominantly in **diabetics**. It is characterized by the involvement of the **renal papilla**, called **papillary necrosis**. It is characterized by the presence of **ischemic** and **suppurative necrosis** at the tip of the renal papilla.

Conditions showing renal papillary necrosis:

- [Diabetes mellitus](#)
- NSAIDs abuse
- Acute pyelonephritis
- Sickle cell trait

Emphysematous Pyelonephritis

This is a rare, acute, and necrotizing form of pyelonephritis that occurs in **diabetic or immunocompromised patients**. EP is also associated with urinary tract obstructions. It is typically caused by *E. coli* or *K. pneumoniae*, and is characterized by an **accumulation of gas** in the renal parenchyma, collecting system, or perinephric tissue viewed using a CT scan or ultrasound. The patient will present with acute renal failure, micro- or macroscopic hematuria, and severe proteinuria. Prognosis is poor in **emphysematous pyelonephritis** because of septic complications.

Xanthogranulomatous Pyelonephritis

This is a chronic inflammatory disorder of the kidney characterized by the destruction of the renal parenchyma by the growth of granulomatous mass. Chronic infection associated with urinary tract obstruction (usually by **staghorn calculi**) results in **suppurative infection** of the kidney. It is typically caused by *Proteus*, *E. coli*, or *Pseudomonas*. Histopathological changes show infiltration by lipid-laden **macrophages** and the presence of large, irregular, yellow-orange masses which can be confused for true renal neoplasms.

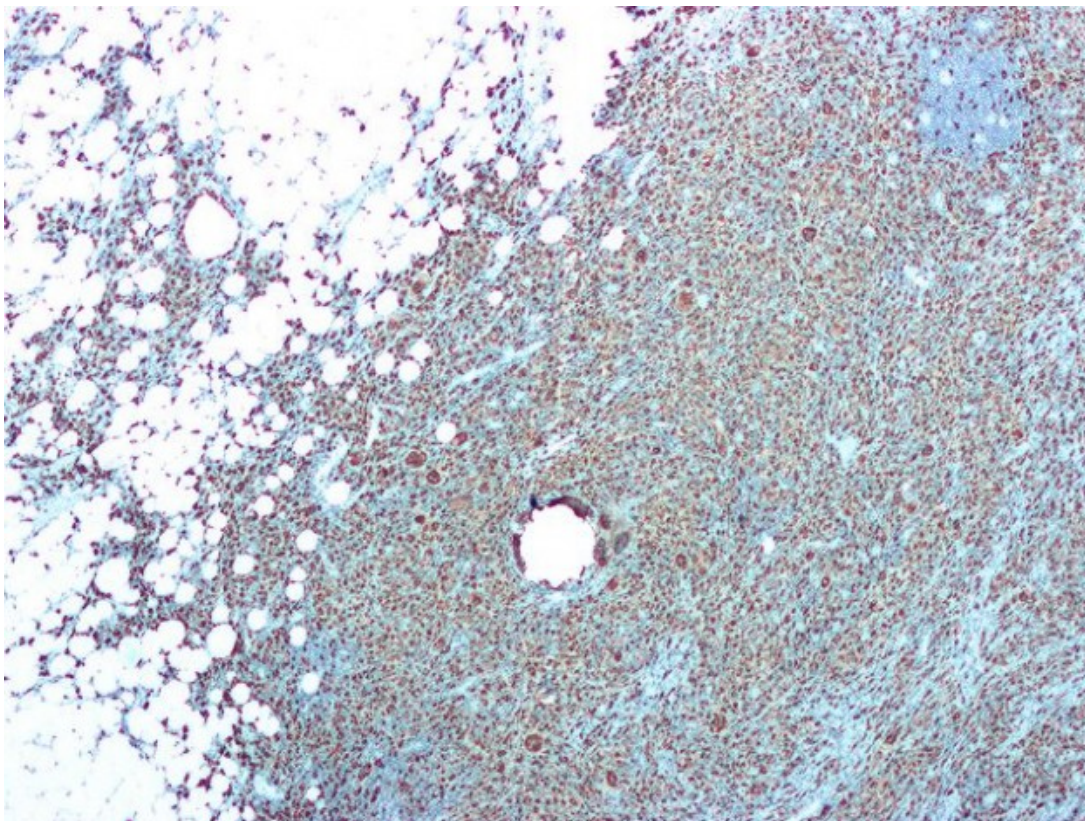


Image: "CD68 immunohistochemical staining of macrophages and giant cells in a case of xanthogranulomatous pyelonephritis." by Nephron. License: [CC BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/)

Clinical Examination and Symptoms

Acute Uncomplicated Pyelonephritis

The classic triad of symptoms of acute uncomplicated pyelonephritis is:

- Fever
- Costovertebral tenderness
- Nausea/vomiting

It is usually associated with symptoms of **cystitis**, which include increased frequency, urgency, dysuria, and suprapubic tenderness.

