CANADIAN UNDERGRADUATE UROLOGY CURRICULUM

Urinary Tract Infections

A Message from CanUUC

This educational material is intended to supplement medical student knowledge on urological health and medical practices. We are committed to promoting inclusion across all our materials. We acknowledge that some language used within this content may include terminology from source materials and research studies, which has been maintained to reflect the scientific context in which information was gathered.

Wherever possible, we aim to use language that is respectful of all individuals, recognizing gender diversity, variations in sex characteristics, and the importance of inclusive terminology.

Learning Objectives

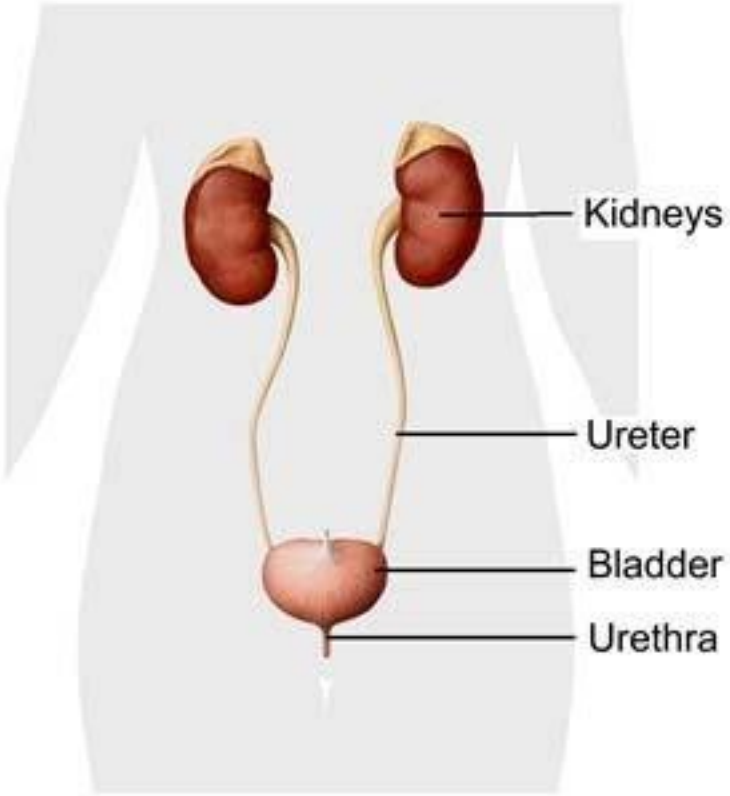
1. Describe the signs and symptoms of bacterial cystitis and pyelonephritis.
2. List the reasons to treat asymptomatic bacteriuria.
3. List the common bacteria causing urinary tract infections.
4. List the common antibiotics used to treat urinary tract infections.
5. Outline the investigations and treatment of bacterial cystitis and urinary tract infections.
6. Describe treatment options available for patients with recurrent bacterial cystitis.
7. Recognize the importance of an early diagnosis and emergent treatment of obstructed urinary tract infections.

Urinary Tract Infections (UTIs)

Infection and inflammation at some level of the urinary tract:

- Urethra: Urethritis
- Bladder: Cystitis
- Kidneys +/- ureters: Pyelonephritis

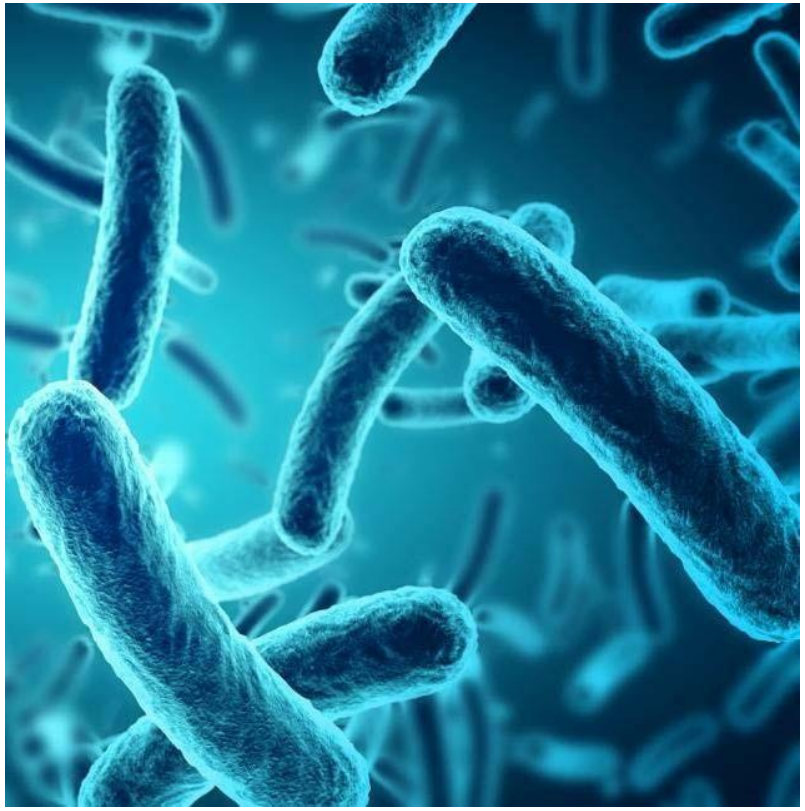
Location of infection is usually determined based on signs/symptoms



