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Definitions

- UTI is infection of the bladder (cystitis), kidneys (pyelonephritis), ureter (ureteritis), or urethra (urethritis). There is an associated inflammatory response of the urothelium to bacterial invasion, leading to a constellation of symptoms.
- Bacteriuria: presence of bacteria in the urine and may be asymptomatic or symptomatic. Bacteriuria without pyuria may indicate the presence of bacterial colonization of the urine.
- Pyuria : presence of WBCs in the urine, implying an inflammatory response of the urothelium to bacterial infection, or in the absence of bacteriuria (sterile pyuria) e.g / TB infection, bladder stones, or other inflammatory conditions

Definitions

- **An uncomplicated UTI**: occurring in a patient with a structurally and functionally normal urinary tract. The majority of such patients are women who respond quickly to a short course of antibiotics.
- **A complicated UTI**: occurring in the presence of an underlying anatomical or functional abnormality. Most UTIs in men are defined as complicated.

Definitions

- **Isolated UTI** : an interval of at least 6 months between infections.
- **Recurrent UTI**: >2 infections in 6 months or three within 12 months.
 - Recurrent UTI may be due to re-infection (i.e. infection by different bacteria) or bacterial persistence (infection by the same organism originating from a focus within the urinary tract).
- **Unresolved infection**: inadequate therapy and is caused by natural or acquired bacterial resistance to treatment, infection by (multiple) different organisms, or rapid re-infection.

General risk factors

- ♀ sex.
- Increasing age.
- Low oestrogen states (menopause).
- Pregnancy.
- Diabetes mellitus.
- Previous UTI.
- Institutionalized elderly patients.
- Stone disease (kidney, bladder).
- Genitourinary tract malformation.
- Voiding dysfunction (including obstruction).
- Indwelling catheters. Catheter associated UTIs (CAUTIs) account for up to 80% of hospital-acquired UTIs.

Microbiology

- Most UTIs are bacterial in origin. The commonest cause is *Escherichia coli*, a Gram-negative bacillus, which accounts for 85% of community-acquired and 50% of hospital-acquired infections. Other common causative organisms include *Staphylococcus saprophyticus*, *Proteus mirabilis*, and *Klebsiella*, *Pseudomonas*.

Route of infection

- **Ascending:** They ascend along the urethra to the bladder (risk in ♀ as the urethra is shorter), causing cystitis. From the bladder, they may ascend via the ureters to involve the kidneys (pyelonephritis).

Reflux is not necessary for infection to ascend to the kidneys, but it will encourage ascending infection.

- **Haematogenous** : uncommon, but is seen with Staphylococcus aureus, Candida fungaemia, and Mycobacterium tuberculosis (causing TB).
- Infection via **lymphatics**: seen rarely in inflammatory bowel disease and from retroperitoneal abscess.

General investigation of UTI

- Dipstick of MSU specimen:

- White blood cells (indirect testing for pyuria) Leucocyte esterase activity detects the presence of WBCs in the urine. Leucocyte esterase is produced by neutrophils.

- Nitrite testing (indirect testing for bacteriuria) Nitrites are not normally found in urine, and their presence suggests the possibility of bacteriuria. Many species of Gram-negative bacteria can convert nitrates to nitrites.

- Blood:

Hb has a peroxidase-like activity, causing oxidation of a chromogen indicator on the dipstick, which changes colour when oxidized. False positives are seen with menstrual blood and dehydration.

- Ph:

Urinary pH usually lies between 5.5 and 6.5 .A persistent alkaline pH associated with UTI indicates a risk of stones. Urease-producing bacteria (such as *p. mirabilis*) hydrolyse urea to ammonia and carbon dioxide, leading to the formation of magnesium, calcium, and ammonium phosphate stones (triple phosphate or struvite calculi)

- **Microscopy of MSU:**

- False negative: low bacterial counts may make it very difficult to identify bacteria.
- False positive: bacteria may be seen in the MSU in the absence of infection. This is most often due to contamination with commensals from the distal urethra and perineum.

