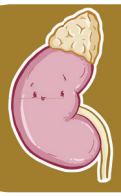

NOTES
URINARY & KIDNEY INFECTIONS

GENERALLY, WHAT ARE THEY?

PATHOLOGY & CAUSES

- Infections involving kidneys, ureters, bladder, urethra (UTI)

TYPES

Upper UTIs (kidneys)
- Pyelonephritis

Lower UTIs (bladder, urethra)
- Cystitis, urethritis

CAUSES

Bacterial infection (most common)
- *Gram negative bacteria:* *Escherichia coli* (*E. coli*), 80% of cases; *Klebsiella*; *Proteus*; *Enterobacter*; *Citrobacter*
- *Gram positive bacteria:* *Enterococcus*; *Staphylococcus saprophyticus* (*S. saprophyticus*), second most common, esp. in young individuals who are biologically female, sexually active

Ascending infection
- Bacteria move from rectal area → urethra → bladder → kidney

Descending infection
- Bacteria starts in blood/lymph → kidney → bladder, urethra

COMPLICATIONS
- Urosepsis, septic shock

SIGNS & SYMPTOMS

Lower UTIs
- Dysuria (painful urination), frequent urination/urgency

Upper UTIs
- Flank pain, fever, chills, nausea, vomiting, malaise, lower UTI symptoms

DIAGNOSIS

DIAGNOSTIC IMAGING

Renal scintigraphy, dimercaptosuccinic acid (DMSA), radionuclide/DMSA scan
- Kidney scarring

LAB RESULTS
- Pyuria (white blood cells in urine)
- > 105 colony-forming units/mL
- Leukocyte esterase (enzyme created by white blood cells)

TREATMENT

MEDICATIONS
- Antibiotic treatment (e.g. trimethoprim-sulfamethoxazole, nitrofurantoin, penicillin) to dialysis
- Pain medications

SURGERY
- Kidney transplantation

PYELONEPHRITIS

osms.it/pyelonephritis

PATHOLOGY & CAUSES

- Inflamed kidney; result of bacterial infection; affects tubules, interstitium, renal pelvis
- Interstitial abscesses filled with pus
- Tubules damaged, contain neutrophil casts

Chronic pyelonephritis

- Repeated episodes of acute pyelonephritis.
- Leads to fibrosis, renal interstitium scarring, renal tubules atrophy
- Localized in upper, lower poles of kidney
- Xanthogranulomatous pyelonephritis (XGP)
  - Rare type of chronic pyelonephritis
  - Infected kidney stone forms granulomatous tissue
  - Can be mistaken for kidney tumors on imaging

RISK FACTORS

- Urinary tract abnormalities, indwelling urinary catheter, diabetes, immunocompromised status, enlarged prostate

CAUSES

Chronic pyelonephritis

- Vesicoureteral reflux (VUR)
  - Most common cause
  - VUR → predisposed to recurrent infections
  - Failure of vesicourethral orifice → urine moves backward up urinary tract from bladder
  - Increases risk of ascending upper UTI
  - May result from primary congenital defect, bladder outlet obstruction

SIGNS & SYMPTOMS

- May be asymptomatic
- Hematuria, polyuria/nocturia
- Flank pain
- Inflammatory response
  - Leukocytosis; fever; chills; nausea, vomiting; gerontologic (e.g. altered mental status)

Chronic pyelonephritis

- Same as acute pyelonephritis
- Hypertension

DIAGNOSIS

LAB RESULTS

- Urine culture, bacteria
- Pyuria, hematuria, bacteriuria, leukocyte casts
- Leukocyte esterase, nitrites, hematuria

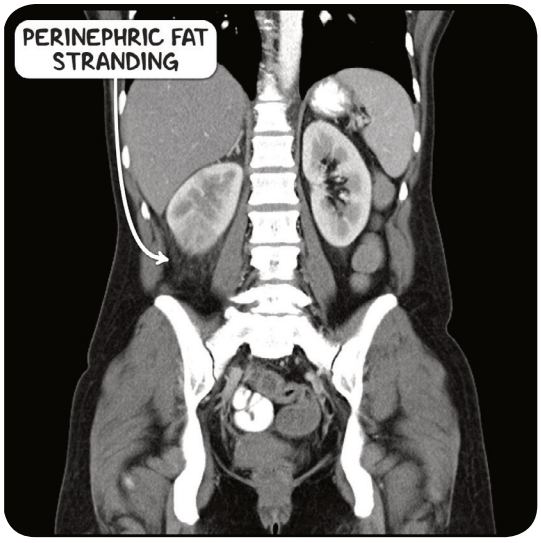

Figure 120.1 A CT scan in the coronal plane demonstrating perinephric fat stranding and cortical rim loss seen in acute pyelonephritis.

