VIRIDANS AND OTHER STREPTOCOCCI

VIRIDANS STREPTOCOCCI

Consisting of multiple species of α-hemolytic streptococci, the viridans streptococci are a heterogeneous group of organisms that are important agents of bacterial endocarditis (Chap. 155). Several species of viridans streptococci, including *Streptococcus salivarius*, *Streptococcus mitis*, *Streptococcus sanguis*, and *Streptococcus mutans*, are part of the normal flora of the mouth, where they live in close association with the teeth and gingiva. Some species contribute to the development of dental caries.

Previously known as *Streptococcus morbillorum, Gemella morbillorum* has been placed in a separate genus, along with *Gemella haemolysans*, on the basis of genetic-relatedness studies. These species resemble viridans streptococci with respect to habitat in the human host and associated infections.

The transient viridans streptococcal bacteremia induced by eating, toothbrushing, flossing, and other sources of minor trauma, together with adherence to biologic surfaces, is thought to account for the predilection of these organisms to cause endocarditis (see Fig. 155-1). Viridans streptococci are also isolated, often as part of a mixed flora, from sites of sinusitis, brain abscess, and liver abscess.

Viridans streptococcal bacteremia occurs relatively frequently in neutropenic patients, particularly after bone marrow transplantation or high-dose chemotherapy for cancer. Some of these patients develop a sepsis syndrome with high fever and shock. Risk factors for viridans streptococcal bacteremia include chemotherapy with high-dose cytosine arabinoside, prior treatment with trimethoprim-sulfamethoxazole or a fluoroquinolone, treatment with antacids or histamine antagonists, mucositis, and profound neutropenia.

The *S. milleri* group (also referred to as the *S. intermedius* or *S. anginosus* group) includes three species that cause human disease: *S. intermedius, S. anginosus*, and *Streptococcus constellatus*. These organisms are often considered viridans streptococci, although they differ somewhat from other viridans streptococci in both their hemolytic pattern (they may be α-, β-, or nonhemolytic) and the disease syndromes they cause. This group commonly produces suppurative infections, particularly abscesses of brain and abdominal viscera, and infections related to the oral cavity or respiratory tract, such as peritonsillar abscess, lung abscess, and empyema.

TREATMENT **INFECTION WITH VIRIDANS STREPTOCOCCI**

Isolates from neutropenic patients with bacteremia are often resistant to penicillin; thus these patients should be treated presumptively with vancomycin until the results of susceptibility testing become available. Viridans streptococci isolated in other clinical settings usually are sensitive to penicillin.

ABIOTROPHIA AND *GRANULICATELLA* SPECIES (NUTRITIONALLY VARIANT STREPTOCOCCI)

Occasional isolates cultured from the blood of patients with endocarditis fail to grow when subcultured on solid media. These *nutritionally variant streptococci* require supplemental thiol compounds or active forms of vitamin B_6 (pyridoxal or pyridoxamine) for growth in the laboratory. The nutritionally variant streptococci are generally grouped with the viridans streptococci because they cause similar types of infections. However, they have been reclassified on the basis of 16S ribosomal RNA sequence comparisons into two separate genera: *Abiotrophia*, with a single species (*Abiotrophia defectiva*), and *Granulicatella,* with three species associated with human infection (*Granulicatella adiacens, Granulicatella para-adiacens,* and *Granulicatella elegans*).

TREATMENT **INFECTION WITH NUTRITIONALLY VARIANT STREPTOCOCCI**

Treatment failure and relapse appear to be more common in cases of endocarditis due to nutritionally variant streptococci than in those due to the usual viridans streptococci. Thus the addition of gentamicin (1 mg/kg every 8 h for patients with normal renal function) to the penicillin regimen is recommended for endocarditis due to the nutritionally variant organisms.

OTHER STREPTOCOCCI

Streptococcus suis is an important pathogen in swine and has been reported to cause meningitis in humans, usually in individuals with occupational exposure to pigs. Strains of *S. suis* associated with human infections have generally reacted with Lancefield group R typing serum and sometimes with group D typing serum as well. Isolates may be α- or β-hemolytic and are sensitive to penicillin. *Streptococcus iniae*, a pathogen of fish, has been associated with infections in humans who have handled live or freshly killed fish. Cellulitis of the hand is the most common form of human infection, although bacteremia and endocarditis have been reported. *Anaerobic streptococci*, or *peptostreptococci*, are part of the normal flora of the oral cavity, bowel, and vagina. **Infections caused by the anaerobic streptococci are discussed in Chap. 201.**

174 Enterococcal Infections

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Enterococci have been recognized as potential human pathogens for more than a century, but only in recent years have these organisms acquired prominence as important causes of nosocomial infections. The ability of enterococci to survive and/or disseminate in the hospital environment and to acquire antibiotic resistance determinants makes the treatment of some enterococcal infections in critically ill patients a difficult challenge. Enterococci were first mentioned in the French literature in 1899; the "entérocoque" was found in the human gastrointestinal tract and was noted to have the potential to produce significant disease. Indeed, the first pathologic description of an enterococcal infection dates to the same year. A clinical isolate from a patient who died as a consequence of endocarditis was initially designated *Micrococcus zymogenes*, was later named *Streptococcus faecalis* subspecies *zymogenes*, and would now be classified as *Enterococcus faecalis*. The ability of this isolate to cause severe disease in both rabbits and mice illustrated its potential lethality in the appropriate settings.

ETIOLOGY

Enterococci are gram-positive organisms. In clinical specimens, they are usually observed as single cells, diplococci, or short chains (Fig. 174-1), although long chains are noted with some strains. Enterococci were originally classified as streptococci because organisms of the two genera share many morphologic and phenotypic characteristics, including a generally negative catalase reaction. Only DNA hybridization studies and later 16S rRNA sequencing clearly demonstrated that enterococci should be grouped as a genus distinct from the streptococci. Nonetheless, unlike the majority of streptococci, enterococci hydrolyze esculin in the presence of 40% bile salts and grow at high salt concentrations (e.g., 6.5%) and at high temperatures (46°C). Enterococci are usually reported by the clinical laboratory to be nonhemolytic on the basis of their inability to lyse the ovine or bovine red blood cells (RBCs) commonly used in agar plates; however, some strains of *E. faecalis* do lyse RBCs from humans, horses, and rabbits. The majority of clinically relevant enterococcal species hydrolyze pyrrolidonyl-β-naphthylamide (PYR); this characteristic is helpful in differentiating enterococci from organisms of the *Streptococcus gallolyticus* group (formerly known as *S. bovis*), which includes *S. gallolyticus, Streptococcus pasteurianus*, and *Streptococcus infantarius*, and from *Leuconostoc* species. Although at least 18 species of enterococci have been isolated from human infections, the overwhelming