Review of Current Treatment Options for Methicillin Resistant Staphylococcus Aureus (MRSA)

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Methicillin resistant Staphylococcus aureus (MRSA) is a gram-positive staph bacteria that has been found to be resistant to several antibiotics. MRSA is not only resistant to Methicillin, it also has resistance to other popular forms of antibiotics such as oxacillin, penicillin, and amoxicillin. Hospital acquired MRSA infections are the most threatening forms of the infection. Several antibiotic treatment options exist for MRSA infection including, vancomycin, teicoplanin, linezolid, and daptomycin. However resistance to these antibiotics is becoming more common. Preventative measures are often the best defense against MRSA infections and hospitals should implement their own prevention system. Future implications of MRSA infection include continued antibiotic resistance, training hospital workers, and increased death rate among patients.

Keywords: MRSA, Treatment options, Methicillin resistant Staphylococcus aureus, antibiotic resistant bacteria, MRSA prevention, hospitalizations, hospital-acquired infection, voncomycin, daptomycin, gram-positive bacteria.

Introduction

Methicillin resistant Staphylococcus aureus, commonly referred to as MRSA, is a type of staph bacteria that is resistant to several antibiotics (Centers for Disease Control and Prevention, 2012). MRSA is resistant to Methicillin, but it also has resistance to other popular forms of antibiotics such as oxacillin, penicillin, and amoxicillin. Annually in the United States, MRSA is responsible for over 19,000 deaths, which is comparable to the number of deaths due to AIDS, tuberculosis, and viral hepatitis combined (Boucher & Corey, Epidemiology of Methicillin-Resistant Staphylococcus Aureus, 2008).

There are two places where MRSA is commonly found; in a community setting (often referred to as community acquired infection (CAI)), or in a hospital setting (referred to as hospital acquired infection (HAI)). CAI’s of MRSA are often skin infections that result from contact of the bacteria in closed places such as schools, prisons, and gyms and these infections are usually not life-threatening (Skariyachan, et al., 2011). The most severe and life-threatening form of MRSA infections occur in hospital settings, where the bacteria has developed extreme resistance to antibiotics and can live and thrive in hospital conditions (Centers for Disease Control and Prevention, 2012). The most at-risk part of the population, those with existing wounds and infections, are typically found in hospitals where the bacteria is already colonized, and it is in these settings where most people get the infection.

This review article seeks to establish the most current treatment options available for hospital acquired infections of MRSA. It will also cover hospital prevention and cleanliness standards reducing MRSA infection rates. Current trends in most studies of MRSA infections focus on epidemiology studies, rather than the treatment options and patient outcomes of these options (Eseonu, Middleton, & Eseonu, 2011). The scope of this review article is limited to the most current treatment options available for hospital acquired MRSA infections, rather than community acquired infections, as hospital acquired infections are more common and life-threatening.

History of MRSA

The discovery and wide use of the antibiotic, penicillin, largely decreased the worldwide occurrence of many bacterial infections, and the widespread use of the antibiotic saved thousands of lives and cured many patients around the world. Penicillin seemed to be a universal remedy for bacterial infections until it met its match with a bacterial strain known as Staphylococcus aureus (S. aureus) in the 1940s. S. aureus is a gram-positive bacteria that produces an enzyme,
known as beta-lactamase, that is resistant to penicillin (Buzaid, Elzouki, Taher, & Ghenghesh, 2011).

S. aureus’s increase in resistance to penicillin led to the production and development of semi-synthetic groups of penicillin such as methicillin, which were known to be resistant to the enzyme, beta-lactamase. Methicillin helped control outbreaks of S. aureus for over 20 years until the 1960s when the first groups of methicillin resistant s.aureus (MRSA) was first discovered (Buzaid, Elzouki, Taher, & Ghenghesh, 2011). Since then MRSA has been found in community and hospital settings around the world, and continues to meet resistance with new antibiotics every day. It has developed into one of the world’s most widely publicized bacterial infections as many deaths occur because of it each year. A “cure” for MRSA, even today, has yet to be discovered (Boucher & Corey, Epidemiology of Methicillin-Resistant Staphylococcus Aureus., 2008).

Common Causes of MRSA Infection in Hospital Patients

MRSA can be spread in a hospital setting frequently because it is a bacterium that is already commonly found on human skin (Rivera & Boucher, 2011). Many hospital workers, as well as people in general, have the bacteria on their skin and can transmit it to others without realizing it (Gould, 2011). The problem with hospital acquired infection (HAI) of MRSA is that, in terms of epidemiology, it has a different phenotype and genotype than community acquired infection’s (CAI’s) of MRSA; meaning that it typically has more antibiotic-resistance than CAI-MRSA (Upshaw-Owens & Bailey, 2012).

S. aureus or MRSA cause many types of infections, of which the most common type is an infection on the skin that results in a wound or bloodstream infection (Rivera & Boucher, 2011). According to Rivera and Boucher, in their journal article titled, Current Concepts in Antimicrobial Therapy Against Select Gram-Positive Organisms: Methicillin-Resistant Staphylococcus aureus, Penicillin-Resistant Pneumococci, and Vancomycin-Resistant Enterococci, S. Aureus has the ability to infect and destroy normal healthy tissue causing not only skin, wound, and bloodstream infections, but also pneumonic, osteomyelitis, endocarditis, lung abscess, and pyomyositis infections.

