Chapter-18

Infection Diseases-I

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Abstract

Infectious diseases remain a significant global health concern, with meningitis, typhoid, and leprosy being notable examples. Meningitis is an inflammation of the protective membranes covering the brain and spinal cord, often caused by bacterial, viral, or fungal infections. The pathophysiology involves the invasion of pathogens into the central nervous system, leading to inflammation and swelling. Epidemiologically, bacterial meningitis is a serious and sometimes fatal condition, particularly affecting infants, young children, and those in close living quarters. Symptoms include severe headache, fever, neck stiffness, and altered consciousness. Diagnosis is made through lumbar puncture and cerebrospinal fluid analysis. Treatment includes antibiotics for bacterial meningitis and supportive care for viral forms. Complications can include hearing loss, brain damage, and death. Prevention includes vaccination and prompt treatment of initial infections. Typhoid fever, caused by Salmonella typhi, is a bacterial infection characterized by prolonged fever, abdominal pain, and systemic involvement. The pathophysiology involves ingestion of contaminated food or water, leading to bacterial invasion of the intestinal mucosa and bloodstream. Epidemiologically, typhoid is prevalent in areas with poor sanitation, affecting millions annually. Symptoms include high fever, weakness, stomach pains, headache, and loss of appetite. Diagnosis is confirmed through blood cultures and serological tests. Treatment involves antibiotics, with resistance being an increasing concern. Complications can include intestinal perforation and severe sepsis. Prevention includes improved sanitation, vaccination, and safe food and water practices. Leprosy, caused by Mycobacterium leprae, is a chronic infectious disease affecting the skin, peripheral nerves, and mucous membranes. The pathophysiology involves the slow replication of bacteria, leading to nerve damage and skin lesions. Epidemiologically, leprosy primarily affects tropical and subtropical regions, with a significant number of cases in India, Brazil, and Indonesia. Symptoms include skin patches, numbness, muscle weakness, and eye problems. Diagnosis is through clinical evaluation, skin biopsy, and PCR testing. Treatment involves multidrug therapy (MDT) to prevent resistance and cure the infection. Complications can include permanent nerve damage, deformities, and social stigma. Prevention focuses on early diagnosis, treatment, and reducing the spread through close contact management.

I. INTRODUCTION

Infection and sexually transmitted diseases (STDs) encompass a broad range of conditions caused by pathogenic microorganisms. Here's a detailed introduction:

Infection

1. **Definition:** Infection occurs when pathogenic microorganisms (bacteria, viruses, fungi, or parasites) invade and multiply within the body, leading to disease. The immune system usually defends against these invaders, but sometimes the pathogens overcome this defense and cause illness.

2. **Types of Infections**
   a. **Bacterial Infections:** Caused by bacteria such as *Streptococcus*, *Staphylococcus*, and *Escherichia coli*. Examples include strep throat, tuberculosis, and urinary tract infections.
   b. **Viral Infections:** Caused by viruses like influenza, HIV, and hepatitis viruses. Examples include the common cold, HIV/AIDS, and hepatitis B and C.
   c. **Fungal Infections:** Caused by fungi such as *Candida* and *Aspergillus*. Examples include athlete's foot, ringworm, and candidiasis.
   d. **Parasitic Infections:** Caused by parasites like protozoa, helminths, and ectoparasites (e.g., lice, ticks). Examples include malaria (protozoa), hookworm (helminth), and scabies (ectoparasite).

3. **Transmission Routes**
   a. **Direct Contact:** Physical contact with infected individuals or their bodily fluids.
   b. **Indirect Contact:** Contact with contaminated surfaces or objects.
   c. **Airborne:** Inhalation of droplets containing pathogens.
   d. **Vector-borne:** Transmission through vectors like mosquitoes (e.g., malaria).
   e. **Fecal-oral:** Ingestion of contaminated food or water.

