CHAPTER 25 MICROBIAL DISEASES OF THE LOWER DIGESTIVE SYSTEM

I. ANATOMY AND DEFENSE MECHANISMS
   A. Anatomy
   B. Defense Mechanisms
      1. Acid
      2. Peristalsis
      3. Epithelium
      4. IgA, Macrophages
      5. Diarrhea, Vomiting
      6. Normal Flora

II. BACTERIAL INFECTIONS
   A. Salmonella
      1. Gastroenteritis
      2. Typhoid Fever
   B. Shigella - (Bacillary Dysentery)
   C. Campylobacter
   D. Cholera
   E. E. coli -

III. BACTERIAL INTOXICATION
   A. Staphylococcus - discussed previously
   B. Clostridium perfringens
   C. Clostridium botulinum
   D. Clostridium difficile

IV. HELICOBACTER PEPTIC DISEASE SYNDROME

V. VIRUSES
   A. Twenty-four Hour “Flu”
   B. Rotavirus
   C. Hepatitis
      1. A
      2. B
      3. C
      4. D

VI. FUNGAL TOXINS - discussed previously

VII. PROTOZOA

VIII. HELMINTHS
Size and Location of the Liver

The liver is the largest organ in the body, weighing between three and four pounds in a normal adult. It is located in the abdomen immediately under the diaphragm (Figure 1).

The liver is one of the most remarkable and versatile organs in our body. In fact, it is the only organ able to regenerate itself—up to 80% to 85% of the liver can be destroyed and eventually may recover.

FIGURE 1:
Location of the Liver
FIGURE 2
Hepatitis A Virus Picornavirus

FIGURE 4
Hepatitis B Virus

FIGURE 6
Hepatitis D Virus
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Hepatitis A</th>
<th>Hepatitis B</th>
<th>Hepatitis C</th>
<th>Hepatitis D</th>
<th>Hepatitis E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route of transmission</td>
<td>Fecal-oral (ingestion of contaminated food and water)</td>
<td>Parenteral (injection of contaminated blood or other body fluids), including sexual contact</td>
<td>Parenteral</td>
<td>Parenteral (host must be coinfected with hepatitis B)</td>
<td>Fecal-oral</td>
</tr>
<tr>
<td>Causative agent</td>
<td>Hepatitis A virus (HAV); single-stranded RNA; no envelope</td>
<td>Hepatitis B virus (HBV); double-stranded DNA; envelope</td>
<td>Hepatitis C virus (HCV); single-stranded RNA; envelope</td>
<td>Hepatitis D virus (HDV); single-stranded RNA; envelope from HBV</td>
<td>Hepatitis E virus (HEV); single-stranded RNA; no envelope</td>
</tr>
<tr>
<td>Incubation period</td>
<td>2–6 weeks</td>
<td>4–26 weeks</td>
<td>2–22 weeks</td>
<td>6–26 weeks</td>
<td>2–6 weeks</td>
</tr>
<tr>
<td>Manifestations of symptoms</td>
<td>Mostly subclinical; severe cases: fever, headache, malaise, jaundice</td>
<td>Frequently subclinical; similar to HAV, but fever, no headache, and more likely to progress to severe liver damage</td>
<td>Similar to HBV, but more likely to become chronic</td>
<td>Severe liver damage; high mortality rate</td>
<td>Similar to HAV, but pregnant women may have high mortality rate</td>
</tr>
<tr>
<td>Antibody prevalence in U.S.</td>
<td>33%</td>
<td>5–10%</td>
<td>1.8%</td>
<td>Unknown</td>
<td>0.5%</td>
</tr>
<tr>
<td>Chronic liver disease</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Vaccine</td>
<td>Inactivated vaccines; immune globulin provides temporary protection</td>
<td>Genetically engineered vaccine produced in yeasts</td>
<td>None</td>
<td>HBV vaccine is protective because co-infection required</td>
<td>Under development</td>
</tr>
</tbody>
</table>
Critical Thinking

1. Why is a human infection of trichinosis considered a dead-end for the parasite?

2. Complete the following table:

<table>
<thead>
<tr>
<th>Disease</th>
<th>Conditions Necessary for Microbial Growth</th>
<th>Basis for Diagnosis</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcal food poisoning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salmonellosis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Clinical Applications