Upshaw-Owens and Bailey, in their journal article, Preventing Hospital-Associated Infection: MRSA, say that in hospital settings, risk factors for patients to acquire MSRA include: age, previous antibiotic use, prolonged hospitalizations, central line insertions, dialysis, MRSA colonization, and proximity to a patient with MRSA colonization or infection. Patients who have open wounds and infections are particularly at high-risk for developing a MRSA infection because MRSA can more easily spread through skin contact and into the patient’s blood stream (Upshaw-Owens & Bailey, 2012).

Hospitals act as breeding grounds for the bacteria and surgical patients admitted to hospitals have an increased risk of developing an infection of the bacteria (Eseonu, Middleton, & Eseonu, 2011). The length of inpatient stay also is significantly in patients who suffer an adverse outcome of MRSA infection (Eseonu, Middleton, & Eseonu, 2011). MRSA is also more commonly found in the southern regions of the United States, and similar instances of MRSA infection occurring in southern regions have also been true of patients in European countries (Boucher & Corey, Epidemiology of Methicillin-Resistant Staphylococcus Aureus., 2008).

Treatment Options and Management of MRSA

Several treatment options exist for patients with MRSA today. Most lines of treatment are antibiotics, but one study conducted by Sinosh Skariyachan, Rao Shruti Krishnan, Snehapriya Bangalore Siddapa, et al., stated that herbal remedies may be of use for treating MRSA infections, however this treatment option is not covered in this review article. Antibiotic’s commonly used include: vancomycin, teicoplanin, linezolid, daptomycin, tigecycline, telavancin, and ceftaroline. The first four antibiotic treatment options, vancomycin, teicoplanin, linezolid, daptomycin are discussed here in detail.
**Vancomycin**

Typically the first line of defense against MRSA in patients with serious infections of the bacteria is the antibiotic vancomycin (Rivera & Boucher, 2011). There are several generic formulations of vancomycin and it is well-tolerated among patients, with a low incidence of bad adverse reactions. However treatment of MRSA with vancomycin is decreasing, as many advanced MRSA strains are beginning to show signs of resistance towards it (Karchmer & Arnold, 2008).

**Teicoplanin**

The next line of defense for MRSA infections is teicoplanin, a widely used antibiotic in the United States used to treat gram-positive strains of bacteria like MRSA (Rivera & Boucher, 2011). It is related to vancomycin, and it is also widely accepted by many patients with little adverse reactions. Teicoplanin’s effectiveness however is often dependent on the local epidemiology of the MRSA infection, and this factor would influence the use of teicoplanin over vancomycin (Rivera & Boucher, 2011).

**Linezolid**

Linezolid is a gram-positive antibiotic that inhibits the protein synthesis of certain ribosomes within MRSA (Rivera & Boucher, 2011). It is currently approved by the United States Food and Drug Administration (FDA) for the treatment of complicated cases of MRSA infection. It is generally well tolerated among patients, but can have implications that affect serotonin levels in patients. Since these effects are common linezolid is typically not chosen over vancomycin unless specific qualities of the MRSA infection in question are found to be particularly responsive to the linezolid treatment (Rivera & Boucher, 2011).

**Daptomycin**

Daptomycin is another gram-positive antibiotic commonly used to treat MRSA. It was approved by the FDA for the treatment of serious MRSA infections and has been show to be extremely effective against MRSA strains. However, resistance to daptomycin has been found in several clinical trials (Boucher & Sakoulas, Perspectives on Daptomycin Resistance, with Emphasis on Resistance in Staphylococcus Aureus, 2007). As resistance to vancomycin increases, the use of daptomycin and linezolid as treatment options for MRSA has become increasingly popular (Karchmer & Arnold, 2008).

**Prevention of MRSA**

Preventing the spread of MRSA infection should be one of the main priorities of any healthcare setting. Hospital worker and patient hygiene are necessary components in reducing the spread of MRSA infection. According to Marcella Upshaw-Owens and Catherine Bailey, authors of the article “Preventing Hospital Associated Infection: MRSA,” prevention methods include: education about MRSA, hand hygiene, environmental decontamination, dedicated equipment use, and contact prevention. Best practices for the prevention of MRSA also includes risk assessment procedures, monitoring of current programs for dealing with MRSA infections, and cleaning and disinfecting the environment and equipment used in a hospital setting (Upshaw-Owens & Bailey, 2012).

It is important for hospitals to properly identify MRSA infections and isolate patients with known MRSA infections from other patients (Buzaid, Elzouki, Taher, & Ghenghesh, 2011). Surveillance of infection rates and identifying ways to control rapid outbreaks is also an essential part of the preventative process (Gould, 2011).

**Future Implications of MRSA**

The future of MRSA infections will need to be focused on preventative efforts and development of better treatment options. Implications of MRSA include increased antibiotic usage and increased antibiotic resistance (Gould, 2011). Stronger antibiotics will need to be created to control outbreaks of the bacteria, and creating these antibiotics will be a challenge, as the bacterium has a rapid growth rate and is ever-changing. In the future, patients may not be able to be treated for MRSA, so prevention of it will be crucial (Gould, 2011). Other implications include training and educating hospital staff about how to control the spread of MRSA infections and an increased death rate among patients (Harbarth, 2006).
References


