

Bacterial Classification and Disease

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Purpose

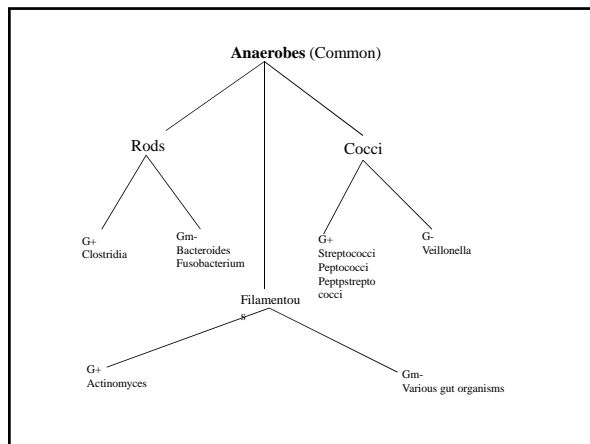
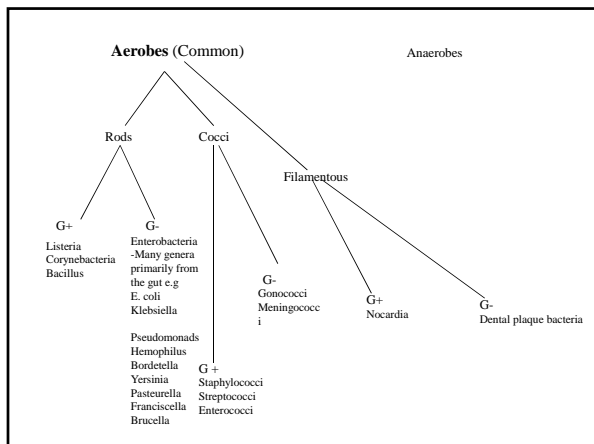
- To provide an overview of how we think when confronted with a bacterial infection
- To alert you to the importance of bacterial classification in treatment
- The importance of knowing the etiology of organ system based infection and the gram stain

- Bacterial classification based on several major properties
 - Gram Staining characteristics
 - Morphology
 - Metabolic behavior
 - DNA sequence

- **Natural classification scheme that reflects major differences in cell wall structure and to some extent the mechanisms involved in disease and help in choosing therapy**
- **Gram positive (blue)** single membrane consisting of a thick peptidoglycan layer--No lipopolysaccharides
- **Gram negative (pink)**, inner and outer membranes, with outer membrane having lipopolysaccharide molecules

- Morphology
 - Rods or cocci
 - Curved or spiral
 - Filamentous
- Some correlation between morphology and disease e.g.
 - spiral bacteria---**Treponemes, Borrelia, Leptospira, Spirillum tend to cause systemic diseases**
 - Pathogenic Filamentous bacteria **Actinomyces, Nocardia, Mycobacteria tend to cause chronic diseases**
 - Gram positive bacteria, **Staphylococcus, Streptococci** more likely to cause skin infections

- Metabolic properties may influence the type of disease caused, but not exclusively
 - aerobic versus anaerobic (microaerophilic, facultative aerobes)
 - Anaerobes have a greater propensity to cause abscesses
 - Brain, Lung, Liver, Intra-abdominal abscesses, however they may not always be in pure culture



How does an experienced Physician approach bacterial diseases

- **Organ system approach**
 - Which bacteria cause disease in a certain location
 - E.g. lungs, skin, subarachnoid space.
 - With experience the answer comes easily
- **Gram stain approach**
 - What does the gram stain show--**used to treat empirically before cultures are completed**
 - Requires that one is able to get a gram stain, which is not always the case

Taking the Organ system approach (Most common organisms)

- **Meningitis**
 - Pneumococci, Meningococci, *Hemophilus influenzae*, Listeria in adults, neonates and children somewhat different
- **Sinusitis**
 - Pneumococci, *H. influenzae*, Moraxella, *Staphylococcus aureus*
- **Otitis media**
 - Pneumococci, *H. influenzae*, Moraxella
- **Pharyngitis**
 - Group A streptococci

Now add in gram stain

- **Gram negative rod** seen in CSF in meningitis in an older child or adult, what is it most likely to be
- **Gram positive coccus** in meningitis
- **Gram positive coccus** in sinusitis
 - Gram stain may suggest the organism --clusters or diplococci?

Gram stain may be a defining point in therapy, we would drugs based on gram stain characteristics

Chest

- **Pneumonia**
 - Pneumococcus, *H. influenzae*
- **Pleural cavity**
 - Pneumococcus, Staphylococcus, Anaerobic bacteria
- **Endocarditis**
 - Streptococcus, Staphylococcus, Enterococci

Add in the gram stain

- **Pneumonia-sputum gram stain**
 - Gram positive coccus as the predominant organism
 - Likely organism Pneumococcus--the most common gram positive coccus found in pneumonia
 - Therapy can be chosen
- **Endocarditis-blood culture positive**
 - Gram positive coccus on the stain
 - May be Streptococci, Enterococci or Staphylococci
 - Treatment decision made on this basis- Vancomycin +

Abdomen

- Likely organisms in intraabdominal infections come from the GI tract
 - *Therefore all enteric flora need to be considered*
 - **Not respiratory flora as in Head and Chest**
- Aerobic (Enterobacteriaceae) and anaerobic (Bacteroides, Fusobacteria) **gram negatives rods.**
- Aerobic (Enterococci and Streptococci) and anaerobic **gram positives cocci** (Streptococci)
- Anaerobic **gram positive rods** (Clostridia)

- Peritonitis-fecal flora spilled into abdominal cavity from surgery or perforation
 - All morphological forms and all metabolic types
- Liver abscesses
 - All types
- Biliary tract infections
 - Fewer types of organisms
 - Aerobic gram negative rods and gram positive cocci predominate

- **Skin infections**
 - Skin flora-Gram positive cocci
 - *Staphylococcus aureus* and *Strep. pyogenes*
- **This is of immediate help in therapy**
- **Complex skin infections**
 - Skin flora plus enteric flora and environmental flora.

Urinary tract infection

- Because of proximity to GI tract Enteric flora are the prime suspects in most cases
 - **Unusual to find Staphylococci and streptococci or anaerobes**
 - Aerobic Enteric gram negative rods
 - Aerobic gram positive cocci from the gut
 - What are these

Examples of possible life saving decisions based on a knowledge of classification

- A neutropenic patient (after chemotherapy for leukemia) developed high grade fever and was placed a broad spectrum cephalosporin antibiotic (gram positive and gram negative activity)
- 48 hours later he was still febrile to 103° F and his blood pressure was now low. Blood cultures were now positive and a gram stain was done on the culture
- Gram positive cocci in clusters seen

- Why did the patient not respond to broad spectrum antibiotic therapy
 - What could this resistant virulent gram positive coccus be.
 - What therapy can be added

- An elderly was admitted with signs of meningitis and a lumbar puncture was done
 - CSF gram stain showed gram negative rods
 - What organism is likely to be the cause
 - *E. coli*, *Pseudomonas*, *Listeria* or *H. influenzae*

- A 60 y.o. female patient with Pneumonia was found to have fluid in the pleural cavity on admission. She could not cough up sputum for examination
- Pleural fluid was drawn and it showed many PMNs and gram positive cocci in pairs and chains
 - What is the etiology

Take home messages

- Classification boring but important for initial therapy
- Know what organisms are common at the various sites of infection as you go through the course
- Know what the gram stain and metabolic properties are of the common bacteria found at each organ system infection
- Don't memorize it now it will come if you pay attention through the lectures that follow.