Box 12.4 Factors That Affect Ability to Provide Adequate Midstream Clean-Catch Sample

- Increased body mass index
- Vaginal atrophy
- Poor manual dexterity
- Inability to bear weight
- Intravaginal pessary
- Nonsterile collection receptacle

Further investigation

- If this is a one-off infection in an otherwise healthy individual, no further investigations are required. Investigation for uncomplicated recurrent UTI also has a low diagnostic yield in women. However, investigation is required if:-
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**The patient develops symptoms and signs of upper tract infection (loin pain, malaise, fever)—if clinical suspicion of acute pyelonephritis, pyonephrosis, or perinephric abscess.

**Recurrent UTIs develop.

**The patient is pregnant.

**Unusual infecting organism (e.g. Proteus), suggesting the possibility of an infection stone.

**Red flag symptoms—such as bladder pain, storage symptoms, or haematuria persisting after UTI is treated.

_These further investigations will include imaging with USS (or CT if suspecting stones) and cystoscopy

Box 12.6 Risk Factors for Recurrent Urinary Tract Infections

- Sexual activity
- New sexual partner within past year
- Family history of urinary tract infection (UTI) in first-degree female relative
- Recent antimicrobial use
- Spermicide use
- History of UTI before menopause
- Menopause
- Incontinence, elevated postvoid residual, cystocele

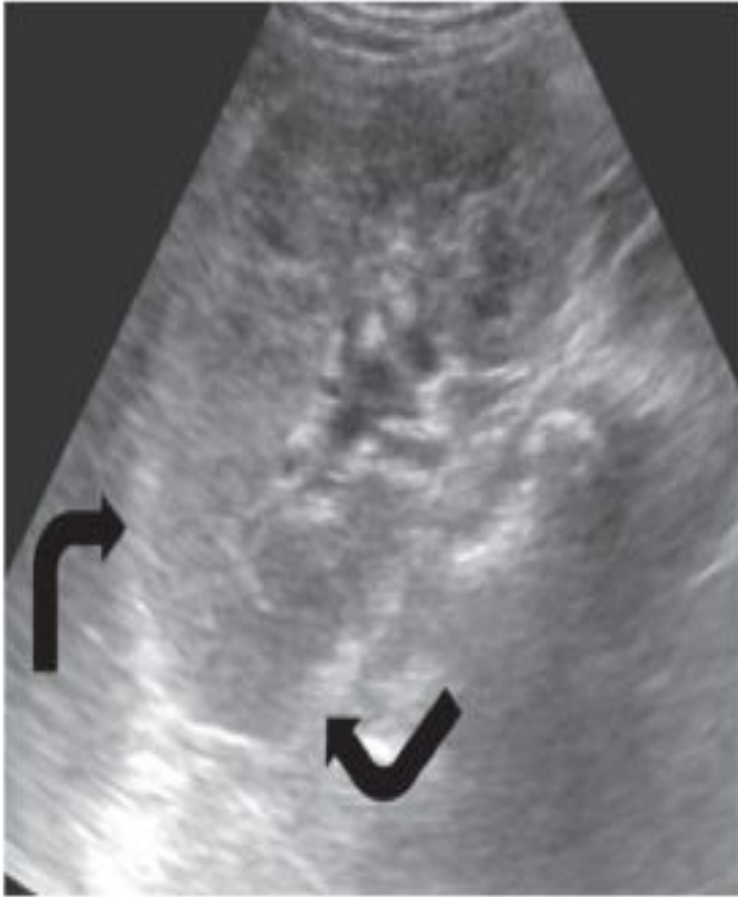
Box 12.7 Indications for Further Investigation of Recurrent Urinary Tract Infections

