Genitourinary System
Kasus - 1

Kelompok A-7

Pemicu

- Ibu M, 25 tahun, seorang ibu rumah tangga datang ke praktek dokter, dengan keluhan nyeri buang air kecil sejak 3 hari yang lalu. Nyeri hilang timbul, frekuensi (+), urgensi (+).
  Keluhan ini pernah dirasakan ibu M 1 tahun yang lalu. Nyeri juga diikuti dengan demam mengigil.

- Apa yang terjadi pada Ibu M?

More Info

- Dilakukan pemeriksaan darah rutin dan urin rutin.
- Hasil pemeriksaan darah rutin, didapati leukosit 11.200/mm3, neutrofil segmen 76%.
- Dari hasil urinalisa didapati leukosit 10-15/lpb

- Dilakukan pemeriksaan kultur urin, dan hasil pemeriksaan laboratorium mikrobiologi, ditemukan bakteri E.coli sejumlah 105 CFU/ml

Klarifikasi Istilah

- Frekuensi
- Urgency

Identifikasi Masalah

- Dysuria, frekuensi, urgency
- Demam, mengigil
- 1 tahun yang lalu mengalami hal yang sama

Hipotesa

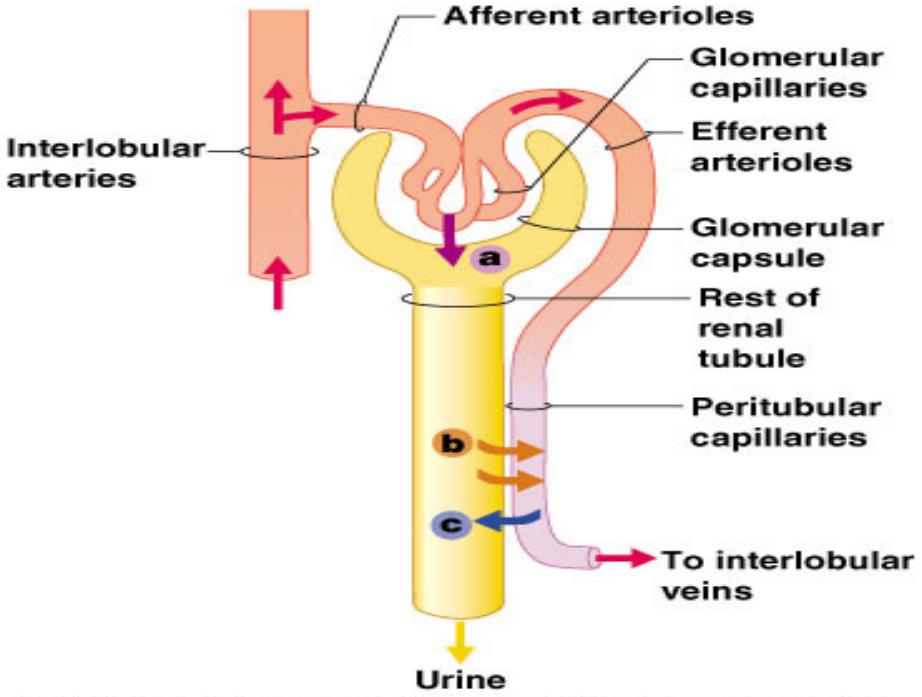
- Infeksi saluran kemih
- Batu ginjal

Learning Issue

Formation of Urine

Involves three main processes:

- 1.Filtration
- 2.Reabsorption
- 3.Secretion



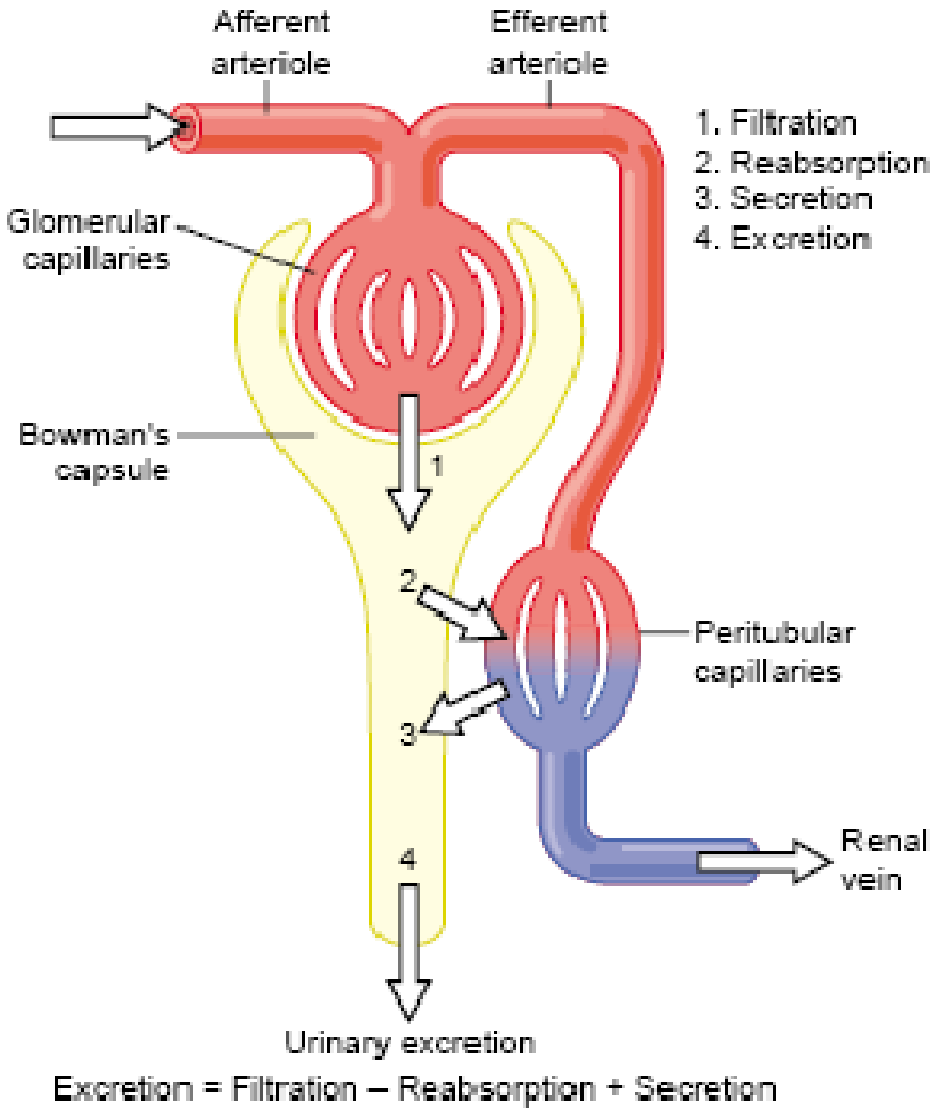


Figure 26–8

Basic kidney processes that determine the composition of the urine. Urinary excretion rate of a substance is equal to the rate at which the substance is filtered minus its reabsorption rate plus the rate at which it is secreted from the peritubular capillary blood into the tubules.