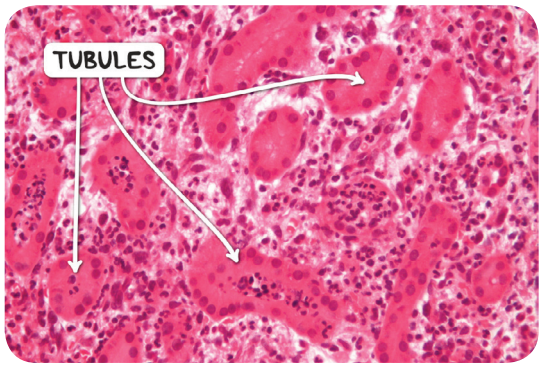

Figure 120.2 The histological appearance of the kidney in a case of acute pyelonephritis. There are neutrophils present in the interstitium and within the tubular lumina.

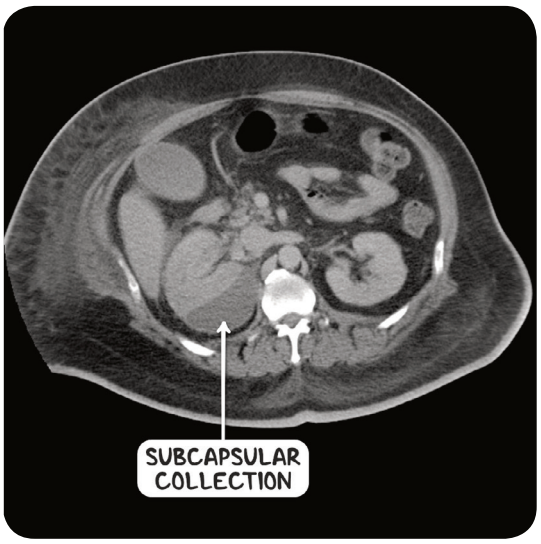

Figure 120.3 A CT scan of the abdomen in the axial plane demonstrating a subcapsular abscess secondary to pyelonephritis of the right kidney.

TREATMENT

MEDICATIONS

- Antibiotics targeted to bacterial infection

SURGERY

Chronic pyelonephritis

- Correct kidney obstruction/VUR
- *Nephrectomy:* removal of part/all of damaged kidneys
- Kidney transplant

OTHER INTERVENTIONS

- Ensure individual well hydrated

Chronic pyelonephritis

- *Dialysis:* machine works for kidneys too damaged to function

URINARY TRACT INFECTIONS

osms.it/UTI

PATHOLOGY & CAUSES

- UTI; bladder inflammation due to bacterial/fungal infection, chemical irritants, foreign bodies, trauma
- AKA cystitis

CAUSES

- **Most common:** bacterial infections (e.g. *E. coli*, *S. saprophyticus*)
  - Ascending infection → bacteria move from rectal area → urethra → bladder
  - Descending infection → bacteria starts in blood/lymph → kidney → bladder, urethra

RISK FACTORS

- Young individuals who are biologically female (shorter urethra → shorter distance for ascending bacteria)
- Sexual intercourse; penile foreskin
- Postmenopause (decreased estrogen levels → decreased vaginal flora)
- Indwelling catheter
- Diabetes mellitus (hyperglycemia inhibits neutrophil diapedesis)
- Impaired bladder emptying/urinary stasis

COMPLICATIONS

- Pyelonephritis
- Urosepsis
- Septic shock

SIGNS & SYMPTOMS

- Suprapubic pain, dysuria, frequent urination/urgency, urine voids small in volume
- *Infants:* fussy, fever, difficulties feeding
- *Elderly individuals:* fatigue, incontinence, altered mental status

DIAGNOSIS

DIAGNOSTIC IMAGING

Renal ultrasound

- Children with kidney malformation

Voiding cystourethrogram (VCUG)

- Individual given radiocontrast liquid, fluoroscopy (real-time X-rays); healthcare provider monitors urination
- Children with severe/recurrent UTIs, to detect vesicoureteral reflux (retrograde movement of urine from bladder back up into ureters, kidneys)

LAB RESULTS

- Positive for nitrites
  - Gram negative organisms (e.g. E. coli) convert nitrates to nitrites
- > 10^5 colony-forming units/mL from clean catch urine sample
- < 10^5 colony-forming units/mL, infection still possible
- Sterile pyuria (pyuria, urine culture without bacteria) → urethritis (urethra inflammation)
  - *Neisseria gonorrhoeae*, *Chlamydia trachomatis:* most common causes, sexually transmitted infections (STIs)

Pyuria

- Cloudy urine
- > five white blood cells, high-powered field on microscopy, > 10 white blood cells/mL on hemocytometer
- Hematuria

Dipstick test

- Leukocyte esterase

TREATMENT

MEDICATIONS

- *Antibiotics:* trimethoprim-sulfamethoxazole, ciprofloxacin, ceftriaxone, azithromycin, penicillin
- Pain medications

OTHER INTERVENTIONS

- Increase fluid intake