- Previous urinary tract trauma or surgery
- Previous bladder or renal calculi
- Gross hematuria after resolution of infection
- Obstructive symptoms, high post-void residual (PVR)
- Urea-splitting bacteria on culture
- Previous abdominopelvic malignancy
- Bacterial persistence after sensitive-based treatment
- Diabetes or other immune compromise
- Pneumaturia, fecaluria, anaerobic bacteria, or history of diverticulitis
- Repeated pyelonephritis
- Asymptomatic microhematuria after resolution of infection

Upper urinary tract infection: *acute pyelonephritis*

- Definition: pyelonephritis is an inflammation of the kidney and renal pelvis.
- Classic symptoms consist of an acute onset of fever, chills, and flank pain and/or costovertebral tenderness.
- Risk factors: ♀ > ♂, VUR, urinary tract obstruction, calculi, SCI (neuropathic bladder), diabetes mellitus, congenital malformation, pregnancy, indwelling catheters, urinary tract instrumentation.
- Pathogenesis and microbiology: initially, there is patchy infiltration of neutrophils and bacteria in the parenchyma. Later changes include the formation of inflammatory bands, extending from the renal papilla to the cortex, and small cortical abscesses. Eighty per cent of infections are secondary to E. coli.

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- Blood cultures should be obtained in patients with systemic toxicity, those requiring hospitalization, or with risk factors such as pregnancy.
 - In patients with a fever lasting longer than 72 hours, CT is most helpful for ruling out obstruction and identifying renal and perirenal infections.
 - If the patient responds to IV antibiotics, change to an oral antibiotic of appropriate sensitivity when they become afebrile .



Ultrasound of acute pyelonephritis. Arrows show an abnormal and swollen upper pole.



FIG. 12.7 Computed tomography of focal pyelonephritis. Arrows show patchy regions of diminished heterogeneous enhancement and swelling.

Pyonephrosis

- An infected hydronephrosis where pus accumulates within the renal pelvis and calyces. It is associated with damage to the parenchyma, resulting in loss of renal function.
- The causes are essentially those of hydronephrosis where infection has supervened (e.g. ureteric obstruction by stone, PUJO).
- Presentation : Patients with pyonephrosis are usually very unwell, with a high fever, flank pain, and tenderness
- Risk factors : Stone disease, previous UTI, or surgery

Pyonephrosis

- Investigation:

- USS: shows evidence of obstruction (hydronephrosis) with a dilated collecting system, fluid–debris levels, or air in the collecting system.

- CT: shows hydronephrosis , stranding of perinephric fat, and thickening of the renal pelvis.

- Treatment:

- IV fluids and IV antibiotics (as for severe pyelonephritis), with urgent percutaneous drainage (nephrostomy) and/or ureteric stent.

Renal Abscess

- is a collection of purulent material confined to the renal parenchyma. Gram-negative organisms are typically implicated.
- Patients may present with fever, chills, abdominal or flank pain, and, occasionally, weight loss and malaise.
- Patients typically have marked leukocytosis. Pyuria and bacteriuria may not be evident unless the abscess communicates with the collecting system. Bacteremia may be present.

- CT is the diagnostic procedure of choice and will characteristically show abscesses as well-defined lesions with decreased attenuation.

