EDUCATIONAL COMMENTARY – STAPHYLOCOCCUS SAPROPHYTICUS IDENTIFICATION

Learning Outcomes
Upon completion of this exercise, the participant will be able to:

- discuss the clinical significance of *Staphylococcus saprophyticus*.
- explain how to presumptively and definitively identify *S. saprophyticus*.

Before the 1960s, coagulase-negative staphylococci in urine cultures were thought to be skin contaminants. This concept began to change in 1962 with the publication of a study by Torres Pereira concluding that coagulase-negative staphylococci isolated from the urine of women with acute urinary tract infections were the cause of the disease.\(^1\) Subsequent studies confirmed this finding.\(^1\)

The organism isolated in these studies is now known as *Staphylococcus saprophyticus*, and, after *Escherichia coli*, it is the second most common cause of uncomplicated urinary tract infections in women younger than 40 years. It is particularly prevalent in sexually active women in their teens and 20s. Although it is most common in young women, *S. saprophyticus* also causes urinary tract infections in men. Complications include kidney stones and pyelonephritis, and in men, prostatitis, urethritis, and epididymitis. Infections at sites other than the urinary tract are rare, but *S. saprophyticus* has been implicated in septicemia and endocarditis.

The major reservoir for *S. saprophyticus* is the gastrointestinal tract, and it also colonizes the skin and the mucosa of the genitourinary tract. Unlike other organisms commonly implicated in urinary tract infections, *S. saprophyticus* is not associated with hospital-acquired infections. Instead, colonization is community-acquired, and infection occurs when the bacteria are introduced into the sterile urinary tract. Epidemiological studies have shown that urinary tract infections caused by *S. saprophyticus* are more prevalent during the late summer and fall.\(^1\) These infections are also associated with recent sexual intercourse, hormonal influences related to menstruation, and changes in genital flora caused by candidal infections or spermicides (specifically, condoms coated with nonoxynol 9).\(^1\)

Although the mechanisms by which *S. saprophyticus* causes disease are not yet well understood, researchers have identified 3 virulence factors:\(^1\)

1. Adherence to uroepithelial cells
2. Production of a hemagglutinin
3. Production of extracellular slime

*Staphylococcus saprophyticus* can infect the urinary tract even when it is present in low numbers (<10,000 colony-forming units[CFU]/mL in urine cultures). Also, since traditional urine dipstick tests for bacteriuria usually detect gram-negative bacteria, they may not detect infection with *S. saprophyticus*. 
Identification of *S. saprophyticus* is based on colony appearance and biochemical tests. On 5% sheep blood agar, colonies appear large (5-8 mm in diameter), glossy, smooth, and convex. They have a buttery consistency and may be white, cream, yellow, or orange (50%-65% of strains produce pigment). Suspicious colonies that are isolated from urine samples can be presumptively identified as *S. saprophyticus* in 2 steps:

First, perform a tube coagulase test to determine whether the organism is a coagulase-negative staphylococcus or *Staphylococcus aureus*, which is coagulase-positive. The tube coagulase test must be used because the slide coagulase test alone cannot reliably distinguish *S. aureus* from coagulase-negative staphylococci. This is because 10% to 15% of *S. aureus* strains give a negative slide coagulase test result, and *S. saprophyticus* may produce a positive result with some rapid agglutination test kits.

Next, if the organism is tube coagulase-negative, test for susceptibility to novobiocin using a 5-µg novobiocin disk on phenylethyl alcohol agar, Mueller-Hinton agar, or tryptic soy sheep blood agar. *Staphylococcus saprophyticus* is resistant to novobiocin, whereas most other coagulase-negative staphylococci are sensitive. If the isolate is from a urine culture and is a coagulase-negative staphylococcus that is resistant to novobiocin, it can be reported as “Presumptive *S. saprophyticus*.” *Staphylococcus saprophyticus* can be definitively identified with 5 additional tests. First, perform a 2-hour PYR (L-pyrrolidonyl-β-naphthylamide) broth hydrolysis test. If the result is negative, test the organism for production of urease, oxidase, alkaline phosphatase, and acid from D-trehalose to distinguish *S. saprophyticus* from other coagulase-negative, PYR-negative, novobiocin-resistant staphylococci (Table).

<table>
<thead>
<tr>
<th><strong>Level of Identification</strong></th>
<th><strong>Test Results</strong></th>
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<tbody>
<tr>
<td>Presumptive</td>
<td>Tube coagulase negative</td>
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<tr>
<td></td>
<td>Novobiocin resistant</td>
</tr>
<tr>
<td>Definitive</td>
<td>Tube coagulase negative</td>
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<tr>
<td></td>
<td>Novobiocin resistant</td>
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<tr>
<td></td>
<td>2-hour PYR broth hydrolysis negative</td>
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<tr>
<td></td>
<td>Urease positive</td>
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<tr>
<td></td>
<td>Oxidase negative</td>
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<td></td>
<td>Alkaline phosphatase negative</td>
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<td>D-trehalose positive</td>
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Finally, in addition to traditional testing methods, several commercially available automated and rapid multitest systems can identify *S. saprophyticus*. 
EDUCATIONAL COMMENTARY – STAPHYLOCOCCUS SAPROPHYTICUS IDENTIFICATION (cont.)

Conclusion

Although coagulase-negative staphylococci often appear in urine cultures as skin contaminants, S. saprophyticus is a common cause of urinary tract infections, especially in young women. Moreover, it can cause infections even when it is present in low numbers. For this reason, even low numbers of coagulase-negative staphylococci in urine cultures should not be dismissed as skin contaminants. Instead, the organism should be tested to determine if it is S. saprophyticus so that patients can be treated appropriately.

Reference


Suggested Reading


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