4. **Prevention and Control**
   a. **Vaccination:** Immunization against certain infectious diseases (e.g., measles, influenza).
   b. **Hygiene:** Hand washing, sanitizing surfaces, and safe food handling.
   c. **Safe Practices:** Using barriers (e.g., condoms), and safe practices in healthcare settings.
   d. **Antimicrobial Medications:** Antibiotics, antivirals, antifungals, and antiparasitics as appropriate.

Sexually Transmitted Diseases (STDs)

1. **Definition:** STDs, also known as sexually transmitted infections (STIs), are infections transmitted primarily through sexual contact. They can also be transmitted through non-sexual means, such as from mother to child during childbirth or through blood transfusions.

2. **Common STDs**
   a. **Chlamydia:** Caused by *Chlamydia trachomatis*, often asymptomatic but can lead to pelvic inflammatory disease (PID) if untreated.
   b. **Gonorrhea:** Caused by *Neisseria gonorrhoeae*, can cause urethritis, cervicitis, and PID.

c. **Syphilis:** Caused by *Treponema pallidum*, has primary, secondary, latent, and tertiary stages with varied symptoms.
d. **Herpes Simplex Virus (HSV):** Causes oral and genital herpes, characterized by painful sores.
e. **Human Papillomavirus (HPV):** Can cause genital warts and is associated with cervical and other cancers.
f. **Human Immunodeficiency Virus (HIV):** Leads to AIDS and compromises the immune system.
g. **Hepatitis B and C:** Affect the liver and can lead to chronic liver disease and cancer.

3. **Transmission:** STDs are primarily spread through:
   a. Vaginal, anal, or oral sex.
   b. Sharing of contaminated needles.
   c. Direct contact with infectious lesions or bodily fluids.

4. **Symptoms:** Symptoms vary depending on the infection but can include:
   a. Painful urination.
   b. Unusual discharge from the genitalia.
   c. Sores or ulcers in the genital area.
   d. Itching or irritation.

5. **Diagnosis**
   a. **Laboratory Tests:** Including blood tests, urine tests, and cultures.
   b. **Physical Examination:** To identify symptoms and signs of infection.
   c. **Imaging:** In some cases, to assess the extent of disease or complications.

6. **Treatment**
   a. **Antibiotics:** For bacterial STDs (e.g., chlamydia, gonorrhea, syphilis).
   b. **Antiviral Medications:** For viral STDs (e.g., HSV, HIV).
   c. **Supportive Care:** For managing symptoms and complications.

7. **Prevention**
   a. **Safe Sex Practices:** Using condoms and reducing the number of sexual partners.
   b. **Regular Screening:** Especially for high-risk individuals.
   c. **Vaccination:** For HPV and hepatitis B.

8. **Public Health Considerations:**
   a. **Education:** Raising awareness about prevention and symptoms.
   b. **Access to Healthcare:** Ensuring availability of testing and treatment.
   c. **Contact Tracing:** Identifying and notifying sexual partners to prevent spread.

II. INFECTIOUS DISEASES

Meningitis

Introduction

Meningitis is an inflammation of the protective membranes (meninges) covering the brain and spinal cord. This condition can be caused by infections with viruses, bacteria, fungi, or

parasites, as well as by non-infectious factors such as certain drugs or autoimmune diseases. Meningitis can lead to serious health complications and requires prompt medical attention.

Pathophysiology

1. **Entry and Spread:** Pathogens can enter the central nervous system (CNS) through the bloodstream, direct extension from nearby infected areas (e.g., sinusitis or otitis media), or through direct inoculation (e.g., trauma or surgery).
2. **Immune Response:** The body's immune response to the invading pathogen leads to inflammation of the meninges. This response includes the release of inflammatory mediators, increased permeability of the blood-brain barrier, and recruitment of immune cells.
3. **Cerebral Edema:** Inflammation can cause cerebral edema, increasing intracranial pressure. This can lead to decreased cerebral blood flow and potential damage to brain tissue.
4. **Neuronal Damage:** Persistent inflammation can result in neuronal damage and dysfunction, contributing to the neurological symptoms associated with meningitis.