Urinary Tract Infections (UTIs)

Diagnosis can be supported with positive urinalysis and urine cultures

Most symptomatic episodes should be documented with cultures



Definitions

Uncomplicated cystitis: a lower urinary tract infection (UTI) in non-pregnant patients who are who are otherwise healthy.

Complicated cystitis: infection associated with factors that increase the chance of acquiring bacteria and decrease the efficacy of therapy, such as:

- Nephrolithiasis
- Immunocompromised status
- Presence of foreign bodies (i.e.: urinary catheter)
- Urinary tract instrumentation
- Functional or anatomic abnormality of the urinary tract
- Urinary stents
- Renal insufficiency
- Strictures
- Obstructive uropathy
- Pregnancy
- Male sex

Li R, Leslie SW. Cystitis. [Updated 2023 May 30]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK482435/

More Definitions

Persistent UTI: Persistence of symptoms and positive cultures with same bacteria despite culture-adjusted antibiotic treatment

Recurrent UTI: Recurrence of symptomatic UTIs and positive cultures with asymptomatic periods between episodes

- Two episodes of acute bacterial cystitis within six months, or
- Three episodes within one year.

Asymptomatic bacteriuria: Presence of bacteria in urine without symptoms or signs of UTI

Pyuria: Presence of white blood cells in urine

- May be present in UTI, but is not specific for UTI

Bacterial Cystitis: Signs & Symptoms

SIGNS:

- Suprapubic tenderness

SYMPTOMS:

- Frequency
- Urgency
- Dysuria
- Hematuria - microscopic or gross
- Pain - suprapubic or urethral

Pyelonephritis: Signs & Symptoms

SIGNS

- Fever
- Abdominal tenderness
- Costovertebral angle tenderness
- Tachycardia
- Hypotension
- Unwell, flushed, diaphoretic, toxic (if severe/sepsis)

SYMPTOMS

- Flank pain
- General malaise
- Chills, sweats, rigors
- Nausea & vomiting
- Confusion / decreased level of consciousness (if severe/ sepsis)

May also be associated with symptoms of bacterial cystitis

Classic triad: Fever, flank pain, positive urine cultures

Asymptomatic Bacteriuria: When to treat?

In most patients, asymptomatic bacteriuria should not be treated.

Absolute indications to treat:

- Pregnancy
- Before urological procedures

Relative indications to treat:

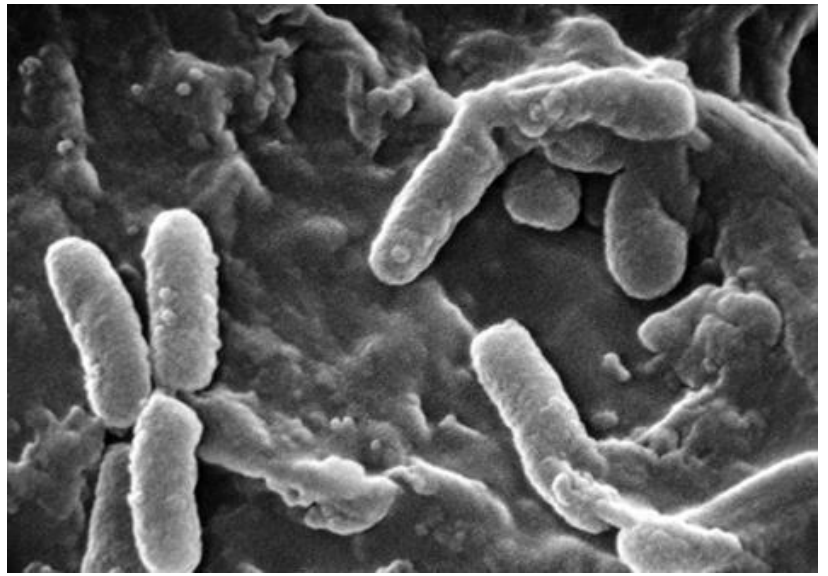
- Before surgical procedures with implant material
- Immunosuppressed state
- Atypical micro-organisms

