GRAM negative pathogens
cocci and bacilli
Chapter 20

Virulence of G negatives?

• Outer membrane of cell wall
• Lipid A
• What is it?
• DIC: Disseminated Intravascular Coagulation
• Fever, vasodilation, inflammation, shock

Neisseria

• Only G- cocci that cause diseases in humans
• Class Betaproteobacteria
• Diseases: gonorrhea and meningitis

Pathogens (virulence factors)

• Fimbriae
• Capsules
• endotoxin

Growth

• Fastidious
• Chocolate agar (autoclaved blood agar)
• Or modified Thayer-Martin media (selective)
Gonorrhea: Sexually transmitted

Neisseria gonorrhoea

Gonorrhea infection

Gonorrhea pus

Pus smear

“gonococcus”

salpingitis

Incidence of gonorrhea in U.S.

Neisseria gonorrhoea
**Neisseria meningitidis**

- Pathogenic, Gram-negative, facultative, bacilli
  - Class Gammaproteobacteria
    - Enterobacteriaceae (oxidase negative)
    - Pasteurellaceae (oxidase positive)
  - Most of the gram negative human pathogens

**Meningitis causes**

TABLE 22.1 Relative Incidence of Bacterial Meningitis in United States and Canada

<table>
<thead>
<tr>
<th>Bacterium</th>
<th>Percentage of Cases</th>
<th>Fatality Rate</th>
</tr>
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<tbody>
<tr>
<td>Streptococcus pneumonia</td>
<td>30–50</td>
<td>19–46</td>
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<td>3–17</td>
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<td>Haemophilus influenzae</td>
<td>2.2*</td>
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Other bacteria causing meningitis account for 6–8% of cases.

*Before introduction of Hib vaccine, H. influenzae accounted for about 45% of cases of bacterial meningitis; about 75% of these cases occurred in children under age 5.*


**Petechiae in meningococcal septicemia**

(a) (b)

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**Enterobacteriaceae (enteric bacteria)**

- 150 different species
- Most common Gram-negative human pathogen
- Intestinal microbiota of humans and animals
- Pathogenic and opportunistic pathogens
- Cocco-bacilli or bacilli
Enterobacteriaceae

Enterobacter aerogenes

Escherichia coli

Nosocomial infections

Dichotomous key for enterics

Enteric antigens and virulence factors:
know these p. 571

Diagnostic, treatment and prevention

• Page 571
• Complete from text (see specific species)

Coliforms

• Aerobic or facultative Gram– rods
• Ferment lactose to gas at 35 C
• Intestinal tract of humans and animals, in soil, on plants and decaying vegetation
• Fecal coliforms indicate impure water quality
• Most common opportunistic coliform pathogens
  – Escherichia
  – Klebsiella
  – Serratia
  – Enterobacter
  – Hafnia
  – Citrobacter
**E. coli**

- **Description**
  - O, K and H antigens: O157:H7
  - Water quality indicator
- **Virulence factors:**
  - fimbriae, adhesins, exotoxins
- **Diseases:**
  - UTI’s, septicemia, neonatal meningitis, gastroenteritis (enterotoxins), acute pyelonephritis

**E. coli O157:H7**

- 70,000 cases annually
- Bloody diarrhea, hemorrhagic colitis, hemolytic uremic syndrome
- Displaces normal, harmless strains in intestines
- Produces shiga-like toxin (kills host cells)

**Klebsiella pneumoniae**

- Capsules

**Serratia marcescens:** common nosocomial pathogen in urinary and respiratory systems

**MacConkey Agar**

- Staphylococcus aureus
- Salmonella choleraesuis
API System: a Multitube Micromethod for Identification of Enterobacteriaceae

P. B. Smith, K. M. Tomfohrde, D. L. Rhoden and A. Balows
Center for Disease Control, Atlanta, Georgia 30333

ABSTRACT

The API system for identification of Enterobacteriaceae was evaluated with 366 culture. Overall accuracy of identification was 96.4%; of the 13 cultures misidentified, 7 were atypical strains.

Non-coliform (cannot ferment lactose) opportunistic Enterobacteriaceae

- **Proteus**
- **Morganella**
- **Providencia**
- **Edwardsiella**
- Nosocomial: UTI’s

Proteus mirabilis

- UTI with long-term catheter use
- Urease positive
- Kidney stones develop
- Swarming cells

Other opportunistic Enterobacteriaceae

- **Morganella**
- **Providencia**
- **Edwardsiella**
- UTI

Truly Pathogenic Enterobacteriaceae

- **Salmonella**
- **Shigella**
- **Yersinia**

**Common descriptors:**
- Not normal microbiota
- Virulence factors include type III secretion systems

**Enterobacter, Hafnia, Citrobacter**

Nosocomial infections blood, wounds, surgery, UTI

API results

Figure 20.12
**Salmonella enterica:** 2000 serotypes
- S. typhimurium (strain)
- Food contaminated with animal feces
- Poultry or eggs
- Salmonellosis food poisoning

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**Typhoid fever:** S. typhi

---

**Shigellosis:** abdominal cramps, fever, diarrhea, and purulent bloody stools

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**Yersinia pestis:** virulent, non-enteric pathogen

---

**Buboes:** bubonic plague
**Pasteurellaceae Family**

- Oxidase positive
- 2 pathogenic genera
  - *Pasteurella*: normal in oral and nasopharyngeal cavities of dogs and cats; can infect immunocompromised humans
  - *Haemophilus*

**Haemophilus**

- Require heme and NAD+
- Obligate parasites
- Obligate intracellular parasite
  - K (capsule) antigen for typing; strain b
  - Most common cause of meningitis in children before Hib vaccine

**Meningitis causes**

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**Haemophilus influenzae**

*Hib vaccine*

**Meningitis vaccine**
Chancroid caused by *Haemophilus ducreyi*

**Pathogenic, G-, aerobic bacilli**
- Phylum Proteobacteria
- Bartonella
- Brucella
- Bordetella
- Burkholderia
- Pseudomonas
- Moraxella
- Francisella
- Legionella

**Cat-scratch disease:** *Bartonella*

Name other diseases

**Incidence of brucellosis (Brucella melitenses) in U.S.:**
- Undulant fever; Malta fever
- From unpasteurized dairy products and animal products

**Pertussis:** whooping cough

**Bordetella pertussis**
**Burkholderia**

- Can decompose many organic compounds
- PCB’s and Agent Orange
- Opportunistic pathogen in cystic fibrosis patients

**Pseudomonads**

- G-aerobic rods
- Ubiquitous
- Where are they found in the community and hospital?

**Pseudomonas aeruginosa**

**Francisella**

- *F. tularensis*
- Tularemia
- Transmission, virulence, diagnosis, treatment?
Figure 20.27
Legionella pneumophila

Cooling tower
Air intake
Chiller unit

Figure 20.28
Coxiella burnetii

Figure 20.29
Bacteroides fragilis

Figure 20.30
Typhoid Mary