Cortical & Juxtamedullary nephron

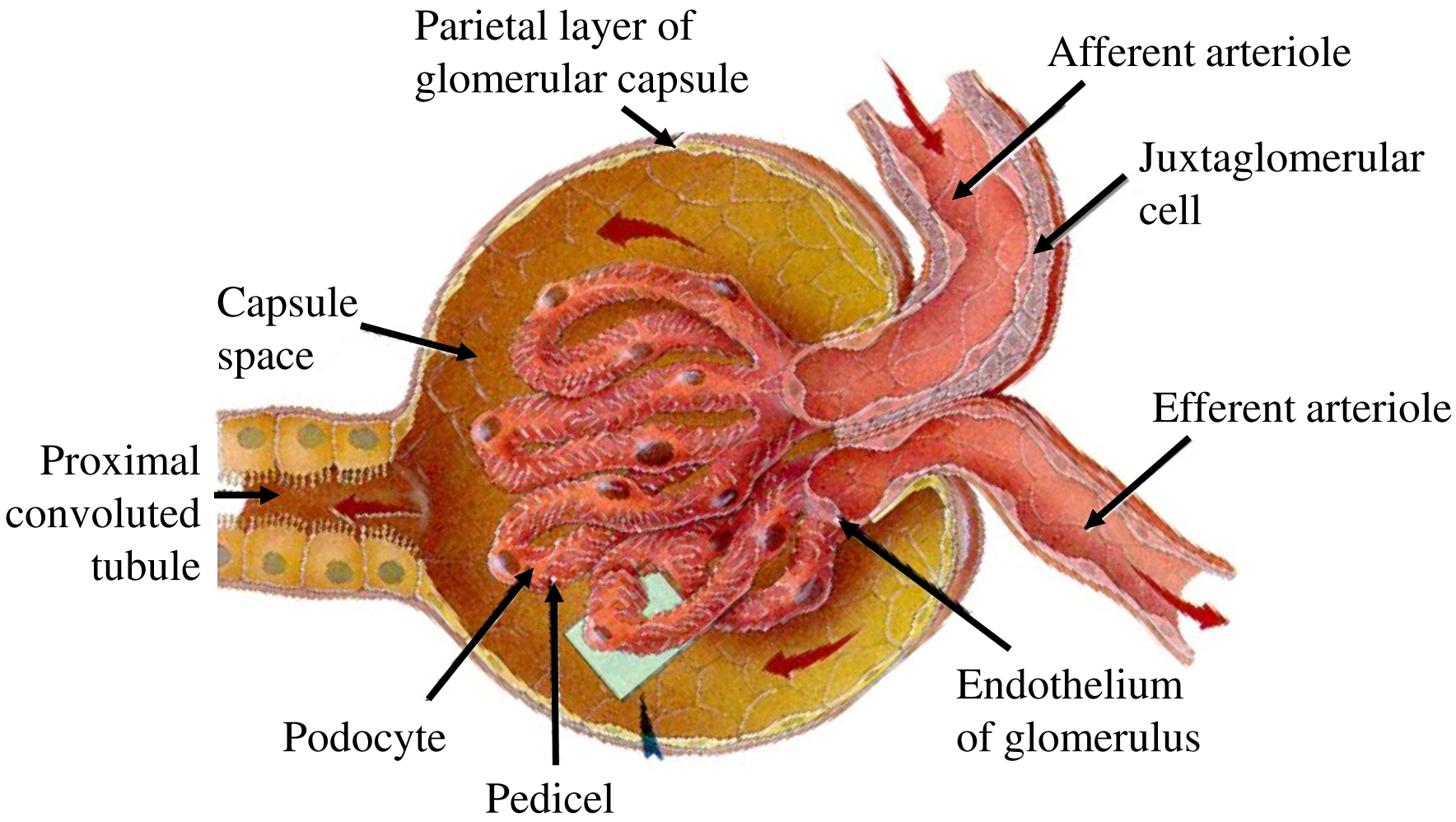
Cortical Nephron

- Glomerulus terletak 2/3 bagian luar cortex
- 85% dari seluruh nephron
- Loop of henle pendek
- Dikelilingi oleh kapiler peritubular berbentuk jala → network

Juxtamedullary Nephron

- Terletak bagian dalam cortex dekat medulla
- 15% dari seluruh nephron
- Loop of henle panjang, lebih dalam masuk ke medulla
- Dikelilingi kapiler berbentuk U → vasa recta

Structure of the Bowman's (glomerular) capsule



Filtration membrane

Is composed of three layers:

1. fenestrated glomerular endothelium
2. basement membrane
3. filtration slits are formed by the pedicels of the podocytes

Substance are filtered are on the basis of size and/or electrical properties

Glomerular Filtration Membrane

- Filtrate must pass through the basement membrane:
  - Thin glycoprotein layer.
  - Negatively charged.