Uncomplicated Cystitis: Common uropathogens

- Escherichia coli
    - By far the most common; 75-90% of cases
- Staphylococcus saprophyticus
- Klebsiella species
- Proteus species
- Enterococcus faecalis

Complicated Cystitis: Common uropathogens

- Escherichia coli
    - Most common; 35% of cases
- Pseudomonas species
- Enterococcus faecalis
- Staphylococcus saprophyticus
- Klebsiella species
- Proteus species



UTI Antibiotics: Common agents

- Trimethoprim/sulfamethoxazole
- Nitrofurantoin
- Fosfomycin

First line agents for uncomplicated cystitis

- Fluoroquinolones
    - Ciprofloxacin, levofloxacin
- Penicillins/aminopenicillins
    - Amoxicillin, ampicillin
- Cephalosporins
    - Cephalexin, cefadroxil, ceftriaxone
- Aminoglycosides
    - Gentamicin, tobramycin

Uncomplicated Cystitis: Investigations

Microscopic urinalysis can help make a diagnosis:

Pyuria (WBCs)

- Sensitivity: 80-95%
- Specificity: 50-75%

Hematuria (RBCs)

- Sensitivity: 40-60%

Bacteriuria

- Sensitivity: 40-70%
- Specificity: 85-95%

Uncomplicated Cystitis: Investigations

Rapid screen method (dipstick)

- Can help diagnosis, but low sensitivity
  - Should not replace microscopic urinalysis or culture
- Nitrites
  - Produced by some bacteria in urine
- Leukocyte esterase activity
  - Associated with pyuria

Urine culture & sensitivity

- Not always necessary if typical, uncomplicated presentation and positive urinalysis
- Should obtain to identify pathogen if recurrent, persistent or atypical symptoms

Uncomplicated Cystitis: Treatment

- When possible, antibiotic treatment should be guided by urine cultures and sensitivities and local resistance patterns.
- In the absence of cultures, first-line antibiotics in Canada include:
    - Trimethoprim/sulfamethoxazole
    - Nitrofurantoin
    - Fosfomycin
- Do not perform repeat urine cultures if symptoms resolve.

Recurrent Bacterial Cystitis: Investigations & Management

Must document every symptomatic episode with **urinalysis and urine cultures**

- Allows for the tailoring of therapy based on bacterial antimicrobial sensitivities

No evidence that these practices reduce rUTI but they may be helpful in some:

- Post-coital voiding
- Avoiding hot tubs
- Changing wiping methods, etc.

Evidence-based UTI prophylaxis:

- Increased water intake
- Cranberry products
- Vaginal estrogen therapy
    - In peri-menopause (vaginal atrophy associated with more UTIs)

Recurrent Bacterial Cystitis: Investigations & Management

Consider referral to urology for imaging, cystoscopy, urodynamics

Consider low-dose antibiotic prophylaxis

- Should only be used as last resort due to risk of bacterial resistance
- Intermittent, continuous, or post-coital
- Antibiotic options (usually ½ or ¼ of regular daily dose):
  - Trimethoprim/sulfamethoxazole
  - Nitrofurantoin
  - Fosfomycin
  - Cephalexin

Rarely consider self-start antibiotic prescriptions for patients to self-treat UTIs

- Must document each UTI with cultures before taking antibiotics and follow up

Complicated Cystitis: Investigations & Management

Must obtain urinalysis and urine culture

Acute treatment:

1. Fluoroquinolones can be used as first-line, empirical treatment
    - Or based on local resistance patterns
2. Adjust treatment based on cultures if necessary
    - Consider TMP/SMX, amoxicillin/clavulanic acid, cefadroxil, cefixime, cephalexin
    - Avoid fosfomycin, nitrofurantoin
3. Treat for a total of 10 to 14 days