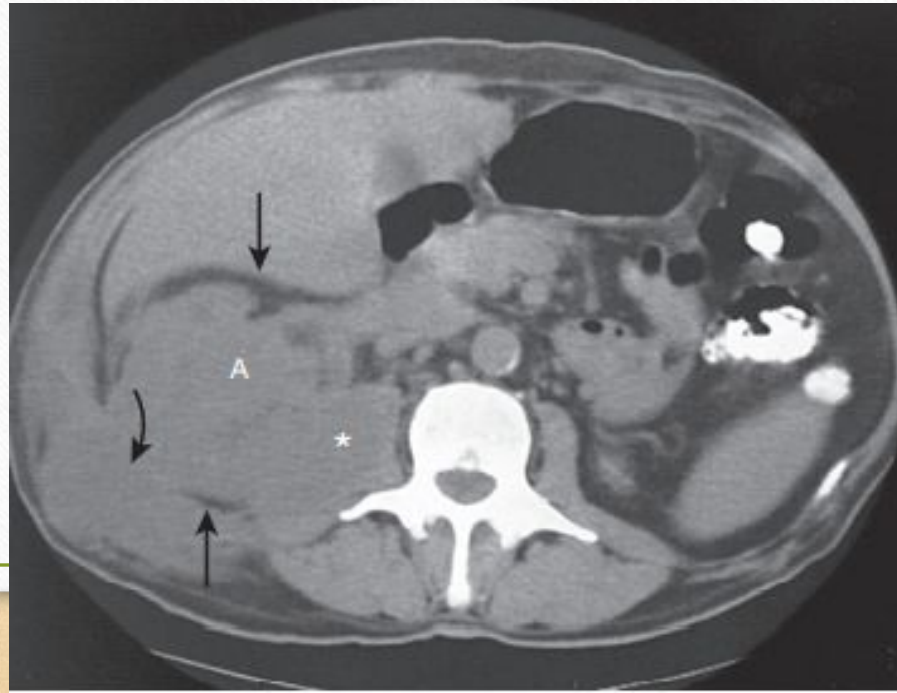


- Patients should be immediately started on IV antibiotics.
- Conservative management with antibiotics and careful observation may be employed in clinically stable patients with small abscesses (3–5 cm in diameter).
- The size of the abscess may be assessed radiographically for improvement.
- Image-guided needle aspiration may be necessary to differentiate abscess from tumor.
- Percutaneous drainage remains the first-line procedure of choice for most renal abscesses >5 cm in diameter.

Perinephric abscess

- extends beyond the renal capsule but is contained by Gerota's fascia.
- It usually results from rupture of an acute cortical abscess into the perinephric space, extravasated infected urine from obstruction or trauma, infection of a perinephric hematoma.
- Clinically : Patients may present similar to a renal abscess. An abdominal or flank mass can be felt in approximately half of the cases. Laboratory features include leukocytosis, elevated serum creatinine, and pyuria.
- CT is valuable for demonstrating the primary abscess.

- All patients should be immediately started on IV antibiotic therapy.
- Small abscesses may be treated with antibiotics alone in clinically stable and immune competent patients.
- Unlike renal abscesses, early percutaneous drainage of abscesses >3 cm in diameter is recommended.
- Nephrectomy may be necessary if the kidney is nonfunctioning or severely infected.



Other forms of pyelonephritis

- **Emphysematous Pyelonephritis (EP):**

- EP is a urologic emergency characterized by an acute necrotizing parenchymal and perirenal infection caused by gas-forming uropathogens.

- The condition usually occurs in patients with diabetes and in the setting of urinary tract obstruction.

- Urine culture is invariably positive, most commonly with E. coli. Proteus and Klebsiella are less common.

- CT will demonstrate mottled gas distributed in the renal parenchyma.