- Podocytes:
  - Foot pedicels form small filtration slits.
  - Passageway through which filtered molecules must pass.

Common component of the glomerular filtrate:

- Organic molecules: glucose,amino acids
- Nitrogenous waste: urea, uric acid, creatinine
- Ions: sodium, potassium, chloride

Forces affecting filtration

- Glomerular hydrostatic pressure (blood pressure) promotes filtration=55 mmHg
- Capsular hydrostatic pressure opposes filtration=15 mmHg
- Glomerular osmotic pressure opposes filtration=30 mmHg
- Net filtration pressure =

  55 – (15+30) =10 mmHg

Glomerular filtration rate

The total amount of filtrate formed by the kidney per minutes

- Sekitar 20% dari renal plasma flow
- Nilai GFR ditentukan oleh: (1) keseimbangan antara tekanan hidrostatis dan osmotik (2) filtration coefficient kapiler (Kf) yaitu permeabilitas dan area permukaan filtrasi
- GFR normal 125 ml/min, atau 180 L/day.

Juxtaglomerular apparatus

- As the thick ascending loop of henle transition into early distal tubule, the tubule runs adjacent to the afferent and efferent arteriole.
- Where these structure are contact they form the monitoring structure called the juxtaglomerular apparatus (JGA), which is composed macula densa and JG cells

- JG monitor the blood pressure within the arteriole (baroreceptor),
- Macula densa; monitor and respond to changes of the osmolarity of the filtrat in the tubule

Autoregulation Mechanism

To counteract changes in GFR

1. Myogenic mechanism

- Increased systemic pressure: Autoregulation: afferent arteriole diameter decreased (constricted) to maintain the GFR
- Decreased systemic pressure: Autoregulation: afferent arteriole diameter increased (dilated) to maintain the GFR

Autoregulation Mechanism

2. Tubuloglomerular mechanism:

   the sensitivitiy of the macula densa cells of juxtaglomerular apparatus to the filtrate osmolarity and/or rate of filtrate flow in the terminal portion of the ascending loop of henle

- High osmolarity: macula densa release the vasonconstrictor that effects: afferent arteriole constricts
  - GFR decrease
  - Tubular filtrate flow slows
  - Reabsorption of sodium & chloride ions increase

- Low osmolarity: macula densa cells: release less vasonconstrictor afferent arteriole dilated, signal to the juxtaglomerular cells to release Renin.
- JG cells also sense to the very low blood pressure directly and release renin in response
- Renin release triggers production of Angiotensin II
- Angiotensin causes : efferent arteriole diameter ↓, blood flow out of glomerulus ↓, glomerular hydrostatic pressure ↑, GFR ↑