Complicated Cystitis: Investigations & Management

- Initial management and investigations:
  - ABCs and vital signs with appropriate systemic support and monitoring
  - Bloodwork (complete blood count, creatinine, electrolytes)
  - Urine and blood cultures (before starting antibiotics, if possible)
- Antibiotics:
  - If patient has aggravating factors or worrisome findings, should consider inpatient course of IV antibiotics and monitoring, with subsequent shift to oral antibiotics
    - Hemody namic instability
    - Patient unwell, toxic
    - High-grade fever
    - Significant anomalies on bloodwork
    - Immunosuppression
    - Unreliable patient
  - If patient is well, stable, reliable, and only has mild-to-moderate symptoms, can consider outpatient oral antibiotics
  - Long-term culture-adjusted antibiotic therapy necessary (10-14 days total)
- Follow-up may be necessary

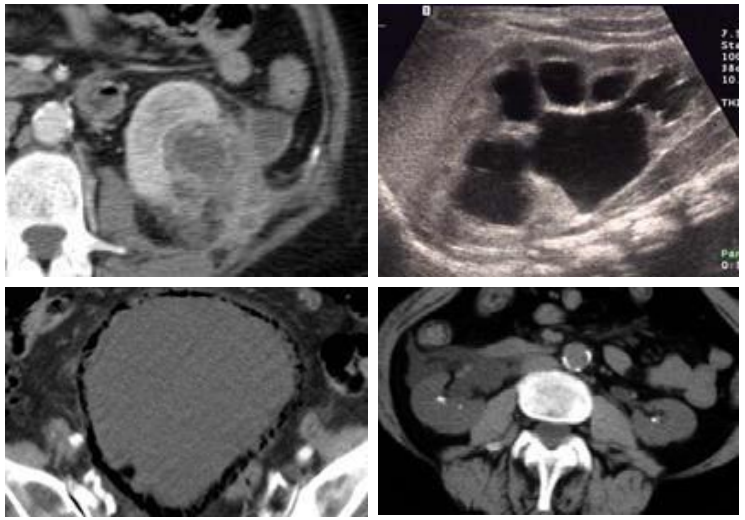
Complicated UTI: Investigations & Management

In patients with suspected UTI/pyelonephritis, should consider imaging to rule out immediate, possibly life-threatening complications, if risk factors are present:

- History of urolithiasis
- History of urinary retention or BPH
- Other anomalies of the urinary tract
- Immunosuppression
- Atypical clinical presentation
- Suboptimal response to IV antibiotics
- Persistent fever
- Highly elevated creatinine, unresolved with hydration

CT scan or ultrasound usually used; want to rule out:

- Hydronephrosis
- Obstructive urolithiasis (“septic stone”)
- Urinary retention
- Abscess of the urinary tract
- Xanthogranulomatous pyelonephritis
- Emphysematous pyelonephritis/cystitis

