MODULE 8: Identification of Gram-Positive Cocci

LEARNING OUTCOMES

1. Discuss the purpose of identifying medically important Gram-positive bacteria.
2. Name several tests used to identify staphylococci and streptococci.

INTRODUCTION

In clinical care, identification of bacterial pathogens is essential to determining appropriate treatment options for an infected patient. Gram-positive bacteria of the human microbiome are often implicated in opportunistic infections of skin, respiratory tract, and enteric regions. Some of these infections are *nosocomial,* or hospital acquired. Methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococcus* (VRE) are two predominating nosocomial pathogens in health care settings.

Staphylococci

Staphylococcus species are commonly found on the skin, with *S. epidermidis* and *S. hominis* being prevalent in the normal microbiota. *Staphylococcus aureus* is also commonly found in the nasal passages and on healthy skin in some individuals, but pathogenic strains are often the cause of a broad range of infections of the skin and other body systems.

When a staphylococcal infection is suspected, patient samples are collected, Gram stained, and cultured. Under the microscope, Gram-positive staphylococci cells are arranged as grapelike clusters; when grown on blood agar, colonies have a unique pigmentation ranging from opaque white to cream. Since the Gram reaction of staphylococci and streptococci is often similar in appearance, a catalase test is performed on colonies to initially distinguish the two types of bacteria. Catalase is an enzyme that is only produced by aerobic bacteria, including *Staphylococcus.* Streptococci are anaerobic and do not produce catalase.

The plasma-clotting protein coagulase produced by *S. aureus* is used to distinguish this species from other staphylococci. Other biochemical tests, such as growth and fermentation on mannitol salt agar, are also useful in confirming the identity of staphylococcal species.

Streptococci

Similar to staphylococci, streptococci are normally present on skin and mucous membranes. *Streptococcus pyogenes* (Group A streptococci) in the respiratory tract is a common cause of "strep throat" or acute pharyngitis, and *Streptococcus agalactiae* (Group B streptococci) in the genital region has been implicated in neonatal meningitis following vaginal delivery. Group D enterococci, particularly *Enterococcus faecalis* and *E. faecium*, reside in the large intestine.

These bacteria are often opportunistic pathogens of wounds and bedsores and can acquire resistance to vancomycin through horizontal gene transfer with other resistant bacteria.

Recall that following a Gram stain, one way to identify streptococci is by observing hemolysis patterns of colonies on blood agar. Beta hemolysis, typical of Group A and Group B streptococci, results in complete lysis of red blood cells and a clear color of the agar around colonies. Alpha hemolysis, or partial lysis, results in the release of methemoglobin and greenish brown discoloration of agar around colonies which is characteristic of viridans streptococci. Gamma hemolytic Group D enterococci do not lyse blood cells and produce no change of color in the agar around colonies.

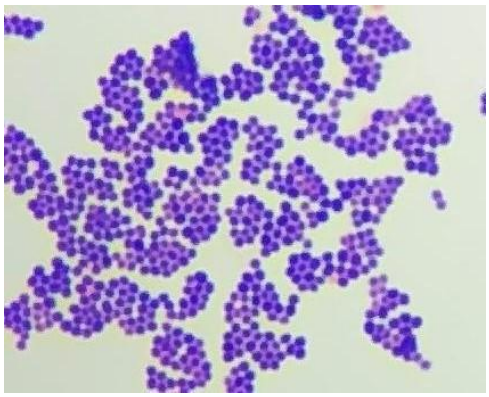

Figure 8.1: Gram staining is the initial step for the identification of Gram-positive cocci.

Two additional procedures, the CAMP and bile esculin tests, are useful for identifying Group B streptococci and Group D enterococci respectively. In the CAMP reaction, beta hemolysis of *S. agalactiae* is enhanced when grown near *Staphylococcus aureus.* The bile esculin test detects the ability of *Enterococcus* to hydrolyze esculin, a derivative of glucose, in the presence of bile.

Figure 8.2 depicts the relationship between the major tests in this module and their use in the identification of Gram-positive cocci.