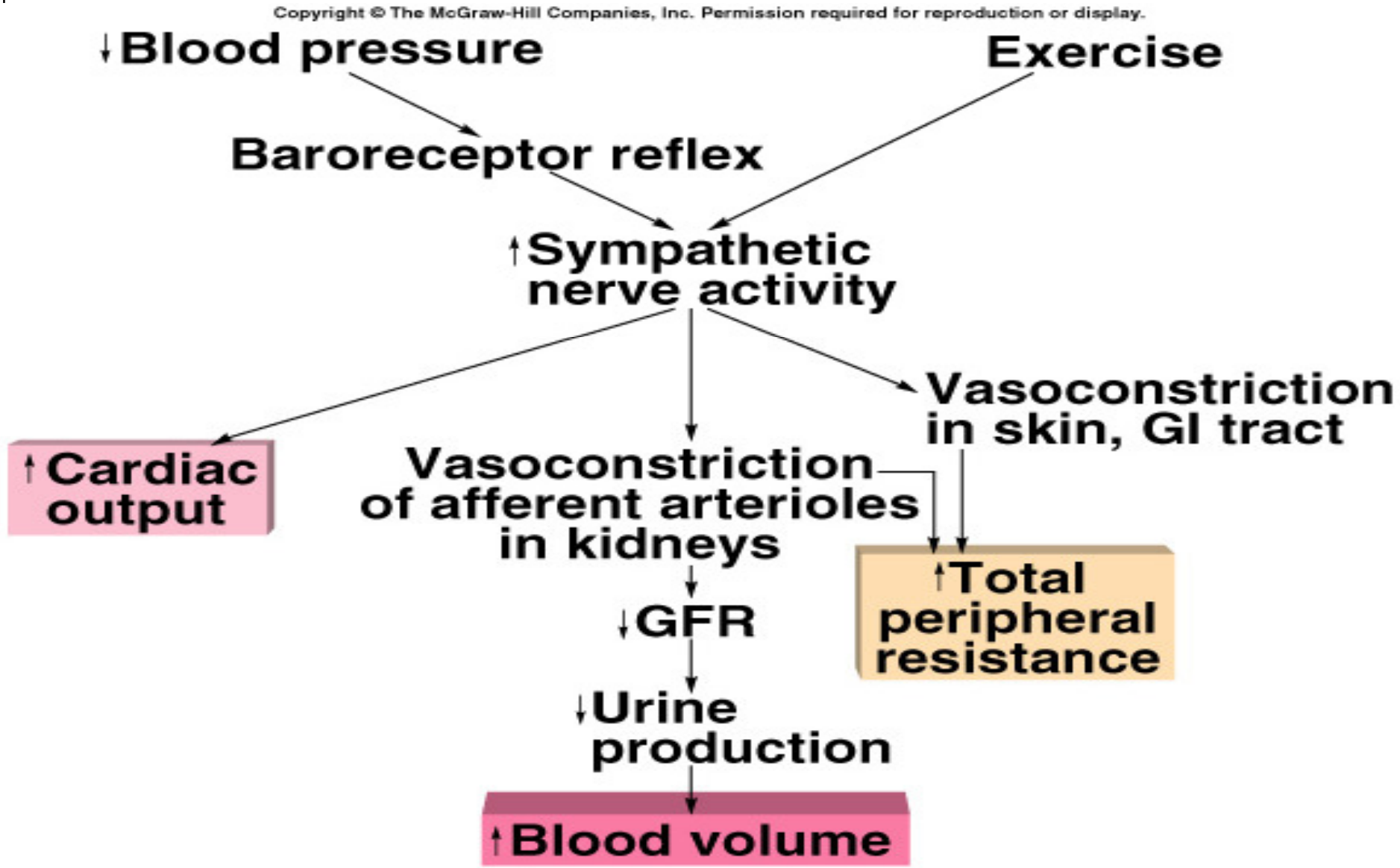
Sympathetic control

In extreme stress or blood loss, sympathetic stimulation overrides the autoregulation

- Increased sympathetic discharge cause intense constriction of renal blood vessel
- Blood is shunted to other vital organs
- GFR reduction causes minimal fluid loss from blood

- Reduction filtration can not go indefinitely, a waste product build up & metabolic imbalances increase in blood
- IV fluid increases blood volume → restores blood pressure to resting levels → reduced sympathetic stimulation allows for normal arteriole diameter → GFR & filtrate flow is normalized

Sympathetic Regulation of GFR



Infeksi Saluran Kemih

Patogenesis

Bacterial Entry

1. periurethral bacteria ascending. Consequently, the short nature of the female urethra combined with its close proximity to the vaginal vestibule and rectum likely predisposes women to more frequent UTIs than men
2. Hematogenous spread can occur in immunocompromised patients and in neonates. Staphylococcus aureus, Candida species, and Mycobacterium tuberculosis are common pathogens that travel through the blood to infect the urinary tract.
3. Lymphatogenous spread through the rectal, colonic, and periuterine lymphatics
4. Direct extension of bacteria from adjacent organs into the urinary tract can occur in patients with intraperitoneal abscesses or vesicointestinal or vesicovaginal fistulas.