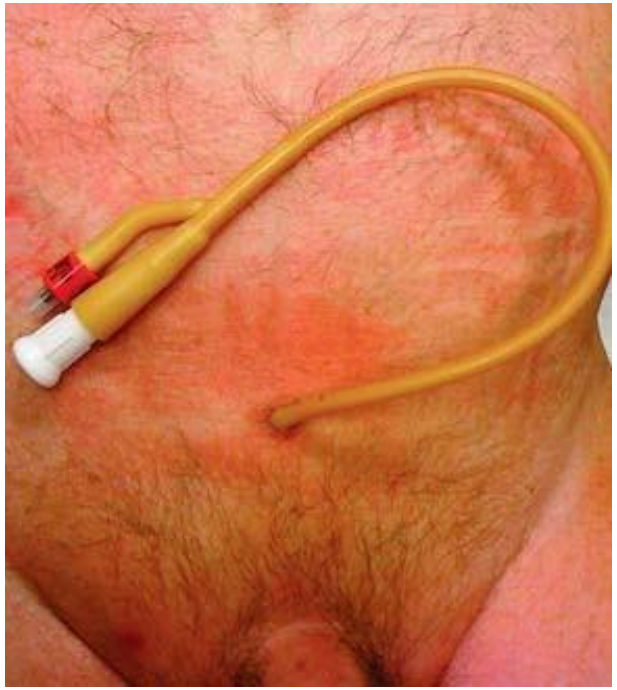


Complicated UTI: Investigations & Management

- Same initial management and investigations as pyelonephritis
- Usually requires early intravenous antibiotics and admission
- Urgent urinary drainage as indicated, via:
  - Urinary catheter (urethral or suprapubic)
    - For urinary retention or obstruction below the bladder level (BPH, urethral stricture, etc.)
  - Percutaneous nephrostomy / ureteral stent
    - For ureteral obstruction (stones, ureteral stricture, extrinsic compression from mass, ureteropelvic junction obstruction, etc.)
  - ❖ Obstructive urinary sepsis is a urologic emergency and requires urgent, appropriate drainage
- Other surgery/intervention as indicated:
  - Percutaneous drainage may be required for some abscesses
  - Surgical management (ie: nephrectomy) may be required in refractory cases of emphysematous or Xanthogranulomatous pyelonephritis
- Long-term, culture-adjusted antibiotic therapy usually necessary (10-14 days total)

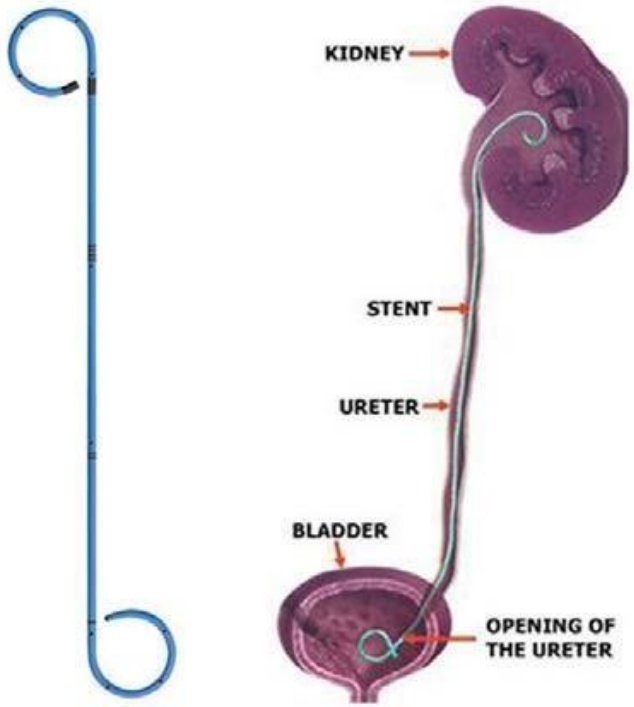
Complicated UTI: Investigations & Management

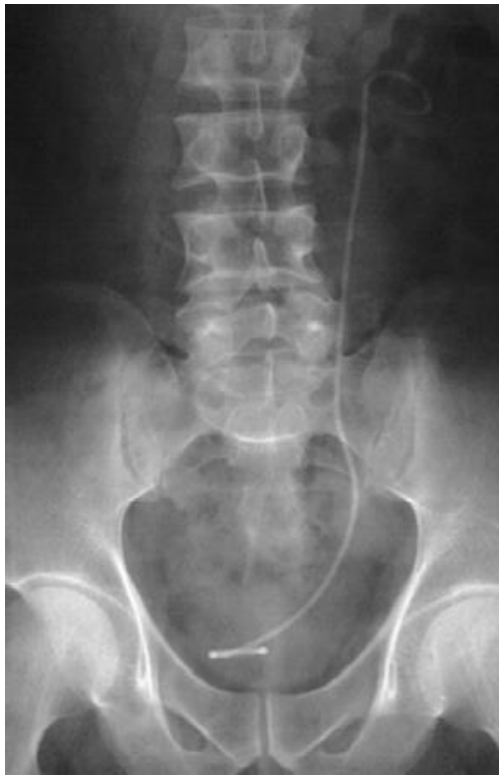
- Urinary drainage:
  - Urinary catheter / suprapubic catheter



