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Please read this section first

The HPCSA and the Med Tech Society have confirmed that this clinical case study, plus your routine review of your EQA reports from Thistle QA, should be documented as a "Journal Club" activity. This means that you must record those attending for CEU purposes. Thistle will not issue a certificate to cover these activities, nor send out "correct" answers to the CEU questions at the end of this case study.

The Thistle QA CEU No is: **MTS 17/012**

Each attendee should claim ONE CEU points for completing this Quality Control Journal Club exercise, and retain a copy of the relevant Thistle QA Participation Certificate as proof of registration on a Thistle QA EQA.

MICROBIOLOGY LEGEND
CYCLE 42 ORGANISM 4

METHICILLIN-resistant STAPHYLOCOCCUS aureus

Methicillin-resistant Staphylococcus aureus (MRSA) is a bacterium responsible for difficult-to-treat infections in humans. It may also be referred to as to as multidrug-resistant Staphylococcus aureus or Oxacillin-resistant Staphylococcus aureus (ORSA).
MRSA is by definition a strain of Staphylococcus aureus that is resistant to a large group of antibiotics called the beta-lactams, which include the penicillins and the cephalosporins.

The organism is often sub-categorized as Community-Acquired MRSA (CA-MRSA) or Health Care-Associated MRSA (HA-MRSA) although this distinction is complex. Some have defined CA-MRSA
by criteria related to patients suffering from a MRSA infection while other authors have defined CA-MRSA by genetic characteristics of the bacteria themselves.

CA-MRSA strains were first reported in the late 1990s; these cases were defined by a lack of exposure to the health care setting. In the next several years, it became clear that CA-MRSA infections were caused by strains of MRSA that differed from the older and better studied healthcare-associated strains. These strains also commonly cause skin infections in athletes, jail and prison detainees, and soldiers.
It has evolved an ability to survive treatment with beta-lactam antibiotics, including methicillin, dicloxacillin, nafcillin, and oxacillin. MRSA is especially troublesome in hospital-associated (nosocomial) infections. In hospitals, patients with open wounds, invasive devices, and weakened immune systems are at greater risk for infection than the general public. Hospital staff that do not follow proper sanitary procedures may transfer bacteria from patient to patient. Visitors to patients with MRSA infections or MRSA colonization are advised to follow hospital isolation protocol by using the provided gloves, gowns, and masks if indicated.

Clinical presentation

S. aureus most commonly colonizes the anterior nares (the nostrils), although the respiratory tract, opened wounds, intravenous catheters, and urinary tract are also potential sites for infection. Healthy individuals may carry MRSA asymptomatically for periods ranging from a few weeks to many years. Patients with compromised immune systems are at a significantly greater risk of symptomatic secondary infection. MRSA can be detected by swabbing the nostrils of patients and isolating the bacteria found inside. The initial presentation of MRSA is small red bumps that resemble pimples, spider bites, or boils that may be accompanied by fever and occasionally rashes. Within a few days the bumps become larger, more painful, and eventually open into deep, pus-filled boils.

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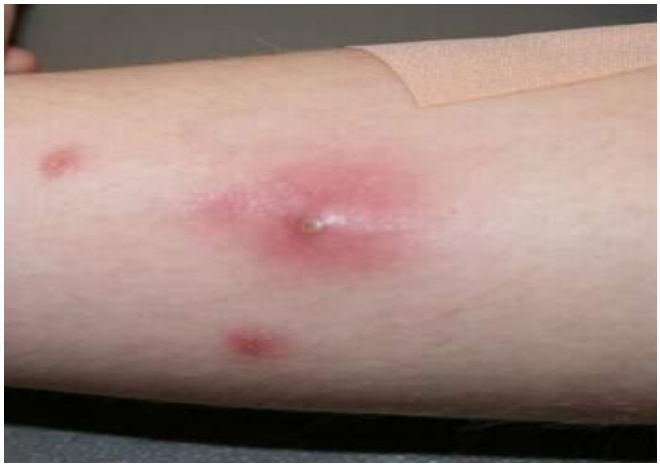

Figure 1 : MRSA Skin Infection.