- Host Defenses

1. the urine itself has specific characteristics (its osmolality, urea concentration, organic acid concentration, and pH) that inhibit bacterial growth and colonization . It also contains factors that inhibit bacterial adherence, such as Tamm-Horsfall glycoprotein. Urinary retention, stasis, or reflux of urine into the upper urinary tract can promote bacterial growth and subsequent infection. Consequently, any anatomic or functional abnormalities of the urinary tract that impede urinary flow can increase the host's susceptibility to UTI. These abnormalities include obstructive conditions at any level of the urinary tract, neurologic diseases affecting the function of the lower urinary tract, diabetes, and pregnancy. Similarly, the presence of foreign bodies (such as stones, catheters, and stents) allows the bacteria to hide from these host defenses.

the normal flora of the periurethral area or the prostate. In women, the normal flora of the periurethral area composed of organisms such as lactobacillus provide a defense against the colonization of uropathogenic bacteria. Alterations in the periurethral environment (such as changes in the pH or estrogen levels or the use of antibiotics) can damage the periurethral flora, allowing uropathogens to colonize and subsequently to infect the urinary tract. In men, the prostate secretes fluid containing zinc, which has potent antimicrobial activity.

Aging is associated with an increased susceptibility to UTI, in part because of the increased incidence of obstructive uropathy in men and alteration in the vaginal and periurethral flora from menopause in women. Other causes include soiling of the perineum from fecal incontinence, neuromuscular diseases, increased instrumentation, and bladder catheterization .

- Bacterial Pathogenic Factors

Not all bacteria are capable of adhering to and infecting the urinary tract. Of the many strains of Escherichia coli, the uropathogens belong to a limited number of O, K, and H serogroups. They have increased adherence properties to uroepithelial cells, resistance to the bactericidal activity of human serum, production of hemolysin, and the increased expression of K capsular antigen.

CAUSATIVE PATHOGENS

Most UTIs are caused by a single bacterial species.

At least 80% of the uncomplicated cystitis and pyelonephritis are due to E coli, with most of pathogenic strains belong to the O serogroups.

Other less common uropathogens include Klebsiella, Proteus, and Enterobacter spp. and enterococci.

In hospital-acquired UTIs, a wider variety of causative organisms is found, including Pseudomonas and Staphylococcus spp.

UTIs caused by S aureus often result from hematogenous dissemination. Group B ß-hemolytic streptococci can cause UTIs in pregnant women. Staphylococcus saprophyticus, once often thought of as urinary contaminants, can cause uncomplicated UTIs in young women. In children, Klebsiella and Enterobacter spp. being more common causes of UTI. Anaerobic bacteria, lactobacilli, corynebacteria, streptococci (not including enterococci) and Staphylococcus epidermidis are found in normal periurethral flora. They do not commonly cause UTIs in healthy individuals and are considered common urinary contaminants.

Diagnosis

- Urinalysis

leukocyte esterase, a compound produced by the breakdown of white blood cells (WBCs) in the urine.

Urinary nitrite is produced by reduction of dietary nitrates by many gram-negative bacteria. Esterase and nitrite can be detected by a urine dipstick and are more reliable when the bacterial count is greater than 100,000 colony-forming units (CFU) per milliliter. Microscopic examination of the urine for WBCs and bacteria is performed after centrifugation. When bacteria counts are greater than 100,000 CFU/ mL, bacteria can be detected microscopically. More than 3 WBCs per high-power field suggests a possible infection

- Urine Culture

The gold standard.