Complicated UTI: Investigations & Management

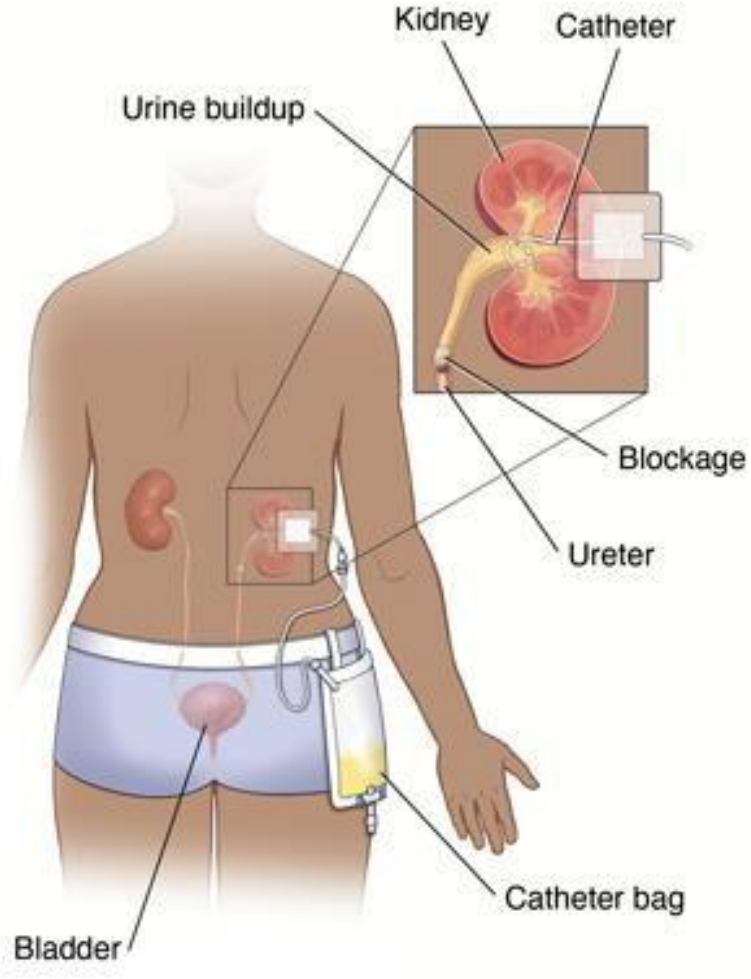
- Urinary drainage:
  - Ureteral stent (Double J stent)





Complicated UTI: Investigations & Management

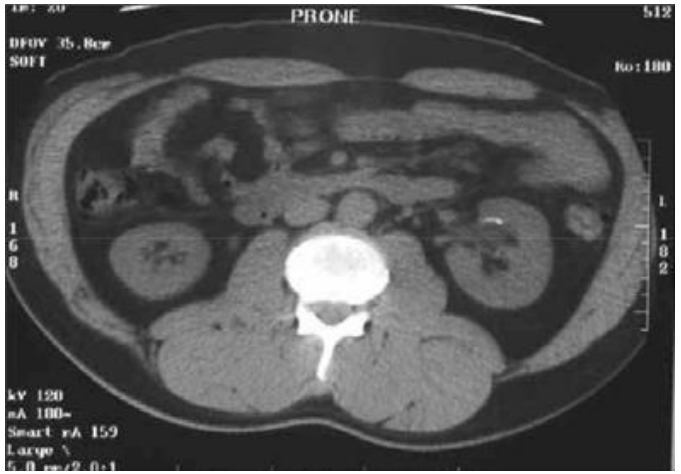
- Urinary drainage:
  - Percutaneous nephrostomy



Complicated UTI: Additional Investigations

Other factors that may warrant further long-term investigations (diagnostic imaging, endoscopy, urodynamics):

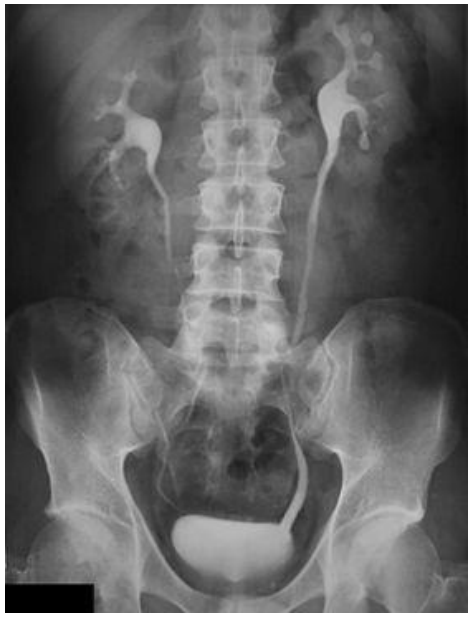
- Recurrent pyelonephritis
- Gross/microscopic hematuria after appropriate treatment of UTI
- Pneumaturia/fecaluria
- Obstructive lower urinary tract symptoms
    - Low urinary flow, high post-void residual volume
- History of urolithiasis (bladder or kidney)
- History of urinary tract surgery or trauma
- History of abdominopelvic malignancy
- Immunosuppression
- Urea-splitting bacteria on urine culture

