Therapeutic areas – Part 1

Infectious Diseases

Module 4 Topic 4_1

Microbiology

Introduction to Microbiology

- **Microorganisms -** organisms seen only through a microscope
  - **Bacteria** (singular - bacterium) are unicellular microorganisms that possess a cell wall & multiply by cell division
  - **Virus** is a tiny, infectious particle that can reproduce only by infecting a host cell
  - **Fungi**

Microbiology

Structure of bacterial cell

- **Cell envelope**
  - Cell wall
  - Cell membrane
- **Cytoplasm**
  - **Nucleus** – chromosomes carrying the genetic information.
  - **Cytoplasmic organelles** – perform metabolic functions vital for the cell, include mitochondria, ribosomes, endoplasmic reticulum

Microbiology

Classification of bacteria

- **Aerobes** and **anaerobes**
- **Pathogens** and **non-pathogens**
- **Gram positive** and **Gram negative**
- **Cocci** or **Bacilli**

Infectious Diseases

Organism	Diseases
A] Aerobes **Gram positive Cocci**	
Staphylococcus aureus	boils, cellulitis, endocarditis, eye infections, food poisoning, hospital-acquired infections, impetigo, osteomyelitis, otitis externa, pneumonia, septicaemia, toxic shock syndrome
Staphylococcus epidermidis	abscess, endocarditis, endometritis, hospital-acquired infections, neonatal meningitis, urinary tract infections, wound infections
Streptococcus pyogenes (grp A)	cellulitis, erysipelas, glomerulonephritis, impetigo, pyoderma, respiratory tract infections, rheumatic fever, septicaemia, toxic shock syndrome, wound infections
Streptococcus agalactiae (grp B)	endocarditis, neonatal meningitis, respiratory tract infections, urinary tract infections, wound infections
Streptococcus faecalis (grp D)	endocarditis, urinary tract infections
Streptococcus pneumoniae	bronchitis, eye infections, meningitis, otitis media, pneumonia, septicaemia

Infectious Diseases

Organism	Diseases
A] Aerobes **Gram positive Bacilli**	
Bacillus anthracis	Anthrax
Corynebacterium diphtheriae	Diphtheria
Listeria monocytogenes	meningitis, meningoencephalitis, septicaemia

Organism	Diseases
A] Aerobes **Gram negative Cocci**	
Neisseria meningitides	Meningitis, septicaemia
Neisseria gonorrhoeae	Gonorrhoea, endocarditis, meningitis, ophthalmia neonatorum, septic arthritis, septicaemia

Infectious Diseases

Organism	Diseases
A] Aerobes **Gram negative Bacilli**	
Escherichieae coli	Cholecystitis, gastroenteritis, liver abscess, neonatal meningitis, peritonitis, septicaemia, urinary tract infections
Haemophilus influenzae	Arthritis, cellulitis, chronic bronchitis, conjunctivitis, meningitis, otitis media, pneumonia, sinusitis
Haemophilus ducreyi	Chancroid
Klebsiella pneumoniae	Cholecystitis, pneumonia, infections in immunocompromised patients
Pseudomonas aeruginosa	Abscess, burns infections, endocarditis, hospital-acquired infections, malignant otitis externa, meningitis, pneumonia, urinary tract infections, wound infections
Salmonella spp.	Typhoid, paratyphoid, gastroenteritis
Shigella spp.	Bacillary dysentery
Vibrio cholerae	Cholera
Yersinia pestis	Plague
Bordetella pertusis	Whooping cough

Infectious Diseases

Organism	Diseases
B] Anaerobes **Gram positive cocci**	
Peptostreptococcus spp.	Abdominal infections, acute necrotising gingivitis, aspiration pneumonia, brain abscess, periodontitis, wound infections
Gram positive bailli	
Clostridium botulinum	Botulism
Clostridium welchii	Gas gangrene, food poisoning, necrotic enteritis, septic abortion
Clostridium tetani	Tetanus
Clostridium difficile	Antibiotic-associated colitis
Actinomyces spp.	Actinomycosis
Gram negative cocci	
Veillonella spp.	Periodontitis, lung infections
Gram negative bacilli	
Bacteroides fragilis	Abscess, intra-abdominal infections
Fusobacterium spp.	Aspiration pneumonia, necrotising gingivitis

Infectious Diseases

Antibacterial Agents

Mode of action	Chemical group	Antibacterial agents
Inhibition of cell wall synthesis	Penicillins (beta lactam)	Benzylpenicillin, ampicillin, amoxycillin, cloxacillin, piperacillin
	Cephalosporins (beta lactam)	Cephalexin, cefadroxil, cefuroxime, cefotaxime, ceftazidime, ceftriaxone
	Glycopeptides	Vancomycin, teicoplanin