Each bacterium will form a single colony on the plates. The number of colonies is counted and adjusted per milliliter of urine (CFU/mL).

Treatment

The following principles underlie the treatment of UTIs:

1. Except in acute uncomplicated cystitis in women, a quantitative urine culture or a comparable alternative diagnostic test should be performed to confirm infection before empirical treatment is begun. When culture results become available, antimicrobial sensitivity testing should be used to further direct therapy.
2. Factors predisposing to infection, such as obstruction and calculi, should be identified and corrected if possible.
3. Relief of clinical symptoms does not always indicate bacteriologic cure.

4. Each course of treatment should be classified after its completion as a failure (symptoms and/or bacteriuria not eradicated during therapy or in the immediate posttreatment culture) or a cure (resolution of symptoms and elimination of bacteriuria). Recurrent infections should be classified as same-strain or different-strain and as early (occurring within 2 weeks of the end of therapy) or late.

5. In general, uncomplicated infections confined to the lower urinary tract respond to short courses of therapy, while upper tract infections require longer treatment. After therapy, early recurrences due to the same strain may result from an unresolved upper tract focus of infection but often (especially after short-course therapy for cystitis) result from persistent vaginal colonization. Recurrences 2 weeks after the cessation of therapy nearly always represent reinfection with a new strain or with the previously infecting strain that has persisted in the vaginal and rectal flora.

6. Despite increasing resistance, community-acquired infections, especially initial infections, are usually due to more antibiotic sensitive strains.
7. In patients with repeated infections, instrumentation, or recent hospitalization, the presence of antibiotic-resistant strains should be suspected.

Antibiotics

Trimethoprim-Sulfamethoxazole

- commonly used to treat many UTIs, except those caused by Enterococcus and Pseudomonas spp. It interferes with the bacterial metabolism of folate. Adverse reactions occur in 6-8% of patients using this medication; they include hypersensitivity reactions, rashes, gastrointestinal upset, leukopenia, thrombocytopenia, and photosensitivity. Trimethoprim-sulfamethoxazole should not be used in patients who have a folic acid deficiency state, glucose-6-phosphate dehydrogenase deficiency, or AIDS, or in pregnant patients

- Fluoroquinolones

have a broad spectrum of activity, especially against gram-negative bacteria. Although they have adequate activity against Staphylococci species, fluoroquinolones do not have good activity against Streptococci species and anaerobic bacteria. They interfere with the bacterial DNA gyrase, preventing bacterial replication. Although they are highly effective in the treatment of UTI, fluoroquinolones are relative expensive. Adverse reactions are infrequent and include mild gastrointestinal effects, dizziness, and lightheadedness. Fluoroquinolones should not be used in patients who are pregnant and should be used judiciously in children because of potential damage to developing cartilage.

- Nitrofurantoin

has good activity against most gram-negative bacteria (except for Pseudomonas and Proteus spp.), Staphylococci, and Enterococci species. It inhibits bacterial enzymes and DNA activity. Adverse reactions are relatively common and include gastrointestinal upset, peripheral polyneuropathy, and hepatotoxicity.

- Aminoglycosides

are commonly used in the treatment of complicated UTI. They are highly effective against most gram-negative bacteria. They inhibit bacterial DNA and RNA synthesis. The principal adverse effects of aminoglycosides are nephrotoxicity and ototoxicity. Aminoglycosides are primarily used in patients with complicated UTIs who require intravenous antibiotics

- Cephalosporins

have good activity against most uropathogens. First-generation cephalosporins have good activity against gram-positive bacteria, E coli, and Proteus and Klebsiella spp. Second-generation cephalosporins have increased activity against anaerobes and Haemophilus influenzae. Third-generation cephalosporins have broader coverage against gram-negative bacteria but less against gram-positive bacteria. The cephalosporins inhibit bacterial cell wall synthesis. Adverse reactions include hypersensitivity and gastrointestinal upset.