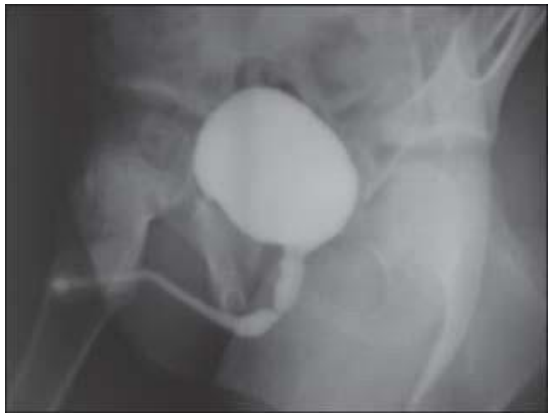


Complicated UTI: Additional investigations

Diagnostic imaging:

1. **Kidney-Ureter-Bladder (KUB) radiography**
   - Low-cost; asses for stones and gas
2. **Voiding cystourethrogram (VCUG)**
   - Images of voiding patient with contrast- filled bladder
   - Assess for vesicoureteral reflux or posterior urethral valve
3. **Intravenous pyelogram (IVP) – rarely done now**
   - Radiography with IV contrast injection; better visualization of urinary tract

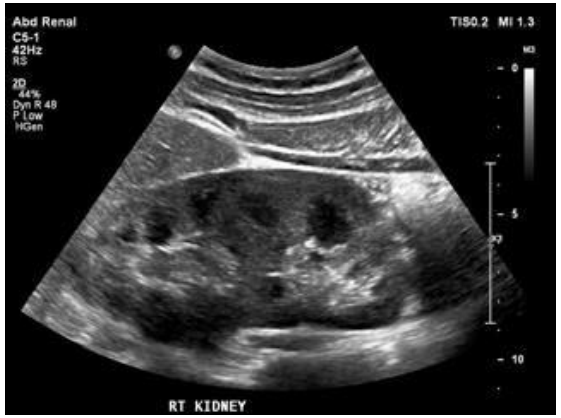


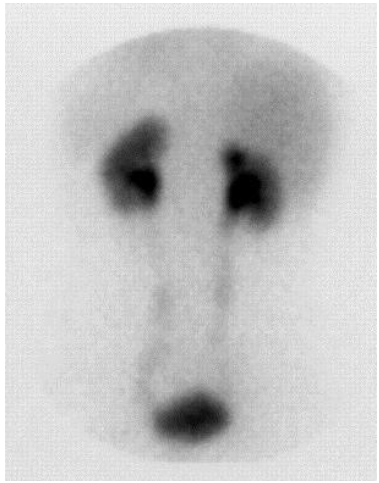


Complicated UTI: Additional investigations

Diagnostic imaging:

4. **CT**
   - Best anatomic detail for evaluation of UTI
   - Reliable diagnosis of acute focal bacterial nephritis, renal and perirenal abscesses, and stones
5. **Ultrasound**
   - Excellent to assess hydronephrosis or post-void residual volume
6. **Magnetic resonance imaging (MRI)**
   - Little benefit over CT, except lack of radiation
7. **Nuclear medicine / Renal scintigraphy**
   - Evaluate renal function, assess for renal scarring (ie: DMSA)
   - Dynamic studies can help diagnose urinary tract obstruction (e.g. MAG3 Lasix renogram)





Complicated UTI: Additional investigations

Endoscopy:

Cystoscopy

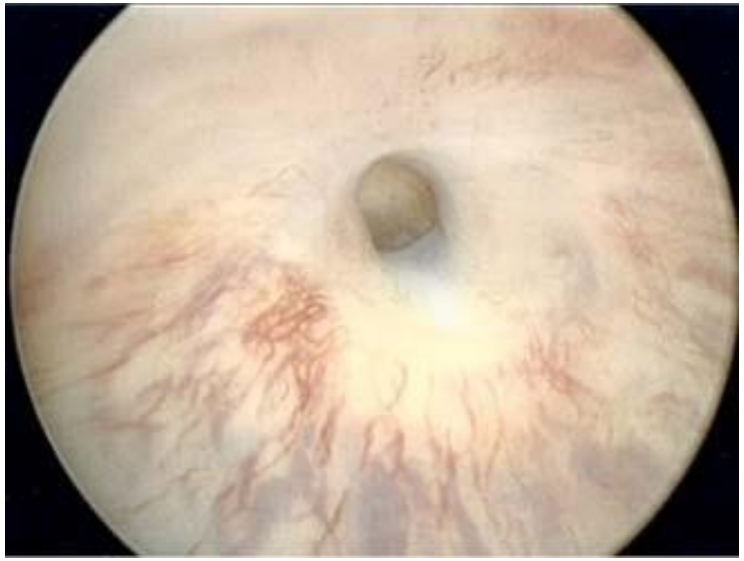
- Endoscopy of the **lower urinary tract**
- Assessment of the **urethra**
  - Obstructive benign prostatic hyperplasia (BPH)
  - Urethral stricture
  - Urethral diverticulum
- Assessment of the **bladder**
  - Bladder stones
  - Bladder diverticula
  - Colo-vesicular fistulas

Ureteroscopy/pyeloscopy

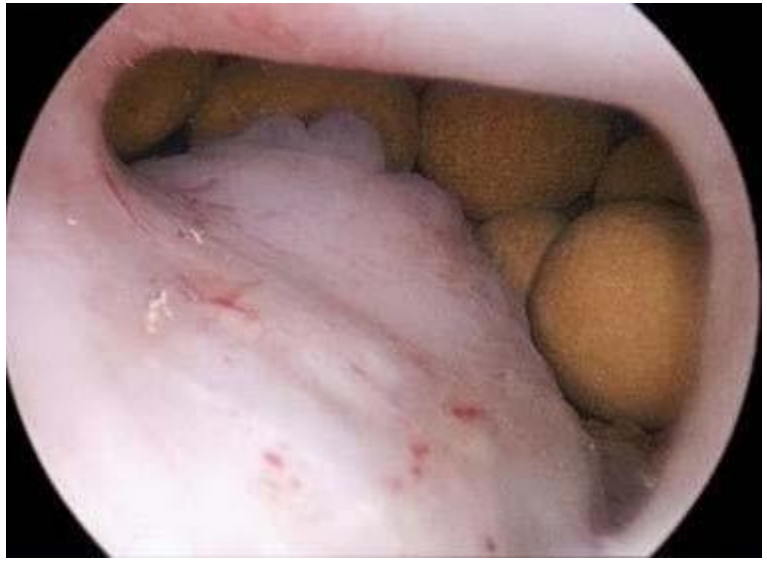
- Endoscopy of the **upper urinary tract**
- Assessment of the **ureters**
  - Ureteral strictures
  - Ureteral stones
- Assessment of the **kidneys**
  - Renal stones
  - Fungus balls
  - Sloughed renal papillae

Complicated UTI: Additional investigations

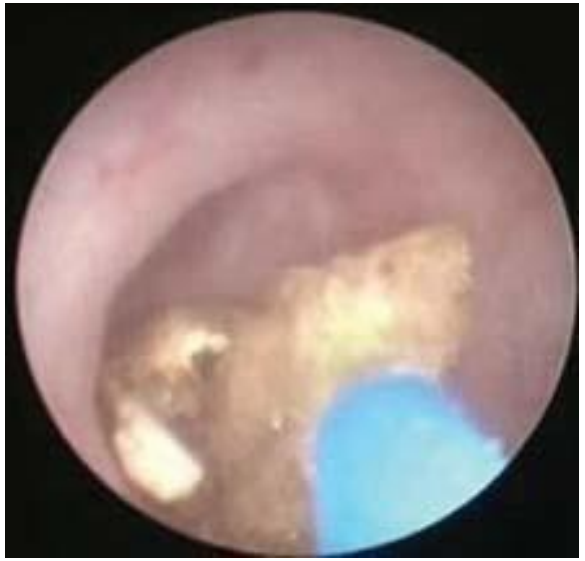
Endoscopy:



Urethroscopy
Urethral stricture



Cystoscopy
Bladder stones



Ureteroscopy
Ureteral stone