Epidemiology

1. **Bacterial Meningitis:** Commonly caused by *Streptococcus pneumoniae*, *Neisseria meningitidis*, *Haemophilus influenzae*, and *Listeria monocytogenes*. Incidence varies by region and population, with higher rates in developing countries and certain high-risk groups.
2. **Viral Meningitis:** Often caused by enteroviruses, herpes simplex virus, varicella-zoster virus, and mumps virus. It is more common than bacterial meningitis but generally less severe.
3. **Fungal Meningitis:** Caused by fungi such as *Cryptococcus neoformans*, particularly in immunocompromised individuals.
4. **Parasitic Meningitis:** Rare, caused by parasites like *Naegleria fowleri*.

Symptoms

1. **General Symptoms:** Fever, headache, stiff neck, photophobia (sensitivity to light), and altered mental status.
2. **Bacterial Meningitis:** Symptoms are often more severe and can progress rapidly, including nausea, vomiting, seizures, and coma.
3. **Viral Meningitis:** Symptoms are usually milder and may include fever, headache, and neck stiffness, often resolving without specific treatment.

Diagnosis

1. **Clinical Evaluation:** Assessment of symptoms and physical examination, including checking for signs of meningeal irritation (e.g., Kernig's sign, Brudzinski's sign).
2. **Lumbar Puncture (Spinal Tap):** Analysis of cerebrospinal fluid (CSF) to identify the presence of pathogens, inflammatory cells, and changes in CSF chemistry (e.g., glucose and protein levels).
3. **Microbiological Tests:** Gram stain, culture, polymerase chain reaction (PCR), and antigen detection tests on CSF samples.
4. **Imaging:** CT or MRI scans to assess for complications or to rule out other conditions.

Treatment

1. **Bacterial Meningitis:** Prompt empirical antibiotic therapy, adjusted based on the identified pathogen and its susceptibility. Common antibiotics include ceftriaxone, vancomycin, and ampicillin.
2. **Viral Meningitis:** Primarily supportive care, including hydration, pain management, and antiviral therapy if a specific virus is identified (e.g., acyclovir for herpes simplex virus).
3. **Fungal Meningitis:** Antifungal medications such as amphotericin B and flucytosine.
4. **Parasitic Meningitis:** Specific antiparasitic treatments depending on the causative organism.
5. **Supportive Care:** Management of symptoms, including fever control, hydration, and addressing complications such as seizures or increased intracranial pressure.

Complications

1. **Neurological Sequelae:** Hearing loss, cognitive deficits, motor impairments, and seizures.
2. **Hydrocephalus:** Accumulation of cerebrospinal fluid leading to increased intracranial pressure.
3. **Septic Shock:** Particularly in severe bacterial meningitis, can lead to multi-organ failure.
4. **Death:** Meningitis can be fatal, especially if not treated promptly and appropriately.

Prevention

1. **Vaccination**
   a. **Haemophilus influenzae type b (Hib):** Vaccine for children.
   b. **Pneumococcal Vaccines:** PCV13 and PPSV23 for children, adults, and high-risk groups.
   c. **Meningococcal Vaccines:** MenACWY and MenB vaccines for adolescents and high-risk populations.
2. **Prophylactic Antibiotics:** For close contacts of individuals with meningococcal or Hib meningitis.
3. **Public Health Measures**
   a. **Hand Hygiene:** Regular handwashing to reduce the spread of infections.
   b. **Safe Practices:** Avoiding close contact with infected individuals and using protective measures during outbreaks.
4. **Environmental Controls:** Reducing overcrowding and improving living conditions to decrease transmission risk.

III. TYPHOID

Introduction

Typhoid fever is a systemic bacterial infection caused by *Salmonella enterica* serotype Typhi (commonly referred to as *Salmonella Typhi*). The disease is characterized by prolonged fever, gastrointestinal disturbances, and systemic involvement. It is primarily transmitted through the ingestion of contaminated food and water and is a significant public health problem in developing countries.