- Penicillins

First-generation penicillins are ineffective against most uropathogens and are not commonly used in the treatment of UTI. However, the aminopenicillins (amoxicillin and ampicillin) have good activity against Enterococci, Staphylococci, E coli, and Proteus mirabilis. However, gram-negative bacteria can quickly develop resistance to many aminopenicillins. The addition of ß-lactamase inhibitors such as clavulanic acid makes the aminopenicillins more active against the gram-negative bacteria. Although penicillins and aminopenicillins are inexpensive, the addition of the ß-lactamase inhibitors makes them more expensive. Adverse reactions include hypersensitivity (which can be immediate or delayed), gastrointestinal upset, and diarrhea. In general, penicillins are not commonly used in the treatment of UTI unless they are combined with ß-lactamase inhibitors

Prevention

- **PREVENTION Women who experience frequent symptomatic UTIs (3** per year on average) are candidates for long-term administration of low-dose antibiotics directed at preventing recurrences. Such women should be advised to avoid spermicide use and to void soon after intercourse.
- Daily or thrice-weekly administration of a single dose of TMP-SMX (80/400 mg), TMP alone (100 mg), or nitrofurantoin (50 mg) has been particularly effective. Norfloxacin and other fluoroquinolones have also been used for prophylaxis.

- Prophylaxis should be initiated only after bacteriuria has been eradicated with a full-dose treatment regimen. The same prophylactic regimens can be used after sexual intercourse to prevent episodes of symptomatic infection in
- women in whom UTIs are temporally related to intercourse. Other patients for whom prophylaxis appears to have some merit include men with chronic prostatitis; patients undergoing prostatectomy, both during the operation and in the postoperative period; and pregnant women with asymptomatic bacteriuria. All pregnant women should bescreened for bacteriuria in the first trimester and should be treated ifbacteriuria is demonstrated.

Follow Up

Kepentingan:berdasarkan faktor host,umur,resiko,
komplikasi dan angka kesakitan
dengan kegagalan terapi.

o)Pada Penderita dengan komplikasi ISK

Faktor-faktor yang dapat menyebabkan komplikasi:

1)Abormalitas Struktur yaitu Calculi,Fract Anomalies,Obstruksi

2)Penyakit Metabolic yaitu DM,Renal insuficiency

3)Impaired Host DefenseYaitu HIV,Penderita Ca

*)Pasien Yang secara klinis tidak memiliki komplikasi Fyelonafritis

o)Pasien yang tidak dapat memaintain hidrasi oral yang adekuat atau yang tidak memiliki kestabilan pada vasomotor.

o)Pasien yang tidak mendapatkan perawatan yang adekuat dirumah seperti homless,adolescenst,dll

Tugas utama adalah mencegah terjadinya komplikasi lebih lanjut ISK dan mencegah terjadinya

infeksi ulangan penyerta melalui penanganan terhadap penyakit penyerta.

Prognosis

- ISK yang disertai faktor2 yang memperburuk prognosis:

✓ Umur tua

✓ Debilitas

✓ Renal calculi

✓ Recent hospitalization

✓ DM

✓ Anemia sel sabit

✓ Ca & Chemoteraphy

- Bila segera di obati umumnya baik
- Dapat terjadi gagal ginjal
- Pada sistitis hampir slalu terjadi reinfeksi
- Pada SKA cenderung terjadi relaps
- Pengontrolan terhadap faktor2 yang memperberat keadaan akan meningkatkan angka kesembuhan dan quality of life dari penderita.

Kesimpulan

- Di lihat dari gejala klinis dan hasil pemeriksaan laboratorium, Ibu M mengalami infeksi saluran kemih bagian bawah yaitu cyctitis. Ibu M mungkin juga mengalami infeksi saluran kemih bagian atas yang disebabkan oleh cystitis-nya.