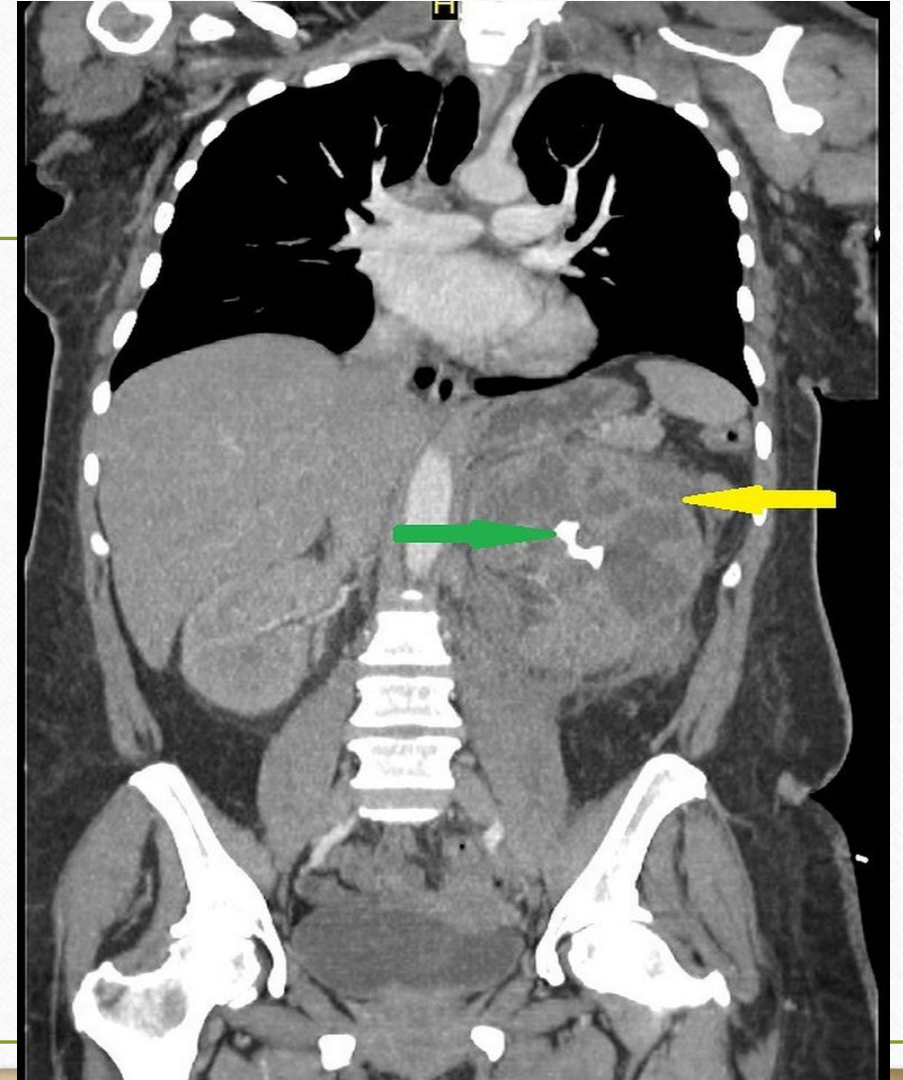
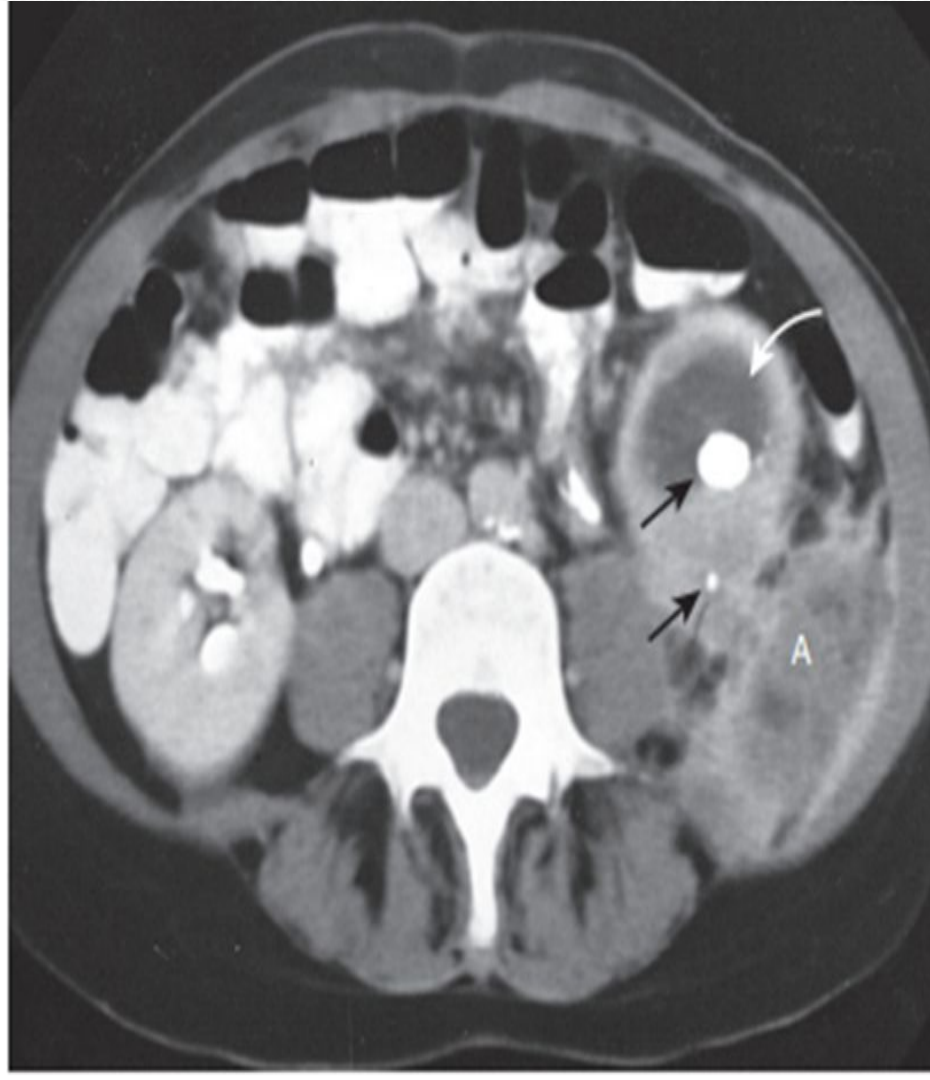


