

Clostridium

4 Clostridia are 3–8 μm long, thick, Gram-positive, sporing rod bacteria that can only be cultured anaerobically. Their natural habitat is the soil. The pathogenicity of the disease-causing species in this genus is due to production of exotoxins and/or exoenzymes. The most frequent causative organism in **anaerobic cellulitis** and **gas gangrene** (clostridial myonecrosis) is *C. perfringens*. **Tetanus** is caused by *C. tetani*. This pathogen produces the exotoxin tetanospasmin, which blocks transmission of inhibitory CNS impulses to motor neurons. **Botulism** is a type of food poisoning caused by the neurotoxins of *C. botulinum*. These substances inhibit stimulus transmission to the motor end plates. **Pseudomembranous colitis** is caused by *C. difficile*, which produces an enterotoxin (A) and a cytotoxin (B). Diagnosis of clostridial infections requires identification of the pathogen (gas gangrene) and/or the toxins (tetanus, botulism, colitis). All clostridia are readily sensitive to penicillin G. Antitoxins are used in therapy of tetanus and botulism and hyperbaric O_2 is used to treat gas gangrene. The most important preventive measure against tetanus is active vaccination with tetanus toxoid. ■

Occurrence. Clostridia are sporing bacteria that naturally inhabit the soil and the intestinal tracts of humans and animals. Many species are apathogenic saprophytes. Under certain conditions, several species cause gas gangrene, tetanus, botulism, and pseudomembranous colitis.

Morphology and culturing. All clostridia are large, Gram-positive rod bacteria about 1 μm thick and 3–8 μm in length (Fig. 4.7). Many cells in older cultures show a Gram-negative reaction. With the exception of *C. perfringens*, clostridia are flagellated. Clostridia sporulate. They are best cultured in an anaerobic atmosphere at 37 °C. *C. perfringens* colonies are convex, smooth, and surrounded by a hemolytic zone. Colonies of motile clostridia have an irregular, ragged edge.

The Pathogens That Cause Gas Gangrene (Clostridial Myonecrosis) and Anaerobic Cellulitis

Pathogen spectrum. The pathogens that cause these clinical pictures include *Clostridium perfringens*, *C. novyi*, *C. septicum*, and *C. histolyticum*. Species observed less frequently include *C. sporogenes*, *C. sordellii*, and *C. bifermentans*. The most frequent causative pathogen in gas gangrene is *C. perfringens*.

Toxins, enzymes. The toxins produced by invasive clostridia show necrotizing, hemolytic, and/or lethal activity. They also produce collagenases,

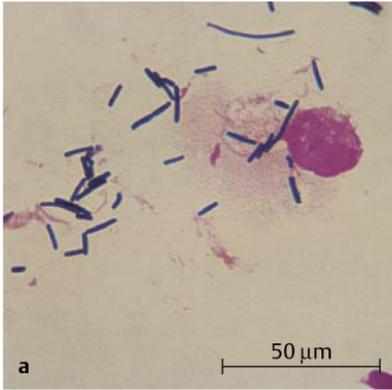
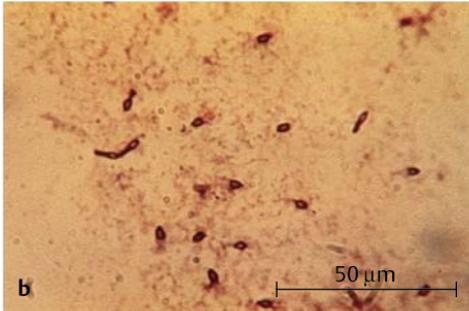
Clostridium perfringens* and *sporogenes

Fig. 4.7 **a** *C. perfringens*: gram staining of a preparation of wound pus. Large, thick, gram-positive rods. Clinical diagnosis: gas gangrene in a gunshot wound.

b *C. sporogenes*: Spore staining of a preparation from an aged broth culture. Thick-walled spores stained red. Occasionally “tennis racquet” forms.



proteinases, DNases, lecithinases, and hyaluronidase, all of which destroy tissue structures, resulting in accumulations of toxic metabolites.

Pathogenesis and clinical picture. Due to the ubiquitous presence of clostridia, they frequently contaminate open wounds, often together with other microorganisms. Detection of clostridia in a wound is therefore no indication of a clostridial infection. These infections develop when a low tissue redox potential makes anaerobe reproduction possible, resulting in tissue necrosis. Two such infections of differing severity are described below:

■ **Anaerobic cellulitis.** Infection restricted to the fascial spaces that does not affect musculature. Gas formation in tissues causes a cracking, popping sensation under the skin known as crepitus. There is no toxemia.