Infectious Diseases

Antibacterial Agents (Contd)

Mode of action	Chemical group	Antibacterial agents
Inhibition of protein synthesis	Aminoglycosides	Streptomycin, gentamicin, amikacin, tobramycin
	Macrolides	Erythromycin, roxithromycin, clarithromycin, azithromycin
	Tetracyclines	Tetracycline, doxycycline
	Chloramphenicol	Chloramphenicol
	Lincosamides	Clindamycin

Infectious Diseases

Antibacterial Agents (Contd)

Mode of action	Chemical group	Antibacterial agents
Inhibition of bacterial DNA synthesis	Quinolones	Norfloxacin, ciprofloxacin, ofloxacin, gatifloxacin
	Sulphonamides	Sulphadoxine, sulphmethoxazole, co-trimoxazole
	Metronidazole	Metronidazole

Infectious Diseases

Antibacterial Agents (contd)

- Agents that act against Mycobacterium tuberculosis, the microbe that causes tuberculosis, including streptomycin, rifampicin, isoniazid, ethambutol, and pyrazinamide

Infectious Diseases

Viruses have:

- A protective protein shell, or **capsid**
- A nucleic acid genome made of **DNA** or **RNA**
- A lipid layer of membrane called the **envelope** (some but not all viruses)

Viral Infection

Viral infection

- **Attachment** - Virus binds to receptor on cell surface
- **Entry** - Virus enters cell by endocytosis
- **Replication** and **gene expression** - The genome is copied and translated into viral proteins using a host ribosome
- **Assembly** - Capsid proteins and genomes come together to make new viral particles
- **Release** - The cell bursts releasing viral particles, which then infect other host cells

Fungal Infections

- **Tinea** is the name of a group of diseases caused by a fungus. It is also called as "ringworm" or "**dermatophytosis**."
  - tinea pedis or "athlete's foot": red, swollen, peeling, itchy skin between the toes
  - tinea capitis: scaly, itchy, red, circular bald spot on scalp
  - tinea cruris or "jock itch": scaly, itchy, red spots in the groin
  - tinea barbae: scaly, itchy, red spots on the cheeks, chin, and upper neck filled with pus, affected hair might fall out
- Treatment
  - over-the-counter topical antifungal products - clotrimazole, terbinafine
  - Chronic or extensive disease may require oral antifungal agents such as terbinafine, itraconazole, or fluconazole

Fungal Infections

Fungal Nail Infections ("onychomycosis.")

- More common in toenails than fingernails
  - Discolored (yellow, brown, or white), thick, fragile or cracked
- Treatment
  - Difficult to cure, can take several months to a year
  - Topical antifungal agents often ineffective.
  - Oral terbinafine for 6 weeks for fingernails and 12 weeks for toenails, Azoles can also be used
  - Surgical debridement or removal of the affected nail for cases resistant to antifungals

Fungal Infections

Candidiasis

- Fungal infection caused by yeasts that belong to the genus *Candida*, most commonly *Candida albicans*.
- *Candida* yeasts normally reside in the intestinal tract and can be found on mucous membranes and skin

Fungal Infections

Oropharyngeal candidiasis or **"thrush"**

- Seen commonly in people who -
  - Wear dentures
  - Have diabetes
  - Have cancer
  - Have HIV/AIDS
  - Take inhaled corticosteroids for conditions like asthma
  - Smoke
- Treatment
  - Antifungal medicines like clotrimazole, miconazole, or nystatin applied to the inside of the mouth for 7 to 14 days

Fungal Infections

Vaginal Candidiasis

- More likely in women who -
  - Are pregnant
  - Use hormonal contraceptives (for example, birth control pills)
  - Have diabetes
  - Have a weakened immune system (for example, due to HIV infection or treatment with steroids or chemotherapy)
  - Are taking or have recently taken antibiotics
- Treatment
  - Topical antifungal applied inside the vagina or a single dose of fluconazole taken by mouth

Fungal Infections

Invasive Candidiasis

- Common species are *C. albicans*, *C. glabrata*, *C. parapsilosis*, *C. tropicalis*, and *C. krusei*
- Serious infection that may include endocarditis, peritonitis, meningitis, osteomyelitis, arthritis, and endophthalmitis
- Candidemia, a bloodstream infection with *Candida*, is a common infection in hospitalized patients
- Treatment
  - Fluconazole, amphotericin B, or echinocandin (caspofungin, micafungin) IV for 2 weeks after signs and symptoms have resolved