2. The 2130 students and employees of a public school system developed diarrheal illness on April 2. The cafeteria served chicken that day. On April 1, part of the chicken was placed in water-filled past and cooked in an oven for 2 hours at a dial setting of 177°C. The oven was turned off, and the chicken was left overnight in the warm oven. The remainder of the chicken was cooked for 2 hours in a steam cooker and then left in the device overnight at the lowest possible setting (43°C). Two serotypes of a gram-negative, oxidase-negative, lactose-negative rod were isolated from 32 patients. What is the pathogen? How could this outbreak have been prevented?

3. Staff members of one hospital ward noted an increase in the number of cases of HBV. Fifty cases occurred during a 6-month period compared with four cases during the previous 6 months. Between January 1 and 15, all 50 patients had multiple invasive procedures as shown below:
   - Transfusion, fingerstick, IV catheter, heparin injection: 78%
   - Transfusion, insulin injection, surgery, fingerstick: 64%
   - Fingerstick, IV catheter, insulin injection, heparin injection: 80%
   - Transfusion, heparin injection, surgery, IV catheter: 2%
   - Heparin injection, IV catheter, insulin injection, surgery: 0%

   How did the patients acquire HBV? Provide an explanation for the 2% and 0%.

STUDY QUESTIONS

4. A 31-year-old male became febrile 4 days after arriving at a vacation resort in Idaho. During his stay, he ate at two restaurants that were not associated with the resort. At the resort, he drank soft drinks with ice, used the hot tub, and went fishing. The resort is supplied by a well that was dug 3 years ago. He went to the hospital when he developed vomiting and bloody diarrhea. Gram-negative, lactose-negative bacteria were cultured from his stool. The patient recovered after receiving intravenous fluids. What microorganism most likely caused his symptoms? How is this disease transmitted? What is the most likely source of his infection, and how would you verify the source?
Critical Thinking

1. Humans are not usually consumed by other animals. The larval stage of *Trichinella* is encysted in humans and must be ingested to mature in the intestines of a definitive host.

2. Disease | Conditions | Diagnosis | Prevention
--- | --- | --- | ---
Staph. | Lack of refrigeration | Symptoms, presence of *S. aureus* in food | Refrigeration
Salmonellosis | Fecal contamination, inadequate heating | Isolation of *Salmonella* from stools | Sanitation, thorough heating of foods

3. Beef: c
   Deli: d
   Eggs: e
   Milk: b
   Oysters: a
   Pork: f

4. The gram-negative bacterial infections, hepatitis A and E, viral gastroenteritis, and the protozoal diseases. The organisms are not likely to be salt-tolerant (except *Vibrio*), and an ocean swimmer swallows less water than a freshwater swimmer.

Clinical Applications

1. Source of infection: Crabs
   Bacteria: *Vibrio cholerae*
   Prevention: Proper cooking temperature.

2. Source of infection: Chickens and improper cooking procedures.
   Bacteria: *Salmonella heidelberg* and *S. stanley*.
   Prevention: Refrigeration overnight; higher cooking temperature.

3. Fingersticks to draw blood samples. The disposable lancet was reused. The 2% and 0% did not receive fingersticks.

Case History: A Case of Food Poisoning

Background
Twenty-eight kindergarten children and seven adults visited a certified raw milk (CRM) bottling plant, where they were given ice cream and CRM. Three to six days later, nine children and three adults developed gastroenteritis. The only foods eaten by all these children (ill and well) were in the school-provided lunches. No one else in the school became sick. Stool cultures showed one bacterium in common to nine of the ill children and not present in samples from nine well children. This bacterium is a curved, gram-negative rod; it neither ferments nor oxidizes glucose.

Questions
1. Identify the etiologic agent of this outbreak of food poisoning.
2. Was it food infection or intoxication?
3. How did the food get contaminated, and what item was contaminated?
4. Briefly explain how you arrived at your conclusions.

The Solution:
Source of infection: Raw milk
Bacterium: *Campylobacter*
Prevention: Pasteurization