Community-Acquired-MRSA Therapy Diagnoses Staphylococcus Aureus Strain, Treats Infection with Topical Antibiotics

This CA-MRSA (community-acquired methicillin-resistant Staphylococcus aureus) treatment consists of a combination of antibiotics and inhibition of penicillin-binding protein 4 in the bacteria. The antibiotic cefoxitin binds irreversibly to the bacteria’s penicillin-binding protein 4 (PBP4), rendering the MRSA strain sensitive to the antibiotic oxacillin. The combination of cefoxitin, PBP4 inhibition, and oxacillin has proved effective at killing the two most prevalent CA-MRSA strains in the United States, USA300 and USA400. The proposed method of treatment is a topical antibiotic.

In addition, Dartmouth scientists isolated four genes specific to this strain of the Staph bacteria. This discovery created an effective way to diagnose a MRSA infection as either hospital-acquired (HA) or community-acquired (CA) and treat it accordingly. HA-MRSA differs from CA-MRSA in its epidemiology, virulence, and susceptibility to antibiotics. It is crucial to be able to distinguish between infections in order to provide effective treatment and prevent severe complications or death.

Until recently, most cases of MRSA infection were the hospital-acquired variety occurring in patients whose immune systems were already compromised. Within the last decade, cases of MRSA have appeared outside the hospital in otherwise healthy people. The community-acquired MRSA strains cause skin and soft tissue infection, necrotizing fascitis, sepsis, prothetic joint infections, and pneumonia. Emergency room visits for CA-MRSA infections have tripled in the last decade. It is the number one cause of skin infection in the United States. Because the Staph bacteria is always mutating, it has been one step ahead of our attempts to treat it with antibiotics.

Most Prevalent CA-MRSA Strains, USA300 and USA400, Targeted

Scientists tested the cefoxitin/oxacillin combination therapy in in vitro studies on 300 isolates of MRSA collected from patients at Dartmouth-Hitchcock Medical Center. The therapy proved most effective on USA300 and USA400, also known as MW4. The positive results of the studies confirmed that PBP4 is a key element in beta-lactam resistance in CA-MRSA. Since it does not play this same role in HA-MRSA, this genetic difference can be used to help diagnose and design further treatments for CA-MRSA. Allowing scientists and the medical community to keep ahead of these superbug strains.

Applications

- Treatment of CA-MRSA infections
- Diagnosis of CA-MRSA infections, differentiating them from HA-MRSA
- Creation of therapies for other strains of the bacteria
Advantages

- Diagnoses CA-MRSA versus HA-MRSA, allowing for effective, life-saving treatment
- Uses FDA-approved antibiotics, which can speed in vivo testing and approval
- Four specific gene markers for CA-MSRA are identified, increasing understanding of the bacteria

Inventors

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Dr. Cheung received his medical degree from Northwestern University Medical School. His major research interest is in regulating the virulence gene in Staphylococcus aureus (S. aureus). Dr. Cheung’s lab has four major research directives: regulation of virulence determinants in S. aureus, expression of virulence genes in vivo, interaction of S. aureus with host cells, and development of novel targets for antimicrobial therapy.