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MYCOLOGY - CHAPTER TWO

ACTINOMYCETES

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In this section, we shall discuss three genera of actinomycetes: *Actinomyces*, *Nocardia*, and *Streptomyces*. These organisms have been shown to be higher bacteria, but they were thought to be fungi for many years because they have filamentous forms, 0.5 to 0.8 microns in diameter, which appear to branch (figure 1). Some species form aerial **mycelia** in culture. The clinical manifestations of infection are similar to those of a systemic fungal infection. It is now clear that they are not fungi but are closely related to the mycobacteria. Some properties of these genera include:

Actinomyces are anaerobic, while *Nocardia* and *Streptomyces* are aerobic.

Nocardia stain partially acid-fast, *Actinomyces* and *Streptomyces* are not **acid-fast**.

Actinomyces and *Streptomyces* produce granules. Most actinomycetes in tissue do not stain with the H & E stain commonly used for general histopathology. All genera may produce granules. *Actinomyces* almost always produce granules.

ACTINOMYCOSIS

Actinomycosis is a chronic **suppurative** and **granulomatous** disease of the cervico-facial, thoracic or abdominal areas.

The most common cause of actinomycosis is the organism *Actinomyces israelii* which infects both man and animals. In cattle, the disease is called "lumpy jaw" (figure 2) because of the huge abscess formed in the angle of the jaw. In man, *A. israelii* is an endogenous organism that can be isolated from the mouths of healthy people. Frequently, the infected patient has a tooth abscess or a tooth extraction and the endogenous organism becomes established in the traumatized tissue and causes a suppurative infection. These abscesses are not confined to the jaw and may also be found in the thoracic area and abdomen. The patient usually presents with a pus-draining lesion, so the pus will be the clinical material sent to the laboratory. This diagnosis can be made on the hospital floor. When the vial of pus is rotated, the yellow sulfur granules, characteristic of this organism, can be seen with the naked eye. These granules can also be seen by running sterile water over the gauze used to cover the lesion. The water washes away the purulent material leaving the golden granules on the gauze. This organism, which occurs worldwide, can be seen histologically as "sulfur granules" (figure 3 and 4) surrounded by polymorphonuclear cells (PMN) forming the purulent tissue reaction. The organism is a gram positive rod that frequently branches. The laboratory must specifically be instructed to culture for this anaerobic organism. These lesions must be surgically drained prior to antibiotic therapy and the drug of choice is large doses of penicillin.

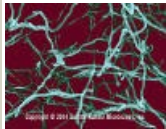


Figure 1

Streptomyces spp. -Gram-positive, filamentous or irregular-shaped prokaryote; used in the production of the antibiotic streptomycin. Causes madura foot and mycetoma. © Dennis Kunkel Microscopy, Inc. Used with permission



Figure 2

Actinomycosis, Cervicofacial © Dr Arthur DiSalvo

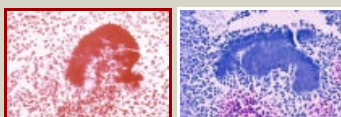


Figure 4





Figure 3

Sulphur granules in actinomycosis

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Figure 4A. Gram-positive aerobic *Nocardia asteroides* slide culture reveals chains of amongst aerial mycelia. CDC/Dr. Lucille K. Georg

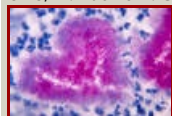


Figure 4B. Gram-positive acid-fast *Nocardia brasiliensis* bacteria using a modified Fite-Faraco stain. 80% of cases of Nocardiosis show clinical features of invasive pulmonary infection, disseminated disease, or brain abscess; 20% show cellulitis. In the United States an estimated 500 - 1,000 new cases of Nocardiosis infection occur annually. CDC/Dr. Lucille Georg

histopathologic changes due to the gram-positive organism, *Actinomyces israelii*. Using a modified Fite-Faraco stain, a "sulphur granule" is shown in the middle of the image. These granules actually represent colonies of *A. israelii*, a gram-positive, anaerobic filamentous bacteria. Dr Arthur DiSalvo and CDC/Dr. Lucille Georg

NOCARDIOSIS

Nocardiosis primarily presents as a pulmonary disease or brain abscess in the U.S. In Latin America, it is more frequently seen as the cause of a subcutaneous infection, with or without draining abscesses. It can even present as a lesion in the chest wall that drains onto the surface of the body similar to actinomycosis. Brain abscesses are frequent secondary lesions.

The most common species of *Nocardia* that cause disease in human beings are *N. brasiliensis* and *N. asteroides*. These are soil organisms which can also be found endogenously in the sputum of apparently healthy people. *N. asteroides* (figure 4A) is usually the etiologic agent of pulmonary nocardiosis (figure 5) while *N. brasiliensis* (figure 4B) is frequently the cause of sub-cutaneous lesions. The material sent to the lab, depending on the presentation of the disease, is sputum, pus, or biopsy material. These organisms rarely form granules. The *Nocardia* are aerobic, gram-positive rods and stain partially acid-fast (i.e., the acid-fast staining is not uniform) (figure 4B). There are no serological tests, and the drug of choice is Bactrim (Trimethoprim plus sulfamethoxazole). The *Nocardia* grow readily on most bacteriologic and TB media. The geographic distribution of these organisms is worldwide.



Figure 5. Pleurisy due to nocardiosis © Bristol Biomedical Image Archive. Used with permission



Figure 6.

Actinomycotic mycetomatous granule due to the bacteria *Streptomyces somaliensis*. *Streptomyces spp.* are Gram-positive aerobic actinomycetes known for their production of antimicrobial substances. Though they seldom cause human disease, infections can manifest as localized, chronic suppurative lesions of the skin. CDC

STREPTOMYCOSIS

The *streptomyces* species usually cause the disease entity known as mycetoma (fungus tumor). These infections are usually subcutaneous, but they can penetrate deeper and invade the bone. Some species produce a protease which inhibits macrophages. Material sent to the lab is pus or skin biopsy. The streptomycetes are aerobic like *Nocardia*, and can grow on both bacterial and fungal (Sabouraud) media. They produce a chalky aerial mycelium with much branching. It is important to let the lab know the suspected organism because most bacterial pathogens will grow out overnight, but the actinomycetes take longer to be visible on the culture plates (48-72 hours). The various species of *streptomyces* produce granules of different size (figure 6), texture and color. These granules, along with colonial growth and biochemical tests, allow the bacteriologist or mycologist to identify each species. The organisms are found world-wide. There are no serological tests, and the drugs of choice are the combination of sulfamethoxazole/trimethoprim or amphotericin B. In the tropics this disease may go undiagnosed or untreated for so long that surgical amputation may be the only effective treatment.



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