Children present with additional features of difficulty in feeding and failure to thrive, while elderly patients present with additional features of altered mental status and general disorientation.

Acute Complicated Pyelonephritis

Uncomplicated pyelonephritis, in the presence of any of the following associations, is considered **complicated pyelonephritis**:

- A recent history of urinary tract instrumentation
- **Diabetes**
- Pregnancy
- Multi-drug resistant pathogens
- Urinary tract obstruction
- Recent history of hospitalization

Renal abscess, emphysematous pyelonephritis, and papillary necrosis are also associated with complicated pyelonephritis.

Chronic Pyelonephritis

A past history of acute pyelonephritis is usually present. Chronic and recurrent infections can predispose children to **hypertension**. In children, symptoms such as fever, lethargy, flank pain, and nausea may be present.

Overview of sign and symptoms of pyelonephritis and perinephric abscess

Children	Women	Men
<ul style="list-style-type: none"> • Non-specific • Fever • Failure-to-thrive • Vomiting 	<ul style="list-style-type: none"> • Fever (a sign of sepsis) <ul style="list-style-type: none"> • Flank pain • Frequent, painful urination of small amounts of turbid urine • Suprapubic heaviness or pain (occasional) <ul style="list-style-type: none"> • Costovertebral angle tenderness 	<ul style="list-style-type: none"> • Presence of fever may indicate prostatitis or pyelonephritis • All cases of pyelonephritis or perinephric abscess need urologic evaluation

Diagnosis and Laboratory Investigations

Blood and Urine Examinations

- Acute pyelonephritis classically shows the presence of **WBC casts and hematuria** along with **pyuria** and **bacteriuria**.
- **Blood** investigations show increased serum creatinine levels. Complete blood count results show leukocytosis and the characteristic increase in the number of **neutrophils**. Inflammatory markers, such as C-reactive protein and erythrocyte sedimentation rate, are also elevated.

Gross and Histopathology Findings

Acute Pyelonephritis

This condition is characterized by a focal abscess formation in the cortex and medulla. The lower pole of the kidney is relatively spared; renal tubules show characteristic microabscess.

Chronic Pyelonephritis

Scarring of the **glomeruli** and tubular atrophy are characteristic of chronic pyelonephritis. There is an increased **eosinophilic substance** in the tubules (due to atrophy). This characteristically resembles the **thyroid tissue** on histopathological examination. This process of depositing an eosinophilic substance in the tubule is called **thyroidization**.

Radiological Investigations

- A **voiding cystourethrogram** helps diagnose **vesicoureteral reflex**.
- CT scanning is the investigation of choice whenever an obstruction or congenital anomalies are suspected.
- On intravenous pyelogram, typical **cortical scars** with blunt calyces are seen.

Treatment

Acute Pyelonephritis

Acute complicated pyelonephritis requires treatment with intravenous **cephalosporins**, followed by oral **fluoroquinolones**. **Oral fluoroquinolones** alone are sufficient for treating **uncomplicated pyelonephritis**.

Chronic Pyelonephritis

Preventing **reflux uropathy** in childhood forms the cornerstone of managing chronic pyelonephritis. It might require surgical correction depending on the grade of the vesicoureteric reflex. Almost all VUR cases should begin treatment with medical therapy. **Hypertension** should be treated with angiotensin receptor blockers.

Prognosis

Acute uncomplicated pyelonephritis has an excellent prognosis, and complete recovery is seen. **Emphysematous pyelonephritis** in diabetics shows a very poor prognosis irrespective of the treatment. Chronic pyelonephritis in children, due to **vesicoureteral reflux**, usually resolves spontaneously and only a few need surgical correction. Complications of chronic pyelonephritis include **focal glomerulosclerosis and renal scarring**, which progress gradually to end-stage renal failure.

References

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[Acute complicated cystitis and pyelonephritis](#) via uptodate.com

[Xanthogranulomatous pyelonephritis](#) via uptodate.com

[Chronic Pyelonephritis Clinical Presentation](#) via emedicine.medscape.com

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