DIFFERENTIAL TESTING OF GRAM-POSITIVE COCCI

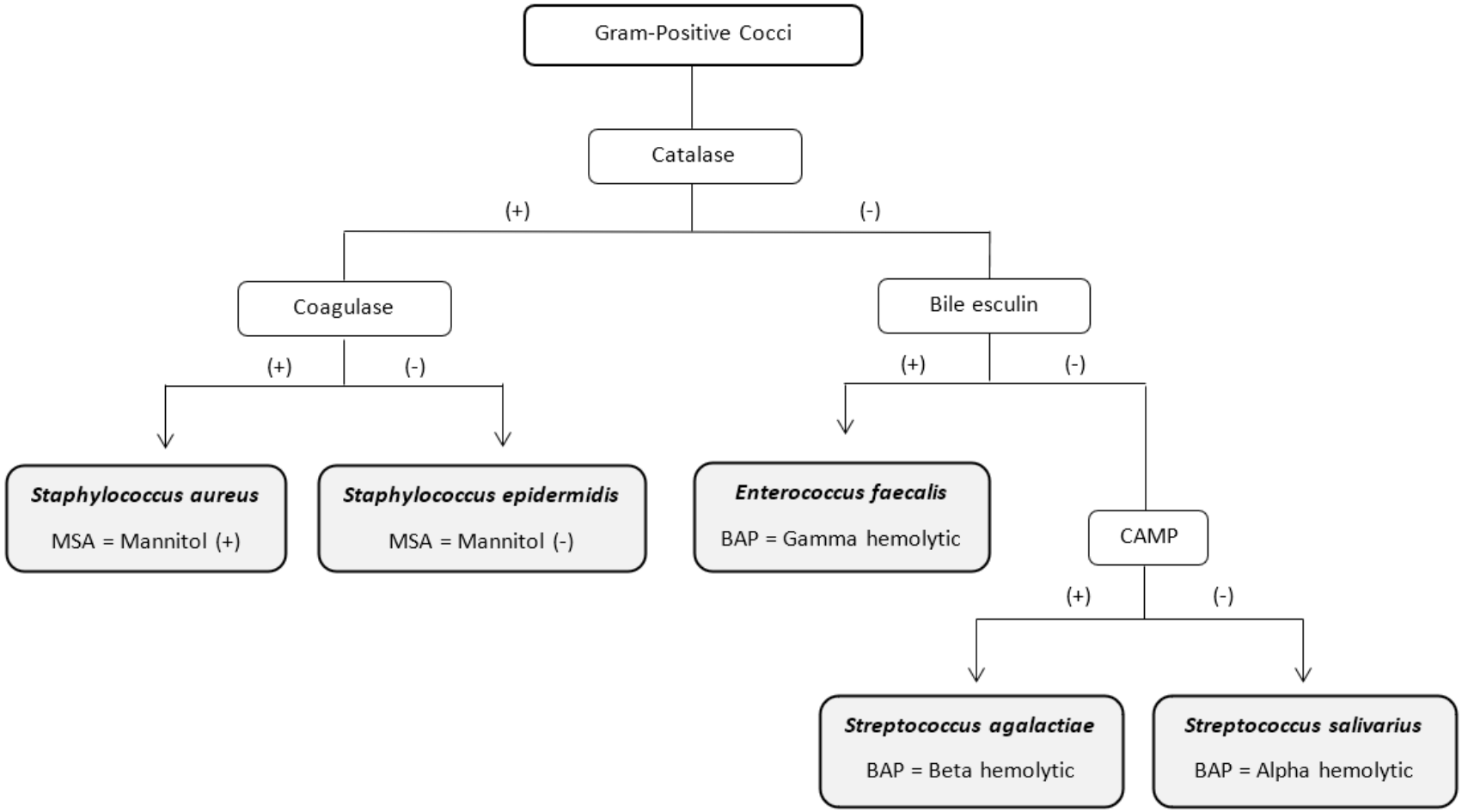

Figure 8.2. Differential testing of Gram-positive cocci.