Antimicrobial Drugs
(Chapter 20)

Lecture Materials
for
Amy Warenda Czura, Ph.D.
Suffolk County Community College
Eastern Campus

Primary Source for figures and content:
Selective toxicity = kill pathogen without harming host
Chemotherapy = treatment with chemical substances
Antibiotic = substance produced by microbes that inhibits or kills other microbes
First: Penicillin, Fleming 1928
Antibiotic producers:
- *Streptomyces* species
- *Bacillus* species
- *Penicillium*
- *Cephalosporium*
Antimicrobial drugs = both antibiotics and synthetic chemotherapy
Spectrum of microbial activity = range of microbial types affected by particular antimicrobial
e.g Penicillin → Gram +
(Gram negative more resistant in general: outer membrane only allows substances through porins, drug has to be small to pass)

Broad spectrum “antibiotics”:
-work on wide range of bacteria
-tend to kill off normal flora/microbiota
-can lead to superinfection:
Superinfection = one remaining organism takes over and causes disease, usually multi-drug resistant

Antibacterial drugs are
1. Bactericidal = kill bacteria directly
2. Bacteriostatic = prevent bacterial growth so host immune defenses can kill it
Modes of Action of Antibacterial Drugs:
*best drugs target bacterial specific feature so toxicity to humans is low

1. Inhibition of cell wall synthesis
- peptidoglycan not found in humans
- can inhibit NAG and NAM synthesis or crosslinking
- only affects actively growing cells: new walls thin and weak

2. Inhibition of protein synthesis
- eukaryotes = 80s ribosome, prokaryotes = 70s
- can target 70s but toxicity to mitochondria
- inhibit peptide bond formation, attachment of tRNA, or cause misreading of mRNA
3. Injury to plasma membrane
-alter permeability = loss of metabolites
-all membranes similar: toxicity risk
4. Inhibition of nucleic acid synthesis
-interfere with DNA replication or transcription
-all cells similar enzymes and nucleotides: toxicity risk

5. Inhibit synthesis of essential metabolites
-drug = competitive inhibitor of enzyme in metabolite synthesis pathway
-(metabolite = any organic needed for growth)
-must target bacterial specific pathways

Key Concept
Antimicrobial drugs function in one of the following five ways: inhibiting cell wall synthesis, inhibiting protein synthesis, inhibiting nucleic acid synthesis, injuring the plasma membrane, or inhibiting synthesis of essential metabolites.
Tests to guide chemotherapy:
-different species have different susceptibilities
-resistance can appear over time
-must choose right drug in right concentration

1. Disk-diffusion/Kirby-Bauer test
-to determine which drug microbe is most susceptible to

method:
-plate lawn of bacteria
-place disks of known antimicrobials on lawn
-measure zones of inhibition, compare to resistance chart to choose best
2. E-test
-to estimate MIC (minimal inhibitory concentration) for effective dose method:
  - plate lawn
  - apply strip with concentration gradient of antimicrobial
  - read minimum level that inhibits growth
3. Broth Dilution Test
-to determine MIC and MBC (minimal bactericidal concentration)
-differentiate bacteriocidal versus bacteriostatic drug action
method:
  -create sequence of decreasing concentration of drug in broth
  -inoculate test bacteria
  -test no growth wells for live bacteria in drug free media: growth = static (MIC)
  no growth = cells dead = cidal (MBC)

Common Drugs (on handout)
Mechanisms of Drug Resistance
1. destruction/inactivation of drug
2. prevent penetration to target site in cell
3. alteration of drug target site
4. rapid efflux (pump out of cell before drug finds target)

*resistance is passed on plasmids: gene to produce protein that will do one of the above, (typically mechanism #1 or 4)