At-risk populations

At risk populations include:

- People with weak immune systems (people living with HIV/AIDS, cancer patients, severe asthmatics, etc.)
- Diabetics
- People participating in contact sports or weight training
- Young children
- The elderly
- Persons staying in a health care facility for an extended period of time
- Prisoners or anyone living in confined space with other people.
- People who spend large amounts of time in coastal waters where MRSA is present

Treatment

Vancomycin and Teicoplanin are glycopeptide antibiotics used to treat MRSA infections. Teicoplanin is a structural congener of Vancomycin that has a similar activity spectrum but a longer half-life (t½). Because the oral absorption of Vancomycin and Teicoplanin is very low, these agents must be administered intravenously to control systemic infections. Treatment of MRSA infection with Vancomycin can be complicated, due to its inconvenient route of administration. Moreover, many clinicians believe that the efficacy of Vancomycin against MRSA is inferior to that of anti-staphylococcal beta-lactam antibiotics against MSSA.

Several newly discovered strains of MRSA show antibiotic resistance even to Vancomycin and Teicoplanin. These new evolutions of the MRSA bacterium have been dubbed Vancomycin Intermediate-Resistant Staphylococcus aureus (VISA). Linezolid, quinupristin/dalfopristin, daptomycin, and tigecycline are used to treat more severe infections that do not respond to glycopeptides such as Vancomycin. MRSA infections can be treated with oral agents, including Linezolid, rifampicin+fusidic acid, rifampicin+fluoroquinolone, pristinamycin, co-trimoxazole (trimethoprim-sulfamethoxazole), doxycycline or minocycline, and clindamycin. On May 18, 2006, a report in Nature identified a new antibiotic, called platensimycin that had demonstrated successful use against MRSA.

Alternative treatments

An entirely different and promising approach is phage therapy (e.g., at the Eliava Institute in Georgia), which has a reported efficacy against up to 95% of tested Staphylococcus isolates. It has also been reported that maggot therapy to treat MRSA infection has been successful. In February 2009 Science News published an article on early-stage research which found that ocean-dwelling living sponges produced compounds that resensitise bacteria to antibiotics. A study at the University of East London, has found that allicin, a compound found in garlic, successfully treats MRSA. Extensive studies at the University of York have found that minute quantities of silver carbonate nanoparticles show excellent antimicrobial effectiveness. Chemical analyses identified a compound called ageliferin. Biofilms, communities of bacteria notoriously resistant to antibiotics, dissolved and did not re-form when treated with fragments of the ageliferin molecule. So far, the ageliferin offshoot has, in the

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lab, successfully resensitized bacteria that cause whooping cough, ear infections, septicemia and food poisoning. The compound also works on Pseudomonas aeruginosa, which causes infections in wounded soldiers, and MRSA infections.

A promising natural option for fighting MRSA is with essential oils. In a December 2004 study, Dr. Peter Warn, a researcher at the University of Manchester England, told BBC reporters that he and his team had researched essential oils and MRSA. They found that three essential oils destroyed MRSA and E. coli bacteria, two of them within 2 minutes of contact. Conventional medical treatments, such as antibiotics, are made up of single compounds which MRSA very quickly becomes resistant to. Essential oils are made up of a complex mixture of chemical compounds naturally occurring in plants, which the mutating bacteria find difficult to resist. Because no two essential oils are alike, they are the perfect complex compound to fight a mutating "superbug".

Laboratory diagnosis

Diagnostic microbiology laboratories and reference laboratories are key for identifying outbreaks of MRSA. New rapid techniques for the identification and characterization of MRSA have been developed. These techniques include Real-time PCR and Quantitative PCR and are increasingly being employed in clinical laboratories for the rapid detection and identification of MRSA strains. Another common laboratory test is a rapid latex agglutination test which detects the PBP2aprotein. PBP2a is a variant penicillin binding protein that imparts the ability of S. aureus to be resistant to oxacillin.

Figure 2: MRSA on blood Agar.

References

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2. Klein E, Smith DL, Laxminarayan R (2007). "Hospitalizations and Deaths Caused by Methicillin-Resistant Staphylococcus aureus, United States, 1999–2005".
3. https://en.wikipedia.org/wiki/Methicillin-resistant_Staphylococcus_aureus

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Questions

1. What is MRSA?
2. Discuss the clinical presentation of MRSA.
3. Discuss the treatment protocol in MRSA.