- Most patients are septic and require intensive care.
- Fluid resuscitation, glucose and electrolyte management, and broad-spectrum antimicrobial therapy are essential.
- Patients may initially be managed via placement of a ureteral stent or percutaneous nephrostomy tube.
- Nephrectomy is advised in cases where patients do not respond to conservative management or if there is extensive and diffuse gas with renal destruction.

Xanthogranulomatous Pyelonephritis (XGP)

- XGP is a rare, severe, chronic renal infection typically resulting in diffuse renal destruction. The primary factors involved in the pathogenesis are nephrolithiasis, obstruction, and infection.
- XGP is characterized by accumulation of lipid-laden, foamy macrophages. It begins within the pelvis and calyces and subsequently extends into and destroys renal parenchymal and adjacent tissues.
- XGP should be suspected in patients with UTIs and a unilateral, enlarged, nonfunctioning, or poorly functioning kidney with a stone or a mass lesion indistinguishable from malignancy.

- Patients with XGP commonly experience flank pain, fever, chills, and persistent bacteriuria.
- Proteus is the most common organism involved, followed by E. coli.
- CT classically shows unilateral renal enlargement with little or no function and a large calculus in the renal pelvis. Renal parenchyma is replaced by multiple water density masses representing dilated calyces and abscesses.



- XGP is treated by surgical excision of the infected kidney and all surrounding inflammatory tissue.
- Antimicrobial therapy may be necessary to stabilize the patient preoperatively.
- The surrounding inflammatory reaction may make surgery difficult Intraoperative .
- frozen section is unreliable because the lipid-laden macrophages associated with XGP closely resemble clear cell adenocarcinoma
- Incision and drainage or percutaneous drainage is not curative.

Lower urinary tract infection: *cystitis*

- Cystitis is infection and/or inflammation of the bladder.
- Presentation: frequent voiding of small volumes, dysuria, urgency, offensive urine, suprapubic pain, haematuria, fever $\pm$ incontinence.
- Examination: check for a palpable bladder and post-void urine residuals. Include a pelvic examination in women to assess for atrophic vaginitis, prolapse, and the presence of a urethral diverticulum.
- first line antimicrobial therapies include nitrofurantoin, trimethoprim
- Approximately 90% of women are asymptomatic within 72 hours after initiating antimicrobial therapy.

