Chapter 5

Anaerobic Bacterial Infections
(Non-Spore-Forming)

SYDNEY M. FINEGOLD

**Disease:** Embraces infections of all types in any tissue or organ of the body. Major types of anaerobic infections, in terms of frequency encountered, include pleuropulmonary, intraabdominal, and female genital tract infections of various types. Other infections in which anaerobes are commonly involved are brain abscess, chronic sinusitis and otitis media, dental infections, bite wound infections, soft tissue infections, and bone and joint infections.

**Etiologic Agents:** Numerous species of *Bacteroides, Fusobacterium, Peptostreptococcus, Actinomyces,* and other species of non-spore-forming anaerobic gram-positive bacilli.

**Source:** Virtually always the indigenous flora of the host, particularly the oral, intestinal, and female genital tracts.

**Clinical Manifestations:** Very variable. Common features are gas production, tissue destruction, abscess formation, foul odor, and features typical of the specific infection involved (e.g., pneumonia, brain abscess).

**Pathology:** Variable. Purulence, abscess formation, tissue invasion with necrosis and gas production, and granuloma formation (in the case of actinomycosis).

**Laboratory Diagnosis:** Recovery of non-spore-forming anaerobic organisms, alone or together with clostridia and/or aerobic or facultative organisms, from appropriate specimens in patients with compatible clinical illness. Demonstration of such organisms in tissues or specimens by direct means such as fluorescent antibody technique or DNA probes.

**Epidemiology:** Not pertinent. Even when non-spore-forming anaerobic infection is associated with surgical manipulation and implantation of a foreign body (e.g., ventriculocingular shunt, implanted intrauterine device), the etiologic agent comes from the host’s indigenous flora.

**Treatment:** Surgical debridement, surgical or percutaneous drainage of abscesses, and antimicrobial agents.

**Prevention and Control:** Careful surgical technique, maintaining good oxygenation of tissues when possible, avoidance of aspiration of material into the respiratory tract, antimicrobial prophylaxis for dental and selected other procedures, and minimizing the spread of anaerobic bacteria from mucosal surfaces into deeper tissues.

## Description of Disease

Non-spore-forming anaerobic bacteria of clinical significance are found primarily in the genera *Bacteroides, Fusobacterium, Peptostreptococcus, Actinomyces, Arachnia, Bifidobacterium,* and *Propionibacterium.* These organisms are prevalent among the normal flora of the human body (Table 1). They take part, in a mixed aerobic/facultative and anaerobic flora, in a variety of infections throughout the body.

## Pathogenesis

As with clostridial infections, infection due to non-spore-forming anaerobes occurs chiefly in an anaerobic environment, which usually results from impaired circulation, trauma, surgery, or malignant or other disease. These factors often cause a breach in the mucosal surface of the oral, intestinal, or female genital tract and thus permit endogenous anaerobes to enter deeper tissues to produce the infection. Prior or concurrent infection with nonanaerobes may re-

A. Balows et al. (eds.), *Laboratory Diagnosis of Infectious Diseases*

© Springer-Verlag New York Inc. 1988
Table 1. Incidence of various anaerobes as normal flora in humans

<table>
<thead>
<tr>
<th>Site</th>
<th>Clostridium</th>
<th>Actinomyces</th>
<th>Propionibacterium</th>
<th>Bacteroides</th>
<th>Fusobacterium</th>
<th>Gram positive</th>
<th>Gram negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Upper respiratory tract</td>
<td>±</td>
<td>1</td>
<td>±</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>±</td>
</tr>
<tr>
<td>Mouth</td>
<td>±</td>
<td>1</td>
<td>±</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>±</td>
</tr>
<tr>
<td>Intestine</td>
<td>2</td>
<td>±</td>
<td>±</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>±</td>
</tr>
<tr>
<td>External genitalia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>±</td>
<td>U</td>
</tr>
<tr>
<td>Urethra</td>
<td>±</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>±</td>
<td>U</td>
</tr>
<tr>
<td>Vagina</td>
<td>±</td>
<td>0</td>
<td>1</td>
<td>±</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

b U = Unknown; 0 = not found or rare; ±, irregular; 1 = usually present; 2 = usually present in large numbers.
c Includes nasal passages, nasopharynx, oropharynx, and tonsils.

...duce the oxygen content or the oxidation-reduction potential at the site, thus facilitating involvement of anaerobes. Other factors involved in synergy, which is common in mixed infections, include production of nutrients essential for the growth of anaerobes and production of toxins or other virulence factors. Putative virulence factors produced by gram-negative anaerobic bacilli (the most commonly encountered in infections of the non-spore-forming anaerobes) include ability to adhere to surfaces such as the peritoneal mesothelium or gingival crevice epithelium, production of capsular material (by Bacteroides fragilis, in particular; the capsule inhibits macrophage migration, is antiphagocytic for aerobes and anaerobes, and promotes abscess formation), production of superoxide dismutase and catalase (which confers oxygen tolerance), production of immunoglobulin proteases, production of hyaluronidase, collagenase, chondroitin sulfatase, neuraminidase, fibrinolysin, and heparinase and other coagulation-promoting factors, and production of lipopolysaccharide, "leukotoxin," butyrate, and soluble inhibitors of chemotaxis.

In the case of aspiration pneumonia and other pleuropulmonary infections involving anaerobes, the pathogenesis is usually different, with aspiration of oropharyngeal or gastric contents the major background factor and periodontal disease or gingivitis also important in some patients. Such aspiration, of course, carries oral anaerobes and other organisms from the mouth down into the bronchial tree.

Clinical Manifestations

Non-spore-forming anaerobic bacteria are involved in a wide variety of infections; the clinical manifestations depend on the site and type of infection.

Circulatory Infections

The chief circulatory infections involving non-spore-forming anaerobes are bacteremia and endocarditis, although mycotic aneurysm or other endovascular infection may occur in appropriate circumstances. In most series, anaerobes have been recovered from 10 to 25% of all positive blood cultures. The most common isolate, Propionibacterium acnes, usually represents a skin contaminant but may actually cause bacteremia in the setting of an implanted prosthetic or intravascular device. Clinically significant bacteremia accounts for about 5 to 15% of all bacteremias. Among these, the Bacteroides fragilis group is by far the most commonly encountered. This finding may reflect, to some extent, the ease with which this group of organisms is cultured and identified, but it is clearly a very important pathogen as well. The second most common blood culture isolate of significance is various Peptostreptococcus species. Anaerobes are found with some frequency in polymicrobial bacteremia. For the most part, anaerobic bacteremia will not be distinctive clinically from other bacteremias; suppurative thrombophlebitis, metastatic infection, and hyperbilirubinemia are features that may suggest involvement of anaerobes.

The incidence of anaerobes as causes of endocarditis is quite low. The most common isolates are anaerobic cocci, most of which are actually microaerophilic streptococci and belong in the genus Streptococcus. Bacteroides (and perhaps other anaerobic) endocarditis tends to produce large vegetations and embolic phenomena in large vessels.

Central Nervous System Infections

The chief infection of the central nervous system involving anaerobes is brain abscess; indeed, anaer-