
# What to do with Coagulase-Negative Staphylococci

**Ramzi M. Helewa, BSc; and John M. Embil, MD, FRCPC**

Coagulase-negative staphylococci (CNS) are seen as relatively indolent and benign microorganisms acting as frequent colonizers and common culture contaminants. However, despite being commonly found on the skin, these unlikely pathogens may be virulent in select patient populations. Therefore, CNS are this month's **Bug of the Month**.

## Infection vs. colonization

This is a frequently encountered dilemma when swabs are obtained from cutaneous ulcers that are not clinically infected or when urine specimens are obtained from urinary catheter collection systems. The absence of the constitutional symptom or local signs of infection would more likely support local colonization than a true infection. The treatment of microorganisms from presumably colonized wounds or urinary catheter collection systems may lead to unnecessary antibiotic-related complications or even the evolution of antimicrobial resistant pathogens. Infection is traditionally considered where there is evidence of invasive disease, such as:

- Constitutional symptoms
- Erythema
- Edema
- Purulence

The recovery of a microorganism from a clinically uninfected wound or urinary catheter collection system should not be undertaken. It is strongly recommended that specimens not be obtained from individuals in whom clinical signs of infection are absent.

## What are coagulase-negative staphylococci?

Staphylococci are common gram-positive cocci known to produce catalase, which aids in the protection from neutrophilic antimicrobial effects. Coagulase is an enzyme involved in the clotting cascade. *Staphylococcus aureus (S. aureus)* produces coagulase, while other staphylococcal species do not. Therefore, the production of coagulase can be used to differentiate different species of staphylococci, such as the more virulent *S. aureus* from the less virulent CNS. Two common species of CNS are *S. epidermidis* and *S. saprophyticus*. These organisms, especially *S. epidermidis*, may be implicated in pyogenic infections in human hosts. This is especially true in those who are immunocompromised or who have implanted foreign bodies, such as vascular-access catheters, prosthetic joints and other orthopedic hardware. In contrast, *S. saprophyticus* is a commonly noted cause of urinary tract infections. Other frequently recovered species of CNS include *S. simulans*, *S. hominis* and *S. warnerii*.

*Staphylococcus saprophyticus is a commonly noted cause of urinary tract infections.*

## Where can they be found?

*S. epidermidis* is part of the normal resident microflora on the human body. The colonizing nature of this microorganism contributes to the difficulty faced by clinicians in delineating between natural colonization and pathological infection. Notably, most infections due to the CNS are nosocomial in nature.

## Slimy friend or well-guarded foe?

*S. epidermidis* has the ability to form a "biofilm" or glycocalyx that allows organisms to cling to foreign materials such as dialysis catheters, heart valves, cardiac rhythm control devices, cerebrospinal fluid shunts and orthopedic hardware. The glycocalyx can lead to immunomodulation by interfering with cell-mediated immunity and both macrophage and polymorph nuclear cell migration. By attaching to the foreign material, bacteria are also protected from antimicrobial therapy and can act as a source of ongoing and non-resolving infection. For example, this can lead to a state where there is a continuous release of bacteria in the bloodstream, leading to a recurring bacteremia. These foreign materials can become colonized/infected most frequently at the time of implantation or during


a manipulation procedure. Regarding intravascular access catheters, skin flora, such as the CNS, can colonize both intraluminally and extraluminally. Due to the often co-occurring presence of foreign material, there is difficulty in treating CNS infections. This situation is further complicated by increasing the prevalence of antimicrobial resistance.

## How to deal with CNS in a culture

The difficulty faced by most physicians arises in differentiating between a clinically significant infection by CNS as opposed to contamination or colonization. This is especially true regarding bacteremias. A blood culture yielding *S. epidermidis* can easily be seen as contamination from a patient's skin due to a suboptimal collection technique. However, the result must be interpreted with caution with regards to the clinical context. A patient with a prosthetic heart valve and a blood culture yielding CNS may indeed have prosthetic valve endocarditis, particularly if multiple blood culture bottles are positive. The converse is true if one of multiple blood cultures is positive, particularly in the absence of underlying implanted prosthetic hardware. A positive tissue or catheter swab may be due to colonization from direct extension of skin flora or implantation contamination.

**Mr. Helewa** is a Senior Medical Student, Faculty of Medicine, University of Manitoba, Winnipeg, Manitoba.

**Dr. John Embil** is a Consultant, Infectious Diseases and an Associate Professor, University of Manitoba. He is also the Medical Director, Infection Prevention and Control Program, Health Sciences Centre and Winnipeg Regional Health Authority, Winnipeg, Manitoba.

## Common Infections with CNS

### Bacteremia

Bacteremia is usually associated with the presence of an indwelling vascular access catheter acting as the source. It is often nosocomial in nature. As many patients are often not clinically ill with CNS bacteremias, difficulty is faced when determining whether the culture represents an actual infection. The culture status must be judged in light of various clinical findings, such as elevated white blood cell count, fever, hypotension and repeatedly positive blood cultures.

### Intravascular catheter infection

Colonization and infection of the catheter can lead to catheter-related blood stream infections (CRBSI). With *S. epidermidis*, the area around the catheters may lack to overt signs of infection, such as rubor and purulent exudates.

### Bacterial endocarditis

Bacterial endocarditis occurs when native valves become infected with the CNS. Prosthetic valves are the most frequently affected by CNS.

### Urinary tract infections

Urinary tract infections are commonly due to *S. saprophyticus* in sexually active young women.

### Osteomyelitis

In the general population, *S. aureus* (a coagulase-positive staphylococcus), is the primary cause of osteomyelitis. However, in immunocompromised patients, such as those on dialysis with indwelling vascular access catheters, CNS can commonly cause hematogenous osteomyelitis. CNS may also cause osteomyelitis of diabetic feet or of the sternum following cardiothoracic surgery.

### Other infections

Devices that are exceptionally difficult to sterilize due to the inability of antibiotics to penetrate through the glycocalyx are:

- Prosthetic joints
- Cerebrospinal fluid shunts
- Pacemakers
- Ocular implants
- Cosmetic implants

These devices may all become infected and most frequently need to be removed to achieve successful clearing of the infection.

## What should I do?

A blood, wound, or urine culture must always be taken in the clinical context and never hastily disregarded as being insignificant. If this patient does not demonstrate signs of an obvious infection, it is possible that the result that has been obtained represents colonization and not true infection. In the event of a patient with implanted hardware, such as a prosthetic heart valve, repeating the blood culture will be of benefit to try and ascertain whether the previous blood culture represented infection or suboptimal technique for collecting the specimen.

## How to treat

The CNS are difficult microorganisms to treat due to their inherent antimicrobial resistance. Empirically, vancomycin may be used to treat bacteremias and deep seeded infections. In light of the increasing incidence of bacterial resistance, once the susceptibility report becomes available, therapy should be modified accordingly.