Asymptomatic Bacteriuria (AB)

- AB occurs when a person has no signs or symptoms of UTI, yet bacteria are identified in a urine sample.
- AB should not be treated in most patients, but treatment is recommended in pregnant women and in patients undergoing procedures in which transmucosal bleeding is anticipated.
- Antimicrobial selection should be influenced by efficacy, safety, cost, and compliance. The choice of agent and duration of therapy are critical in preventing the perpetuation of antimicrobial resistance as well as treatment-related adverse effects.

Emphysematous Cystitis (EC)

- Is a rare and potentially life threatening form of complicated cystitis that is associated with a high mortality rate.
- Finding of this disease process is gas noted within the bladder wall on computed tomography (CT) image.
- EC is typically observed in older women with poorly controlled diabetes



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- The majority of these patients are treated with medical therapy alone, which consists of IV antibiotics, bladder drainage, and aggressive treatment of underlying medical conditions.
 - Surgical intervention is reserved for those who respond poorly to initial medical management or those who have severe necrotizing infections.

Acute Orchitis and Epididymitis

- Involve pain, swelling, and inflammation of the testicle and epididymis, respectively.
- In sexually active men the infective organism is commonly *N. gonorrhoeae*, *C. trachomatis*, In older men and children, the infective organisms are usually common uropathogens (i.e. *E. coli*)
- Examination of the scrotum usually reveals a tender testis and spermatic cord.
- Urine culture should be obtained in all patients.
- Imaging with scrotal US can help to distinguish testicular torsion from orchitis and identify testicular tumors and abscesses.

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- In patients with signs of infectious orchitis, antibiotics to treat gram-negative uropathogens should be started and treatment adjusted based on the result of urine culture.
 - A patient suspected of having a STI should have appropriate treatment started.
 - Patients with orchitis, especially those whose symptoms do not resolve, need follow up to rule out missed torsion or testicular tumor.

Acute bacterial prostatitis

- Acute infection of the prostate associated with lower UTI and generalized sepsis.
- Risk factors: • UTI • Acute epididymitis • Indwelling urethral catheters. • Transurethral surgery • Intraprostatic ductal reflux • Phimosis. • Prostatic stones.
- Presentation: fevers, chills, nausea, and vomiting, Pain: perineal/prostatic, suprapubic, penile, groin, external genitalia , urinary symptoms (irritative or & obstructive)

DRE: prostate is usually swollen and tender.

- Treatment:

- If the patient is systemically well, use an oral fluoroquinolone (i.e. ciprofloxacin 500mg bd) for 10 days.
- For a patient who is systemically unwell, IV antibiotic options include broad-spectrum penicillin, third-generation cephalosporin or fluoroquinolone , combined with an aminoglycoside (gentamicin) for initial treatment.

Fournier's gangrene

- Necrotizing fasciitis of the external genitalia and perineum, primarily affecting ♂ and causing necrosis and subsequent gangrene of infected tissues. It is a urological emergency.
- Causative organisms:-
 - _Culture of infected tissue reveals a combination of aerobic bacteria (E. coli, enterococci, Klebsiella, S. aureus, Streptococcus spp.) and anaerobic organisms which are believed to grow in a synergistic fashion.

Predisposing factors

- Diabetes mellitus.
- Chronic alcohol excess.
- Local trauma to the genitalia and perineum (e.g. zipper injuries to the foreskin, peri- urethral extravasation of urine following traumatic catheterization, or instrumentation of the urethra).
- Surgical procedures such as circumcision.
- Paraphimosis.
- Perianal and perirectal infections