Pathophysiology

1. **Ingestion and Entry:** *Salmonella Typhi* is ingested through contaminated food or water and survives the acidic environment of the stomach.

2. **Invasion and Dissemination:** The bacteria penetrate the intestinal mucosa, enter the bloodstream, and are carried to various organs, including the liver, spleen, and bone marrow.
3. **Immune Response:** The host immune system responds, leading to the release of inflammatory cytokines. The bacteria can survive and replicate within macrophages, facilitating their spread.
4. **Biliary Excretion and Reinfection:** The bacteria are excreted into the biliary system and re-enter the intestines, leading to reinfection and shedding in feces.

Epidemiology

1. **Geographic Distribution:** Typhoid fever is endemic in many developing countries, particularly in South Asia, Southeast Asia, and sub-Saharan Africa.
2. **Incidence:** There are an estimated 11–20 million cases and 128,000–161,000 deaths annually worldwide.
3. **Risk Factors:** Poor sanitation, lack of clean drinking water, and overcrowding contribute to the spread of typhoid fever. Travelers to endemic areas are also at risk.

Symptoms

1. **Early Symptoms (1-2 weeks):** Gradual onset of high fever, malaise, headache, and abdominal pain.
2. **Progressive Symptoms:** Sustained high fever, hepatosplenomegaly (enlarged liver and spleen), rose-colored spots on the abdomen, and relative bradycardia.
3. **Gastrointestinal Symptoms:** Diarrhea or constipation, nausea, vomiting, and abdominal distension.

Diagnosis

1. **Clinical Evaluation:** Based on symptoms and epidemiological context (travel history, contact with known cases).
2. **Laboratory Tests**:
   a. **Blood Culture:** The most definitive test, particularly during the first week of illness.
   b. **Bone Marrow Culture:** More sensitive than blood culture and useful in chronic cases.
   c. **Stool and Urine Cultures:** Useful in later stages of the disease.
   d. **Serological Tests:** Widal test, though less specific and sensitive compared to cultures.
3. **Molecular Tests**: PCR for rapid and specific detection of *Salmonella Typhi* DNA.

Treatment

1. **Antibiotic Therapy**
   a. **First-line:** Fluoroquinolones (e.g., ciprofloxacin) for non-resistant strains.
   b. **Second-line:** Third-generation cephalosporins (e.g., ceftriaxone) and azithromycin for resistant strains.
   c. **MDR and XDR Typhoid:** Multi-drug resistant (MDR) and extensively drug-resistant (XDR) strains require alternative treatment regimens.
2. **Supportive Care:** Hydration, antipyretics for fever, and nutritional support.

Complications

1. **Intestinal Perforation:** Can lead to peritonitis, a life-threatening condition requiring surgical intervention.
2. **Sepsis and Septic Shock:** Systemic infection leading to multiple organ dysfunction.
3. **Neuropsychiatric Symptoms:** Delirium, confusion, and other mental status changes.

4. **Chronic Carrier State:** Persistent excretion of bacteria in stool, posing a risk of transmission to others.
5. **Relapse:** Recurrence of symptoms after apparent recovery, often requiring additional treatment.

Prevention

1. **Vaccination**
   a. **Typhoid Conjugate Vaccine (TCV):** Recommended for children in endemic areas.
   b. **Oral Live-Attenuated Vaccine (Ty21a):** Taken in capsule form.
   c. **Vi Capsular Polysaccharide Vaccine:** Injectable form, recommended for travelers.

2. **Sanitation and Hygiene**
   a. **Safe Drinking Water:** Use of purified or boiled water.
   b. **Proper Sewage Disposal:** To prevent contamination of water supplies.
   c. **Hand Hygiene:** Regular handwashing with soap and clean water.

3. **Food Safety**
   a. **Safe Food Handling:** Proper cooking and storage of food.
   b. **Avoiding Raw Foods:** Particularly in endemic areas where contamination is likely.

4. **Education and Awareness:** Public health campaigns to promote hygiene and vaccination, especially in high-risk areas.