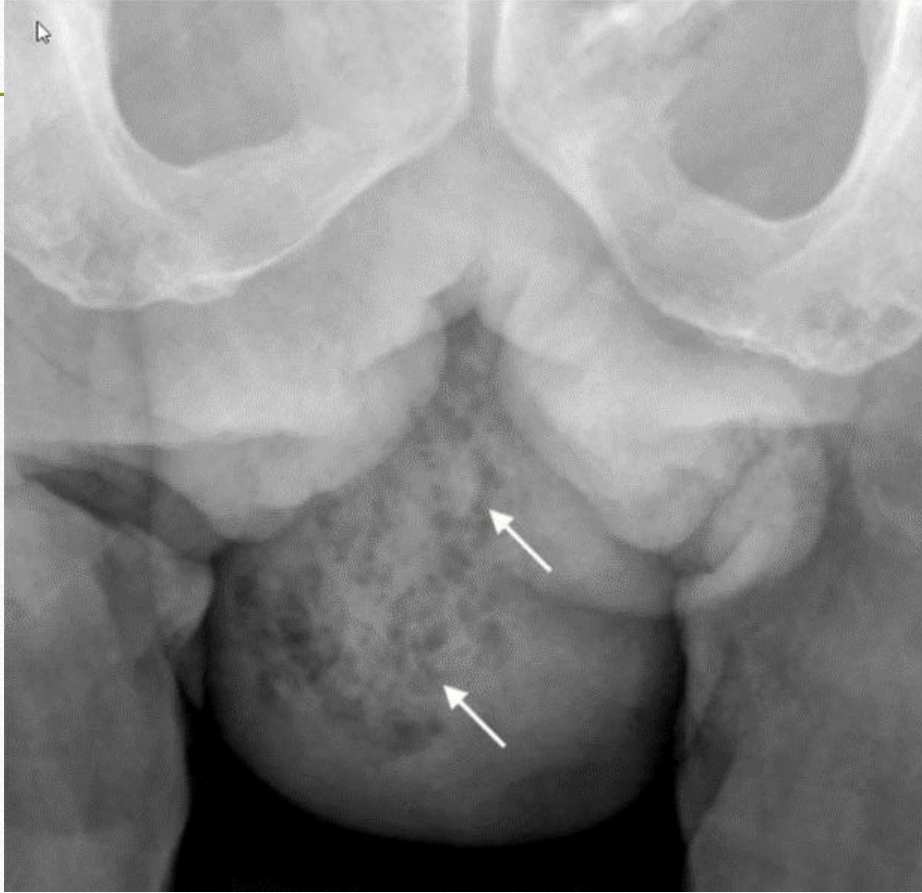
- Presentation:-

- Early clinical features include localized skin erythema, tenderness and oedema, and sometimes associated LUTS (dysuria, difficulty voiding, urethral discharge).

- This progresses to fever and sepsis, with cellulitis and palpable crepitus in the affected tissues indicating the presence of subcutaneous gas produced by gas-forming organisms.

- As the infection advances, blisters (bullae) appear in the skin, and within a matter of hours, areas of necrosis may develop, which spread to involve adjacent tissues (e.g. lower abdominal wall).

- The diagnosis is a clinical one and is based on the awareness of the condition and a high index of suspicion.
- In early stages of disease, abdominal Xray and scrotal USS or CT may demonstrate the presence of air in tissues.
- Mortality is in the order of 20– 30%. Mortality rates are reported to be higher in patients with a degree of immunocompromise (diabetics, alcohol excess) and those with anorectal or colorectal disease/ involvement



Management

- Do not delay.
- Resuscitate the patient.(Start IV fluids; administer oxygen)
- Broad- spectrum parenteral antibiotics are given immediately to cover both Gram-positive and Gram- negative aerobes and anaerobes.
- Transfer the patient to theatre as quickly as possible for debridement of necrotic tissue until healthy bleeding tissue margins are found, but it is unusual for the testes or deeper penile tissues to be involved and these can usually be spared.
- Send tissue for culture.

- If there is extensive perineal/ perianal involvement, faecal diversion with colostomy may be required.
- Wound irrigation with hydrogen peroxide may be used at the end.
- catheter (urethral or SPC) is inserted to divert urine and allow monitoring of urine output.
- Repeat examination under anaesthetic $\pm$ further debridement to remove residual necrotic tissue is required at 24h and then guided by clinical progress.
- Vacuum- assisted closure of wounds can hasten patient recovery.
- Reconstruction can be contemplated when wound healing is complete.



Thank You!

